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Highlights

- Utah and the Rocky Mountain states are becoming an increasingly important component of the nation's natural gas supply. The Rocky Mountain states now account for nearly 20 percent of the country's gas production, up from less than 10 percent 20 years ago. Simultaneously, the Southern Plains and Gulf Coast states, traditionally the source of the vast majority of the nation's gas supply, are experiencing declining production due to aging gas fields. Imports, primarily from Canada, have also increased dramatically over the past two decades. Net natural gas imports to the U.S. increased by almost 300 percent from 1982 to 2002 and now account for over 15 percent of the total U.S. natural gas supply. Without increased production from the Rocky Mountain states and Canadian imports, natural gas prices would undoubtedly be noticeably higher than the current price.
- Utah has an integral role in Rocky Mountain gas production. The Natural Buttes field in Uintah County and the Drunkards Wash field on the Carbon-Emery County line each rank in the top 20 natural gas fields nationally in terms of proved gas reserves. Utah's dry gas production increased by over 200 percent from 1982 to 2001, from 90.3 billion cubic feet to 272.5 billion cubic feet. Increased production in the Rocky Mountain states, accompanied by new pipeline infrastructure has resulted in a closer integration with the nation's natural gas system. Utah historically was a net importer of natural gas, with gas produced in southwestern Wyoming transported to the Wasatch Front for consumption. With the completion the Kern River Pipeline from Wyoming, through Utah and Nevada to California coupled with increased production, Utah became a net exporter of natural gas during the late 1990s. Other pipelines also connect Rocky Mountain gas production with consumption areas in the Northwest and Midwest. As Utah's natural gas industry becomes more integrated with the nation's, the price advantage historically enjoyed by Utah consumers will undoubtedly subside.
- Natural gas production has a fiscal impact on Utah through federal mineral royalties, one-half of which are returned to the state, royalties on production from state School and Institutional Trust Lands, and severance tax paid on all production in the state.

The Structure of Utah's Natural Gas Industry

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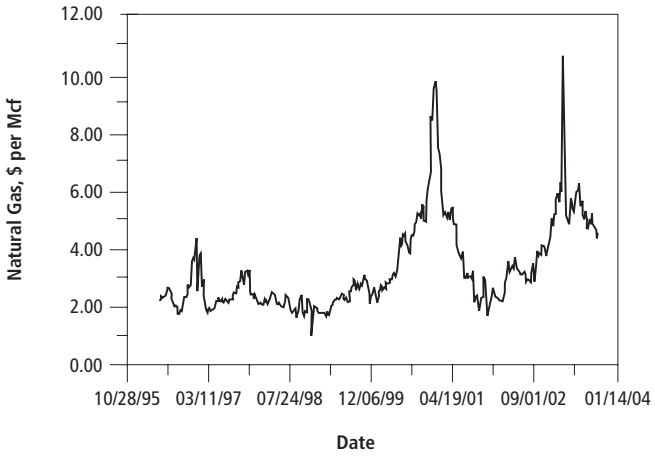
Changing dynamics in the natural gas industry have resulted in Utah's natural gas system becoming more sensitive to nationwide market forces due to greater integration with the rest of the country. As the industry was deregulated during the 1980s and 1990s, greater pipeline capacity was built across the country and numerous trading hubs emerged. Simultaneously, a vast majority of new electric-generating capacity built in the U.S. was gas-fired, creating new demand for natural gas. Finally, production is shifting as fields in the Southern Plains states and Gulf of Mexico age and production rises in the Rocky Mountain states. These changes are having nationwide effects, with Federal Reserve Chairman Alan Greenspan prompted to testify before both the U.S. Senate and the U.S. House of Representatives on the price of natural gas and its effect on the nation's economy. In Utah, the price advantage traditionally enjoyed by residents will subside, as demand for natural gas increases, and new pipelines make Utah's natural gas resources available to wider markets.

Nationwide Natural Gas Production and Use

The price of natural gas has spiked several times in the past several years (Figure 1) and has remained above $4.00 per thousand cubic feet (Mcf)[1]. Prior to the increases of the past several years, the price of natural gas was relatively stable at about $2 per Mcf. This stability in natural gas prices was made possible by additional supply coming onto the market from sources that previously were not significant suppliers in the United States. Traditionally, most natural gas in the U.S. was produced in the Southern Plains and Gulf Coast regions and transported to high consumption areas in the Northeast and Midwest via pipeline. (Figure 2). The sources of natural gas in the U.S. have shifted in recent years, with less reliance on the Gulf Coast area, increasing dependence on the Rocky Mountain states, and increasing imports (Table 1).

[1] The New York Mercantile Exchange (NYMEX) uses the Henry Hub as the delivery point for its natural gas futures contract. The Henry Hub connects nine interstate and four intrastate natural gas pipelines at Sabine Pipe Line LLC's Henry Gas Processing Plant near Erath, Louisiana. Approximately 49 percent of U.S. wellhead gas production either occurs near the Henry Hub or passes close to the Henry Hub.

Figure 1
Natural Gas Spot Price
(Friday close at the Henry Hub)



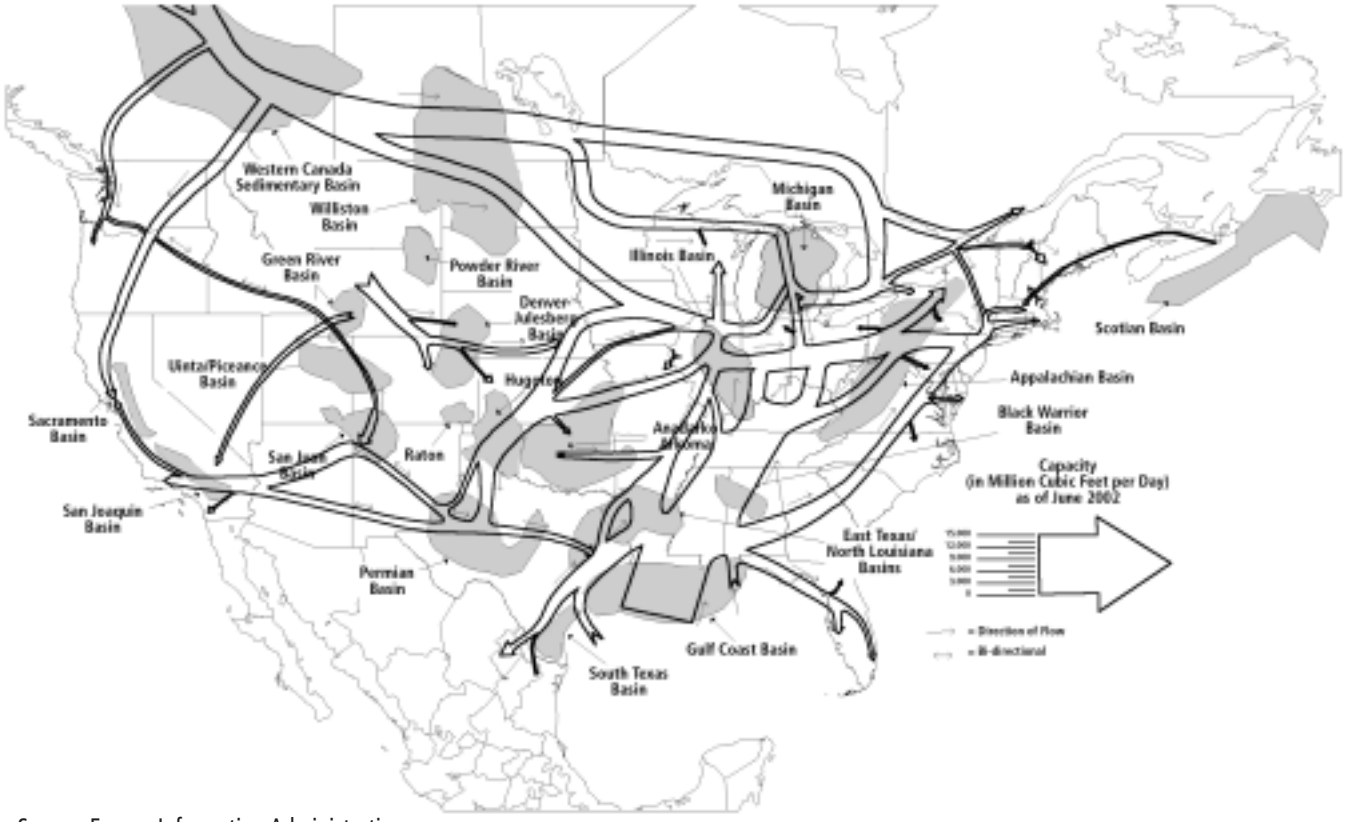
Source: Energy Information Administration

