Illinois Mineral Industry 1996–1998

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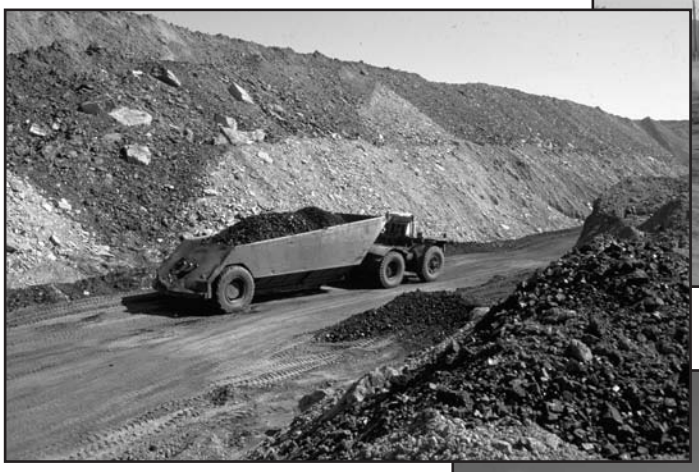

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Cover photos, top to bottom: *Salem Oil Field; coal mining at Arch of Illinois Captain Mine; Thornton Quarry; rock crusher; 85-ton haul truck (photos by Joel Dexter).*

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

ISGS Illinois State Geological Survey

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Abstract

This report provides an overview and analysis of the mineral industry in Illinois from 1996 through1998. Long-term trends are also discussed. Major minerals extracted from the ground, minerals processed, and manufactured mineral products such as cement and lime are discussed (fig.1). This report, the only one of its kind for Illinois, provides the basic information needed to identify problems and trends in the Illinois mineral industry.

Mineral Industry in 1998

The total value of minerals extracted, processed, and manufactured in Illinois in 1998 was $1.95 billion, which is 3.5% lower than the reported values for 1997 and 10.9% less than the 1996 total value (table 1). Extracted minerals accounted for 86.4% of the total value; processed crude minerals and manufactured minerals accounted for the remaining 13.6%. Among the extracted minerals, coal continued to lead in value, followed by construction stone, sand and gravel, and oil (fig. 2).

The minerals processed in the state included ground barite, expanded perlite, sulfur, calcined gypsum, exfoliated vermiculite, iron oxide pigments, slag and fly ash, natural gas liquids, bismuth, iron and steel, and primary and secondary slab zinc. Mineral products manufactured in Illinois, primarily from minerals mined within the state, included cement (portland and masonry), coke, clay products, lime, and glass.

Illinois continues to be a significant contributor to total U.S. production of minerals such as coal, sand and gravel, crushed stone, and industrial sand. In 1998, the state accounted for about 3.6% of the total production of coal in the country (table 2), which is down from 4.4% in 1996. In 1998, Illinois accounted for 4.5% of the nation's production of crushed stone and 3.1% of its construction sand and gravel. The state continues to lead the country in production of industrial sand. Illinois accounted for 17.3% of the nation's production of industrial sand. The production of construction sand and gravel in 1998 was 1.2% greater than in 1997. The production of stone in 1998 was 4% greater than in 1997 and 2.7% more than in 1996.

Employment in mining, quarrying, and oil and gas extraction has been declining (table 3). The number of employees in the mining sector continued to decline, from 12,600 employees in 1996 to 10,900 in 1998, even though total nonagricultural employment went up from 5.67 million in 1996 to 5.95 million in 1998.

Consumption of coal in Illinois accounted for about 4.4% of total U.S. consumption in 1998 (table 4). In 1998, the state's share of petroleum consumption ranged from 0.3% for residual fuel oil to 6% for lubricants.

Extracted Fuel Minerals

Coal

Production In terms of its dollar value, coal is the most important mineral produced in Illinois. The total value of the coal produced in Illinois in 1998 was $908.3 million (table 1), 46.7% of the total value of all minerals produced. Illinois is the seventh largest producer of coal in the nation and, in 1998, accounted for 3.6% of the total U.S. production.

Production remained near 60 million tons per year from 1966 to 1992, except during 1978, 1981, and 1983 (fig. 3), when strikes affected production. Production has shown a declining trend since 1992. The sharp decline (18 million tons) in production in 1993 was due to a workers' strike, but production never rebounded fully as it had after the previous strikes. Considering that 1993 production was affected by labor strikes, Illinois coal production has shown a consistently declining trend since 1990 (table 5, fig. 3).

The factors that are expected to continue to affect Illinois coal production adversely are the low price of low-sulfur western coal, increased competition among electric utilities, the Clean Air Act Amendments (CAAA) of 1990, and the increasing concerns about global warming. The CAAA of 1990 required that electric utilities cut overall sulfur dioxide emissions by 50% by 2000. Compliance required installation of costly scrubbers when high-sulfur Illinois coal was burned or the purchase of a free market device called "pollution credits" that permitted continued higher emissions. These regulations and particularly the comparatively low price of western coal prompted many electric utilities to shift to western coal.

The deregulation of electric utilities is another factor that may adversely affect the demand for Illinois coal. By forcing utilities to reduce their average and marginal costs of electricity production, deregulation may result in utilities using more western coal, further lowering the demand for Illinois coal.

Production from Illinois surface mines has been declining since 1980 as surface-minable deposits have been mined out and land reclamation costs have increased. Underground mines accounted for about 88.7% of the total coal produced in Illinois in 1998 compared with 56% in 1980. Similarly, the proportion of employment in underground mines went up from 71% in 1980 to 88.3% in 1998 (table 5).

In 1998, 14 counties produced coal (table 6, fig. 4) compared with 17 in 1996. In 1998, Saline County was the largest producer, contributing 22.5% of the total. Macoupin County was the second largest producer in 1998 (14.5%), followed by Jefferson County (10.3%). In terms of cumulative production over the period, however, Franklin County ranked first, followed by Perry County (table 7).

During 1998, 19 companies produced coal (table 8, fig. 5) at 15 underground mines and 7 surface mines. The top three producing companies were American Coal Company with one underground mine (13.9%), Consolidation Coal Company (10.3%) with one underground mine, and Peabody Coal (10.3%) with one underground mine.

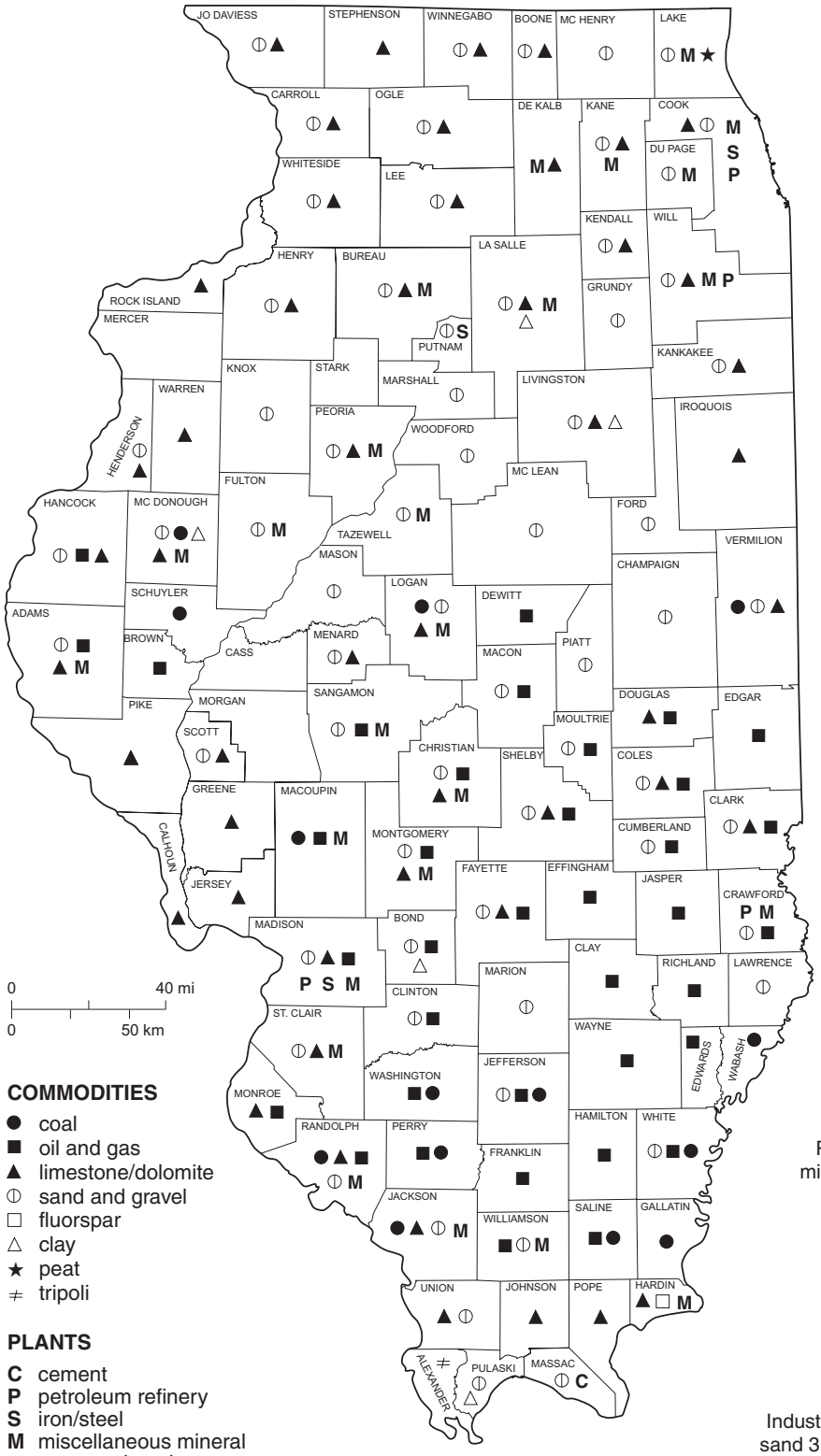

Figure 1 Mineral production and mineral processing plants.

Productivity The productivity of underground coal mines in Illinois is higher than the national average (table 9, fig. 6) and generally has been increasing. The productivity of surface mines in Illinois is much less than the national average (table 9, fig. 7). The high nationwide average productivity of surface mines is largely due to the relatively high productivity of the surface mines in the two western states (Wyoming and Montana) that account for a major share of the total surface-mine production in the country. The productivity of surface mines in the country increased 6.4% from 1980 to 1998, whereas the productivity of surface mines in Illinois grew only 2.43%. Surface-mine productivity in Illinois compares favorably with that in the Indiana, Kentucky, and Appalachian coal fields.

Employment Employment in the coal mining sector in Illinois increased from 9,772 persons in 1960 to an all-time high of 18,499 in 1979, but has generally fallen thereafter, declining to 4,102 persons in 1998 (table 5, fig. 8). Underground mines accounted for 88.3% of the total employment in 1998.

Coal demand Total demand for coal (Illinois mined and non-Illinois coal) in Illinois has generally increased (table 10, fig. 9). From 1992 to 1998, demand by all consumers increased by 5.92% annually. In 1998, electric utilities

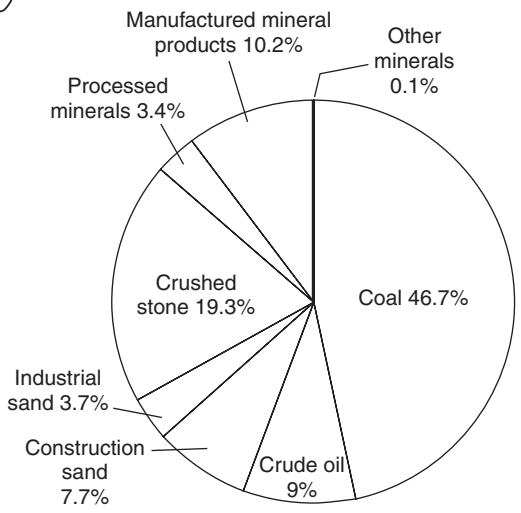

Figure 2 Relative value of minerals extracted, processed, and manufactured, 1998.

accounted for about 85.7% of the total demand in Illinois. Industrial consumers, including coke plants, accounted for the remainder. Although coal consumption by electric utilities is increasing, Illinois coal's share of the total consumed in the state is declining (table 11).

Prices Average mine prices and prices paid by electric utilities have generally decreased in Illinois (table 10) and nationally (table 12). From 1992 to 1998, the average mine prices and the prices paid by electric utilities fell at an average annual rate of 3% and 3.3%, respectively.

Distribution of coal produced in Illinois In 1998, of the total Illinois-mined coal distributed domestically,

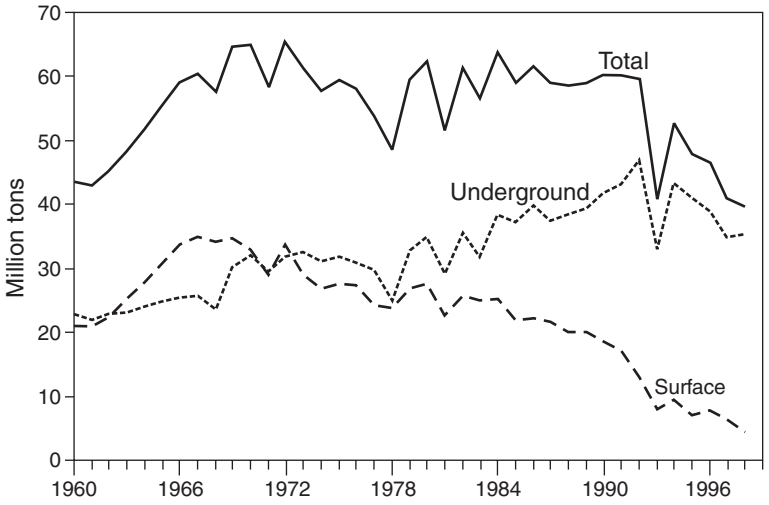

Figure 3 Trends in coal production in Illinois, 1960–1998.

