

Prospects for the Tenth District Energy Industry

By Tim R. Smith and Tim Sheesley

Volatile world oil markets have led to wide swings in the Tenth District's important oil industry. OPEC price hikes in the 1970s and early 1980s spurred oil production and set off a boom in exploration in the region. Then, after oil prices collapsed in 1986, oil production slowed and exploration nearly halted. As the 1990s unfold, oil activity in the region is expected to remain weak.

Does this dim outlook for oil spell trouble for the district's energy industry? The answer is probably no because, while oil is only part of the district's energy industry, the district also has rich deposits of natural gas and coal. And, new environmental policies will probably boost the demand for natural gas and low-sulfur coal in the decade ahead. Therefore, while the region's oil output could fall in the 1990s, natural gas and coal production is likely to rise.

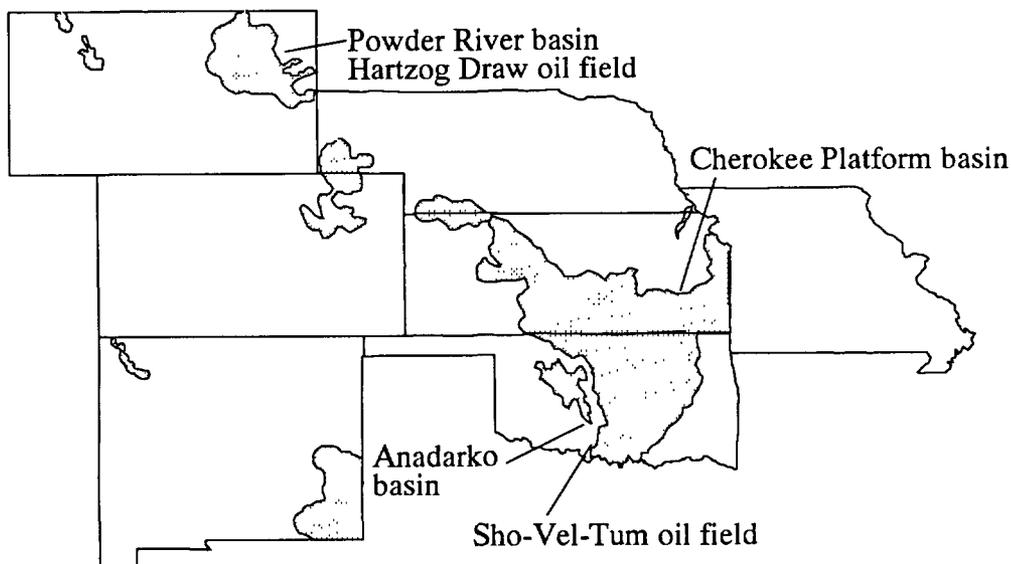
This article describes the strengths and weaknesses of the district's energy industry in the market of the 1990s. The first section describes the district's main energy resources—oil, natural gas, and coal. The second section considers how prospective energy market conditions and special features of the district's energy resources will influence the outlook for energy production in the district.

District Energy Resources

Reserves of oil, natural gas, and coal and their current levels of production provide a foundation for assessing the outlook for the district's energy industry.¹ Reserves indicate the potential output of energy resources in the region. Production reflects how much output is forthcoming under current market conditions and thus gives a

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Figure 1
Oil Fields in the Tenth District



Source: Petroleum Information Corporation.

starting point for predicting the future course of production.

Special features of the district's energy resources also play an important role in formulating the outlook. While market conditions will determine the overall direction of production, certain features of the district's energy resources may strengthen or weaken the region's production outlook.

Oil

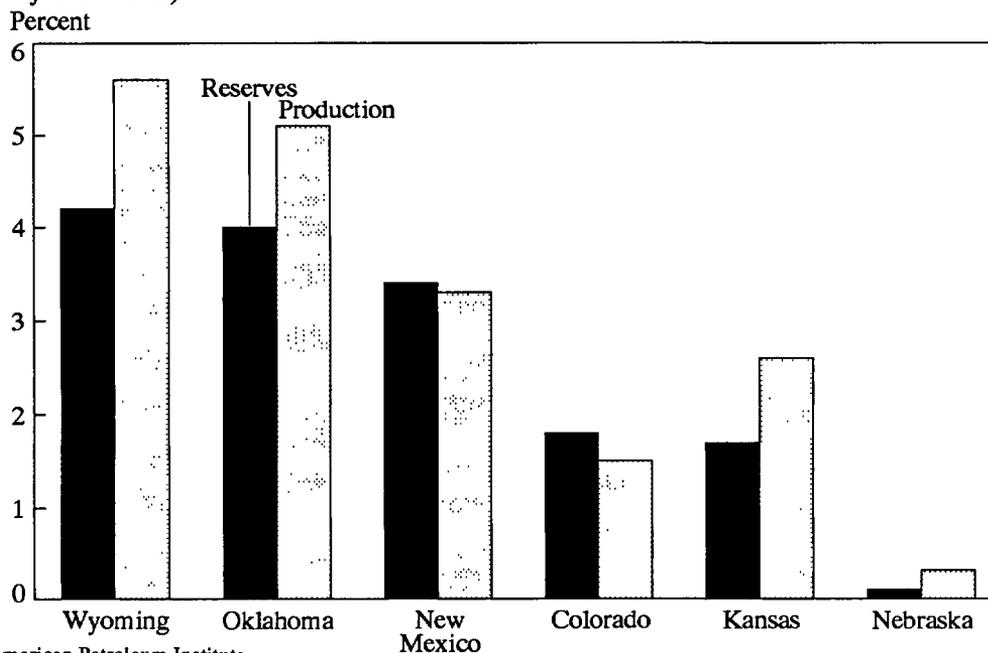
The energy industry in the Tenth Federal Reserve District has been identified with oil since the discoveries of the 1800s. More recently, the energy boom of the late 1970s and early 1980s boosted reserves and production, focusing even more attention on the district's oil. Most district states have oil reserves, but their size and associated production vary considerably. A notable feature of district oil

