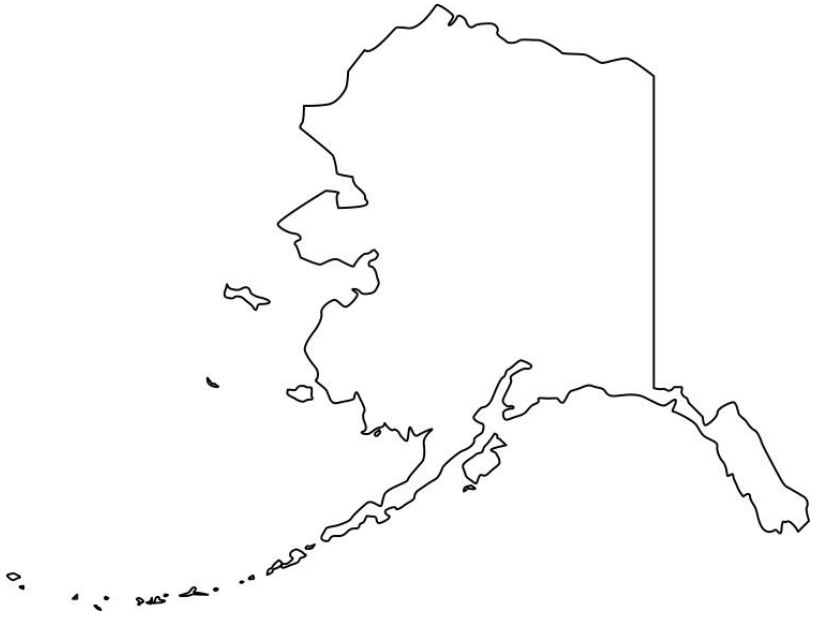
The Role of Metal Mining in the Present and Future Alaskan Economy



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Executive Summary

1. The Recent Alaska Recession and the Fiscal Crisis Caused by Alaska's Over-Reliance on Oil

- Alaska has a long history of reliance on natural resources that has led it through a series of booms and busts since before it was a state. Its current reliance on oil is, however, unprecedented.
- Oil production in Alaska peaked in 1988 at about 2 million barrels of oil per day and has been declining ever since. Currently Alaska produces about a quarter of that peak oil production. Compounding that decline in production was a dramatic decline in the value of oil.
- Because of Alaska's reliance on oil production for state revenues, the dramatic decrease in the value of oil production has left a massive fiscal hole in the state's budget and contributed to a lingering Alaska-specific recession.

2. Expanded Metal Ore Mining Will Not Fill the Fiscal "Hole" Created by the Decline in the Value of Alaska's Petroleum Production

- One suggested partial solution to these oil-related set of economic problems has been that Alaska dramatically increase its metal ore mining to fill the fiscal hole left by declining oil.
- The annual revenue to Alaska governments from petroleum-related sources has been in the *billions* of dollars while the revenues from mining to the state of Alaska and local government has been in the tens of *millions* of dollars. For instance, on average between 2009 to 2014, the petroleum government revenues were over 60 times larger than the mining revenues flowing to Alaska governments.
- To replace all of the lost fiscal revenues from petroleum production through an expansion in metal mining so as to generate the same revenue for state and local governments as the petroleum taxes and royalties contributed between 2009-2014, *metal mining production would have to expand from five large metal mines to 300 large metal mines in Alaska* (5 times 60). From an environmental, socioeconomic, and geological point of view, that would not be a feasible policy objective.
- Metal ore mining in Alaska directly represents only a tiny part of both the overall Alaskan economy and the state's fiscal revenues.
- The five "large" metal ore mines in Alaska directly provide only a fraction of one percent of total Alaskan industry employment.
- Metal mining, like oil production, is economically volatile and can be expected to fluctuate in similarly disruptive ways as oil has in the recent past.

3. How Competitive Is Alaska for New Investments in Mining?

- Measured by an overall Mining Investment Attractiveness Index, combining both a Mineral Potential Index and a Policy Perception Index, Alaska is ranked 4th out of 76 state, provincial, and national jurisdictions in 2019.
- If we focus only on the Policy Perception Index, Alaska's ranking was not as high but still respectable: Alaska was within the top fifth of the jurisdictions studied in 2019.
- Alaska's attractiveness to mining companies, has a very favorable mining policy perception, and is overall a very attractive place for mining companies to work.

4. Metal Mining Is Unlikely to Support Local Economic Development in Isolated Rural Areas

- If a new mine is in a relatively isolated rural area, as they are in many of the mine sites in Alaska, there is unlikely to be much local commercial infrastructure where the mine can purchase the inputs it needs or where employees and their families can spend their mine earnings. Because of this, many of the potential economic benefits of mining will "leak out" of the local communities to distant urban centers.
- These low positive impacts on local employment and income are not just a metal mining phenomenon. The same is true of almost any industrial activity at an isolated geographic location, whether it be a mine, mill, or timber harvest and processing facility.
- One possible exception to this is mining that takes place on Alaska Native mineral deposits such as the Red Dog mine. The NANA Native Alaskan Regional Corporation has successfully redistributed much of the royalties that it has received from Red Dog to many different rural villages in Alaska.

5. Socioeconomic Impacts of Metal Mining.

- Assessing local well-being using commercial measures of the expansion of the commercial economy due to the operations of a new mining project seriously distorts the usual weighing of positive and negative impacts (benefits and costs) associated with any economic decision.
- There are many important social issues associated with mining in rural areas that have significant impacts on the well-being of residents and communities, e.g., increases in alcohol and drug consumption, increased pressure on local law enforcement, increased pressure on schools and emergency services, increased incidence of sexual and aggravated physical assaults, increased presence of convicted felons, etc.
- Any town located nearby a proposed mine should prepare itself to counter these specific maladies. The most basic steps that need to be taken would be an increase in police presence, the creation of outreach programs for substance abuse and domestic abuse, and some type of plan to try and assimilate the miners into the local culture.
- Given that the mining workforce is likely to be male, relatively young, not accompanied by family, and have considerable income available for spending, the impact of these workers could be socially stressful for both the community and the mine workers.
- Because of these stresses, there will be changes in the local community as it tries to accommodate the new resident miners. These towns must plan for the arrival of the miners and the stress that they are likely to put on the local services.

6. A Brief Look at Other Metal Mining Dependent Areas in the United States

- Butte, Montana, was a major copper producer from the late 1800s through the middle 1970s. Credited with "electrifying" the U.S., Butte played an important role in copper production for a good part of 100 years.
- The population of Butte peaked in the 1920s and the underground mine that provided all of that copper turned into an open pit that literally swallowed a large portion of the town. For the first time in 100 years, Butte is finally starting to treat the toxic water in the Berkley Pit that is threatening to poison the entire community ground water.
- When considering the pros and cons of Alaska heavily investing in metal mining to stabilize its economy and try to get back in fiscal balance, it can be instructive to look at the Copper Triangle of Arizona.
- Arizona also has had over a century of economic history with copper mining, concentrating, smelting, and refining. Over the last 110 years, one can count at least seven major expansions in copper production followed by significant declines by as

much as 75 percent and, most recently, a decline by more than half, 54 percent, between 1998-2011.

- Between 1974 and 1997, when copper production increased by 73 percent, the copper industry workforce in Arizona was cut by more than half, 56 percent or about 16,000 jobs.
- What is clear is that the enormous wealth that can be created by mineral extraction in rural areas is not always, and we show, not generally, accompanied by long term prosperity. If Alaska is going to hitch itself once again to the rollercoaster of an extractive industry, with its global price and volume fluctuations, then it must at least learn from the lessons of its own past, including its most recent experience riding the petroleum rollercoaster.

Contents

1. The Recent Alaska Recession and the Fiscal Crisis Caused by Alaska's Over-Reliance on Oil

Alaska has a long history with different boom and bust industries, but nothing in that history can compare to the Prudhoe Bay oilfields. Although Alaska has seen a series of different extractive industries come and go, Alaska has never been so reliant on them as they currently are on the oil that comes from Prudhoe Bay. Alaska's reliance on extraction from the natural environment to help lift its economy up has been present since Alaska was a territory. A long history of reliance on limited natural resources has consistently and historically put Alaska in a position of dependence on the finite resources long after those resources have been economically exhausted.

> "The permanent funding curse would prove to be especially virulent when the basic economy shifted from one prime resource to another, such as from fur to gold, gold to fish, or fish to military and government spending. Inevitably the government revenue structure set by political forces lagged the changing economic structure, as people and politicians are often highly resistant to economic facts they do not want to accept."[1]

As a response to this historical dependence on a particular natural resource for government revenues, the Permanent Fund was created. The basic idea was that Alaska would finally learn from its past mistakes and set aside a portion of the truly vast resources of the Prudhoe Bay oil play in perpetuity, so that it would not have to continually ride the resource roller coaster. The Alaska Permanent Fund was established when the Prudhoe Bay oilfields were leased and oil began to flow through the trans-Alaskan pipeline in 1976.[2] By 1980, when more than a million barrels of oil per day were flowing through the trans-Alaskan pipeline, and the state was starting to collect fairly large revenues from the oil that was being produced, the state income tax was abolished.[3] With those substantial oil-related revenues flowing in, Alaska should have been able to control its own fiscal destiny. The obvious problem was that, instead, Alaska chose to directly tie state government solvency to the volume of oil produced and the global price of oil.

> "The Permanent Fund was supposed to have been the answer to the curse of natural resource development, the antidote to the mining camp mentality—or "Kennecott Syndrome"—of here today gone tomorrow, double or nothing, easy come easy go, take out the profits and leave behind an empty hole in the ground. By permanently stashing away surplus returns of mineral revenues, the Permanent Fund provided the opportunity to fundamentally alter the nature of the Alaskan economy."[4]

For some time, the Alaska government was indeed flush with cash, and, thanks to the Permanent Fund, Alaskans not only did not pay a personal income tax, but each Alaskan was paid a dividend every year by the state of Alaska. However, almost immediately, the writing was

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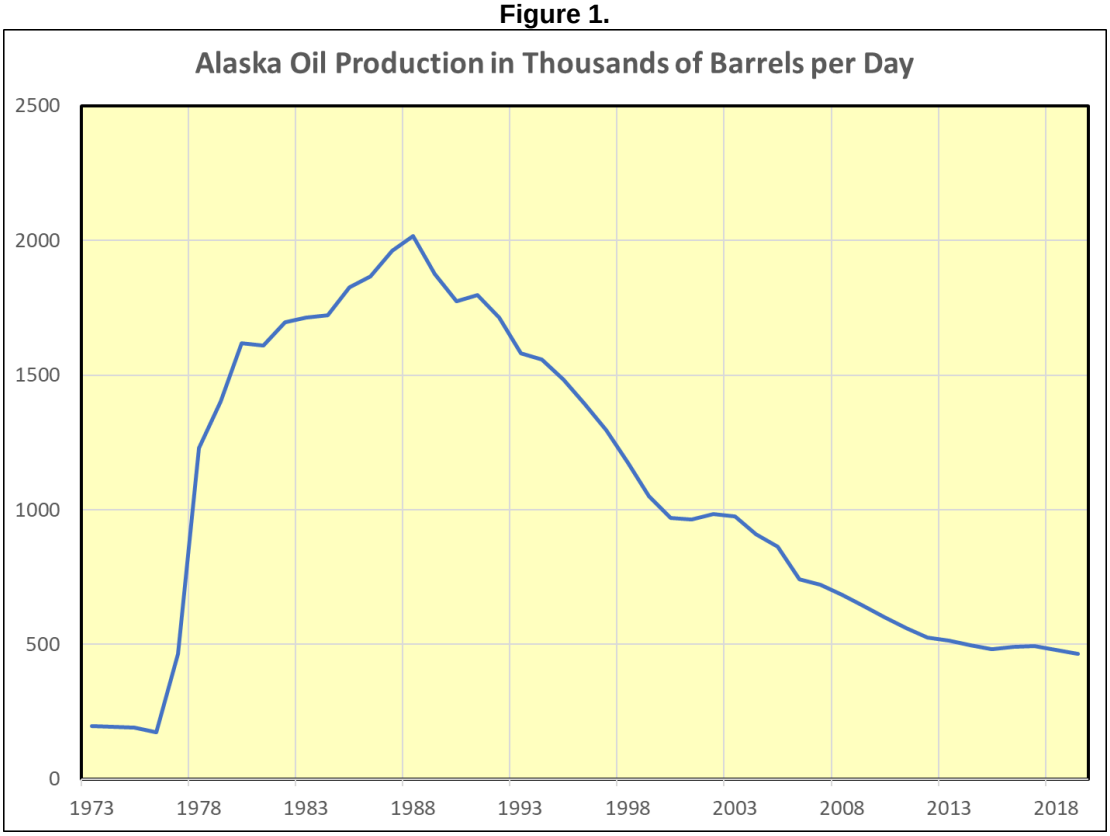
[1] Cole, T. Blinded by Riches: The Permanent Funding Problem and the Prudhoe Bay Effect. Institute of Social and Economic Research at the University of Alaska Anchorage. Page 12. January 2004.
[2] https://apfc.org/fund-education/
[3] Seaton. History of Individual Income Tax. http://www.akleg.gov/basis/get_documents.asp?session=30&docid=17151
[4] Cole, T. Blinded by Riches: The Permanent Funding Problem and the Prudhoe Bay Effect. Institute of Social and Economic Research at the University of Alaska Anchorage. Page 12. January 2004

on the wall for another looming fiscal crisis in Alaska. By tying the funding of a state government to a global commodity, it is not only the price of the commodity, but the volume of the commodity that can be produced that determines the state's fiscal balance.

Oil production in Alaska peaked in 1988 at about 2 million barrels of oil per day and has been declining ever since. Currently Alaska produces only about a quarter of that peak oil production. See Figure 1, below. If we could assume that global oil prices would remain constant, then we could also assume that the revenue stream from Alaskan oil production would be tied to oil output. In this scenario, which is clearly not based on the global reality of a volatile oil market, Alaska could then assume that it would receive about one-quarter of the peak oil proceeds for fiscal purposes. Under this fanciful scenario Alaska would be receiving about a third of the oil proceeds that it was receiving when it got rid of the income tax in 1980.

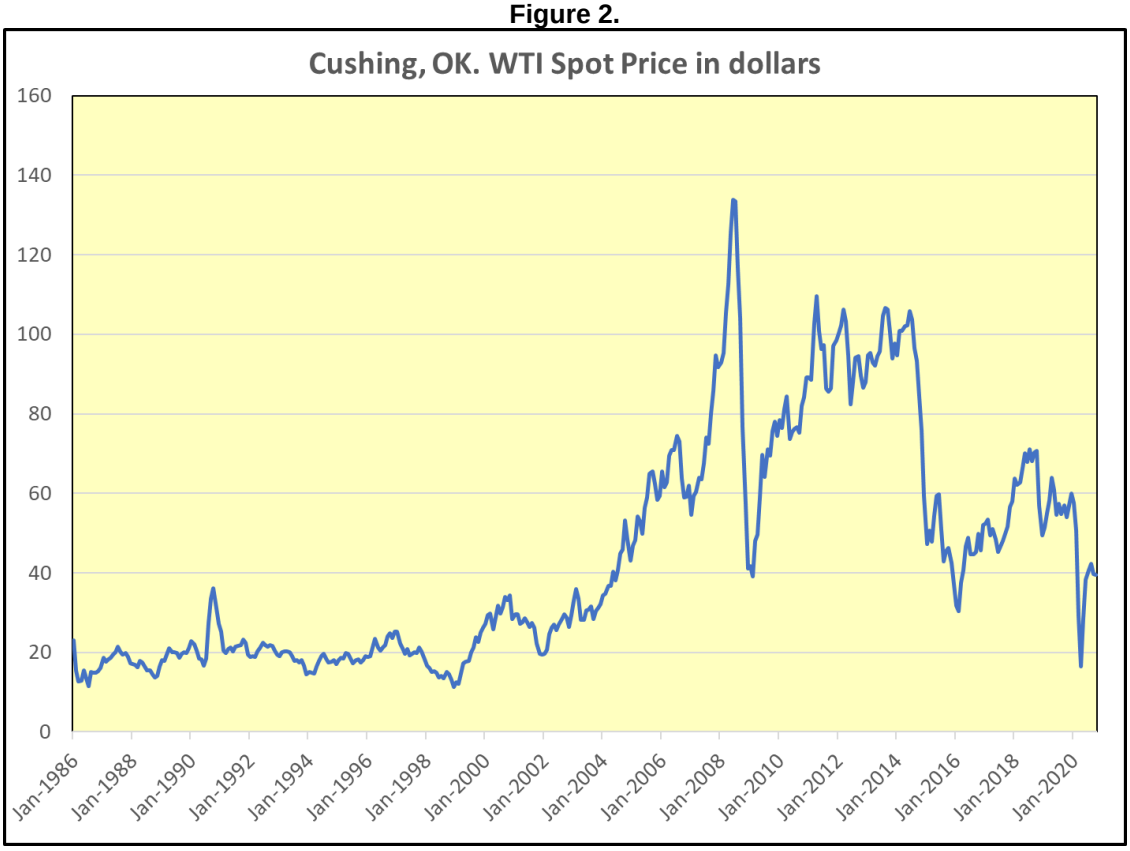
Figure 1.



Source: EIA. Alaska Field Production of Crude (thousands of barrels per day)

Of course, the other half of this basic equation is that global oil prices are not constant. In fact, they are extremely volatile. This allowed, for example, the state of Alaska to earn very large amounts of money on oil production in 2008 even as oil production continued to flag. It also allowed, unfortunately, for the state of Alaska to see a significant drop in the value of oil like it did in 2015-2016 despite the level of oil production remaining relatively constant. Even if production holds steady, declining oil prices can cause the state revenue derived from that oil to rise or fall depending on the international price of oil. See Figure 2, below.

Figure 2.

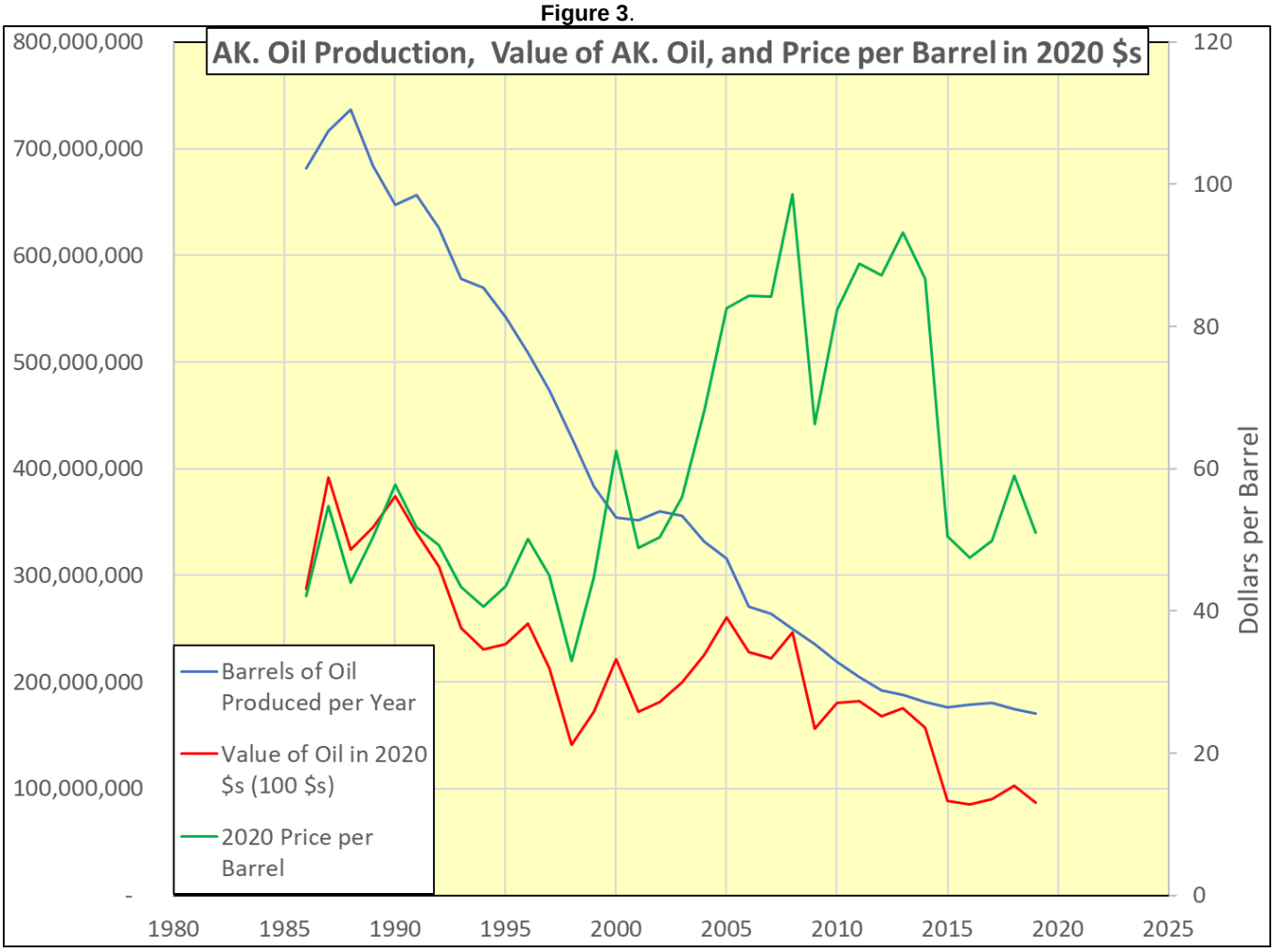


Source: EIA. Cushing, OK. WTI Spot Price FOB ($/barrel)

From June in 2014 to February of 2016 the price of oil, as shown in Figure 2, above, went from $105.79 a barrel to $30.32 per barrel. In other words, the price of the oil in February 2016 was about 29 percent of what it was in June of 2014. The obvious problem with this is that if a large portion of your state budget is predicated on the June 2014 price of oil continuing at that high level, there will be a massive shortfall in the state's budget. If, at the same time, you are consistently producing less oil than you were the year before, then you will have a massive hole in the state budget. That is exactly what sent Alaska into a recession in 2015.

To put this into a context that may be easier to understand, see Figure 3 below. In Figure 3 the price of produced oil is simply the Cushing, OK, spot price of the oil multiplied by the volume or oil that was produced. While this leaves much to be desired when compared the actual value of the produced oil as it leaves Alaska, it provides a first order approximation of the value of the oil that was produced in Alaska that can still be instructive.

Figure 3.



Source: EIA. Cushing, OK. WTI Spot Price FOB ($/barrel) and Alaska Field Production of Crude (thousands of barrels per day)

A critical part of Figure 3 to understand is that the "produced value of oil"[5] is largely tracking with the price per barrel of oil between 1985 and 2005, but it is also trending downward because of declining level of oil production. In figure 3 we have adjusted the price of the oil as well as the value of the oil produced to 2020 dollars based on the Alaska Consumer Price Index.[6] This allows us to see that when the price per barrel of oil trends upward it helps to keep the value of the oil produced from nose-diving because the production of oil is nosediving. But ultimately the value of the produced oil is dragged down by the declining production of oil. For example, in the late 1990s through 2008, the rising price of oil largely cancels out the continued declining production of oil and, with some instability, the produced value of oil avoids a downward trend. The more serious problem occurs, in the 2014-2019 period, when the price of oil drops *and* the production continues to decrease. When both determinants of the value of the oil produced are

[5] Here we use the term "implied value of oil" or "produced value of oil" as a way to look at the taxable value of oil for Alaska. This is a simplified metric that uses the Cushing, OK spot price of crude oil. This implied value does not take into account shipping or refining costs and is not meant to imply that Alaskan oil is refined in Cushing, OK. It is meant as a simple way of looking at the value of the Alaskan oil produced using the standard of the U.S. benchmark price of crude.