Table 1 Production and value of minerals extracted, processed, and manufactured into products in Illinois, 1996–1998.[1]

	1996		1997		1998	
	Quantity	Value[2]	Quantity	Value	Quantity	Value
Extracted fuel minerals						
Coal (thousand U.S. tons)	46,656	1,060,957	41,159	882,449	39,732	908,274
Crude oil (thousand barrels)	15,575	277,235	16,030	306,333	13,732	175,495
Natural gas (million cu ft)	298	844	231	619	209	474
Subtotal a		1,339,036		1,189,401		1,084,243
Extracted nonfuel minerals						
Clay,[3] common (thousand tonnes)[4]	155	736	100	533	102	544
Fuller's earth	330	W[5]	330	W	W	W
Gemstones	NA	890		8		8
Sand and gravel						
Construction (thousand tonnes)	34,600	144,000	33,400	143,000	33,800	149,000
Industrial sand (thousand tonnes)	4,460	66,400	4,610	67,900	4,870	71,500
Stone (limestone and dolomite)						
Crushed and broken (thousand tonnes)	66,500	364,000	65,700	357,000	68,300	376,000
Subtotal b		576,026		568,441		597,052
Total value of minerals extracted (a + b)		1,915,062		1,757,842		1,681,295
Processed minerals						
Sulfur	NA	NA	NA	NA	NA	NA
Combined value of barite, cement, copper, fluorspar, lead, lime, peat, silver, stone, tripoli, and others	89,100		73,600			67,100
Subtotal c	89,100		73,600			67,100
Minerals manufactured into products						
Cement, portland (thousand tonnes)	2,620	181,000	2,590	186,000	2,690	198,000
Subtotal d		181,000		186,000		198,000
Total value (a + b + c + d)		2,185,162		2,017,442		1,946,395

[1] Sources: Energy Information Agency's Coal Industry Annual (1997, 1998), Natural Gas Annual (1997, 1998), and Petroleum Supply Annual (1997, 1998); U.S. Geological Survey, Mineral Industry Surveys (1997, 1998a,b,d,f,g).
[2] Values are reported as thousands of dollars.
[3] Excluding absorbent clay.
[4] One metric tonne equals 1.023 U.S. tons.
[5] W, withheld to avoid disclosure of individual company data; NA, not available.

Table 2 Production of minerals in Illinois compared with U.S. mineral production, 1996–1998.[1]

Commodity	Illinois		United States		% share of Illinois	
	Quantity	Value[2]	Quantity	Value	Quantity	Value
1996						
Coal (million tons)	46.7	1,061.0	1,064	19,681	4.4	5.4
Crude oil (million barrels)	15.6	277.2	2,366	43,677	0.7	0.6
Natural gas (million cu ft)	298.0	0.9	24,113,536	52,326	NS[3]	NS
Clays (thousand tons)	792.0	0.6	43,100	1,577	1.8	NS
Sand and gravel						
Construction (million tons)	35.4	142.0	914	4,003	3.9	3.5
Industrial sand (million tons)	4.4	62.6	28	495	15.7	12.7
Stone (excluding dimension; million tons)	66.6	364.0	1,330	7,182	5.0	5.1
Cement, portland (million tons)	2.5	168.0	79	5,905	3.2	2.8
1997						
Coal (million tons)	41.2	882.4	1,090	19,771.4	3.8	4.5
Crude oil (million barrels)	16.0	306.3	2,362	40,697	0.7	0.8
Natural gas (million cu ft)	231.0	0.6	24,212,677	56,173	NS	NS
Sand and gravel						
Construction (million tons)	33.4	143.0	952	4,260	3.5	3.4
Industrial sand (million tons)	4.6	67.9	28	518	16.1	13.1
Stone (excluding dimension; million tons)	65.7	357.0	1,420	8,050	4.6	4.4
Cement, portland (million tons)	2.6	186.0	79	5,710	3.3	3.3
1998						
Coal (million tons)	39.7	908.3	1,118	19,747	3.6	4.6
Crude oil (million barrels)	13.7	175.5	2,282	24,804	0.6	0.7
Natural gas (million cu ft)	209.0	0.5	24,108,128	47,252	NS	NS
Sand and gravel						
Construction (million tons)	33.8	149.0	1,080	4,920	3.1	3.0
Industrial sand (million tons)	4.9	71.5	28	513	17.3	13.9
Stone (excluding dimension; million tons)	68.3	376.0	1,510	8,130	4.5	4.6
Cement, portland (million tons)	2.7	198.0	80	6,030	3.4	3.3

[1] Source: Energy Information Agency's Coal Industry Annual (1997, 1998), Petroleum Supply Annual (1996, 1997, 1998), and Natural Gas Annual (1996, 1997, 1998); U.S. Geological Survey, Mineral Industry Surveys (1996, 1997, 1998a–f); and Illinois State Geological Survey (unpublished).
[2] Values are in million dollars.
[3] NS, not significant (P<0.05).

only 42.2% was used for consumption within Illinois. About 0.31 million tons (0.8% of the total) was exported to foreign countries.

Coal produced in Illinois is distributed to six major geographical regions: East North Central, West North Central, South Atlantic, East South Central, West South Central, and the Mountain regions (table 13). The East North Central region, consisting of Illinois, Indiana, Michigan, Ohio, and Wisconsin, received the major share of the coal mined in Illinois: 55.3% in 1998. The major destinations for Illinois coal for use in electricity generation are Illinois, Florida, Indiana, Tennessee, and Missouri, (table 14, fig. 10). Consumption of Illinois coal by electric utilities in Georgia, Indiana, and Kansas has in general been decreasing over the last few years. In Illinois, consumption has stayed slightly below 1991 levels and, in Missouri, has remained unchanged (table 14).

Consumption of coal in Illinois Electric utilities are the major consumers of coal in Illinois. In 1998, electric utilities accounted for 85.7% of the total consumption. The share of Illinois coal in the total coal used by electric utilities in the state is declining and fell from about 59% in 1991 to about 35% in 1998. At the same time, the share of Wyoming coal in the total quantity of coal consumed by electric utilities in Illinois has increased significantly from 13.4% in 1991 to 51.2% in 1998 (table 15).

Cost and quality of Illinois coal The quality of coal used for electricity generation and other industrial purposes is judged in terms of its sulfur, ash, and energy contents. Both the price per unit and price per million

Table 3 Employment and wages in the Illinois mineral industry, 1996–1998.[1]

Sector	1996 Employees (×1,000)	1996 Avg. earnings ($/wk)	1996 Avg. worked (hr/wk)	1996 Avg. wage ($/hr)	1997 Employees (×1,000)	1997 Avg. earnings ($/wk)	1997 Avg. worked (hr/wk)	1997 Avg. wage ($/hr)	1998 Employees (×1,000)	1998 Avg. earnings ($/wk)	1998 Avg. worked (hr/wk)	1998 Avg. wage ($/hr)
Mining	12.6	706.44	42	16.82	11.8	728.83	41.6	17.52	10.9	743.15	40.9	18.17
Masonry, stonework	16.7	791.48	37.6	21.05	17.7	823.44	37.6	21.9	19	857.3	37.7	22.74
Stone, clay, glass	21.3	564.48	42	13.44	21.6	571.2	42.5	13.44	21.8	561.46	41.9	13.4
Primary metal industries	45.8	634.1	42.7	14.85	45.5	668.3	44.2	15.12	45.3	675.17	44.1	15.31
Blast furnaces	20.5	697.31	43.5	16.03	20.5	739.5	44.9	16.6	19.9	750.07	44.7	16.78
Iron and steel foundries	6.4	650.16	43	15.12	5.9	634.25	43	14.75	6	629.45	43.5	14.47
Petroleum and coal products	10.1	752.24	41.4	18.17	9.9	777.25	41.9	18.55	9.7	827.28	43.2	19.15
Gas production and distribution	7.4	751.96	44.6	16.86	6.8	780.86	44.8	17.43	6.5	803.6	44.3	18.14
Total nonagricultural	5,676				5,772.6				5,898.5			
Goods producing	1,205.3				1,220.7				1,225.6			
Service producing	4,470.7				4,552				4,672.9			

[1] Employment figures are rounded to the nearest hundred. Source: Bureau of Labor Statistics, U.S. Department of Labor (1996–1998), Monthly Report on Employment, Hours and Earnings.

Table 4 Consumption of fuel and nonfuel minerals in Illinois compared with U.S. consumption, 1996–1998.[1, 2]

Consumption	1996 Illinois	1996 U.S.	1996 Illinois share (%)	1997 Illinois	1997 U.S.	1997 Illinois share (%)	1998 Illinois	1998 U.S.	1998 Illinois share (%)
Fuel minerals									
Coal (million tons)	44.43	983	4.52	47.62	1,008	4.72	44.6	1,012	4.41
Petroleum									
Asphalt and road oil (million barrels)	9.13	177	5.16	8.35	184	4.54	9.96	190	5.24
Aviation gasoline (million barrels)	0.20	7	2.89	0.20	8	2.46	0.168	7	2.4
Distillate fuel oils (million barrels)	37.93	1,232	3.08	39.19	1,254	3.12	41.426	1,263	3.28
Jet fuel (million barrels)	12.08	578	2.09	12.50	583	2.14	13.152	592	2.22
Kerosene (million barrels)	0.40	23	1.73	0.37	24	1.53	0.349	28	1.25
LPG[2] and ethane (million barrels)	23.92	736	3.25	24.17	744	3.25	15.783	713	2.21
Lubricants (million barrels	3.29	55	5.99	3.48	58	6.00	3.641	61	5.97
Motor gasoline (million barrels)	111.55	2,888	3.86	113.34	2,926	3.87	113.707	3,012	3.78
Residual fuel oil (million barrels)	2.01	311	0.65	1.45	291	0.50	1.065	324	0.33
Other (million barrels)	37.66	695	5.42	39.12	724	5.40	29.66	714	4.15
Total (million barrels)	238.16	6,701	3.55	242.15	6,796	3.56	228.809	6,905	3.31
Natural gas (trillion cu ft)	1.12	21.97	5.09	1.08	22	4.90	0.958	21.27	94.5
Nonfuel minerals									
Crushed stone (million tons)	66.50	1,338	4.97	65.7	1,418	4.63	72.1	1,520	4.74
Limestone (million tons)	57.70	868.9	6.64	56.9	909	6.26	55.6	952	5.84
Dolomite (million tons)	8.80	86	10.23	8.85	101	8.76	16.5	105	15.71
Sand and gravel, construction (million tons)	34.60	914	3.79	33.4	952	3.51	33.8	1,070	3.16
Cement (million tons)	3.48	90.36	3.85	3.52	96	3.67	3.644	103.45	3.52

[1] Source: Energy Information Agency, State Energy Data Report (1996, 1998), consumption estimates; U.S. Geological Survey, Mineral Industry Surveys (annual estimates).

[2] Liquid propane gas.

Table 5 Number of mines, employment, and production in the coal sector in Illinois, 1960–1998.[1]

	All mines			Surface mines			Underground mines		
Year	Mines (no.)	Employment (no.)	Production (million tons)	Mines (no.)	Employment (no.)	Production (million tons)	Mines (no.)	Employment (no.)	Production (million tons)
1960	78	9,772	43.70	40	3,168	20.95	38	6,604	22.76
1961	67	8,252	42.83	36	3,114	21.00	31	5,138	21.83
1962	62	7,892	45.26	37	2,984	22.48	27	4,908	22.78
1963	67	8,002	48.38	42	3,089	25.19	25	4,913	23.18
1964	68	8,225	51.89	40	3,091	27.86	28	5,134	24.02
1965	63	8,135	55.45	39	3,053	30.71	24	5,082	24.74
1966	56	8,298	59.26	35	3,143	33.73	21	5,155	25.54
1967	52	8,054	60.49	32	3,129	34.79	20	4,925	25.69
1968	48	8,547	57.67	25	3,173	34.14	23	5,374	23.53
1969	62	9,591	64.83	34	3,647	34.66	48	5,944	30.17
1970	59	9,272	65.12	31	3,220	33.03	28	6,057	32.09
1971	63	10,571	58.42	36	3,483	28.96	27	7,088	29.45
1972	59	11,237	65.52	33	3,367	33.81	26	7,870	31.72
1973	56	11,409	61.55	32	3,615	28.97	24	7,794	32.58
1974	55	12,467	58.07	32	3,749	26.97	23	8,718	31.10
1975	58	12,850	59.54	37	3,840	27.66	21	9,010	31.88
1976	62	14,731	58.14	39	4,335	27.22	23	10,396	30.91
1977	70	16,114	53.88	45	4,739	24.29	25	11,375	29.59
1978	71	17,861	48.74	43	5,241	23.85	28	12,620	24.89
1979	71	18,499	59.54	40	5,299	26.86	31	13,200	32.68
1980	66	17,735	62.54	35	5,125	27.57	31	12,610	34.97
1981	58	18,418	51.80	27	4,797	22.56	31	13,351	29.24
1982	61	14,950	61.43	28	4,396	25.74	33	10,554	35.68
1983	55	15,825	56.85	23	4,315	25.01	32	11,510	31.84
1984	55	13,339	63.77	22	3,545	25.27	33	9,794	38.50
1985	54	13,858	59.20	20	3,509	21.86	34	10,349	37.34
1986	53	13,003	61.87	21	3,450	22.15	32	9,553	39.72
1987	51	12,171	59.16	22	3,239	21.63	29	8,932	37.52
1988	48	10,022	58.59	20	2,582	20.07	28	7,440	38.52
1989	48	10,003	59.27	18	1,919	19.93	30	8,084	39.34
1990	45	10,018	60.39	17	2,611	18.72	28	7,407	41.67
1991	51	9,102	60.26	15	2,046	17.12	29	7,056	43.13
1992	43	8,323	59.86	12	1,543	12.89	27	6,780	46.96
1993	39	7,303	41.10	12	1,107	8.00	25	6,196	33.10
1994	34	6,591	52.80	11	996	9.52	23	5,595	43.28
1995	31	5,652	48.18	11	872	7.06	20	4,780	41.12
1996	31	5,174	46.66	11	918	7.71	20	4,256	38.95
1997	28	4,612	41.16	9	568	6.33	19	4,044	34.82
1998	24	4,102	39.73	8	478	4.48	16	3,624	35.25

[1] Source: Energy Information Agency, Coal Industry Annual (1997, 1998).