The U.S. natural gas supply has historically been centered in Louisiana, Texas, Oklahoma, and offshore in the Gulf of Mexico. In 1982, these three states accounted for 78.6 percent of U.S. dry gas production with a combined output of 14.0 trillion cubic feet (Tcf). By 2001, dry gas production from Louisiana, Oklahoma, and Texas had declined to12.8 Tcf and accounted for 65.0 percent of U.S. production. As natural gas production from the Gulf Coast and the Southern Plains decreased, gas production was rising in the Rocky Mountain states of Colorado, Montana, New Mexico, Utah and Wyoming. Dry gas production in these five states increased from 1.7 billion cubic feet (Bcf) in 1982 to 3.9 Bcf in 2001 with the proportion of total U.S. production increasing from 9.5 percent to 19.8 percent.

Rising natural gas production in New Mexico resulted in it surpassing Oklahoma as the nation's third-largest gas producer in 2001 (Table 2), while Wyoming and Colorado were ranked fifth and sixth, respectively. In all, natural gas was produced in 32 of the 50 states during 2001, with Texas ranking number one with 6.16 Tcf produced and Nevada ranking 32nd with 7 million cubic feet (MMcf) produced. Utah ranked 11th with 272.5 Bcf produced.

During the 1980s and 1990s, reliance on imported natural gas was rising as demand increased at a faster rate than domestic production. From 1982 to 2001, the amount of the U.S. natural gas supply accounted for by imports increased from 4.7 percent to 15.5 percent. Large amounts of natural gas in southern Alberta, Canada,

Figure 2
Major Natural Gas Producing Areas and Pipeline Transportation Corridors



Source: Energy Information Administration

Table 1
U.S. Natural Gas Supply 1982-2002

	U.S.	Louisiana, Oklahoma, Texas		Colorado, Montana, New Mexico, Utah, Wyoming		Imports	
	Production (dry gas) MMcf	Production (dry gas) MMcf	% of U.S. Production	Production (dry gas) MMcf	% of U.S. Production	Net Imports, MMcf	% of total supply
1982	17,820,063	14,003,658	78.6	1,686,328	9.46	881,608	4.71
1983	16,094,461	12,409,921	77.1	1,525,422	9.48	863,768	5.09
1984	17,466,472	13,371,264	76.6	1,706,660	9.77	788,307	4.32
1985	16,453,857	12,401,318	75.4	1,533,169	9.32	894,447	5.16
1986	16,059,030	12,418,555	77.3	1,307,389	8.14	689,178	4.11
1987	16,620,581	12,733,748	76.6	1,506,292	9.06	938,512	5.34
1988	17,102,621	13,052,196	76.3	1,518,760	8.88	1,220,174	6.66
1989	17,310,645	12,997,040	75.1	1,784,869	10.31	1,274,648	6.86
1990	17,809,674	13,285,317	74.6	2,013,068	11.30	1,446,694	7.51
1991	17,697,802	12,884,125	72.8	2,164,387	12.23	1,644,068	8.50
1992	17,839,903	12,466,127	69.9	2,514,836	14.10	1,921,222	9.72
1993	18,095,460	12,673,344	70.0	2,580,290	14.26	2,209,931	10.88
1994	18,821,025	12,847,246	68.3	2,874,073	15.27	2,462,101	11.57
1995	18,598,679	12,627,458	67.9	2,953,023	15.88	2,686,929	12.62
1996	18,854,063	12,856,587	68.2	2,902,454	15.39	2,784,020	12.87
1997	18,902,389	12,749,570	67.4	3,038,441	16.07	2,837,167	13.05
1998	19,023,564	12,729,594	66.9	3,248,642	17.08	2,993,051	13.59
1999	18,832,232	12,450,677	66.1	3,332,661	17.70	3,422,090	15.38
2000	19,181,980	12,481,957	65.1	3,658,161	19.07	3,537,887	15.57
2001	19,676,428	12,787,064	65.0	3,898,810	19.81	3,603,661	15.48
2002	19,046,741	na	na	na	na	3,491,283	15.49

Source: Energy Information Administration, U.S. Department of Energy.

coupled with the ease of pipeline transportation resulted in Canada accounting for the vast majority of natural gas imports into the U.S. Although there are massive natural gas reserves in Russia and the Middle East, the relative difficulty in transporting liquified natural gas (which requires cooling the gas to minus 160° C) via ocean tanker makes the importation of natural gas from these areas more costly. During 2002, 94.2 percent of a total of 4,007.5 Bcf of natural gas imported to the U.S. arrived from Canada. The Carribean island of Trinidad accounted for the majority of the remainder.

Natural gas, as it is drawn directly from the ground, varies widely in both chemical constituents present and concentration of these constituents, depending upon the source of the gas. Because of the variation in wellhead natural gas, the gas usually undergoes some type of treatment or processing to remove impurities for safety, economic, or system and material compatibility reasons. Numerous processes are used to treat natural gas and the technology used varies widely, depending upon the impurities present.

There are 590 gas processing plants in the United States, with a total gas capacity of 71,919.9 MMcf per day. As with production, gas processing capacity is concentrated in the Gulf Coast and Southern Plains region, with Louisiana, Oklahoma, and Texas the site of 331 gas plants with 54 percent of U.S. capacity. The Rocky Mountain states of Colorado, New Mexico, Montana, Utah, and Wyoming have 124 gas plants with 14 percent of U.S. capacity.

Nationwide, about 80 percent of gross withdrawals of natural gas is marketed as dry gas (Table 3). Just under 15 percent of gross withdrawals is re-injected into oil and gas formations for repressuring to achieve greater ultimate recovery. About 5 percent to 6 percent of gross withdrawals is lost in the process of removing the nonhydrocarbon gases and natural gas liquids. There is also a minor amount (less than 0.5 percent) that is vented or flared-off.

Natural gas consumption is seasonal, with space heating resulting in the highest consumption during the winter months (Figure 3). Compared to consumption, natural gas production is relatively stable throughout the year, with excess production during the summer months stored for winter use. Natural gas is most commonly stored under pressure in three different types of underground facilities. The most common type of storage facility is depleted oil and natural gas fields. Converting a field

Table 2
U.S. Dry Gas Production by State, 2001

Rank	State	Production (MMcf)	% of U.S.
1	Texas	6,164,044	31.33
2	Louisiana	5,096,521	25.90
3	New Mexico	1,580,167	8.03
4	Oklahoma	1,526,499	7.76
5	Wyoming	1,298,139	6.60
6	Colorado	667,042	3.39
7	Alabama	508,045	2.58
8	Kansas	441,628	2.24
9	Alaska	435,291	2.21
10	California	366,764	1.86
11	Utah	272,534	1.39
12	Michigan	270,534	1.37
13	West Virginia	239,838	1.22
14	Arkansas	166,396	0.85
15	Pennsylvania	156,309	0.79
16	Ohio	100,021	0.51
17	Mississippi	92,087	0.47
18	Montana	80,927	0.41
19	Kentucky	80,165	0.41
20	Virginia	71,543	0.36
21	North Dakota	48,564	0.25
22	New York	27,787	0.14
23	Florida	4,551	0.02
24	Tennessee	2,000	0.01
25	Nebraska	1,208	0.01
26	Oregon	1,110	0.01
27	South Dakota	1,100	0.01
28	Indiana	1,064	0.01
29	Arizona	307	0.00
30	Illinois	150	0.00
31	Maryland	32	0.00
32	Nevada	7	0.00
	United States	19,676,428	100.00

Source: Energy Information Administration, U.S. Department of Energy.

from production to storage has the advantage of existing infrastructure such as wells, gathering systems, and pipeline connections. The second most common type of natural gas storage facility is natural aquifers, which are frequently used in the Midwest. Natural aquifers are suitable for gas storage if water-bearing sedimentary rock is overlain with an impermeable cap rock but usually require more base gas than depleted oil fields. Caverns constructed in natural salt deposits are the third most common type of storage facility and are used primarily along the Gulf Coast. Salt caverns have relatively high injection and withdrawal rates and low base gas requirements, but cavern construction is more costly than depleted oil field conversion. There have also been attempts to use abandoned mines for gas storage, but none are currently operational. Nationwide, there is 8,357 Bcf of natural gas storage capacity, with 83.8 percent being depleted oil and gas fields followed by aquifers (14.3 %), and salt caverns (2.6%).

