Economic TRENDS in Wyoming's Mineral Sector: GAS & OIL

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At the dawn of the coalbed methane era, it seems appropriate to step back and look at how gas and oil development affects Wyoming's economy. New opportunities and challenges await in the new century. Resource and revenue decisions made today could impact the state for the rest of the century. Development of gas and oil resources touches every sector of the state's economy—if not directly, then through the revenue generated by the industry and distributed by state and federal government. The mining and minerals sector is the largest in the state's economy (based on Gross State Product). This report explores current trends in the industry with respect to their impacts on Wyoming's economy. Along the way, important issues behind these trends are outlined in order to provide a better understanding of gas and oil development's important economic role in the state's economy.

The early years

Gas and oil have been important to the state's economy since territorial days. Mike Murphy completed Wyoming's first oil well near Lander in 1884. The presence of oil springs had been known for some time, but Wyoming's distance from East Coast markets made exploitation unfeasible (Mackey, 1997).

Another early pioneer of Wyoming's oil industry was Cy Iba. Iba was a forty-niner on his way to California when he mixed flour with oil from a spring near Lander to grease the axles on his wagon. He returned to Wyoming when gold was discovered in South Pass. Later he moved to the Glenrock area and, along with his sons, started staking claims in what would become the Salt Creek Oil Field, north of Casper. Early techniques had strong links to mining. Iba once remarked that digging and blasting for oil was much cheaper and easier than drilling (Mackey, 1997).

Iba organized the Casper Mountain Mining District and set the rules to validate a claim. A person needed to make improvements, to "prove up," a claim by digging a trench 6 feet by 8 feet by 10 feet deep or sink a timber-lined shaft 20 feet deep and show "commercial potential." The term "commercial potential" was open to broad interpretation as the claim owner often considered any kind of "show" (trace) commercial (Mackey, 1997). Iba's background in mining left its mark on oil development in Wyoming.

Pennsylvania oilman Phillip M. Shannon drilled and brought in the first well in the Salt Creek Field in 1889. The Salt Creek Field eventually produced over 656 million barrels (WOGC, 1998), but it was a rough road to development. Oil was loaded into barrels, placed in horse-drawn wagons, and taken almost 50 miles to the railhead in Casper. The Pennsylvania Oil and Gas Company was incorporated in August of

1895. Earlier that same year, Shannon and his investors started Wyoming's first oil refinery in Casper. It had a capacity of approximately 100 barrels per day (1 barrel equals 42 gallons). But even this was not the boom that many had expected (Mackey, 1997).

Wyoming's first oil boom did not occur until 1908 when James and "Daddy" Stock brought in the "Big Dutch," a gusher in the Salt Creek Oil Field. This well proved that there was a sufficient quantity of oil to attract the attention of drillers (Mackey, 1997). The next 12 years saw growth and consolidation as the many entrants into this new industry jockeyed for position.

Three factors worked to increase demand for petroleum products in the second decade of the twentieth century: 1) the widespread introduction of the automobile, 2) conversion of U.S. Navy vessels from coal to oil, and 3) World War I. Exploration and production continued to increase in Wyoming during this time. Oil consumption grew 700 percent from 1900 to 1920. The average price producers received for Wyoming crude in 1919 was $2 per barrel. Prices became depressed following World War I, and the $2 per barrel mark was not reached again until the 1950s (Mackey, 1997). Even with increased demand due to the automobile, production outstripped consumption and Wyoming's remote location and lack of pipeline infrastructure kept prices low.

The oversupply of the 1920s and the Great Depression of the 1930s were hard on Wyoming's oil industry. Although there were many business failures, production continued. Larger oil companies such as the Ohio Oil Company, the Texas Oil Company, and the Continental Oil Company came to control much of the production. These companies had the access to capital required not only to weather hard economic times, but to invest in the risky business of exploration and production.

World War II had the same significant effects on Wyoming's oil industry as it did on the rest of the country. A world at war, especially a mechanized war, needed oil. Wyoming producers still suffered from the lack of infrastructure that would have allowed them equal footing with producers in other areas of the country. Namely, there was still no pipeline that would transport the volume of oil that could be produced in Wyoming to refineries and markets in the East. The one pipeline that did exist came from Teapot Dome and was built in the mid-1920s. Its capacity had been continually upgraded until, by 1950, it could carry 55,000 barrels per day.

However, Wyoming producers had excess production capacity of 23,000 barrels per day. The problem was solved in 1952 when the Platte Pipeline was completed. The new pipeline had a capacity of 110,000 barrels per day (Mackey, 1997). Finally, 68 years after the first well was drilled in Wyoming, oil could be shipped in quantity to refineries in the East without the penalty of high transportation costs.

The peak years

Wyoming oil production increased 199 percent from 1947 to 1960 (Figure 1). This is likely due to the increased availability of pipeline transportation capacity. Production stagnated in the first half of the 1960s and then went on to peak at 160 million barrels in 1970 (Figure 1). This peak was short-lived and was followed by the period of slow decline that continues through today. The Oil Embargo of 1973 (October 19, 1973 to March 18, 1974) does not appear to have had any significant effect on annual oil production in Wyoming, though short-term effects are not often seen in annual data because of the time it takes to develop an oil field. The embargo had more long lasting psychological effects than it did physical. The 1973 Oil Embargo was a wake-up call to the nation's dependency on foreign oil.

The first half of the 1980s is commonly referred to as the "oil boom" in Wyoming, yet from a production standpoint, this is only partially true. Annual production did rise somewhat (12 million barrels from 1982 through 1985), but the larger trend was essentially downward (Figure 1). Although there was a boom during that time, it was, in essence, an exploration and construction boom for natural gas (see discussion later in this report). Oil production has been in continual decline in Wyoming since 1985. Oil production in 1997 was about 70 million barrels, a level similar to the early 1950s. The relative smoothness of the curve shown in Figure 1 points to the fact that Wyoming oil production was largely unaffected by short-term disruptions in supply and changes in pricing. It appears that oil producers have been extracting Wyoming's oil reserves at a steady pace. The decline in production is due to the age of the very large oil fields. Many fields are in their final stages of development.