BTU (British thermal units) of Illinois coal are greater than the corresponding prices for Wyoming coal (table 16).

Although Illinois coal has a higher heat content, it is inferior because of its higher sulfur and ash contents. This difference is a significant disadvantage relative to western coals in the context of the environmental regulations facing the utility industry. This disadvantage is exacerbated by the higher average price of Illinois coal.

Crude Oil

Production Illinois is a not major oil producer at this time. During 1998, crude oil accounted for only 9% of the total value of minerals produced in the state. Production fell by 14.3% from 16 million barrels in 1997 to 13.7 million barrels in 1998 (table 1) and has been decreasing since 1985 (see fig. 11). The unit value of crude oil in 1998 was $12.8 per barrel, a 33% decrease from 1997.

Crude oil production reached a peak of 147.6 million barrels in 1940 (fig. 12). Since then, oil produced by primary recovery methods declined rather steadily until 1979, although some years showed small gains. Introduction of the hydraulic rock-fracturing method in 1954 and the increased use of water flooding for secondary recovery stabilized oil production at about 78 million barrels per year from 1955 to 1962. Since 1962, production has

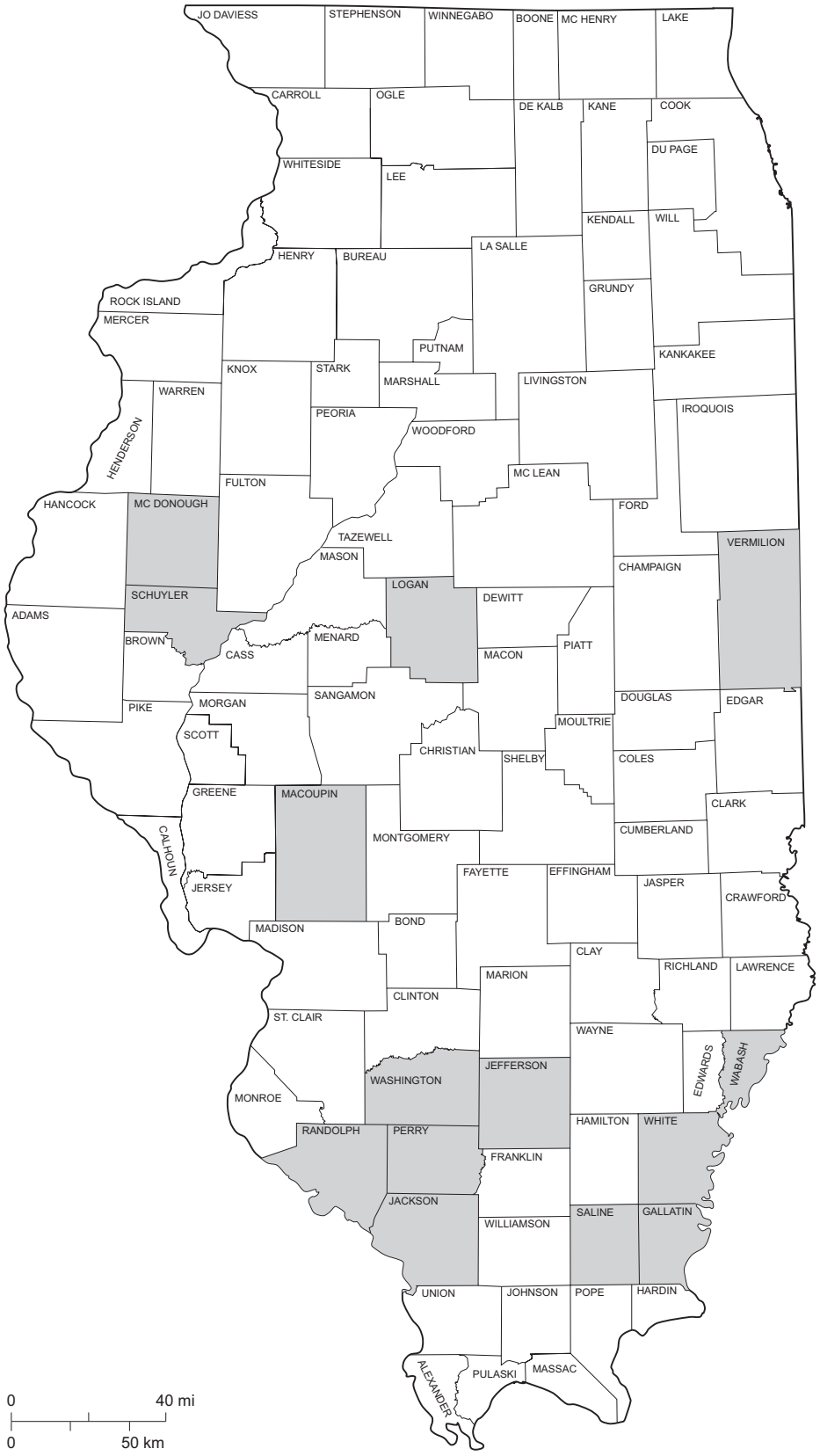

Figure 4 Illinois counties producing coal in 1998.

Table 6 Number of mines and production of coal in Illinois counties, 1993–1998.[1]

	1996				1997				1998			
		Production[2]				Production				Production		
County	Mines (no.)	Underground	Surface	Total	Mines (no.)	Underground	Surface	Total	Mines (no.)	Underground	Surface	Total
Clinton	1	1,701		1,701								
Franklin	2	3,635		3,635								
Fulton	1	205	205									
Gallatin	2	1,324	673	1,997	1	1,563		1,563	2	1,911	903	2,815
Jackson					1		139	139	2		474	474
Jefferson	2	4,299		4,299	2	4,336		4,337	1	4,097		4,097
Logan	1	1,982		1,982	1	2,059		2,059	1	2,372		2,372
Macoupin	3	5,454		5,454	3	6,478		6,478	3	5,775		5,775
Mc Donough	1		533	533	1		596	596	1	495	495	
Perry	3	1,850	5,213	7,064	3	2,017	4,087	6,104	2	2,334	1,242	3,476
Randolph	1	2,090		2,090	2	3,006		3,024	1	2,388		2,388
Saline	3	8,549		8,549	4	7,294	986	8,305	4	8,062	881	8,942
Schuyler	1		417	417	1		461	461	1	410	410	
Vermillion	1	123		123	1	635		635	1	795		795
Wabash	1	3,240		3,240	1	1,588		1,406	1	1,389		1,389
Washington	1	3,674		3,674	1	3,975		3,977	1	4,065		4,065
White	1	1,796		1,796	1	2,009		2,009	1	2,129		2,129
Williamson	2		549	549	2		558	558				
Total	27	39,718	7,590	47,307	25	34,960	6,827	41,787	24	35,217	4,405	39,622

[1] Source: Energy Information Agency, Coal Industry Annual (1997, 1998), and Illinois Department of Natural Resources (1996, 1997, 1998).
[2] Production values are in thousand tons.

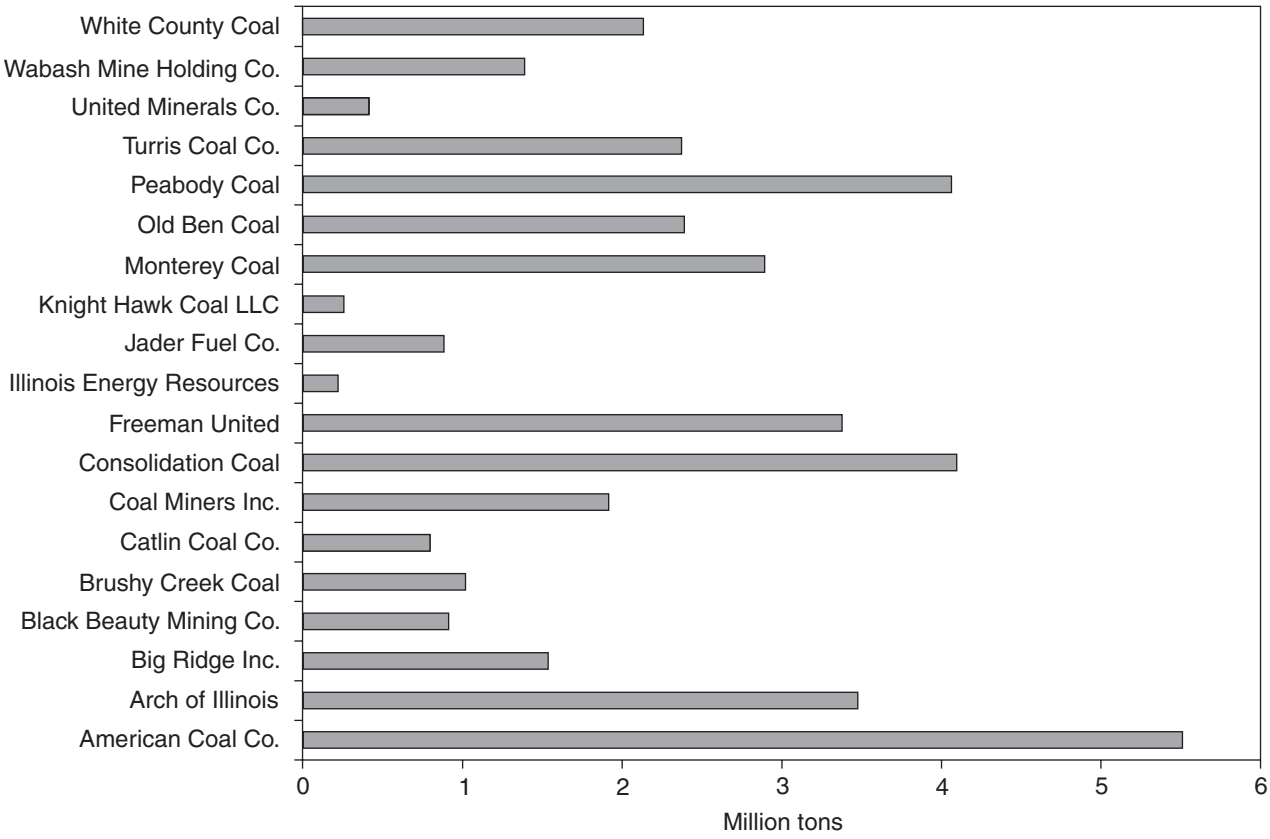

Figure 5 Coal production by companies, 1998.