Natural Gas Pipeline System

The pipeline system transporting natural gas has three functions. Gas is gathered from wells in the producing areas, transported to the consuming areas, and distributed to the final consumer. Since 1992, interstate gas pipeline companies have operated as common carriers, providing open-access transportation and storage for gas owned by other entities and separating natural gas sales from transportation services.

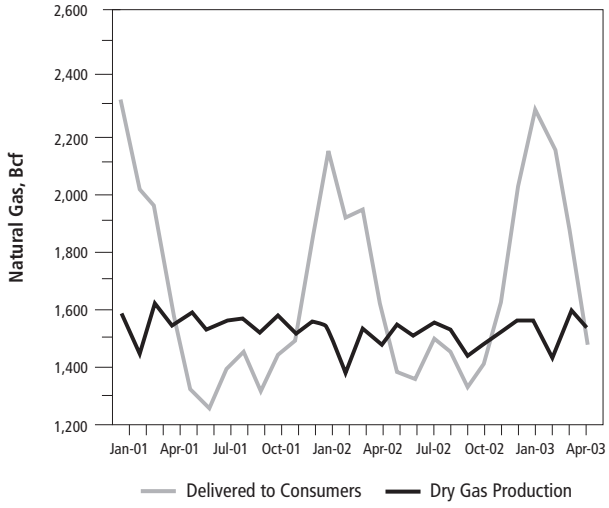
While most pipeline capacity historically has been from the producing areas in the Southern Plains and Gulf Coast, the most rapid expansion in recent years has been in the western portion of the country. As a result of rapidly increasing coalbed methane production in Wyoming's Powder River Basin, pipeline capacity in this area increased by 19 percent from 2000 to 2002. Driven largely by increasing numbers of gas-fired electric power generation plants, pipeline capacity into northern California and southern California increased by 15 percent and 7 percent, respectively, over the same time period. By comparison, there was no expansion in pipeline capacity from Canada into the Midwest or into the Chicago area and only a 5 percent expansion in pipeline capacity serving Gulf Coast production.

Table 3
U.S. Natural Gas Production and Disposition (MMcf), 1998-2002

	1998	1999	2000	2001	2002
Number of Producing Gas Wells	316,929	302,421	341,678	366,849	na
Gross Withdrawals	24,108,128	23,822,711	24,173,875	24,475,969	24,129,872
From Gas Wells	17,728,520	17,590,187	17,726,056	19,049,757	18,312,404
From Oil Wells	6,379,608	6,232,524	6,447,820	5,426,213	5,817,738
Repressuring	3,427,045	3,292,564	3,379,661	3,296,291	3,699,001
Nonhydrocarbon Gases Removed	616,715	615,014	505,472	463,587	378,072
Vented and Flared	103,019	110,285	91,232	85,678	83,803
Marketed Production (wet)	19,961,348	19,804,848	20,197,511	20,630,412	19,968,906
Extraction Loss	937,784	972,616	1,015,531	953,984	922,164
Dry Production	19,023,564	18,832,232	19,181,980	19,676,428	19,046,741
Wellhead Price ($ per Mcf)	1.96	2.19	3.69	4.02	2.95

Source: Energy Information Administration, U.S. Department of Energy.

Figure 3
Nationwide Natural Gas Production and Consumption



Source: Energy Information Administration

The pipeline system serving Utah includes over 3,000 miles of transmission pipeline operated by 11 different entities (Table 4, Figure 4). Questar Gas Company operates the most miles of transmission pipeline in Utah with 1,373, followed by Questar Pipeline, the interstate pipeline subsidiary of Questar Corporation, which operates 966 miles of transmission pipeline in Utah.

Overall, Questar Pipeline operates 2,475 miles of transmission pipeline located in six states (Figure 5). The company's main system is a "hub and spoke" system with 1,978 miles of pipeline and a capacity of 1.5 Bcf per day. The system connects several major natural gas producing areas in Colorado, Utah, and Wyoming with Questar Gas' main customer base in Utah and several other interstate pipeline systems. Other interstate pipeline companies with connections to Questar's main system are Colorado Interstate Gas, Kern River Gas Transmission, Northwest Pipeline, Rocky Mountain Natural Gas Company, TransColorado Pipeline, Williams Gas Pipeline Central, and Wyoming Interstate Company. In addition to transporting gas for other Questar subsidiaries, Questar Pipeline also has contracts to transport gas for over 30 other entities.

Questar Pipeline also operates the Overthrust Pipeline and the Southern Trails Pipeline. The 88-mile long Overthrust Pipeline is the western-most segment of the Trailblazer Pipeline System. The Trailblazer System extends eastward into Nebraska and is mostly owned by Kinder, Morgan, Inc. Questar Pipeline placed the Southern Trails pipeline into operation during 2002. This 488-mile long former oil pipeline was reconditioned to transport natural gas from producing areas near the Four Corners region to customers in Arizona and California. Although California was originally intended to be the primary market, a sizable amount of the natural gas is delivered to gas-fired electric power plants in Arizona.

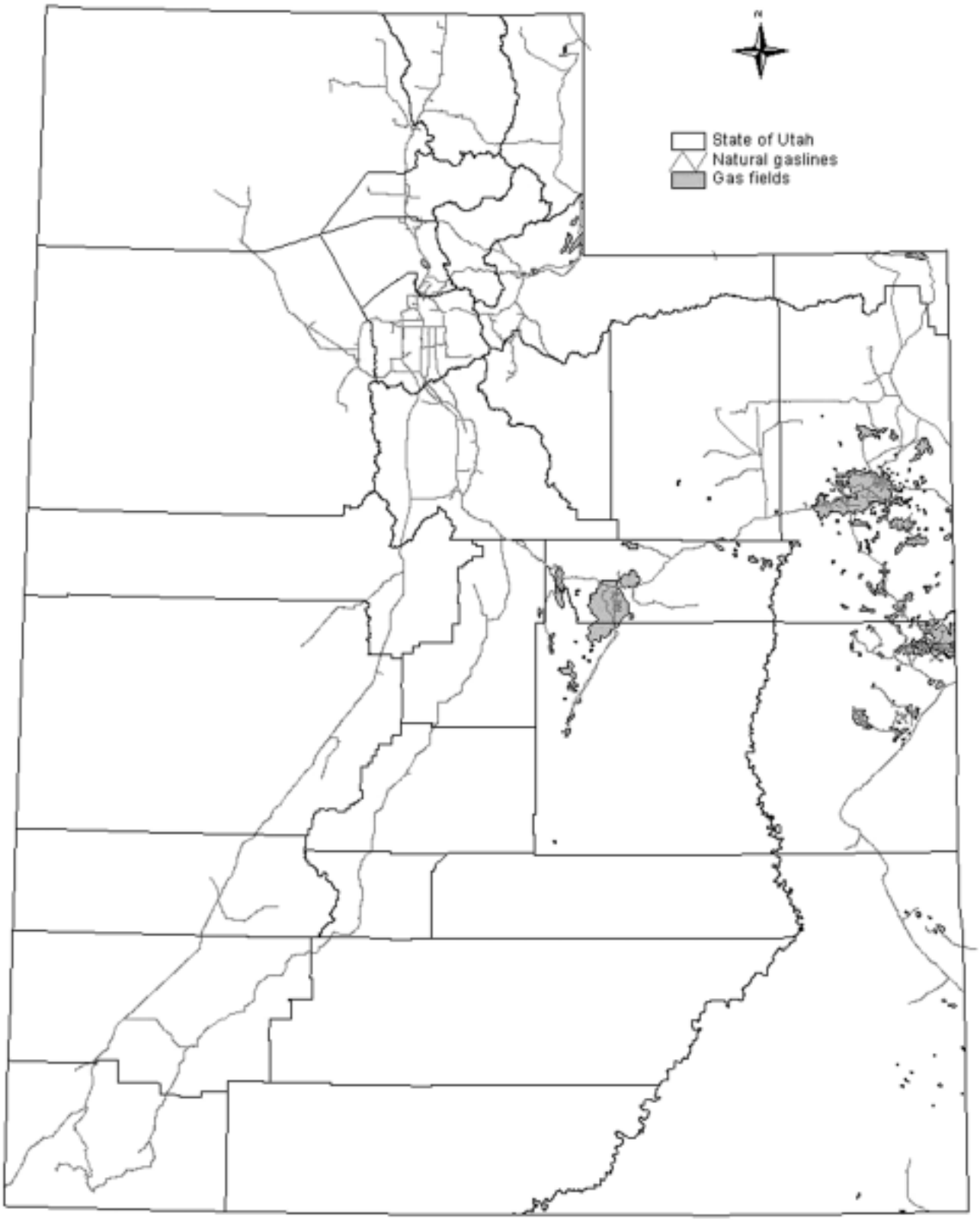
Other owners of major portions of the natural gas transmission system in Utah are Kern River Gas Transmission Company and Northwest Pipeline Corporation. The Kern River Pipeline begins at Opal, Wyoming, enters Utah near the southwest corner of Wyoming, and travels southwest through Utah and Nevada to Southern California. The line was constructed during 1991 with an expansion of additional pipe and compressor stations completed in 2003. The current capacity is 1.7 Bcf per day. The Kern River Pipeline is connected to the Questar Pipeline system near Elberta,

