

The Energy Materials Industry in the Tenth Federal Reserve District

By Dale N. Allman

The embargo of oil shipments into the United States imposed in 1973 by the Organization of Petroleum Exporting Countries dramatically underscored the heavy dependence of the United States on energy and the nation's vulnerability to interruption of foreign supplies of energy materials. As a result, much attention is currently focused on domestic sources of energy. The seven states of the Tenth Federal Reserve District—Colorado, Kansas, Missouri, Nebraska, New Mexico, Oklahoma, and Wyoming—have been important suppliers of primary energy materials for many years.¹ The purpose of this article is to provide a broad overview of the Tenth District's role in the domestic energy materials industry and to show how that role has changed over the past two decades.

The first section of the article focuses on the current role of the District as a whole and

¹ The District includes only portions of Missouri, New Mexico, and Oklahoma, but the totals used in the article represent totals for the entirety of all seven states rather than just the District portion.

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changes in that role from 1960 to 1980, using data on District energy materials production, value, and employment, as well as national energy data and District economic data. The second section focuses on the current and changing roles of four primary types of energy materials—crude oil, natural gas, coal, and uranium—again from the perspective of the total District.² The third section treats the energy materials industry in the individual states in the Tenth District, focusing on those states where energy activity is most important.

THE GROWTH OF ENERGY ACTIVITY IN THE TENTH DISTRICT

The Tenth District plays an important role in the domestic energy materials industry, with its role in energy being greater than in the overall economy. In 1980, District production of energy materials, measured in energy equivalent units, was 6.8 billion barrels of crude oil, or 37.4 percent of total U.S. output

² Although the article focuses on those four primary types of energy materials, activity in energy markets also includes supplementary sources such as wood, hydroelectricity, geothermal, wind, solar, and oil shale. While these other energy sources are of increasing interest, the dominant types of energy still come from oil, gas, coal, and uranium.

Table 1
ENERGY RESOURCES IN THE TENTH DISTRICT AND IN THE UNITED STATES,
1980, INCLUDING COMPARATIVE DATA

	Tenth District			United States	
	Level 1980	Percent of United States	Growth Rate 1960-80 (In Percent)	Level 1980	Growth Rate 1960-80 (In Percent)
Energy Data:					
Production (billion barrels of crude oil equivalent)	6.8	37.4	2.1	18.2	2.1
Value of Production (billion dollars)	\$13.5	16.3	11.1	\$83.2	10.9
Employment in Energy					
Production (thousand)	131.4	18.6	1.7	708.1	1.9
Rotary Rigs Active (number)	866	29.8	2.6	2,910	2.6
Exploratory and Development Wells Drilled (number)	19,253	31.6	1.7	60,845	1.3
Comparative Data:					
Personal Income (billion dollars)	\$154.7	7.2	9.0	\$2,162.9	8.8
Population (million)	16.4	7.2	1.1	227.2	1.2
Nonagricultural Employment (thousand)	6,603.4	7.3	2.9	90,564.0	2.6

of these materials (Table 1).³ The dollar value of energy materials produced in the Tenth District was at \$13.5 billion, 16.3 percent of the national total. The discrepancy between the District's percentages of production and value reflects the low price of uranium, which accounts for a large share of District energy production. Employment in the energy sector in the Tenth District in 1980 amounted to 18.6 percent of total national energy industry employment. As indicated by these percentages, the role of the District in the energy materials industry is much greater than its role in overall economic activity, as the District accounts for only about 7 percent of the nation's