Table 7 Cumulative production of coal in Illinois counties, 1996–1998.[1]

County	Cumulative production[2] To 1996	To 1997	To 1998	County	Cumulative production[2] To 1996	To 1997	To 1998
Adams	341.9	341.9	341.9	Mc Lean	39,247.7	39,247.7	39,247.7
Bond	7,355.6	7,355.6	7,355.6	Madison	12,516.1	12,516.1	12,516.1
Brown	74.1	74.1	74.1	Marion	7,569.5	7,569.5	7,569.5
Bureau	53,823.1	53,823.1	53,823.1	Marshal	5,544.1	5,544.1	5,544.1
Calhoun	96.2	96.2	96.2	Menard	13,462.0	13,462.0	13,462.0
Cass	212.5	212.5	212.5	Mercer	15,519.9	15,519.9	15,519.9
Christian	358,959.7	358,959.7	358,959.7	Monroe	8.3	8.3	8.3
Clark	4.5	4.5	4.5	Montogomery	141,824.7	141,824.7	141,824.7
Clay	0.8	0.8	0.8	Morgan	190.8	190.8	190.8
Clinton	85,332.9	85,332.9	85,332.9	Moultrie	2,032.2	2,032.2	2,032.2
Coles	210.9	210.9	210.9	Peoria	96,718.7	96,718.7	96,718.7
Crawford	45.4	45.4	45.4	Perry	520,405.4	526,509.4	530,062.4
Douglas	44,397.2	44,397.2	44,397.2	Pike	5.1	5.1	5.1
Edgar	2,295.9	2,295.9	2,295.9	Pope	36.3	36.3	36.3
Effingham	0.8	0.8	0.8	Putnam	10,071.9	10,071.9	10,071.9
Franklin	720,987.4	720,987.4	720,987.4	Randolph	247,848.2	250,872.2	253,262.2
Fulton	318,608.6	318,608.6	318,608.6	Richland	0.2	0.2	0.2
Gallatin	59,412.3	60,975.3	63,790.3	Rock Island	3,846.2	3,846.2	3,846.2
Greene	693.2	693.2	693.2	St. Clair	367,612.8	367,612.8	367,612.8
Grundy	40,872.4	40,872.4	40,872.4	Saline	352,448.6	360,753.6	369,691.6
Hamilton	6,172.9	6,172.9	6,172.9	Sangamon	233,449.6	233,449.6	233,449.6
Hancock	771.3	771.3	771.3	Schuyler	14,861.0	15,341.0	15,751.0
Henry	22,910.1	22,910.1	22,910.1	Scott	612.5	612.5	612.5
Jackson	128,258.1	128,397.1	128,871.1	Shelby	4,119.8	4,119.8	4,119.8
Jasper	23.7	23.7	23.7	Stark	9,569.3	9,569.3	9,569.3
Jefferson	182,080.4	186,417.4	190,514.4	Tazewell	17,633.8	17,633.8	17,633.8
Jersey	120.4	120.4	120.4	Vermillion	166,008.4	166,643.4	167,438.4
Johnson	314.3	314.3	314.3	Wabash	53,285.0	54,691.0	56,080.0
Kankakee	19,192.1	19,192.1		Warren	685.5	685.5	685.5
Knox	65,896.6	65,896.6	65,896.6	Washington	47,248.6	51,225.6	55,290.6
La Salle	65,547.6	65,547.6	65,547.6	White	21,672.7	23,681.7	25,845.7
Livingston	10,111.4	10,111.4	10,111.4	Will	37,553.7	37,553.7	37,553.7
Logan	31,987.1	34,046.1	36,418.1	Williamson	467,231.7	467,277.7	467,277.7
Macon	11,000.5	11,000.5	11,000.5	Woodford	7,810.2	7,810.2	7,810.2
Macoupin	356,802.8	363,280.8	369,055.8	Total	5,679,536.5	5,720,694.5	5,760,426.5
Mc Donough	165,971.7	166,567.7	167,062.7				

[1] Source: Illinois Department of Natural Resources (1996, 1997, 1998).
[2] Production values are thousand tons.

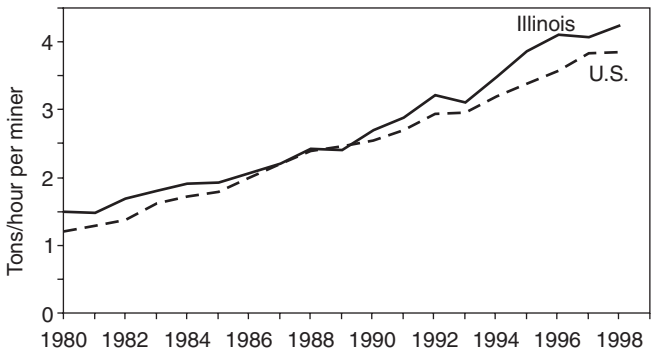

Figure 6 Trends in productivity of underground mines, 1980–1998.

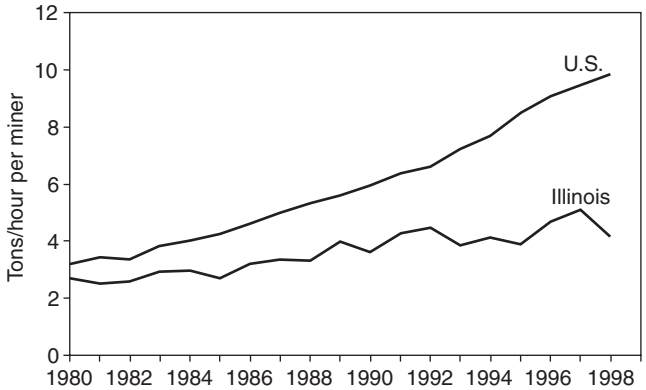

Figure 7 Trends in productivity of surface mines, 1980–1998.

Table 8 Number of mines and production of coal by companies, 1996–1998.[1]

Company	1996				1997				1998			
	Underground (no.)	Surface (no.)	Production[2]	% of total	Underground (no.)	Surface (no.)	Production	% of total	Underground (no.)	Surface (no.)	Production	% of total
Amax Coal	1	1	3,761	7.95	1	1	2,109	5.05				
American Coal Co.									1		5,509	13.90
Arch of Illinois	1	1	4,933	10.43	1	1	4,984	11.92	1	1	3,476	8.77
Arclar Co.	1		1,452	3.07	1		1,434	3.43				
Big Ridge Inc.									1		1,538	3.88
Black Beauty Mining Co.										1	911	2.30
Brushy Creek Coal	1		577	1.22	1		892	2.13	1		1,016	2.56
Catlin Coal Co.			123	0.26	1		635	1.52	1		795	2.01
Coal Miners Inc.	1		1,322	2.79	1		1,563	3.74	1		1,916	4.83
Consolidation Coal	1	1	5,314	11.23	1	1	5,203	12.45	1		4,097	10.34
Cottonwood Coal Co.	1		36	0.08		1	36	2.53				
Freeman United	3	1	4,668	9.87	3	1	4,403	10.53	2	1	3,379	8.52
Illinois Energy Resources						1	139	0.33		1	218	0.55
Jader Fuel Co.	1	1	673	1.42		1	986	2.36		1	880	2.22
Kerr-McGee Coal Corp.	1		6,520	13.76	1		4,969	11.89				
Knight Hawk Coal LLC										1	259	0.65
Midstate Coal	1		205	0.43								
Monterey Coal	2		4,133	8.73	1		2,923	6.99	1		2,891	7.29
Old Ben Coal	4		5,725	12.10	2		3,006	7.19	1		2,388	6.02
Peabody Coal	1		3,674	7.77	1		3,995	9.56	1		4,065	10.26
Triad Mining Inc.	1	1	417	0.88		1	461	1.10				
Turris Coal Co.	1		1,982	4.19	1		2,059	4.92	1		2,373	5.99
United Minerals Co.										1	410	1.03
Wabash Mine Holding Co.									1		1,389	3.50
White County Coal	1		1,796	3.80	1		2,009	4.81	1		2,129	5.37
Total	21	6	47,311	100	17	8	41,805	100	15	7	39,639	100

[1] Source: Illinois Department of Natural Resources (1996, 1997, 1998).
[2] Production values are in thousand tons.

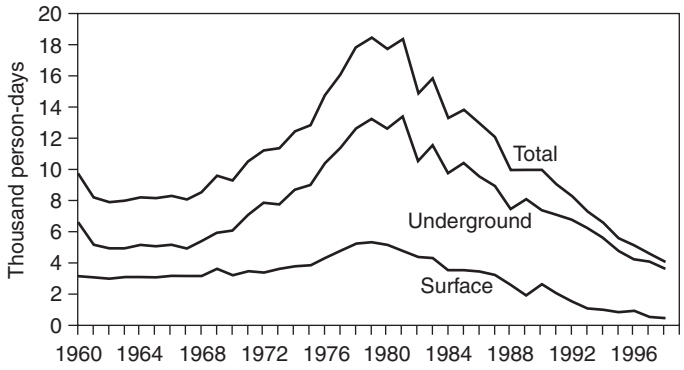

Figure 8 Employment in coal mining in Illinois, 1960–1998.

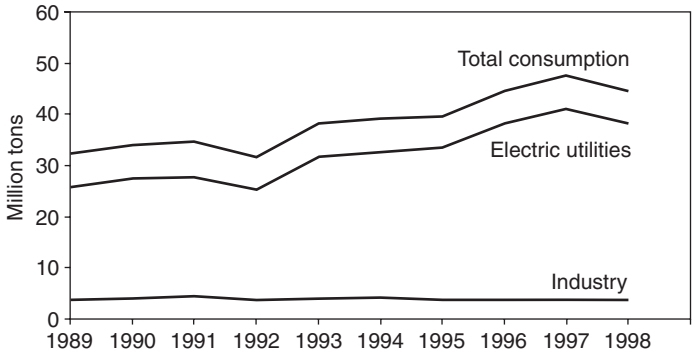

Figure 9 Consumption of coal by major consumers, 1989–1998.

Table 9 Average productivity of coal mining in the United States and Illinois, 1980–1998.[1]

	Underground[2]		Surface		Total	
Year	U.S.	Illinois	U.S.	Illinois	U.S.	Illinois
1980	1.20	1.49	3.21	2.70	1.93	1.86
1981	1.29	1.48	3.42	2.52	2.10	1.81
1982	1.37	1.68	3.36	2.57	2.11	1.97
1983	1.61	1.80	3.81	2.94	2.50	2.17
1984	1.72	1.91	4.03	2.96	2.64	2.22
1985	1.78	1.92	4.24	2.69	2.74	2.14
1986	2.00	2.06	4.60	3.22	2.37	3.01
1987	2.20	2.20	4.98	3.37	3.30	2.52
1988	2.38	2.43	5.32	3.32	3.55	2.67
1989	2.46	2.41	5.61	3.96	3.70	2.77
1990	2.54	2.70	5.94	3.64	3.83	2.94
1991	2.69	2.88	6.38	4.30	4.09	3.18
1992	2.93	3.21	6.59	4.47	4.36	3.42
1993	2.95	3.11	7.23	3.86	4.70	3.23
1994	3.19	3.49	7.67	4.12	4.98	3.59
1995	3.39	3.86	8.48	3.89	5.38	3.87
1996	3.57	4.10	9.05	4.67	5.69	4.18
1997	3.83	4.07	9.46	5.11	6.04	4.20
1998	3.84	4.24	9.85	4.16	6.22	4.23

[1] Source: Energy Information Agency, Coal Industry Annual (1980–1998).
[2] Production values are in tons per hour per miner.

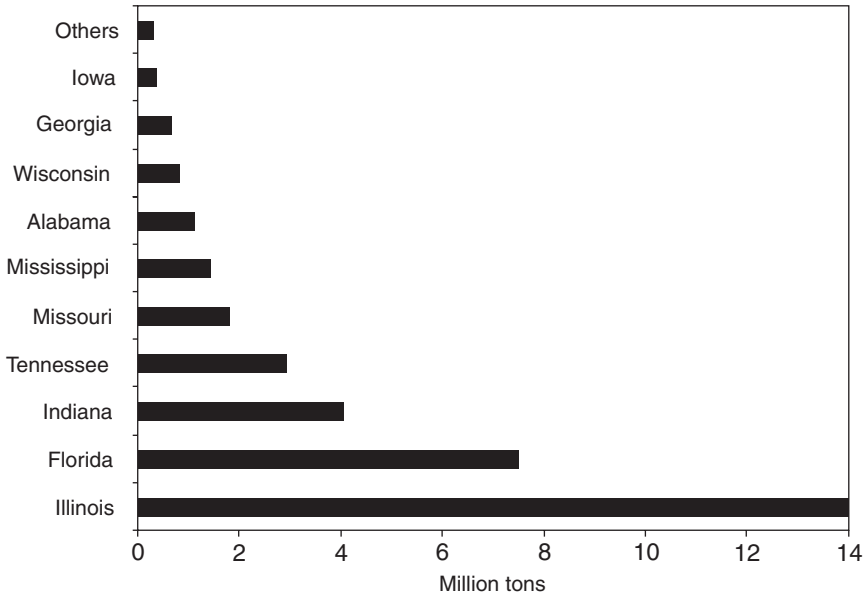

Figure 10 Domestic distribution of Illinois coal to electric utilities by state, 1998.

Table 10 Production, distribution, consumption, and prices of coal in Illinois, 1992–1998.[1]

Category	1992	1993	1994	1995	1996	1997	1998
Supply (million tons)							
Recoverable reserves	1,199.31	1,063.83	963.47	882.32	891.11	744.51	743.59
Productive capacity	75.79	69.32	69.41	56.63	61.73	51.52	47.62
Production total	60.33	41.10	52.80	48.18	46.66	41.16	39.73
Underground	47.48	33.10	43.28	41.12	38.95	34.82	35.25
Surface	12.85	8.00	9.52	7.06	7.71	6.33	4.48
Capacity utilization	79	59	76	85	75.58	79.87	83.43
Ratio of recoverable reserves to production	20.00	25.90	18.30	18.30	19.10	18.10	18.7
Miners (no.)	8,323	7,303	6,591	5,652	5,174	4,612	4,102
Productivity total (tons/hr per miner)	3.42	3.23	3.59	3.87	4.18	4.20	4.23
Underground (tons/hr per miner)	3.21	3.11	3.49	3.86	4.10	4.07	4.24
Surface (tons/hr per miner)	4.47	3.86	4.12	3.89	4.67	5.11	4.16
Imports	54	51	346	223	210	148	61.00
Distribution (million tons)							
Total	58.91	42.00	52.21	47.87	47.08	41.22	39.75
Domestic	57.67	41.33	51.97	45.17	45.19	40.45	39.45
Within state	18.17	15.21	17.52	15.59	16.05	18.08	16.65
To other states	39.50	26.12	34.22	29.58	29.14	22.36	22.80
Foreign distribution	1.24	0.67	0.27	2.70	1.89	0.77	0.31
Demand (million tons)							
Consumption total	31.60	38.14	39.08	39.62	44.43	47.62	44.63
Electric utilities	25.26	31.74	32.60	33.46	38.09	41.02	38.26
Industry	3.74	3.97	4.19	3.65	3.74	3.86	3.81
Coke	W[2]	W	W	W	W	W	W
Residential/commercial	W	W	W	W	W	W	W
Consumer stocks							
Electric utility	7.40	4.02	4.53	5.33	4.58	4.83	6.57
Coal prices (nominal $/ton)							
Mine total	27.66	25.27	23.14	23.05	22.74	21.44	22.86
Underground	27.93	25.54	23.18	22.88	23.12	22.22	22.96
Surface	26.69	24.18	22.92	24.04	20.86	17.12	22.07
Consumer							
Electric utilities	37.06	35.30	32.69	32.58	32.14	30.41	30.22
Industrial	29.24	29.42	29.13	29.03	29.69	29.76	29.46
Coke	W	W	W	W	W	W	W

[1] Source: Energy Information Agency, Coal Industry Annual (1993–1998).
[2] W, withheld.

declined, and the 13.7 million barrels produced in 1998 is the least since long before 1940. The reasons for the decline in oil production are low oil prices, relatively high average costs of production, and depletion of reserves in existing reservoirs. Nevertheless, studies by the Illinois State Geological Survey indicate that significant quantities of unrecovered oil reserves are available in Illinois.