[6] Department of Labor and Workforce Development. Consumer Price Index for Urban Alaska. https://live.laborstats.alaska.gov/cpi/index.cfm

decreasing at the same time, the impact is a dramatic decrease in the value of oil production. Of course, this makes sense since the value of the oil production is simply the product of the price of oil and the amount of oil produced.

What should be abundantly clear from the three previous figures, is that basing a state's fiscal balance on oil production that has been declining for three decades, on the exceedingly volatile price of oil, or on the produced value of the oil that is a combination of the two, can only eventually result in a fiscal shortfall. An increase in the price of oil or the increase in production can temporarily buoy the value of the produced oil, but eventually, as Alaska has experienced over the last decade, a fiscal crisis due to the shortfall in oil revenues is likely to emerge both contracting the Alaska economy and disrupting the provision of important public services and public infrastructure investment.

2. The Ability of Expanded Metal Ore Mining to Fill the Fiscal "Hole" Created by the Decline in the Value of Alaska's Petroleum Production

A. Introduction

The decline in both Alaska oil production and the value of that oil on international markets have had severe impacts on the overall Alaskan economy, bringing on an Alaska-specific lingering recession. That recession set in *before* the economic disruption associated with the COVID pandemic. Within the Alaska state government, the decline of those oil revenues has created a state budgetary crisis that has been difficult to resolve.

One suggested partial solution to this oil-related set of economic problems has been that Alaska more aggressively diversify the commercial minerals on which its economy depends, so that "all of Alaska's economic eggs are not in one mineral basket," namely oil.[7] In particular, it has been pointed out that Alaska has substantial metal ore resources most of which have not been developed. This implied "solution" to current Alaskan economic problems is not surprising given the outsized role that metal mines are assumed to have played in the popular "origin stories" of how the European-American settlement and "modern" economic development in Alaska came about, e.g. the "gold rushes" of the past.

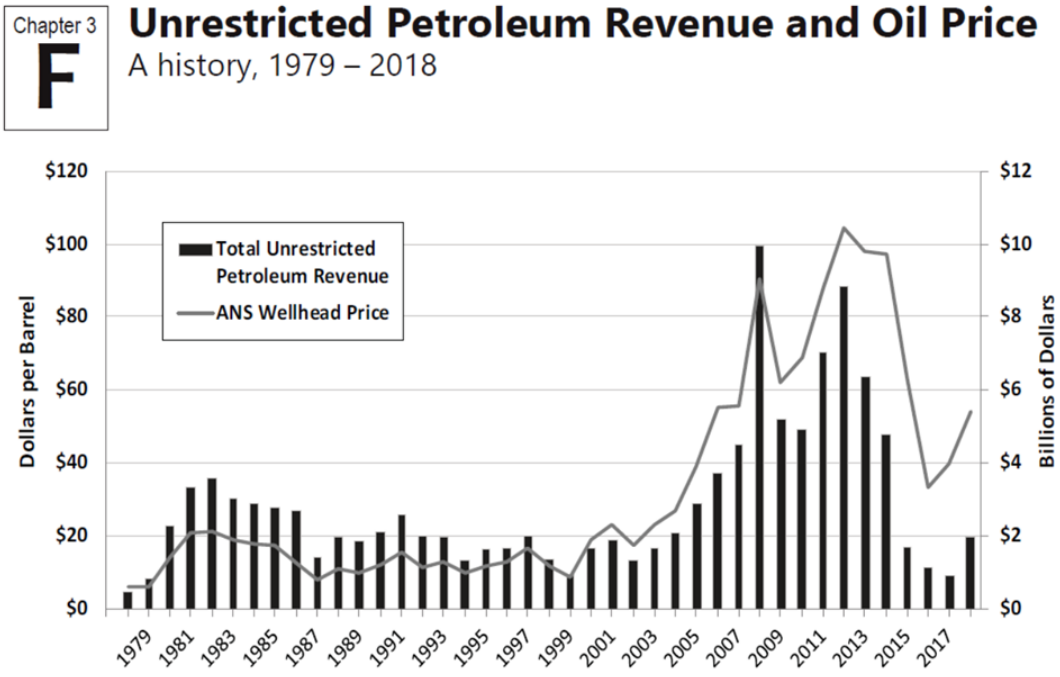
[7] Defining "mining": In the economic data collected by various government agencies, "mining" sometimes means the removal of any material from the earth. In that broad meaning, oil and natural gas would be considered part of mining. The Alaska Department of Labor and Workforce Development (DLWD), for instance, includes the oil and gas industry in its "mining category." On the other hand, the Division of Geological and Geophysical Surveys (DGGS) within the Alaska Department of Natural Resources, does not include oil and gas in the category "mining." The more common definition of "mining" excludes the removal of liquid and gaseous fossil fuels from the "mining" category and reports that extractive activity separately, simply labeled "oil and gas" or "petroleum." The solid fossil fuel, coal, *is* included in mining. Mining also does not focus exclusively on valuable metals such as gold, silver, or platinum. It also includes extracting building materials such as sand, gravel, and rock. In this report, we will use the Alaska DGGS mining definition, treating oil and gas extraction separately from "mining." The Alaska Division of Geological & Geophysical Survey (DGGS) annually produces a report on "Alaska's Mineral Industry" that, among other things, "serves as the authoritative historical record of mining in the State." (Alaska's Mineral Industry 2018, p. 5.) Often, we will compare overall mining or, more narrowly, metal ore mining, with the oil and gas (O&G) industry in Alaska's economy.

An analysis of the potential opportunity that expanded metal ore mining offers for supplementing or replacing the shrinking oil-based economy of the recent past requires a careful review of the economic potential represented by metal mining in Alaska. In a recent overview of "Metal Mining in Alaska" by the Alaska Department of Labor and Workforce Development (DLWD), Alaska metal mining was characterized as a "small, high-value industry with a long history [in Alaska that] is growing."[8] We begin our analysis by looking at the feasibility of metal mining expanding to take the place of the declining oil revenues that have been so important in supporting Alaska state government services and infrastructure investments in recent decades.

B. The Decline in the Revenue Flowing to Alaska State Government from Oil Production

In the 2000s, the revenues flowing from Alaska oil production to the Alaska state government surged as oil prices rose. Figure 4, below, shows what is labeled "unrestricted Petroleum Revenue." That refers to tax and royalty payments by oil producing companies to the state of Alaska. "Unrestricted" simply refers to the fact that those revenues to the state are not already committed to particular uses. The legislature is free to allocate those revenues to state programs as the legislature deems appropriate. The black bars in Figure 4 show the rise in tax and royalty revenues to the state government in the 2000s as oil prices per barrel rose steeply and then fell, reducing revenues from oil production to state government by 90 percent. As discussed above, the decline in oil revenues was tied to both the decline in oil prices and the decline in the amount of oil that could be produced in Alaska.

Figure 4.



Source: "Sources of Revenues, Fall 2019, AK Department of Revenues, Tax Division.

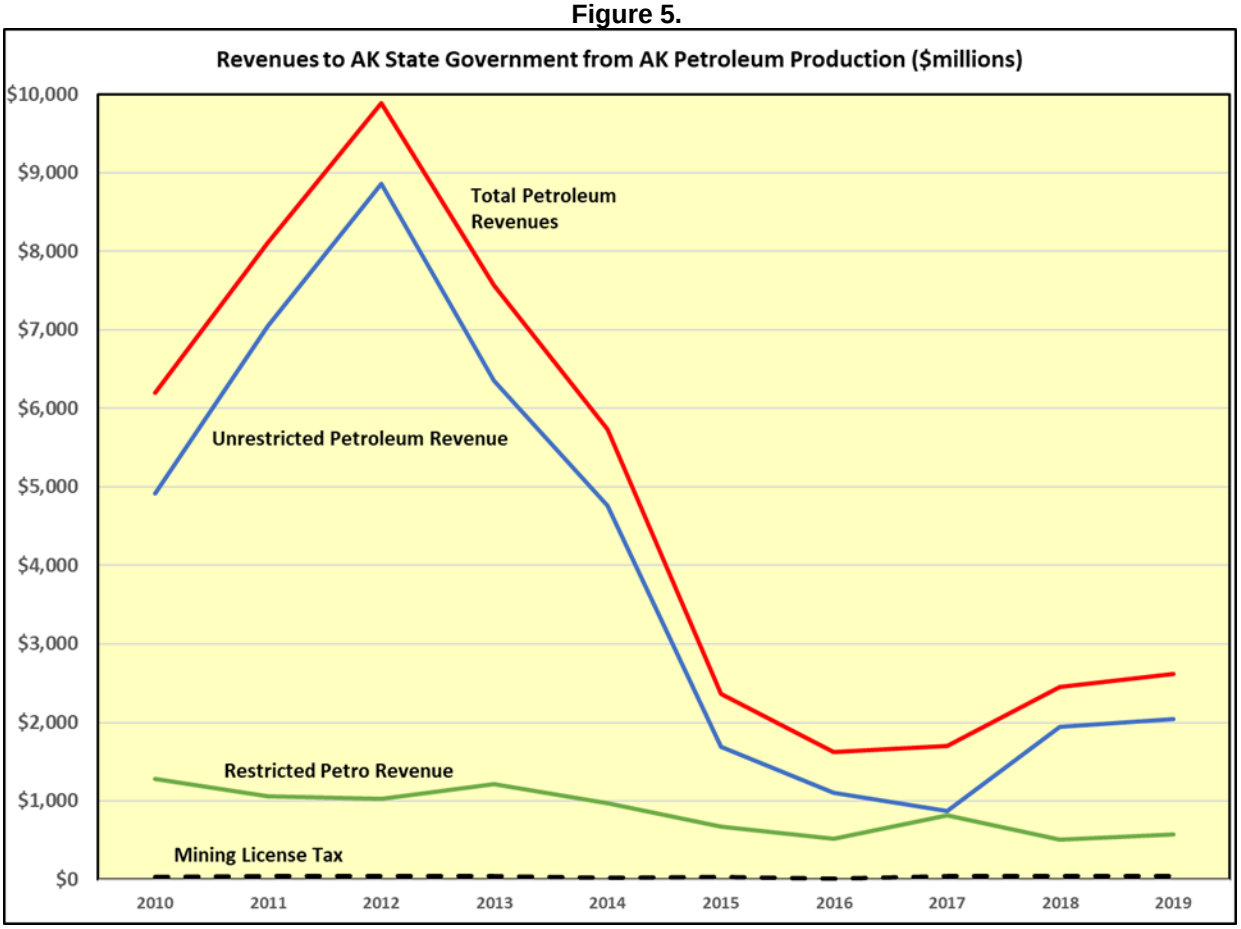
[8] ***Alaska Economic Trends,*** Metal Mining in Alaska, Vol. 39, No. 5, May 2019, pp. 4-10. Sara Teel, p. 4.

The revenues flowing from oil producing companies to the Alaska state government come from a variety of tax and non-tax payments including:

- Oil production tax
- Oil's share of corporate income tax
- Oil company property taxes
- Oil and gas royalties, bonuses, rents, and interest.

As Figure 4 above and Figure 5 below indicate, the revenues flowing to the Alaska state government from oil production totals billions of dollars. In the 2008-2014 period, those revenue flows rose to a high of $10 billion and stayed above $4 billion for most of that period. By the 2015-2018 period, the revenues were as low as $1 billion.

Figure 5.

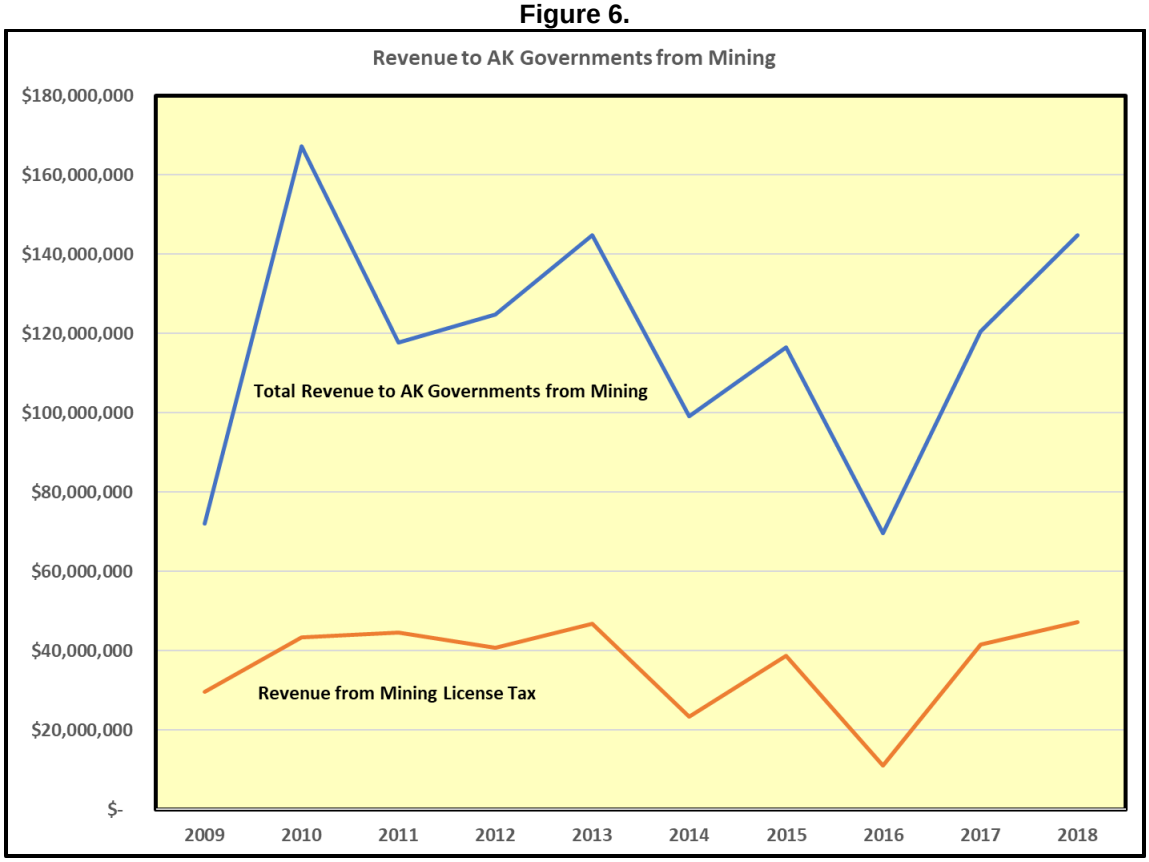


Sources: Alaska Department of Revenue-Tax Division, Annual Report. (tax.alaska.gov)

Figure 5, above, shows the dollar flow of revenues to the Alaska state government, both the revenues that are unrestricted in terms of their use and those that are restricted to particular uses. The top line shows the total revenues paid to the state by Alaskan oil producers. Note that those government revenues from petroleum production are in the *billions* of dollars, from one to ten billion dollars. As Figure 6 below indicates, the Alaska government revenues from mining are in the tens to hundreds of *millions* of dollars.

Metal mines as well as other mines in Alaska also produce revenue flows to state and local governments from the mining license tax based on a percentage applied to mining net income and royalties.[9] That revenue flow from the mining license tax, is also shown on Figure 5 above. However, that mining license tax revenue is so small compared to the petroleum revenues, that its size is difficult to determine on that figure. If we had data on just the part of those mining revenues coming from *metal* mining, that revenue stream, which is just part of the government revenues from all mining activities, would be even smaller than *all* of the mining license tax. The Mining License Tax line at the bottom of Figure 5 appears to hover near zero. Figure 6 below shows the mining license tax revenues, much of which comes from metal mines, as well at the total estimated revenue from mining to Alaska state and local governments. From 2010 to 2018, the annual average revenue raised by the mining license tax was $23.5 million while the average total revenue flowing to Alaska governments from mining, including the mining license tax, was $122.8 million, over five times as high.

Figure 6.



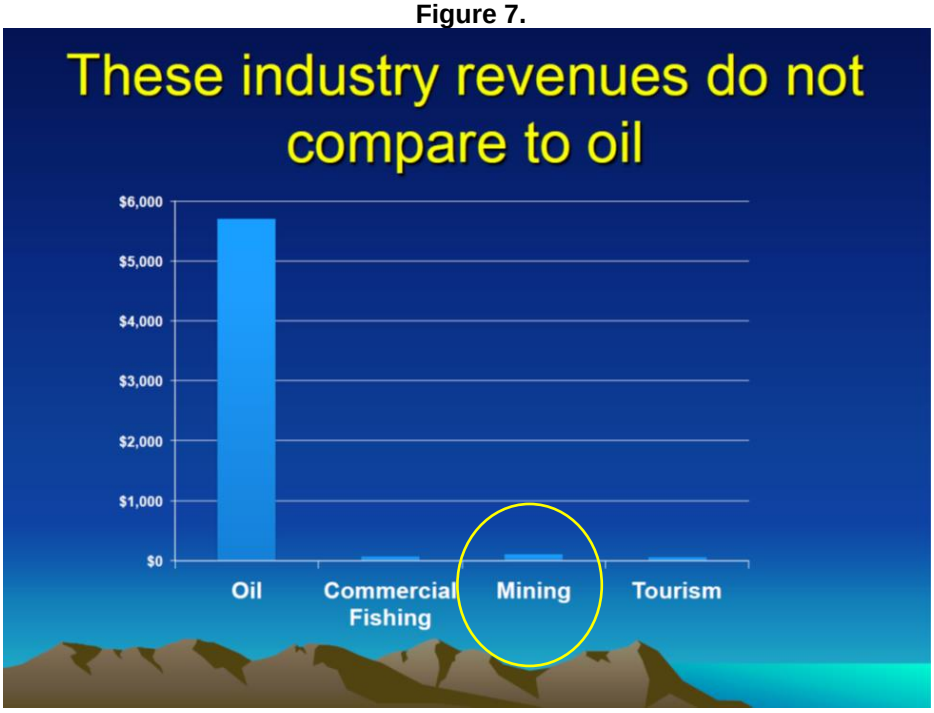
Source: Alaska Mineral Industry 2012 and 2018, Alaska Department of Natural Resources, DGGS, Table 3.

The other sources of government revenues from mining includes coal mining rent and royalty revenues. Some mining companies pay the corporate income tax; some pay royalties and rents to the state of Alaska; the government sells sand, gravel, and rock from state land. There are also other miscellaneous payments to the state government by mining companies. In addition,

[9] This tax is primarily collected from metal mines and Alaska's single large coal mine. In 2019, 91 percent of employment in "mining" was employed in metal mining and 89 percent of total mining wages were associated with metal mining. Annual Employment and Wages, Quarterly Census of Employment and Wages, Alaska.

some mining companies pay substantial property taxes or make payments in lieu of taxes to the *local* governments where the mine is located.[10] As a result, the total revenue flows from mining companies to the Alaska state governments were significantly larger than just the mining license tax, 3.6 times the size of just the mining license tax over the 2010-2018 period. The mining license tax in that period was the source of only about a quarter of all of the estimated revenues flowing from mining activities to state and local goverments.

Figure 7.



Source: Fiscal Effects of Commercial Fishing, Mining & Tourism: What Does Alaska Receive in Revenue? What Does It Spend?, Bob Loeffler, Institute of Social & Economic Research, UAA, Jan 7, 2016, Power Point Presentation. Figure 6, page 7. The circle around mining was added to the figure by the authors. Data is from FY 2014.

Note that the annual revenue from petroleum-related sources has been in the *billions* of dollars while the revenues from mining to the state of Alaska and local government has been in the tens of *millions* of dollars. For instance, on average between 2009 to 2014, before the last of the collapses of Alaskan petroleum value, *the ratio of the petroleum revenues to state and local governments were over 60 times larger than the mining revenues flowing to Alaska governments*.[11] Figure 7, above, shows the relative size of the fiscal revenues flowing from all of

[10] Some of the data used above and below stretches ten to fifteen years into the past. This is due to the fact that the last detailed analysis of the fiscal effects of mining on state and local government budgets was published in late 2015 and used revenue and cost data from 2010 to 2014. "Fiscal Effects of Commercial Fishing, Mining and Tourism." Bob Loeffler and Steve Colt, Institute of Social and Economic Research, UAA. Prepared for AK Division of Economic Development. December 2, 2015. In addition, the Alaska Department of Revenue, Tax Division, in its Revenue Sources Book, Fall 2018, provided a 60-year review for the sources of funds flowing into Alaska state governments from 1959-2018 that allowed a further look back with consistent data.

[11] The time period used was chosen to include some of the last years in which oil revenues to state government were still substantial. See Figure 4 above. That provides a better indicator of the size of the fiscal hole caused by the decline of oil revenues to state government. The Alaskan Department of

the government revenues from the mining industry, metal mining and non-metal mining, compared to the fiscal revenue flowing from petroleum companies to Alaska state and local governments.

To replace all of the lost fiscal revenues from petroleum production through an expansion in metal mining so as to generate the same revenue for state and local governments as the petroleum taxes and royalties contributed between 2009-2014, *metal mining production would have to expand from five large metal mines to 300 large metal mines in Alaska* (5 times 60).[12] From an environmental, socioeconomic, and geological point of view, that would not be a feasible policy objective.

The heading on Figure 7 above is the interpretation of that figure by the Institute for Social and Economic Research at the University of Alaska-Anchorage authors of the "Fiscal Effects of…Mining…" done for the Alaska Division of Economic Development and partially funded by the Council of Alaska Producers. That report used Figure 7 above to emphasize how small the revenue flows to the Alaska state and local governments from mining, commercial fishing, and tourism were compared to the revenues from oil producers. As the report stated:

> "Commercial fishing, mining, and tourism are important revenue sources for the communities in which they operate, but the fiscal impact on state government (revenue minus cost) pales in comparison with state oil revenues…the oil industry is unique. When discussing revenue from commercial fishing, mining, and tourism, one can lose sight of the fact that the state revenue from these industries is extremely small—individually or collectively—when compared with oil industry revenue to Alaska."[13]

In addition, as Figures 4 and 6 make clear, the revenue generated by the current taxation of metal mines is unstable just as the revenue from petroleum production has proved to be. Large scale reliance on metal mining as the primary support for funding state government would keep Alaska on a natural resource economic roller coaster, with all of its socioeconomic disruptions, indefinitely into the future. We will discuss this rollercoaster and the impact that it has had in other states later in this report.