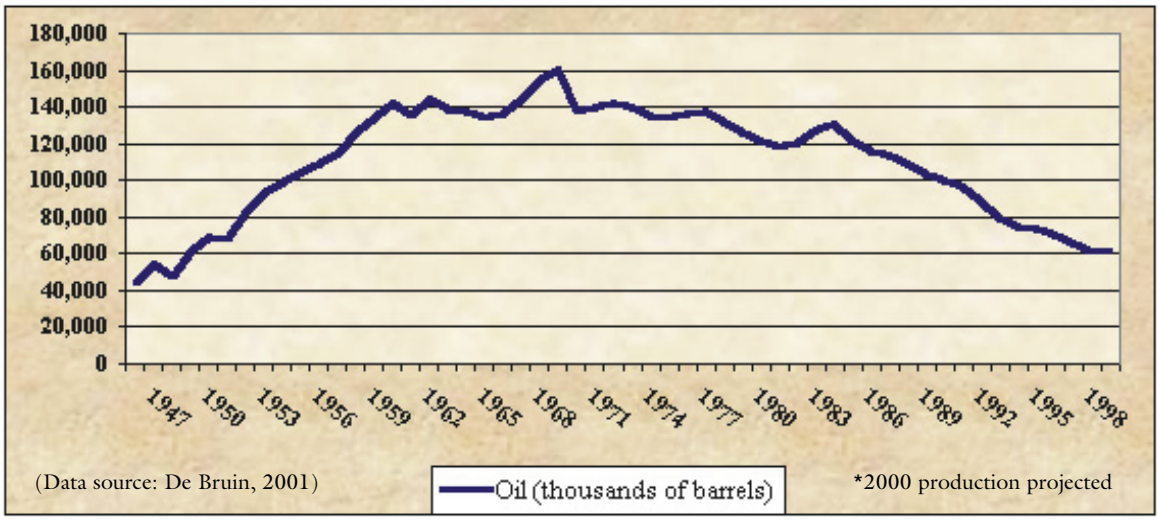


Figure 1. *Oil production, Wyoming (1947-2000).*

Oil prices and allocation were regulated in various ways up until the mid-1970s when the move to deregulate prices was pushed by volatile world oil markets. Stripper well oil prices were deregulated in 1976, and other categories followed over the next several years. President Reagan lifted the remaining price and allocation controls in 1981 (EIA, Brief, 1999). The effects of policy changes that allow for changes in pricing can be easily discerned. Figure 2 shows that oil prices rose very slowly from the beginning of the data set (1947) until 1973, when President Nixon's "phased control," during a period of unstable world oil market activity, allowed regulated prices to rise some.

The price of oil soared from 1978 to 1981. This was a watershed time that significantly impacted global oil pricing and policy. The Iranian revolution (1978) and the Iran-Iraq war (1980-1988) were catalysts that increased instability in world oil markets. With Iranian oil output at a 27-year low due to the revolution, The Organization of Petroleum Exporting Countries (OPEC) increased prices 14.5 percent in the spring of 1979. The United States was in the midst of phased decontrol of prices. OPEC raised prices and cut production again in 1980. Prices for deregulated crude oil in the U.S. correspondingly soared. The price received for Wyoming crude peaked in 1981 at $32.30 per barrel. Although oil production in Wyoming increased for the next four years, prices received plummeted until 1986, when the average price received was $12.94 per barrel. The reason behind these events can be traced to OPEC and the global events that influenced oil markets.

OPEC, profit maximization, and world oil markets

The events of the 1970s and 1980s and their effects on oil prices and Wyoming's economy can seem incongruous without some understanding of the driving factors behind the OPEC cartel's production decisions. Some of these decisions were driven by economics, some by politics, and most by both. OPEC began to assert its power in late 1970 and early 1971 by establishing a 55 percent tax rate and demanding more influence in pricing and production from

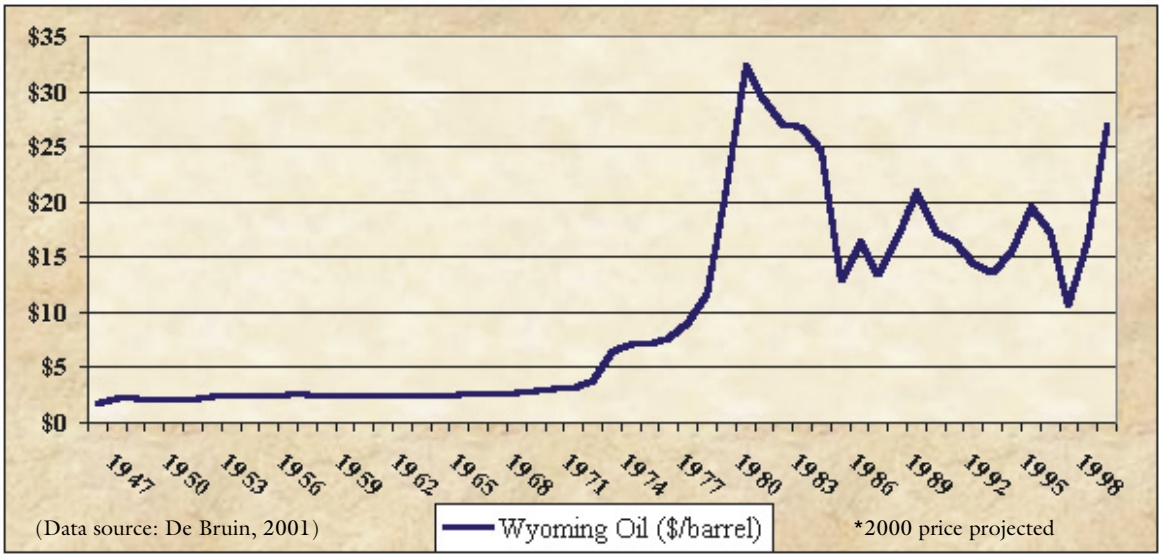


Figure 2. *Average price paid for Wyoming oil, (1947-2000).*

foreign companies operating in OPEC countries (EIA, Chronology, 2001). These decisions were both economic and political, as these countries desired more control over the exploitation of their natural resources (gas and oil) and a larger piece of the economic pie. As the cartel spoke more with one voice, their influence on prices increased and countries that imported their oil began to feel pinched. During the years of peak oil prices (1978 to 1985), OPEC countries enjoyed massive profits, which drove economic development. This profit-maximizing behavior in OPEC pushed up the price of oil, increasing profits. As the price of oil increased, OPEC countries went on a spending spree in western nations to obtain the manufactured goods they did not produce themselves.

Interestingly, higher oil prices also fueled inflation and raised interest rates. OPEC countries, borrowing from the West, faced higher and higher interest payments, funneling huge amounts of money back into the financial institutions of the West. Debts mounted as the flow of goods increased to these developing nations. To pay the bills, these countries produced more oil, circumventing their own (OPEC) production quotas and flooding the market. Soon, spot oil prices dominated the official OPEC price and countries such as Britain, Norway, and Nigeria cut prices (EIA, Chronology, 2001).

With prices dropping, and the developing nations still in need of money to pay for their purchases in the West, the behavior of these countries turned from profit-maximizing to revenue-maximizing. That is, because of the low price of oil, they needed to produce more oil in order to obtain the revenue to pay their bills. The cheating created a vicious circle that kept

oil prices down (and an over supply of oil on the market) until the end of the 1980s (EIA, Chronology, 2001). When the price of oil finally came down, these countries faced additional economic hardship in trying to repay their debts.