An oil field producing more than 200,000 barrels per year is considered to be a major oil field in Illinois. In 1998, there were 10 major oil fields, which together produced 52.7% of the state's total production (table 17). The three largest oil fields, Lawrence, Main Consolidated, and Clay City Consolidated, which each produced one million barrels or more during 1998, together produced 26% of the state's total.

Consumption Although its total production is modest, Illinois is a major consumer of oil, using 242 million barrels in 1997 (table 18). The petroleum products consumed in the greatest amounts in Illinois are motor gasoline, distillate fuel oil, liquefied petroleum gas, and jet fuel (table 18, fig. 13). Motor gasoline was the petroleum product consumed the most. In 1997, motor gasoline accounted for 46.8% of the total quantity of petroleum products consumed, followed by distillate fuel (16.2%) and liquefied petroleum gases (10%).

Natural Gas

Production Illinois is not a major producer of natural gas and is almost totally dependent on gas produced elsewhere. Production of natural gas fell from 298 million cubic feet in 1996

Table 11 Consumption of coal in Illinois,1970–1998.[1]

Year	Illinois coal	Total consumption
1970	33.98	42.31
1971	28.54	38.29
1972	31.33	42.03
1973	29.08	40.63
1974	26.37	39.05
1975	26.04	41.95
1976	24.97	41.46
1977	21.77	38.30
1978	20.51	38.70
1979	21.74	42.72
1980	21.58	42.11
1981	17.00	36.58
1982	19.18	36.34
1983	18.79	36.33
1984	20.84	38.80
1985	19.00	37.02
1986	19.00	38.09
1987	18.61	35.36
1988	17.25	32.88
1989	17.56	30.12
1990	18.70	33.90
1991	18.79	34.68
1992	18.17	31.60
1993	15.21	38.14
1994	17.52	39.08
1995	15.59	39.62
1996	16.05	44.47
1997	18.08	47.62
1998	16.65	44.63

[1] Source: Energy Information Agency, Coal Industry Annual (1970–1998).
[2] Values are million tons.

to 209 million cubic feet in 1998 (table 19). The average wellhead value of gas decreased from $2.83 per thousand cubic feet in 1996 to $2.27 in 1998 (table 21).

St. Clair County was the major producer of natural gas in 1998, followed by Saline County (table 20, fig. 14). As increasingly more gas and oil fields are being idled or depleted in Illinois, gas production in Illinois is expected to continue to fall.

Consumption The natural gas consumption in the state has generally been decreasing over the reporting period (table 21, fig. 15). In 1998, residential consumers accounted for about 42.8% of total natural gas

Table 12 Average mine price of coal in Illinois and in the United States, 1984–1998.[1]

	Illinois		U.S. total	
Year	Nominal	Real	Nominal	Real
1984	29.89	32.90	25.61	28.19
1985	30.80	32.65	25.20	26.72
1986	29.99	30.88	23.79	24.50
1987	29.56	29.56	23.07	23.07
1988	28.55	27.56	22.07	21.30
1989	28.17	26.10	21.82	20.21
1990	27.73	24.62	21.76	19.32
1991	28.35	24.21	21.49	18.35
1992	27.66	22.99	21.03	17.48
1993	25.27	20.47	19.85	16.08
1994	23.13	18.33	19.41	15.38
1995	23.05	17.80	18.83	14.54
1996	22.74	17.23	18.45	13.98
1997	21.44	15.93	18.14	13.48
1998	22.86	16.79	17.67	12.97

[1] Source: Energy Information Agency, Coal Industry Annual (1984–1998).
[2] Nominal prices are in dollars per ton; real prices are in 1992 dollars deflated by GDP deflated.

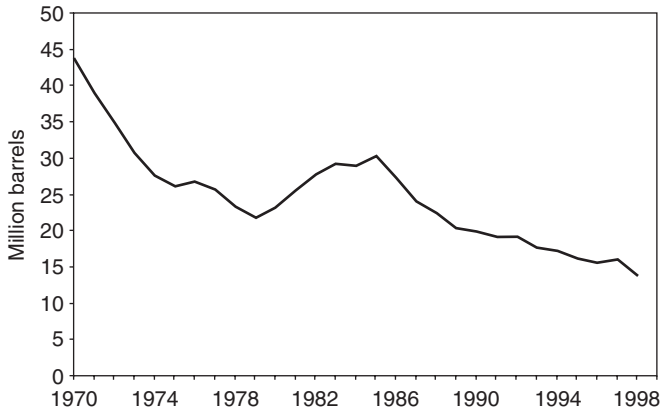

Figure 11 Production of crude oil in Illinois, 1970–1998.

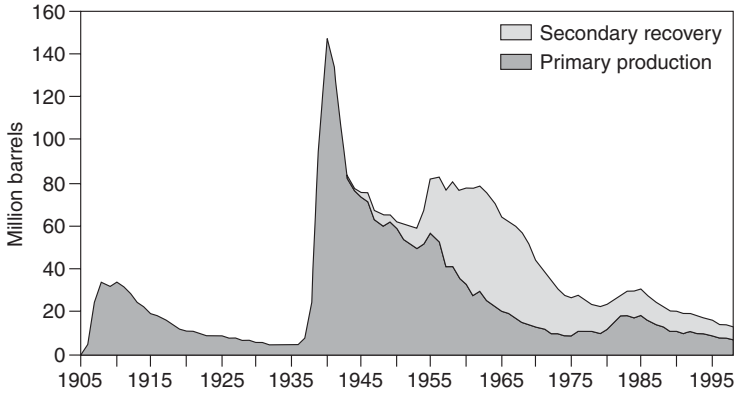

Figure 12 Yearly oil production in Illinois, 1905–1998. Water flood values are estimated for 1986–1998.

Table 13 Distribution of coal produced in Illinois (thousand tons), 1990–1998.[1]

	1990	1991	1992	1993	1994	1995	1996	1997	1998
East North Central	30,701	29,022	28,821	20,483	28,299	25,629	25,315	23,224	21,808
Illinois	18,700	18,787	18,617	15,206	17,517	15,587	16,052	18,085	16,652
Indiana	10,571	9,185	9,595	4,541	9,574	8,559	8,178	4,272	4,184
Michigan	10	5	6		51	70	59		
Ohio	58	73		18	1	18		2	
Wisconsin	1,362	971	1,053	736	1,139	1,412	1,008	868	969
West North Central	15,856	15,470	13,499	7,783	9,448	6,270	5,346	3,934	3,767
Iowa	1,592	1,473	1,175	179	1,535	1,216	694	731	949
Kansas and Nebraska	1,157	1,320	640	43	193	128	149	129	41
Minnesota	41	40	58		179	111	100	176	104
Missouri	13,607	12,637	11,625	6,027	7,541	4,815	4,403	2,897	2,674
South Atlantic	9,019	8,811	10,485	8,137	8,403	6,642	7,255	6,612	6,941
Florida	4,150	4,464	5,529	4,782	5,846	6,058	6,052	5,585	6,265
Georgia	4,869	4,347	4,955	3,355	2,557	584	1,204	1,027	676
South Carolina		1							
East South Central	4,482	4,482	4,780	4,823	5,453	6,511	7,130	5,600	5,795
Alabama	813	813	632	401	750	1,146	2,155	1,348	809
Kentucky	453	453	7	535	343	274	1	152	686
Mississippi	1,218	1,218	1,879	1,106	1,164	1,304	1,749	1,228	1,538
Tennessee	1,998	1,998	2,261	2,780	3,195	3,787	3,225	2,872	2,762
West South Central	82	99	81	58	46	76	86	1,055	1,125
Arkansas	82	99	81	37	30	76	76	67	12
Louisiana			21			987	1,113		
Oklahoma				16		10	1		
Mountain	11	201							
Montana		201							
Wyoming	11								
Other states					23	40			
Exports	237	1263	1242	670	236		1,886	773	307
Total	60,459	58,553	58,912	42,000	51,973	45,170	47,058	40,447	39,447

[1] Source: Energy Information Agency, Coal Industry Annual (1990–1998).

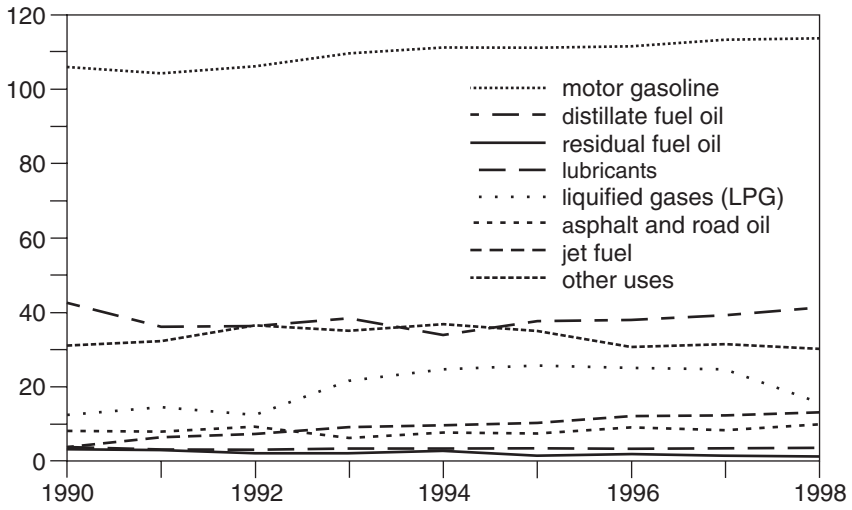

Figure 13 Petroleum products consumed in Illinois, 1990–1998.

Table 14 Domestic distribution of Illinois coal to electric utilities, 1991–1998.[1, 2]

Year	AL	FL	GA	IL	IN	IA	KS	KY	MI	MN	MS	MO	OH	TN	WI	Total
1991	1,030	4,637	5,055	15,870	8,452	1,336	1,485	15		53	1,340	12,438		2,357	761	54,831
1992	956	5,504	5,137	14,818	9,565	1,417	767	7		63	1,239	11,376		2,831	823	54,504
1993	763	5,406	3,345	12,594	6,338	442	302	433		43	1,080	5,415		3,773	445	40,378
1994	1,137	5,544	2,543	14,314	10,556	1,219	305	440	51	94	1,063	6,990	1	3,151	900	48,308
1995	980	5,961	604	11,879	10,661	770	138	285	42	36	1,236	4,168		3,949	1,232	41,941
1996	1,723	6,392	1,203	13,365	9,007	164	207	75	29	69	1,703	3,924	9	3,756	756	42,382
1997	1,557	6,015	1,033	14,315	4,788	288	129	504		114	1,149	2,652		1,918	719	35,182
1998	1,124	7,466	677	13,985	4,043	360	30	246	25	42	1,415	1,803	2	2,915	828	34,961

[1] Source: Energy Information Agency, Quarterly Coal Report (1991–1998).
[2] Values are in thousand tons.

Table 15 Sources of coal consumed by electric utilities in Illinois, 1991–1998.[1, 2]

Year	IL	CO	IN	KY	MT	OH	UT	WV	WY	Other	Total
1991	15,870	336	1,616	1,434	3,228			721	3,598	10	26,813
1992	14,818	470	826	1,187	3,036		239	492	4,382		25,449
1993	12,594	1,095	1,368	1,602	3,249	54	198	422	7,509		28,091
1994	14,314	1,371	1,221	1,351	4,240	35	235	243	9,927		32,936
1995	11,879	1,526	1,040	1,027	2,685		1,648	19	14,081		33,905
1996	13,365	803	1,173	391	2,162		1,846		17,701		37,441
1997	14,315	1,135	1,708	226	1,572		1,377	47	20,370		40,750
1998	13,985	1,204	1,625	98	1,713		818		20,425		39,867

[1] Source: Energy Information Agency, Quarterly Coal Report (1991–1998).
[2] Values are in thousand tons.