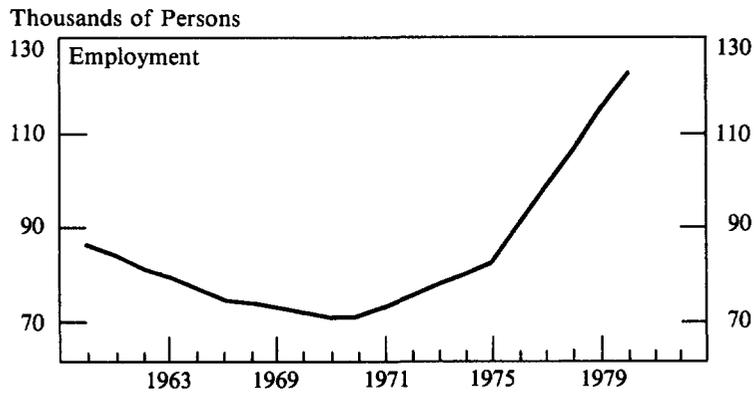
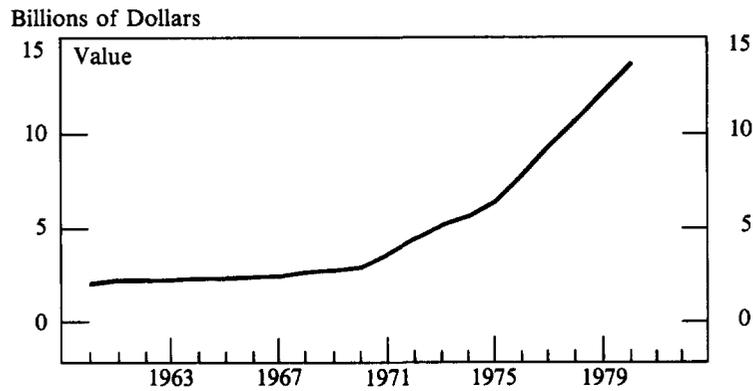
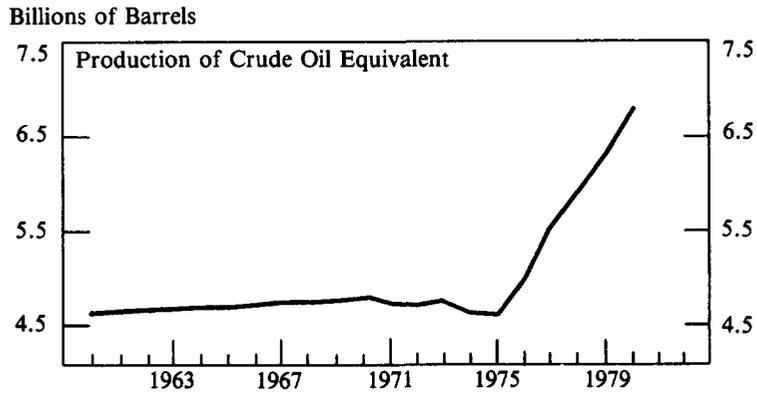
population, personal income, and nonagricultural employment.

The energy materials industry has grown considerably in the Tenth District over the past two decades, as District growth has kept pace with that in the nation (see Chart 1). From 1960 to 1980, District production grew at an annual rate of 2.1 percent, the same as the nation's, while District energy employment rose 1.7 percent per year, only slightly below national growth (Table 1). The value of output of energy materials increased at a much more rapid annual rate of about 11 percent in both the District and the nation. The greater growth in value reflects the sharp rise in the price of energy caused by general inflation and by actions of the OPEC oil cartel.

In the District as well as the nation, there were three distinct phases in the growth of energy activity between 1960 and 1980. In the first phase, from 1960 to 1970, energy materials

³ The outputs of crude oil, natural gas, coal, and uranium are not usually added together since those outputs are measured in different units. In order to make them additive, each measure of output is converted to a common unit, such as barrels of crude oil, using conversion factors based on heat content.

Chart 1
ENERGY MATERIALS IN THE TENTH DISTRICT
1960-80



output and the value of energy production increased at moderate rates in the Tenth District and the nation, while energy industry employment declined. In the second phase, from 1970 to 1975, output declined in both the District and the United States, although employment increased. The value of energy output increased dramatically during the second phase, due to general inflation and to the OPEC embargo and subsequent sharp increases in the prices of energy materials. In the third phase, from 1975 to 1980, the rate of increase in total value moderated somewhat compared to the early 1970s in both the Tenth District and the nation. In contrast, though, the 1970-75 drop in output was reversed, as the production of energy materials increased. Also, employment increased more rapidly than in the 1970-75 period.

