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URBANA

REPORT OF INVESTIGATIONS—NO. 54

THE MARKET FOR ILLINOIS OIL
IN 1937 AND 1938

BY

WALTER H. VOSKUIL



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CONTENTS

	PAGE
Illinois in the national oil picture.	6
Producing fields.	6
Refining districts.	6
Relation of refining districts to producing districts.	8
Central Refining District and its relation to the Illinois oil industry.	10
Relation of refineries to source of crude petroleum.	10
Description by refining districts.	11
Refined products.	13
Market for oil products.	15
Water transportation of oil products.	18
Oil shipments on the Upper Mississippi Waterway.	19
Summary of water-borne commerce in oil products.	19
Competitive position of Illinois oil.	20
Pipe line connections.	21
New refineries.	24
Gasoline recovery.	24
Disposal of residual stocks.	25
Geographic distribution of residual oil market.	26
Commercial and domestic heating.	27
Market for residual oils.	27
Geographic distribution of residual oil consumption in Illinois.	28
Summary of the Illinois market.	30
Illinois oil production and refining capacity.	30
Possible changes in crude oil supply.	33
Oklahoma and the Central Refining District.	34
Kansas and the Central Refining District.	35

ILLUSTRATIONS

FIGURE

1. Daily capacity of U. S. crude oil refineries, by districts, Jan. 1, 1938.	7
2. Refineries in the Central Refining District, Jan. 1, 1939.	12
3. Ratio of Illinois production of crude oil to runs-to-stills in the Central Refining District, 1937-38.	20
4. Oil production in the Central Refining District and in Illinois, 1937-38.	21
5. Consumption of industrial fuel oils in Illinois (including crude oils and gas oils and gas oils used as fuel) by market areas, 1929.	29
6. Location of principal Illinois oil fields and their pipe line connections.	31

TABLES

	PAGE
1. Petroleum in Illinois and the United States, 1936-38.	5
2. Petroleum production in the United States, by principal districts, 1937-38.	6
3. Refining districts, location and capacity, as of Jan. 1, 1938	7
4. Movement of crude oil from mid-Continent to refining districts, 1937.	9
5. Crude oil shipped from principal oil-producing states to Central Refining District refineries, 1937.	9
6. Capacities of refineries, by states, Jan. 1, 1938.	10
7. Refineries by market groups in the Central Refining District.	11
8. Crude runs-to-stills in the Central Refining District, 1932-38.	13
9. Sources of crude petroleum in states comprising the Central Refining District, 1937.	14
10. Output of refined products in the Central Refining District, 1936-38.	14
11. Production and consumption of three major oil products, 1936-37.	15
12. Consumption of major oil products in the Central Refining District market territory, 1936-37.	16
13. Consumption of fuel oil, by uses, in the Central Refining District market territory, 1936-37.	17
14. Lakewise shipments of principal oil products from Lake ports, 1936.	18
15. Lakewise receipts of principal oil products at Great Lakes ports, 1936.	19
16. Movement of principal oil products on the Mississippi river from Minneapolis, Minnesota to mouth of Missouri river, 1936.	19
17. Shipments of principal oil products on the Illinois Waterway, 1936.	20
18. Ratio of Illinois production to runs-to-stills in the Central Refining District, 1937-38.	22
19. Crude oil capacity in United States plants, Jan. 1, 1938.	25
20. Production of residual oils in the Central Refining District, 1937-38.	26
21. Sales of heating oil, by states, 1934-37, and approximate per capita consumption in 1937.	27
22. Consumption of fuel oils (including crude oils and gas oils used as fuel), 1929.	28
23. Production of petroleum in Illinois, 1907-16.	33
24. Petroleum production and change, in mid-Continent fields and Illinois, 1933-38.	34
25. Production and consumption of Oklahoma crude petroleum, by specified areas, 1936-37.	34
26. Production and consumption of Kansas crude petroleum, by specified districts, 1936-37.	36

THE ILLINOIS OIL MARKET AREA IN 1937 and 1938

BY

WALTER H. VOSKUIL

The rapid rise in the production of petroleum in Illinois since the opening of the discovery well in the deep portion of the Illinois basin at Clay City by the Pure Oil Company on February 2, 1937, has brought with it the problem of the profitable disposal of this crude petroleum and the refined products obtained therefrom. The rise in production since 1936, the last year in which production was derived solely from the old fields, is as follows:

TABLE 1.—PETROLEUM PRODUCTION IN ILLINOIS AND THE UNITED STATES, 1936-38,^a
(Thousands of barrels)

Year	PRODUCTION		Per cent, Illinois, of total
	Illinois	United States	
1936	4,475	1,099,687	0.41
1937	7,426	1,277,653	0.58
1938	23,929	1,212,530	1.97

^a U. S. Department of the Interior, Bureau of Mines, Monthly Petroleum Statements.

In terms of percentage increase of the national total, the gain in Illinois output is not a large figure. Nevertheless, the quantity of petroleum added to the national supply has seriously affected previously existing market connections and made necessary curtailed operations in mid-Continent fields to the extent that their customary output was displaced by oil produced in Illinois. The districts particularly affected were those located in Oklahoma and Kansas, and to a lesser degree the oil-producing districts in Texas and in some eastern fields.

The more important factors contributing to the displacement of mid-Continent oil by oil produced from the Illinois basin are:

- The low cost of producing Illinois oil
- The nearness of large oil consuming markets
- The absence of proration in Illinois

Under these conditions, it is possible to expand Illinois production to a considerable degree and, under conditions of free competition, to dispose of a large

quantity of oil in a market near which the Illinois oil fields are favorably located.

In this paper an attempt will be made to measure the extent of the market for crude oil and for refined products within which Illinois oil can find an outlet.

ILLINOIS IN THE NATIONAL OIL PICTURE

A clearer perspective of the position of Illinois in the oil market can be obtained by presenting, in brief summary form, a pattern of the oil producing and oil consuming districts of the United States.

PRODUCING FIELDS

The principal oil producing fields in the United States and their contribution to the total oil supply in 1937 and 1938 are shown in table 2.

TABLE 2.—PETROLEUM PRODUCTION IN THE UNITED STATES,
BY PRINCIPAL FIELDS, 1937-38.
(Thousands of barrels)

Field	1937 ^a	Per cent	1938 ^b	Per cent
Mid-Continent.....	774,717	60.5	677,253	55.8
California.....	238,521	18.7	249,749	20.5
Gulf Coast.....	176,743	13.9	181,478	15.0
Rocky Mountain.....	26,576	2.0	25,323	2.1
Central West (Ill., Ind., Ky., Mich., Ohio).....	34,014	2.7	53,228	4.4
Eastern fields.....	28,512	2.2	26,155	2.2
Other.....	77	.....	68	.....
Total.....	1,279,160	100.0	1,213,254	100.0

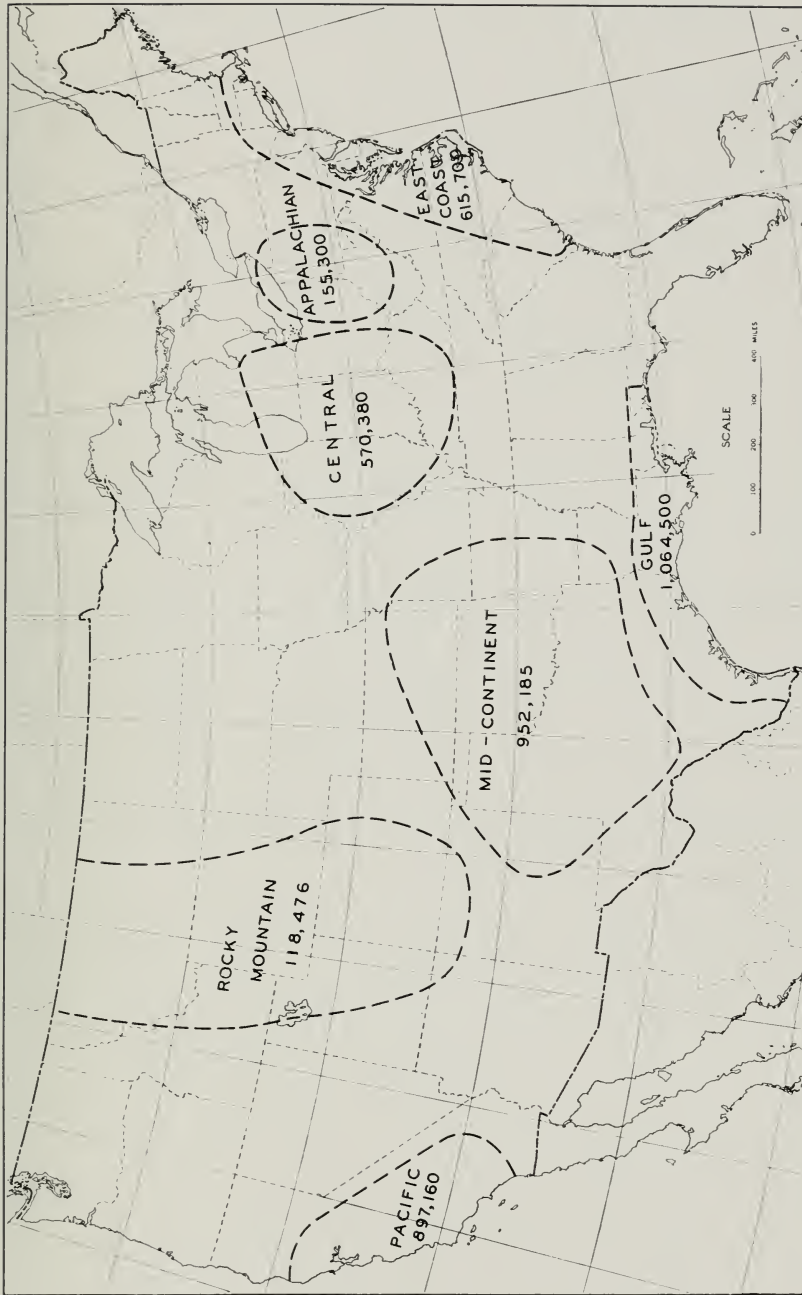
^a U. S. Bureau Mines, Minerals Yearbook, p. 823, 1938.