Once again, politics intercepted economics in the form of the Gulf Crisis and then the Gulf War. Iraq, devastated by its eight-year war with Iran, occupied its oil rich neighbor, Kuwait. The disruption in oil supply was more perceived than real, yet prices spiked until President Bush released 17.3 million barrels (a token amount) from the Strategic Petroleum Reserve and Operation Desert Storm liberated Kuwait (EIA, Brief, 1999).

The decade of the 1990s was punctuated with periods of cohesiveness in OPEC, which resulted in increased oil prices. Generally, however, world oil prices reflected an over supply condition that depressed prices for much of the decade. An upward trend in demand after the Gulf War was put in reverse during the Asian Economic Crisis (1997). Oil prices slumped in 1998 and 1999, only to rebound sharply in 2000 when the surpluses were drawn down and OPEC once again started acting more cohesively.

Gas

Natural gas is a combination of methane, ethane, and propane with small amounts of carbon dioxide, nitrogen, and sometimes helium. Methane usually makes up between 73 and 95 percent of the total composition. Natural gas, or simply "gas," was used as a lighting source in the last half of the nineteenth century until it was displaced by electricity in the 1890s (EIA, Brief, 1999).

The ability to transport gas to market is critical in developing new gas fields. The first all welded steel pipeline over 200 miles in length was built in Texas in 1925. This technology helped drive gas development. Residential gas demand (for heating and cooking) grew 5,000 percent between 1906 and 1970. The United States was self-sufficient in natural gas until 1986. Since then, demand has outstripped production, with most imported natural gas coming from Canada (EIA, Brief, 1999).

In contrast to today, gas was a problem for early oilmen in Wyoming. Most deposits were not exploitable for lighting or heating purposes due to their remote locations. Either the wells were capped off, or the gas was "flared" (burned) off the wellhead in hopes of obtaining oil beneath the gas. Still, Wyoming's gas industry developed alongside the oil industry. Drillers trying for one product often obtained the other, both, or neither. Many wells in the Oregon Basin Field near Cody were capped off when high-pressure gas was discovered. Not until 1927, when a pipeline was built to Cody, was gas exploitable from the Oregon Basin Field (Mackey, 1997). As with oil, transportation—or the lack thereof—was critical in the rate of development of Wyoming's gas resources.

The Supreme Court's 1954 Phillips decision regulated the wellhead price of interstate natural gas sales (EIA, Energy, 1995). Price regulation dampened the development of gas resources in Wyoming for much of the period from the 1950s to the 1970s (Figure 3). Prices did start to rise in the 1970s, but pipeline capacity kept a lid on over-expansion. Deregulation and open

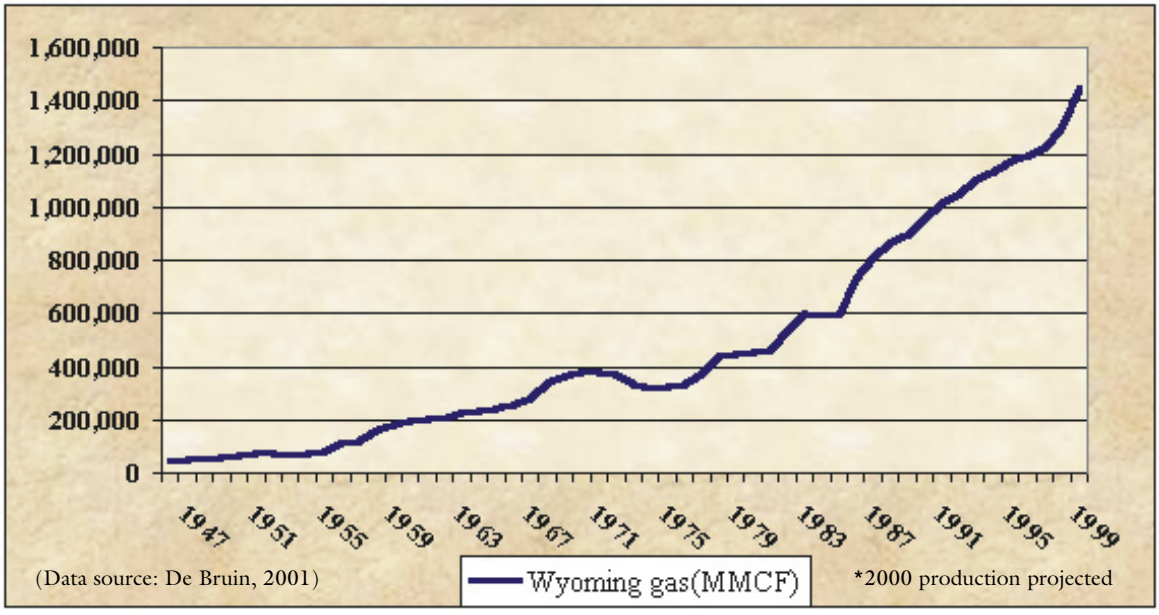


Figure 3. *Natural gas production, Wyoming (1947-2000).*

access transportation in the 1980s and early 1990s helped the gas industry grow. The decontrol of oil prices in 1981 signaled to producers that it was only a matter of time before gas prices would be deregulated as well. The repeal of the Power Plant and Industrial Fuel Use Act in 1987 removed restrictions on large electric utilities and allowed the natural gas industry to expand and compete in this market (EIA, Energy, 1995). The boom in Wyoming had already gone bust by this time, but the pipelines and proven reserves were in place to allow for increased production of the gas resource.

The Natural Gas Wellhead Decontrol Act of 1989 removed price controls from natural gas as of January 1, 1993 (EIA, Energy, 1995). This allowed natural gas prices to be set freely in the marketplace. At the same time, the Federal Energy Regulatory Commission (FERC) was putting in place a series of regulatory actions designed to improve the market's performance and allow natural gas consumers to benefit from market prices for natural gas. FERC Order 436, issued in 1987, allowed end users (mainly utilities and large industries) and local distribution companies to use interstate pipelines to transport gas they owned (CO&GC, 1998). The Restructuring Rule (FERC Order 636, issued in 1992) ordered the "unbundling" of services provided by interstate pipeline companies. Prior to Order 636, interstate pipeline companies had acted both as transporters and as merchants of gas, effectively combining these services, reducing market efficiencies, and increasing costs (EIA, Natural Gas, 1996). Order 636 transformed the industry and created a new industry niche for marketers of natural gas. Finally, the Clean Air Act Amendments of 1990 and the Energy Policy Act of 1992 provided increased opportunities for the use of natural gas in transportation (cars and trucks) and electrical power generation. The latter has had significant impact in the utilities sector and continues to impact the gas and oil sector positively (EIA, Natural Gas, 1996).