C. The Employment Potential of Additional Metal Mining in Alaska

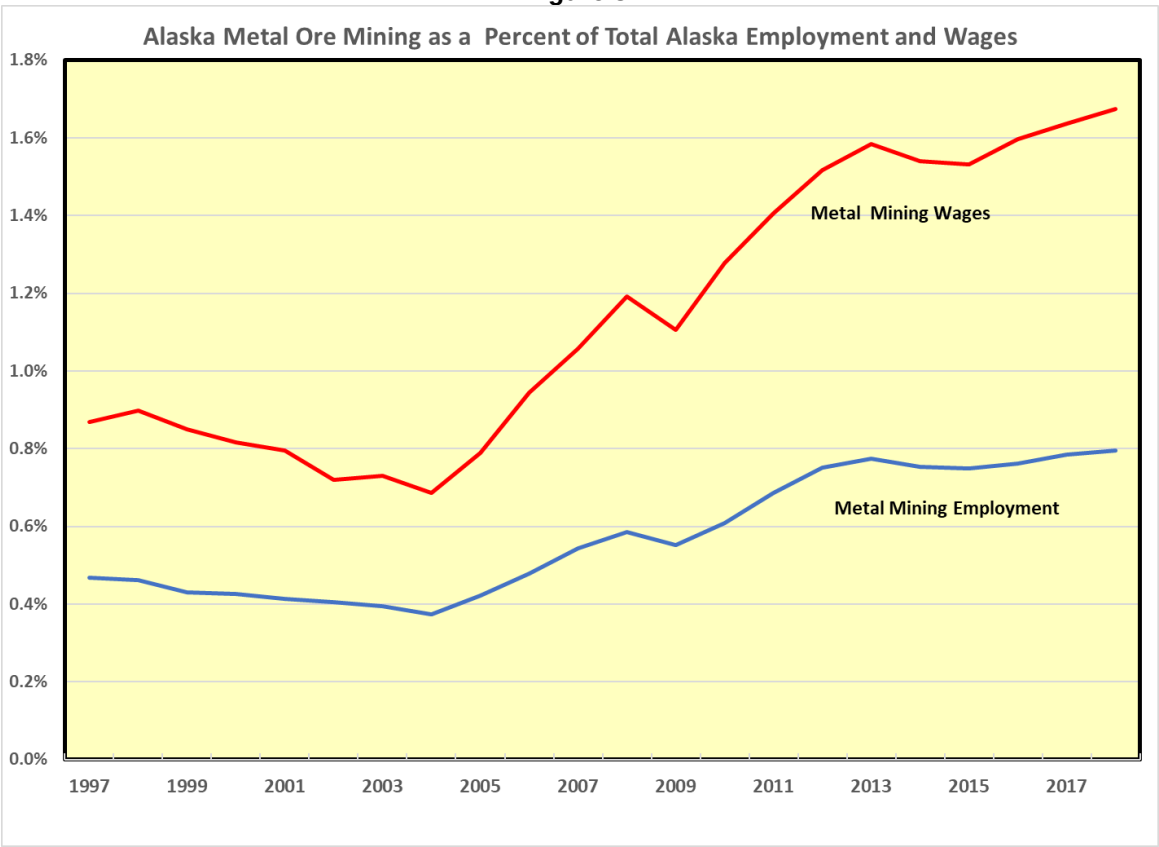
In 1997 Alaska's direct metal mining employment represented a fraction of one percent (0.5%) of total Alaska employment and, also, a fraction of one percent of total Alaska wage income (0.9%). Two decades later, in 2018, with the opening of additional large metal mines, metal mining's share of direct employment remained a fraction of one percent of total Alaska employment (0.8%), but total direct metal mining wages had passed the one percent level, reaching 1.7 percent of total Alaska wage income. Metal mining was quite small but growing, with wages growing faster than employment. That growth, however, has not made metal mining a significant "economic engine" in Alaska and that is not likely to change in the foreseeable future. See Figure 8, below.

Revenue annually produces a "Revenue Sources Book" that provide information on state revenues coming from petroleum production in the state. The Alaskan Department of Natural Resources, Division of Geological & Geophysical Surveys also produces an annual report, "Alaska Mineral Industry" accounting of the state and local revenues associated with all mining activity.

[12] This assumes that non-metal mining also expands 60-fold.

[13] Op. cit. p. 7.

Figure 8.



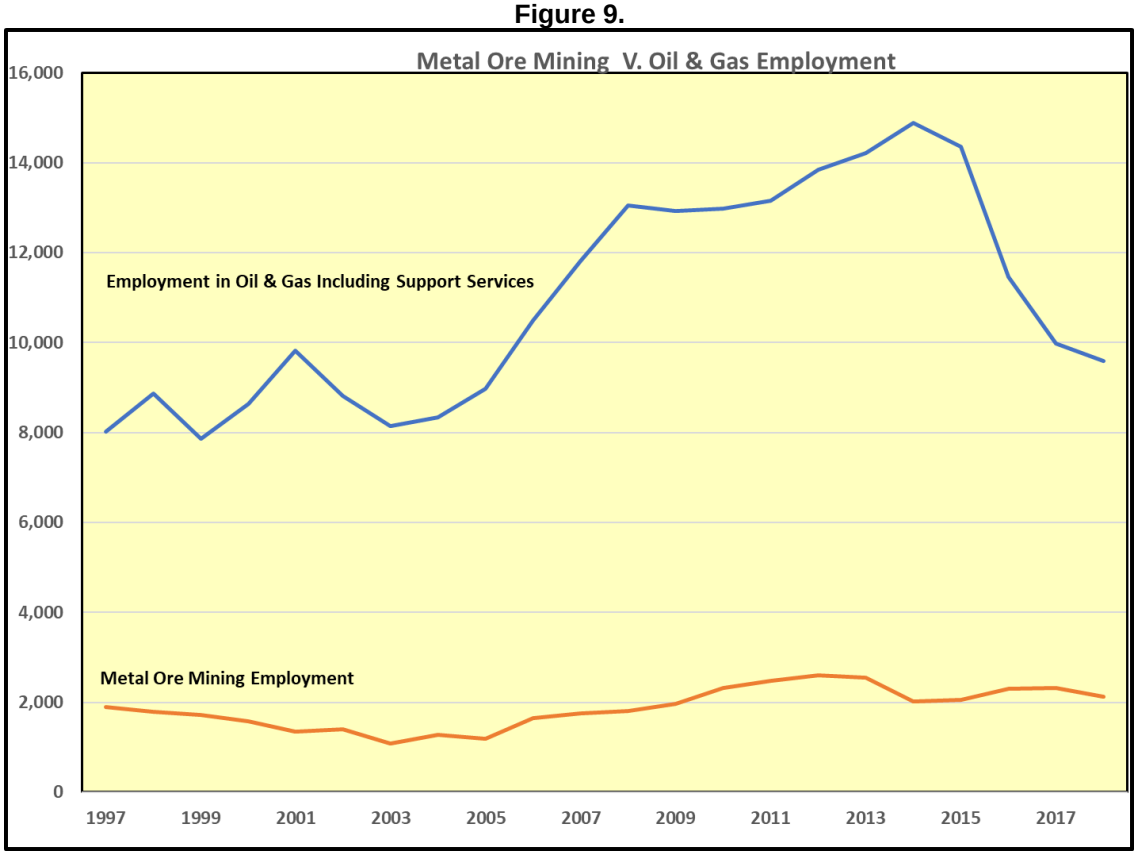
Source: AK Department of Labor and Workforce Development Current Quarterly Census of Employment and Wages.

The relatively small role that metal mining plays in the overall Alaska Economy reduces its capacity to significantly offset the loss of jobs, payroll, and revenue to governments due to the decline in production and value in the petroleum sector. Even if metal mining would double or triple in size, it would only offset a small part of the loses associated with the decline in the size of the petroleum sector.

If the metal ore mining industry employment in Alaska is compared directly to employment in the oil and gas industry, the difficulty of metal mining expansion replacing the lost jobs in the oil industry is clear: Over the last quarter century, employment in Alaska's oil and gas industry has averaged almost *six times* the employment in metal ore mining. In 2014, the peak year of oil and gas employment in Alaska, total oil and gas employment was a little more than seven times the employment in metal mining. See Figure 9 below.

In Figure 9, where employment in oil and gas is directly compared to employment in metal ore mining, it is hard to judge the size of the variation in metal ore mining employment because the oil and gas industry employment is so much larger. Figure 10, below, provides a closeup view of the changes in metal ore mining employment in Alaska since 1994.

Figure 9.



Source: Alaska Mineral Industry 2018, 2008, 2000, DGGS. Table 2. Oil and Gas, DOLWD, OCEW.

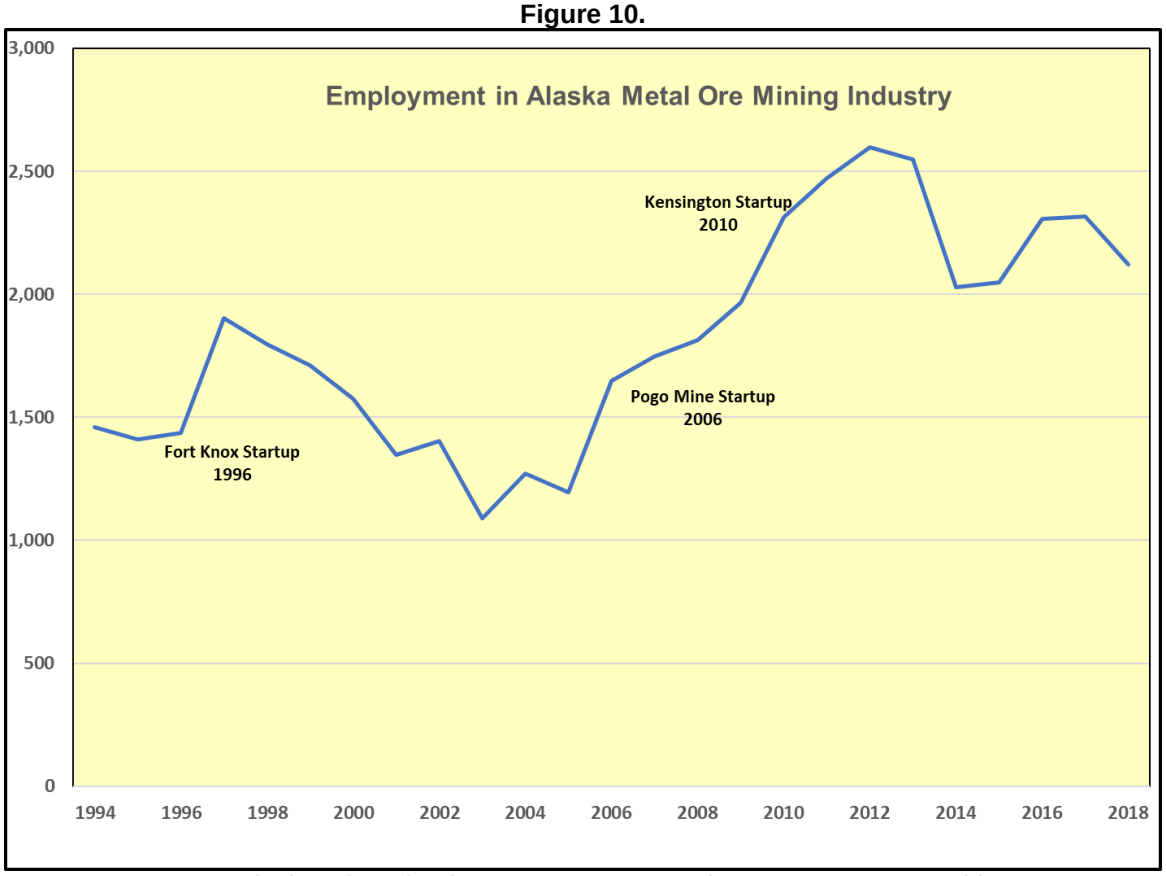
Gold mining, the metal mining that laid the basis for the original European-American settlement of Alaska, collapsed during the Great Depression as world demand for metals contracted and because federal monetary and war policy discouraged gold mining. It was not until the 1980s that renewed interest and investments in metal ore extraction began to revive in Alaska. By 1989 two large metal mines, Red Dog and Greens Creek had been brought into production and more metal mining potentials were being explored. By 2020 there were five relatively large metal mines operating in Alaska.[14] Figure 10 shows the impact of the opening of several of Alaska's large metal ore mines on the growth of metal ore mining employment overall. As more mines opened, more people were employed.

Figure 10, below, might be interpreted as primarily showing significant growth in metal mining employment. Metal ore mining employment in Alaska between 2005 and 2012 more than doubled (2.4x). As new metal mines were brought into operation, metal ore mining employment stepped up. Of course, employment does not only step up as time passes. Changes in the quality of the ore, the costs of mining, concentrating, and shipping the ore, as well as declines in the international value of the extracted metal ore can also lead to reductions in production, revenues, and employment. This can be seen in the significant fluctuations in metal ore mining employment over the last quarter-century, 1994-2018, depicted in Figure 10, below. Such instability is typical of most mineral extraction and processing industries. Figure 9, above, shows the fluctuations in the employment in Alaska's oil and gas industry including the most

[14] Alaska Mining Timeline, pp. 5-8, "Overview of Mining in Alaska," Legislative Research Report Number 13.156," January 30, 2013.

recent collapse. The volatile characteristic of mineral extraction industries will be explored in more detail below.

Figure 10.



Source: Alaska Mineral Industry 2019, 2008, and 2000. AK DGGS, Table 2.

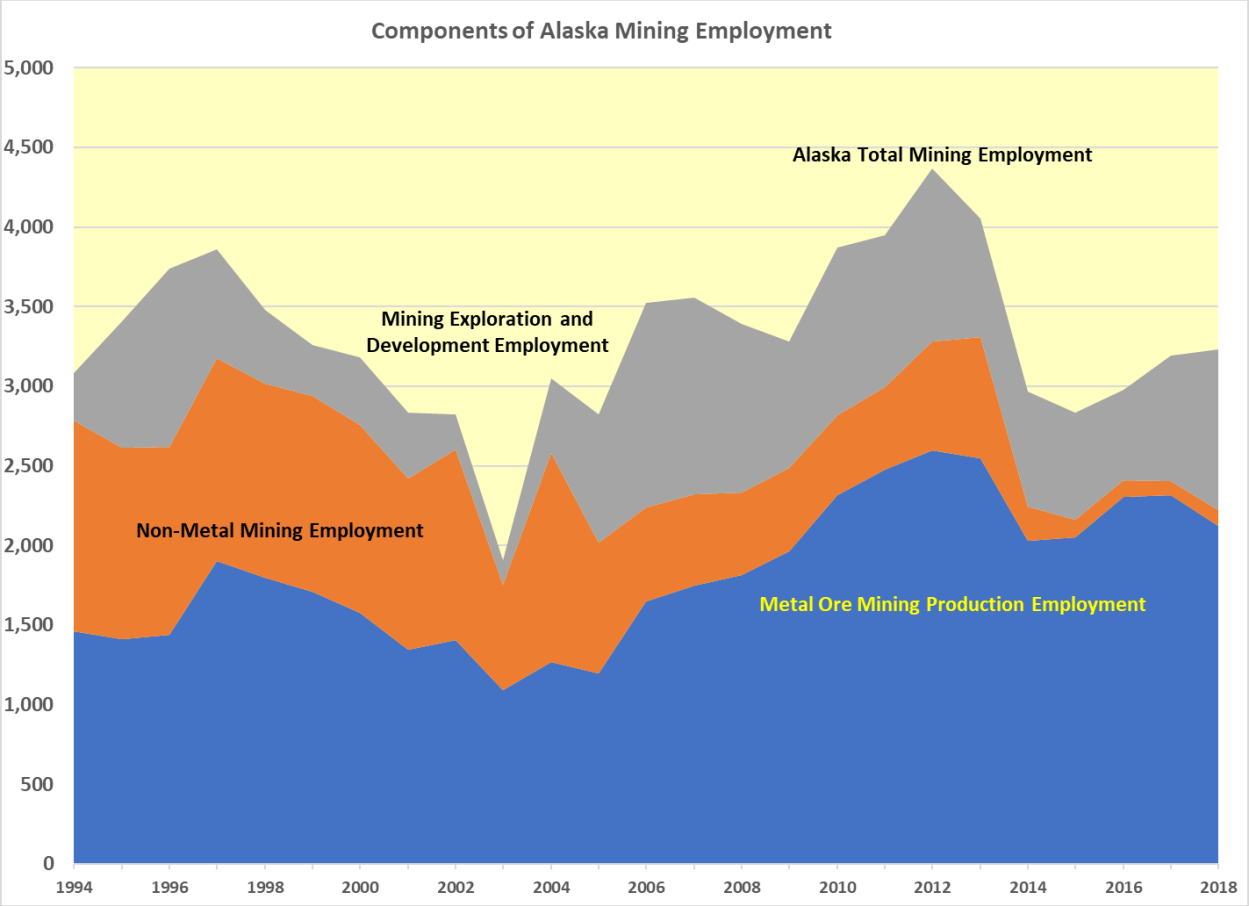
Metal ore mining is not the only significant source of mining employment in Alaska. There is also non-metal mining that includes coal, sand, gravel, rock, and a variety of other relatively small miscellaneous mining activities. In addition, mining is made possible by expenditures on mineral exploration activities and then the “development” of the mine site so that the minerals can be extracted.

Figure 11, below, shows those particular components of total Alaska mining employment. In that figure the components of total Alaskan mining employment are stacked up to show the division of total mining employment into its parts: metal mining, non-metal mining, and exploration for and development of Alaskan mineral deposits.

The bottom block of employment shown in Figure 11 is the same representation of how metal ore mining employment has varied over the last quarter century as shown in Figure 10 above. The second block shows non-metal mining. It is dominated by building materials: sand, gravel, and rock, the demand for which fluctuates with the level of overall construction activity in the Alaskan economy, potentially adding to the overall volatility of total mining employment. The top block of employment, mine exploration and development, usually can be adjusted more easily by mining companies than they can ramp the level of mine production up and down. This too can add to the fluctuation of overall mining-related employment. The steep decline of about 900

employees in 2002 and then the quick recovery of about 1,100 in 2003 indicates just how volatile total mining employment in Alaska can be.

Figure 11.



Source: "Alaska Mineral Industry" 2018, 2008, 2000, Table 2, Special Reports 74, 63, 55, Alaska Division of Geological & Geophysical Surveys

D. Conclusions about the Ability of Expanded Metal Mining "Filling the Hole" Created by the Decline in the Value Alaska's Produced Petroleum

Conclusion 1: Metal ore mining in Alaska directly represents only a tiny part of both the overall Alaskan economy and the revenues that the Alaskan state government relies on to provide important services and public infrastructure. This makes it very unlikely that any feasible expansion in metal ore mining in Alaska could offset the impacts of the decline in oil production and value.

Conclusion 2: The five "large" metal ore mines in Alaska directly provide only a fraction of one percent of total Alaskan industry employment. Because it is such a small sliver of the Alaskan economy, no plausible expansion of metal ore mining is likely to replace the petroleum industry employment lost recently to declines in the quantity and value of petroleum production in Alaska.

Conclusion 3: Metal ore mining, like oil extraction, is economically volatile, with production, employment, payroll, and revenues to government fluctuating as international commodity values change. Figure 6, above, showed the fluctuations in the revenue from the mine license tax as well the fluctuations in the total flow of revenue to Alaska governments from mining. The costs of extraction, ore quality, and extraction technologies available can contribute to this economic volatility. Finally, there is volatility in the world's demand for metals. As a result, the economic impacts of metal ore mining, including employment, payroll, purchases of inputs, and payments to governments and owners, also can be expected to fluctuate in disruptive ways as the decline in the value Alaskan oil production has demonstrated. Seeking to substitute metal ore mining for oil extraction to avoid economic and fiscal instability is not likely to succeed. It is a "more of the same" strategy that ignores the economic lessons taught by Alaska's own recent as well as past economic history.

3. How Competitive Is Alaska for New Investments in Mining?

Conclusions 1 and 2, above, emphasize the relatively small size of metal mining in the Alaska economy. If an industry is only a tiny sliver of the overall economy, even major expansions in that industry may have only minor implications for the overall economy. One response to this economic fact has been the assertion that there is something seriously wrong in the way in which the metal mining industry in Alaska is taxed and/or regulated that has kept metal mining from growing into a much more substantial part of the Alaska economy.

The Council of Alaska Producers, an organization representing Alaska's large metal mining industry,[15] while worried about potential increases in taxes on metal mining, does not view Alaska's current, 2019, tax structure as a block to additional investment that would expand metal mining:

> To compete successfully for global exploration and development dollars, Alaska's tax structure at the state and local government levels must be stable, predictable, and competitive with other metal mining jurisdictions. Tax policy must also be compatible with the economic realities of the mining industry and the challenges of doing business in Alaska. Other than limiting the taxation authority of local government to broadly applicable property taxes, Alaska's current mineral taxation system does not need to be revised. The system is comprehensive and fair to the State and the industry.[16]

The competitiveness of Alaska's public policy towards metal mining can be explored by comparing Alaska's mining taxation and regulatory policies to other metal mining jurisdiction in North America and other mining jurisdictions around the world. When that is done, there is no evidence that Alaska's public policy towards mining is more costly to metal mining than elsewhere. In fact, Alaska's mining tax and regulatory policies are more favorable towards investments in mining than those found in most other mining jurisdictions.

A. Comparing Alaska's Taxation of Mining with Other Mining Areas Around the World

Directly comparing the mining taxation and regulatory policies found in different states, provinces, and nations around the world, however, is difficult to do since each government

[15] https://www.alaskaproducers.org/about
[16] Mining Taxation In Alaska, p. 11, Conclusion

tends to write its taxation laws somewhat differently than other jurisdictions do.[17] Most taxes are not as simple as a percentage rate being levied on the market value of the mine's output. The very definition of that "market value" is likely to vary; the level of taxation may vary depending on the volume or value of the output; deductions may be allowed in calculating value or what volumes are taxed. Etc. In essence, each taxing jurisdiction tends to craft its tax codes differently depending on local circumstances, policies, and histories. In addition, each jurisdiction is likely to have different regulations that impose costs on operating mines. Taxation is not the only action taken by governments in their efforts to regulate mining.

One way that mining industry organizations have tried to compare the costs associated with mining regulation in different jurisdictions is to seek the subjective judgement of people intimately involved in mining about how different types of mining regulation discourage investments in the development of mines. The Fraser Institute[18], for instance, annually publishes a ranking of various mining jurisdictions in terms of how supportive or discouraging those governments are when it comes to investment in mining.

This could be interpreted as a pooling of the judgements of experts in the field being studied, i.e. the impact of public policy on the investments that mining companies are willing to make to develop a mine. These mining company executives are being asked to report how they would expect themselves and other mining company executives to respond to various types of regulations and taxes with which they have had experience.

However, the "data" that is generated by these surveys is based on the subjective judgements of individuals about policy measures that have a direct impact on their own and their company's self-interest. The policies on which they are asked to comment may well be policies they have opposed or supported as that public policy was considered and adopted. In short, these executives are not likely to be unbiased, independent, analysts.

The Fraser Institute has developed an "Investment Attractiveness Index" that combines a Mineral Potential Index based on a jurisdiction's geologic attractiveness for mining and a Policy Perception Index built around the expected effects of various government policies that impact the attractiveness of that jurisdiction for mine development.[19] Because of the Fraser Institute's close relationship with mining companies in North America, the Fraser Institute is able to collect data that most mining companies would otherwise be unwilling to provide.