production is the predominance of low-volume stripper wells.

Reserves. The district's 3 billion barrels of oil reserves represent about 15 percent of total U.S. oil reserves.² These reserves, with a 1989 market value of about \$53 billion, are scattered throughout the region but are concentrated in Wyoming and Oklahoma. Figure 1 shows the approximate location of the district's oil fields. Chart 1 shows the relative size of reserves in district states, ranking the states by their share of total U.S. reserves. Wyoming and Oklahoma hold the largest oil reserves with over half the district total. These holdings together represent nearly 8 percent of the nation's 26.5 billion barrels of oil reserves. The Hartzog Draw field, part of the energy-rich Powder River basin in northeastern Wyoming, is the region's largest single oil reserve. This field contains 273 million barrels of oil (Petzet).

Production. The district produces nearly a

Chart 1
Oil Reserves and Production, 1989
(Shares of U.S. total)



Source: American Petroleum Institute.

fifth of the nation's total oil output. In 1989, the district pumped 386 million barrels of oil with a market value of nearly \$7 billion.³ Several district states pump sizable quantities of oil, but production is concentrated in Oklahoma, Wyoming, and New Mexico (Chart 1). Oklahoma alone produced 5.6 percent of domestic oil in 1989. The largest producing field in the district was Oklahoma's Sho-Vel-Tum field, which pumped almost 17 million barrels of oil in 1989 (McCaslin).

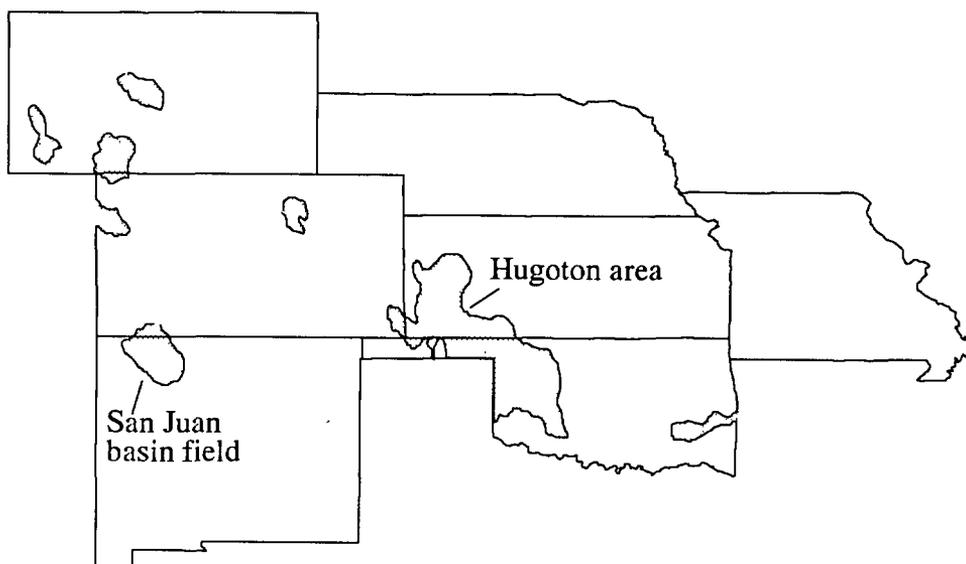
Special features. The district's oil industry is characterized by an abundance of low-volume wells. These "stripper wells" are common throughout the district because many of the district's oil reserves, particularly those in Kansas and Oklahoma, lie in small shallow pockets of underground rock formations. Over 40 percent of the district's oil comes from stripper wells, which average only about three barrels a day.⁴ In contrast, only 14 percent of

the nation's oil comes from stripper wells. Because the costs of production are spread across a small volume of output, stripper wells become unprofitable in a low-oil-price environment, making them subject to abandonment.