Table 4
Natural Gas Transmission Pipelines in Utah by Owner and Size

	Miles of Pipeline					
	Less than 4 inch	4 inch - 10 inch	10 inch - 20 inch	20 inch - 28 inch	Greater than 28 inch	Total
Questar Gas Company	170.0	671.0	520.0	12.0	0.0	1,373.0
Questar Pipeline Company	6.0	179.0	662.0	119.0	0.0	966.0
Kern River Gas Transmission Co.	0.0	0.0	0.0	0.0	370.0	370.0
Northwest Pipeline Corp.	0.0	5.5	10.5	208.4	0.0	224.4
City of Blanding	0.0	33.0	0.0	0.0	0.0	33.0
Colorado Interstate Gas Co.	0.0	0.0	29.0	0.0	0.0	29.0
City of Hildale	0.0	23.0	0.0	0.0	0.0	23.0
JM Huber Corp.	0.0	13.0	0.0	0.0	0.0	13.0
Exxon Company USA	7.0	0.0	0.0	0.0	0.0	7.0
City of Eagle Mountain	0.0	6.0	0.0	0.0	0.0	6.0
Enterprise Products Operating LP	1.0	0.0	0.0	0.0	0.0	1.0
Total	184.0	930.5	1,221.5	339.4	370.0	3,045.4

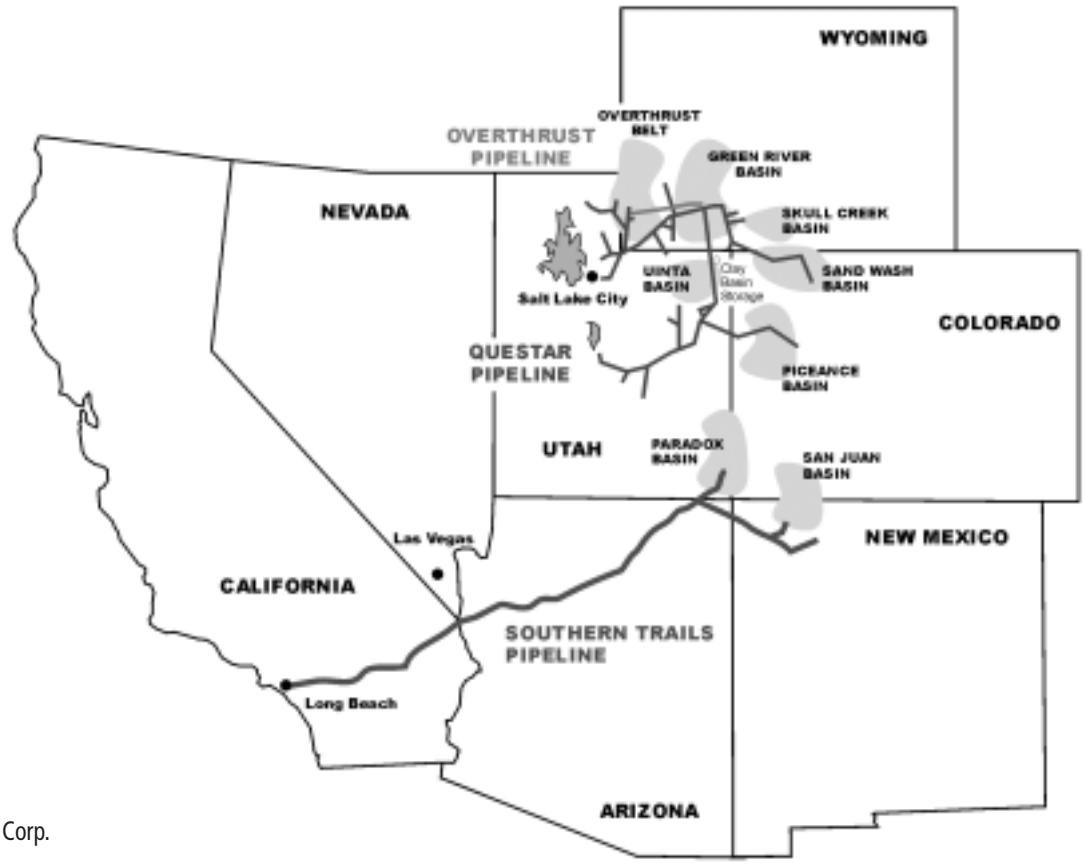
Source: Office of Pipeline Safety, U.S. Department of Transportation.

Figure 4
Utah Natural Gas Pipeline System



Source: Utah Geological Survey

Figure 5
Questar Pipeline System



Source: Questar Corp.

Utah. Large industrial users of natural gas, who often purchase gas directly from producers, can tap either the Kern River Pipeline or the Questar Pipeline system for delivery of gas. Questar Gas also has taps on the Kern River Pipeline that allow it to obtain delivery of natural gas on high demand days. The original purpose of the Kern River pipeline was to provide natural gas to stimulate oil wells near Bakersfield, California, but much of the gas is now being consumed by electric power generation.

Northwest Pipeline Corporation is a subsidiary of The Williams Companies and operates the Northwest Pipeline that extends from producing areas in New Mexico, Colorado, Utah, and Wyoming northwest through southern Idaho to Oregon and Washington. The pipeline has a capacity of 2.9 Bcf per day and is 3,826 miles long. The majority of the Northwest Pipeline system in Utah is located in the producing area in the eastern part of the state, although a minor portion cuts across the northwest corner of Rich County between Wyoming and Idaho.

The interstate pipeline system, coupled with producing areas in eastern Utah, western Colorado, and southwestern Wyoming results in Utah being a net exporter of natural gas to other states (Table 5). Natural gas transported both ways across the Utah-Colorado border is a result of natural gas production in the area. The majority of the gas traveling from Utah to Idaho is a result of the Northwest Pipeline cutting across the northeast corner of Rich County. A small portion of the gas exported to Idaho, about 150 MMcf annually, is Questar Gas service to Franklin County, Idaho. The gas exported from Utah to Nevada is the Kern River Pipeline transporting gas from Wyoming, through Utah and Nevada, to southern California. With the 2003 expansion of the Kern River Pipeline, the amount of gas transported

Table 5
Interstate Transportation of Natural Gas Between Utah and Adjacent States (MMcf), 2001

	Utah Receipts from	Utah Deliveries to	Utah Net Receipts from
Colorado	8,870	60,029	(51,159)
Idaho	0	162,707	(162,707)
Nevada	0	303,262	(303,262)
Wyoming	534,891	112,124	422,767
Total	543,761	638,122	(94,361)

Source: Energy Information Administration, U.S. Department of Energy.