The result of deregulation in the natural gas industry was that production increased and prices dropped (at least initially). Preliminary figures show that natural gas production in Wyoming increased 143 percent from 1986 to 2000 (Figure 3). Prices, shown in Figure 4, initially decreased when deregulation came into effect, as marketers were able to free capacity that was not available prior to deregulation. With the surplus capacity worked out of the system by 1995, prices started to rebound. Average prices in 2000 reached $3.42 per thousand cubic feet, a 47 percent increase over 1986 prices, due to increased demand on the West Coast and tighter supplies. Utilities have been taking advantage of the "clean" fossil fuel by building new, smaller, and more efficient generating stations using

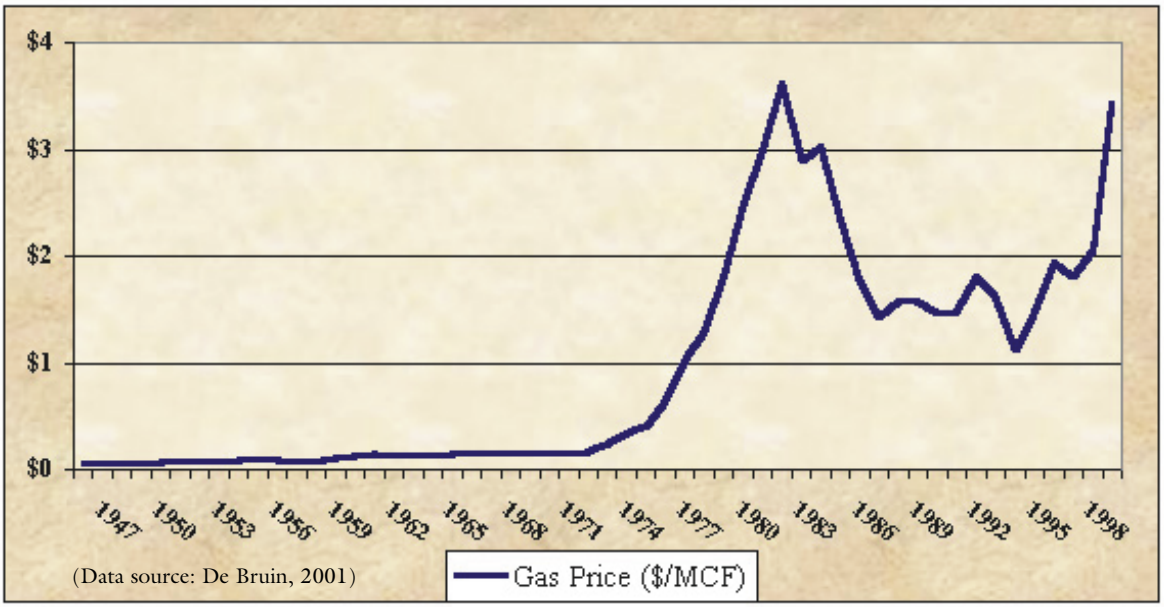


Figure 4. *Average price paid for Wyoming natural gas (1947-2000).*

new technologies (cogeneration). However, demand for electricity has outstripped supply and utilities are scrambling to build even more generating capacity. Virtually all of this new capacity will be fueled by natural gas.

Coalbed methane

Coalbed methane is distinguished from the traditional concept of "natural gas" mainly in its extraction process, not its composition. Both are predominately methane, and both are derived as a result of the decay of organic matter in the earth. There are two processes which can form coalbed methane: 1) thermogenic natural gas (thermogenic: "formed by heat") results from the decay of organic matter under anaerobic (without oxygen) conditions of heat and pressure deep within the earth, and 2) biogenically derived coalbed methane (biogenic: "formed by life") results from an aerobic (in the presence of oxygen) process where waste from microorganisms produced the gas during the formation of the coal. The gas is absorbed in water in the fractures or "cleats" in the coal seam. When water in the coal seam is pumped out, lower pressure in the vicinity of the drill casing allows the gas to separate from the water, much as carbon dioxide leaves an open can of soda pop. Additionally, Powder River Basin coalbed methane is essentially pure biogenically formed methane that contains only minor amounts of carbon dioxide (1.5 to 2 percent). Other coalfields in the state probably contain thermogenically formed coalbed methane that may contain trace amounts of the higher gases (ethane and propane). Coalbed methane wells essentially produce two products, natural gas and water (De Bruin, 2000).

Wyoming has known about coalbed methane for some time. A well drilled as far back as 1916 produced gas for a ranch in the Powder River Basin. The U.S. Geological Survey encountered gas in evaluation holes drilled in the mid 1970s in Campbell County. Commercial production of coalbed methane started in 1986 with a well drilled by Wyatt Petroleum in

Campbell County. That well produced 24 mcfd (thousand cubic feet per day) (Jones and De Bruin, 1990).

The potential of coalbed methane in Wyoming was recognized by Jones and De Bruin in 1990 when they said, "this resource has the potential to become a very significant part of Wyoming's energy industry." They estimated Powder River Basin coalbed methane resources to be between 5.15 and 103.1 trillion cubic feet. The wide range was due to a lack of data at the time. The most current estimate is 25 trillion cubic feet of recoverable gas (WSGS, 2000). The Powder River Basin represents the state's most significant play in coalbed methane, but there is potential in the Hanna coalfield and in areas east of Rock Springs for some shallow reserves to be found as well. Current estimates give coalbed methane a 20 to 30 year period (from 2000) of exploitation (Conference, 2000).

Transportation

Transportation was a key obstacle in the development of Wyoming's gas and oil resources. Had Wyoming been closer to eastern markets, development might have taken a different course. Wyoming's first pipeline was built in 1915 by the Ohio Oil Company. It was a 4-inch line, 28 miles from Grass Creek to the railhead at Chatham (Mackey, 1997). The first gas line was built in the early 1920s by an Ohio Oil Company subsidiary. It supplied gas from Elk Basin, 67 miles to Billings, Montana. Wyoming's first interstate oil pipeline came from Naval Petroleum Reserve Number 3, otherwise known as Teapot Dome. It was built in the mid-1920s but carried mainly government oil (Mackey, 1997). All told, the industry's beginnings in the state predated the first long distance all welded steel pipeline by 35 years. And it was another 25 years before a high volume pipeline served oil producers with enough capacity to carry production. This means that for the first 60 years, most oil left Wyoming in railroad tank cars for refineries in the Midwest. The added shipping costs put Wyoming producers at a decided disadvantage over Gulf Coast and California producers. Wyoming oil did not sell for the same mid–continent oil price as that from other locations until the Platte Pipeline was completed in 1952. It carried 110,000 barrels of oil per day. By the time oil production peaked in 1970, gas and oil were both being shipped interstate via pipeline.