This allows the separation of the underlying mineral endowment of a particular area from the government policies in that area that can impact mining investment decisions. One of the government policies evaluated was taxation policy. In its 2019 Annual Survey of Mining Companies, the Fraser Institute gathered enough information on particular mining jurisdictions to rate the attractiveness of 76 jurisdictions (nations, American states, and Canadian provinces)

[17] For an example of how difficult it is to compare taxes across jurisdictions, see, for instance, the 2019 effort by the U.S. Government Accountability Office (GAO) to compare the taxes and royalties paid by mining companies in twelve Western states. "Hardrock Mining: Updated Information on State Royalties and Taxes," letter to Senator Tom Udall, July 16, 2019, file number B-330854. Including Enclosures 1 and 2.

[18] The Fraser Institute (www.fraserinstitute.org) is headquartered in Vancouver, British Columbia. The Institute's focus is on how government policies affect Canadians' quality of life. It supports economic freedom and entrepreneurship while being skeptical of government intervention in the economy. The Fraser Institute advocates for, among other things, lower levels of taxation and regulation of mining in order to facilitate the economic benefits associated with mining.

[19] "Fraser Institute Annual Survey of Mining Companies 2019," Ashley Stedman, et al., February 2020

for mining due to the character of the public policy towards mining in each jurisdiction.[20] The existing taxation regime included personal, corporate, payroll, capital, and other taxes and the complexity of tax compliance.

Mining industry respondents from around the world were asked to evaluate each particular public policy measure with which they were familiar within a particular jurisdiction (with which they were also familiar) by choosing one of the following characterizations of that public policy, The tax regime in that jurisdiction had what sort of impact on mining investment:

i. Encourage exploration investment.
ii. Not deter exploration investment.
iii. Mildly deter exploration investment.
iv. Strongly deter exploration investment.
v. Effectively blocks exploration investment. [21]

If we focus on the overall Policy Perception Index, Alaska's ranking was respectable: Alaska was within the top fifth of the jurisdictions in 2019. In the five-year period 2015-2019, Alaska's rank put it in the top fifth to top third judged just by public policies affecting mining development.[22] Alaska's public policies taxing and regulating mining activity in the state, were quite competitive with other mining areas across the U.S. and around the world.

If we focus only on these mining companies' rankings of the taxation regimes in the various jurisdictions, Alaska in 2019 was in the top 10 of 76 jurisdictions. Arizona, Nevada, and Utah were ranked modestly higher than Alaska on whether its mineral tax system supported mineral exploration or, at least, did not discourage it.[23] American mining states were among the most highly ranked jurisdictions when evaluated on the basis of how supportive the taxation regimes on mining were among all of the world-wide mining jurisdictions studied.

The results of these annual surveys of mining company executives about how various aspects of a jurisdiction's tax and other regulatory policies affected the investment decisions of mining companies indicate that Alaska's mining policies have a positive impact on mining companies investment decisions. Overall mining regulation in Alaska was seen as encouraging mining or, at least not discouraging it. For mining taxation in particular, Alaska was judged to be approximately in the middle of the seventy-six to one-hundred mining jurisdictions included in the study.

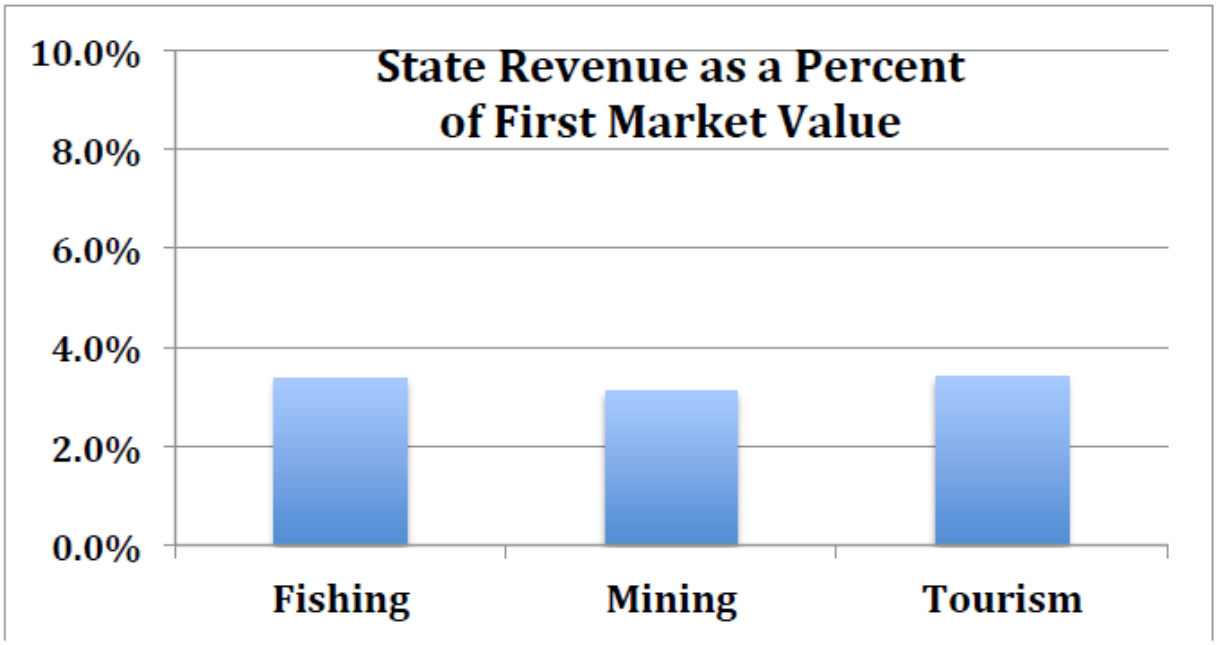
[20] This data was collected by contacting mining company executives as well as mining consultants. Participants were asked to respond to a survey form asking about the mineral and legal contexts associated with a particular jurisdiction. Each of the respondents was asked to indicate how each of 15 specific policy factors would impacted the mining companies' decisions to invest in that particular jurisdiction. Respondents were to respond only about jurisdictions with which they had had significant experience and to evaluate the impact only of public policies in that jurisdiction about which they were knowledgeable.
[21] Ibid. p. 7.
[22] Ibid. Table 2.
[23] Ibid. Figure 20.

B. Comparing the Level of Revenues Different Industries Pay to the State of Alaska

As we have discussed above, the revenues Alaska state and local governments collect from metal ore mining companies are very small compared to the revenues collected from oil and gas production, even after the decline in the quantity of produced petroleum and the value of that production. That might suggest that metal ore mining is not taxed as heavily as oil and gas or other important Alaskan industries.

The Alaska Department of Revenue annually provides a review of the revenue state and local governments receive from different industries. Those studies focus on petroleum producers, mining companies, commercial fishing, and tourism or the visitor economy. One of the ways the Alaska Department of Revenue quantifies the level of taxation on different economic activities is to look at what part of the market value of the output of each industry is collected in revenues by the state government. See Figure 12 below.

Figure 12.



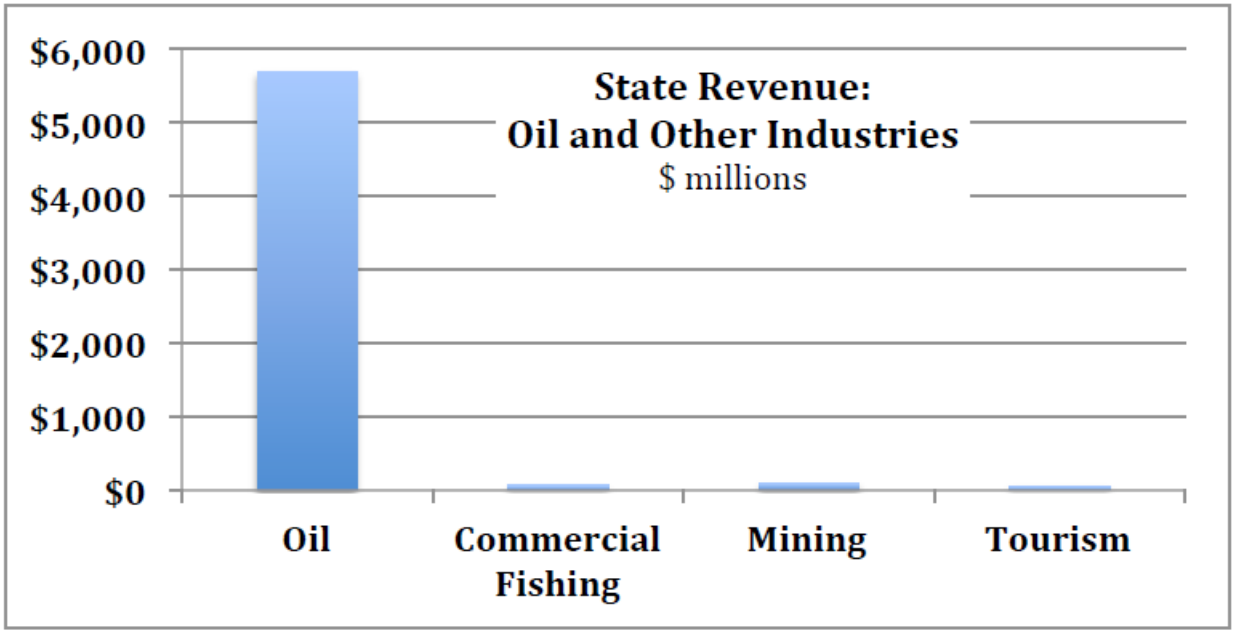
Source: Figure 4, p. 6, "Fiscal Effects of Commercial Fishing, Mining and Tourism." Bob Loeffler and Steve Colt, Institute of Social and Economic Research, UAA. Prepared for AK Division of Economic Development. December 2, 2015

The state analysts concluded that the proportion of first market value collected by the state from these three industries was "remarkably similar." "The numbers all fall in the relatively narrow range of 3.1% to 3.4%." [24] The state of Alaska, however, provides different levels of funds and services to these industries to promote and regulate them. Including those state *costs* from industry activities would result in different *net* impacts of the three industries on state budgets.

[24] "Fiscal Effects of Commercial Fishing, Mining and Tourism." Bob Loeffler and Steve Colt, Institute of Social and Economic Research, UAA. Prepared for AK Division of Economic Development. December 2, 2015, p. 6.

The revenues that flow from the oil and gas industry to the Alaska state government are not shown in Figure 12, above, because the revenues flowing to state government from the Alaska oil and gas industry are so large that they make it hard to identify what revenues are flowing from the mining, commercial fishing, and visitor economy to the state government. See Figure 13 below that demonstrates the difficulty of showing the differences in the revenues from non-oil industries when the much larger oil revenues are also included in the comparison.

Figure 13: FY 2014 State Oil Industry Revenue Compared with State Revenue from Commercial Fishing, Mining, and Tourism



Source: Figure 6, p. 7, "Fiscal Effects of Commercial Fishing, Mining and Tourism," Bob Loeffler and Steve Colt, ISER UAA, prepared for Alaska Division of Economic Development

Interestingly, while oil is the largest contributor of revenue to the state government among the state's major industries, it is a much smaller contributor of jobs in the Alaska economy. See Figure 14 below. Both metal mining and oil production are very capital intensive compared to commercial fishing and leisure and hospitality. As a result, the labor force that is necessary is smaller in those two mineral extraction industries oil and mining. The role of labor-displacing technology in mineral extraction will be discussed in more detail below.

Figure 14.

Sources: (1) The Economic Value of Alaksa's Seafood Industry. McDowell Group prepared for Alaska Seafood Marketing Institute. P.4. January 2020. (2) Alaska Economic Trends. Leisure and Hospitality 2018 monthly averages. P. 5, Table 2. January 2019. (3) Alaska Economic Trends. Oil Industry Ups and Downs. Total Oil Industry Employment 2017-2019. June 2020. (4) Alaska Economic Trends. Metal Mining Jobs 2017. P. 8, Table 5. May 2019.

4. Metal Mining Is Unlikely to Support Local Economic Development in Isolated Rural Areas

A. Rural Alaskan Residents Are Unlikely to Benefit from New Metal Mines

The "ripple" or "multiplier" effects associated with mining activity are tied to where the mining company purchases its supplies and equipment and where its employees spend their wages and salaries. In the lexicon of economic impact analysis, these are the "indirect" and "induced" impacts that, at least conceptually, can help spread the benefits of new metal mining to a broader part of the population. Beyond those hired directly by the mining company to operate the mine and ore processing facilities, these benefits are assumed, in a normal market setting, to reach a much broader swath of society.

However, if the new mine is in a relatively isolated rural area, as they are in many of the mine sites in Alaska, there is unlikely to be much local commercial infrastructure where the mine could purchase the inputs it needs or where employees and their families could spend their mine earnings. New mines, like existing mines, need to import the supplies they need via private access or haul roads, airplanes, barges or transport ships, pipelines, etc. Both mine and

residents must obtain the supplies they need from large urban areas at some distance from the mine site, much of it even outside of Alaska.[25]

In addition, the mining companies operating in relatively isolated locations are likely to build living facilities, including lodging, food service, recreation, electricity, and health care at the isolated mine site. In this situation there may be no possibility for local "induced impacts" associated with employees spending their income. Employees will be transported in and out and not allowed to leave the mine site to access services in local communities, even if such services were available in the relatively small villages. As the Pebble Draft Environmental Impact Statement described it:

> "The temporary and long-term camps housing workers would be self-contained and operated and maintained by [the mining company] throughout the project. The work camps would be in remote areas, and employees would not have access to services in local communities. Therefore, local community services would not be adversely impacted by additional workforce population needs. In addition to housing facilities, the camps would be equipped with appropriate emergency medical facilities, electrical power generation, fuel storage, and facilities for sewage treatment and solid waste disposal and management. Potable water for the camps would be trucked in or sourced from on-site wells."[26]

The Pebble Limited Partnership projected that the vast majority (71 percent) of the employees of that proposed mine would not be residents of the local communities. When the employees are off-shift and driven or flown back to where they reside, they will spend their pay in that location or the closest urban trade center to their residence. As the Pebble DEIS said: "It is estimated that during operations, 250 employees would come from surrounding communities and the remaining 600 would be flown to the project area from Anchorage or Kenai" [27]

In this setting, the *local* "multiplier" impacts of the construction and operation of a new mine are likely to be near zero. Effectively that means that the economic impacts are shifted to those locations where the mine can purchase its supplies and worker households can shop for what they need. Through this "leakage" of payroll and other mine expenditures away from the local communities, the multiplier impacts shift to the larger, more diverse, and more densely settled areas such as the Anchorage or Fairbanks areas.

These long-distance mineworker commuting patterns from Alaska's urban areas and areas outside of Alaska to isolated rural areas shift the "economic impact" of the mining away from rural Alaska to urban centers both in and outside Alaska. As stated above, this can reduce the local economic impact of a mine in a rural area to near zero as well as limit the positive impact on Alaska as a whole. The FEIS for the Ambler Mining District Industrial Access Road (AMDIAR) recognized the way that what otherwise be positive local impacts of mining may shift to large urban areas: "Those [local residents] with mining jobs may move away from their

[25] Of course, some mines are likely to be built within commuting distance of a large urban trade center. The mines in the vicinity or Fairbanks and Juneau are likely to have larger "multiplier" effects on the "local" economy than mines in more isolated areas with only very small villages in the vicinity of the mine.
[26] Pebble Project Draft Environmental Impact Statement, February 2017, U.S. Army Corps of Engineers, pages 4.3-4.
[27] Ibid. p. 4.3-3

communities, as some have done in association with the Red Dog Mine, to larger urban centers."[28]

These low positive impacts on local employment and income are not just a metal mining phenomenon. The same is true of almost any industrial activity at an isolated geographic location, whether it be a mine, mill, or timber harvest and processing facility. A 2003 study of small forest communities in Southeast Alaska documented the absence of a reliable impact associated with the rise and fall in forest products production and other export-oriented activities. The impact of fluctuations in export industry employment and income in 15 small communities on locally oriented employment and income were studied to see if there was a reliable positive correlation between them. That is, to see if a positive multiplier effect could be detected. In general, there was no such positive multiplier effect of the extractive activity on the rest of the local economy when that economic activity took place in isolated locations. The primary explanation offered for this result was the one suggested above: "…an extremely high degree of income leakage in small communities means that impacts from changes in [export-oriented] employment and income may appear outside the local community in question."[29] That is, the indirect and induced multiplier impacts are felt outside of the area where the industrial facility and its jobs are located.

B. A Counter Example? The Red Dog Mine

The Red Dog Mine is located in northwestern Alaska in the Northwest Arctic Borough. The mine produces lead and zinc ores. The Northwest Arctic Borough has a population of about 7,800, about 3,200 of which live in the regional hub, Kotzebue. The rest live in 10 peripheral Inupiat Native villages varying in size from 160 to 900 people. There is no road network in the area that links the villages. The movement of people and goods is by light airplanes or once-per-year barges. The exception to this is a haul road built specifically to link the Red Dog Mine to a port that was built for the export of the metal ore produced and the import of materials needed for the operation of the Red Dog mine.[30]

The Red Dog Mine's workforce is flown in by airplane from area villages or from Anchorage (the air cost is paid by the mine). The workforce resides at the mine site on workdays, working, typically, on a schedule of two weeks at the site and two weeks off the site. The setting of the mine and the way it is operated would suggest that there would be very little positive economic impacts on the local villages. Most of the payroll would "leak out" of the area surrounding the mine to the area of the residences of the workers, e.g., the Anchorage area. The supplies for the mine operation would also be purchased there or from large urban areas in Canada or the lower forty-eight states. However, the results of this particular mine were somewhat different in terms of the distribution of its economic impacts. Those differences are tied to specific institutional arrangements that allowed Native Alaskans to capture and hold a substantial share of the wealth created by the Red Dog Mine.[31]

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[28] Amber FEIS, Volume 2, Appendix H, p h-88.
[29] "A Test of the Economic Base Hypothesis in the Small Forest Communities of Southeast Alaska," Guy C. Robertson, General Technical Report NSW-GTR-592, Summary, December 2003.
[30] Mining and Sustainable Communities: A Case Study of the Red Dog Mine," Bob Loeffler. ***Economic Development Journal***, Spring 2015, 14(2):23-31
[31] Ibid. The following two pages are drawn from Mining and Sustainable Communities: A Case Study of the Red Dog Mine," Bob Loeffler. ***Economic Development Journal***, Spring 2015, 14(2):23-31

Ownership of significant land and mineral resources was transferred to Native Alaskan hands by the 1971 Alaska Native Claims Settlement Act. For-profit regional Alaskan Native corporations with exclusively Native shareholders managed those natural resources in their own interests. The regional Native corporation for the Northwest Arctic is the NANA Regional Corporation. The Alaska Native Claims Settlement Act gave the NANA the ability to select over 2.2 million acres of land in the region. The area of the Red Dog metal deposit was specifically chosen by the NANA because of its mineral values. Ultimately NANA shareholders decided to enter into an agreement with a mining company (Cominco, now Teck) to develop that metal deposit in a way that would help protect the traditional way of life of the region. NANA negotiated an agreement with the mining company to share the revenue associated from the mine. Ultimately, after the mining company recovered its capital investment in Red Dog, NANA would receive 25 percent of the net proceeds. Every five years that share would increase until the mining company and NANA were sharing the net proceeds equally, 50-50 percent.

The Alaska Native Claims Settlement Act, while giving ownership of developable mineral resources to individual Regional Corporations such as NANA, also required to them to share their natural resource revenues with other Regional Corporations. This sharing agreement helps to distribute the wealth that was created in a relatively isolated area around the Red Dog mine to a broader geographic area reaching Native Alaskan throughout much of the Alaskan interior. In many ways this is an artificially created ripple or economic multiplier that helps to circulate the wealth that would otherwise leak away from the isolated rural area where the mine was located. We say artificial here because the NANA are purposely spreading wealth to a much broader geographic area that would otherwise have been very concentrated and would not encourage broad economic activity.

As owner of the mineral resources, NANA was able to bargain with the mining company over more than just the sharing of net revenues the mine produced. They also bargained over how NANA shareholders could benefit from employment rights in the overall mining operation. They agreed that the ultimate target would be that 100 percent of the mining jobs would go to NANA shareholders.[32] In addition, the mining company would contract with NANA to operate the worker residential facility, providing food and housekeeping services. Another NANA firm contracted to haul the ore and material between the mine and the port using a NANA-owned fleet of trucks.

The environmental impacts of the mine were monitored by a committee of Native elders and mining company representatives. For certain types of impacts, the Native elders had the right to shut the mine down until the environmental problem was solved. This included impacts on the traditional subsistence activities of the Native Alaskans.

One of the other things that NANA negotiated with the mining company was a payment in lieu of taxes to fund a local school district and the Borough government. Previously, although the Northwest Arctic Borough had been established, it had no tax base that allowed it to fund any public services. One of the significant “spin offs” associated with the development of the Red Dog Mine was the establishment of funded self-government, including schools, in the Northwest Arctic Borough. The mine also runs training and apprenticeship programs, and scholarships providing access to these programs for youth. The intent is to provide a career path for students

[32] This objective of filling all of the Red Dog mining jobs with NANA shareholders has not been realized. In 2017, 55 percent of the Red Dog work site employment went to NANA shareholders. See “Long-term benefits to Indigenous communities of extractive industry partnerships: Evaluating the Red Dog Mine” Matthew Berman et. al, ***Resources Policy*** 66 (2020), Table 1, p. 4..

and help with the transition from the work culture associated with subsistence activities to that associated with industrial activity.

It is important to note the institutional arrangements, which are relatively unique, that were adopted by NANA and Teck, the mining company, to help assure that many of the problems associated with mining activities in isolated rural areas were avoided.

- Groups of Native Alaskans were given ownership of mineral and other natural resources in a way that allowed them to manage those lands as they saw fit: protecting them for their cultural and subsistence values and/or developing their commercial value.
- This allowed the Native Alaskan Regional Corporations to negotiate a broad range of sharing agreements with commercial interests. These include significant sharing of the net revenues from the mining taking place on Native Alaska land and mineral resources.
- Those negotiations from a position of ownership also allowed Native Alaskans to obtain a larger share of the employment benefits through hiring agreements and sub-contracting with mining interests to obtain the employments benefits associated with the secondary employment in servicing the mine, e.g. transportation services, food and accommodation services, etc.
- Payments in lieu of taxes funded local government infrastructure and services including schools that helped prepare Native Alaskans to take jobs at the mine or in providing services to the mine operation by working for a NANA subsidiary business.
- Allowed the Native Alaskans to choose how to balance commercial development with protection of subsistence resources and cultural values.
- The required sharing of natural resource revenues among Native Alaska Regional Corporations helps to reduce inequality that would otherwise develop between resource rich and resource poor Native Alaskan areas.