Table 6
Natural Gas Prices by End User, 1983-2002

	Residential Price, $/Mcf			Commerical Price, $/Mcf			Industrial Price, $/Mcf		
	United States	Utah	Utah as % of U.S.	United States	Utah	Utah as % of U.S.	United States	Utah	Utah as % of U.S.
1983	6.06	4.26	70.3	5.59	4.32	77.3	4.18	3.15	75.4
1984	6.12	5.68	92.8	5.55	4.96	89.4	4.22	3.52	83.4
1985	6.12	4.86	79.4	5.50	4.91	89.3	3.95	3.23	81.8
1986	5.83	4.64	79.6	5.08	4.73	93.1	3.23	3.00	92.9
1987	5.54	4.97	89.7	4.77	4.98	104.4	2.94	3.20	108.8
1988	5.47	5.11	93.4	4.63	4.08	88.1	2.95	3.10	105.1
1989	5.64	5.14	91.1	4.74	4.16	87.8	2.96	3.30	111.4
1990	5.80	5.28	91.1	4.83	4.30	89.1	2.93	3.62	123.3
1991	5.82	5.44	93.3	4.81	4.50	93.6	2.69	3.69	136.8
1992	5.89	5.44	92.3	4.88	4.40	90.0	2.84	3.91	137.9
1993	6.16	5.13	83.3	5.22	4.06	77.7	3.07	3.67	119.5
1994	6.41	4.96	77.4	5.44	3.84	70.7	3.05	2.74	89.9
1995	6.06	4.74	78.2	5.05	3.64	72.1	2.71	2.34	86.4
1996	6.34	4.47	70.5	5.40	3.38	62.5	3.42	2.10	61.6
1997	6.94	5.13	73.9	5.80	3.92	67.6	3.59	2.55	71.0
1998	6.82	5.57	81.7	5.48	4.35	79.4	3.14	3.00	95.5
1999	6.69	5.37	80.3	5.33	4.13	77.5	3.10	2.94	94.8
2000	7.76	6.20	79.9	6.59	4.93	74.8	4.48	3.93	87.7
2001	9.64	8.09	83.9	8.43	6.78	80.4	5.18	5.28	101.9
2002	7.85	6.38	81.3	6.56	5.21	79.4	3.99	3.90	97.7

Source: Energy Information Administration, U.S. Department of Energy.

will undoubtedly increase. Gas travels both ways across the Utah-Wyoming border. Gas exits Wyoming into Utah via the Northwest Pipeline, Kern River Pipeline and the Questar Pipeline system. Producing areas in Summit County export gas to Wyoming for treatment and connection to the interstate pipeline system. Questar Pipeline also transports gas from the Clay Basin storage facility in Daggett County to Wyoming as part of its spoke and hub system.

The interstate pipeline system serving the Rocky Mountain region will undoubtedly continue to expand in the future, resulting in closer integration of the Utah natural gas system with the remainder of the country. Additional pipeline capacity is continually being added in the Rocky Mountain region, allowing additional natural gas to be transported to the consuming areas in the Midwest and the West Coast. Kinder, Morgan, Inc. announced during September, 2003 that the company intends to expand the capacity of the TransColorado Pipeline, which extends from northwest Colorado to Blanco, New Mexico, by 42 percent to over 400 MMcf per day. Also during September, Cheyenne Plains Pipeline Company decided to increase the size of its proposed pipeline from Cheyenne, Wyoming to Greensburg, Kansas from 30-inch diameter pipe to 36-inch diameter pipe, increasing capacity by at least 30 percent. Additionally, the Grasslands Pipeline project, designed to transport gas from Wyoming's Powder River Basin to the Northern Border Pipeline and ultimately to markets in the Midwest received final authorization for construction in June, 2003. As these and other pipeline projects are constructed, the natural gas industry in the Rocky Mountains will become more closely integrated with the remainder of the country. The price advantage historically enjoyed by Utah residents will subside as this integration occurs.

Table 7
Utah Natural Gas Production by Operator, 2002

	Gross Withdrawals (Mcf)	% of Total
Phillips Petroleum Company	75,538,760	25.8
BP America Production Co.	38,331,062	13.1
El Paso Production Oil & Gas Co.	36,963,822	12.6
Shenandoah Energy Inc.	27,218,122	9.3
Anadarko Petroleum Corp.	20,578,797	7.0
EOG Resources Inc.	17,129,231	5.8
Tom Brown Inc.	15,923,248	5.4
Dominion Exploration & Production Inc.	13,545,006	4.6
Inland Production Company	4,927,616	1.7
Wexpro Company	4,815,124	1.6
The Anschutz Corporation	4,633,854	1.6
Chevron USA Inc.	3,740,324	1.3
Exxonmobil Oil Corp.	2,808,510	1.0
Devon Energy Production Co. LP	2,391,412	0.8
Rosewood Resources Inc.	2,376,280	0.8
Del-Rio Resources Co.	2,243,487	0.8
Marathon Oil Co.	2,233,695	0.8
Lone Mountain Production Co.	1,951,493	0.7
Texaco Exploration and Production Inc.	1,820,980	0.6
Williams Production RMT Co.	1,546,792	0.5
Other (89)	12,404,895	4.2
Total	293,122,510	100.0

Source: Utah Division of Oil, Gas, and Mining, Utah Department of Natural Resources.

Table 8
Utah Natural Gas Production by Field, 2002

Field Name	County	Gross Withdrawals (Mcf)	% of Total
Drunkards Wash	Carbon/Emery	86,276,583	29.4
Natural Buttes	Uintah	76,429,979	26.1
Anschutz Ranch East	Summit	37,990,691	13.0
Lisbon	San Juan	15,851,881	5.4
Wonsits Valley	Uintah	13,928,896	4.8
Helper	Carbon	11,583,216	4.0
Buzzard Bench	Emery	5,088,706	1.7
Anschutz Ranch	Summit	4,974,225	1.7
Monument Butte	Duchesne	4,887,618	1.7
Bluebell	Duchesne/Uintah	3,918,708	1.3
Greater Aneth	San Juan	3,669,963	1.3
Altamont	Duchesne	2,740,134	0.9
Flat Rock	Uintah	2,149,567	0.7
San Arroyo	Grand	2,082,563	0.7
Rock House	Uintah	2,076,430	0.7
Brundage Canyon	Duchesne	1,554,828	0.5
Gypsum Hills	Uintah	1,258,907	0.4
Clay Basin	Daggett	1,250,965	0.4
Red Wash	Uintah	1,095,138	0.4
Bar X	Grand	867,090	0.3
Other (120)	Various	13,446,422	4.6
Total		293,122,510	100.0

Source: Utah Division of Oil, Gas, and Mining, Utah Department of Natural Resources.

Natural Gas in Utah

While Utah has experienced the same increase in natural gas prices as has the rest of the country in the past several years, Utah has consistently experienced lower-than-average prices for natural gas (Table 6). Over the past 20 years, the price of natural gas for both residential and commercial use in Utah has run about 80 percent of the nationwide average. The industrial price of natural gas in Utah has been much closer to the national average, and actually exceeded it from 1987 to 1993. Industrial gas prices are more sensitive to market forces than residential and commercial consumption, with industrial users often negotiating directly with producers and paying pipeline companies to transport the gas.