^b U. S. Bureau Mines, Monthly Petroleum Statement No. 180.

REFINING DISTRICTS

The primary consumer of crude petroleum is the refinery, and therefore the location and capacity of refineries determines the direction and quantity of crude oil flow from the producing fields. For statistical purposes, the Bureau of Mines has divided the nation into 10 refining districts. Some of these are located primarily in oil producing districts and others are located mainly or solely in oil consuming areas. The daily refining capacity by districts is shown in table 3.

Figure 1 shows a map of the United States with principal refining districts outlined.



Above map not subject to copyright. Illinois State Geological Survey.

FIGURE 1.—Daily capacity of U. S. crude oil refineries, by districts, Jan. 1, 1938.

RELATION OF REFINING DISTRICTS TO PRODUCING DISTRICTS

Since Texas, Oklahoma, Louisiana, Kansas, and New Mexico supply 90 per cent of the crude oil produced east of California, it is evident that there is a large interstate movement of petroleum. The movement from these states to refining districts for the year 1937 is shown in table 4.

TABLE 3.—REFINING DISTRICTS, LOCATION, AND CAPACITY
AS OF JAN. 1, 1938.^a
(Barrels per day)

District	CRUDE OIL CAPACITY			
	Operating	Shut down	Building	Total
East Coast.....	595,900	19,800	35,000	615,700
Appalachian.....	136,450	18,850	—	155,300
Ind., Ill., Ky., etc.....	512,110	50,570	48,400	570,380
Mid-Continent:				
Okla., Kans., Mo., etc.....	390,580	76,870	7,500	467,450
Texas inland.....	264,680	103,055	1,000	367,735
Ark., La., inland.....	99,500	11,500	11,000	117,000
Gulf Coast:				
Texas.....	906,500	9,500	94,200	916,000
Louisiana.....	143,500	—	5,000	148,500
Rocky Mountain.....	102,366	12,260	4,000	118,476
California.....	818,610	78,550	76,920	897,160
Total.....	3,970,196	380,955	283,020	4,634,171

^a Petroleum Refineries, including cracking plants, in the United States, Jan. 1, 1938, U. S. Bureau Mines, Inf. Cir. 7034, p. 4, 1938.

It will be noted from an examination of this table that the two principal crude oil movements from the mid-Continent and Gulf Coast to outside refining districts are to the East Coast Refining Districts and to the Central Refining District. A smaller quantity moves to the Appalachian refining District and negligible quantities move into the Rocky Mountain Refining District. A further examination of the table shows that the largest portion of Texas oil moving to refining districts outside of the mid-Continent and gulf coast refining districts is shipped to the East Coast and only a small proportion moves into the Illinois-Indiana-Kentucky-etc. Refining District.¹

On the other hand, Oklahoma, Kansas, and New Mexico ship a considerable portion of their output to refineries in the Central Refining District. Minor quantities are also received from Texas. The quantities and percentages shipped from these states in 1937 into this district are shown in table 5.

¹ Hereafter referred to as the Central Refining District.

TABLE 4.—MOVEMENT OF CRUDE OIL FROM MID-CONTINENT
TO REFINING DISTRICTS, 1937.^a
(Thousands of barrels)

To East Coast:		To Texas Gulf:	
From Texas.....	126,674	From Texas.....	208,544
Oklahoma.....	12,543	Oklahoma.....	17,201
Louisiana.....	19,043	Louisiana.....	40,497
N. Mexico.....	9,072	N. Mexico.....	14,953
	167,302		281,195
To Appalachian:		To Louisiana Gulf:	
From Texas.....	160	From Texas.....	26,314
Oklahoma.....	13,034	Oklahoma.....	434
Kansas.....	26,727	Louisiana.....	19,451
	39,921	N. Mexico.....	1,714
To Illinois-Indiana- Kentucky, etc:			47,913
From Texas.....	12,474	To Arkansas and Louisiana Inland:	
Oklahoma.....	85,795	From Texas.....	11,143
Kansas.....	26,727	Louisiana.....	5,370
N. Mexico.....	10,260		16,513
	135,256	To Rocky Mountains:	
To Texas Inland:		From Texas.....	500
From Texas.....	71,893	N. Mexico.....	1,478
Oklahoma.....	1,073		1,978
Louisiana.....	670		
N. Mexico.....	2,184		
	75,825		

^a U. S. Bureau Mines, Minerals Yearbook, p. 847, 1938.

TABLE 5.—CRUDE OIL SHIPPED FROM PRINCIPAL OIL
PRODUCING STATES TO CENTRAL REFINING
DISTRICT REFINERIES, 1937.^a

	Quantity shipped (Thousands of barrels)	Per cent of State output
Texas.....	12,474	2.4
Oklahoma....	85,795	37.5
Kansas.....	26,727	37.8
New Mexico.	10,260	26.4

^a U. S. Bureau Mines, Minerals Yearbook, p. 847, 1938.

Since petroleum from Illinois fields is processed mainly in the refineries of the Central Refining District, the principal competition comes from the Oklahoma-Kansas-New Mexico oil fields. These sources of oil received in the Central Refining District, the disposal of the products, and the market for refined products in the consuming district tributary to this refining district will therefore be analyzed in detail.

CENTRAL REFINING DISTRICT AND ITS RELATION TO THE ILLINOIS OIL INDUSTRY

The Central Refining District² includes refineries in Illinois, Indiana, Kentucky, Michigan, and western Ohio. The distribution of refineries in operation Jan. 1, 1939 is shown in figure 2. The capacity of refineries in operation on Jan. 1, 1938, is shown in table 6.

TABLE 6.—CAPACITIES OF REFINERIES BY STATES,
JAN. 1, 1938,^a
(Barrels per day)

State	Capacity	Cracking
Illinois	142,800	46,310
Indiana ^b	228,000	75,500
Kentucky	28,600	8,150
Michigan	68,350	10,050
Western Ohio	93,900	37,200

^a U. S. Bureau Mines, Petroleum Refineries, including cracking plants, in the United States, Inf. Cir. 7034, January 1, 1938.

^b Practically all located in the Chicago district.

The above includes plants that are shut down. The first column represents the maximum daily average crude throughput of the plant in complete operation on straight distillation, with due allowance for time closed down. The capacity of cracking plants is given as the maximum daily production of cracked gasoline.

Of more significance for a study of the market than a tabulation of refinery capacities by states is the geographical location of the refineries with respect to their accessibility to supplies of crude oil. For this purpose, the tabulation of capacities, as given in table 7, is assembled to group refineries according to group location.

RELATION OF REFINERIES TO SOURCE OF CRUDE PETROLEUM

The refineries located within the Central Refining District vary in capacity from small plants of 2,000 to 3,000 barrels daily capacity to large refineries with capacities ranging from 10,000 to 40,000 barrels and one plant with 100,000 barrels capacity. Some of the small refineries depend entirely upon local supplies of crude oil whereas the large refineries have pipe line connections with producing fields in the mid-Continent area.

Practically all of the larger refineries are equipped with cracking plants for increasing the recovery of gasoline from crude oil. These types of refineries also manufacture lubricants, waxes, and special products in addition to the several

² Designated by the Bureau of Mines as the "Illinois-Indiana-Kentucky-etc." Refining District.

oil fuels. The smaller refineries confine their operations to the recovery of gasoline by straight run distillation together with the recovery of kerosene, gas oil and distillate fuel, and residual fuel oils.

Description by refinery districts.—The largest aggregate and individual refinery capacities are located in the Chicago industrial area which includes Lockport and Joliet. Refineries in Indiana are all located in the Chicago district with the exception of a small skimming plant of 200 barrels daily capacity at Troy. Refineries in the Chicago district have four pipe line connections with producing fields in Texas, Oklahoma, and Kansas. Since the development of the Illinois basin fields, pipe line connections have been established there.

TABLE 7.—REFINERIES BY MARKET GROUPS IN THE CENTRAL REFINING DISTRICT.^a

(Barrels per day)

Group	Capacity	Cracking Capacity
Chicago district (Ill. and Ind.).....	266,500	57,810
Southeastern Illinois....	26,000	7,200
Western Illinois (E. St. Louis-Wood River....	66,910	27,610
Kentucky.....	28,600	8,150
Michigan.....	68,350	10,050
Ohio, Lake Erie ports....	64,500	28,700
Ohio, interior.....	11,900	2,700
Ohio, Cincinnati.....	18,000	8,000

^a Petroleum refineries, including cracking plants, in the United States, Jan. 1, 1938: U. S. Bureau Mines, Inf. Cir. 7034, 1938.