Although energy activity in the three phases followed the same general pattern in the Tenth District as in the United States, there were important differences. For example, from 1960 to 1970 the energy materials industry grew less in

the District than in the nation. Thus, production grew 2.8 percent per year in the District compared with 4.2 percent nationwide, while the District value of production grew at a rate of 2.5 percent, compared with 5.3 percent in the United States (Table 2). Also, employment in energy declined more in the District in the 1960s than in the nation.

During the early 1970s, the relative growth of the District energy industry increased somewhat over the 1960s. Thus, the level of energy production declined less in the District than in the nation. Moreover, the very rapid 17.8 percent per year rise in the value of Tenth District energy output was only slightly less than the 18.9 percent increase in the U.S. From 1970 to 1975, employment in the District energy industry increased somewhat less than in the nation.

In contrast to both the 1960s and early 1970s, during the 1975-80 period energy activity in the Tenth District increased more rapidly than in the nation. Energy materials output rose 3.5 percent per year in the District between 1975

Table 2
THE GROWTH OF ENERGY ACTIVITY IN THE TENTH DISTRICT
AND UNITED STATES, 1960-80

	Average Annual Growth Rates					
	Tenth District			United States		
	(In Percent)					
	1960-70	1970-75	1975-80	1960-70	1970-75	1975-80
Energy Materials:						
Production (based on crude oil equivalent)	2.8	-0.6	3.5	4.2	-1.3	1.4
Value (based on total dollar value of production)	2.5	17.8	14.9	5.3	18.9	13.0
Employment (based on number employed)	-2.1	3.4	8.0	-1.5	5.1	5.8
Comparative Data:						
Total Personal Income	6.7	10.4	12.2	7.3	9.4	11.4
Total Nonagricultural Employment	2.5	2.9	3.8	2.7	1.7	3.3

and 1980, as opposed to 1.4 percent nationwide. The value of output rose 14.9 percent per year in the District, compared with 13 percent in the nation. Employment in energy activity during the latter 1970s also increased more rapidly in the District than in the United States. This more rapid growth of energy activity in the Tenth District from 1975 to 1980 was largely due to increased production of coal and natural gas, as will be discussed in the next section.

As the District's contribution to national energy activity gained in importance in the 1970s, it contributed to District economic activity as well. As measured by personal income and nonagricultural employment, general economic activity increased more rapidly in the Tenth District than in the nation during both the 1970-75 and 1975-80 periods. In contrast, in the 1960s, when District energy activity grew relatively slowly, District personal income and nonagricultural employment grew less than did the nation's.

The Tenth District's recoverable deposits of energy materials have also increased in importance in the past 20 years.⁴ District reserves rose more in the 1960s than did the nation's, fell less in the first half of the 1970s, then rose more in the 1975-1980 period (Chart 2). Thus, the relative importance of energy reserves in the District increased over the 1960-80 period, rising from about 6 percent to about 30 percent of total domestic deposits of recoverable energy materials by 1980.

⁴ The measure of energy deposits is known as recoverable or proved reserves. The amount of energy materials in reserve is estimated based on geological, engineering, and economic data. The level of reserves thus depends on existing technology in energy production and on current costs of using that technology to produce energy. See Hans H. Landsberg and Sam H. Schurr, *Energy in the United States—Sources, Uses and Policy Issues*, New York: Random House, 1968, pp. 79-81, for a discussion of energy reserves.

THE COMPOSITION OF ENERGY MATERIALS IN THE TENTH DISTRICT

This section deals with the contributions of the four primary energy materials produced in the Tenth District. The contributions as of 1980 are considered first, followed by a look at how the mix of energy materials has changed over time.

Crude oil is the most important energy material in the Tenth District in terms of value of output. In 1980, the total dollar value of District crude oil produced was \$6.3 billion, 46.3 percent of the value of all energy materials output in the District (Table 3). Ranked by value of output, natural gas is the District's second most important energy material, contributing 37.3 percent to the value of District production in 1980. Coal ranks third, accounting for 10.8 percent of the District total, while uranium is the least important Tenth District material in terms of value of output.