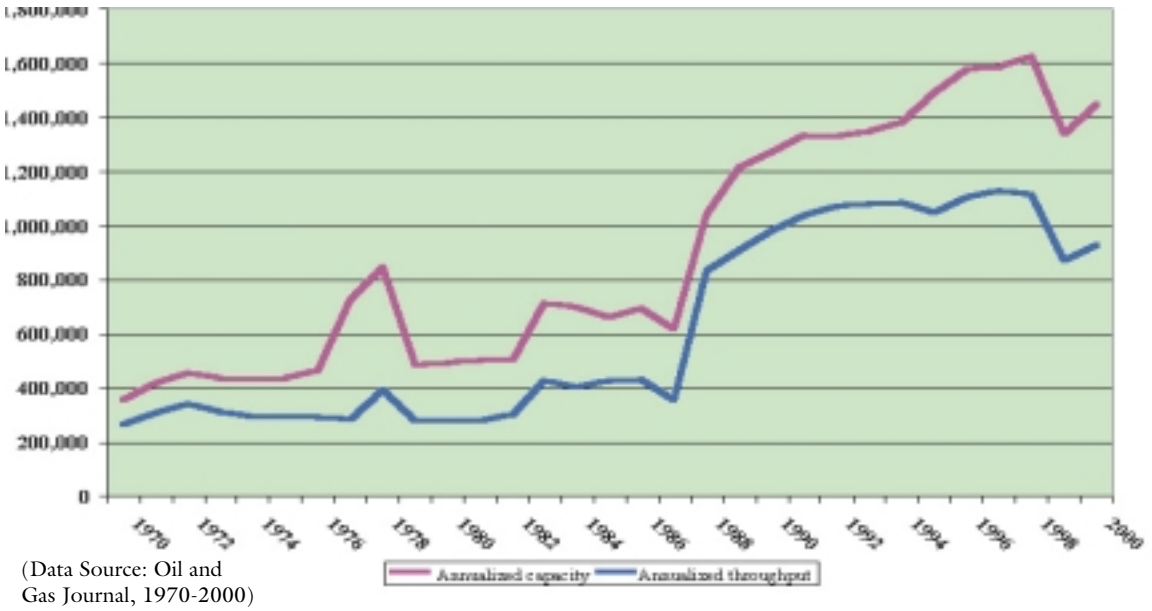
Figure 5 shows Wyoming natural gas annualized capacity and throughput for the years 1970 to 2000. (Please note that this data may not correspond with data from other sources due to calculation methods

used by the Oil and Gas Journal.) Annualized capacity (top line), measured in millions of cubic feet per day (mmcfd), is used to show the maximum pipeline capacity for the state. Annualized throughput (lower line) measures the amount of gas processed and shipped via pipeline, also in mmcfd. Capacity is the theoretical maximum that producers could sell in a given year. Due to various constraints, there is normally some surplus left in the system. The difference between these two lines is the surplus capacity available to producers.

As the number of pipelines (and thus capacity) increases, producers are free to increase production. The chart shows that throughput mirrors capacity at a narrow distance in the early 1970s, widening in the 1980s. A big jump is evident between 1987 and 1988, when a large capacity line was completed. Throughput followed the increased capacity but not as closely in the 1990s, when gas demand was not as high. It is important to understand that producers have to take into account the availability of pipeline capacity in the region to know how much to produce. Without the ability to transport their products, they will not produce. This is one reason why it took so long to develop Wyoming's gas and oil resources—the transportation infrastructure simply did not exist.

The rate of coalbed methane development in the Powder River Basin is dependent largely on the ability to transport gas to market. Currently, pipelines have the capacity to transport 500 mmcfd of coalbed methane out of the region. Yet projections are that production could reach 900 bcfd (billion cubic feet per day) by 2010. To transport this volume of gas, pipeline capacity will have to quintuple (WSGS, 2001).

Another development in transportation is the possibility of a carbon dioxide pipeline from La Barge to the Powder River Basin. Lines currently exist to the Lost Soldier Field (north of Rawlins) and could be connected by 2002. Carbon dioxide would be pumped into the ground in older fields, such as Salt Creek, and could yield an additional 1 billion barrels of oil (De Bruin, 2001).



(Data Source: Oil and Gas Journal, 1970-2000)

Figure 5. *Annualized pipeline capacity and throughput, Wyoming (1970-2000).*

Employment

Mineral extraction not only provides revenue for state and local governments, but also provides jobs for local residents. Jobs are arguably just as important to the state's economy for several reasons. Jobs provide both employment and income for local residents, and employee expenditures in communities can be the driving force behind local economic development. As employees spend their wages in local communities, these dollars create additional dollars as they are re-spent in the local economy. Long-term stable employment leads to sustainable growth. Unfortunately, mining and mineral sector jobs have, in the past, been a two-edged sword for local economies. The boom and bust cycle has, in turn, created uncontrolled growth and uncontrolled collapse in those cities and towns fortunate (or unfortunate) enough to be located near mineral resources. Yet because mining is a location-specific activity, the communities that it affects directly are in some fashion pre-ordained. In other ways, spillover from minerals extraction can affect neighboring or more remote locations due to transportation and infrastructure issues (pipelines and railroads), or the fact that the nearest larger center of population is removed from the resource yet has the services that the mineral sector requires. A good example of this phenomenon is Casper, Wyoming. Casper has the employment pool to draw from and the services, such as drilling, consulting, and government offices, the industry requires, but is somewhat removed from some of the oil and gas fields. It is important to note that Casper grew up as an oil town with the development of the Salt Creek Oil Field. The city's history is steeped in the industry, and it is no coincidence that many of the gas and oil industry services

are located there. Wyoming's economy, however, does not exist in a vacuum. States all over the country benefit from gas and oil extraction in Wyoming in a myriad of ways, from sales of specialized tools and equipment through federal mineral royalties, to corporate profits, to employees who work temporarily in Wyoming's gas and oil fields.

State residents are justifiably more concerned with the employment and growth aspects that more directly affect them. Wyoming is especially focused in this direction since much of the economic gains of the 1990s bypassed the state. Low energy prices appear to be the culprit and point to the state's dependence on the well being of the sector to drive economic growth. Figure 6 clearly shows the effects of gas and oil industry expansion on employment for the period 1969 to 1999.

Employment in the gas and oil industry nearly quintupled in the ten-year period between 1971 and the peak employment year of 1981. Employment then fell precipitously back to early 1970s levels in the five years following. Gas and oil industry employment has been essentially flat for the period 1987 to 1999. There are indications that employment in the sector may already have started to increase, but how much remains to be seen. If the past is any guide, then as mineral commodity prices rise, employment will start to creep up.

Coalbed methane production is not expected to yield the boom in employment that previous energy booms have. This is because of the way that gas is extracted, from shallow wells using truck-mounted drilling rigs instead of large pad-mounted rigs. More employment is expected in the western part of the state, as the deeper gas will require more traditional extraction methods. But even there, new technology may lessen the impact. Horizontal drilling technology will enable more wells to be drilled from the same rig, reducing the number of rigs and employees.

Another aspect of the employment picture is the lead-lag of production and employment. During the last energy boom in the 1980s, employment peaked in 1981 (Figure 6). Oil production peaked in 1985 (Figure 1), and gas production leveled off slightly but has yet to peak (Figure 3). Exploration, development, and infrastructure requirements—as opposed to actual production—create the up-front need for employment. In the past, this lead-lag relationship had a time frame of approximately 10 years. However, newer computerized seismic evaluation helps to shorten the time by reducing the risk associated with drilling repeated dry holes in attempt to locate the resource. This may have the effect of reducing the influx of workers into communities and shortening the amount of time that these workers remain. Additionally, pipeline infrastructure is already in place (several gas pipelines were built in the 1980s, and several oil pipelines have been converted to gas). More pipelines will have to be built to accommodate increased gas production.