Refineries in the southeastern Illinois field have a daily capacity of 26,000 barrels and a cracking capacity of 7,200 barrels daily. The refinery at Lawrenceville, with a capacity of 16,000 barrels, is connected with the mid-Continent field through the Illinois Pipe Line Company and with the Illinois basin fields through the Central States pipe line. The refinery in Robinson has depended mainly on local crude oil supplies but is connected with the mid-Continent through the Texas-Empire pipe line.

Refineries in the Wood River crossing and East St. Louis district are served by three pipe lines from the mid-Continent with connections in Kansas, Oklahoma, and Texas. Pipe line connections have also been established between the Illinois fields at Centralia and Salem *via* the Illinois Pipe Line Company to the refinery at East St. Louis *via* the Wood River connection.

Refineries in Kentucky are all small in size, the largest being at Latonia (near Cincinnati), Ohio, with a daily capacity of 8,000 barrels. This refinery is served by a branch line of the Illinois Pipe Line Company with connections

in the mid-Continent field. The remaining refineries probably serve a local market and do not extend their activities into the Illinois basin area.

The Michigan refineries are mainly small plants, the largest refineries having a daily capacity of 8,000 barrels with an average daily capacity of less than 3,000 barrels. Michigan petroleum, in addition to a market outlet in the refineries in the field, is also carried by pipe line to Detroit, Toledo, Port Huron, and Canadian refineries.



Above map not subject to copyright. Illinois State Geological Survey.

FIGURE 2.—Refineries in the Central Refining District, Jan. 1, 1939.

In western Ohio, the largest refining capacity is located in the Toledo district. These refineries have pipe line connections with the mid-Continent, the Michigan fields, and the Illinois basin. The refineries in west-central Ohio, located at Lima and Findlay, have a capacity of 11,900 barrels. Pipe line connections with Illinois basin fields and the mid-Continent provide the source of crude petroleum.

The refinery at Hooven (near Cincinnati), Ohio, has a capacity of 18,000 barrels daily. This refinery receives its supply of crude by the Gulf Refining Company pipe line from the mid-Continent territory.

The Central Refining District possesses approximately 14 per cent of crude oil run to refineries in the United States. The quantity run to stills from 1932 to 1937 and the percentage of the United States total is shown in table 8.

TABLE 8.—CRUDE RUNS-TO-STILLS IN THE CENTRAL REFINING DISTRICT, 1932-38.^a
(Thousands of barrels)

Year	Central Refining District	United States	Per cent
1932.....	106,758	819,997	13.0
1933.....	117,073	861,254	13.6
1934.....	119,166	895,636	13.3
1935.....	129,958	906,243	13.4
1936.....	147,724	1,068,570	13.9
1937.....	164,243	1,183,440	13.9
1938.....	159,446	1,165,015	14.1

^a Data from Minerals Yearbooks, U. S. Bureau Mines.

In table 9 is shown the production of crude petroleum in each state in the Central Refining district in 1937, the receipts from other states, the total crude runs-to-stills, and the delivery of oil to other states. With the exception of small quantities of oil from Wyoming to Indiana, and of West Virginia to Ohio, "Receipts from other states" are supplied by Kansas, Louisiana, New Mexico, Oklahoma, and Texas. Receipts from principal states in the mid-Continent area are shown in table 9.

It should also be noted that in 1937 approximately one-sixth of Illinois oil moved to refineries in Ohio and Kentucky.

REFINED PRODUCTS

The principal fuel products obtained from crude petroleum are gasoline, kerosene, gas oil and distillate fuel, and residual fuel oil. Output of these products in the Central Refining District in 1936, 1937, and 1938 is shown in table 10.

TABLE 9.—SOURCES OF CRUDE PETROLEUM IN STATES COMPRISING THE CENTRAL REFINING DISTRICT, 1937.^a
(Thousands of barrels)

State	Production	Receipts from other states	Runs-to-stills	Delivery to other states	States to which oil is delivered
Illinois.....	7,426	40,470	45,626	1,293	Ky. and Ohio
Indiana.....	826	70,677	70,585	1,044	Ill. and Ky.
Kentucky-Tennessee...	5,510	2,303	7,474	365	Illinois
Michigan.....	15,928	4,877	12,931	8,553	Ohio and Canada
Ohio.....	3,559	36,772	38,663	675	Penn. and W. Va.
Total.....	33,249	155,099	175,279	11,930	

^a U. S. Bureau Mines, Minerals Yearbook, p. 848, 1938.

Gasoline is used mainly as a motor fuel. The kerosene fraction finds an outlet in domestic cooking and as a fuel for space heaters. The market classification of range oil is sometimes included in the kerosene group. Gas oil and distillate fuel is the main source of supply of oils used in commercial and domestic heating. This market is also the principal outlet for this product. About two thirds of the oil sold for domestic heating is obtained from this fraction and the remainder is obtained from the lighter portions of the residual fuel oil. Consumption of fuel oil for Diesel engines in this market area is not yet large. The amount reported in 1936 was 719,000 barrels and in 1937, 1,616,000 barrels. Residual oils find their main outlets as fuel for industrial purposes, railroads, and water transportation.

TABLE 10.—OUTPUT OF REFINED PRODUCTS IN THE CENTRAL REFINING DISTRICT, 1936-38.^a
(Thousands of barrels)

	1936	1937	1938
Input:			
Crude runs-to-stills.....	147,724	164,243	159,446
Natural gasoline.....	3,766	4,077	4,488
Total input.....	151,490	168,320	163,934
Output:			
Gasoline.....	85,812	95,409	95,511
Kerosene.....	5,724	6,238	7,096
Gas, oil and distillate fuel.....	16,174	17,033	17,397
Residual fuel oil.....	20,441	24,650	23,319
Total refined oil fuels.....	128,151	143,330	143,323
Per cent of crude oil and natural gasoline.....	84.6	85.2	87.4

^a U. S. Bureau Mines, Minerals Yearbook, 1938, p. 860.

The percentage of output of these products may be varied somewhat in the refining process to adapt itself to market demands. In recent years the refinery output of gas oil and distillate fuel has been increased somewhat to meet the rising demand for heating oils.

MARKET FOR OIL PRODUCTS

The market area in which the refineries of the Central Refining District distribute their products cannot be precisely outlined. There is no doubt a considerable movement of refined oil products from one refining district into territories normally supplied by other refining districts. For purposes of analysis of market demand and oil product supply, the market territory is here delimited to include the states of Illinois, Indiana, Ohio, Michigan, Kentucky, Wisconsin, Minnesota, Iowa, North Dakota, and South Dakota.

Consumption of oil products in the above defined market territory as compared with the production of these products is shown in table 11.

TABLE 11.—PRODUCTION AND CONSUMPTION OF THREE MAJOR OIL PRODUCTS, 1936-37.
(Thousands of barrels)

	Production in the Central Refining District	Consumption in Illinois market territory
1936 ^a		
Gasoline.....	85,812	138,469
Gas oil and distillate fuels..	16,174	20,853
Residual fuel oils.....	20,441	32,738
Total.....	128,151	192,060
1937 ^b		
Gasoline.....	95,409	150,692
Gas oil and distillate fuels..	17,033	24,379
Residual fuel oils.....	24,650	34,167
Total.....	137,092	209,238

^a U. S. Bureau Mines, Mineral Market Report No. 625, Jan. 27, 1938.

^b U. S. Bureau Mines, Mineral Market Report No. 708, Feb. 16, 1939.

Within the consuming market area, thus outlined, there is no doubt a substantial shipment of refined oil products from the East Coast and Appalachian refining districts westward into Ohio, Kentucky, and Michigan and from the mid-Continent Refining District northward by pipe line, river barge, and tank

car into the market territory of the Central Refining District. The Great Lakes Pipe Line Company connects nine large refineries in northern Oklahoma to terminals located at Kansas City, Omaha, Des Moines, Minneapolis and Chicago.

TABLE 12.—CONSUMPTION OF MAJOR OIL PRODUCTS IN THE CENTRAL REFINING DISTRICT MARKET TERRITORY, 1936-37.
(Thousands of barrels)

State	Gasoline	Gas oil and distillate fuel	Residual fuel oil	Total
1936 ^a				
Illinois.....	28,379	8,158	10,193	46,730
Indiana.....	13,367	1,359	6,091	20,817
Ohio.....	27,807	1,169	6,004	34,980
Michigan.....	23,709	2,655	6,345	32,709
Kentucky.....	5,437	226	573	6,236
Wisconsin.....	12,012	2,452	1,570	16,034
Minnesota.....	11,449	3,014	1,079	15,542
Iowa.....	10,957	1,205	668	12,830
N. Dakota.....	2,652	231	63	2,946
S. Dakota.....	2,700	384	152	3,236
Total.....	138,469	20,853	32,738	192,060
1937 ^b				
Illinois.....	30,794	9,873	10,295	50,962
Indiana.....	14,587	1,375	6,358	22,320
Ohio.....	30,251	1,230	6,647	38,128
Michigan.....	26,443	3,249	6,422	36,114
Kentucky.....	5,996	223	594	6,813
Wisconsin.....	12,883	2,972	1,592	17,447
Minnesota.....	12,134	3,545	1,281	16,960
Iowa.....	11,997	1,307	697	14,001
N. Dakota.....	2,399	256	81	2,736
S. Dakota.....	2,708	346	200	3,254
Total.....	150,192	24,376	34,167	208,735

^a U. S. Bureau Mines, Minerals Yearbook, 1938, p. 876, and *idem.*, Mineral Market Report, M.M.S. No. 625, Jan. 27, 1938.

