

STATE OF ILLINOIS

DEPARTMENT OF REGISTRATION AND EDUCATION



# SOME ECONOMIC ASPECTS OF THE ILLINOIS OIL INDUSTRY

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ILLINOIS STATE GEOLOGICAL SURVEY

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## ABSTRACT

The 75 to 80 million barrels of crude oil produced annually in Illinois contribute significantly to income and employment within the state. Payment of royalties, wages and salaries, purchase of supplies and equipment, and payments for contract services provide a substantial economic stimulus to the oil producing districts. Refineries in Illinois and surrounding states process crude oil into refined products to serve industrial, transportation, and household needs within a broad Upper Mississippi Valley market area. Much of the oil processed in these refineries comes from the western and southwestern United States, while most of Illinois crude oil moves eastward to other refinery districts.

## ILLINOIS CRUDE OIL'S CONTRIBUTION TO INCOME AND EMPLOYMENT

Crude oil, estimated at 2.384 billion barrels and having an estimated value of 4.869 billion dollars, has been obtained from the oil fields of Illinois during the period from the 1880's through 1962. More than 82 percent of this oil and 88 percent of the value have occurred since 1937 when major production began in the Illinois Basin.

The production of crude oil has contributed inestimably to the economy of the state of Illinois and even more significantly to those counties in which the production occurred. Payments for royalties, wages, salaries, supplies and materials, and contract services as well as capital investments, pump millions of dollars into the oil producing regions each year. The full impact of this income upon the economies of the counties and of the state cannot be accurately measured, for in addition to direct income payments by the industry multiplying effects of the expenditure of this income upon the level of business activity and tax collections must be considered also.

Table 1 shows the annual production of crude oil in Illinois, the value of total production, and the average value per barrel; United States production and value per barrel also are shown. The quantity of oil runs to stills and receipts at refineries operating within Illinois are given also. These refineries process each year about  $2\frac{1}{2}$  times the quantity of oil produced in Illinois. In general, however, only about a third of the crude oil produced in Illinois is refined within the state. The remainder moves eastward to find its way into refineries in Indiana, Ohio, Pennsylvania, New York, Michigan, Kentucky, and Tennessee. Meanwhile, about 175 million barrels of crude oil move into Illinois from the west and southwest for processing each year.

TABLE 1 - UNITED STATES AND ILLINOIS PRODUCTION, AND AVERAGE VALUE PER BARREL OF CRUDE OIL PRODUCED, 1931-1961

United States <sup>a</sup>			Illinois <sup>b</sup>			
Year	Crude oil produced (1,000 bbls.)	Estimated av. value per barrel	Crude oil produced (1,000 bbls.)	Estimated total value (1,000)	Estimated av. value per barrel	Crude oil runs to stills and refinery receipts (1,000 bbls.)
1931	851,081	\$ 0.65	5,039	\$ 4,500	\$ 0.89	na
1932	785,159	0.87	4,673	4,720	1.01	na
1933	905,656	0.67	4,244	3,690	0.87	na
1934	908,065	1.00	4,479	4,990	1.11	na
1935	996,596	0.97	4,322	4,810	1.13	35,469
1936	1,099,687	1.09	4,475	5,390	1.23	39,803
1937	1,279,160	1.18	7,499	9,970	1.34	45,626
1938	1,214,355	1.13	24,075	30,100	1.30	46,996
1939	1,264,962	1.02	94,912	102,800	1.09	57,651
1940	1,353,214	1.02	147,647	160,900	1.09	73,422
1941	1,402,228	1.14	134,138	174,379	1.30	85,206
1942	1,386,645	1.19	106,590	144,962	1.36	91,676
1943	1,505,613	1.20	82,256	112,700	1.37	88,154
1944	1,679,904	1.21	77,413	107,370	1.39	95,146
1945	1,713,655	1.22	75,210	105,294	1.40	96,587
1946	1,733,939	1.41	75,297	119,722	1.59	100,114
1947	1,856,987	1.93	66,459	139,564	2.10	112,899
1948	2,020,185	2.60	64,808	179,518	2.77	121,064
1949	1,841,940	2.54	64,501	178,668	2.77	118,711
1950	1,973,574	2.51	62,028	171,818	2.77	128,249
1951	2,247,711	2.53	60,244	166,876	2.77	153,490
1952	2,289,836	2.53	60,071	166,397	2.77	159,272
1953	2,357,082	2.68	59,025	171,586	2.91	165,552
1954	2,314,988	2.78	66,940	200,820	3.00	169,635
1955	2,484,428	2.77	81,131	237,714	2.93	189,614
1956	2,617,283	2.79	82,314	242,826	2.95	203,567
1957	2,616,901	3.09	76,649	239,911	3.13	199,225
1958	2,448,987	3.01	80,779	242,337	3.00	207,277
1959	2,574,590	2.90	76,727	230,181	3.00	191,517
1960	2,574,933	2.92	77,341	230,338	2.98	199,578
1961	2,621,578	2.89	77,478	232,434	3.00	205,375
1962 <sup>c</sup>	2,676,185	2.90	78,800	236,400	3.00	205,712

na not available.