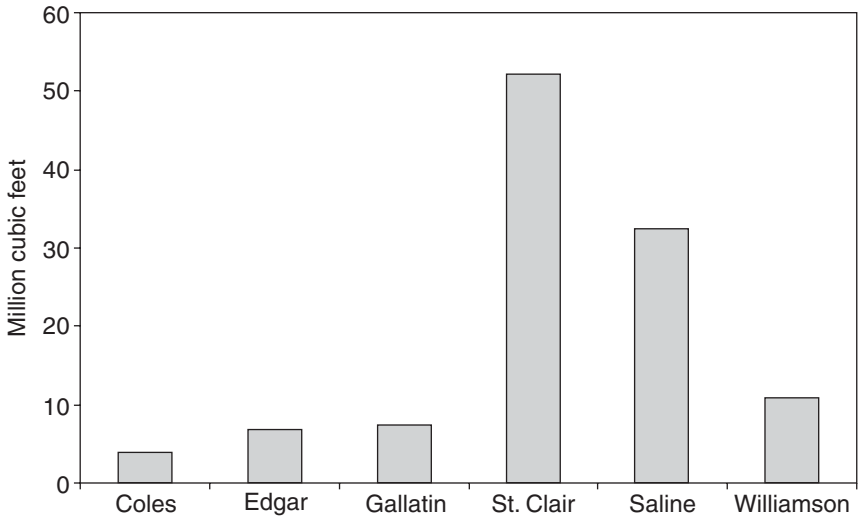

Figure 14 Production of natural gas from large fields by county, 1998.

Table 16 Cost[1] and quality of coal received by electric utilities, 1990–1998.[2]

	Illinois coal				Wyoming coal				Average for all kinds of coal received			
Year	(BTU/lb)	Sulfur (%)	Ash (%)	($/million BTU)($/ton)	(BTU/lb)	Sulfur (%)	Ash (%)	($/million BTU)($/ton)	(BTU/lb)	Sulfur (%)	Ash (%)	($/million BTU)($/ton)
1990	11,642	2.81	8.84	2.06 47.84	8,389	0.43	5.33	1.68 28.11	11,910	1.38	8.01	1.74 41.48
1991	11,682	2.78	8.83	2.05 47.97	8,457	0.41	5.20	1.52 25.71	11,862	1.34	7.86	1.72 40.78
1992	11,729	2.79	8.55	1.90 44.67	8,388	0.45	5.28	1.46 24.44	11,777	1.31	7.97	1.67 39.32
1993	11,738	2.56	8.43	1.75 40.99	8,360	0.42	5.25	1.49 24.85	11,685	1.20	7.75	1.65 38.49
1994	11,616	2.44	8.40	1.64 38.19	8,466	0.36	4.94	1.49 25.28	11,642	1.13	7.83	1.62 37.66
1995	11,754	1.95	7.81	1.71 40.12	8,502	0.34	5.01	1.53 25.96	11,539	0.98	7.68	1.61 37.21
1996	11,865	1.84	7.47	1.70 40.43	8,527	0.38	5.12	1.55 26.39	11,520	0.98	7.50	1.58 36.44
1997	11,967	1.68	7.58	1.61 38.45	8,469	0.41	5.54	1.29 21.80	11,270	0.98	7.92	1.54 34.59
1998	12,053	1.89	7.94	1.51 36.39	8,474	0.39	5.52	1.24 20.93	11,225	0.96	7.69	1.48 33.29

[1] Costs are average delivered costs at the utility.
[2] Source: Energy Information Agency, Quarterly Coal Report (1990–1998).

consumption in Illinois, followed by industrial consumers (30.2%). The other major consumers were commercial users (18.2%) and electric utilities (6.2%).

Extracted Industrial and Construction Materials

Sand and Gravel

Production In 1998, sand and/or gravel was produced in 68 counties (fig. 16). The primary source of construction sand and gravel is glacial deposits, primarily the deposits called outwash plain valley trains formed in modern and ancient stream valleys by rivers and glacial meltwater. Although environmental regulations and zoning restrictions have tended to force new pits to locate away from highly populated areas, the best deposits may lie where exploration and development are prohibited. Because sand and gravel are bulk commodities that have large transportation costs, these operations generally are located as close as possible to the major areas of demand, but away from densely populated areas.

Illinois continues to be a leading producer of sand and gravel in the country. In 1998, the state produced 33.8 million tons of construction sand and gravel (3% of the nation's production) valued at $149 million (table 1). Production of sand and gravel has been increasing since 1982–1983 (fig. 17) and has now returned to the levels of the late 1970s. Growth in sand and gravel production in recent years has not kept pace with the growth of stone production, partly because sand and gravel does not make as good a concrete or asphalt mix as crushed stone does. Hence, relatively more stone aggregate is used in portland cement and asphalt pavement in recent years, resulting in greater demands for stone than for sand and gravel.

The state is divided into four crushed stone/sand and gravel production districts for the reporting of construction aggregate production (fig. 18). District 1, which includes Cook County and surrounding areas, accounted for 64% of the state's total production; District 2, 8.2%; District 3, 18.1%; and District 4, 9.2%.

Consumption Sand and gravel are used primarily as various types of aggregate materials for constructing buildings and roads. The major markets for sand and gravel are in Cook County and the five surrounding metropolitan counties, where about 62% of Illinoisans live. Because of its low unit price, most construction sand and gravel are not shipped farther than 50 miles from the pit, except for opera-

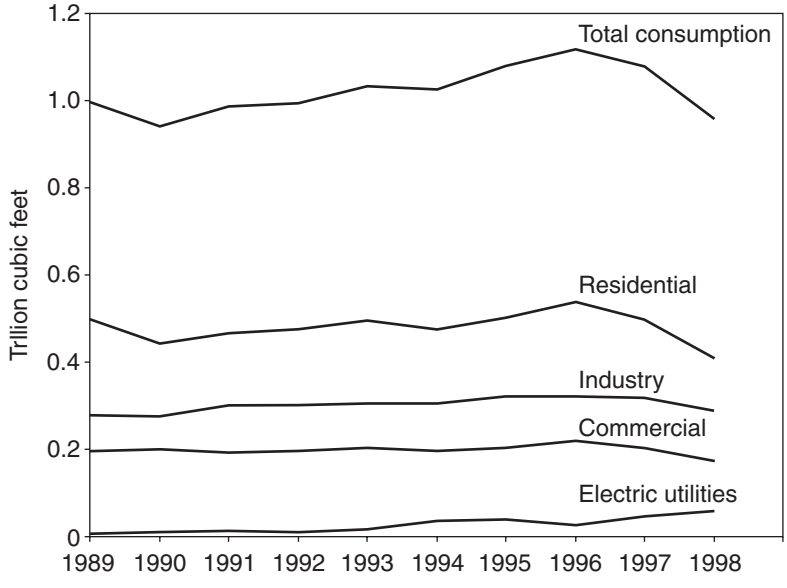

Figure 15 Consumption of natural gas in Illinois, 1989–1998.

Table 17 Crude oil production from major oil fields (more than 200,000 barrels annually) in Illinois, 1996–1998.[1]

		1996		1997		1998	
Field	County	Production[2]	% of IL total	Production	% of IL total	Production	% of IL total
Clay City Consolidated	Clay	1,145.83	7.36	1,046.22		1,005.08	7.32
Enfield South	White	238.43	1.53	220.38			
Johnsonville Consolidated	Wayne	512.29	3.29	363.60		335.86	2.45
Lawrence	Lawrence	1,816.39	11.66	1,678.86	10.47	1,521.32	11.08
Louden	Fayette	915.68	5.88	873.62	5.45	778.54	5.67
Main Consolidated	Crawford	1,080.97	6.94	1,104.93	6.89	1,090.20	7.94
Miletus	Crawford			637.58	3.98	715.72	5.21
New Harmony Consolidated	White	650.60	4.18	616.31	3.84	578.12	4.21
Philipstown Consolidated	White	303.00	1.95	313.34	1.95	236.70	1.72
Roland Consolidated	White	226.29	1.45	209.98	1.31		
Sailor Springs Consolidated	Clay	267.17	1.72	253.24	1.58	233.54	1.70
Salem Consolidated	Marion	941.49	6.04	857.08	5.35	735.70	5.36
Total		8,098.15	51.99	8,175.16	51.00	7,230.76	52.66

[1] Source: Illinois State Geological Survey (unpublished).
[2] Production values are in thousand barrels.

Table 18 Petroleum products consumed in Illinois, 1990–1998.[1, 2]

Product	1990	1991	1992	1993	1994	1995	1996	1997	1998
Motor gasoline	105.95	104.38	106.30	109.59	111.26	111.21	111.55	113.34	113.71
Kerosene	0.17	0.20	0.14	0.18	0.20	0.29	0.40	0.37	0.35
Distillate fuel oil	42.53	36.15	36.38	38.38	33.95	37.54	37.93	39.19	41.43
Residual fuel oil	3.62	3.45	2.35	2.28	2.71	1.46	2.01	1.45	1.07
Lubricants	3.56	3.18	3.24	3.30	3.45	3.39	3.29	3.48	3.64
Liquified gases (LPG)	12.47	14.54	12.48	21.65	24.71	25.82	25.11	24.78	15.78
Asphalt and road oil	8.34	7.92	9.29	6.31	7.80	7.46	9.13	8.35	9.86
Aviation gasoline	0.16	0.18	0.18	0.23	0.20	0.22	0.20	0.20	0.17
Jet fuel	3.95	6.44	7.40	9.17	9.62	10.36	12.08	12.50	13.15
Other	30.74	32.03	36.02	34.72	36.39	34.52	30.18	30.88	29.66
Total	211.49	208.46	213.79	225.81	230.29	232.27	231.87	234.52	228.81

[1] Source: Energy Information Agency, State Energy Data Report 1998; data for 1998 were not available when this report was prepared.
[2] Values are in million barrels.

tions located on navigable rivers, which may ship materials much farther by barge. About three-quarters of the material is shipped from the pits by truck, and the remainder is transported by barge or rail.

Industrial Sand

Production Illinois ranked first in the production of industrial sand in 1998. The area best known for production of industrial (silica) sand is the Ottawa District of La Salle County, which produces from the St. Peter Sandstone of Middle Ordovician age. Within the district, the St. Peter is called the "Ottawa Sand." Industrial sand is also produced in Ogle County from the St. Peter Sandstone and in Mason County from sand dunes formed during and after the retreat of Wisconsin age glaciers. The production of industrial sand in 1998 was 4.87 million tons valued at $71.5 million (tables 1 and 2). The state accounted for 17.3% of the total industrial sand produced in the country in 1998 (table 1). The average unit value of industrial sand in 1998 was $14.68 per ton (not shown).

Consumption Industrial silica sand is marketed in ground and unground forms. Unground silica sand is used primarily in glass manufacturing. Other uses include making foundry casting

Table 19 Production of natural gas in Illinois, 1985–1998.[1]

Year	Gas wells[2]	Oil wells	Total
1985	1,228	96	1,324
1986	1,546	342	1,888
1987	1,215	156	1,371
1988	1,290	181	1,471
1989	1,268	209	1,477
1990	653	24	677
1991	453	13	466
1992	336	10	347
1993	330	10	340
1994	323	10	333
1995	325	10	335
1996	289	9	298
1997	228	3	231
1998	204	5	209

[1] Source: Illinois State Geological Survey (unpublished).
[2] Production values are in million cubic feet.

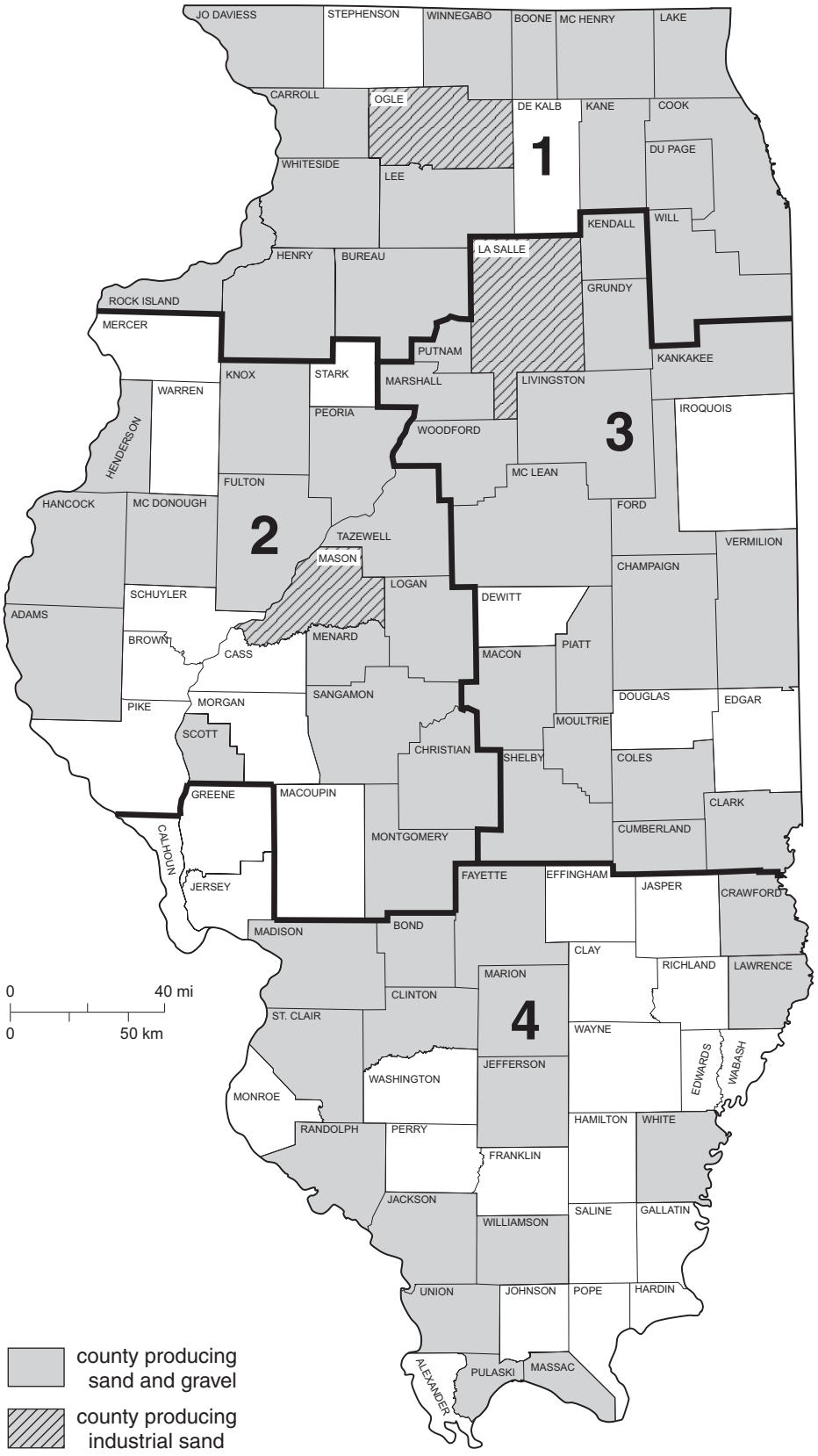

Figure 16 Illinois districts and counties producing sand and gravel, 1998.

molds; blasting, grinding, and polishing; railroad traction; filtration; and "frac" sands used for propping open the fractures formed in oil reservoir strata during hydraulic fracturing operations. Ground sand is used in chemicals, abrasives, enamels, pottery, porcelain, tile, and various fillers.