On the other hand, in terms of production, uranium is the most important material. In 1980 uranium accounted for 75.2 percent of total energy output. Uranium ore accounts for the relatively large share of output because of its high heat content, which is used as a basis for comparison. The price of uranium, though, is comparatively low, keeping down the dollar value of output. Ranked by the level of production, natural gas is the Tenth District's second most important energy material, with crude oil being third and coal last. Natural gas ranks ahead of crude oil in production but behind in value in part because controls hold down the price of natural gas.

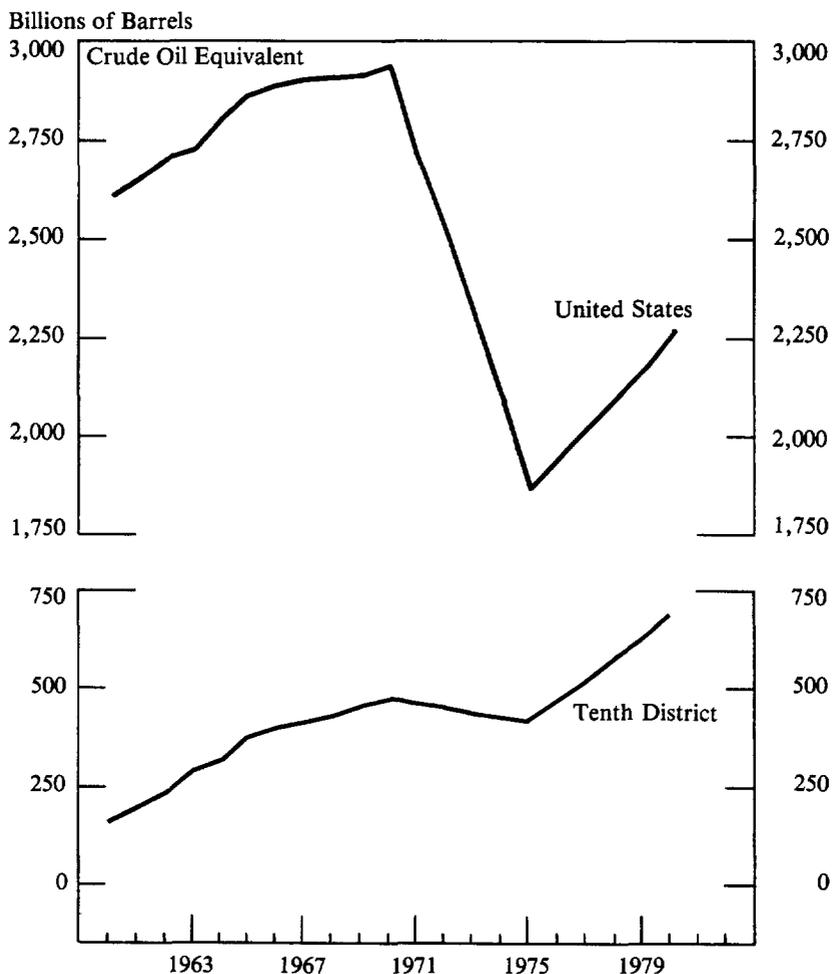
In terms of both production and value of production, the Tenth District plays a major role in the national energy industry with respect to each of the four energy materials. The value of District uranium output accounts for over 60 percent of the total value of the nation's uranium production. Comparable percentages

for natural gas, crude oil, and coal are 20.9 percent, 15.9 percent and 7.9 percent, respectively.

There have been significant changes in the composition of the District's energy materials industry since 1960. Crude oil has declined in significance, while natural gas, coal, and uranium have increased, with coal increasing the most. The number of barrels of crude oil

produced declined from 619.1 million in 1960 to 452.7 million in 1980 (Table 3). As a percentage of District output of energy materials, oil production dropped from 13.8 percent to 6.7 percent in that 20-year period. As a percentage of national production, District output fell from 24 percent in 1960 to 14.4 percent in 1980. On the other hand, the production of natural

**Chart 2
RESERVES OF ENERGY MATERIALS**



gas rose slightly as a percentage of District and national totals, from 1960 to 1980, while coal production gained significantly, rising from 1.0 percent to 6.8 percent of the District's energy production and from 2.7 percent to 15.2 percent of the nation's coal production. In terms of dollar value, the same pattern was evident: crude oil declined as a percentage of the total while natural gas and coal increased.