This is not to suggest that most of the problems of local residents of isolated rural areas not benefiting significantly from mine development were solved as a result of these creative institutional changes. One 2020 study of the employment patterns at the Red Dog mine found that most of the Indigenous shareholders in NANA did *not* live in the area of the mine, i.e. the Northwest Arctic Borough. Only 16 percent, 1 in 6, lived in the Northwest Arctic Borough and only 14 percent of the Red Dog payroll went to local residents. That is, 86 percent of the Red Dog payroll "leaked" out of the Northwest Arctic Borough, much of it, probably, to the Anchorage area. Thus the high percentage of indigenous workers at the Red Dog Mine (55 percent) were not a sign that jobs had gone to local residents.[33]

This would be consistent with the fear expressed by some village elders that the opening of the mine might, with its high paid jobs and free transportation from the Anchorage area to the mine, actually encourage local residents to move out of the Northwest Arctic Borough to the Anchorage area where they could enjoy the urban amenities that they could afford given a mining job paycheck. The Ambler Access Road FEIS expressed that concern too.[34]

NANA and Tech gave priority to applicants for jobs who were "local" and NANA shareholders but had limited success. Job tenure of local residents at Red Dog were relatively short. After 6

[33] This paragraph and the following paragraphs draw on "Long-term benefits to Indigenous communities of extractive industry partnerships: Evaluating the Red Dog Mine," Matthew Berman et. al. ***Resources Policy*** 66 (2020) 101609

[34] Op. cit. Ambler Access Road FEIS, Volume 2, Appendix H, p.H-88

years, about half of local resident workers hired by Red Dog had quit. In the first year, 13 percent of resident men and 23 percent of resident women workers quit.

These difficulties that NANA and Tech faced trying to hire Alaska Native workers suggests that for a mine that did not have all of the institutional advantages listed above and the commitment to hire locally, would have an even more difficult time trying to hire their workforce from local residents when a mine is located in a rural, relatively isolated, area. It was NANA's ownership of the metal ore deposit that the Red Dog Mine developed that allowed NANA to negotiate the favorable and cooperative terms discussed above. If metal ore mining is dramatically increased as some propose to offset the loss of revenues from oil and gas, it is unlikely that most of those mines will be on Native Alaskan Regional Corporation ore deposits. As a result, the impacts on local rural Native Alaskan villages will be even less positive than was the case with the Red Dog Mine.

The discussion above of the NANA objectives that were not completely reached is not meant to suggest that NANA failed to bring economic benefits to its Native Alaska shareholders. In December 2020, Bradners' Alaska Economic Report summarized the payments made by the Red Dog Mine to Alaska Native regional corporations. "Red Dog has paid over $2 billion in production royalties since it started production in 1989, with about $800 million paid and retained by NANA and $1.4 billion paid to other Native regional and village corporations."[35] But, again, these revenue flows to Native Alaskan Regional Corporations are the result of NANA's ownership of the metal ore deposit, something that will not usually be the case.

C. Unstable Metal Prices and Risk at Red Dog Mine

Almost as soon as the Red Dog Mine began shipping zinc and lead concentrates in 1990, it faced financial problems. Zinc and lead commodity prices began a multi-year decline that stretched into the early 2000s, challenging the economics of the project. Analysis indicated that the Red Dog mine's production had to be increased to take advantage of potential economies of scale that would bring costs down. See Figure 15 below.

Despite the low metal prices and the uncertainty about the costs associated with the expanded production level at the mine, major additional investments were needed. AIDEA in cooperation with the mining company and NANA borrowed another $85 million for the port and mine expansion that the mining company would repay over time as it mined, processed, and shipped the metal concentrates. At the time of the new agreement with the mining company in 1997, "zinc markets were consistently low for several years with an unclear future; the mine had lost money since its opening; and the future life of the mine…only provided certainty for operations through 2020…Despite these risks, AIDEA moved forward with the additional financing…: [36]

[35] Alaska Economic Report No.23/2020, p. 3.
[36] "Delong Mountain Transportation System Asset Management Review," December 2017, prepared for AIDEA by Arcadis, p. 7.

Figure 15.

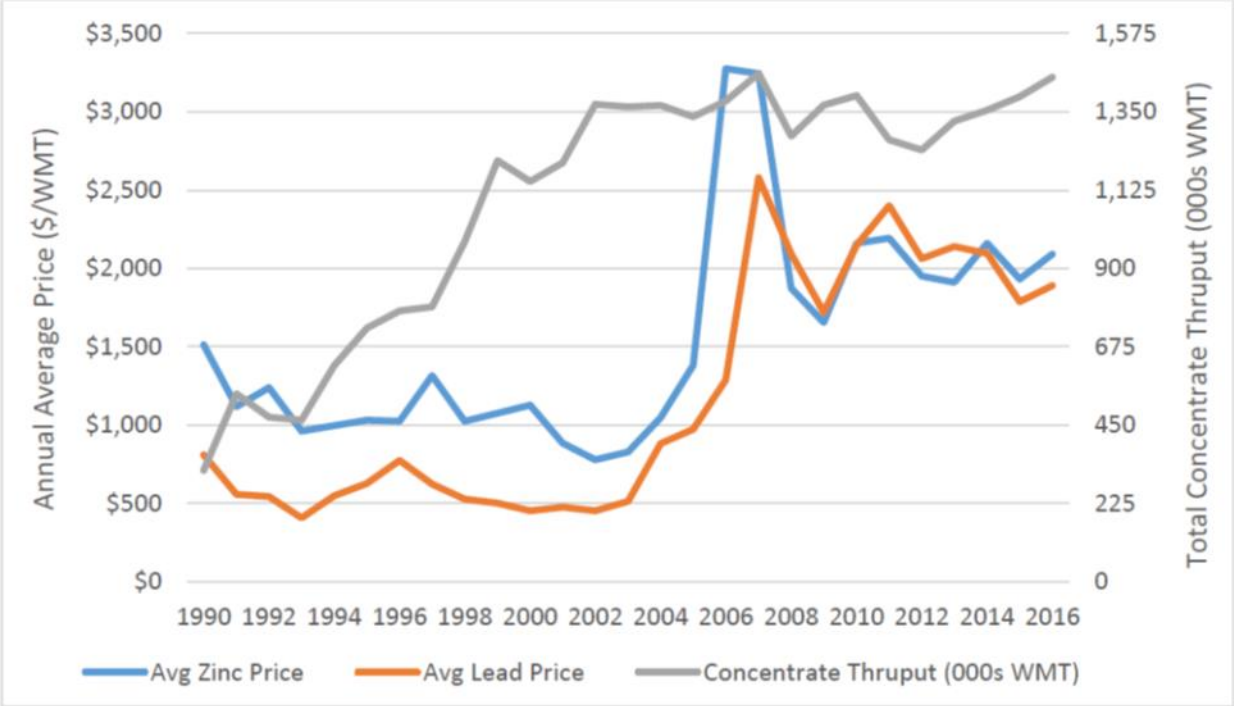

Figure ES-1. Graph of historical lead and zinc prices and Red Dog concentrate production

Source: "Delong Mountain Transportation System Asset Management Review," December 2017, prepared for AIDEA by Arcadis.

Zinc and lead prices did not stabilize as can be seen in Figure 16 that show the ongoing fluctuations in tin prices from 2016 to 2020.

Figure 16.

5. Socioeconomic Impacts of Metal Mining

A. Introduction

Often the description and measurement of the *socioeconomic* impacts of a new mineral extraction projects on local populations and communities are focused on a few narrow economic measures: value of mineral production, number of jobs, size of payroll, value of purchases from outside suppliers, royalties paid, and revenues that support local and state government services. The choice of these particular mining impacts is partially tied to the ready availability of data on commercial market transactions. In addition, many local residents, businesses, and governments are likely to see their own self-interests tied to expanded local commercial transactions associated with a new mining project.

Assessing local well-being using commercial measures of the expansion of the economy due to the operations of a new mining project seriously distorts the usual weighing of positive and negative impacts (benefits and costs) associated with any economic decision. Measuring only the expansion of the commercial economy typically means that only "benefits" are considered. i.e., the new mining project is depicted as generating only positive impacts. Implicitly, the mine is assumed to be costless. One of the reasons these local social impacts often are not analyzed is that they are harder to quantify, especially in monetary terms, than, for instance, numbers of jobs and income levels. The evaluation of such social impacts is often dismissed as unavoidably subjective and therefore resistant to objective evaluation. Researchers are now delving into these topics and expanding our understanding of the social impacts that a mine can have in a local community. Ignoring social impacts because they are more difficult to express in monetary terms implicitly places a very precise monetary value on them, namely zero. In fact, most social impacts *can* be quantified, and it is inappropriate to insist that only *monetary* valuations are appropriate.

B. Mining Town Maladies: A Look into the Dark Side of Mining's Social Impacts

There are many important social issues associated with mining in rural areas that have significant impacts on the well-being of residents and communities, e.g., increases in alcohol and drug consumption, increased pressure on local law enforcement, increased incidence of sexual and aggravated physical assaults, increased presence of convicted felons, etc. These impacts will not show up in the typical commercial statistics on jobs and income that are typically used to document the benefits of expanded mineral extraction, but these social changes can have substantial impacts on resident well-being.

Small towns near a new or expanding mine typically experience an increased pressure on the police force and many other social services provided by local governments. There can be a myriad of different reasons for this, but the basic principle is easy to understand: Increased population requires the police and other social services providers to do more work. This statement was highlighted by Archbold in "Policing the Patch", where "the Patch" referred to the Bakken "oil patch" on the North Dakota-Montana border.[37] In that study Archbold reported that 80 percent of the police officers interviewed said the oil boom had affected their work. While the impacts were many and varied, the most basic impact was that the officers were called out for service significantly more than they had been before the oil boom in the Bakken. In fact, "…Four out of the eight police agencies included in this study have had triple the number of calls for

[37] Archbold, C. Policing the Patch: And Examination of the Impact of the Oil Boom on Small Town Policing and Crime in Western North Dakota. *Police Quarterly*. 2014.

service since 2008. One agency had double the number of calls for service…"[38] Police get called out on all sorts of service calls, but the basic fact that the Bakken area had 2-3 times the service calls to the police since the oil boom got well underway points to something in the community dramatically changing due to the oil boom, serious enough that residents asked the police for assistance much more often.

Other studies of the Bakken area have shed some light on the kinds of calls to which the police were responding. Jayasundrara found that nearly all of the regional analyses had an increase in domestic violence, dating violence, sexual assault, and stalking.[39] It is also important to mention that the Jayasundrara study cautioned that: "…not all communities in the Bakken region had the same experiences, and some were more affected than others…" That there was an increase in violent crime in the Bakken mirrors directly the experience in the Marcellus Shale region of Pennsylvania which saw a 30 percent increase in violent crime as the unconventional gas boom developed there.[40] The same sort of story is told in Australia where mining towns in Queensland experienced rates of violence to which police responded increased between 1.4 and 2.3 times the state average at the five different mining communities studied.[41] While no two communities are identical, the added presence of a significant number of new mine workers is likely to increase the service calls to the police and other social services, and there will likely be a rise in the number of assault cases. As Ennis and Finlayson, who studied the Boom Town of Darwin, Australia put it:

> "There must be recognition of the likely impact of resource industry structures, workplace practices and culture, and the local "frontier" cultures which combine to support high levels of alcohol consumption and associated violence. Until this occurs, the alcohol and violence-related social disruptions will continue to be a hallmark of any boomtown scenario but especially for Darwin."

Much of the literature on mining camps and mining town maladies attempts to draw a correlation between community dependence on mining and alcohol use and abuse. In the Northwest Territories of Canada, which have seen a large increase in mining in the last decade, Gibson has quoted the Canadian Police (the RCMP): "The RCMP estimates that 80% of crime is directly or indirectly related to alcohol or drug abuse."[42] In the United States, in fact, mining has had the top billing as the drunkest industry. According to Bush:

> "Workers in the mining (17.5 percent) and construction (16.5 percent) industries had the highest rates of past month heavy alcohol use."[43]

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[38] Archbold, C. Policing the Patch: And Examination of the Impact of the Oil Boom on Small Town Policing and Crime in Western North Dakota. *Police Quarterly*. 2014.
[39] Jayasundara, D. Heitkamp, T., Mayzer, R., Legerski, E., and Evanson, T. Exploratory Research on the Impact of the Growing Oil Industry in North Dakota and Montana on Domestic Violence, Dating Violence, Sexual Assault, and Stalking: A Final Summary Overview. National Institute of Justice Award Number 2013-ZD-CX-0072. 2016.
[40] Komarek, T. Crime and natural resource booms: evidence from unconventional natural gas production. *Annals of Regional Science*. 2017.
[41] Carrington, K. The resource boom's underbelly: Criminological impacts of mining development. Australian and New Zealand Journal of Criminology. 2011.
[42] Gibson, G. Canada's Resilient North: The Impact of Mining on Aboriginal Communities. *Pimatisiwin: A Journal of Aboriginal and Indigenous Community Health* 3(1).
[43] Bush, M. Substance use and Substance use Disorder by Industry. The CBHSQ Report from the National Survey on Drug Use and Health. April 2015.

This was the second time in a row that mining had topped this list of industries by level of alcohol use. While we might be tempted to think that this was just a U.S. problem, studies focused on mining-impacted communities around the world show that it is a common problem no matter where the mining town is located.

The influx of strangers into areas experiencing a mining boom may undermine existing community social controls on resident behavior and create an environment attractive to those with a history of criminal behavior. One study of energy development in the Greater Yellowstone region found that the number of Registered Sex Offenders grew about 2-3 times faster in counties dependent on oil and gas extraction relative to those dependent on recreation or agriculture.[44]

One should not be shocked by these findings. A large group of single, transient, males who work long hours out of sync with the local standard work week, who have a large amount of money to spend and long blocks of idle time, are not likely to make good neighbors without significant public planning and provision of support services. While the miners' barracks or man-camps may indeed be "dry" in the sense that alcohol is banned on mining company property and the mining company may have very stringent rules about what the miners can and cannot do when on company property, the same rules cannot, and likely should not, be applied to towns in the vicinity of the mine when the miners are on their own time pursuing their private interests.

Any town located nearby a proposed mine should prepare itself to counter these specific maladies. The most basic steps that need to be taken would be an increase in police presence, the creation of outreach programs for substance abuse and domestic abuse, and some type of plan to try and assimilate the miners into the local culture. Is there a large enough police force, can the police force work more hours, or do they need to hire more police? Are there social services available for the inevitable spike in violence and substance abuse? Is there enough housing if the miners are going to be housed in the local area? For example, in the Bakken, where oil workers had to find their own shelter, housing was a serious issue that the area is just now sorting out. If the miners are being housed in "man camps," will they be traveling back to their "hometowns" on their block breaks or staying in one of the towns in the vicinity of the mine? Can the towns accommodate the miners' demand for housing during their time off? These are the sorts of questions that need to be asked and concrete strategies need to be developed before the mine is in full swing.

C. Man Camps and the Increasing Transience of Mine Workers

The volatility of international markets for commodities such as copper, oil, or coal has always led to fluctuations in the level of employment and payroll in the extractive industries. Employment and payroll tend to "flicker" as mines adjust their levels of exploration, development, and production to market conditions. Given that miners are very mobile, this can lead to fluctuations in population and expanded ripple effects in the local economy. The construction of "man camps" to house, feed, and serve miners outside of urban areas, adjacent to the mineral extraction site, adds to worker transience. This situation is especially prevalent in Alaska where the metal mines are often in extremely remote locations where there may well be no roads that lead to and from the mine and only very small population centers near the mine. In

[44] Berger, J. Sexual Predators, Energy Development, and Conservation in Greater Yellowstone. *Conservation Biology* 24(3):891-896. 2010.

this situation transience is a necessity since the mine would have a nearly impossible time attempting to convince a miner to relocate and build a house in such a remote location.

Because of this, the additional transience is tied to the movement of mine workers to and from man camps with each work cycle, e.g., two weeks on the job with long workdays and two weeks off the job and out of the man camp. Workers who reside in company housing near the mine site during their on-shift have to vacate that housing and provide themselves with an alternative residence, locally or not, during their off-shift when a new set of workers come in to keep the mine continuously operating. This can lead to fluctuating impacts in local rural communities as these waves of workers come and go. This transience is a product of the remote nature of many of the mineral deposits that are still undeveloped and the difficulty of getting the required workforce reliably to the remote mine site on time for the continuous operations of the mines.[45]

There may be limited hiring from the existing, local population because the high pay associated with mining jobs is partially tied to the experience and skill of people with past mining employment. The mining company will recruit regionally, and the miners will either fly-in, fly-out or drive-in, drive-out. The flicker in economic activity as mining companies adjust production levels to international market conditions and commodity prices as well as the long on-job and off-job work shifts at man camps both work to increase the transience of the mine work force in the area where the mine is located.

This scene is currently playing itself out in Australia where much of the population lives near the coast and many of the mining developments are in the interior of that nation:

> "Alongside these radical structural shifts in employment practices, the organization of work itself – the seven-day, 35-hour working week won by coal miners in a historic 1970 victory (Murray and Peetz, 2010: 13) – has been transformed with multiple-week block rosters of 12-hour shifts to support continuous production processes. An increasingly non-resident workforce leaves their homes to work these extended rosters (e.g. 14 days on, 7 days off or 9 days on, 5 days off). They are accommodated in work camps or other single persons' quarters – caravan parks or motels – during work cycles." [46]

This isolation and mandatory coming and going of the workers helps to erode what social structure may have existed in the local area around the mine. Because of the extended work hours and block nature of the work, it is hard for families and even communities to adapt to this type of schedule. Workers who live with this schedule find themselves with a relatively large paycheck and a large block of time with no structure in a community that does have structure that the miners do not understand.

Others have described how this transient nature of work and workers makes it hard for mining communities to invest in the services that the incoming workers will use. Although a local area might well know that a mine is coming, they may be reluctant to invest in the infrastructure necessary to accommodate the new workers for a number of different reasons. If the workers are living in company housing near the mine, it may be unclear how much strain they will put on

[45] This is the work schedule of the proposed Pebble Mine in Bristol Bay, AK. as well as the proposed Stibnite mine outside of McCall, ID. It is also what the Palmer Project plans according to its Preliminary Economic Analysis, to name three proposed mines.

[46] Carrington, K. The resource boom's underbelly: Criminological impacts of mining development. Australian and New Zealand Journal of Criminology. 2011.

local resources. If the mine is housing people in the local community, local residents may be reticent to have their community invest in providing services to a population of transient strangers from general tax revenues. According to Ruddell:

> "Demands on a community's physical infrastructure (such as water, sewage, waste, housing, roads, and transportation), as well as health, social, education, and protective services (emergency medical, fire, and law enforcement) increase but often there is a political reluctance to invest in these services as population increases are sometimes short-lived or followed by an economic bust. Consequently, there is often a lag between the recognition of a boom and the time when local services actually match the community's needs. "[47]

It can be hard for a local community to invest in the increased infrastructure and services to support in-migrating workers to a new mine because it is hard to tell how long they will be in town. In the Ruddell quote above, the lack of investment in the Fort McMurray, Alberta, tar sands area led to a crime rate three times higher than the national average and ranked Fort McMurray in the top five Canadian cities for violent crime in 2009.[48] While the police officials per capita ratio finally reached the national average in 2009, it lagged well behind the national average for the two decades that preceded 2009 precisely because the local government was reluctant to invest in public services for transient workers and industry.

The uncertainty associated with volatile global commodity values that leads to uncertainty about the level of mineral production, number of jobs, total payroll, and revenues to local governments also leads to hesitation on the part of local governments, local businesses, and residents to make investments that might be stranded or lost if world mineral prices turn downward. It is not just hesitation to expand local government budgets, for instance, for additional police. School districts are also likely to be hesitant to expand schools to handle the increased population. Small businesses will be hesitant to invest in the expansion of their businesses given the uncertainty about future resident spending, and residents, including miners, may be hesitant to invest in new homes in the vicinity of the mine since they might lose value if the markets for the minerals soften or collapse or pollution from the mineral extraction ultimately undermines the quality of life and stigmatizes the location as unpleasant or unhealthy. The net result of this unavoidable uncertainty about the level of production at the mine is an overall underinvestment in the community that can lead to the general run-down character of almost all mining towns.

D. The Impact of Transient Workers on Rural Communities

While above we noted increases in crime and lack of public infrastructure and public service investment, it is the social toll that may be the most under-reported and under-analyzed of mining impacts. Because of the nature of the mining workforce, and the new work schedules that are increasingly used at mine sites, the basic schedules of the local mine workers do not fit with the local community's schedules. This can have number of different impacts as Carrington points out.

[47] Ruddell, R. Boomtown Policing: Responding to the Dark Side of Resource Development. *Policing.* 2011.
[48] Ruddell, R. Boomtown Policing: Responding to the Dark Side of Resource Development. *Policing.* 2011.

> "In other words, precarious work practices may have a range of diffuse, often adverse social consequences for individuals and communities, even if work is generously rewarded in economic terms." And…
>
> "What is clear is that the rapid swelling of local populations in small residential communities potentially imposes enormous pressures on existing local services, infrastructure, amenity and the social fabric." And…
>
> "On the one hand, median weekly incomes for full-time workers ranged from 1.5 times to almost double the national median income in 2006. On the other hand, good economic times drive up local living costs. In some towns, housing costs have reached exorbitant levels." And…
>
> "In crude terms, the mining industry has been at the forefront of a trend to encourage trading of rights, security and [work] conditions for high wages."[49]

Given that the mining workforce is likely to be male, relatively young, not accompanied by family, and have considerable income available for spending, the impact of these workers spending two-weeks in a local community every month could be socially stressful for both the community and workers. Communities around mines may see their populations swell as miners with large blocks of time off come to town with much higher-than-average pay.

While this might not be a problem for a relatively large town, such as Juneau, Anchorage, and Fairbanks, which may be able to accommodate the needs of mine workers with large blocks of time off, it may be hard for small towns, like Homer, that was planned to be the "bedroom community" for the proposed Pebble Mine, to accommodate such schedules. This is not to say that it is impossible and there is some literature that shows, at least when using conventional commercial metrics, that having a large mine near a rural town did not cause problems. But what is clear is that there will be changes in the local community as it tries to accommodate the new resident miners and that these towns must plan for the arrival of the miners and the stress that they are likely to put on the local services. If a town near a mine has adequate social services to welcome the miners, it is possible that the impacts will be minimized as Hajkowicz found in Australia:

> "We find no evidence of systematic negative associations between quality of life and the gross value of minerals production. Instead, mining activity has a positive impact on incomes, housing affordability, communication access, education and employment across regional and remote Australia."[50]

Note that this conclusion focused primarily on the positive economic outcomes typically emphasized in mine "economic impact" studies: mines provide relatively well-paid jobs. That is the promise of mining. Yet mining areas and towns rarely show the economic affluence and quality of life projected when the mine seeks the required permits. It is partially the social impacts due to miner transience and mineral market instability that limit the positive impacts associated with the additional jobs and income. Our point is not that mining projects always lead to drunkenness and a concentration of bad actors. In fact, there are some very positive benefits

[49] Carrington, K. The resource boom's underbelly: Criminological impacts of mining development. Australian and New Zealand Journal of Criminology. 2011.
[50] Hajkowicz, S., Heyenfa, S., and Moffat, K. The relationship between mining and socio-economic wellbeing in Australia's mining regions. *Resource Policy.* 2010.

to the miners that hold the jobs and the communities that receive the royalties and/or tax base from the mine. What we are attempting to stress is that there is more to a mine locating near a local community than the narrow "jobs and income" commercial view of the impact on a local community. This is especially true when looking at the impact on Indigenous or Aboriginal people.