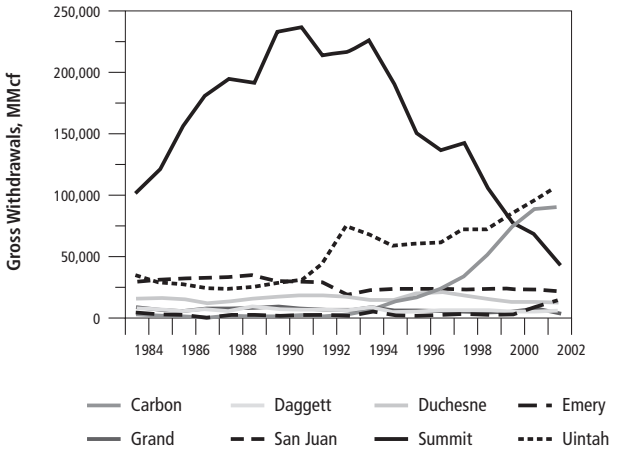
During 2002, 109 operating companies (Table 7) reported gross withdrawals of natural gas to the Utah Division of Oil, Gas, and Mining from 140 oil and gas fields (Table 8). Uintah, Carbon, and Summit counties

Table 9
Utah Natural Gas Production by County, Gross Withdrawals (Mcf)

	Carbon	Daggett	Duchesne	Emery	Garfield	Grand	San Juan	Sanpete	Summit	Uintah	State Total
1984	308,527	2,910,970	16,635,636	346,588	0	9,632,308	29,580,534	0	101,189,835	33,845,794	194,450,192
1985	227,256	1,484,501	18,035,067	929,407	0	8,591,848	32,155,722	0	120,121,593	28,721,729	210,267,123
1986	121,290	1,008,820	16,594,450	781,321	0	5,539,544	32,207,130	0	155,561,383	27,445,502	239,259,440
1987	85,838	1,438,279	14,870,376	288,559	0	8,401,603	33,086,001	0	179,857,177	24,056,594	262,084,427
1988	345,006	2,883,969	15,356,855	504,789	0	7,186,156	34,163,042	0	194,166,958	23,971,638	278,578,413
1989	243,401	2,024,593	15,452,052	640,914	0	9,640,308	33,743,519	0	190,259,804	26,316,449	278,321,040
1990	218,723	1,632,449	19,554,495	750,526	0	9,021,607	31,701,985	0	231,141,130	29,007,555	323,028,470
1991	237,459	1,748,220	20,168,073	1,438,400	0	8,805,702	30,191,636	0	235,626,826	31,248,012	329,464,328
1992	333,704	1,461,753	19,877,439	1,256,481	0	8,222,146	30,038,961	0	213,660,691	42,911,913	317,763,088
1993	1,067,921	1,530,491	17,640,155	1,210,380	0	8,249,625	19,508,219	0	215,551,149	73,518,068	338,276,008
1994	4,932,277	1,854,631	16,750,850	873,199	0	8,523,892	22,493,251	0	225,435,809	67,275,895	348,139,804
1995	12,379,993	1,018,292	17,582,965	703,166	0	6,404,169	24,088,983	0	189,373,184	57,146,159	308,696,911
1996	17,124,314	1,415,327	19,332,426	778,051	0	7,077,875	25,363,081	0	149,296,517	60,051,360	280,438,951
1997	22,760,216	1,637,463	20,631,221	926,911	0	7,321,799	23,834,821	425	134,841,492	60,599,426	272,553,774
1998	31,903,361	1,293,202	19,204,848	1,345,422	2,300	6,392,678	24,977,524	0	141,757,578	70,621,273	297,498,186
1999	50,175,216	1,405,755	15,352,521	2,317,596	9,123	6,309,417	24,782,925	0	104,949,508	72,154,481	277,456,542
2000	72,586,077	1,955,920	13,924,567	4,042,810	6,875	5,284,844	23,977,443	0	76,284,083	83,053,924	281,116,543
2001	86,531,650	1,159,278	13,878,803	7,736,759	9,125	5,600,283	24,264,486	100	67,999,791	95,317,359	302,497,634
2002	90,701,081	1,250,965	12,519,753	13,878,399	6,050	5,538,588	21,428,813	0	43,567,222	104,231,639	293,122,510
% of State Total, 2002	30.9	0.4	4.3	4.7	0.0	1.9	7.3	0.0	14.9	35.6	100.0

Source: Utah Division of Oil, Gas, and Mining, Utah Department of Natural Resources.

Figure 6
Utah Natural Gas Production by County



Source: Utah Division of Oil, Gas and Mining

dominate natural gas production in Utah, accounting for 81.4 percent of 2002 production (Table 9). Summit County's natural gas production has dropped dramatically in the past several years as a result of aging fields in the Overthrust Belt (Figure 6). Gross withdrawals from the Anschutz Ranch East field, the largest producing field in Summit County, peaked at 231.4 Bcf in 1991, and declined to 38.0 Bcf in 2002. While Summit County production has dropped dramatically in the past several years, this has had little effect on the amount of gas actually marketed. Most of the gross withdrawals from Summit County during the late 1980s and early 1990s was used for repressuring oil and gas wells to maintain production. From 1984 through 1991, over 50 percent of gross withdrawals in Utah was used for repressuring. As recently as 1995, nearly 8.9 percent of gross withdrawals in Utah was used for repressuring. Currently, repressuring accounts for only about 0.2 percent of gross withdrawals in Utah.

Gross withdrawals of natural gas are currently relatively stable or slightly declining in Daggett, Duchesne, Grand, and San Juan counties while increasing in Uintah and Carbon counties, and to a lesser, but still notable, extent in Emery County.

The sizable increase in production from Carbon and Emery counties is due to development of the coalbed methane industry. This methane is adsorbed, or accumulated onto the surfaces in coal deposits and held there with water pressure. To release the methane from the coal surface, the water must be pumped from the coal deposit, which allows the methane to desorb from the coal. Therefore, coalbed methane wells initially produce large amounts of water before significant quantities of gas are produced. By contrast, conventional gas wells produce large amounts of gas when first drilled and water production increases as gas production drops. Coalbed methane wells are usually not as deep as conventional gas wells and therefore generally cheaper to drill. The production of coalbed methane has increased dramatically in Utah in recent years, rising from 1.3 percent of wellhead gas production in 1994 to 34.8 percent in 2002. Current estimates indicate there are 1,685 Bcf of proved coalbed methane reserves in Utah. Several exploration projects by different companies are examining other coal fields throughout Utah for coalbed methane potential.

As with natural gas produced in other parts of the country, some naturally occurring components of natural gas produced in Utah must be removed before the gas is delivered to consumers. There are 14 gas processing plants in Utah with a total capacity of 531 MMcf per day. Duchesne, San Juan, and Summit counties each have three gas processing plants, two each are located in Grand and Uintah counties, and one is located in Carbon County. Additionally, much of the natural gas produced

Table 10
Utah Natural Gas Production and Disposition (MMcf), 1998-2002

	1998	1999	2000	2001	2002
Number of Producing Gas Wells	1,643	1,978	4,178	4,601	na
Gross Withdrawals	297,265	276,967	281,117	301,422	293,025
From Gas Wells	253,761	238,947	244,826	264,809	260,471
From Oil Wells	43,504	38,020	36,290	36,612	32,554
Repressuring	559	519	563	575	431
Nonhydrocarbon Gases Removed	na	na	na	na	na
Vented and Flared	19,365	13,835	1,941	1,847	10,447
Marketed Production (wet)	277,340	262,614	169,285	283,913	282,147
Extraction Loss	11,801	11,407	12,795	11,379	na
Dry Production	265,539	251,207	256,490	272,534	na
Wellhead Price ($ per Mcf)	1.73	1.93	3.28	3.52	na

Source: Energy Information Administration, U.S. Department of Energy.

Table 11
Natural Gas Consumption in Utah (MMcf), 1998-2002

	1998	1999	2000	2001	2002
Total Consumption	169,776	159,889	164,557	159,258	na
Lease and Plant Fuel	27,466	23,810	24,670	20,014	na
Pipeline Fuel	2,788	2,561	2,674	4,161	na
Delivered to Consumers	139,522	133,518	137,213	134,650	132,538
Residential	56,843	55,474	55,626	55,008	58,895
Commercial	30,955	30,361	31,282	30,917	33,894
Industrial	45,501	40,859	39,378	33,585	26,888
Vehicle	278	347	382	433	na
Electric Power	5,945	6,478	10,544	15,141	12,861

Source: Energy Information Administration, U.S. Department of Energy.

in Summit County is treated at a gas plant in Uinta County, Wyoming. Overall, about 90 percent of gross withdrawals of natural gas in Utah is marketed as dry gas (Table 10). Components of the wellhead gas extracted at the gas plants account for most of the gross withdrawals that are not marketed. Lesser amounts are accounted for by gas vented and flared and gas used for repressuring.