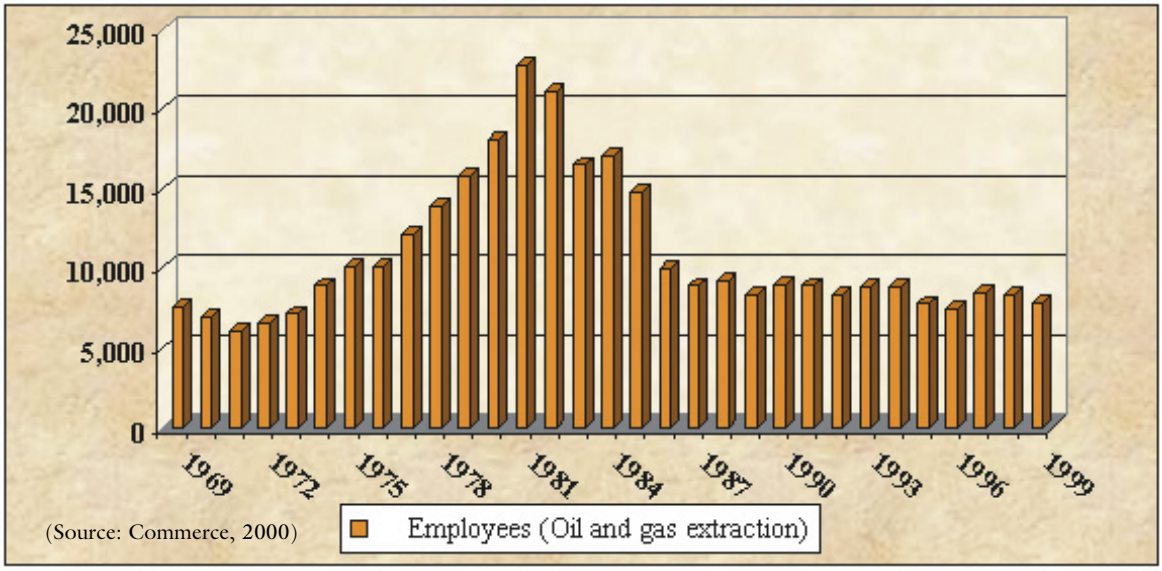


Figure 6. *Gas and oil employment, Wyoming (1969-1999).*

Finally, gas and oil industry employment in Wyoming appears to follow a similar pattern to the price of natural gas (compare Figures 4 and 6), yet with a time lag of about 2 years. One possible explanation is that gas reserves are kept in the ground until needed and then exploited through additional drilling and construction of pipelines, as demand (reflected in the price) dictates. This partially explains the reason oil production made only slight gains in the 1980s "oil boom." The "oil boom" was really a gas exploration and infrastructure boom, with additional oil production as a by-product. Gas production continued its climb throughout the 1990s, regardless of employment and prices, due to the infrastructure completed in the late 1980s and early 1990s. Demand for natural gas accelerated in 2000, with a price spike in the winter of 2000-2001. If the correlation between price and employment is correct, employment in the sector will continue to see strong gains into 2002.

Income

Income from gas and oil extraction is a major contribution to Wyoming's economy. Figure 7 shows total real earnings from gas and oil extraction for the years 1969 to 1999, adjusted for inflation to 1999 dollars. Note that the values in Figure 7 are in thousands of dollars so that, for example, $800,000 actually represents $800,000,000. Earnings are different from wages in that earnings include, among other things, proprietor's income. While this makes earnings look larger, it more accurately reflects the amount of money earned in the sector. The chart shows, as one would expect, that earnings grew significantly during the industry's expansion in the late 1970s and early 1980s and then suddenly slumped. The 1990s trend slightly upward, with a dip in 1996.

Average real wages per job are shown in Figure 8. These values have been adjusted for inflation to 1999 dollars. The wage category excludes proprietor income to show the average value of jobs in the sec-

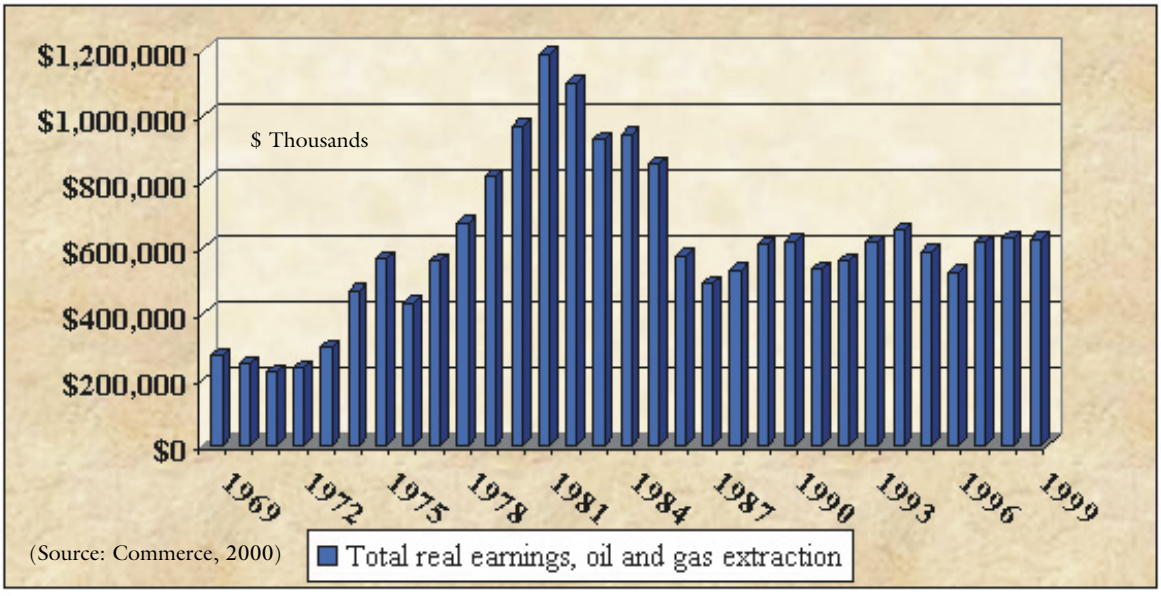


Figure 7. *Total real earnings from gas and oil extraction, Wyoming (1969-1999).*