^b U. S. Bureau Mines, Mineral Market Report, No. M.M.S. 708, Feb. 16, 1939.

Refining companies participating in the line include Continental Oil Company, Barnsdall Oil Corporation, Mid-Continent Petroleum Corporation, Skelly Oil Company, Pure Oil Company, Phillips Petroleum Company, Sinclair Refining Company, Texas Company, and Cities Service Company.³

³ Oil and Gas Journal, Vol. 37, No. 19, p. 127, Sept. 22, 1938.

TABLE 13.—CONSUMPTION OF FUEL OIL AND RANGE OIL BY USES, IN THE CENTRAL REFINING DISTRICT MARKET TERRITORY, 1936-37.^a
(Thousands of barrels)

State	Rail-roads	Vessels	Gas and electric power plants	Smelters and mines	Manu- factur- ing In- dustries	Heating oils	U. S. Navy, Army, Coast Guard	Oil Company use	Miscellaneous	State totals	Range oil ^c
1936											
Illinois.....	358	21	297	82	3,769	11,505	104	1,983	232	18,351	595
Indiana.....	46	167	228	113	3,223	1,487	1	2,160	25	7,450	79
Ohio.....	64	30	26	143	4,279	994	21	1,366	250	7,173	196
Michigan.....	71	74	225	88	4,815	3,223	26	390	88	9,000	201
Kentucky.....	48	110	16	2	114	224	.....	251	34	799	17
Wisconsin.....	19	26	226	32	562	3,117	1	5	34	4,022	190
Minnesota.....	21	.....	109	9	435	3,439	2	3	75	4,093	221
Iowa.....	73	.....	280	2	194	1,207	.....	8	109	1,873	151
N. Dakota.....	1	.....	31	.....	17	243	.....	.....	2	294	55
S. Dakota.....	79	.....	114	2	5	316	3	3	14	536	59
Total.....	780	428	1,152	473	17,413	25,755	158	6,169	863	53,591	1,764
Per cent of total.....	1.4	0.8	2.9	0.9	32.5	48.1	0.3	11.5	1.6	100.0	.....
1937											
Illinois.....	633	300	190	(b)	3,877	13,329	2	1,993	343	20,667	762
Indiana.....	52	247	242	.....	3,412	1,655	.....	2,200	68	7,876	104
Ohio.....	81	52	33	.....	4,731	1,087	39	1,690	297	8,019	230
Michigan.....	70	47	223	.....	5,006	3,820	13	427	121	9,727	261
Kentucky.....	45	133	13	.....	160	265	16	251	89	972	20
Wisconsin.....	36	.....	275	.....	669	3,607	.....	6	97	4,690	257
Minnesota.....	79	1	99	.....	461	4,186	2	2	163	4,993	302
Iowa.....	60	.....	280	.....	200	1,467	3	5	156	2,171	191
N. Dakota.....	1	.....	30	.....	14	270	.....	.....	60	375	69
S. Dakota.....	54	.....	118	.....	5	380	.....	4	38	599	75
Total.....	1,111	780	1,503	.....	18,535	30,066	75	6,587	1,432	60,089	2,271
Per cent of total.....	1.7	1.3	2.5	.....	30.8	50.0	.1	10.9	2.7	100.0	.....

^a U. S. Bureau of Mines, Mineral Market Reports, M.M.S. Nos. 625, Jan. 27, 1938, and 708, Feb. 16, 1939.

^b Not given separately for 1937.

^c Not included in state totals.

The Phillips Petroleum Company operates a pipe line extending from the company's refinery at Borger, Texas, to East St. Louis, Illinois.

The Shell Pipe Line Company connects the Shell refinery at Roxana, Ill., to Indianapolis, Ind., Lima, Ohio, and Springfield, Ohio. Arrangements have been made for the delivery of gasoline through the Standard of Ohio system to Toledo, Ohio.

From the Eastern Refining District, and the Appalachian Refining District, the Susquehanna Pipe Line Company connects the Sun Oil Company refinery at Marcus Hook to terminals in Akron and Cleveland. The Tuscarora Oil Company, Limited, a subsidiary of the Standard Oil of New Jersey, operates a pipe line from refineries at Elizabeth, Bayway, and Linden, N. J., to marketing points in Pennsylvania, terminating at Midland, near Pittsburgh. The Keystone Pipe Line Company, a subsidiary of the Atlantic Refining Company connects the refinery near Philadelphia with terminals at Pittsburgh, Pa., Buffalo, N. Y., and Rochester, N. Y.

TABLE 14.—LAKEWISE SHIPMENTS OF PRINCIPAL OIL PRODUCTS FROM LAKE PORTS, 1936.^a
(Tons)

Commodity	SHIPPING PORT		
	Chicago	Toledo	Cleveland
Crude oil.....	24,815	.....	.....
Gasoline.....	1,421,426	100,676	189,335
Fuel oil.....	213,188	272,025	20,703
Kerosene.....	77,953	3,376	.....
Gas oil and distillate fuel.....	31,652	.....	.....
Bunker fuel.....	171,872	.....	.....

^a U. S. Army Corps of Engineers, Annual Report, Vol. II, 1937.

WATER TRANSPORTATION OF OIL PRODUCTS

Water transportation on the Great Lakes and the inland waterways affords a means of transportation of oil products from refineries in the Central Refining District to ports on the Great Lakes, and on the Mississippi River. The principal shipping points on the Great Lakes affecting the Central Refining District market are Chicago, Toledo, and Cleveland. Shipments of oil products from these ports in 1936 are shown in table 14. In addition to these lakewise shipments, a movement of 120,331 tons of crude oil to Canadian ports is reported.

Receipts at principal ports on the Great Lakes are given in table 15.

OIL SHIPMENTS ON THE UPPER MISSISSIPPI WATERWAY

The principal shipments on the internal waterway system is over the Mississippi river, with smaller but increasing quantities moving over the Illinois and Missouri river waterways. Movements on the Mississippi river between Minneapolis and the mouth of the Missouri river and from the mouth of the Missouri river to the mouth of the Ohio river are shown in table 16. Shipments on the Illinois waterway are shown in table 17.

TABLE 15.—LAKELIKE RECEIPTS OF PRINCIPAL OIL PRODUCTS AT GREAT LAKES PORTS, 1936.^a
(Tons)

	Duluth-Superior	Green Bay, Wisconsin	Milwaukee, Wisconsin	Muskegon, Michigan	Detroit, Michigan	Toledo, Ohio	Cleveland, Ohio
Crude oil.....						375,190	61,931
Gasoline.....	303,511	139,177	30,950	277,143	569,277	123,819	281,708
Fuel oil.....	62,616	9,659		10,578	364,882	5,470	85,549
Kerosene.....	22,403	9,851		15,128	31,470		1,864

^a U. S. Army, Corps of Engineers, Annual Report, Vol. II, 1937.

TABLE 16.—MOVEMENT OF PRINCIPAL OIL PRODUCTS ON MISSISSIPPI RIVER FROM MINNEAPOLIS, MINNESOTA TO MOUTH OF MISSOURI RIVER, 1936.^a
(Tons)

	Upbound	Upbound (Out-bound)	Upbound (In-bound)	Down-bound	Down-bound (Out-bound)	Down-bound (Inbound)	Down-bound (Through)
Gasoline.....	31,767	57,600	1,628	2,305	307,310		
Fuel oil.....	7,240	270	3,936	513	3,439		

FROM MOUTH OF MISSOURI TO MOUTH OF OHIO

Gasoline.....		1,628	631	125	73,051	774	305,536
Fuel oil.....	1,731	4,038		8,212		3,439	

^a U. S. Army, Corps of Engineers, Annual Report, Vol. II, 1937.

Shipments of oils on the Missouri in 1936 were limited to fuels used in waterway development.

SUMMARY OF WATER-BORNE COMMERCE IN OIL PRODUCTS

The principal movements of oil on internal waterways are shipments of refined products from lower lake ports to destination in the upper lake dock territory. Movements on the upper Mississippi consist mainly of refined products

shipped to markets both north and south of the refineries located near St. Louis. Movements on the Illinois waterway are limited by the fact that there are large refinery facilities at each end of the waterway to supply the respective markets.

TABLE 17.—SHIPMENTS OF PRINCIPAL OIL PRODUCTS ON THE ILLINOIS WATERWAY, 1936.^a
(Consolidated report for entire waterway from Grafton, Ill., to Lake Street, Chicago, on Chicago river and to turning basin No. 5 on Calumet river.)
(Tons)

	MISSOURI RIVER: KANSAS CITY TO MOUTH				Internal ship-ments	Internal receipts
	Inbound	Outbound	Down-bound	Upbound		
Fuel oil.....	35,580	.....	.....	60	3,265	.....
Gasoline.....	.....	.....	.....	.....	249,491	.....
Crude.....	42	.....	.....	.....	.....	.....
Lubricating.....	48	59	.....	.....	2,201	.....
Refined.....	.....	18	.....	.....	.....	.....
Kerosene.....	.....	.....	.....	.....	1,901	.....

^a U. S. Army, Corps of Engineers, Annual Report, Vol. II, 1937.