Again, the 1960-80 period shows three separate phases in the production of each of the four energy materials (Table 4). The value of output of each of the materials increased

according to the same patterns identified in the previous section, beginning by rising moderately during the 1960-70 period in both the Tenth District and the United States, with the value of crude oil and natural gas output rising more slowly in the District than nationwide, and the value of coal output increasing more rapidly in the District. In the 1970-75 period, advances in the value of crude oil, natural gas, and coal output accelerated considerably in both the Tenth District and the nation. During this middle period, the value of District oil and coal output grew more rapidly than in the United States,

Table 3
ENERGY MATERIALS PRODUCTION AND VALUE
IN THE TENTH DISTRICT, 1960 and 1980

Production						
	1960			1980		
	Level ¹	Percent of Total	Percent Of U.S.	Level ¹	Percent of Total	Percent of U.S.
Crude Oil	619.1	13.8	24.0	452.7	6.7	14.4
Natural Gas	2,562.0	10.3	20.1	4,423.4	11.7	21.6
Coal	11.1	1.0	2.7	117.8	6.8	15.2
Uranium	9.5	73.9	73.7	14.6	75.2	67.2
Total	4.5	100.0	40.7	6.8	100.0	37.4

¹ Level indicates production of crude oil in million barrels, natural gas in billion cubic feet, coal in million tons, uranium in thousand tons, and total in billion barrels of crude oil equivalent.

Value						
	1960			1980		
	Level (Billions of Dollars)	Percent of Total	Percent of U.S.	Level (Billions of Dollars)	Percent of Total	Percent of U.S.
Crude Oil	\$1.752	79.8	23.6	\$ 6.262	46.3	15.9
Natural Gas	0.369	16.8	20.6	5.043	37.3	20.9
Coal	0.058	2.6	3.0	1.464	10.8	7.9
Uranium	0.018	0.8	48.4	0.759	5.6	61.1
Total	\$2.197	100.0	19.6	\$13.528	100.0	16.3

while the value of natural gas production grew less rapidly (Chart 3).

In the second half of the 1970s, the growth rate of the value of crude oil output declined sharply to 7.7 percent in the Tenth District from 16.8 percent in the 1970-75 period (Table 4). The drop reflected the moderation during the late 1970s in the extent of OPEC and world oil price increases. However, the value of crude oil production slowed more in the District than nationwide.

Growth in the value of coal output also decreased in the Tenth District in the last five years of the 1970s. In contrast however to a sharp drop in the United States from 27 percent in the early 1970s to 8.2 percent, the District growth rate slowed only moderately, from 28.8 percent to 24.6 percent. The greater growth in the District was due to the continued rapid in-

crease in the level of coal production in the Tenth District, reflecting the greater availability of coal reserves in the District and the accessibility of coal resources through surface mining.

In contrast to crude oil and coal, the value of natural gas and uranium output in the Tenth District continued to accelerate in the 1975-80 period relative to the early 1970s (Table 4). The District value of natural gas output grew at a rate of 26.6 percent in the latter 1970s up from 18 percent in the early part of the decade and higher than the national growth in the 1975-80 period. The value of District uranium output grew at a rate of 31.5 percent per year in the late 1970s, sharply higher than in the 1970-75 period. The rapid growth in the value of natural gas and uranium output in the Tenth District during the second part of the 1970s reflects the availability of reserves of these two energy materials in the District and underlines the importance of the Tenth District as a domestic natural gas and uranium supplier.

THE VALUE OF ENERGY PRODUCTION IN TENTH DISTRICT STATES

The seven states in the Tenth District differ considerably in their relative importance in the different sectors of the District energy materials industry. Oklahoma is the District's largest producer of crude oil and natural gas, making up, as of 1980, 36.5 percent of District value of crude oil output and 40.9 percent of the value of natural gas output (Table 5). Kansas is the second most important crude oil state, while New Mexico ranks second in terms of value of natural gas production. Wyoming and New Mexico are also important crude oil states, and Wyoming makes a significant contribution to the total value of District natural gas output.