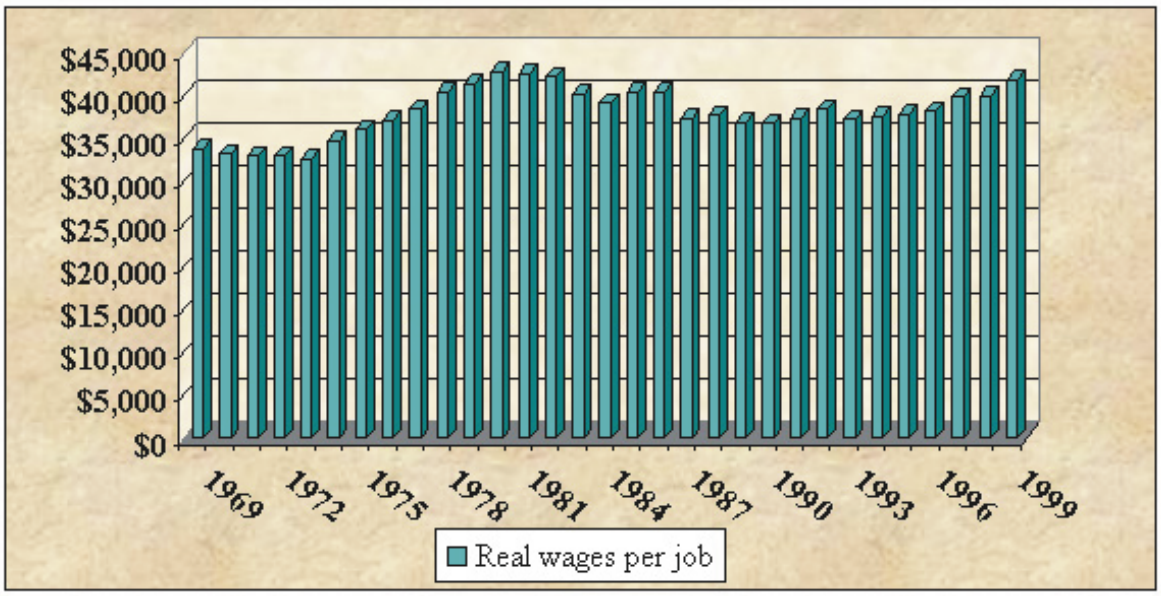


Figure 8. *Real wages per job, Wyoming gas and oil extraction (1969-1999).*

tor. Average wages have increased 18.11 percent over the thirty-year period. This means that wages increased at a rate of 0.6 percent per year.

The relative flatness of the advancing trend indicates that the industry has a history of stable wages (as opposed to employment numbers). Also, wage growth has been less affected by the amount of gas and oil activity in the state as evidenced by the subdued bulge in wages during the energy boom of the 1980s. Energy workers, like many occupations, must go where the work is, so wages are likely to be comparable on a more regional basis. Real wages peaked in 1980 at $42,755 per year (1999 dollars). Average wages have been advancing in recent years, with the latest value at $41,887 in 1999. Indications are that this value will surpass the 1980 peak in the coming years.

Mineral revenue

The economic importance of mineral extraction to the state of Wyoming cannot be understated. Wyoming's mining and minerals sector contributes more to Gross State Product (GSP) than any other sector of the economy. Minerals currently account for 31.39 percent of Wyoming's GSP, or over $5.5 billion (1997), and support approximately 15,790 full-time wage earners, or 9.76 percent of Wyoming's employment base (WY, DEA, 2000). The gas and oil industry, included in the mining sector, employs 7,866 (1999) and accounts for 49 percent of mining sector employment (Commerce, 2000).

Table 1 shows total mineral revenue to Wyoming state and county governments for the years 1999 and 2000. In 1999, the state legislature was grappling with a projected $200 million shortfall in its budget. Two years later, the surplus was projected at over $600 million. The difference came

from the fact that gas and oil prices skyrocketed in 2000, bringing with them significant increases in all forms of mineral revenue along with increasing coalbed methane production (Table 1).

Natural gas prices rose in 2000 due to tighter supplies, lower storage stocks, and market perceptions (EIA, Chronology, 2001). In the late 1990s, these sources of income were declining as prices for gas and oil were depressed. With renewed market pressure in late 1999, the value of production increased, as did corresponding taxes. Furthermore, increased exploration and lease auctions drove up the bonus payment component. Yet, in total, mineral revenue for Wyoming decreased in 1999 by 6.32 percent from 1998, as the effects of increased prices were not felt until the end of the year. Those effects were markedly pronounced in 2000 as the significance of the price increase became clear. Mineral revenue for 2000 increased 28.10 percent over 1999. The three largest sources of revenue were: ad valorem production taxes, severance taxes, and federal mineral royalties (see definitions on page 18). Overall, mineral revenue increased $228,841,555, or 25.06 percent, from 1999 to 2000. The authors' research leads them to believe that this is just the first year of increased mineral revenue and that gas production, particularly, will drive future revenues higher for the foreseeable future.

Table 1. Total mineral revenue to Wyoming state and local government, 1999 and 2000

	1999	2000	Change	Percent
Ad valorem-production	$224,308,663	$265,433,379	$41,124,716	18.33
Severance taxes	$196,459,204	$275,122,976	$78,663,772	40.04
Federal mineral royalties	$198,657,100	$263,941,707	$65,284,607	32.86
Ad valorem-property	$47,816,041	$55,557,427	$7,741,386	16.19
Sales and use taxes	$28,800,218	$29,491,611	$691,393	2.40
State royalties	$27,720,888	$34,099,206	$6,378,318	23.01
Federal bonus payments	$32,371,984	$45,151,140	$12,779,156	39.48
State rent	$6,747,746	$8,434,827	$1,687,081	25.00
Total govt. revenue	$762,881,844	$977,232,273	$214,350,429	28.10
PWMTF interest	$107,285,509	$118,312,856	$11,027,346	10.28
AML reclamation grants	$23,815,989	$27,279,768	$3,463,779	14.54
Grand total mineral revenue	$893,983,342	$1,122,824,897	$228,841,555	25.60

Sources: WY Dept. of Revenue, U.S. Minerals Management Service; Equality State Almanac; WY Office of State Lands and Investments; WY DEQ, AML Division; U.S. Dept. of Interior; Bureau of Land Management.