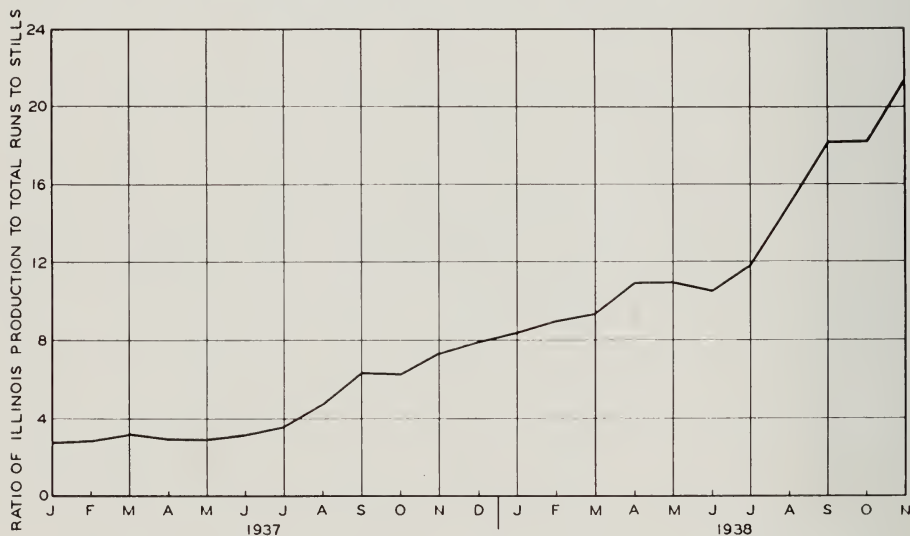


FIGURE 3.—Ratio of Illinois production of crude oil to runs-to-stills in the Central Refining District, 1937-38.

COMPETITIVE POSITION OF ILLINOIS OIL

Prior to the discovery of the Illinois basin fields the production of the old southeastern field was processed mainly in the Ohio Oil Company refinery at Robinson, Illinois. The discovery of oil in the basin, and the rapid development of production brought about a critical condition with respect to market

outlets. There were, during the early stages of development, no pipe line connections with large refining centers near Chicago, western Illinois, or the refineries in Ohio. Although pipe line and market connections were gradually established, the rate of growth was so rapid that difficulties arose in an orderly market outlet development. The rate of growth of oil output in Illinois and its relation to runs-to-stills, in the Central Refining District, in 1937 and 1938, is shown in figures 3 and 4 and table 18.

Illinois' portion of crude oil refined in the Central Refining District rose from 2.8 per cent in January 1937 to 28.3 per cent in December 1938. This oil could be absorbed only by the displacement of crude from Oklahoma, Kansas, and Texas, or the construction of additional refinery capacity in an attempt to compete in the refined oil market.

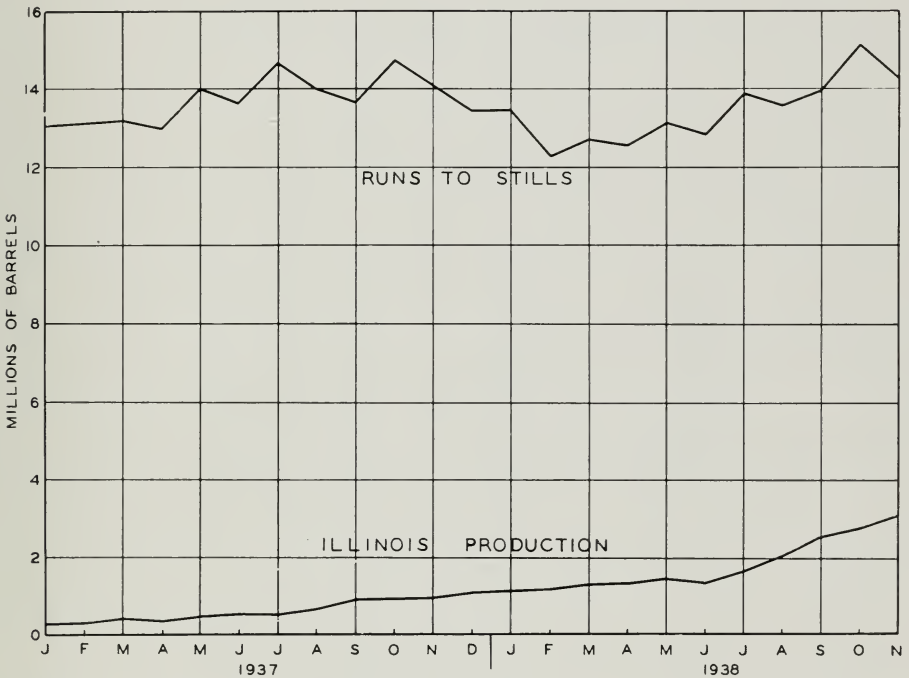


FIGURE 4.—Oil production in the Central Refining District and in Illinois, 1937–38.

PIPE LINE CONNECTIONS

At present there are more than 1,600 miles of crude oil pipe lines in Illinois operated by 15 pipe line companies. These are:

- Gulf Companies Pipe Line
- Illinois Pipe Line Company
- Clay City Pipe Line Company

Wabash Pipe Line Company
 Shell Pipe Line Company
 Sinclair Refining Company
 Stanolind Pipe Line Company
 Texas-Empire Pipe Line Company
 Central States Pipe Line Company
 Magnolia Petroleum Company
 Tidewater Pipe Line Company
 Manley Pipe Line Company
 Western Pipe Line Company
 Oklahoma Pipe Line Company
 Owensboro Pipe Line Company

TABLE 18.—RATIO OF ILLINOIS PRODUCTION TO RUNS-TO-STILLS IN CENTRAL REFINING DISTRICT, 1937-38.^a
 (Thousands of barrels)

Month	Runs to stills	Illinois production	Per cent
1937			
January	13,192	368	2.79
February	11,753	343	2.92
March	13,211	410	3.10
April	13,167	386	2.93
May	14,041	416	2.96
June	13,684	463	3.38
July	14,644	530	3.68
August	14,131	674	4.77
September	13,825	849	6.31
October	14,925	912	6.11
November	14,080	990	7.03
December	13,590	1,085	7.98
1938			
January	13,567	1,128	8.31
February	12,358	1,108	8.96
March	12,921	1,330	10.3
April	12,624	1,388	10.9
May	13,229	1,440	10.9
June	12,914	1,361	10.5
July	13,955	1,642	11.8
August	13,810	2,062	14.9
September	14,095	2,553	18.1
October	15,225	2,768	18.1
November	14,369	3,067	21.3
December	14,073	3,981	28.3

^a U. S. Bureau Mines, Monthly Petroleum Statements, Jan.-Dec., 1937 and 1938.

Seven of these are interstate pipe lines connecting mid-Continent fields with refineries at Wood River, in the Chicago district, in eastern Illinois and in Ohio. Pipe line facilities for the new oil fields in Illinois have been provided partly by connections to existing pipe lines and partly by independent lines to serve newly erected or existing refineries.

The Manley Pipe Line Company's line connects the Lake Centralia-Salem field with a refinery in Centralia and also with loading stations on the Missouri and Illinois Railroad.

The Wabash Pipe Line Company connects Noble, Clay City and Cisne fields with the Illinois Pipe Line at Martinsville, and also with the Texas-Empire in northeast Jasper County. Loading stations are also provided on the B. & O. Railroad. These pipe line connections give the fields access to markets in Ohio and the Chicago district.

The Oklahoma Pipe Line Company has a gathering system in the Beecher City-Louden field connecting with Illinois Pipe Line at the Brownstown station in Fayette County.

The Western Pipe Line Company has a gathering system in the Beecher City-Louden field connecting with the Illinois Pipe Line at Brownstown Station, and another gathering system in Lake Centralia-Salem field leading to a loading station on the Old Southern Railway. The Illinois Pipe Line Company has been delivering oil to the Texas-Empire line which is shipping the oil for the Globe Refining Company.

The Magnolia Petroleum Company has a short pipe line from the Centralia-Salem field to the Illinois Pipe Line Company station at Sandoval. Petroleum is carried westward in the latter line to the Wood River station where it enters the Magnolia line running south to the refinery at East St. Louis.

The Lake Centralia-Salem field is also provided with pipe line service to the refinery at Lawrenceville by the Central States Pipe Line Company. A branch line extends to producing fields in Wayne County.

The Illinois Pipe Line Company is providing additional facilities for handling Illinois oil by laying 198 miles of loops to the main line through Illinois, Indiana and Ohio. This will add an additional 25,000 barrels daily capacity to the company's lines.

Owensboro Pipe Line Company has a 6-inch pipe line from Centralia to Sandoval.

The Clay City Pipe Line Company has gathering lines in Clay City, Noble, Beecher City-Louden and St. James fields. This company also has a line from the Dix through Centralia to the Illinois Pipe Line Company at Sandoval, with a branch line extending to Lake Centralia field.

In addition to the oil carried from the new fields by pipe line, there are considerable quantities shipped by tank cars on the Missouri-Illinois Railroad Company, the Illinois Central, and the C. B. & Q.

NEW REFINERIES

In an effort to find a market for the increased supplies of oil made available by the production in the basin, four refineries have been erected—three in Centralia and one at St. Elmo, in the Beecher City-Louden field. Authentic data on the capacity of these refineries has not been released although they are reported to be of relatively small capacity—ranging from 2,000 to 3,500 barrels daily and are of the type classified as skimming plants.