Because of the remote nature associated with many new mining developments and because Indigenous or Aboriginal people were often given, relocated, or restricted to remote land, Indigenous people are increasingly impacted by mining developments. While the average Non-Indigenous resident of a community is clearly impacted by the transient nature of the mining industry, for the Indigenous residents this impact may be greatly multiplied. The Indigenous cultural structure of "work" and "leisure" is even less similar to the block-structure of the new mining working schedule; subsistence hunting and fishing, oral tradition, traditional jobs, and community relations can be strained for Indigenous people that are hired on by mines. Gibson reports that the Canadian town of Polaris, Nunavut, the northernmost town in Canada, was also the richest in 1992 with a per capita income of almost $93,000 for each of the 200 residents.[51] While towns in Canada used to be created around ore bodies, the government now encourages temporary housing and community developments as *the* model for mine development to discourage the possibility of a ghost town in the future. Gibson goes on to say that:

> "Participation in the mine economy can also alter the subsistence lifestyle. For people employed by the mine, who work long daily hours and a two week on/off schedule, less time can be spent on the land hunting and fishing. A study of the Slave Lake [Alberta] Metis community found 71% of workers employed by the mine reported spending less time on the land (North Slave Metis Association, 2002)."[52]

Along with a lack of time and energy to continue the subsistence lifestyle, since the learning and history of Native societies has traditionally been orally based, "and involve knowledge transmission through *observing*, decreased practice of hunting practices may also signal the loss of associated knowledge."[53] This has led to fewer people speaking the Aboriginal languages of the Northwest Territories and has preferentially led the mining companies to hire those more traditionally western educated people[54] that rely less on their native languages which in turn discourages their speaking of the native language. Those communities that have been able to change their culture so that they could become more effective miners, and thus lose some of their Indigenous ways, have also reaped the reward of a much higher salary. This, then, further separates them from the other Indigenous communities that are farther from the mine site.[55]

While the plight of the Indigenous mine worker is something of a special case, many of the cultural dislocations that they acutely experience are felt throughout mining towns all around the

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[51] Gibson, G. Canada's Resilient North: The Impact of Mining on Aboriginal Communities. *Pimatisiwin: A Journal of Aboriginal and Indigenous Community Health* 3(1).
[52] Gibson, G. Canada's Resilient North: The Impact of Mining on Aboriginal Communities. *Pimatisiwin: A Journal of Aboriginal and Indigenous Community Health* 3(1).
[53] Gibson, G. Canada's Resilient North: The Impact of Mining on Aboriginal Communities. *Pimatisiwin: A Journal of Aboriginal and Indigenous Community Health* 3(1).
[54] Here we take "traditionally educated" to mean the more European classical forms of education such as a college degree or standard U.S. or Canadian high school education.
[55] Gibson, G. Canada's Resilient North: The Impact of Mining on Aboriginal Communities. *Pimatisiwin: A Journal of Aboriginal and Indigenous Community Health* 3(1).

world. Parkins recognized those experiences in his paper on social structure, fragmentation, and substance abuse in resource-based communities:

> "Specifically, the linkages between social structure, community fragmentation, and family dysfunction offer a way of understanding differential resistance and susceptibility to substance abuse. Five thematic areas were linked to susceptibility in this study: (1) an economy based on multiple divergent sectors, which gives rise to income disparity and social inequality; (2) a highly transient population, which results in social distancing and lack of social support; (3) shift work, which prevents opportunities for consistent and productive family and community relationships; (4) high incomes, which lead to material competition and financial stress; and (5) a culture of entitlement, which produces certain expectations and perceived privileges among some workers and their families."[56]

These "thematic" areas are exactly those that must be carefully considered when evaluating the social impacts of mining. It is the combination of these social impacts that leads a mining town, or a man camp, or the local area around a mine to become separated from the mine workers and leads to social dysfunction. Whether this dysfunction is happening in Indigenous communities where there is the possibility for an even larger negative impact, or in the more typical setting of a new mine in other small communities around the world, specific themes appear repeatedly in the literature. A separate culture is created by the mine that, because of its structure, its pay, and the diverse cultures of its workforce, may not fit well with the existing residents of the towns and cities that are closest to that mine. The results are the specific social maladies discussed above.

6. A Brief Look at Other Metal Mining Dependent Areas in the United States

A. Introduction

"Everything that you own, and everything that humans make, comes from the Earth." This is a familiar refrain that comes from mining companies: "If you cannot grow it; you have to mine it." This report certainly does not seek to debate, in some sense, the intrinsic value of the different goods and services, including metals, that flow from the earth and natural systems. There is no doubt that metals, precious, base, and rare earth, are important to our high-tech economy. We need to have those metals for our cell phones, our cars, our batteries, etc. This is only going to become truer as our global economy moves toward renewable energy sources and devices such as electric vehicles. But it would also be foolhardy not to recognize the massive costs that can be associated with metal mining that threaten natural systems on which our lives and the quality of those lives depend..

These costs are environmental, social, and economic, and can last just short of forever, which is the time frame for the damage associated with many metal mines of the past and present. While mining companies generally tout their enhanced fiscal contributions to local communities, the mining companies, unlike the towns, do not exist in these communities forever, and neither do their fiscal contributions. Long after the mining companies leave, the local areas around the mines must deal with these external costs which often far exceed the fiscal contributions that were made many years in the past.

[56] Parkins, J. Linking social structure, fragmentation, and substance abuse in a resource-based community. *Community work and family*. 2011.

The key economic point is that the “polluter should pay” for the damage done by production and consumption. For that to happen an accurate price signal must be sent to users of those metals. It is those price signals to producers and consumers that can create economic incentives to choose less environmentally damaging locations and production technologies and encourage conservation in the use and, for reusable materials like metals, the reuse of those gifts of nature.

It is only with a full understanding of the benefits and drawbacks associated with metal mining that states and individual communities can make rational decisions about allowing and/or encouraging metal mining in or adjacent to their communities. The familiar refrain from mining companies is that the past environmental and socioeconomic damage associate with mining should not be a concern with new mining proposals because “this time it will be different.” But many communities’ and the nation’s actual experience with metal mining is that “this time” of significant differences in the legacy of environmental and community damage from metal mining has yet to materialize despite the promises that continue to be made. The obvious problem with metal mining, or mining in general, is that it carries with it long lasting and potentially devastating environmental risks and impacts, depending on the mine location and the mining technology chosen. The history of mining also indicates that there can be significant and long-term negative socioeconomic impacts associated with contemporary mines.

Alaska is not the only state to have pinned its hopes on extractive industry, and indeed Alaska has done so on more than one occasion in its history. States like Arizona and Montana have also pinned their hopes and dreams on metal mining, and we do not have to guess or theorize about how those hopes and dreams turned out. We can look to the historic mining communities of Alaska, Montana, and Arizona, to see how well those metal mining states and local communities have fared both in terms of historical mining as well as contemporary mining. This section will explore exactly that.

One of the drawbacks, which at times is a boon for metal mining, is that metal mining is dependent on the *global* metal prices driven by production and consumption decisions around the world. The same is true, these days, with oil production. When there is a spike in demand, and before new production can come online around the globe, the price of many different metals and or/oil, will spike. This can cause a bonanza for the mines and mineral plays that are already developing or operating. It can also cause a spike in the interest to open new mines around the world. It is not until that demand can be met that there will be a corresponding drop in the price of the commodity. This is the classic economic view of supply and demand. This classic view also leads to the “resource rollercoaster” that may see high levels of mining and employment only to be followed by dramatic declines the production of mineral value. The ongoing cycles of expanding mineral production followed by declining production, revenue to governments, employment, and payrolls does not lay the basis for sustained economic vitality. Alaska’s most recent experience with oil is not unique or unusual in the history of mineral development.

The wrinkle in this classic view is that different metals, as well as oil and natural gas, are found all around the world. It is then the richness of the play, or the concentration of the play, and how cost effective it is to get the commodity out of the ground and transported to market that becomes important. How quickly can a mine ramp up or down its production to meet a change in demand and price? This is the story of the rise and fall of the Copper Kings in Butte, Montana. It is the century-long repeated rise and fall of copper mining and smelting in the Copper Triangle in Arizona. It is the story of the North Slope oil production in Alaska. All of these stories have multinational corporations that became winners who gained fabulous wealth. The local losers, those who were left with responsibility for the environmental and economic damage

when the global demand for the commodity flags or the local resource becomes too poor in quality and too expensive to mine and refine further. They must then live with what the mining companies have left behind which often requires perpetual treatment of the pollution sources left behind.

In this section, we will try to take a more holistic view of these different mining regions to see what led them from the creation of new wealth and high-paying jobs to a mineral industry contraction and ultimate shut down, leaving these regions to mitigate the environmental damage while coping with the local economic losses that they encountered, and what lessons can be learned from these regions' experiences.

B. The Copper Kings of Butte, Montana

Butte, Montana, or "Butte America" as it is jokingly referred to by the locals, is an excellent place to take a long view of metal mining in the U.S. Once the "Richest Hill on Earth"[57], Butte is now a hardscrabble Montana town that has rebranded itself as a tourist destination providing a view of mining in the days gone by and the physical damage left permanently behind. Butte is also now home to an annual national folk festival as well as the grave of its favorite son, dare-devil, Evel Knievel.

Butte was a major copper producer from the late 1800s through the middle 1970s. Its colorful history which was dominated by the struggles with and among the Copper Kings[58] is the stuff of legend and lore. Credited with "electrifying" the U.S. as electric lighting was being put up across the U.S., Butte played an important role in copper production for a good part of 100 years. By the 1950s the underground copper mining in Butte had become too expensive and open pit mining began in earnest. The Berkley pit, which famously sits in the middle of uptown Butte began to swallow up whole neighborhoods.[59] At the same time, the Anaconda company, that owned the Berkeley open pit mine, was also expanding its operations in Chile.

Uptown Butte was quite literally almost swallowed by the Berkley pit and likely would have been, had the Anaconda company not largely abandoned their operations in Butte to focus their efforts in Chile. This strange coincidence outlines the current reality of metal mining around the globe: If there is a cheaper source somewhere else in the world, metal production and prices are impacted across the globe.

At the beginning of 1983, after more than 100 years of mining and a town that had almost been, literally, consumed by mining, The Anaconda Copper open pit mining operations in Butte and its smelting operations in Great Falls and Anaconda closed their doors for good:[60]

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[57] Gibson, R. Is Butte really "The Richest Hill on Earth?" You'd Better believe it. Montana Standard. 7.25.2016. https://mtstandard.com/news/local/is-butte-really-the-richest-hill-on-earth-youd-better-believe-it/article_3f4fe398-208d-5158-8ed8-29674e4930a1.html

[58] Visit Southwest Montana. Copper Kings. 2.22.2018https://southwestmt.com/blog/copper-kings/

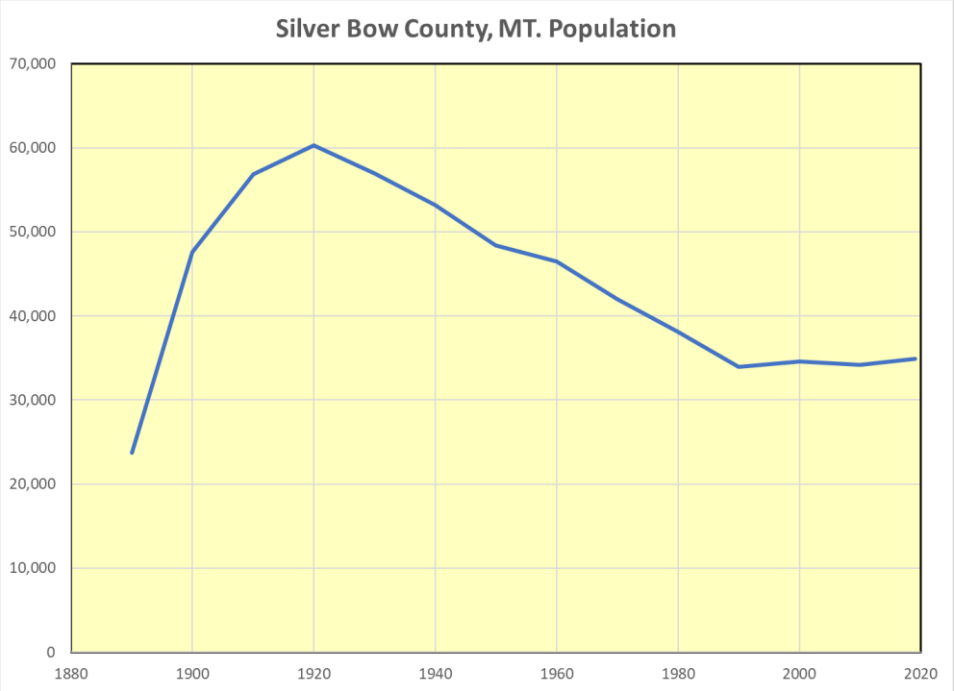
[59] Gibson, R. Butte, 1950-2009: Decline, Loss, and The Rise of Historic Preservation and Cultural Tourism. 2009. http://www.gravmag.com/gibson-20th.pdf

[60] Montana Resources Incorporated bought the mineral rights to an open pit mine adjacent to the Berkley Pit (Continental or East Berkeley mine) in 1986 after Anaconda had shut it down. The oil firm, Atlantic Richfield, owned the Anaconda Company operations at the time. they shut down the smelter (1980) and the Berkeley Pit Mine (1982) were shut down and inherited the environmental cleanup obligation associated with the century of Anaconda operations in the Butte area. The Continental mine has operated under Montana Resources ownership since 1986 with a few brief interruptions, mining and concentrating

> "It was a really ugly time," said Peoples, then Butte's chief executive. "People were upset, and everyone started pointing fingers of blame. A lot people needed to vent."
>
> "It was disbelief," said Boss, who, like many, didn't believe mining would ever completely stop in Butte. "Everybody thought (mining) was forever, something you had and your kids had."[61]

While Butte has attempted to diversify its economy beyond mining, the population of Butte has been generally in steady decline since 1920.[62] See Figure 17, below.

Figure 17.



Source: U.S. Decennial Census. The City of Butte is located in Silver Bow County. The city and county have been consolidated their government into the "City and County of Butte-Silver Bow."

While folk festivals, "Evel Knievel Days"[63], and historic mining tours have attempted to diversify the Butte economy in recent decades, the town is still physically dominated by the huge open pit mines in uptown Butte. Recently the Berkeley Pit, which has been filling for decades with a toxic soup of acid metal mine drainage, began to threaten the citizens of Butte once again with overflow into the valley ground water. Only in 2019, did the treatment of the toxic water in the

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copper, molybdenum, and silver ore. It is the only metal mine currently operating in the Butte area. Figure 17.

[61] Laboe, B. Butte mines closure revisited. *Montana Standard.* 1.6.2013. https://mtstandard.com/news/local/butte-mines-closure-revisited/article_4edeaf5a-57ab-11e2-ae58-0019bb2963f4.html

[62] Gibson, R. Butte, 1950-2009: Decline, Loss, and The Rise of Historic Preservation and Cultural Tourism. 2009. http://www.gravmag.com/gibson-20th.pdf

[63] The City-County of Butte Silver Bow. Events and Festivals. https://co.silverbow.mt.us/490/Events-Festivals

Berkeley pit begin to be treated well enough to be released back into the natural environment.[64] The nation's largest Super Fund has finally begun to heal a few of the wounds that have been visited upon the 100 mile stretch of Silver Bow Creek and the Clark Fork River from Butte to Missoula over the last 100-plus years.

Of course, there is another factor at play, especially when one introduces a term like "Superfund." That factor is the restoration economy. This is a relatively new term of art to explain the impact of these rather large cleanups to heavily mined areas like the Butte-Silver Bow area as well as the state of Montana as a whole. Because of the massive amount of cleanup and money that has been spent and will be spent in Montana cleaning up the mess left by metal mining and smelting throughout western Montana. In Butte, the Montana Department of Labor and Industry commissioned a study to look at Montana's restoration economy in 2009.[65]

The restoration economy study estimated that $113 million would be *directly* spent to clean up the downstream end of the distribution of mine and smelter waste the Butte area to just upriver from Missoula, MT. The study summed the downstream portion of the restoration in the following terms:

> "An estimated $113 million will be spent on the Milltown Dam project [just outside of Missoula], resulting in approximately 1,240 FTE [Full Time Equivalent] jobs in restoration and 2,323 FTE jobs in other industries (a total of 3,563 FTE)…. Further, the Silver Bow Creek case study indicates that each $1 million spent on restoration results in an estimated $2.59 million in economic output. Extrapolating these results, the $113 million budgeted for the Milltown project would result in approximately $292.7 million in economic activity. This economic activity includes $120.2 million in employee compensation, $23.4 million in proprietor income, and $12.8 million in business taxes collected by federal, state, and local governments. Again, this income would be spread over the full timeframe of the project."

While no community would choose to base its prosperity on cleaning up dangerous mine waste and pollution, the impacts of these rather large cleanups can be profound *if* a funding source is available to support that clean up. Montana was fortunate that a prosperous international petroleum company, with deep pockets, purchased the failing Anaconda Company, inheriting the financial responsibility for the cleanup of the Butte to Missoula mining wastes along the Clark Fork River and Silver Bow Creek. While the quote above only focuses on the jobs and money spent cleaning up the area downstream of the Butte mines, the long-lasting environmental benefits are enormous. Of course, the more efficient way to do all of this would be to not pollute the area in the first place so that it does not require such massive cleanup. Assuring that mine operators pay into a substantial cleanup fund for the entire time they are operating and before they shut down, possibly in bankruptcy, is also vitally important to the future economic vitality of the region damaged by the mine.

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64 Sacks, N. Butte Reaches Superfund Milestone, Releasing Berkeley Pit Water Into Silver Bow Creek. https://www.mtpr.org/post/butte-reaches-superfund-milestone-releasing-berkeley-pit-water-silver-bow-creek

65 Montana Department of Labor and Industry. An Estimation of Montana's Restoration Economy. September 2009. https://deq.mt.gov/Portals/112/Land/FedSuperFund/Documents/sst/RestorationEconomyRPT9-17-09.pdf

The residual pollution still haunts the areas around industrial operations. The waste sludge from operations continues to be left behind in tailings storage facilities that often requires near constant monitoring and treatment indefinitely into the future if those areas are to remain pollution free. In fact, although it is not often brought to light until there is a large tailings storage facility failure, these problems persist today and appear to be accelerating with the proliferation of industrial activities like ore concentrators and smelters, waste rock storage, and coal-fired electric generation.

> "In the past 50 years, 63 major tailings dam failures have been reported worldwide, with an upward trend in high-consequence failure events since 1990. According to Vogel, the failure rate after 2000 has increased to a frequency of five to six significant tailings dam failures annually."[66]

The purpose of this section of the report is not to delve into all of the potential disasters associated with metal mining. What we are trying to establish is that controlling the environmental damage associated with building a mine, extracting the ore, and concentrating and processing the metal ores is difficult. The only way that a community, a state, or a nation should encourage and allow metal mining on a large scale is to be completely aware of *all* of the potential benefits as well the large, serious, costs and the long duration of those costs. Large scale pollution lasting just short of forever is something that local communities should take into account before agreeing to allow a mining company to set up their shop in or adjacent to their community. But there are many other factors that should also be considered.

Mining can potentially spawn an enormous amount of economic activity associated with providing the inputs the mine needs to operate. The question is whether the local communities can supply that material or if all of it will be outsourced to larger industrial centers that are likely out of the local area, the state, or in some cases the country. For example, does the local area have the ability to produce or even service the heavy equipment used in mining? Likely it does not. But can the local community even supply the fuel that those large mining machines will use? Again, it really depends on the supply networks that the local area possesses. Metal mining has become so specialized that many of the supplies that are used at the mine site cannot possibly be produced or even supplied by small communities adjacent to the mines. Mining these days is a global endeavor that relies on the global supply lines.

To better understand the potential socioeconomic risks associated with the global demand for copper, and how Butte experienced the "resource roller coaster"[67] for over 100 years, we can look at U.S. primary copper production. It should be immediately apparent from Figure18 that copper production in the U.S. has been anything but stable since 1900 despite an upward trend in copper production over that time period.

While the trend is certainly towards increased copper production in the U.S., there were very large swings in production on a year-to-year, and decade-to-decade basis. It was precisely this instability in copper production and price that eventually stopped copper production in Butte as increased copper production in Chile, at the Anaconda Copper Company owned mines there, began to take off, directly displacing Anaconda Copper Company copper production in Montana.

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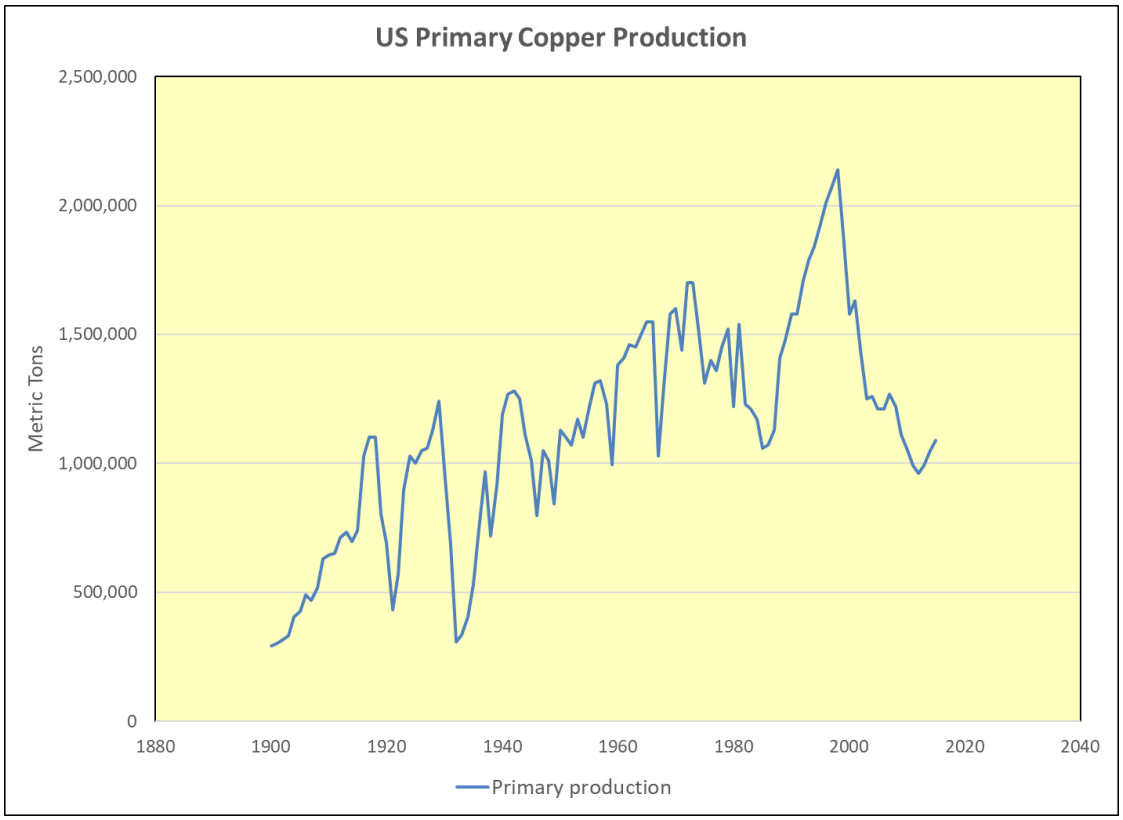
[66] Owen, J. et al. Catastrophic tailings dam failures and disaster risk disclosure. *International Journal of Disaster Reduction*. Volume 42. 2020.