Natural gas

Natural gas has become increasingly important to the district.⁵ The region's shares of the nation's gas reserves and production have increased steadily in the past 20 years. While the district has only about half as many natural gas as oil wells, the region's gas reserves have greater value than its oil reserves. In 1989, the market value of the district's gas reserves exceeded the value of oil reserves by more than \$30 billion. But the region's natural gas reserves are located far from the major markets for gas. As a result, pipeline capacity becomes a critical factor in the outlook for

Figure 2
Gas Fields in the Tenth District



Source: Petroleum Information Corporation.

district gas production.

Reserves. The district's 56 trillion cubic feet of natural gas reserves account for 36 percent of the nation's total gas reserves.⁶ District reserves are scattered throughout the seven district states but are concentrated in Oklahoma and New Mexico (Figure 2, Chart 2). The two states' 31 trillion cubic feet of reserves account for nearly a fifth of the nation's gas reserves. The region's largest known gas reserve—holding over 12 billion cubic feet—lies in the Hugoton field area of southwestern Kansas and northwestern Oklahoma.

Production. District natural gas production reached 4.5 trillion cubic feet in 1989 with a market value of \$6.8 billion.⁷ This production, which comes from all parts of the district, accounts for *a fourth of the nation's total natural gas production*. Oklahoma leads the district states in natural gas production with over 12 percent of national production (Chart 2).

New Mexico's 4.8 percent share of national production places it a distant second.

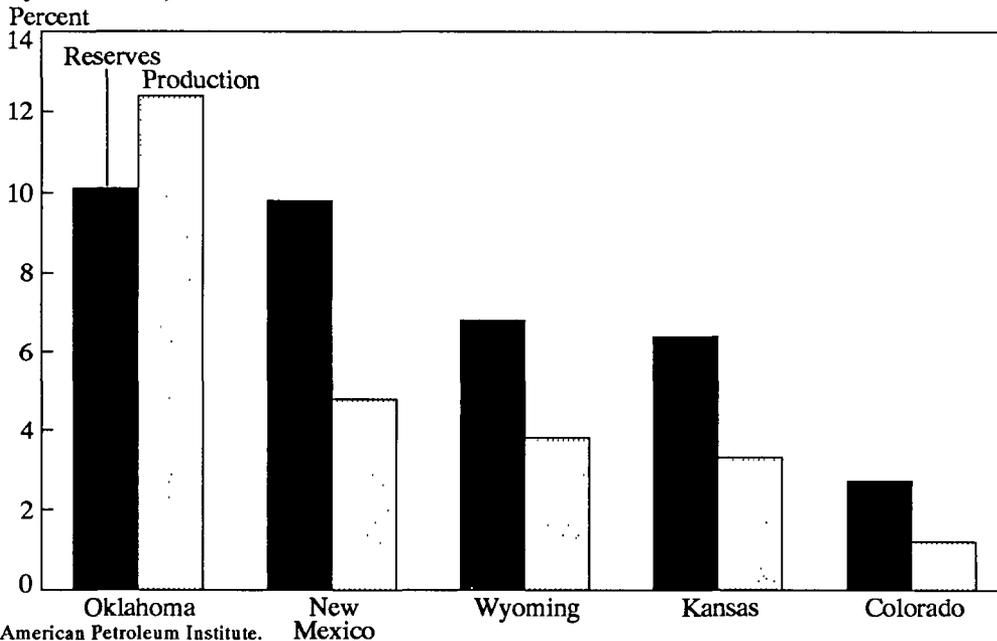
Special features. Location is a key factor in the production of the natural gas in the district. Production from the large gas reserves in the district is much greater than the demand for gas in the region. To move the gas to industrial and residential users in other regions, such as California and the Northeast, district producers must access the interstate pipeline grid, which connects major gas supply basins with major markets. While access to markets in the upper Midwest has generally been good, few major pipeline corridors exist to carry district gas directly to important markets in California (Spiegel, Johnson, and others).

Coal

Coal is an important energy resource to the

Chart 2

Natural Gas Reserves and Production, 1989
(Share of U.S. total)



Source: American Petroleum Institute.

Tenth District by several measures, even though the district's coal mines provide less than a tenth as many jobs in the region as the oil and gas industry. Coal reserves and production, concentrated in Wyoming, have increased substantially over the past 20 years. Moreover, the market value of coal reserves in the district—over \$100 billion in 1989—is higher than the value of either oil or natural gas reserves. A unique feature of the district's coal reserves is their low sulfur content.