Unimin Corporation, U.S. Silica Company, Manley Brothers, and Fairmont Minerals Ltd. mined silica sand in the Ottawa District of La Salle County, and Unimin's operation in Ogle County mined sand for the glass, blasting, foundry, and frac sand markets. Manito Investment Company mined the Quaternary to Holocene age quartz-feldspar dune sand in Mason County for the foundry sand and amber-colored glass markets.

Stone

Among the nonfuel minerals produced in Illinois, crushed stone is the most important in terms of total value. Crushed stone accounted for 63% of the total value of nonfuel minerals and 19.3% of the total value of minerals produced in the state in 1998 (table 1).

Production In 1998, 49 counties produced crushed stone (fig. 18) from limestone and dolomite strata of the Pennsylvannian, Missippian, Devonian, Silurian, and Ordivician systems. Quarries are abundant in both the northern and western parts of the state, but the greatest quantities of stone are produced in District 1. In 1998, the state produced 68.3 million tons of crushed stone worth $376 million. Since 1990, stone production has hovered around 60 to 68 million tons. In 1997, production decreased about 1.2% from 66.5 million tons in 1996 to 65.7 million tons (fig. 17). In 1998, 55.1 million tons of limestone worth $291 million and 17 million tons of dolomite worth $45 million were sold or used by producers in Illinois. The main dolomite-producing counties are Cook, Kankakee, Will, Kane, De Kalb, Stephenson, Whiteside, Lee, and Winnebago.

Stone, a bulk commodity, is primarily transported by truck but also by rail and barge. Crushed stone is barged to in-state destinations as well as to Pennsylvania and Gulf Coast markets in Alabama, Texas, and Louisiana. Stone produced in Illinois is also used for ballast on the entire Illinois Central Railroad track network.

Table 20 Natural gas production from relatively large fields in Illinois, 1993–1999.[1]

Gas field	County	1993[2]	1994	1995	1996	1997	1998
Liberty	Adams		12.00				
Stolletown	Clinton	9.80					
Mattoon	Coles	20.59	16.01	34.07[3]	14.35	11.37	3.93
Ashmore East	Edgar	36.52	21.78		13.94	10.19	6.86
Omaha	Gallatin	42.60	34.59	14.61	11.29	10.28	7.45
St. Libory	St. Clair	93.80	106.86	139.00	62.30	55.69	52.15
Eldorado West	Saline	42.57	35.80	42.13	48.47	31.26	22.96
Harco East	Salin						
Raleigh East	Saline	26.53	20.89	13.94	11.35	9.46	
Pittsburg	Williamson				8.61	10.96	0.29
Other		4.26					
Total		250.13	253.56	216.63	164.30	138.75	113.76

[1] Source: Illinois State Geological Survey (unpublished).
[2] Production values are in million cubic feet.
[3] Total of Coles and Edgar Counties.

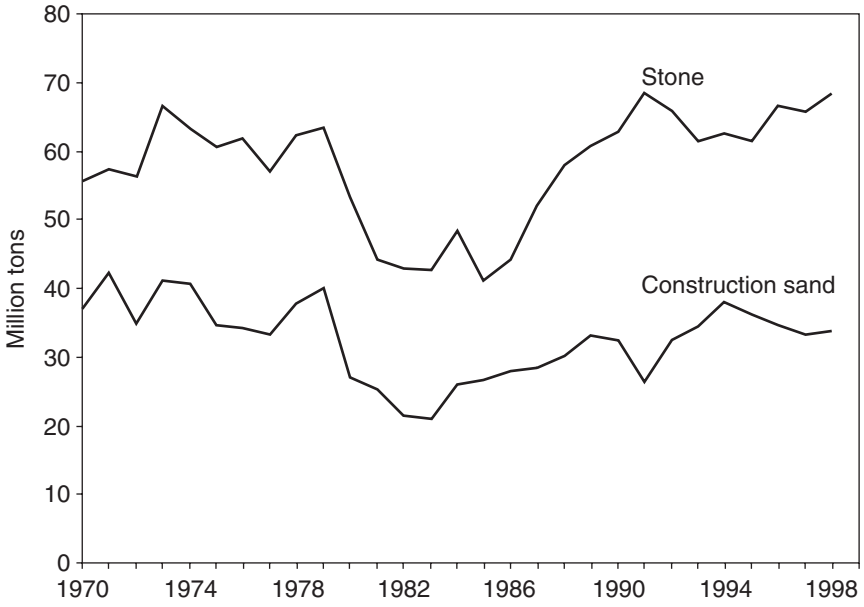

Figure 17 Production of sand and gravel and stone in Illinois, 1970–1998.

Consumption Stone is primarily used as a construction aggregate in making portland cement concrete and bituminous concrete highways; stone is also used as roadbase and shoulder stone. In addition, limestone and dolomite have many chemical, agricultural, and environmental uses. In 1997, about 9 million tons of stone valued at $42.6 million was used as roadstone and coverings, about 2.5 million tons of crushed stone valued at $10.4 million was used in the manufacture of cement, and about 2.2 million tons of stone valued at $8.98 million was used as agricultural limestone in crop production (U.S. Geological Survey 1998f). Agricultural limestone is generally produced from the fines generated when limestone is crushed and screened to make various sizes of aggregate material. Agricultural limestone is used by farmers to neutralize the acidified soils caused by the nitrogen fertilizers used in corn production.

Clays

Production Shale, absorbent clay (fuller's earth), and common clay are mined in Illinois. Absorbent clay is mined in far southern Illinois from the Paleocene age Porters Creek Formation. In Illinois, the Quaternary till deposits and Pennsylvanian claystones and shales are mined to produce common clay, a clay or clay-like material that is sufficiently plastic to permit ready molding.

In 1998, Illinois produced about 0.102 million tons of common clay worth about $0.54 million, an increase of about 2% from its level in 1997 (100,000 tons). The average value of common clay produced in Illinois in 1998 was $5.30 per ton. In addition to common clay, Illinois is a significant producer of absorbent clay, but data are not available on the production and value of the state's absorbent clay. Production of clay in the state has generally followed a downward trend since 1960 (fig. 19).

Uses Common clays and shales mined in Illinois are used to manufacture bricks, drain tiles, flue linings, dinnerware, portland cement, sewer pipe, structural tile, and terra cotta. About 54% of the common clay produced in the country is used in the manufacture of brick; portland cement production accounts for 21%, and the rest goes into other miscellaneous uses (U.S. Geological Survey 1998b). Absorbent clay is used in pet litter and oil-sweep compounds, as a filler and pelletizer in animal feeds, as a decolorizer of oils, and as foundry sand binder.

Fluorspar

Production Fluorspar is the state mineral of Illinois. The first recorded fluorspar mining in Illinois was in 1842 when a small operation was started in Hardin County. Illinois was the principal producer in the country. The production centered around Hardin County in southern Illinois. Production rose from 104,700 tons in 1940 to 198,700 tons in 1943. In 1940, about 48% of the nation's fluorspar demand was met by shipments from the Illinois mine. The state's share increased to 51% in 1943, but declined subsequently.

Table 21 Production, consumption, and average price of natural gas in Illinois, 1989–1998.[1]

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Production (million cu ft)										
Gross withdrawals from										
Gas wells	1,268	653	453	337	330	323	325	289	224	203
Oil wells	209	24	13	10	10	10	10	9	7	6
Total	1,477	677	466	347	340	333	335	298	231	209
Consumption (million cu ft)										
Lease fuel	35	22	10	9	10	10	7	7	6	5
Pipeline fuel	13,531	12,111	11,070	11,330	11,620	13,808	13,208	14,388	14,517	12,995
Plant fuel	17	109	132	98	106	101	90	75	80	84
Delivered to consumers										
Residential	499,984	442,163	466,970	475,360	495,311	473,788	500,798	538,749	497,230	409,812
Commercial	196,171	200,267	193,844	196,964	203,157	197,576	203,802	218,054	202,850	174,598
Industrial	278,826	275,630	302,691	300,366	305,014	305,092	321,465	322,275	317,755	289,642
Vehicle fuel	NA2	5	7	8	12	29	31	32	21	60
Electric utilities	6,967	9,195	12,865	9,293	16,022	34,505	39,143	25,863	44,606	59,850
Total delivered to consumers	981,948	927,261	976,377	981,991	1,019,517	1,010,989	1,065,238	1,104,972	1,062,462	944,563
Total consumption	995,532	939,502	987,589	993,428	1,031,253	1,024,908	1,078,543	1,119,443	1,077,065	957,647
Average price for natural gas ($/thousand cu ft)										
Wellhead (marketed)	2.15	2.11	2.17	2.15	2.30	2.40	1.80	2.87	2.68	2.27
Pipeline fuel	2.17	2.06	2.29	2.44	1.97	1.88	1.66	2.63	2.68	2.27
City gate	NA[2]	3.09	2.91	3.20	3.30	3.02	2.59	3.27	3.28	2.77
Residential	4.92	5.06	4.95	5.09	5.52	3.02	4.66	5.28	5.95	5.47
Commercial	NA	4.64	4.56	4.65	5.10	5.12	4.43	4.92	5.43	5.07
Industrial	NA	4.10	3.77	3.75	4.44	4.39	3.57	4.12	3.97	3.96
Vehicle fuel	NA	4.50	3.41	3.80	4.04	3.26	2.89	3.44	3.01	2.76
Electric utilities	NA	2.73	2.14	2.24	2.48	2.04	1.71	2.62	2.55	2.25

[1] Source: Energy Information Agency, Natural Gas Annual (1998).
[2] NA, not available.

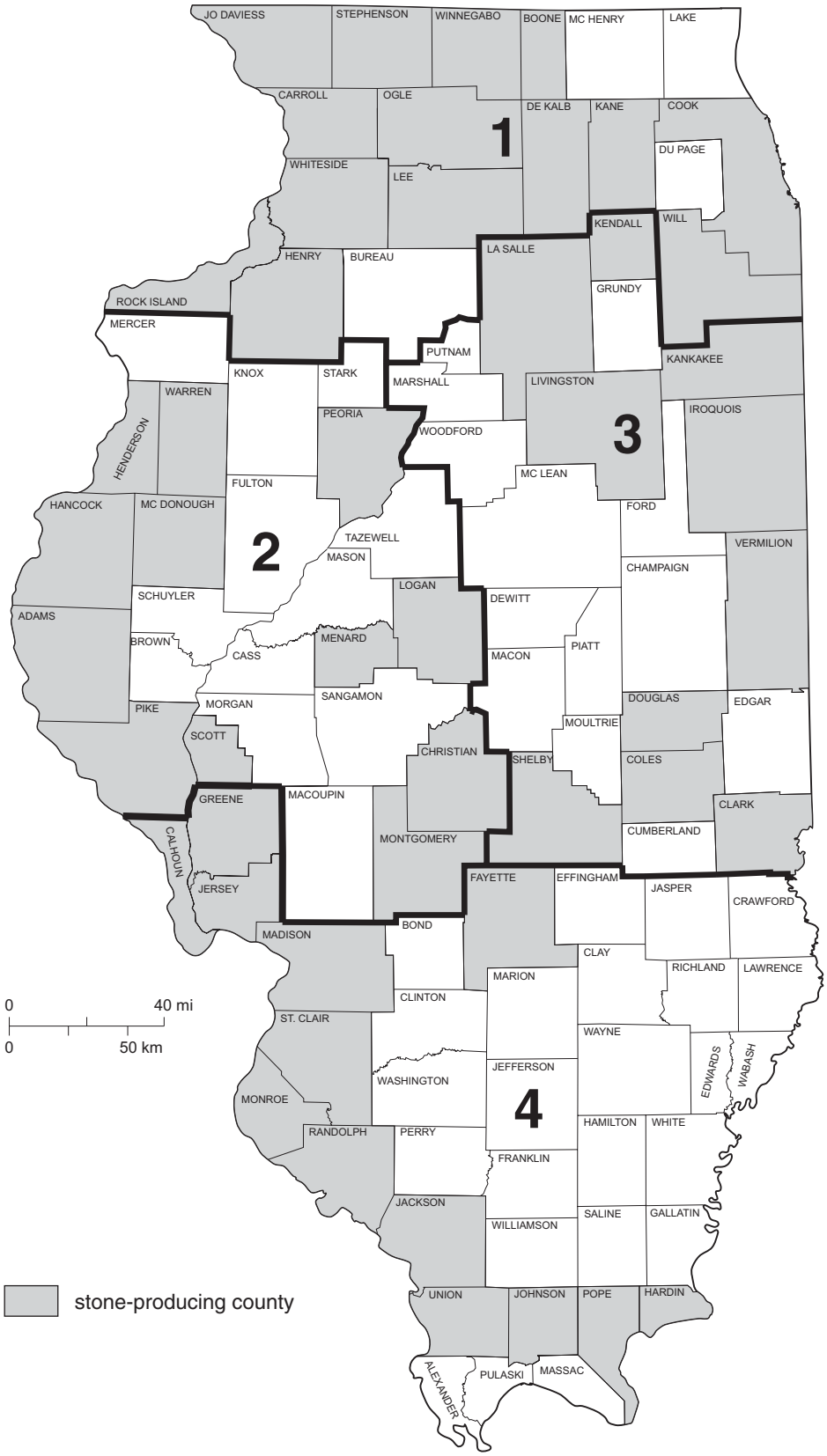

Figure 18 Illinois districts and counties producing stone, 1998.