[67] Lisa J. Wilson coined that phrase in the title of her Ph.D. dissertation and an article based on it: "Riding the Resource Roller Coaster," *Rural Sociology* 69(2)261-281, October 2009).

While the trend is certainly towards increased copper production in the U.S., there were very large swings in production on a year-to-year, and decade-to-decade basis. It was precisely this instability in copper production and price that eventually stopped copper production in Butte as increased copper production in Chile, at the Anaconda Copper Company owned mines there, began to take off, directly displacing Anaconda Copper Company copper production in Montana.

Figure 18.



Source: USGS. Historical statistics mineral and material commodities in the United States.

In Figure 19, below, we compare the same data from U.S. copper production against world copper production (primary).

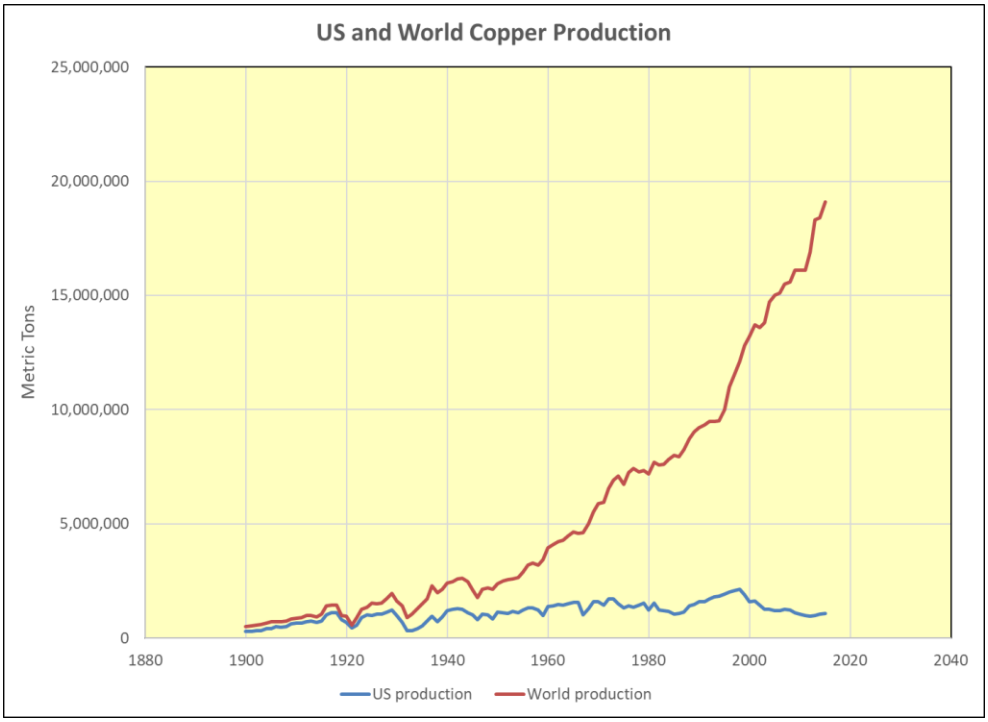
Note that copper production in the U.S. was a relatively small part of world copper production in the second half of the twentieth century. That is why it is difficult to see the fluctuation in U.S. production as clearly as in the previous figure. What is clear is that world production has been trending upward at an increasing rate since the 1950s. This time period, the 1950s, is also the time when truly global copper production began. What we can see is that production was increasing over this long time frame, but the graph above washes out the fluctuations in production in the U.S. because of the relatively small global role that U.S. copper production was playing over that time frame.

To look at the more contemporary view of copper mining, we need to be able to see global production, which was shown above, but we also need to see the per unit value, or price, of that

production and how it has fluctuated. Figure 20, below, provides just such a view of the last 30 years.

Again, what we see, on this much smaller time frame is how truly dynamic the international market for copper is. While the overall trend of the price of copper is trending upward over the more than 30-year time period presented, it is anything but stable. In fact, over relatively small time periods, like 2008-2011, copper loses more than 60 percent of its value and then turns around and triples its value.

Figure 19.



Source: USGS. Historical statistics mineral and material commodities in the United States.

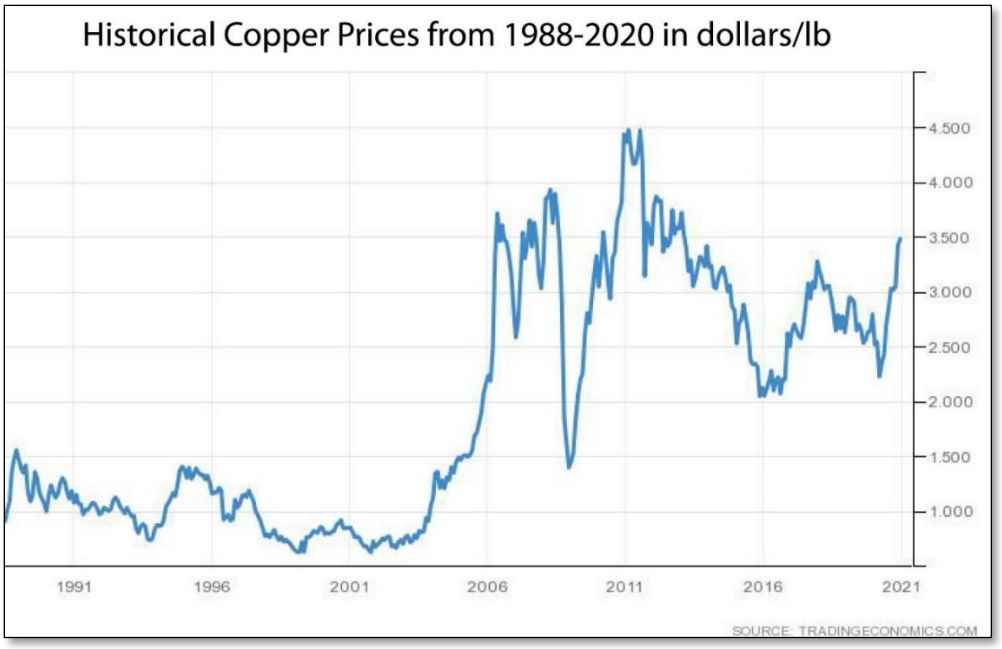
If the copper mine on which a community has become dependent is an inframarginal supplier of copper (neither too cheap nor too expensive to produce), then a copper producer would quite literally have ridden this price-driven rollercoaster over the last 30 years. When the price was up, if it could, it would increase local output and help to saturate the market. When the price was down, if it could, it would decrease the local output and in hopes that the price would rebound soon.

The impact of this type of variation in price, production, and consumption is that metal mines, and in this case, copper mines, very rarely operate at a constant output level over any appreciable length of time. It simply does not make economic sense to continue to produce a commodity at the same level when the price changes so significantly.[68]

[68] This is not to suggest that the level of mining varies day-by-day depending on market commodity price. There are costs associated with significantly raising and lowering the level of production. The point is that production levels do, ultimately, adjust to the commodity price and production costs and how the mining company expects those to change going forward.

There is, of course, a global recession during the time periods presented in the figures above that certainly had a large influence on production, price, and production costs. It is the impact of a limitless number of different global factors that helps to make this data unpredictable. Things like increased use of copper in electronics and a new "greener" economy and a host of other factors that influence the supply, demand, and cost of copper. The production of copper, like many of the other base metals is extremely energy intensive and so the price of copper can fluctuate with energy costs.[69] We are simply trying to point out that the copper mining industry, and metal mining in general, is global, volatile, and influenced by a host of different complex factors. That has implications for the local economies dependent on the mineral extraction industries.

Figure 20.



Source: Tradingeconomics. Historical Copper Prices. https://tradngeconomics.com/commodity/copper

The success of any individual mine or mining area is directly tied to the global market for the mineral and the cost of mining it at each mine. That, unfortunately, means that it is tied to a series of extremely complex variables. For Butte, this not only wrecked their copper mining and smelting industries, but it also, very likely and ironically, saved even more of the city of Butte from the Berkeley Pit that was literally swallowing the town.

We will not discuss the violent and oppressive history of the various copper mining companies that ran the Butte mines. Although it is an interesting and slightly unnerving to look at the power of these mining companies at the turn of the 20th century, it is unlikely that any community would want to return to the conditions and inequality that dominated Butte's mining heyday. From corrupt politicians, unsafe mining conditions including the worst mining disaster of all time in

[69] EIA. Energy commodity prices rose more than other goods in 2019. 1.6.2020. https://www.eia.gov/todayinenergy/detail.php?id=42395

1917,[70] massive and lengthy labor disputes, murders, bombings, paid off judges, and radical union agitators, the history of Butte reads like a dystopian past that most people would not voluntarily wish to be reproduced. For a much deeper historical perspective into the raucous history of Butte, and why Montanans do not want to harken back to the days of the Copper Kings, we suggest the recent podcasts Richest Hill and Death in the West.[71]

But Butte America is far from the only area in the nation that has relied on copper or some other metal, and, in turn, been let down by those mines and smelters. Copper mining and smelting also played important roles in the histories of several other states: New Mexico, Arizona, Nevada, Utah, Idaho, and Michigan. We now turn to Arizona.

C. The Copper Triangle in Arizona

When considering the pros and cons of Alaska heavily investing in metal mining in order to stabilize its economy and allow its governments to get back in fiscal balance, it can be instructive to look at Arizona, and specifically the Copper Triangle of Arizona. This is an area that, also, has seen significant mining for more than a century and is the site of multiple proposed metal mines. For example, the proposed Resolution Copper Mine outside of Tucson as well as the proposed Rosemont Copper Mine outside of Phoenix[72] have been in attempting to be permitted for years. Using Arizona as another example, we can explore the benefits and drawback metal mining has bestowed upon Arizona.

Arizona, too, became an important supplier of copper to the nation in the last quarter of the nineteenth century. Many of the original mining districts developed then continue to be mined today: These areas include the Morenci in Greenlee County, the Globe-Miami district in Gila County, the Green Valley operations in Pima County, and the Bisbee Area in Cochise County. To support the copper ore mining, copper smelters were also built in the area, collectively known as the Copper Triangle. Many other copper mines have been developed during the twentieth century and into the beginning of the twenty-first century and a few mines are in the permitting process now.[73]

Because of this long history and experience with copper mining in Arizona, one need not speculate about the impact of that mining on the sustained prosperity of the communities associated with those mines. Even as mining continued, the mining towns experienced little or no growth and their commercial infrastructure remained limited with very little additional non-copper-related investment taking place in the communities. Globe, for instance, the county seat of Gila County, has seen no population growth over the last century of mining. Between 1910 and 2010 its population fluctuated between 6,000 and 7,000. All of the mining and its accompanying high wages, high levels of mine company spending, and high value of copper removed from the area did not trigger ongoing economic vitality, and a corresponding rise in economic vitality in the area.

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[70] 1917 Butte mine disaster killed at least 166 men. Here are their stories. Montana Standard. 6.18.2017. https://mtstandard.com/news/local/1917-butte-mine-disaster-killed-at-least-166-men-here-are-their-stories/collection_5665d0a2-6fd1-5f4a-a369-9279d1284d0e.html

[71] https://buttepodcast.org/ and https://deathinthewestpod.com/

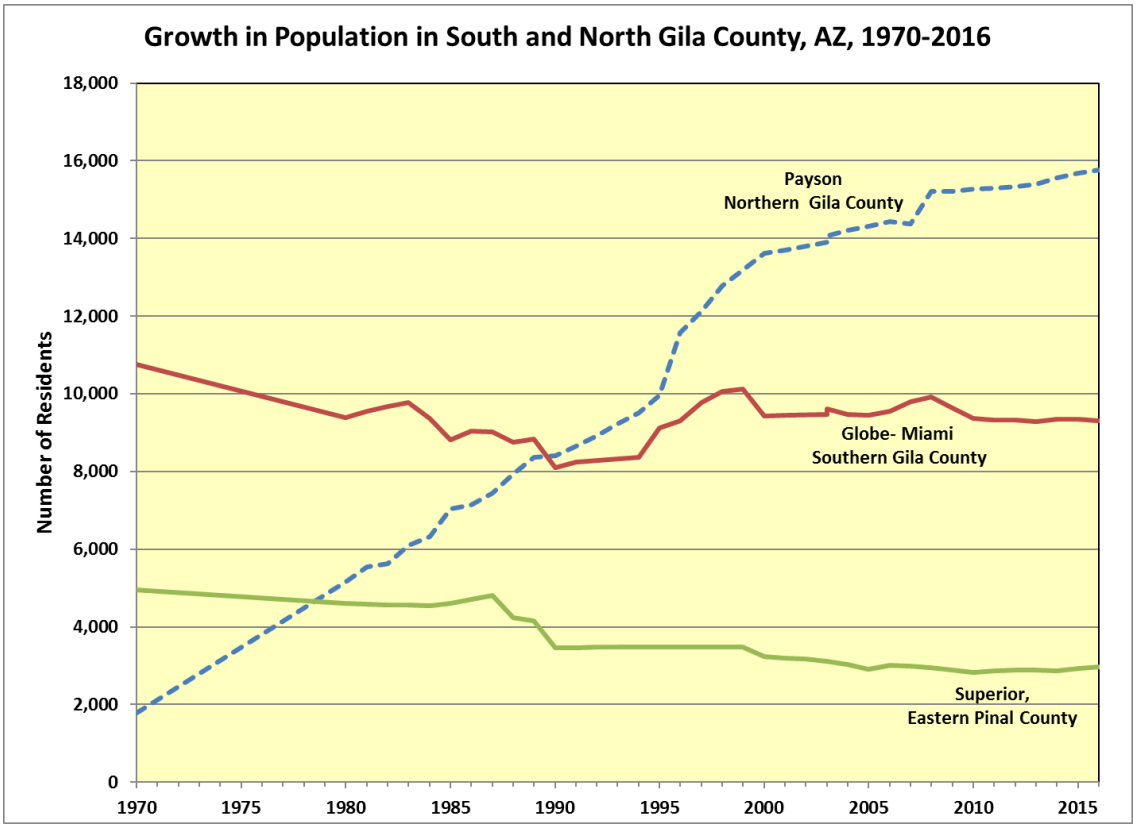
[72] USDA. Resolution Copper Project and Land Exchange. History. https://www.resolutionmineeis.us/project-overview#:~:text=In%201972%2C%20Magma%20geologists%20recognized,south%20of%20the%20Magma%20mine.

[73] Resolution Copper. https://www.resolutioncopper.com/

Interestingly, north of the Copper Triangle, in the Payson area in northern Gila County, which was never a significant mining area, population has been growing dramatically. In 1970 only about 1,800 people resided in Payson. By 1980 population had almost tripled to 5,200. By 2019 the population was nine time what it had been in 1970, reaching almost 16,000.[74] It would seem that people in this area are "voting with their feet" and choosing to live in the general area, but not in the area that was heavily impacted by mining.

Meanwhile, in the center of Gila County's copper mining area, Globe-Miami, population declined 25 percent between 1970 and 1990 before recovering some of the loss in the 1990s. In 2016 the Globe-Miami population was 13 percent below where it had been in 1970. In Superior, another mining town just to the west in Pinal County, population has declined by 40 percent, from about 5,000 to 3,000, between 1970 and 2010. See Figure 21 below.

Figure 21.



Source: The Office of Employment & Population Statistics at the Department of Administration produced the estimates based on the Census.

The Southern Gila County Economic Development Corporation explained some of the difficulties in diversifying the Globe-Miami area economy:

> "At that time, several small manufacturing companies had looked at our area, and after their evaluation, had decided not to locate here. When asked why, their feedback was that while they could get much labor, there were some positions

[74] Census. QuickFacts for Payson, Arizona. https://www.census.gov/quickfacts/paysontownarizona

> that they would have to hire from outside the area. Turned out they were concerned that they wouldn't be able to attract quality people because of things like schools, doctors, parks, libraries, housing, etc. Also, turned out Globe-Miami is ugly. Based on this feedback the [Southern Gila County Economic Development Corporation] decided to try to improve those areas and these "quality of life" groups were formed to make southern Gila County more appealing."[75]

Payson in northern Gila County, which has very purposely moved away from copper mining, has also realized the importance of maintaining a high-quality living environment if economic vitality is to be maintained and enhanced. In its Vision Statement for its General Plan, this is how Payson describe itself and its future:

> "Payson is a vibrant recreation destination amidst the tall pines and cool waters of Arizona's Rim Country. Renowned for its western heritage and friendly people, the Town is a safe and sustainable community that embraces education, culture and economic prosperity through quality development."[76]

In considering the role that a further commitment of the Superior-Miami-Globe area (The Copper Triangle) to continuing its reliance on copper mining to enhance its future economic vitality and the creation and sustaining of prosperity, it is important to focus on why copper mining has not resulted in attaining these economic goals after over a century of effort and why, in the face of a century of lessons to the contrary, it is unreasonable to believe that metal mining will do so in the future?

D. Riding the Copper Mining Roller Coaster in Arizona

One important explanation for the poor economic performance of local economies specializing in metal mining despite the very high-wage characteristics of that industry is the instability of employment and income associated with mineral extraction activity. The experience of Arizona with copper mining dramatizes this.

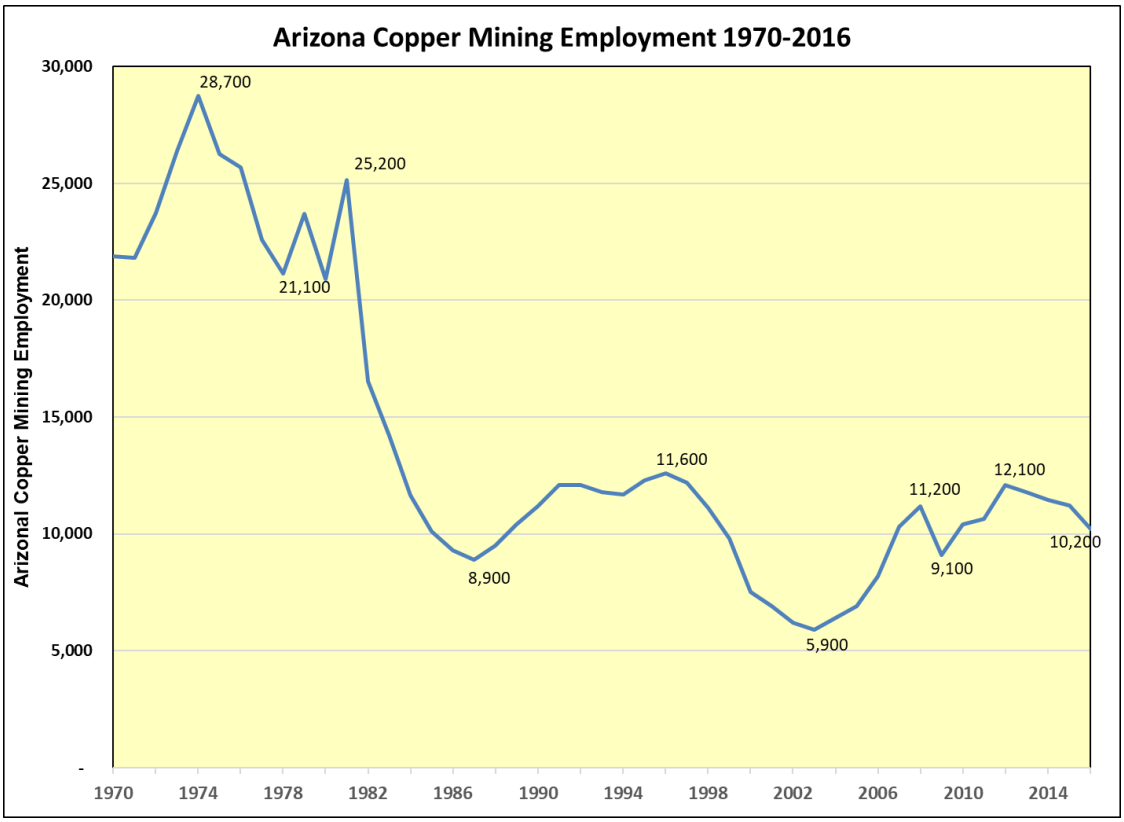
Arizona has had over a century of economic history with copper mining, concentrating, smelting, and refining. During that time, the demands for American copper ore and metal have constantly fluctuated. Over the last 110 years, one can count at least seven major expansions in primary copper production followed by significant declines in production, as much as 75 percent and most recently a decline by more than half, 54 percent, between 1998-2011. Those repeated declines in Arizona copper industry production almost always involved declines in copper production of a quarter to a third or more. With those declines in copper production, of course, came declines in employment and payroll. See Figures 22 and 23 below. Of course, mine purchases and payments of state and local governments also declines when production significantly declines.

Copper, like most commodities sold on national or international markets, suffers through irregular but repeated cycles. When international demand for copper rises, prices will move

[75] Arizona *Silver Belt*, June 30, 2010, Ted Lake, reprinted in Globe Miami Times, August 19, 2010, in *Business, Let's Talk.*
[76] Payson General Plan Update 2014-2024, May 28, 2013, p. 12. http://www.paysonaz.gov/Departments/CommunityDev/General-Plan/Documents/Draft.GP.2014-2024rev5-28-13.pdf

upward motivating existing mines to increase their production to take advantage of the now more profitable market. In addition, the expanding international demand will lead new mines to be built that will add to the overall level of worldwide production sold into international markets. Ultimately, as supply increases, the metal price tumbles downward again. This was also the pattern discussed in the section on Butte, Montana, above.

Figure 22.



Source: 1970-2011 Arizona Mining Association/Arizona State University, “Economic Impact of Arizona Mining 2011” as well as “Copper Mining Operating Statistics Reported by AZ Copper Producers”. Table B1, p. 30 2012-2016.

There is another economic force adding to the instability in metals production from American mining areas: conflicts between labor and management. During periods of tumbling demand when mines are laying off workers, unions do not have much bargaining power. It is an inopportune time to threaten to strike. As metal prices rise and mines and smelters begin rehiring workers to take advantage of the growing profitable opportunities, unions’ bargaining position strengthens and the threat of a strike is both more plausible and more potentially damaging to the mine owners’ bottom line. This can lead to disruptions in copper production, employment, and payroll even during periods of rising copper prices. For instance, in July of 2005 ASARCO faced a strike during a period of steeply rising copper prices and a recovery of Arizona copper production. Ultimately about 1,500 ASARCO workers across North America and 750 workers at the Ray Mine and Hayden mill and smelter in Arizona went on strike. ASARCO was forced to reduce production as it operated with management and non-striking workers. The

reduced level of production and revenues partially led to a Chapter 11 bankruptcy filing by ASARCO. The strike lasted into November 2005.[77]

These repeated fluctuations in the demand for and price of copper leads to ongoing fluctuations in copper mine employment, payroll, supply and equipment purchases, and tax payments. Analysts have come to call this irregular but ongoing instability in the economic impact of metal mining on local communities a "flicker" effect. Arizona copper industry employment over the last forty-six years dramatically demonstrates this volatility in copper industry employment. Employment regularly increases by 5,000 to 15,000 jobs and then tumbles downward in the same dramatic way. See Figures 22 above and 23 below.