<sup>a</sup> U. S. Bureau of Mines Minerals Yearbooks.<sup>b</sup> Illinois Geological Survey data.<sup>c</sup> All 1962 figures are subject to revision.

In table 2 are shown the estimated total production of crude oil in Illinois counties since 1888, estimated production and value of oil output over the past ten years, and salient statistics on the Illinois oil industry in 1958, including county production, value, employment, and payroll data. Data for the years after 1958 are not available. Direct personal income from royalties (normally one-eighth of the oil production value at the wellhead) and from wages and salaries amounted to about 62 million dollars for 1958. Estimates for each county can be obtained from table 2.

Table 3 gives the reported expenditures for various items and for capital investments during 1958. It may be noted that in addition to salaries and wages a significant portion of the money was spent for items that were procured, at least in part, from local sources and thus contributed further to the local economies.

### STRUCTURE OF THE ILLINOIS-INDIANA OIL INDUSTRY

The oil industry in Illinois is engaged in discovering, producing, refining, transporting, and marketing crude oil and oil products in the Upper Mississippi Valley. Of major significance to these diverse functions are the group of refineries in the Illinois-Indiana area in Chicago, the refineries of the Wood River area, and those located in the southeast Illinois-southwest Indiana district. Refineries assemble crude oil supplies locally and by pipe line from the midcontinent and mountain states. By tank car, barge, and products pipe line, refined oils are distributed to markets in Illinois, Indiana, and adjacent states, including Wisconsin, Minnesota, Iowa, and Missouri.

#### Sources of Crude Petroleum for Refineries in Illinois and Indiana

Refineries in Illinois and Indiana receive about 10 percent of their crude oil supplies from producing fields in these states and the remainder from the gulf coast, midcontinent, and Rocky Mountain fields.

Sources and quantities of crude petroleum in 1960, 1961, and the average quantities for the five-year period, 1956-1960, are presented in table 1. This table indicates that shipments from Colorado, Kansas, North Dakota, and New Mexico have shown significant increases, while shipments from Oklahoma have remained stationary and those from Texas have declined.

#### Outgoing Illinois and Indiana Crude Oil Shipments

The U. S. Bureau of Mines reported production of crude oil in Illinois and Indiana as follows:

	(thousands of barrels)		
	<u>Illinois</u>	<u>Indiana</u>	<u>Total</u>
1960	77,341	12,054	89,395
1961	76,818	11,500	88,318
1956-60 average	79,054	11,837	90,891

A considerable portion of this crude petroleum was shipped to refineries in Ohio, Pennsylvania, and other eastern states. The relative importance of eastward shipments is shown in table 5.

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TABLE 2 - ILLINOIS CRUDE OIL PRODUCTION, VALUE AND EMPLOYMENT, BY COUNTIES, FOR SPECIFIED PERIODS