Like the country as a whole, use of natural gas in Utah peaks during the winter months. Since natural gas production is relatively constant throughout the year, excess production during the summer months is stored for use during peak use months. Questar Pipeline operates four underground storage facilities with a total working gas capacity of 53.0 Bcf. The largest of these is the Clay Basin reservoir, developed in a depleted gas field in eastern Daggett County. The Clay Basin facility opened in 1976 and has a working gas capacity of 51.25 Bcf. About 25 percent of the capacity at Clay Basin is subscribed by Questar Gas, other large users of storage at Clay Basin are Williams Pipeline, Puget Sound Energy, and Duke Energy Trading and Marketing. The other three storage facilities operated by Questar Pipeline, all developed in natural aquifers, are the Coalville (256 MMcf) and Chalk Creek (692 MMcf) reservoirs in Summit County and the Leroy (836 MMcf) reservoir in Uinta County, Wyoming. Each of these smaller gas storage reservoirs was developed specifically to serve Questar Gas, which contracts for 100 percent of capacity and is used primarily to supplement Questar Gas supply on peak-demand days.

Residential use is the largest consumer of natural gas in Utah (Table 11), accounting for 44.4 percent of a total of 132,538 MMcf delivered to consumers in 2002 and has been relatively stable over the past several years. Commercial use of natural gas in Utah has also been stable, with an increase of about 10 percent in 2002. Industrial usage has dropped dramatically while use of gas for electric power generation has more than doubled since 1998. Industrial use of natural gas in Utah dropped by 26 percent from 1998 to 2002, reflecting the economic recession and closure of Geneva Steel, a large industrial consumer. Natural gas consumption for electric power generation increased by 116 percent from 1998 to 2002 as an additional 485.1 megawatts of gas-fired electric generating capacity was added in Utah from 2000 to 2002, a response to the 2001 electric power crisis in the Western U.S.

Table 12
Operating Natural Gas Utilities in Utah

	Customers	Annual Deliveries (Mcf)
Blanding	793	53,595
Eagle Mountain	1,958	na
Hildale	86	21,000
Levan	266	43,000
Mona	327	34,000
Navajo Tribal Utilities Authority	121	11,646
Nephi	1,615	250,000
Questar Gas	707,825	85,813,685
Santaquin	480	97,176

Source: Energy Information Administration and city utilities.

Natural Gas Utilities in Utah

Questar Gas Company, an operating subsidiary of Questar Corporation, is by far the largest of the nine natural gas utilities in Utah. Questar Gas owns over 700 producing gas wells in Wyoming, Utah, and Colorado that in 2002 supplied about 45 percent of the company's gas sales. The remainder was purchased by Questar Gas on the open market. Questar has contracts with suppliers located in Wyoming, Colorado, and Utah. Questar is unique in that most regulated gas distribution companies do not own their gas resources. Questar serves about 750,000 customers in Utah, southwestern Wyoming, and southeastern Idaho. About 96 percent of Questar Gas customers are in Utah, where in addition to the Wasatch Front, major cities served are Cedar City, Fillmore, Logan,

Table 13
Fiscal Impact of Natural Gas Production in Utah, 1994-2003

	Federal Royalties[1] (dollars)	Indian Land Royalties[1] (dollars)	State Trust Lands Royalties (dollars)	State Oil & Gas Severance Tax (dollars)
1994	15,140,654	2,713,473	2,084,076	12,756,037
1995	4,062,395	1,549,413	2,756,500	12,984,375
1996	8,438,482	2,166,492	5,043,760	12,069,036
1997	14,462,794	2,876,084	6,223,594	17,217,291
1998	15,358,950	2,378,534	5,345,752	13,988,964
1999	16,627,086	2,150,398	7,751,532	7,942,551
2000	24,743,892	4,869,970	16,358,501	17,312,540
2001	51,160,389	9,400,733	39,782,809	39,357,798
2002	na	na	17,743,242	18,893,082
2003 [2]	48,179,301	7,243,396	26,688,904	na

[1]Includes royalties on natural gas liquids.

[2]Federal and Indian Land Royalties are preliminary.

Note: Fiscal year.

Source: Minerals Management Service, U.S. Department of the Interior, Utah State Tax Commission, Utah State School and Institutional Trust Lands Administration.

Moab, Monticello, Price, Richfield, Roosevelt, St. George, and Vernal. Communities served by Questar Gas in Wyoming (3.2 percent of total customers) include Diamondville, Evanston, Green River, Kemmerer, and Rock Springs. In Idaho, Questar Gas serves Preston, which accounts for 0.2 percent of the company's customers. Questar Gas is regulated by the Public Service Commission of Utah, the Public Service Commission of Wyoming and the Public Utilities Commission of Idaho, although a special contract between the Public Utilities Commission of Idaho and the Public Service Commission of Utah allows rates for Questar Gas customers in Idaho to be set by the Public Service Commission of Utah.

In addition to Questar Gas, seven municipalities and the Navajo Tribal Utilities Authority operate natural gas distribution systems in Utah (Table 12). The municipalities in Utah that operate their own natural gas distribution systems purchase gas from various suppliers and pay the appropriate pipeline company to transport the gas to the city. Nephi, Levan, and Mona have formed the Juab Rural Development Agency under the Utah Interlocal Cooperation Act to procure natural gas on behalf of the three cities. The other four cities, Blanding, Hildale, Eagle Mountain, and Santaquin all act independently in procuring natural gas and often use the service of outside consultants.

Fiscal Impact

Natural gas production in Utah has a fiscal impact on the state in several ways. In addition to the income and sales taxes paid by all businesses, royalties are paid on production from both federal land and state School and Institutional Trust Lands. In addition, there is an oil and gas severance tax on all production, regardless of land owner.

Gas extraction on federal lands is governed by the Mineral Leasing Act of 1920. Under this act, rights to extract natural gas are granted under a competitive bid system. In addition to the amount of the winning bid, referred to as a cash bonus by the federal government, annual rent payments on mineral leases are due until production starts. After production is initiated, royalties of about 10 percent to 12 percent of the value of production are due monthly. Royalty payments are made to the Minerals Management Service, an agency with the U.S. Department of Interior. One-half of federal mineral royalties paid are returned to the state of origin. Of the 50 percent retained by the federal government, 40 percent is placed in the Reclamation Fund administered by the Bureau of Reclamation for water and electric power projects, primarily in the western portion of the country. The remaining 10 percent is placed in the General Fund of the Treasury. The Minerals Management Service also collects royalties for natural gas production on American Indian lands, except payments to four tribes—the Jicarilla Apache, the Blackfeet, the Navajo, and the Southern Ute—are made directly by the lease payor to financial institutions contracted by the tribes to receive their mineral payments.

Table 14
Distribution of Federal Mineral Royalties in Utah

	Percent
Permanent Community Impact Fund	32.50
State Board of Education	2.25
Utah Geological Survey	2.25
Water Research Laboratory	2.25
Department of Transportation	40.00
Department of Community and Economic Development	5.00
Payments in lieu of taxes	52 cents/acre[1]
Permanent Community Impact Fund	Remaining funds

[1]Altered annually according to the Consumer Price Index.
Source: Utah State Code, Title 59, Chapter 21, Paragraph 2

For the federal 2001 fiscal year, a total of $5.37 billion in royalties was paid to the federal government for natural gas production. A majority of this (74.0%) was for offshore natural gas production, followed by onshore production (22.1%), and American Indian lands (3.9%).

Just over $51 million in royalties was paid to the federal government for natural gas and natural gas liquids produced in Utah during the federal 2001 fiscal year (Table 13). Therefore, about $25.5 million was returned to Utah. States have full discretion as to distribution of federal mineral royalties, as long as priority is given to areas with social and/or economic impacts as a result of mineral lease activity. The state of Utah distributes federal mineral funds to several different accounts (Table 14). The funds appropriated to the Department of Transportation are distributed to counties and special service districts, primarily to address road maintenance concerns as a result of natural resource development. The payments-in-lieu-of-taxes are made to county governments for State and Institutional Trust Lands, lands owned by the Division of Parks and Recreation, and lands owned by the Division of Wildlife Resources.

During 2001, a total of $9.4 million in royalties was paid for natural gas production on the Utah portion of the Navajo Indian reservation in San Juan County and the Uintah and Ouray Reservation in Duchesne and Uintah counties. Royalties for production on the Navajo reservation are deposited by the producing companies directly in financial institutions contracted by the Navajo Nation to receive the payments. Royalties for production on the Uintah and Ouray Reservation are paid to the Minerals Management Service, which then transfers the payment to the Office of Trust Fund Management in the Bureau of Indian Affairs.