Besides the constant "flicker" of employment and payroll in the copper industry, there has also been significant dramatic collapses in overall copper industry employment. In 1974 Arizona copper industry employment peaked at about 29,000 workers. By 2003 the number of jobs had tumbled to 5,900, four out of five of the copper mining jobs had disappeared. In total, 22,800 copper mining jobs had disappeared. There was a recovery between 2003 and 2008 but then the "flicker" returned as employment dipped again in 2009, laying off 2,100 workers only to recover to 2008 job levels by 2013. Copper prices then plunged again and the layoffs began again.

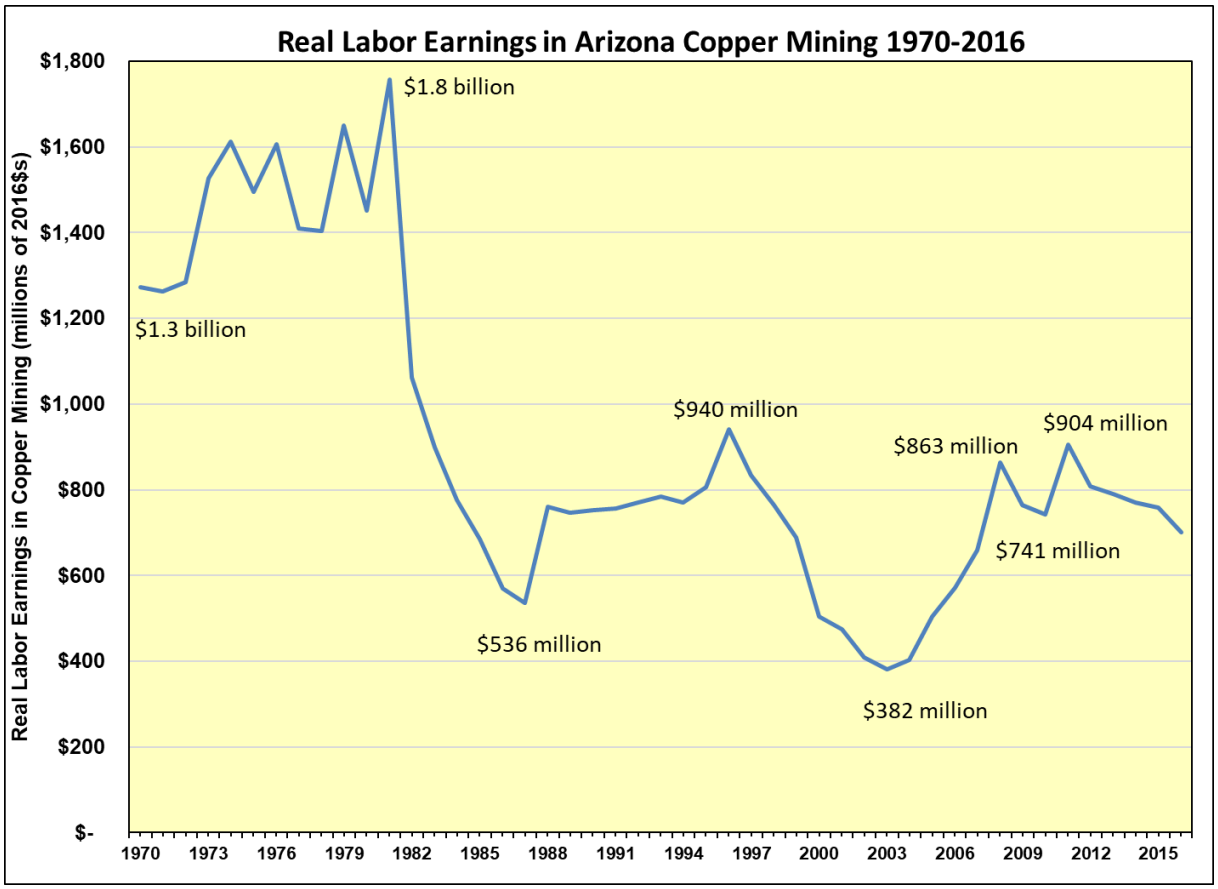
These repeated and substantial fluctuations in copper industry employment and payroll have an unavoidable negative impact on local communities and economies. Workers and their families do not know how long their jobs will last or how long the relatively high pay to workers will circulate within the local economy. That discourages investments by mine workers in the areas around the mines as well as investments by other businesses in the local commercial infrastructure. Because tax payments by mining companies fluctuate with the price of copper and the level of copper production, state and local governments also do not know what tax base they can rely on when contemplating investments in public infrastructure. The result of that volatility in the revenues associated with copper mining is a hesitation across the board to invest in the local economy. That partially explains the relatively run down and depressed character of mining communities despite the high levels of pay in mining and the huge volume of wealth extracted from those mines.

Figure 23, below, shows the fluctuation in real labor earnings in Arizona's metal mining industry over the last 45 years. The difference between $1.8 billion in metal mining industry payrolls circulating in Arizona towns and cities in 1981 and only $536 million, a 70 percent decline by 1987, in metal mining industry payrolls, is substantial and disruptive. But smaller declines such as the 1996-2003 drop from a $940 million payroll to a $382 million payroll, a loss of $558 million or 60 percent of copper mining payrolls, also significantly impacted local economies even though it was followed by an increase in real payroll from $382 million to $863 million between

[77] At the time, the International Brotherhood of Electrical Workers (IBEW) had local unions at several ASARCO Arizona facilities while the United Steelworkers of America represented other groups of Asarco workers. Other Arizona unions joined the strike against ASARCO "in all, unions represented about 1,500 of ASARCO's 2,000 employees in Texas and Arizona." ***Arizona Daily Sun,*** July 5, 2005. In October 2019 unions struck at ASARCO copper-mining facilities in southern Arizona over pay, pensions, and benefits. (***Arizona Central***, October 15, 2019) Eight unions, including the Teamsters, represented about 1,700 workers at copper facilities in Arizona. Besides the Teamsters, IBEW, International Brotherhood of Electrical Workers, International Association of Machinists & Aerospace Workers, United Automobile Workers, International Union of Operating Engineers, and the International Brotherhood of Boilermakers represented ASARCO's striking workers.

2003 and 2008 only to be followed by ongoing “flickers” in aggregate copper mining payrolls of $100 to $200 million per year.

Figure 23.



Source: 1970-1984: George F. Leaming, "The Economic Impact of the Arizona Copper Industry 2010," Western Economic Analysis Center, May 2011, Figure 101, p. 24. 1985-2011 Arizona State University, Seidman Research Institute, "The Economic Impact of the Mining Industry on the State of Arizona-2011, Table B1, p. 30. Adjusted to 2016$s using the CPI.

This ongoing instability in copper production, employment, payroll, and payments to governments have disruptive impacts on the communities in the vicinity of the copper mines that prevent the high wages associated with copper mining from having a reliably positive impact on local economic vitality and stability.

E. The Impact of Technological Change on Copper Mining Employment

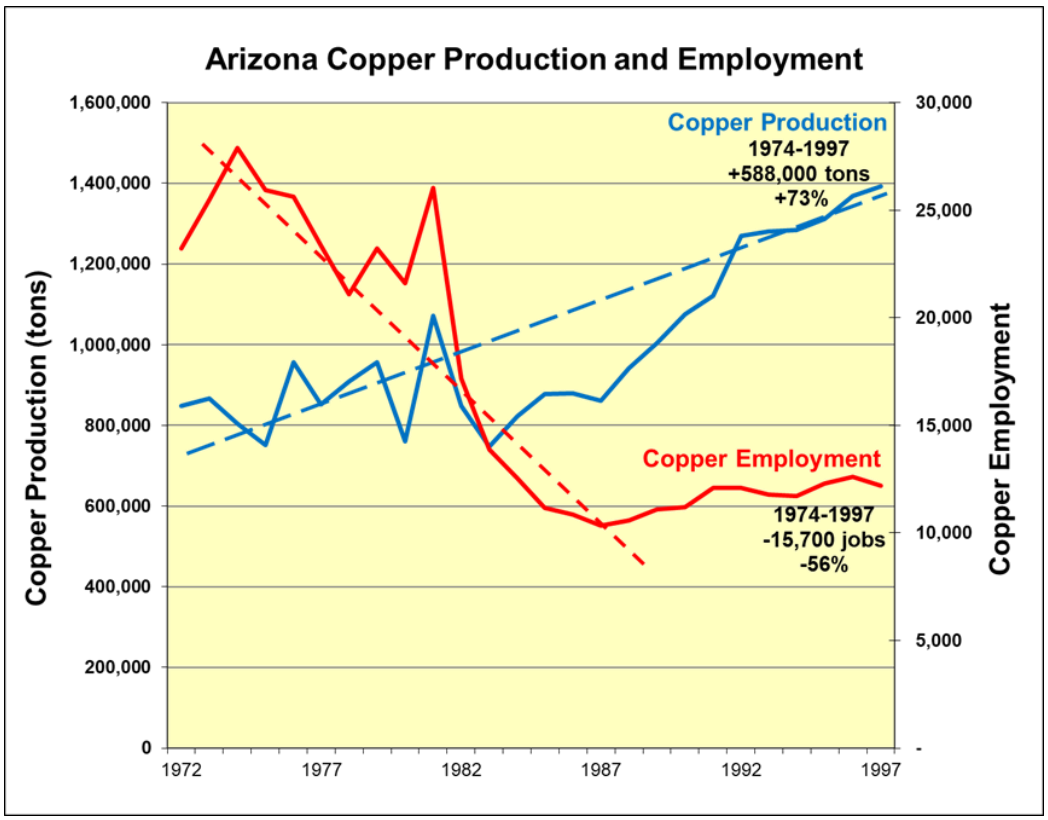
It is interesting to note that substantial increases in copper production in Arizona have not always brought increased copper industry employment. In fact, between 1974 and 1997, when copper production increased by 73 percent, the copper industry workforce in Arizona was cut by more than half, 56 percent or about 16,000 jobs. See Figure 24 below.

This disturbing loss of copper industry jobs while copper production was expanding significantly was then followed by an equally strong collapse of copper production and another deep loss of

copper jobs so that by 2003 copper industry employment was only about a quarter of what it had been in 1974.

The collapse in employment during the boom in copper production during the last quarter of the 20th century was tied to rapid increases in labor productivity that decreased the labor needed to produce a thousand tons of copper. In 1974 it took about 35 workers to produce 1,000 tons of contained copper. In 2003 it took only 7 workers to produce this same quantity of copper. See Figure 24, below. From 2003 to 2012, copper worker productivity declined somewhat, helping to boost copper industry employment.

Figure 24.



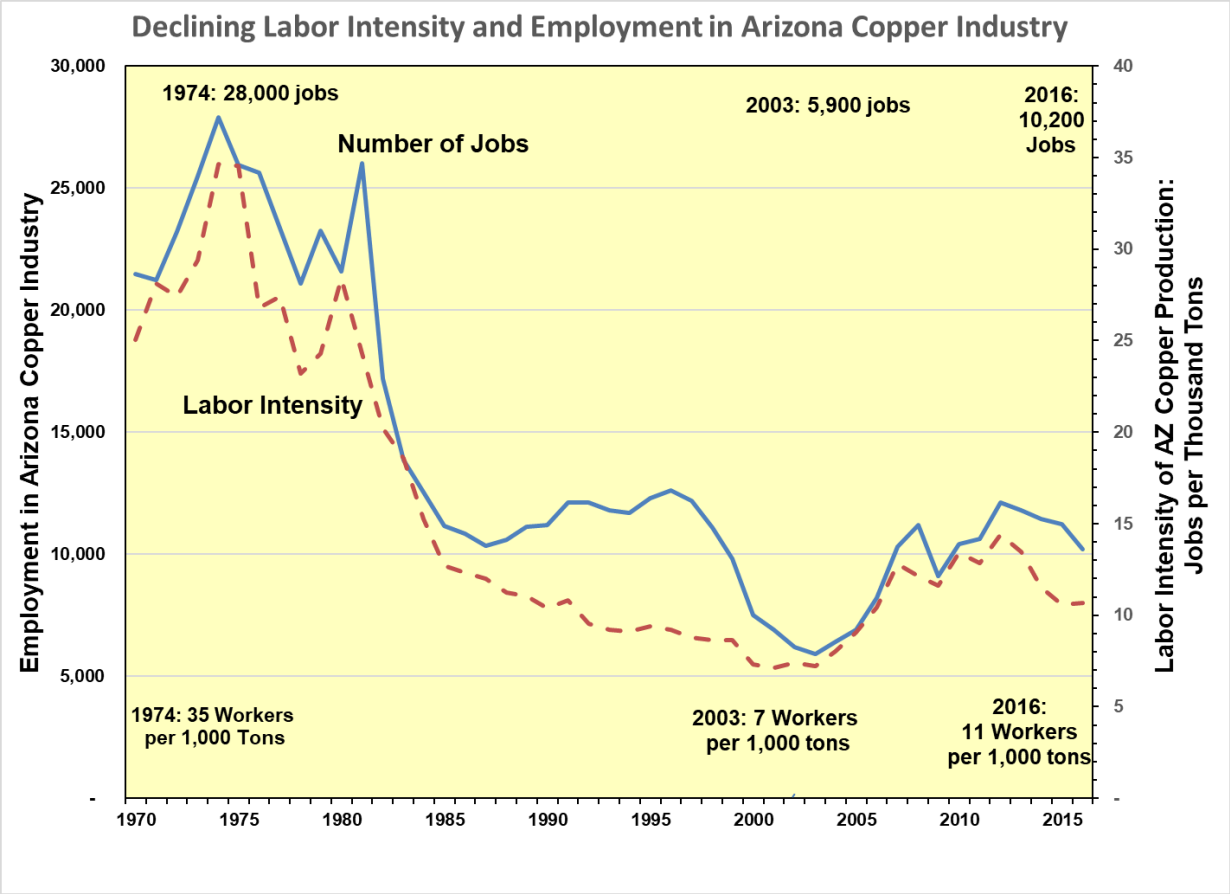
Source: Annual reports on "The Economic Impact of the Arizona Copper Industry", prepared by Western Economic Analysis, George F. Leaming, Ph.D. and annual reports on "The Primary Copper Industry of Arizona", Arizona Department of Mines and Mineral Resources.

This pattern of copper mining job loses despite expanded copper production was not unique to Arizona or to copper mining. Between 1987 and 2002 the number of workers per unit of contained metal mined was cut almost in half across all of metal mining. That is, in a seventeen-year period, the labor force needed to mine any given quantity of metal ore was almost cut in half. See Figure 25, below.

As the metal mining industry becomes more efficient with respect to employees per ton of metal produced, it also becomes more specialized. Where there was once a need for thousands of laborers with pickaxes or pneumatic drills, there is now a need for much fewer miners who can operate highly specialized mining machines. In many cases, the new underground mines that are proposed have robots that do the mining. A recent paper looking at innovation in mining

technology summed up the current and future transitions to “digital technologies” (DT) at the mine site like this:

Figure 25.



Source: Annual reports on “The Economic Impact of the Arizona Copper Industry”, prepared by Western Economic Analysis, George F. Leaming, Ph.D. and annual reports on “The Primary Copper Industry of Arizona”, Arizona Department of Mines and Mineral Resources.

> “Automation, Robotics, and Remote Operation: These technologies might hold the highest level of implementation among the tools offered by DT. The first and more clear benefit of the automation of processes, use of robots in critical activities, and remote operation centers (ROC) is the improving of safety, by reducing the number of operators required in hazardous sites.
>
> ROCs can also significantly reduce OPEX and CAPEX[78] of mining operations. Since less workforce is needed at the mine site, less or no supporting infrastructure is required, such as housing installations, hospitals, or schools. Also, other expenses are reduced, such as transportation of operators. The impact on costs is larger as the location of the mine is more remote, distant, and isolated”[79]

[78] OPEX are generally the day-to-day operating expenses whereas CAPEX are capital expenditures that are generally associated with longer term purchases or long-term use.
[79] Sanchez, F. and Hartlieb, P. Innovation in the Mining Industry: Technological Trends and a Case Study of the Challenges of Disruptive Innovation. *Mining, Metallurgy & Exploration*. (2020) 37:1385-1399.

While these technological changes may indeed be more efficient, the obvious impact on local communities should also be recognized. The remote workers that do not live in the area, thus saving on “housing installations, hospitals, or schools” means that the local area receives less support for those institutions. It also means that the workers who pilot these machines remotely, or on site, need to have very particular technology skill sets. This is unlikely to be something that, for example, small and remote rural towns in Alaska can provide.

Bibliography

Alaska Department of Revenue. Revenue Sources Book. Fall 2018.

Alaska Department of Revenue. Sources of Revenue. Tax Division. Fall 2019.

Alaska Legislative Research Report. Report Number 12.156. 1.30.2013. http://www.akleg.gov/basis/get_documents.asp?session=28&docid=1137

Alaska Legislative Research Report. Alaska Economic Report Number 23. 2020.

Alaska Permanent Fund Corporation. History. https://apfc.org/fund-education/

Archbold, C. Policing the Patch: And Examination of the Impact of the Oil Boom on Small Town Policing and Crime in Western North Dakota. *Police Quarterly*. 2014.

Bush, M. Substance use and Substance use Disorder by Industry. The CBHSQ Report from the National Survey on Drug Use and Health. April 2015.

Berger, J. Sexual Predators, Energy Development, and Conservation in Greater Yellowstone. *Conservation Biology* 24(3):891-896. 2010.

Berman, M. Long-term benefits to Indigenous communities of extractive industry partnerships: Evaluating the Red Dog Mine. *Resources Policy.* 66 (2020) 101609. 2020.

Carrington, K. The resource boom's underbelly: Criminological impacts of mining development. Australian and New Zealand Journal of Criminology. 2011.

Census. QuickFacts for Payson, Arizona. https://www.census.gov/quickfacts/paysontownarizona

Cole, T. Blinded by Riches: The Permanent Funding Problem and the Prudhoe Bay Effect. Institute of Social and Economic Research at the University of Alaska Anchorage. Page 12. January 2004.

Department of Labor and Workforce Development. Consumer Price Index for Urban Alaska. https://live.laborstats.alaska.gov/cpi/index.cfm

Dundas, C., Dundas, Z., Fredrickson, E., Fredrickson, L. Death in the West Podcast. https://deathinthewestpod.com/

EIA. Energy commodity prices rose more than other goods in 2019. 1.6.2020. https://www.eia.gov/todayinenergy/detail.php?id=42395

Gibson, G. Canada's Resilient North: The Impact of Mining on Aboriginal Communities. *Pimatisiwin: A Journal of Aboriginal and Indigenous Community Health* 3(1).

Gibson, R. Butte, 1950-2009: Decline, Loss, and The Rise of Historic Preservation and Cultural Tourism. 2009. http://www.gravmag.com/gibson-20th.pdf

Gibson, R. Is Butte really “The Richest Hill on Earth?” You’d Better believe it. Montana Standard. 7.25.2016. https://mtstandard.com/news/local/is-butte-really-the-richest-hill-on-earth-youd-better-believe-it/article_3f4fe398-208d-5158-8ed8-29674e4930a1.html

Hajkowicz, S., Heyenfa, S., and Moffat, K. The relationship between mining and socio-economic wellbeing in Australia’s mining regions*. Resource Policy.* 2010.

Jayasundara, D. Heitkamp, T., Mayzer, R., Legerski, E., and Evanson, T. Exploratory Research on the Impact of the Growing Oil Industry in North Dakota and Montana on Domestic Violence, Dating Violence, Sexual Assault, and Stalking: A Final Summary Overview. National Institute of Justice Award Number 2013-ZD-CX-0072. 2016.

Komarek, T. Crime and natural resource booms: evidence from unconventional natural gas production. *Annals of Regional Science*. 2017.

Laboe, B. Butte mines closure revisited. *Montana Standard.* 1.6.2013. https://mtstandard.com/news/local/butte-mines-closure-revisited/article_4edeaf5a-57ab-11e2-ae58-0019bb2963f4.html

Loeffler, B. Fiscal Effects of Commercial Fishing, Mining & Tourism What does Alaska receive in revenue? What does it spend?” Power Point Presentation. ISER UAA. January 7, 2016.

Loeffler, B. and Steve Colt. Fiscal Effects of Commercial Fishing, Mining & Tourism. What does Alaska receive in revenue? What does it spend?” ISER UAA. December 2, 2015.

Montana Department of Labor and Industry. An Estimation of Montana’s Restoration Economy. September 2009. https://deq.mt.gov/Portals/112/Land/FedSuperFund/Documents/sst/RestorationEconomyRPT9-17-09.pdf

Montana Standard. 1917 Butte mine disaster killed at least 166 men. Here are their stories. Montana Standard. 6.18.2017. https://mtstandard.com/news/local/1917-butte-mine-disaster-killed-at-least-166-men-here-are-their-stories/collection_5665d0a2-6fd1-5f4a-a369-9279d1284d0e.html

Owen, J. et al. Catastrophic tailings dam failures and disaster risk disclosure. *International Journal of Disaster Reduction*. Volume 42. 2020.

Parkins, J. Linking social structure, fragmentation, and substance abuse in a resource-based community. *Community work and family*. 2011.

Payson General Plan Update 2014-2024, May 28, 2013, p. 12. http://www.paysonaz.gov/Departments/CommunityDev/General-Plan/Documents/Draft.GP.2014-2024rev5-28-13.pdf

Resolution Copper. https://www.resolutioncopper.com/

Robertson, G. A Test of the Economic Base Hypothesis in the Small Forest Communities of Southeast Alaska. General Technical Report NSW-GTR-592, Summary. December 2003.

Ruddell, R. Boomtown Policing: Responding to the Dark Side of Resource Development. *Policing.* 2011.

Sacks, N. Butte Reaches Superfund Milestone, Releasing Berkeley Pit Water Into Silver Bow Creek. https://www.mtpr.org/post/butte-reaches-superfund-milestone-releasing-berkeley-pit-water-silver-bow-creek

Sacks, N. Richest Hill Podcast. https://buttepodcast.org/

Sanchez, F. and Hartlieb, P. Innovation in the Mining Industry: Technological Trends and a Case Study of the Challenges of Disruptive Innovation. *Mining, Metallurgy & Exploration*. (2020) 37:1385-1399.

Seaton. History of Alaska Individual Income Tax. http://www.akleg.gov/basis/get_documents.asp?session=30&docid=17151
Teel, S. **,** Metal Mining in Alaska. *Alaska Economic Trends.* Vol. 39, No. 5, May 2019.

The City-County of Butte Silver Bow. Events and Festivals. https://co.silverbow.mt.us/490/Events-Festivals

Tradingeconomics. Historical Copper Prices. https://tradingeconomics.com/commodity/copper

U.S. Army Corps of Engineers. Pebble Project Draft Environmental Impact Statement. February 2017.

USDA. Resolution Copper Project and Land Exchange. History. https://www.resolutionmineeis.us/project-overview#:~:text=In%201972%2C%20Magma%20geologists%20recognized,south%20of%20the%20Magma%20mine

USGS. Historical statistics mineral and material commodities in the United States.

Visit Southwest Montana. Copper Kings. 2.22.2018. https://southwestmt.com/blog/copper-kings/

Wilson, L. Riding the Resource Roller Coaster. *Rural Sociology* 69(2)261-281. October 2009.