County	Estimated total production, 1888-1962 (1000 bbls.) <sup>a</sup>	Estimated production & value <sup>b</sup> 1953-1962 inclusive		Salient Statistics for 1958 <sup>c</sup>					
		(1000 bbls)	(1000)	Estimated production (1000 bbls.)	Estimated value (1000)	Employment in crude oil & natural gas production <sup>d</sup>		Employees in oil and gas field services <sup>d</sup>	
						Employees	Payroll (1000)	Employees	Payroll (1000)
Adams	105	105	\$ 314.0						
Bond	6,089	4,958	14,851.3	615	\$ 1,845	20	\$ 92		
Brown	162	162	484.5						
Christian	18,211	14,581	44,686.1	1,757	5,271	56	258		
Clark-									
Cumberland	82,282	16,521	49,385.0	1,730	5,190	163	751		
Clay	101,860	38,497	115,089.7	3,605	10,815	346	1,594		
Clinton	71,720	24,755	74,358.8	4,779	14,337	148	682		
Coles	16,655	6,299	18,865.5	554	1,662	95	437		
Crawford	195,946	31,638	94,706.5	2,999	8,997	482	2,220		
Douglas	2,703	2,703	8,174.6	316	948				
Edgar	2,420	1,038	3,094.3	90	270				
Edwards	35,621	14,928	44,634.9	1,721	5,163	126	580		
Effingham	10,288	4,705	14,066.3	427	1,281	105	484		
Fayette	297,548	112,660	337,963.0	14,089	42,267	228	1,050		
Franklin	55,832	21,769	64,954.5	2,175	6,525	77	355		
Gallatin	37,949	20,469	61,251.0	2,377	7,131	84	387	83	\$ 290
Hamilton	98,808	33,765	100,863.2	2,912	8,736	224	1,032		
Hancock-									
McDonough	4,946	601	1,795.6	56	168				
Jasper	37,860	13,747	41,030.2	1,731	5,193	63	290	106	370
Jefferson	64,908	24,318	72,775.4	2,630	7,890	272	1,253		
Lawrence	314,855	56,153	168,093.0	6,196	18,588	533	2,455		
Macon	636	645	1,933.9	80	240				
Macoupin	187	63	188.6	9	27				
Madison	14,843	4,090	12,192.1	344	1,032				
Marion	339,656	77,500	231,792.6	7,171	21,513	409	1,884		
Monroe	2	2	6.2						
Montgomery	100	40	119.2	3	9	443	2,040		
Moultrie	47	47	140.8	10	30			3	10
Perry	441	369	1,073.4	61	183				
Randolph	2,918	2,509	7,468.7	179	537				
Richland	78,253	26,567	79,288.9	2,198	6,594			154	538
St. Clair	2,883	169	500.8	7	21				
Saline	13,117	12,646	37,360.7	1,196	3,588	77	355		
Sangamon	603	603	1,802.9	30	90				
Schuyler	1	1	3.0						
Shelby	879	530	1,588.4	43	129				
Wabash	80,634	29,778	89,042.0	3,101	9,303	318	1,465		
Washington	21,121	9,300	27,773.8	917	2,751	53	244		
Wayne	174,567	64,833	193,674.2	6,529	19,587	538	2,478	117	409
White	201,955	82,773	247,368.9	8,083	24,249	530	2,441	372	1,299
Williamson	347	347	1,048.0	59	177	548	2,526	355	1,400
Total	2,389,958	757,184	\$2,264,802.3	80,779	\$242,337	5,938	\$27,353	1,190	\$4,316

<sup>a</sup> Mineral Production in Illinois in 1962, Illinois Geological Survey Circular 357, 1963, table 13.

<sup>b</sup> Estimates based on estimated average value per barrel each year.

<sup>c</sup> Statistics for 1958 are presented here because this is the latest year for which county employment statistics are available.

<sup>d</sup> 1958 Census of Mineral Industries, Vol. II Area Statistics, U. S. Department of Commerce, Bureau of the Census, 1961, p. 10-9 through 10-12.