These refineries have the advantage of low cost crude oil in nearby fields and a low transportation cost from field to refinery. Difficulties, however, are likely to be encountered in the disposal of refined products.

The problems which these refineries encounter may be grouped under the following headings:

- Percentage of gasoline recovery
- The quality of gasoline
- The disposal of residual stocks

GASOLINE RECOVERY

In the refining process gasoline is recovered from crude oil by straight run distillation of the crude, and a further cracking of part of the residual stock in cases where refineries are equipped to crack oil. The percentages recovered by the two methods in the Central Refining District for the years 1935 to 1937 are as follows:^a

	1935	1936	1937
Straight run.....	23.8	23.8	24.0
Cracked.....	32.4	31.7	31.6
Total.....	56.2	55.5	55.6
Average of U. S. for straight run and cracked.....	44.2	44.1	43.9

The cracking process since 1918 has almost doubled the yield of gasoline from crude oil, as shown by a comparison of that year with 1937.

	1918	1937
Straight run.....	22.7	21.2
Cracked.....	2.6	22.7
Total.....	25.3	43.9

On a basis of straight-run production alone, a gasoline consumption of 517,000,000 barrels in 1937 would have required 2,440,000,000 barrels of crude oil instead of the actual runs-to-stills of 1,183,440,000 barrels. The cracking process not only amply provided for the rapidly increasing demand for gasoline,

^a U. S. Bureau Mines, Minerals Yearbook, p. 869, 1938.

but also converted a large quantity of low value residual oils into higher value motor fuels. Moreover, the cracking process takes from the market a large quantity of residual oils which would otherwise need to find a market as industrial fuel.

Except under conditions of an unusually favorable local gasoline market, the refinery which is equipped for straight run distillation only—that is, the skimming plant—operates at a disadvantage in competing with the complete refinery. A smaller portion of the crude processed in the skimming plant is converted into gasoline and more, in proportion, must be sold as fuel oil at prices competitive with coal. This is reflected in the higher percentage of shut-downs among skimming plants as compared with complete plants. For example, on Jan. 1, 1938, operating data on skimming plants and complete refineries for the nation were as shown in table 19.

TABLE 19.—CRUDE OIL CAPACITY IN UNITED STATES PLANTS, JAN. 1, 1938.^a
(Barrels per day)

	Operating	Shutdown	Building	Total	Per cent of total shutdown
Skimming plants.....	1,338,962	269,185	93,120	1,751,271	15.6
Complete refineries.....	1,819,930	81,170	160,700	2,061,800	3.9
Intermediate types (all kinds).....	761,300	30,600	29,200	821,100	3.7
Total.....	2,970,196	389,955	283,020	4,634,171	8.4

^a U. S. Bureau Mines, Inf. Cir. 7034, 1938.

DISPOSAL OF RESIDUAL STOCKS

The principal refined products here grouped under residual stocks are kerosene, gas oil and distillate fuel, and heavy residual fuel oils. These products are, to a considerable degree, by-products of the gasoline manufacturing industry. The quantities produced by refineries depend, within limits, to the amount of gasoline output. These products must be sold in the general fuel market in competition with coal. In some markets, as for example, the domestic heating market, oil may command a slightly higher price per B.t.u. than coal because of advantages of convenience, but in the general industrial market, the price does not vary greatly from comparable coal prices. Since these by-product fuels constitute 30 per cent of the total crude run to stills, sale of these oils is an important supplementary source of income for the refinery. It is important therefore, in locating a refinery that the market outlet for residual products be given a careful survey, as well as the market for gasoline itself.

The market outlet for a particular refinery depends, among other factors, upon the extent in the preparation of refined products, distance from principal consuming markets, and competition with coal. Residual oils are transported by tank car and not by pipe lines, hence transportation costs per ton-mile are higher than either crude oil or gasoline carried by pipe line. Consumption of major portions of their products is within a relatively short radius of refinery location and the market outlets for residual products are most favorable for those refineries which are located near industrial fuel using centers. Where water transportation is available, such as is the case for oil refineries located on the Great Lakes, the Atlantic Seaboard, or the Interior Waterway system, the market radius is enlarged. Fuel oils, moreover, do not enjoy the specialized and exclusive market held by gasoline. Many of the fuel markets now supplied by fuel oil can also, if necessary, be supplied by coal. Prices of fuel oil therefore are regulated, to some extent, by cost of coal.

Production of by-product fuel oils in the Central Refining District in 1937 and 1938 is shown in table 20.

TABLE 20.—PRODUCTION OF RESIDUAL OILS IN THE CENTRAL REFINING DISTRICT, 1937-38.^a
(Thousands of barrels)

	1937		1938	
	Quantity	Per cent of total	Quantity	Per cent of total
Input:				
Crude runs to stills.....	167,243	.....	159,446	.....
Output:				
Kerosene.....	6,238	3.8	7,096	4.4
Gas oil, etc.....	17,033	10.3	17,397	10.9
Residual fuel oils.	24,650	15.0	23,319	14.6

^a U. S. Bureau Mines, Minerals Yearbook, pp. 856-7, 1938, and Monthly Petroleum Statements, Jan.-Dec., 1938.

Kerosene finds its principal use in cook stoves, space heaters, and to a limited extent, for illumination.

Gas oil and distillate fuel is used mainly for domestic and commercial heating. Residual oils find their principal outlet in manufacturing, and oil company use. A detailed statement of the use of these two refined products in the Illinois oil market area is shown in table 13.

GEOGRAPHIC DISTRIBUTION OF RESIDUAL OIL MARKET

Gas oil and distillate fuel.—Gas oil and distillate fuel is used mainly for commercial and domestic heating, although not altogether so. Smaller quantities are used in gas making, as a fuel for internal combustion engines, as a solvent

for asphalts, and other uses. The chief factor affecting demand for gas oil and distillate fuel as a whole and supply for a given purpose is the proportion of the total available supply that has properties fitting it for specific uses.

COMMERCIAL AND DOMESTIC HEATING

Use of distillate fuel for commercial and domestic heating has grown rapidly in the last 10 years. Consumption for domestic heating by states, is shown in table 21.

TABLE 21.—SALES OF HEATING OIL, 1934-37 AND APPROXIMATE PER CAPITA CONSUMPTION IN 1937, BY STATES.^a

State	HEATING OIL CONSUMPTION (Thousands of barrels)				Population (1930) (Thousands)	Consumption per capita (Barrels) 1937
	1934	1935	1936	1937		
Illinois.....	7,348	8,324	11,505	13,329	7,631	1.74
Indiana.....	971	1,103	1,487	1,655	3,239	0.51
Ohio.....	656	752	994	1,087	6,647	0.16
Michigan.....	1,769	2,384	3,223	3,820	4,842	0.79
Kentucky.....	161	193	224	265	2,615	0.10
Wisconsin.....	1,776	2,227	3,117	3,607	2,939	1.23
Minnesota.....	2,002	2,497	3,439	4,186	2,564	1.63
Iowa.....	651	856	1,207	1,467	2,471	0.59
N. Dakota.....	170	227	243	270	681	0.39
S. Dakota.....	182	283	316	380	693	0.55
Total.....	15,868	18,846	25,755	30,066	34,322	

^a U. S. Bureau Mines, M.M.S. 625, Jan. 27, 1938.

Consumption, per person, is an approximate indicator of the extent to which oil heating is used in each state. In the market area under consideration, Illinois, Minnesota, and Wisconsin are the leading users. Consumers in Illinois are near the large refineries in the Chicago district and costs of transportation from the source of production are low. Minnesota and Wisconsin lie in a high cost fuel area and heating oils are in a favorable competitive position with coal. The remaining states have either abundant supplies of coal or are within short distances of coal producing districts.

MARKET FOR RESIDUAL OILS

The principal use for residual oils in Illinois is as a fuel in manufacturing and for oil company use. Distribution by uses is shown in table 22. Unlike the heating oils, consumption of heavy oils in manufacturing, oil refining and other uses has not increased significantly in the past decade. It appears that competitive balance between coal and industrial fuel oil has been established.

GEOGRAPHIC DISTRIBUTION OF RESIDUAL OIL CONSUMPTION IN ILLINOIS

The geographic distribution of industrial fuel oil consumption in Illinois in 1929 is disclosed in a report of the Census in which consumption of oil in manufacturing, mining and public utilities is given by counties.

For purposes of analysis, the consumption of industrial fuel oil in manufacturing, mining, and public utilities has been grouped into districts shown in table 22 and figure 5 and the consumption in each district is shown.