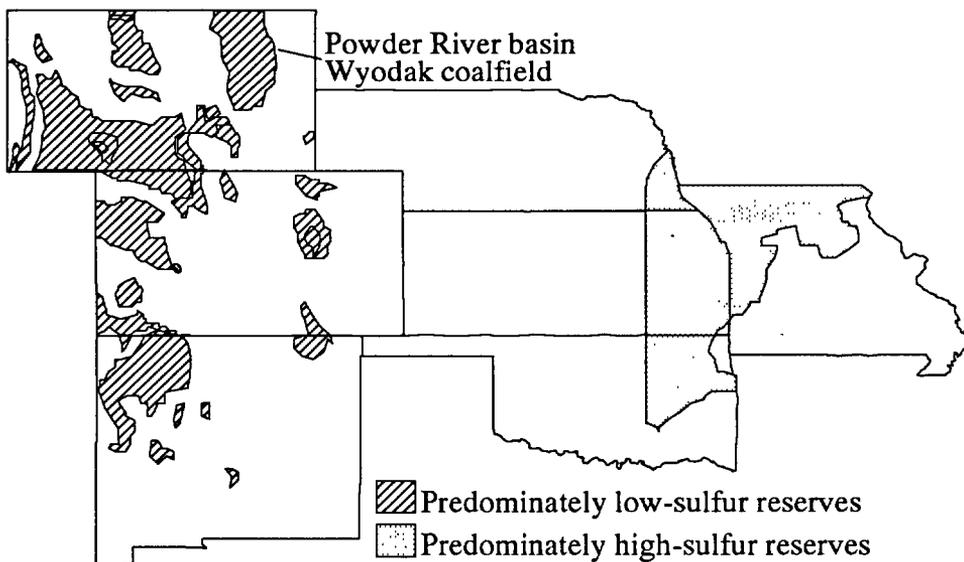
Reserves. The Tenth District holds a considerable amount of the nation's coal resources. At 8.5 billion tons, recoverable coal reserves in the district—the amount of coal that can be mined from coal deposits at active producing mines—account for almost 40 percent of the nation's coal reserves.⁸ Wyoming and New Mexico hold more than 80 percent of the district's total coal reserves and a third of the nation's reserves (Figure 3, Chart 3).

Wyoming, with its enormous Powder River coal field, leads the nation in recoverable reserves and has over three times the deposits of West Virginia, the state with the second-largest reserves.

Production. The district's massive coal reserves supply a substantial share of the nation's coal. District states produced 218 million short tons of coal in 1989, 22 percent of the nation's total coal output. Wyoming and New Mexico, the district's largest coal producers, together produce a fifth of the nation's total coal (Chart 3). Moreover, Wyoming has led the nation in coal production since overtaking Kentucky in 1988. The coal bed with the largest production in the district is Wyoming's Wyodak coal bed in the Powder River basin. Wyodak produced nearly a sixth of the nation's coal in 1989.

Special features. Most of the coal reserves in the Tenth District contain low-sulfur coal,

Figure 3
Coal Reserves in the Tenth District



Note: Sulfur content varies within individual coal deposits, but deposits in the western part of the district generally contain low-sulfur coal.

Source: Energy Information Administration.

which produces less heat per ton than coal mined east of the Mississippi.⁹ But its low sulfur content has made it increasingly attractive to the nation's coal-fired electric power plants. Environmental regulations have increasingly required expensive plant modifications to reduce the harmful emissions that result from burning high-sulfur coal. As a result, district coal can compete effectively with high-sulfur eastern coal even though it must be shipped longer distances.¹⁰

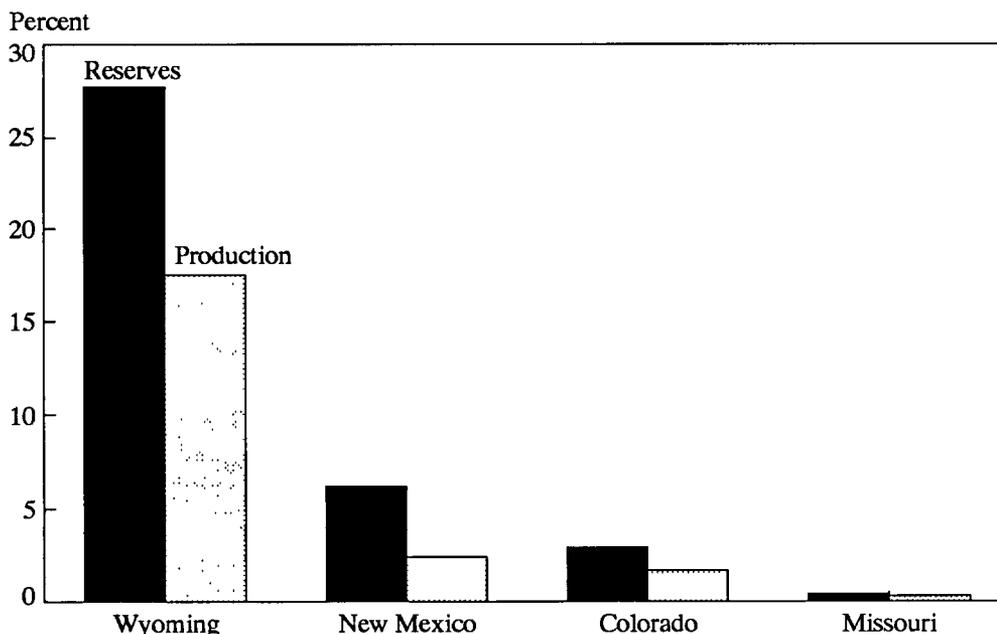
Another important feature of the district's coal reserves is the ease with which the coal can be mined. The region's coal beds are thick and lie close to the surface, enabling efficient strip mining techniques to be used. Strip mines are highly productive, combining large investments in capital equipment with relatively few laborers. As a result, Tenth District states produced almost a fourth of the nation's coal