Wyoming stands out as the most important coal producing state, accounting for 47.4 percent of the total value of District coal production. Colorado and New Mexico rank second

Table 4
THE GROWTH IN THE VALUE OF PRODUCTION OF FOUR PRIMARY ENERGY MATERIALS IN THE TENTH DISTRICT AND UNITED STATES, 1960-80

	Average Annual Growth Rate			
	(In Percent)			
	Tenth District			
	1960-80	1960-70	1970-75	1975-80
Crude Oil	6.6	1.3	16.8	7.7
Natural Gas	15.1	6.2	18.2	26.6
Coal	17.8	9.1	28.8	24.6
Uranium	9.1	N.A.	7.5	31.5
Total	11.1	2.5	17.8	14.9
	United States			
	1960-80	1960-70	1970-75	1975-80
Crude Oil	8.7	4.2	15.6	11.2
Natural Gas	13.9	7.7	19.0	21.9
Coal	11.9	6.8	27.0	8.2
Uranium	10.3	N.A.	7.0	36.2
Total	10.9	5.3	18.9	13.0

and third, respectively, in the value of coal output. New Mexico contributed 56.2 percent in 1980 to the total value of District uranium production, with Wyoming accounting for the remainder.

Growth in the total value of energy materials production in the seven states followed the same pattern described above for the three

phases of the 1960-80 period. Growth in the value of energy production in all seven states was relatively moderate in the 1960s and actually declined in Colorado and Nebraska.

All District states shared in the dramatic acceleration in the value of energy materials production in the 1970-75 period, especially Colorado, where the value of energy output in-

Chart 3
THE VALUE OF ENERGY MATERIALS PRODUCTION

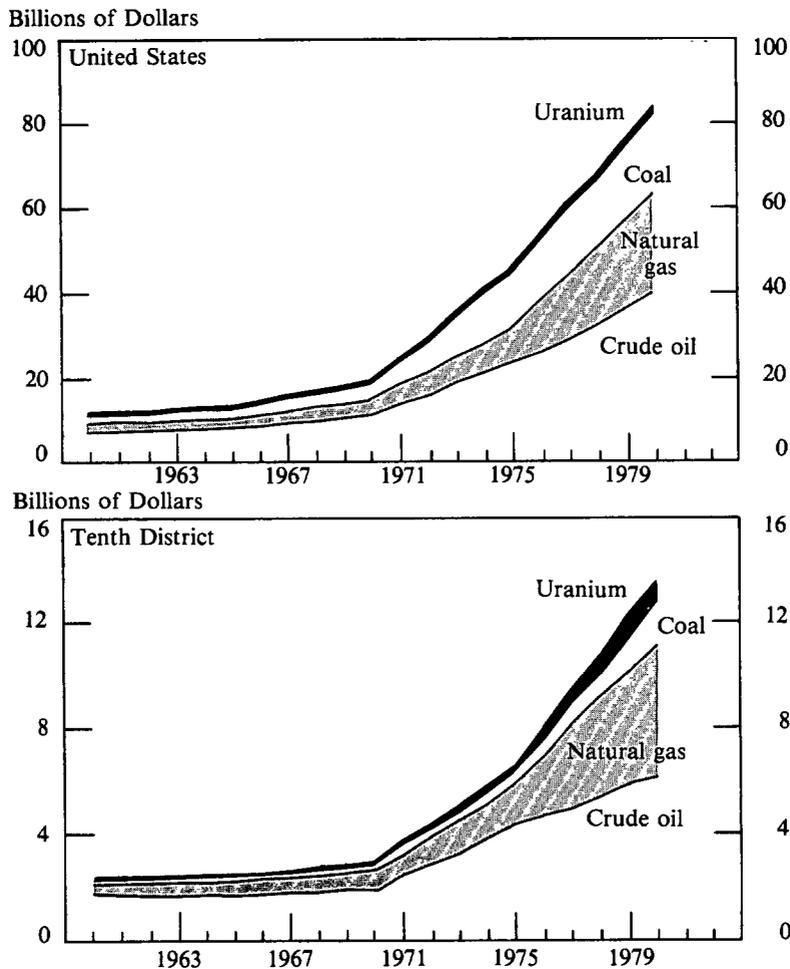


Table 5
THE VALUE OF ENERGY MATERIALS
PRODUCTION IN TENTH DISTRICT
STATES, 1980

CRUDE OIL		
	Dollar Value (millions)	Percent of Total
Oklahoma	\$2,284.6	36.5
Kansas	1,324.4	21.1
Wyoming	1,099.1	17.5
New Mexico	1,061.5	16.9
Colorado	388.9	6.2
Nebraska	104.7	1.7
Missouri	2.0	0.1
Total	\$6,262.2	100.0