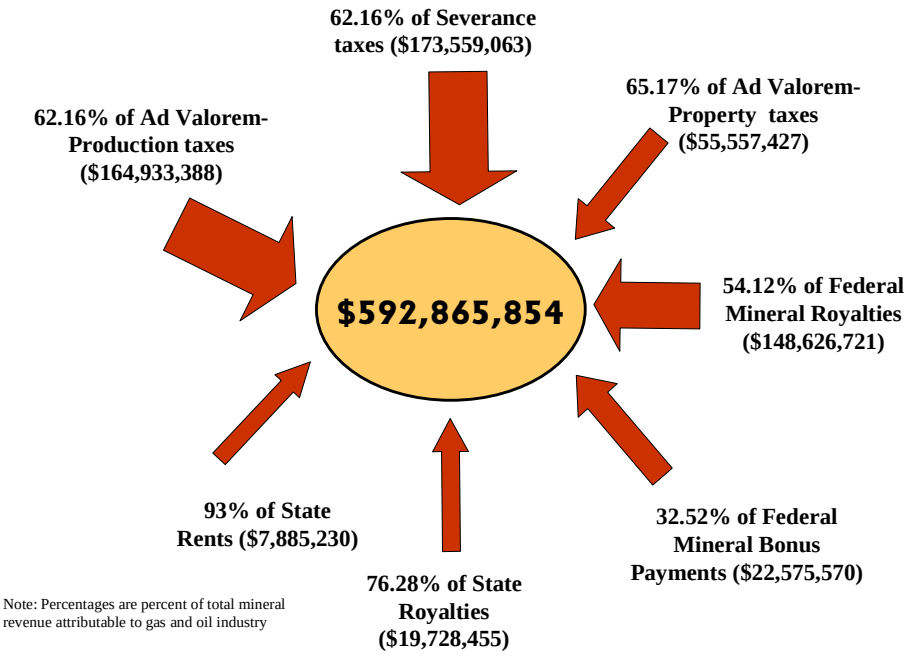


Figure 9. *Estimated revenue contributions of the gas and oil industry to Wyoming state and county governments (2000).*

Figure 9 shows the gas and oil industry's revenue contributions to Wyoming state and county governments for fiscal year 2000. It is important to note that the sales and use tax value shown in Table 1 was not used in the estimation of gas and oils contribution since it was not possible to break down that value by mineral. Figure 9 is therefore conservative but represents the authors' best estimates given the data. The three largest sources are once again severance taxes, ad valorem production taxes, and federal mineral royalties. The overall picture presented in Figure 9 is that gas and oil industry revenues provide about 60 percent of total mineral revenue to state and county governments.

Trends

The trend in increasing mineral revenues is not surprising given that prices for gas and oil rose dramatically in 2000. What is not widely known is that oil production is decreasing and becoming an ever-smaller part of the revenue picture. Gas, on the other hand, is becoming even more significant, and with the addition of coalbed methane, will help maintain the revenue stream for several more decades. Wyoming's tax structure is such that ad valorem and severance taxes take advantage of the value of the minerals extracted. History has shown the effects of decreased mineral revenue on Wyoming's economy, and Wyoming is dependent on the prices of these commodities on world markets. Since revenue depends as much on price as on quantity, should the price of natural gas drop, revenues will drop as well. Even so, like oil, once a gas field is in play, production varies

little over time (see Figure 1). Exploitation follows a relatively smooth curve until the resource is played out. Consequently, Wyoming has a finite time period, regardless of price, to capture value from gas and oil that, when depleted, will no longer produce a revenue stream. The existence of the Permanent Mineral Trust Fund ensures that some of this revenue will keep producing a return when the resource runs out.

Wyoming's long history of isolation from markets was solved in the 1950s with a high-capacity oil pipeline. Additional pipelines and deregulation of natural gas markets in the 1990s assured the future marketability of gas at fair market value. Yet technological advances may not mean huge gains in employment for Wyoming citizens. New technology that lowers the cost of extraction also reduces the need for labor. So Wyoming's citizens may benefit through increased revenues, but may not see as much increase in economic activity as might be expected.

The concern of many is to avoid the boom and bust cycle that comes with the rush to extract mineral wealth. Avoiding the cycle is probably not realistic, but managing growth in a controlled manner is possible. If city, county, and state governments can work together with the industry, community services could be provided to offset the increased temporary population.

Summary

Mike Mackey, in his book *Black Gold: Patterns in Development of Wyoming's Oil Industry*, characterized Wyoming in the nineteenth century as the "hole in the doughnut" because the booms in hard rock mining had come to the surrounding states but not to Wyoming. In some ways, that description applies to Wyoming today. Even as mineral wealth flows into Wyoming's Permanent Mineral Trust Fund, generating over $100,000,000 per year (2000) in interest, the state suffers from a lack of broad-based economic activity that leads to stable economic growth. Low population and distance are still dominate reasons for lack of economic opportunity in Wyoming, while Colorado's Front Range grows explosively. Depressed gas and oil prices in the late 1990s led to dire predictions of a budgetary shortfall in the state's finances. But rebounding global demand for oil and natural gas and the introduction of an efficient recovery method for coalbed methane have brought new optimism and hundreds of millions of dollars in new revenue to state and county governments.

For most of the twentieth century, mineral revenue—primarily from oil—was the major supplement to government. But oil production peaked in 1970 and has since been in slow decline. Wyoming still has vast reserves of low sulfur coal, which will continue to play an important role in the revenue picture. But it is natural gas that holds the spotlight today. With 25 trillion cubic feet of available reserves in the Powder River Basin alone, and a world hungry for clean burning natural gas, it appears that Wyoming has another shot at filling the hole in the economic doughnut.

For more information on trends in Wyoming's economy visit the Wyoming Economic Atlas at Agecon.uwyo.edu/EconDev.

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Glossary of mineral revenue terms

Ad valorem: a tax laid on a commodity as a percentage of its value. Ad valorem taxes on gas and oil in Wyoming go directly to the county in which the commodity is produced. Wyoming ad valorem taxes can be divided into two groups—production and property. Production taxes, as the name implies, are levied on the assessed valuation of the amount of the commodity produced. Property taxes are levied on wells and producing equipment. The property tax rates are levied in mils (thousandths of a percent) set by each county. The overall state average for 2000 was 75.357 mils based on assessed valuation of the property. Production ad valorem taxes are based on a percent of assessed value of production, the mineral, and the source (type of well or mine).

Severance: a state tax on mineral production that is collected and distributed by the Wyoming Department of Revenue. Base oil and natural gas rates are 6 percent, whereas the base surface coal rate is 7 percent. Wyoming distributed $279 million in severance taxes in 2000.

Mineral royalty: the amount of money the owner of the mineral resource receives as a payment or royalty from the mineral producer. The state of Wyoming receives a base royalty of 16.67 percent of the value of production. The federal government receives a royalty of 12.50 percent of the value of production for minerals produced on federal lands. Fifty percent of federal mineral royalties are returned to the state. Unlike severance taxes, royalties are based on the value of the products of production, not just what leaves the ground. For example, natural gas royalties are based on the value of the methane, helium, carbon dioxide, nitrogen, and liquids—not just the volume of raw gas.

Bonus: mineral leases (the right to produce in a given location) that are auctioned off to the highest bidder. The premium the winning bidder pays to the federal government is called a bonus. The federal government keeps half the bonus and returns half to the state.

PWMTF (Permanent Wyoming Mineral Trust Fund): a fund that holds 25 percent of severance taxes currently received by the state and that acts like a savings account for the state. The fund balance is $1.6 billion (2000). Sixty-two million dollars was added to the fund last year. Sixty-five point eight percent or $41.3 million came from gas and oil, and the rest from coal. The principal is not spent, but the interest and investment income is distributed each year.

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