TABLE 22.—CONSUMPTION OF FUEL OILS (INCLUDING CRUDE OILS AND GAS OILS USED AS FUEL), 1929.^a

District	Manu- facturing	Mining	Public utilities	TOTAL		Per cent in each district
	(Gallons)			(Gallons)	(Barrels)	
Illinois	468,362,543	725,071	1,232,448	470,320,062	11,195,716	100.0
Chicago	219,416,514	219,972	.....	219,636,486	5,229,440	46.5
E. St. Louis	149,538,642	12,085	.....	149,550,727	3,536,922	32.4
Peoria	16,732,353	600	.....	16,723,953	398,403	3.5
Old oil field	28,797,304	.....	11,844	28,809,148	685,932	6.1
S. Ill. counties	2,807,293	409,496	304,710	3,521,499	83,845	0.7
Other Illinois	51,070,437	82,918	915,894	52,069,249	1,239,744	10.8

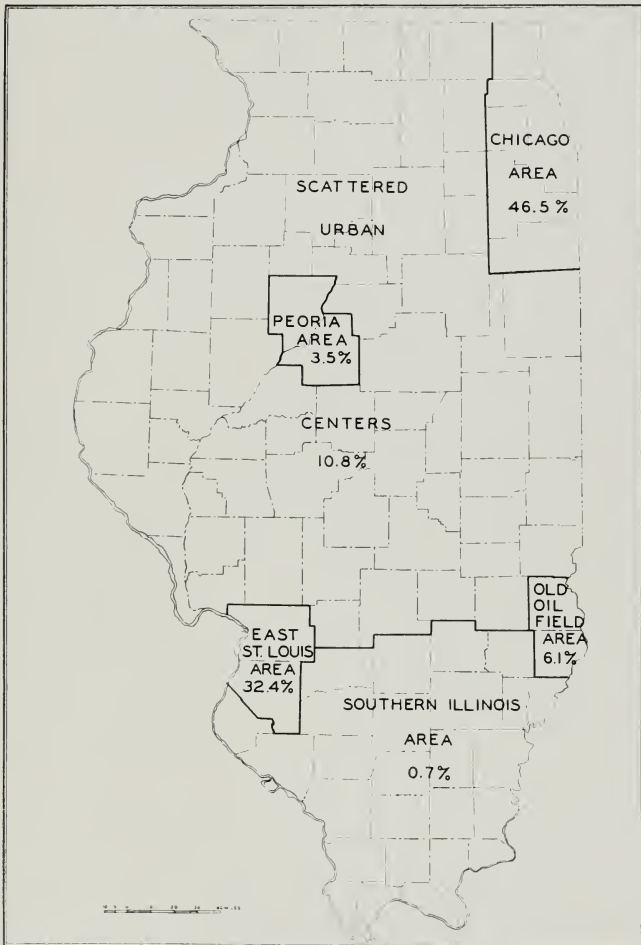
^a Fifteenth Census of the United States. Manufacturers: Consumption of Fuel and Electric Energy in Manufacturing Industries; Consumption of Fuel and Electric Energy in Mining and Quarrying Industries, 1929. U. S. Bur. Mines, Consumption of Fuel by Public Utility Power Plants, 1929.

The Chicago industrial district (in Illinois) and the East St. Louis district consumed nearly 80 per cent of the industrial fuel oils used in the State. The use of fuel oils by refineries is shown in the high consumption in Crawford and Lawrence counties.

The preponderance of the Chicago industrial district as a market for industrial fuel oils becomes still more apparent when Lake County, Ind., is added to the Illinois counties in the Chicago industrial district. Consumption of fuel oil in the combined regions compared with total consumption in the two states is as follows:

	State total (barrels)	Chicago district, Illinois and Lake County, Ind.
Illinois	11,195,716	5,229,440
Indiana	7,351,075	5,468,975
Total	18,546,791	10,698,415
Per cent of total of both states		57.5

Unlike the furnace oils for which demand is conditioned by the demands of the heating season, the market for industrial fuel oil is determined largely by the current rate of industrial activity. With the business recession beginning in late 1937, demand for these fuels was slow and stocks accumulated more rapidly than did either gasoline or gas oil stocks with consequent low prices. With the return of industrial activity, stocks are slowly being reduced.



Above map not subject to copyright.
Illinois State Geological Survey.

FIGURE 5.—Consumption of industrial fuel oils in Illinois (including crude oils and gas oils used as fuel) by market areas, 1929.

SUMMARY OF THE ILLINOIS MARKET

Among the refineries of the Central Refining District, there is a market for approximately 160,000,000 barrels of crude oil annually or the equivalent of about 440,000 barrels daily. Crude petroleum is supplied by producers in Oklahoma, Kansas, Texas, and New Mexico in the mid-Continent field and to a lesser degree by producers in Illinois, Indiana, Ohio, and Michigan in the Eastern Interior oil fields. Prior to the discovery of the Illinois basin fields, the contribution from the State was about 4,500,000 barrels a year or approximately 3 per cent of the requirements of refineries in this district. The oil refining industry, through pipe line facilities and connections with producers, was organized to obtain the bulk of its crude oil requirements from the mid-Continent producing districts. Producers in these fields, through an active drilling campaign sustained over several years, were more than able to supply these crude oil needs.

The rapid increase in production in Illinois following the opening of new production in the Illinois area not only disturbed the crude oil market of the mid-Continent producers; it also supplied a quantity of oil that could not find an immediate outlet in existing refineries, due partly to inadequate pipe line facilities and partly to the reluctance of refineries to break connections entirely with producers in the mid-Continent field.

This condition was corrected to some extent by the construction of gathering and trunk pipe lines and the reversal of flow in existing pipe lines so that connections are now established with refineries in Lawrenceville, East St. Louis, Lemont, and Lockport from the Clay City and Noble fields, the Lake Centralia-Salem field, the Beecher City-Louden field and the Sandoval and Patoka fields. The pipe line capacity, if given preference for Illinois oil, would probably be adequate to handle the present production. Pipe line service, however, is of no avail to producers, unless refineries connecting with these pipe lines are in the market for crude oil. The practical advantage of pipe line facilities lies with those producers who are affiliated with refineries. It is natural, therefore, where there are a large number of independent producers, in a new producing district, that some among them have difficulty in finding outlets for their production.

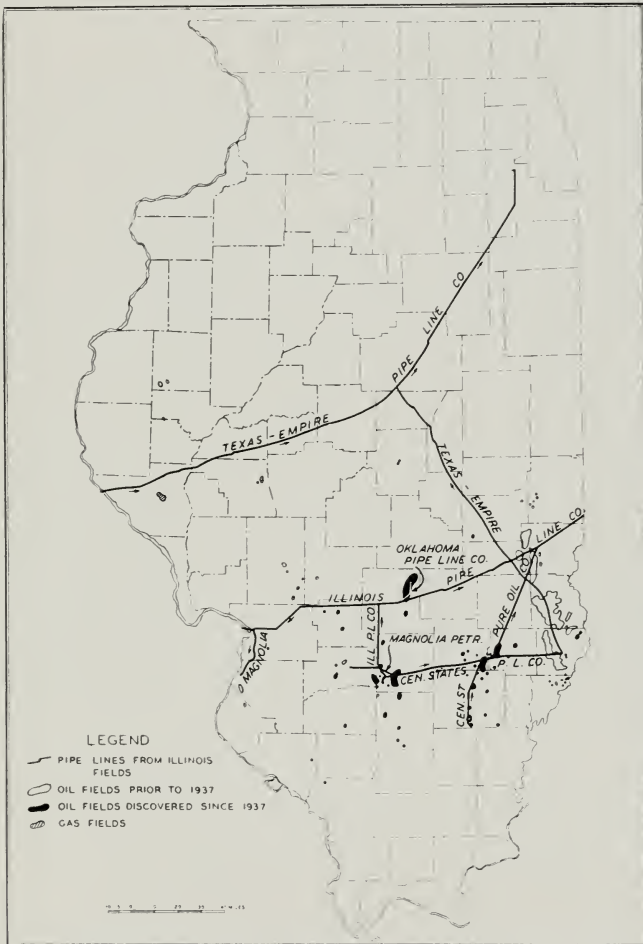
ILLINOIS OIL PRODUCTION AND REFINING CAPACITY

Although crude petroleum is transported by tank car to a certain extent, particularly from newly developed fields, the most economical method is either by pipe line or water transportation. For economical movement of Illinois oil, the ultimate aim will be to effect transportation by pipe line, except in cases where refineries are located in the field itself. It is therefore of interest to survey the extent of refining capacity in the Illinois field and that connected by existing pipe line facilities.

Refineries located in the field at Centralia and St. Elmo have an aggregate estimated capacity of 10,000 to 12,000 barrels daily, although exact data on capacities have not yet been announced.

Refineries with pipe line connections to which Illinois oil is now being shipped are located in Illinois and Ohio. Refineries in Illinois have a total operating capacity of 136,410 barrels daily. At least four of these refineries, with a total daily capacity of 58,500 barrels, are taking part of their needs from the new fields in Illinois.

Refineries of the Standard Oil of Ohio at Toledo and Lima, and of the Pure Oil Company at Toledo, have an aggregate capacity of 32,500 barrels



Above map not subject to copyright.
Illinois State Geological Survey.

FIGURE 6.—Location of principal Illinois oil fields and their pipe line connections.

daily. Additional pipe line is being constructed by the Illinois Pipe Line Company to carry mid-continent and Illinois crude oil to the refinery at Lima and other eastern refining markets.³

In addition to these refining outlets, the pipe line facilities of the Texas-Empire Pipe Line Company are available to refineries in the Indiana portion of the Chicago district.

Crude oil runs-to-stills in Illinois refineries in 1937 were 45,626,000 barrels.⁴ This is a daily average of 125,000 barrels, while the average daily production is about 140,000 barrels. Even if refineries used Illinois-produced oil in this State exclusively, there would still be a surplus that would need to find a market in refineries outside of the State.

While ample pipe line and refinery capacity is available in the Central Refining District to handle Illinois production, to do so would necessitate the displacement of this quantity of oil from the mid-Continent fields, which would require the cooperation of the refining companies.