The State School and Institutional Trust Lands Administration receives royalties on minerals, including natural gas, produced on state trust lands. The Drunkard's Wash gas field, the largest producing field in the state, is primarily located on state trust lands and has had a large impact on the royalties. In the early 1990s, about $2 million annually was being paid to the State School and Institutional Trust Lands Administration for natural gas royalties. With the development of the coalbed methane industry in Carbon and Emery counties, the royalties for natural gas production on School and Institutional Trust Lands rose to $39.8 million in 2001, before dropping with declining natural gas prices to $26.7 million in 2003. Natural gas royalties provide about 35 percent of the operating revenue for the School and Institutional Trust Lands Administration.

In addition to royalties paid on production from public lands, the state of Utah charges a severance tax, deposited in the general fund, on all oil and gas extracted in the state. For the state's 2002 fiscal year, the oil and gas severance tax provided 1.2 percent of general fund revenue. The severance tax rate is 3 percent of the value up to and including the first $13 per barrel for oil and $1.50 per thousand cubic feet (Mcf) for gas; and 5 percent of the value above these prices. There is also a 4 percent severance tax on natural gas liquids. Declining natural gas prices resulted in the total oil and gas severance tax dropping from $38.4 million in 2001 to $18.9 million in 2002. It is estimated that approximately two-thirds of the oil and gas severance tax is due to natural gas production.

Summary

The natural gas industry in Utah is becoming more integrated with that of the nation as a whole. The Rocky Mountain states are an increasingly important component of the nation's natural gas supply and the interstate pipeline system is rapidly being expanded to market gas

produced in the Rocky Mountains to the remainder of the country. Utah residents currently receive about a 25 percent discount from nationwide prices, however as Utah's natural gas resources become available to wider markets, the price advantage traditionally enjoyed by Utah residents will subside.

Utah's natural gas supply originates in Utah, Colorado, and Wyoming, with common-carrier interstate pipelines transporting the gas to Utah. Over 100 operating companies extract natural gas in Utah from fields in nine counties. The presence of the Kern River Pipeline from Wyoming, through Utah and Nevada, to Southern California and the Northwest Pipeline from the producing areas in Colorado, Utah, and Wyoming to the northwest result in Utah being a net exporter of natural gas.

Natural gas production has a fiscal impact on Utah through royalties for production on federal land, one-half of which are returned to Utah, royalties for production on State School and Institutional Trust Lands, and severance taxes. For the federal fiscal year 2003, $48,179,301 in royalties were paid for natural gas production from federal lands in Utah. For the state fiscal year 2003, royalties of $26,688,904 were paid to the State School and Institutional Trust Lands Administration for natural gas production from state lands.

References

Budzik, P. U.S. Natural Gas Markets: Relationships Between Henry Hub Spot Prices and U.S. Wellhead Prices. Energy Information Administration. July 2002.

Energy Information Administration. Natural Gas Navigator Information System. http://tonto.eia.doe.gov/dnav/ng/ng_cons_top.asp

Energy Information Administration. Expansion and Change on the U.S. Natural Gas Pipeline Network - 2002. Energy Information Administration, Office of Oil and Gas. May, 2003. 18 pp.

Eppink, J., W. Hochheiser, R. L. Watson, and D. Crandell. Federal Lands in the U.S. Rockies: Is the Glass 40% Empty or 60% Full? Oil and Gas Journal. June 23, 2003. pp. 48 - 53.

Hammer, G., A. Commichau, et. al. Natural Gas. Chapter is Ullman's Encyclopedia of Industrial Chemistry. Fifth edition. Volume A17. Ed. by B. Elvers, S. Hawkins, and G. Schulz. pp. 73- 124.

Inside FERC. Platts. September 29, 2003. pp. 6-8.

Natural Gas Supply and Demand Issues. Testimony of Chairman Alan Greenspan before the Committee on Energy and Commerce, U.S. House of Representatives, June 10, 2003.

Natural Gas Supply. Testimony of Chairman Alan Greenspan before the Committee on Energy and Natural Resources, U.S. Senate, July 10, 2003.

Questar Pipeline Company. SEC Form 10-K. March 31, 2003.

Questar Gas Company. SEC Form 10-K. March 31, 2003.

Sauter, L. J. Jr. Federal Energy Regulatory Commission Memorandum El Paso/Colorado Interstate Gas' Ruby Pipeline Project Docket No. PF03-7. August 19, 2003.

Schlesinger, B. Winds of Change Roiling U.S. and World Gas Markets. Platts Energy Business & Technology. Sept. 2003. pp. 43-45.

Tabet, D. E., and J. C. Quick. Frontier Areas for Coalbed-Gas Exploration in Utah. Survey Notes. Utah Geological Survey. Vol. 35, No. 2. April, 2003. pp. 10-11.

Takahashi, K. I. ed. U.S. Geological Survey Coalbed Methane Field Conference. May 9-10, 2001. U.S.G.S. Open-file report 01-234 CD Version 1.0. 2001.

True, W. R., Worldwide Gas Processing: Rest of World Continues to Gain Ground on Canada, U.S.. Oil and Gas Journal. June 30, 2003. pp. 52 - 57.

U.S. Geological Survey Uintah-Piceance Assessment Team. Petroleum Systems and Geologic Assessment of Oil and Gas in the Uintah-Piceance Province, Utah and Colorado. U.S.G.S. Digital Data Series DDS-69-B, Version 1.0, 2003.

Woodcock, K. E., and M. Gottlieb. Gas, Natural. Chapter in Kirk-Othmer Encyclopedia of Chemical Technology. Fourth edition. Volume 12. Ed. by J. I Kroschwitz and M. Howe-Grant. John Wiley & Sons, 1994. pp. 318-340.

Common Constituents of Wellhead Natural Gas

Methane (CH_4) - Methane is the primary and desired component of natural gas. Wellhead natural gas varies greatly in methane content, depending on the gas field. Most natural gas delivered to final consumers contains in excess of 85 percent methane, with ethane being the most common other component.

Natural Gas Liquids - Natural gas liquids are higher-order hydrocarbons, usually mixtures of ethane (C_2H_6), propane (C_3H_8), and butane (C_4H_{10}). The absence or presence of these higher-order hydrocarbons results in the gas being classified as "dry" or "wet," respectively. These compounds are gaseous at atmospheric pressure, but condense to a liquid state when pressurized in pipelines. Most natural gas liquids are removed at gas processing plants to prevent pipeline condensation and can be marketed as fuel and feedstock to the petrochemical industry. Minor amounts of natural gas liquids can be tolerated in natural gas and raise the heat content of the gas.

Water (H_2O) - Wellhead natural gas is usually saturated with water vapor. The water vapor is removed to prevent condensation in pipelines and reduce corrosion.

Hydrogen Sulfide (H_2S) - Hydrogen sulfide is a highly toxic and corrosive gas. The absence or presence of hydrogen sulfide results in the gas being classified as either "sweet" or "sour." Because of its toxicity, hydrogen sulfide concentrations must be reduced to very low levels before the gas can be sold. The contained sulfur is often recovered as elemental sulfur and sold.

Carbon Dioxide (CO_2) - Carbon dioxide in the presence of water is corrosive; however, it is nontoxic and processing requirements are less rigorous than those for hydrogen sulfide.

Elemental Sulfur (S) - Natural gas that contains hydrogen sulfide also contains elemental sulfur as vapor. Some natural gas, notably that from Alberta, contain such high quantities of sulfur that it can precipitate in production lines and they become blocked. Also, mixtures of elemental sulfur and water are corrosive.

Nitrogen (N_2) - Nitrogen is a fairly inert gas present in varying concentrations in wellhead natural gas. High concentrations of nitrogen are reduced to levels that do not significantly lower the heat content of the natural gas and add to transportation costs.

Helium (He) - Helium is a low-density inert gas used for a variety of industrial purposes. Most helium is produced from gas extracted in the Central Plains States. In Utah, helium is recovered by Tom Brown, Inc., at the company's gas processing plant near Moab.

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