in 1989 with only 3 percent of the nation's coal mines. The average district coal mine produces seven times more coal than the national average. Moreover, the average Wyoming mine produces 18 times more coal than the national average, making Wyoming mines the most productive in the nation.¹¹

The Outlook for District Energy Production

The outlook for district energy production will be driven largely by overall energy market factors, but the special features of the district's energy resources will also help shape the outlook. This section examines how overall market conditions will combine with the special features to affect future production of district oil, natural gas, and coal. The outlook for energy prices and national energy produc-

Chart 3
Coal Reserves and Production, 1989
(Share of U.S. total)



Source: Energy Information Administration.

tion reflects the most recent long-term energy forecast from the U.S. Department of Energy (Energy Information Administration 1991).¹²

Further decline for oil

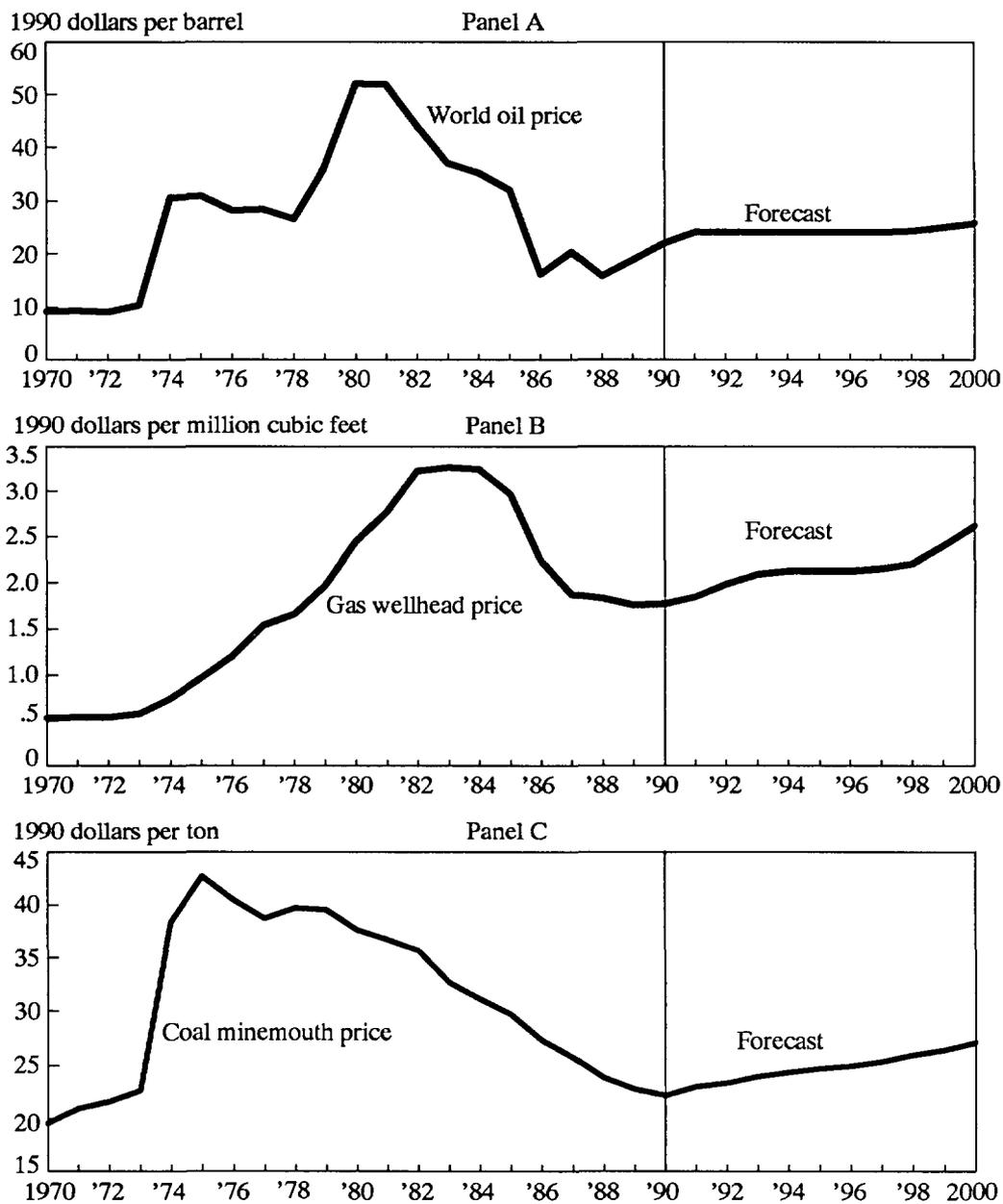
Oil prices and environmental policy will likely depress district oil production in the 1990s. In addition, the district's reliance on low-output stripper wells and high drilling costs in some areas will put further downward pressure on the region's oil output.