NATURAL GAS		
	Dollar Value (millions)	Percent of Total
Oklahoma	\$2,055.7	40.9
New Mexico	1,618.5	32.2
Kansas	606.3	12.1
Wyoming	468.3	9.3
Colorado	269.6	5.4
Nebraska	2.7	0.1
Missouri	0.1	0.0
Total	\$5,043.2	100.0

COAL		
	Dollar Value (millions)	Percent of Total
Wyoming	\$ 694.3	47.4
Colorado	309.3	21.1
New Mexico	211.4	14.4
Oklahoma	126.0	8.6
Missouri	106.5	7.3
Kansas	16.4	1.1
Total	\$1,463.9	100.0

URANIUM		
	Dollar Value (millions)	Percent of Total
New Mexico	\$426.4	56.2
Wyoming	322.8	43.8
Total	\$759.2	100.0

Table 6
GROWTH IN THE VALUE OF ENERGY
MATERIAL PRODUCTION IN
TENTH DISTRICT STATES

	Average Annual Growth Rates		
	(In Percent)		
	1960-70	1970-75	1975-80
Colorado	-2.8	35.2	10.6
Kansas	0.1	11.7	22.1
Missouri	4.5	19.7	17.3
Nebraska	-6.5	9.2	13.9
New Mexico	4.2	19.1	18.5
Oklahoma	3.8	14.8	18.0
Wyoming	4.1	18.1	12.6
Total	2.5	17.8	14.9
United States	5.3	18.9	13.0

creased 35.2 percent per year (Table 6). In addition, the value of output increased relatively rapidly in Missouri, New Mexico, and Wyoming during the early 1970s.⁵

In the 1975-80 period in Colorado, New Mexico, Wyoming, and Missouri, growth in the value of energy material production moderated relative to the first half of the 1970s. In Kansas, Oklahoma, and Nebraska though, growth continued to accelerate in the latter 1970s. In all District states, except Colorado and Wyoming, the value of energy production grew more rapidly than in the United States in the 1975-80 period.

Available information suggests that the value of natural gas and coal output in Tenth District states continued to grow rapidly during 1981. For coal, the increase is especially notable in Colorado, New Mexico, and Wyoming. Wyoming, Kansas, and Oklahoma have registered sizable gains in natural gas production during

⁵ Almost all the growth in the value of energy output in Missouri, both from 1970 to 1975 and from 1975 to 1980, was attributable to expanding output of coal. The state still produces very little crude oil or natural gas.

1981. In addition, there was a slight increase during 1981 in the growth of crude oil value compared with the latter half of the 1970s, in Oklahoma, Kansas, and Wyoming. On the other hand, the value of uranium output for the Tenth District slowed considerably in 1981, primarily because of the uncertainty surrounding the United States nuclear power industry.⁶

SUMMARY

The historical record of energy activity in the Tenth District indicates the growing relative importance of the District's contribution to domestic sources of energy materials, especially in the last few years. The 1973 oil embargo and subsequent increases in the price of imported oil drove up the prices of all domestic energy

materials during the 1970s, contributing to the rapid growth in the value of energy output. The composition of the total value of energy material production in the District has changed over the last two decades. Crude oil has declined in importance while the role of the Tenth District as a domestic supplier of natural gas, coal, and uranium has increased. Available information for 1981 suggests that the Tenth District will maintain that importance, especially in relation to production of natural gas and coal.

⁶ For a discussion of the current status of the nuclear power industry see George J. Church, "Radiation Sickness," *Time*, October 26, 1981, pp. 18-20, and Dale D. Buss, "Uranium Industry Goes Bust as Growth of Nuclear Power Falts," *The Wall Street Journal*, November 3, 1981, p. 31.