TABLE 2 - ILLINOIS CRUDE OIL PRODUCTION, VALUE AND EMPLOYMENT, BY COUNTIES, FOR SPECIFIED PERIODS

County	Estimated total production, 1888-1962 (1000 bbls.) <sup>a</sup>	Estimated production & value <sup>b</sup> 1953-1962 inclusive (1000 bbls) (1000)		Salient Statistics for 1958 <sup>c</sup>						
				Estimated production (1000 bbls.)	Estimated value (1000)	Employment in crude oil & natural gas production <sup>d</sup>		Employees in oil and gas field services <sup>d</sup>		
						Employees	Payroll (1000)	Employees	Payroll (1000)	
Adams	105	105	\$ 314.0							
Bond	6,089	4,958	14,851.3	615	\$ 1,845	20	\$ 92			
Brown	162	162	484.5							
Christian	18,211	14,581	44,686.1	1,757	5,271	56	258			
Clark-Cumberland	82,282	16,521	49,385.0	1,730	5,190	163	751			
Clay	101,860	38,497	115,089.7	3,605	10,815	346	1,594			
Clinton	71,720	24,755	74,358.8	4,779	14,337	148	682			
Coles	16,655	6,299	18,865.5	554	1,662	95	437			
Crawford	195,946	31,638	94,706.5	2,999	8,997	482	2,220			
Douglas	2,703	2,703	8,174.6	316	948					
Edgar	2,420	1,038	3,094.3	90	270					
Edwards	35,621	14,928	44,634.9	1,721	5,163	126	580			
Effingham	10,288	4,705	14,066.3	427	1,281	105	484			
Fayette	297,548	112,660	337,963.0	14,089	42,267	228	1,050			
Franklin	55,832	21,769	64,954.5	2,175	6,525	77	355			
Gallatin	37,949	20,469	61,251.0	2,377	7,131	84	387	83	\$ 290	
Hamilton	98,808	33,765	100,863.2	2,912	8,736	224	1,032			
Hancock-McDonough	4,946	601	1,795.6	56	168					
Jasper	37,860	13,747	41,030.2	1,731	5,193	63	290	106	370	
Jefferson	64,908	24,318	72,775.4	2,630	7,890	272	1,253			
Lawrence	314,855	56,153	168,093.0	6,196	18,588	533	2,455			
Macon	636	645	1,933.9	80	240					
Macoupin	187	63	188.6	9	27					
Madison	14,843	4,090	12,192.1	344	1,032					
Marion	339,656	77,500	231,792.6	7,171	21,513	409	1,884			
Monroe	2	2	6.2							
Montgomery	100	40	119.2	3	9					
Moultrie	47	47	140.8	10	30			3	10	
Perry	441	369	1,073.4	61	183					
Randolph	2,918	2,509	7,468.7	179	537					
Richland	78,253	26,567	79,288.9	2,198	6,594	443	2,040	154	538	
St. Clair	2,883	169	500.8	7	21					
Saline	13,117	12,646	37,360.7	1,196	3,588	77	355			
Sangamon	603	603	1,802.9	30	90					
Schuyler	1	1	3.0							
Shelby	879	530	1,588.4	43	129					
Wabash	80,634	29,778	89,042.0	3,101	9,303	318	1,465			
Washington	21,121	9,300	27,773.8	917	2,751	53	244			
Wayne	174,567	64,833	193,674.2	6,529	19,587	538	2,478	117	409	
White	201,955	82,773	247,368.9	8,083	24,249	530	2,441	372	1,299	
Williamson	347	347	1,048.0	59	177					
Undistributed						548	2,526	355	1,400	
<b>Total</b>	<b>2,389,958</b>	<b>757,184</b>	<b>\$2,264,802.3</b>	<b>80,779</b>	<b>\$242,337</b>	<b>5,938</b>	<b>\$27,353</b>	<b>1,190</b>	<b>\$4,316</b>	

<sup>a</sup> Mineral Production in Illinois in 1962, Illinois Geological Survey Circular 357, 1963, table 13.  
<sup>b</sup> Estimates based on estimated average value per barrel each year.  
<sup>c</sup> Statistics for 1958 are presented here because this is the latest year for which county employment statistics are available.  
<sup>d</sup> 1958 Census of Mineral Industries, Vol. II Area Statistics, U. S. Department of Commerce, Bureau of the Census, 1961, p. 10-9 through 10-12.

TABLE 5 - OUTGOING SHIPMENTS OF ILLINOIS AND INDIANA CRUDE PETROLEUM

		1960	
Delete:	Total	76,048	12,201
Add:	Total	82,238	6,011
			88,249

## Refinery Location and Capacity

Refineries in Indiana are grouped with those in Illinois since both groups serve the same general market. The location, number, and daily capacity of refineries in 1962 are shown in table 6.

Also shown in table 6 are the locations, number, and capacities of other refineries in the market area or closely adjacent to it. Especially important in the latter group are the twelve refineries, with aggregate capacity of 163,739 barrels of crude per day, operating in Michigan and the two refineries, with a combined capacity of 130,000 barrels per day, operating near Kansas City.

## THE OIL MARKET

The relation of an oil market area to its source or sources of supply is difficult to delineate because data available on the consumption of oil products by states give no reference to the refineries from which they come. The Upper Mississippi Valley area (Illinois, Indiana, Wisconsin, Minnesota, Iowa, and Missouri) was selected for analysis because it constitutes the major market for Illinois and Indiana refined products, and this area probably fills the bulk of its requirements from Illinois and Indiana.

The strategic geographic positions of the Illinois-Indiana refining districts as suppliers of the Upper Mississippi Valley market are indicated in table 6. However, competition also is present from refineries on the periphery of the market area and from products pipe lines entering the area from more distant sources. The principal pipe lines involved are those of the Great Lakes Pipe Line Co., Cherokee Pipe Line Co., and Phillips Petroleum Company. Finally, oil products are barged into the area from refineries on the lower Mississippi River.