Oil prices will probably not increase enough during the 1990s to stem the decline in oil production—both in the nation and the district—that began in the late 1980s. Oil prices are expected to remain flat in real terms until steady increases in demand push up prices near the end of the decade (Chart 4, Panel A). Prices are forecast to hold steady until then due

to increases in OPEC production capacity and further gains in energy efficiency. In the United States, rising demand for oil is expected to be increasingly satisfied with imports as domestic production shrinks. Imports reached 42 percent of U.S. petroleum consumption in 1989 and are expected to range between 50 and 65 percent by the end of the current decade (Energy Information Administration 1991).

Environmental policy is another factor dimming the outlook for domestic oil production. Automobile-related pollution, acid rain, and global warming have prompted new national environmental legislation.¹³ Amendments to the Clean Air Act signed into law in November 1990 will bring oil production under pressure if consumers and businesses switch to cleaner fuels, such as natural gas. Moreover, the environmental impact of oil drilling and production will likely come under closer

Chart 4
Energy Prices



Source: Energy Information Administration.

scrutiny in the decade ahead. New air and water quality provisions in the Clean Air Act will increase drilling and production costs to oil producers (Nulty).

Heavy reliance on *low-output stripper wells* will reinforce the downward trend in district oil production. The cost of pumping oil from these wells increases as their reserves are drawn down. As a result, the soft oil prices in prospect will cause many district stripper wells to be abandoned as their operating costs eventually exceed the revenues from their meager output. Moreover, an abandoned stripper well is not likely to be reopened because the drilling costs would exceed the expected revenues even at much higher prices.

Advanced recovery technologies under development could prevent abandonment and enhance recovery from some existing oil fields, such as the Cherokee platform in southeast Kansas and the Anadarko basin in Oklahoma (Figure 1). One way that advanced recovery may become more prevalent in the region is through the Department of Energy's Oil Research Program, which aims to promote and disseminate such technological developments. But this effort is unlikely to significantly boost production in district oil fields until after the year 2000 (Koen).

High drilling costs in some parts of the district will probably discourage exploration, thereby limiting expansion in production capacity. Although average drilling costs are lower in the region than in the nation, drilling costs in Wyoming, New Mexico, and Oklahoma are near or above the U.S. average.¹⁴ Moreover, the modest increase expected in oil prices in the 1990s is not likely to induce a new drilling binge in areas such as Kansas where drilling costs are low. In these areas, now dominated by stripper wells, the payoffs to exploration are also low.

Declining production and a lackluster out-

look for exploration and development in the district oil patch mean that oil-related employment and income in the region probably will continue to shrink. Unfortunately, employment and income data are only available for the combination of oil and gas extraction. However, past trends in employment and income reveal that big increases in both employment and income came in the late 1970s and early 1980s when high oil prices led to a drilling boom in the region (Chart 5, Panel A). Since then, employment and income have fallen to pre-boom levels. Barring another oil price shock, a recovery of jobs and income in the oil patch is not in prospect during the 1990s.