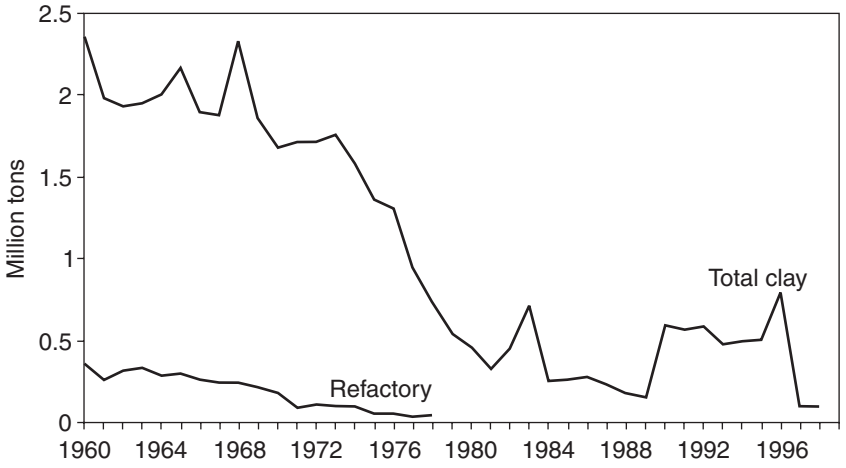

Figure 19 Trends in production of clay in Illinois, 1960–1998.

Early fluorspar output came from numerous mines ranging from those producing only a few hundred tons per year to those producing tens of thousands of tons annually. The extremely competitive conditions and high cost of production gradually forced the producers out of business over time. In 1995, shipments of fluorspar from Illinois in 1995 totaled 48,000 tons, which accounted for 8.5% of the nation's fluorspar requirements. With the closure of Ozark-Mahoning Company's operations in Illinois in 1995, the United States ended 153 years of fluorspar mining.

Currently, fluorspar is not mined anywhere in the United States. In 1995, Ozark-Mahoning Co., a subsidiary of the Pennsylvania-based Elf Atochem North America Inc., was the nation's only fluorspar producer. The Hastie-Sogem Minerals partnership was dissolved in 1998, and its successor, Hastie Mining Trucking Co., finalized the purchase of the former Ozark-Mahoning Co. mill at Rosiclare effective March 1. Hastie Mining and Trucking Co. washed, screened, and dried metallurgical- and acid-grade fluorspar that had been imported or purchased from the national defense stockpile. Seaforth Mineral and Ore Co., Inc. also dried and screened imported or national defense stockpile fluorspar at its facilities at Cave-in-Rock, Hardin County.

Uses Acid-grade fluorspar, containing greater than 97% calcium fluoride, is used primarily as a feedstock in the manufacture of hydrofluoric acid and to produce aluminum fluoride. Ceramic-grade fluorspar (85% to 95% CaF_2) is used for the production of glass and enamel, the manufacture of welding rod coatings, and as a flux in the steel industry. Metallurgical-grade fluorspar (65% to 85% CaF_2) is used primarily as a fluxing agent in the steelmaking industry. The reported domestic consumption increased by about 9.6% from its 491 tonnes in 1997 to 538 tonnes in 1998 (U.S. Geological Survey 1998d). In the ceramic industry, fluorspar is used as a flux and as an opacifier in the production of flint glass, white or opal glass, and enamels.

Tripoli

Tripoli is microcrystalline silica. In 1998, five U.S. firms were known to produce and process tripoli. One of these was Unimin Specialty Minerals Inc., a division of Unimin Corporation. Located in Alexander County in southern Illinois, its mines and plants are currently the only producers of high-grade tripoli in Illinois.

Tripoli processed in Illinois is used as filler in paints, plastics, and rubber products and as an abrasive in buffing and polishing compounds and in soap. Some iron-stained tripoli is being used in the manufacture of portland cement.

Extracted Metals and Other Minerals

Steel, Zinc, Lead, Silver, and Copper

Raw steel manufactured in Illinois is processed from materials obtained from other domestic and foreign sources. According to the American Iron and Steel Institute (1998 Annual Statistical Report 1998), Illinois ranked fourth in the nation in the manufacture of raw steel with an estimated output of 7.4 million metric tonnes (8.2 million tons). Until 1995. Zinc, lead, silver, and copper had been produced in small quantities as by-products of the fluorspar mining industry. With the closure of the fluorspar mines, these metals are no longer produced in significant quantities in Illinois.

Peat

Peat is a natural organic material of botanical origin. All commercial sales of peat in the United States (excluding imports) are for agricultural and horticultural purposes. Three types of peat are produced in Illinois: reed-sedge, moss, and peat moss. In 1998, four Illinois companies produced peat: Dahl Enterprises and Roots Peat Farm in Lake County and Hyponex Corporation and Markman Peat Company in Whiteside County. Peat is sold either as bulk or packaged peat, but more than 99% of the state's peat was sold in package form for general soil improvement (U.S. Geological Survey 1998g). Small amounts were sold in bulk to nurseries and for earthworm cultivation.

Gemstones

With the closing of the last fluorspar mine, the quantity and value of gemstones produced in the state became insignificant. During 1998, Illinois produced gemstones worth $8,000 (table 1). Production was limited to specimen-grade fluorite and accessory minerals.

Processed Minerals

Minerals extracted mainly in other states or foreign countries, but pro-

cessed in Illinois, included calcined gypsum, crude iodine, iron oxide pigments, natural gas liquids, expanded perlite, pig iron, sulfur, exfoliated vermiculite, and primary and secondary slab zinc. The value of these processed minerals is unavailable because some companies declined to provide the needed information.

Calcined Gypsum

Gypsum is used to make wallboard for homes, offices, and commercial buildings. Increasing demand from the construction industry drove gypsum production and consumption to record highs in 1998. Illinois, Indiana, and Kansas together produced 1.57 million tons of calcined gypsum worth $29.4 million; production data for the state of Illinois alone are not available (U.S. Geological Survey, 1998e).

Crude Iodine

Crude iodine is processed into inorganic compounds for commercial use at three Illinois plants: Allied Signal Company in Metropolis, Massac County; West Agro in Des Plaines, Cook County; and Echolab in Joliet, Will County. The end uses of crude iodine are in sanitation (39%), pharmaceuticals (24%), heat stabilizers (13%), catalysts (9%), animal feeds (7%), and miscellaneous other uses (U.S. Geological Survey, 1998c).

Iron Oxide Pigments

Finished pigments were produced from iron ore imported from other states. The producers of iron oxide pigments were Elementis Pigments, East St. Louis; Prince Manufacturing Co., Quincy; and Solomon Grind-Chem Services Inc., Springfield. The types of iron oxide pigments produced are black (magnetite), brown, red iron, and yellow. Synthetic black, brown, red, and yellow iron oxides were also produced.

Natural Gas Liquids

Natural gas liquids processed included ethane, propane, isobutane, unsplit butane, and a combination of gasoline and liquified petroleum gas. Natural gas liquids were processed in Douglas County by the U.S. Industrial and Chemical Company, a Division of Millenium Petro-Chemicals Company. Quantities as well as the sources of natural gas liquids processed in Douglas County are unavailable.

Expanded Perlite

Crude perlite mined outside the state is processed to expanded (processed) perlite by three companies: Silbrico Corporation in Cook County, Illinois Strong-Lite Corporation in La Salle County, and Manville Products Corporation in Will County. Illinois ranked third (after Georgia and Mississippi) among the states in the quantity of expanded perlite sold and used. Expanded perlite is mostly used for acoustic ceiling tile, pipe and roof insulation, concrete aggregates, fillers, filter aids, and horticultural aggregate.

Slag (Iron and Steel)

Slag is used mostly as construction aggregate and roadbase material in asphaltic concrete, as railroad ballast, as fill sand, and for the manufacture of mineral wool. In 1998, three companies, Hecket Multiserv Co., International Mill Service, and Lafarge Corp., were operating nine plants in Illinois. Hecket Multiserv operated three plants in Cook County and one plant at Sterling in Whiteside County. International Mill Service had two plants in Madison County and one plant each in Kankakee and Cook Counties. Lafarge operated one plant in Madison County.

Recovered Elemental Sulfur

In 1998, 0.4 million tons of elemental sulfur were produced in Illinois. Illinois ranked sixth among the states producing elemental sulfur in 1998. Four companies in three counties, Crawford, Madison, and Will, produced sulfur as a by-product of their oil refinery operations. Sulfur differs from most other mineral commodities in its primary use as a chemical reagent rather than as a component of a finished product. The largest use is as sulfuric acid in the manufacture of phosphatic fertilizers (U.S. Geological Survey, Mineral Industry Surveys, Sulfur 1998 Annual Review).

Zinc

One of the three primary zinc refineries in the country is in Illinois: the Big River Zinc Company at Sauget in St. Clair County. The Illinois Smelting Company in Cook County processed secondary slab zinc (U.S. Geological Survey 1998i).

The principal uses of slab zinc are for electrogalvanizing and hot-dip galvanizing, mainly for steel sheets and strips. In Granite City, Madison County, one new hot-dip galvanizing plant began operating in 1996. Most of the secondary feed was crude zinc calcine recovered from dust generated by steelmaking using Electric Arc Furnaces. The dust was processed at the Horsehead Resource Development Company plants in Illinois, Pennsylvania, and Tennessee. At Alton, Madison County, the Laclede Steel Company constructed a facility that could process the 36,000 tons of dust generated by Electric Arc Furnaces each year. This facility started operating in 1992. Eagle Zinc Company at Hillsboro, Montgomery County, produces zinc oxide, which is sold directly for use in animal feed and other agricultural purposes.

Products Manufactured from Minerals

Cement

Production In 1998, four active cement plants in Illinois together produced 2.69 million tons of cement worth $198 million. The state manufactured about 3.21% of the total quantity of portland cement produced in the country. The 1998 figure was 3.7% greater than the 2.59 million tons produced in 1997 (table 1).

The four companies producing portland cement in Illinois were Illinois Cement Company, a subsidiary of Centex Corporation in La Salle County; Lone Star industries in La Salle County; Dixon-Marquette Cement, a subsidiary of Prairie Materials Sales, in Lee County; and Missouri Portland Cement Company, a division of Cementia Oldings AG, in Massac County.

Consumption In 1998, Illinois ranked sixth behind Texas, California, Florida, Ohio, and Georgia in the consumption of portland cement. The state consumed 3.64 million tons of portland cement and 0.8 million tons of masonry cement. Consumption increased by 3.5% from 3.52 million tons in 1997 to 3.64 million tons in 1998. The consumption of masonry cement fell by 2.4% from 82,000 tons in 1997 to 80,000 tons in 1998 (U.S. Geological Survey, 1998a).

Clay Products

Clays mined in the state and imported from outside are used for manufacturing clay products. Information on the amount and value of clay products manufactured in Illinois is not available. Whiteware and pottery are the main clay products manufactured in Illinois.

Lime

Lime refers to six chemicals manufactured by calcining high-purity calcitic or dolomitic limestone, followed by hydration of the oxide formed by calcining. Two plants in Cook County and one plant in Kankakee County produced the state's entire output. The south Chicago plant owned by Marblehead Lime Co., a division of General Dynamics, produced quicklime and hydrated lime. The McCook lime kiln in Cook County owned by Vulcan Materials Co. produced high-calcium quicklime. The Manteno plant in Kankakee County, also owned by Vulcan Materials Co., manufactured dolomitic quicklime.

The major applications of lime are in metallurgy (39%), water softening (26%), manufacture of chemicals (24%), construction (9%), and production of refractory dolomite (1%). The steel industry is the major consumer of lime, which is used as a flux in iron smelting. The steel industry accounted for about 30% of all lime consumed in the country. Lime is also used in the beneficiation of copper ores to neutralize the acidic effects of pyrite and other iron sulfides in nonferrous metallurgical processing. In the environmental sector, lime is used in the softening and clarification of municipal potable water. Lime is also used in sewage treatment for sludge stabilization, as a coagulant aid in the paper industry, and to make precipitated calcium carbonates, a specialty filler used in premium-quality white paper. Other uses of lime are in the manufacture of alkalies in the chemical industry, as "milk of lime" in sugar refining, as a flux in the manufacture of glass, for soil stabilization in the construction industry, and as agricultural lime.

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