## Consumption of Oil Products

The six-state oil fuels market shown in table 7 represents about 16 percent of the national total and in recent years has been divided among the principal products in quantities as shown.

Distribution of oil by states and products for 1959 through 1961 and the average for the period 1956 to 1960 also are shown.

Refining of crude petroleum results in a number of products varying from the highly volatile gasoline—the fuel of the small internal combustion engine—to the heavy residual fuel oil. The refinery classification of products based on ascending degrees of viscosity is gasoline, kerosene, distillate, and residual fuel oil.

Although there is a degree of overlapping of services among these fuels, each has a particular function in the energy market.

Table 8 shows the heat content of the major fuels, including the four oil-derived fuels. Consumption of gasoline, kerosene, distillate, and residual fuel oil in the six state area is in table 9. The differential growth rates among these fuels arises from distinctive competitive conditions within each group.

## Gasoline

Consumption of gasoline, used primarily as a fuel for automobiles, from 1950 to 1961 inclusive is shown in table 9 by states. In this 11-year period the

TABLE 3 - REPORTED EXPENDITURES IN OIL AND GAS PRODUCTION IN ILLINOIS, 1958

Item of expenditure	Amount
Principal expenses	\$ 76,895,000
Wages of production and development workers	21,312,000
Salaries of all other employees	6,869,000
Supplies and materials	18,160,000
Gas purchased for gas lift and repressuring	135,000
Fuel purchased	2,686,000
Electric energy purchased	3,992,000
Contract work	23,741,000
Capital expenditures	\$ 26,549,000
Development and exploration of mineral properties	11,064,000
Buildings, machinery, and equipment	15,485,000

Source: 1958 Census of Mineral Industries, Volume I, Summary and Industry Statistics, United States Department of Commerce, Bureau of the Census, 1961, p. 13B-23.

TABLE 4 - SOURCE OF CRUDE OIL FOR ILLINOIS-INDIANA REFINERIES, 1961, 1960, AND 1956-60 AVERAGE (thousands of barrels)

Producing state	1961			1960			1956-60 average		
	to		Total	to		Total	to		Total
	Illinois	Indiana		Illinois	Indiana		Illinois	Indiana	
Illinois	29,906	7,826	37,732	26,801	7,525	34,326	24,639	6,209	30,849
Indiana		1,347	1,347		1,335	1,335	899	1,055	1,954
Indiana-Michigan	1,213		1,213	1,458		1,458			
Total	31,119	9,173	40,292	28,259	8,860	37,119	25,538	7,264	32,803
Michigan		507	507		364	364			
Colorado	2,450	9,681	12,131	3,252	7,985	11,237	1,493	4,031	5,524
Kansas	10,950	20,496	31,446	9,513	21,491	31,004	12,420	2,441	14,861
Kentucky, Ohio		33	33		35	35		12	12
Louisiana	1,630		1,630	771		771	324		324
Montana	446	9,621	10,067		8,028	8,028	252	6,030	6,282
Nebraska, North Dakota, South Dakota	1,475	10,045	11,520	929	9,515	10,444	2,542	3,573	6,115
New Mexico	15,045	7,394	22,439	11,807	7,720	19,527	8,543	3,734	12,277
Oklahoma	27,172	29,441	56,613	28,470	27,114	55,584	26,928	28,950	55,878
Texas	95,544	20,332	115,876	96,276	24,880	121,156	92,665	35,882	128,547
Utah	1,809		1,809	5,107		5,107	3,136		3,136
Wyoming	17,656	38,969	56,625	15,094	37,785	52,879	13,466	35,598	49,064
Grand Totals	205,296	155,692	360,988	199,478	153,777	353,245			

Source: Minerals Yearbooks, U. S. Bureau of Mines, annual copies.



TABLE 5 - OUTGOING SHIPMENTS OF ILLINOIS AND INDIANA CRUDE PETROLEUM  
(thousands of barrels)

Destination	Illinois	Indiana	Total	Illinois	Indiana	Total
	1960			1961		
New York: West	2,420		2,420	2,790		2,790
Pennsylvania: West	1,851		1,851	1,782		1,782
Illinois	26,081	1,458 <sup>a</sup>	27,539	29,906	1,213 <sup>a</sup>	31,119
Indiana	7,525	1,335	8,860	7,826	1,347	9,173
Kentucky, Tenn.		3,218 <sup>a</sup>	3,218		2,221 <sup>a</sup>	2,221
Michigan	3,268		3,268	2,650		2,650
Ohio: East	27,396		27,396	26,901		26,901
Ohio: West	13,697		13,697	14,206	116 <sup>a</sup>	14,322
TOTAL	76,048	12,201	88,249	86,061	4,897	90,958

Source: Monthly Petroleum Statement No. 465, April 10, 1961. Bureau of Mines, Table 23, page 23, and Table 23, Statement No. 478, April 10, 1962.