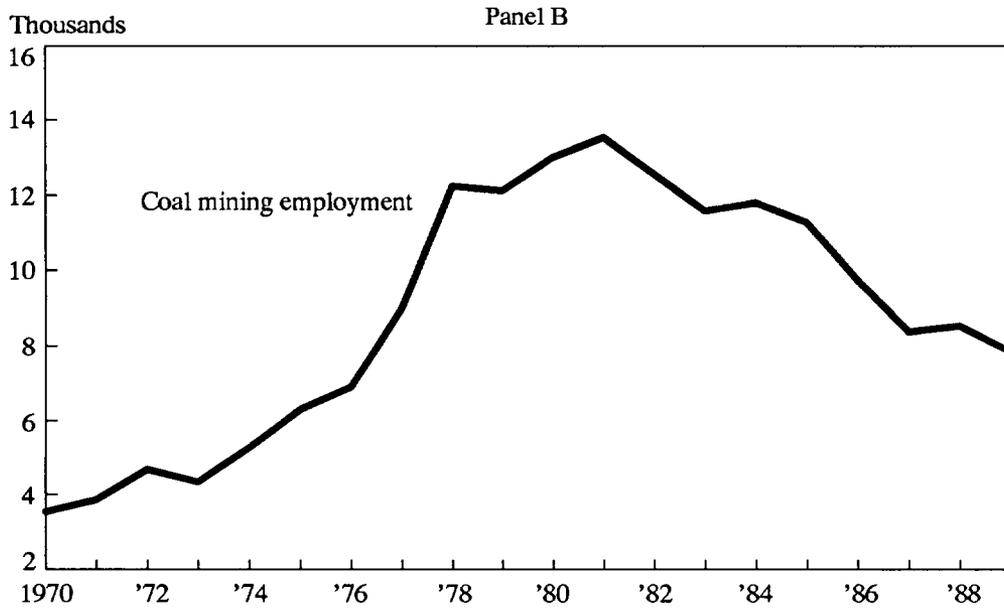
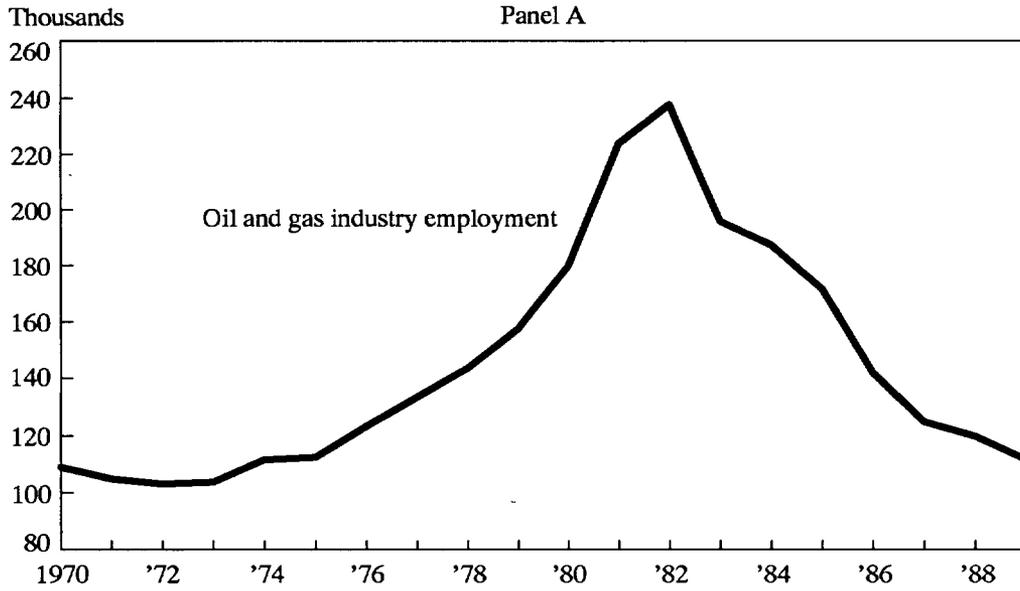
A brighter outlook for natural gas

More favorable natural gas prices and stricter environmental policy in the 1990s will likely boost district natural gas output. Moreover, development of new pipelines may allow further expansion of district gas production.

Natural gas prices are expected to rise modestly until the end of the 1990s (Chart 4, Panel B). More importantly, the gas prices in prospect are low compared to projected oil prices. As a result, the demand for natural gas should increase as some utilities and industrial oil users shift to the lower priced natural gas. This switching should push up natural gas prices and stimulate gas production. Abundant supplies of gas are expected to limit real increases in wellhead gas prices throughout the first part of the decade. By the end of the decade, stronger demand and tighter supplies are expected to push prices up more rapidly.¹⁵

Environmental policy is another factor pointing toward increased demand for and production of natural gas. Provisions in the Clean Air Act Amendments of 1990 will likely

Chart 5
Energy Employment
Tenth District



Sources: Panel A - American Petroleum Institute; Panel B - Energy Information Administration.

lead to some growth in the use of compressed natural gas (CNG) in vehicles. Increased use of natural gas in the transportation sector will combine with increased demand from the nation's utilities and factories to lead to substantial increases in consumption. By the year 2000, consumption of natural gas is projected to range from 20.8 trillion to 22.4 trillion cubic feet, compared with 18.8 trillion cubic feet in 1989 (Energy Information Administration 1991). Expanded imports from Canada may satisfy some of this increased consumption, but domestic producers—including those in the Tenth District—will satisfy the lion's share of the nation's growing appetite for gas.¹⁶

New pipelines could add further impetus to production in the district. For example, the proposed Kern River pipeline project would connect major natural gas fields in Wyoming with the lucrative California market. Other proposed pipeline developments would link New Mexico's San Juan basin with the existing interstate pipeline system. This system will carry natural gas from major supply basins to markets in the West, Midwest, Northeast, and Gulf Coast. While it is uncertain which pipeline projects will actually be built, the pipelines serving the California market appear to be the most feasible among the several proposals nationwide.¹⁷

The generally positive outlook for natural gas production should continue to stimulate drilling activity and help stabilize oil and gas extraction employment in the district. Gas drilling in the Hugoton basin in Kansas has already added over 2,000 new wells since 1987, becoming the chief source of energy-related jobs in the state.¹⁸ Technological advances and a tax credit for unconventional fuels have also stimulated drilling and brought jobs to New Mexico's San Juan Basin, where natural gas is found in coal seams.