The problem of crude oil disposal will not be solved by the erection of new refineries or the building of new pipe line facilities unless markets can be found for refined products or for crude oil at the proposed pipe line terminals. Construction of new refineries or new trunk pipe line facilities should not be undertaken until a survey has been made of the potential supply of crude oil in Illinois and the market outlets for both crude oil and refined products.

The prospect in Illinois is one of sustained production for several years. The short time prospect is one of an increase above current levels. In this connection, the history of production in the old Southeastern Illinois field may throw light on the possible duration of high productivity in the new field. Production in significant quantities in the old field began in 1907, reached a peak in 1908 and a secondary peak in 1910, declining thereafter. The total production from 1907 to 1936 inclusive was 421,000,000 barrels. The annual production, annual percentage of total production, cumulative production, and cumulative percentage of production for the first ten years of the life of the pool is shown in table 23.

During a period of thirty years, the old fields produced 421,000,000 barrels of which nearly two-thirds was recovered in the first 10-year period. The average daily output for the peak year of production in 1908 was 92,300 barrels. Whether or not the performance of the new fields will be similar in character and quantity of output cannot be forecast until further data on proved reserves is available. The present estimates of reserves of 350,000,000 barrels cover only proved areas and make no allowance for untested areas. Since the Illinois basin

³ Oil and Gas Journal, p. 71, Jan. 26, 1939.

⁴ U. S. Bureau Mines, Minerals Yearbook, p. 846, 1938.

fields have not been definitely outlined, a forecast of the probable maximum daily output and of the duration of sustained production at the average current daily level cannot be made. Further discoveries, both in new areas and in deeper horizons of proved areas, are possible. Nevertheless, the extent of known reserves together with the rate of drilling and the number of producing wells drilled indicate a high rate of production for the years immediately ahead.

TABLE 23.—PRODUCTION OF PETROLEUM IN ILLINOIS, 1907-16, INCLUSIVE.^a
(Thousands of barrels)

Year	Production	Per cent of total production	Cumulative production	Cumulative per cent of total production
1907.....	24,282	5.8	24,282	5.8
1908.....	33,686	8.0	57,968	13.8
1909.....	30,898	7.2	88,866	21.0
1910.....	33,143	8.0	122,009	29.0
1911.....	31,317	7.5	153,326	36.5
1912.....	28,602	6.5	181,928	43.0
1913.....	23,894	6.0	205,822	49.0
1914.....	21,920	5.0	227,742	54.0
1915.....	19,042	4.8	246,784	58.8
1916.....	17,714	4.2	264,498	63.0
Total.....	264,498			
Total production, 1907-1936.....				420,961

^a U. S. Bureau Mines, Minerals Yearbook, p. 1,008, 1937.

As a consequence of an expected period of sustained production from Illinois fields, a readjustment of present channels of crude oil flow from mid-Continent producing districts to refineries in the Central Refining District will become necessary. The principal mid-Continent oil-producing states that will be affected are Oklahoma and Kansas, and to a lesser degree, New Mexico.

POSSIBLE CHANGES IN CRUDE OIL SUPPLY

The mid-Continent fields and economically related producing districts on the Gulf Coast increased production rapidly in the years immediately preceding the discovery and development of oil production in the deeper parts of the Illinois basin. Production for 1933-38 and increase (or decrease) from year to year is shown in table 24.

Annual increases in production in all of these states occurred through the year 1937, when an accumulation of crude and refined stocks forced a general curtailment of output. The 1938 increases were registered only in Louisiana

and Illinois. Decreases in the remaining states from the 1937 level of production aggregated 103 million barrels. In this attempt to bring production in line with demand, the added output of Illinois was only a minor element. The principal factor was the accumulation of stocks over the two years preceding 1938.

TABLE 24.—PETROLEUM PRODUCTION AND CHANGE IN THE MID-CENTRINE FIELDS AND ILLINOIS, 1933-38.
(Millions of barrels)

Year	TEXAS		OKLAHOMA		LOUISIANA		KANSAS		NEW MEXICO		ILLINOIS	
	Prod.	Chg.	Prod.	Chg.	Prod.	Chg.	Prod.	Chg.	Prod.	Chg.	Prod.	Chg.
1933.....	403	.....	182	.....	25	.....	42	.....	14	.....	4	.....
1934.....	382	-21	180	-2	33	+8	46	+4	17	+3	4	0
1935.....	393	+11	185	+3	50	+17	55	+9	20	+3	4	0
1936.....	427	+34	207	+22	80	+30	58	+3	27	+7	4	0
1937.....	511	+84	229	+22	91	+11	71	+13	39	+12	7	+3
1938.....	476	-35	175	-54	95	+4	60	-11	36	-3	24	+17

^a Data from Minerals Yearbooks and Monthly Petroleum Statements, U. S. Bureau Mines, Washington, D. C.

OKLAHOMA AND THE CENTRAL REFINING DISTRICT

The Oklahoma producing districts are the principal contributors to the crude oil requirements of refineries in the Central Refining District. For example, receipts of the crude petroleum in this district in 1937 from principal producing states were as follows:⁵

	<i>Barrels</i>
Texas.....	12,474,000
Oklahoma.....	85,795,000
Louisiana.....	255,000
Kansas.....	26,727,000
New Mexico.....	10,260,000

TABLE 25.—PRODUCTION AND CONSUMPTION OF OKLAHOMA CRUDE PETROLEUM BY SPECIFIED AREAS, 1936-37.^a
(Thousands of barrels)

	1936	Daily average	1937	Daily average
Total production.....	206,555	565	228,924	625
Runs to Central Refining District.....	86,000	236	85,795	236
Runs to Illinois refineries.....	24,651	67	21,445	58
Total receipts of Oklahoma crude, all districts.....	204,567	560	206,894	565
Refined in Oklahoma.....	55,065	151	59,254	162

^a U. S. Bureau Mines, Minerals Yearbook, p. 791, 1937; and *idem.*, Minerals Yearbook, p. 846, 1938.

⁵ U. S. Bureau Mines, Minerals Yearbook, p. 847, 1938.

The relation of Oklahoma crude to refineries in Illinois and in the Central Refining District is further detailed in table 25.

Runs-to-stills in Illinois refineries were approximately 60,000 barrels daily and 236,000 barrels daily to the Central Refining District in which Illinois oil must find a market.

Whether this rate of flow from Oklahoma fields can be sustained in the future depends somewhat on maintaining a rate of discovery comparable with current output from that state.

Production in Oklahoma in 1936 to 1938 is as follows:

	<i>Barrels</i>
1936.....	206,000,000
1937.....	228,000,000
1938.....	175,000,000

Restrictions by the Oklahoma Corporation Commission on crude oil production from prolific pools were responsible for the reduction in output in 1938 as compared with the previous year.

When the reserve picture and the present drilling activity are considered, it seems doubtful if Oklahoma can long sustain its present output even if restrictions are lifted.

The quantity and change in proved reserves, as estimated for year's end of 1937 and 1938 are as follows:^a

	<i>Barrels</i>
Reserves, Jan. 1, 1938.....	952,000,000
Discoveries in 1938.....	55,000,000
Total.....	1,007,000,000
Production in 1938.....	175,000,000
Reserves Jan. 1, 1939.....	832,000,000
Decrease in total reserves.....	120,000,000

^a Oil and Gas Journal, vol. 37, no. 37, p. 56, Jan. 26, 1939.

With a production of 175,000,000 barrels and a discovery record of 55,000,000 barrels, the production rate cannot be maintained, unless the discovery trend is reversed. A drop in drilling operations, as was experienced in 1938 and early in 1939, does not present an encouraging picture for large new discoveries in the immediate future.

KANSAS AND THE CENTRAL REFINING DISTRICT

The State of Kansas is the second largest contributor among the mid-Continent states to the crude requirements of the Central Refining District.

TABLE 26.—PRODUCTION AND CONSUMPTION OF KANSAS CRUDE PETROLEUM BY SPECIFIED DISTRICTS, 1936-37.^a

(Thousands of barrels)

	1936	Daily average	1937	Daily average
Total production.....	58,317	159	70,761	193
Runs to Central Refining District.....	22,151	60	26,727	73
Runs to Illinois refineries.....	(b)	.....	(b)	.....
Total receipts of Kansas crude, all districts.....	60,264	165	66,836	183
Refined in Kansas.....	(b)	.....	(b)	.....

^a U. S. Bureau Mines, Minerals Yearbook, p. 847, 1938.^b Data not available.

Kansas crude moves mainly to oil refineries in Illinois and Indiana. Production in Kansas is increasing annually and the reserve picture appears to be more promising than in Oklahoma. Output in recent years has been as follows:

	<i>Barrels</i>
1934.....	46,482,000
1935.....	54,843,000
1936.....	58,317,000
1937.....	70,761,000
1938.....	59,587,000

The quantity and change in proved reserves, as estimated for the years of 1937 and 1938 are as follows:

	<i>Barrels</i>
Reserves, Jan. 1, 1938.....	636,233,632
Discoveries in 1938.....	100,000,000
Total.....	736,233,632
Less production in 1938.....	59,587,000
Reserves, Jan. 1, 1939.....	676,646,632
Increase in total reserves.....	40,412,730

In view of the developments in Illinois, producing districts in Kansas are experiencing difficulties in disposing of crude production. As a consequence, drilling operations in 1938, compared with the previous year's activity, have been curtailed.

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