<sup>a</sup> Indiana-Michigan combined.

TABLE 6 - REFINERY LOCATIONS AND CAPACITIES

Area	Capacity <sup>a</sup>	Number of Refineries
Chicago District Illinois and Indiana	592,000	9
Wood River - E. St. Louis	340,500	4
Southeastern Illinois	128,800	3
Other Indiana	48,100	6
Kentucky, (Louisville)	17,000	1
Michigan	163,739	12
Kansas City (Kansas and Missouri)	130,400	2
Minnesota	79,200	4
Wisconsin	25,000	2

Source: Petroleum Refineries in the United States, January 1, 1963, U. S. Bureau of Mines.

<sup>a</sup> Barrels of crude oil per day.

TABLE 7 - CONSUMPTION OF REFINED PRODUCTS IN THE SIX STATE AREA,  
1961, 1960, 1959, and 1956-60 AVERAGE  
(thousands of barrels)

State	Gasoline	Kerosene	Distillate	Residual Oil	Total
1961					
Illinois	73,835	5,007	42,472	25,750	147,064
Indiana	43,374	3,676	25,842	11,998	84,890
Wisconsin	32,753	2,971	22,330	4,028	62,082
Minnesota	32,702	1,991	15,849	5,524	56,066
Iowa	28,863	2,303	9,990	1,032	42,188
Missouri	41,775	1,466	12,820	2,638	58,699
Total	253,302	17,414	129,303	50,970	450,989
1960					
Illinois	73,591	5,359	42,490	25,893	147,333
Indiana	43,529	3,892	25,596	12,885	85,902
Wisconsin	32,690	2,958	21,711	4,275	61,634
Minnesota	32,916	2,565	16,241	6,363	58,085
Iowa	28,837	2,582	11,141	1,021	43,581
Missouri	41,864	2,083	12,830	3,026	59,803
Total	253,427	19,439	130,009	53,463	456,338
1959					
Illinois	72,221	5,546	40,939	23,689	142,395
Indiana	42,777	4,231	23,329	13,035	83,372
Wisconsin	31,529	3,714	19,345	4,167	58,755
Minnesota	31,618	2,486	14,358	6,399	54,861
Iowa	28,378	2,749	10,816	1,067	43,010
Missouri	41,271	2,737	12,093	3,394	59,495
Total	247,794	21,463	120,880	51,751	441,888
1956-1960 Average					
Illinois	70,254	5,550	39,388	24,089	139,281
Indiana	41,774	3,801	22,890	13,567	82,032
Wisconsin	30,795	2,790	19,087	3,278	55,950
Minnesota	30,747	2,352	16,912	4,734	54,745
Iowa	27,750	2,503	11,386	1,045	42,684
Missouri	39,748	2,239	12,785	4,418	59,190
Total	241,068	19,234	122,447	51,131	433,880

Source: Minerals Yearbooks, Bureau of Mines, 1955 to 1959.

average annual growth in gasoline consumption was 4.1 percent, but since 1957 distinct signs of a declining rate are appearing. This has been attributed to the introduction of compact cars, but other factors not presently discernible also may be contributing factors.

#### Kerosene

Kerosene consumption shows small gains only. Kerosene is used as a range oil, space heater, tractor fuel, and as a furnace oil for certain types of furnaces.

#### Distillate

Distillate fuel has shown the greatest increase among the liquid fuels in the six state area. The principal outlet for distillate is in domestic and commercial heating. The post-war history of distillate fuel use has been that of a replacement of coal for domestic and commercial heating. This is shown in the large increases of fuel consumption each year until about 1957. Displacement of oil heating by natural gas is the factor now significantly affecting heating oil sales adversely. Minor quantities of distillate fuel oil are used by power plants, manufacturing industries, and armed forces.

Diesel fuel is drawn from both the kerosene and distillate groups and is used mainly in railroad locomotives and in lake and ocean vessels and river barge tows. However, it is also used in diesel trucks and tractors.