Coal on the rise

Higher coal prices will continue to support a strong upward trend in national and district coal production. In the district, a high concentration of low-sulfur coal may boost district output further.

Coal prices are projected to rise throughout the 1990s, due mainly to increased demand and slower productivity growth (Chart 4, Panel C). Average coal prices at the minemouth are expected to increase 19 percent in real terms from 1989 to 2000. Rising demand for coal by electric utilities should reverse the steady decline in coal prices that began in the late 1970s. Moreover, productivity in coal mining is expected to level off in the 1990s after achieving rapid gains in the 1980s. These gains were due mostly to the opening of bigger mines, such as the large surface mines in Wyoming's Powder River coal field.¹⁹ While fewer large new mines are likely to be developed in the 1990s, existing mines will be mined more intensively.

An abundance of *low-sulfur coal* will probably boost coal output in the district more than the national average in the 1990s. The reason for the stronger growth in district coal output can be found in the Clean Air Act Amendments, particularly the acid rain provisions that mandate reduction in sulfur dioxide emissions at the nation's electric utilities. Under the new provisions, switching from high-sulfur to low-sulfur coal could provide a low-cost way for existing coal-fired power plants to meet emissions standards.²⁰ As new plants are built near the end of the decade, however, new technology could provide low-cost ways to burn high-sulfur coal cleanly. Thus, the 1990s could be the last decade of rapid growth for district coal production.

Higher transportation costs, however,

could limit future gains in district coal output. Currently, rail rates are low enough to make the district's low-priced, low-heat coal attractive to electric utilities that are located closer to sources of more expensive, high-heat coal. However, growth in output of western coal in the 1990s is certain to put pressure on rail capacity. The resulting increases in transportation costs or the expense of rapidly expanding rail capacity could push up delivered prices of district coal. An increase in the delivered price of district coal might discourage use of district coal, but probably not enough to offset the increase caused by the Clean Air Act Amendments. Moreover, new techniques, such as coal drying to boost the heat content of low-sulfur coal, may enhance the value of district coal. If so, power plants could hold down their transportation costs by generating more power with the same amount of coal.

The rise in district coal output will bring income to the region's coal producers and severance tax revenue to district states, but jobs at district coal mines will probably continue to decline in the 1990s.²¹ Productivity in district coal mining increased faster than production in the 1980s, causing a decline in coal mining employment in the region (Chart 5, Panel B). This trend is expected to continue in the 1990s, but growth in output and a possible

leveling off of productivity gains in the 1990s should slow the decline.

Summary

The Tenth District holds vast reserves of energy resources. While the oil boom of the late 1970s and early 1980s focused attention on the district's oil, other energy resources are also important in the region. In fact, some of the nation's richest natural gas and coal reserves are found within the district boundaries.

The district's diverse portfolio of energy resources will be especially important in the decade ahead. Market conditions will likely lead to further declines in oil production, especially in the district where stripper wells dominate production. But at the same time, market conditions will likely boost production of natural gas and coal. Moreover, proposed pipelines should help support increased gas production in the district, and stricter environmental regulations will provide a boost for the district's unique low-sulfur coal. While the ultimate impact of this energy outlook on district economic activity is uncertain, there is little doubt that the region will be better off in the 1990s with its diverse energy portfolio than if it depended entirely on oil.

Endnotes

¹ The Tenth District also holds a large share of the nation's uranium and oil shale reserves, but this article focuses only on oil, gas, and coal because these resources currently generate almost all of the energy-related jobs in the region. Moreover, little or no growth is expected in the district's uranium and oil shale industries until well beyond the end of the decade.

² This share has remained relatively constant over time despite fluctuations in the district's reserves. For example, district oil reserves fell by 30 percent from 1970 through 1981 as oil production exceeded discovery. But reserves grew by more than 10 percent from 1981 to 1985. After

oil prices collapsed in 1986, reserves fell again to their current level of 3 billion barrels. The discussion of oil considers the reserves and production of the lower 48 states as the national total. Alaska is excluded due to its distance from the markets, relative cost of exploration, and large increase in production during the period. In 1989, Alaska produced 684 million barrels of oil with reserves of 6.7 billion barrels, one-quarter of the U.S. total and second only to Texas in each category.

³ After rising in the early 1980s, oil production in the district fell continuously following the collapse of oil prices in 1986. From 1986 to 1989, district oil production