#### Residual

Residual fuel oil, a product that usually sells for less than the price of crude oil at refineries, competes directly with coal and natural gas for heavy fuel uses. Since it cannot be moved by pipe line, distribution depends primarily on cheap water transport and limited tank-car movements. Consumption of residual fuel oil increased very slowly in the decade from 1950 to 1961. Seventy percent or more of the sales of residual fuel oil consumed in the six state area is in the states of Illinois and Indiana near refinery locations and in heavily industrialized areas. Although imports of residual fuel oil into the United States were placed under mandatory oil import regulations in April 1959, by Presidential Proclamation No. 3279, it is doubtful if this had effect in the six state area. Residual fuel oil prices here must meet the effective competition of nearby coal, which is efficiently produced and delivered to markets.

### FUEL AND ENERGY IN INDUSTRY

Within industry the range of fuel requirements is so wide that a correspondingly wide variety of fuels is needed to meet them. In the power-using industries, the many kinds of engines call for fuels in various specialized forms. In industries where fuel is used only to provide heat a substitution often can be made.

A general classification of fuel-using industries is shown below.

#### CLASSIFICATION OF FUEL USING INDUSTRIES

##### SMELTING AND REFINING

MANUFACTURING – power-using industries including mobile units; heat-using industries

TABLE 8 - HEAT CONTENT OF FUELS

Item	Unit	BTU's per unit
Bituminous Coal . . . . .	ton	26,200,000
Anthracite . . . . .	ton	27,200,000
Crude oil . . . . .	bb1.	6,000,000
Natural gas:		
Before treatment . . . . .	cu. ft.	1,075
After treatment . . . . .	cu. ft.	1,000
Natural gasoline . . . . .	bb1.	4,620,000
Coke-oven and manufactured gas products:		
Coke . . . . .	ton	26,000,000
Gas . . . . .	cu. ft.	Converted to 540
Tar . . . . .	bb1.	6,300,000
Light oils . . . . .	bb1.	5,460,000
Refinery products:		
Motor fuel . . . . .	bb1.	5,250,000
Kerosene . . . . .	bb1.	5,640,000
Diesel and gas oil . . . . .	bb1.	5,920,000
Residual fuel oil . . . . .	bb1.	6,270,000
Coke . . . . .	bb1.	6,000,000
Lubes . . . . .	bb1.	6,060,000
Wax . . . . .	bb1.	5,570,000
Asphalt . . . . .	bb1.	6,640,000
Road oil . . . . .	bb1.	6,640,000
Shale:		
Ore . . . . .	ton	4,000,000
Oil . . . . .	bb1.	6,000,000

Source: U. S. Bureau of Mines, Information Circular 7582, Energy Uses and Supplies, 1939, 1947, 1965, Table 19, p. 32, 1950.

TABLE 9 - SUMMARY OF LIQUID FUEL CONSUMPTION IN SIX STATE AREA (thousands of barrels)

Year	Gasoline	Change %	Kerosene	Distillate	Change %	Residual Fuel Oil
1950	180,056		19,101	76,569		46,212
1951	188,295	+4.6	20,196	86,194	+12.6	48,143
1952	197,442	7.9	19,733	90,738	+ 5.3	48,420
1953	205,940	+3.8	18,105	93,190	+ 2.7	49,191
1954	212,568	+3.2	18,992	98,230	+ 5.4	44,915
1955	222,296	+4.1	18,422	109,385	+11.4	48,540
1956	230,209	+3.6	18,413	116,444	+ 6.4	50,345
1957	234,362	+1.8	14,712	116,673	+ 0.2	48,167
1958	239,960	+2.4	22,158	127,729	+ 9.5	51,945
1959	247,794	+3.3	21,463	120,880	- 5.4	51,751
1960	253,427	+2.2	19,439	130,009	+ 7.6	53,463
1961	253,302	-0.05	17,914	129,303	- 0.5	50,960

Source: U. S. Bureau of Mines Minerals Yearbook.

## ELECTRIC UTILITIES

TRANSPORTATION – rail, highway (truck, bus and automobile), air transport,  
water transport

AGRICULTURE – mobile tractor power, electric power

CONSTRUCTION – mobile earth moving equipment, portable electrical equipment,  
trucks and industrial tractors

MINING – earth-moving equipment, mine locomotives, hoisting equipment,  
mechanical mining equipment, ventilation equipment

In supplying heat or power to the several industries under each of the categories in this classification, each fuel is selected with two general considerations in mind. Technology sets the limits within which one fuel can be substituted for another. Comparative cost is the selective mechanism by which one out of several possible fuels is chosen.

Table 10 shows the quantity (in coal equivalent) and cost of fuels used in manufacturing industries within the six state area for the years 1947, 1954, and 1958. Detailed data on quantities and costs of the several fuels are available from census reports in these years. Oil fuels represent about 10 percent of the total fuel contribution and 17.19 percent of the cost. Although fuel oil costs are considerably above coal or natural gas, other factors favor the use of oil as a fuel in certain industries or industrial operations.

Comparative costs of coal, coke, fuel oil, and gas, used in the primary metal industries in 1954, were reported at 26, 61, 52 and 35 cents per million BTU, respectively (see Circular 259, Illinois Geological Survey, p. 16).

The blast furnace, the largest single user of fuel among the manufacturing industries, depends almost exclusively at present upon coke, the specially prepared fuel obtained from coal. It accounts for about 30 percent of all fuel energy used by manufacturing industries within the United States. Recent experiments indicate that the addition of oil, natural gas, or coal to the blast furnace can effect a saving in the amount of costly coke consumed. These experiments have not yet affected appreciably the demand for oil products but may provide a market in the future. In most other manufacturing activities, oil fuels or gas can meet the fuel requirements as well as coal, and comparative cost or convenience in use is the governing factor.

In electric-power production, oil fuel contributes about one percent of the total. Coal dominates and will continue to dominate the electric utility market because of its lower cost. The extent to which natural gas is used in this industry is primarily the result of a special rate on gas obtained under an industrial interruptible contract.

The introduction of the Diesel locomotive in 1940 effected a gradual but measurable change in type of fuel consumption by railroads as shown in table 11. Coal consumption decreased from a peak of 139 million tons in 1944 to 2.1 million tons in 1960; fuel oil declined from a peak of 116 million barrels in 1933 to 5.6 million barrels in 1959. Meanwhile, diesel fuel consumption climbed from 41 million gallons in 1940 to 3,759 million gallons in 1960. Annual increase in consumption was rapid until 1955 after which year railroad fuel consumption stabilized at about 3,600 million gallons per year. In short, the introduction of the diesel locomotive has brought about a virtual displacement of coal as a fuel and replaced it almost exclusively with distillate. Future increases in consumption of distillate will be very modest.

Quantities of oil fuels used in the agricultural, construction, and mining industries are difficult to estimate.

TABLE 10 - FUELS AND MANUFACTURING - SIX STATE AREA 1947, 1954, and 1958  
(thousands)

Fuel	Year	Tons Equivalent of Coal	Percent of Total	Cost	Percent of Total
Coal	1958	18,880	35.8	\$141,337	20.4
	1954	20,605	27.5	145,382	23.3
	1947	25,632	34.8	145,504	30.8
Coke	1958	10,142	19.2	288,797	41.6
	1954	10,614	14.2	209,307	33.5
	1947	12,373	16.8	174,520	37.0
*Fuel oil	1958	7,219	13.7	103,004	14.9
	1954	6,885	9.2	98,506	15.8
	1947	6,844	9.3	88,140	18.9
Gas	1958	16,448	31.2	160,349	23.1
	1954	36,813	49.1	170,799	27.4
	1947	28,822	39.1	63,458	13.4
Total	1958	52,689		\$693,487	
	1954	74,917		623,994	
	1947	73,671		471,622	

\*Fuel Oil: 4.400 BBL = 1 ton of coal.

Source: Census of Manufactures, U. S. Department of Commerce

TABLE 11 - FUEL USED BY RAILROADS

Year	Thousand tons Coal	Thousand barrels Fuel Oil	Million gallons Diesel Fuel
1960	2,101	7,088	3,759
1959	3,193	5,613	3,688
1958	4,171	5,775	3,519
1957	8,625	6,774	3,704
1956	12,921	10,715	3,718
1955	15,886	14,867	3,527
1954	16,732	15,863	3,231
1953	28,998	27,646	3,141
1952	39,092	39,935	2,841
1951	55,874	54,424	2,459
1950	64,855	60,386	1,979
1949	66,920	63,158	1,535
1948	102,256	89,722	1,207
1947	112,373	96,745	800
1946	110,385	98,442	560
1945	124,220	111,966	454
1944	138,808	113,314	331
1943	133,174	115,563	231
1942	128,308	99,652	186
1941	107,628	80,725	121
1940	91,726	65,198	81

Source: U. S. Bureau of Mines.

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