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APPENDIX B

In this appendix (except under headings IX and X) are reprinted for the information of the Court excerpts from official and trade publications, referred to in the text, containing matters of common knowledge to persons familiar with the petroleum industry.

I. GENERAL DESCRIPTION OF THE INDUSTRY

1. Senate Document No. 61, 70th Cong., 1st Sess., Federal Trade Commission Report, *Petroleum Industry, Prices, Profits, and Competition:*

[Pages 6–9]

SECTION 1. *Characteristics of crude petroleum.*—Crude petroleum consists of various hydrocarbons, including small proportions of oxygen, certain nitrogenous substances, and sometimes sulphur. In general there are three important types of crude petroleum; namely, (1) Paraffin-base crudes, which contain solid paraffin hydrocarbons and practically no asphalt; (2) asphalt-base crudes, containing asphalt and no paraffin; and (3) paraffin-asphalt crudes, which are a combination of the former two types. The crudes produced in different sections of this country vary widely in viscosity and in specific gravity. Some light crudes flow almost as freely as water, while other crudes are so heavy that it is necessary to heat them in order to transport them by pipe line. The wide differences in the quality of different crudes present difficult problems in connection with their production, transportation, and refining, and result in wide differences in price. For example, the light paraffin-base crudes produced in the Appalachian fields have always commanded a much higher price than other crudes, partly because of their high lubricating and gasoline content. In the midcontinent, the Rocky Mountain, and the California fields there is a very wide range in the prices paid at the oil wells for different crudes.

SECTION 2. *Branches of the petroleum industry.*—The domestic petroleum industry includes producing, pipe line, crude purchasing, refining, wholesale marketing, and retail marketing branches. A very large proportion of the business of each branch of the industry is handled either by large integrated companies whose activities compass the entire industry; or by concerns that have subsidiary or affiliated companies engaged in all branches of the business. A number of the larger companies own their own tank cars and operate fleets of tank steamers for coastwise and foreign trade.

Production.—The producing branch of the petroleum industry includes all of the activities incident to the exploration and location of oil lands, the drilling of oil wells, the extraction of crude petroleum from the earth and its storage in field or settling tanks. As natural gas is usually given off as the crude petroleum is brought to the surface, many producers extract casinghead gasoline from the gas and then sell the dry gas to gas companies, or, as has been done in California and in the Seminole (Oklahoma) pool, they maintain the gas pressure in the oil pool by forcing the dry gas back into the oil well.

The great bulk of the oil lands held by producing companies is leased from the landowner on a royalty basis. One-eighth is the most common royalty portion. The producing company, if also a purchaser, usually runs the royalty portion with its own oil paying the royalty owner the current market price. If the producer sells his own crude, it is customary for the purchaser to buy the entire production, paying both the producer and royalty owner direct for his share.

Pipe lines.—The pipe-line branch of the industry collects the crude petroleum from the producer's field or settling tanks through a system of pipes called gathering lines. Gathering-line pipes are usually 4 inches or under in diameter. Much of the gathering-line pipe is laid on top of the ground. These small pipes connect with larger pipes and lead to gathering-line pumping stations. In highly productive oil pools, particularly when different producers own or control small tracts of land, there is an extensive network of gathering lines leading from the oil pool. In many cases several pipe-line companies have gathering lines in the same oil pool and sometimes on the same lease.

The topography of the region in which an oil pool is located is the most important factor in determining the type of gathering-line system that must be established. In some cases the topography of the country is such that a pipe-line company can locate its gathering-line pumping station so that the crude petroleum will flow by gravity from the producers' tanks to the receiving tanks at the pumping station.

In other cases, however, much of the crude petroleum must be forced through the gathering lines by the extensive use of field pumps located on the producer's lease, or be sucked into the gathering-line stations by suction pumps located at the gathering-line pumping station. If the producer pumps his oil into the pipe-line company's lines, he is paid for this service.

Practically all of the crude petroleum produced in the United States is collected by gathering lines, and the great bulk of it is transferred to a trunk pipe line for transportation to near-by refineries, to inland or seaboard refineries, or for transportation to a seaport, from whence it is carried to a refinery in a large tank steamer. Since 1923 large quantities of California crude petroleum have been piped to Los Angeles Harbor and from thence transported to the Atlantic seaboard by tank steamer. In times of temporary overproduction the crude petroleum may be transported to a large "tank farm", where it is stored for use when consumption exceeds current supply. The crude oil in storage, which for some time has been sufficient to supply refinery requirements for half a year or more, is largely owned by large crude petroleum purchasing companies or by petroleum refiners.

Trunk-line pipes have a much greater diameter than gathering-line pipes. The trunk-line pipes of the large interstate pipe-line companies range from 8 to 12 inches in diameter, and in some cases from 4 to 8 lines have been laid parallel to each other in order to handle the tremendous volume of crude oil which is constantly being pumped hundreds of miles to large refining centers.

Comparatively small quantities of crude petroleum are transferred from gathering lines to tank cars for shipment to near-by refineries. Occasionally where a large refiner desires to secure a certain crude unmixed with other crudes, tank-car shipments are made for considerable distances.

Crude purchasing.—The great bulk of the crude petroleum, not refined by the company producing it, is purchased by comparatively few large purchasing companies. Many of these companies are large refiners or are subsidiary to or affiliated with large refining companies. The remaining production is purchased by small refiners and by companies engaged mainly in producing and dealing in crude petroleum. The bulk of the 2,500,000 barrels of crude petroleum now being produced daily is either refined by the producing interest or sold daily at the current market price. In some cases, however, certain large companies have the production of a few large producers under contract for delivery over a considerable period of time.

Refineries.—There are three types of refineries operated in the United States. Some small refineries, called skimming plants, distill crude petroleum at atmospheric pressure and produce only gasoline, kerosene, and fuel oil. Another type of refinery, which may be termed a complete refinery, carries the refining process much farther and obtains a wide range of refined products. A number of the smaller refining companies in the East produce a complete line of refined products. The third type is one equipped with a "cracking plant", which subjects the gas and fuel oil to very high temperatures under superatmospheric pressure, whereby the molecules are broken up or "cracked" and the lighter products are given off. Certain refining companies have produced from 50 to 60 percent of gasoline from ordinary grades of crude petroleum. Cracking plants are generally used by complete refineries and also by a large number of skimming plants.

The bulk of the refining business of the country is done by large integrated companies and by concerns having subsidiary and affiliated companies engaged in the different branches of the business.

Wholesale marketing.—The bulk of the wholesale business in gasoline, kerosene, gas oil, fuel oil, and lubricating oils and greases is done by large integrated companies. Some of these companies extend their marketing activities throughout a large number of States, others market in a single State or in a few States. These large wholesale marketers generally divide their marketing territory into two or more parts under the control of a divisional sales manager. The smaller wholesalers often confine their marketing activities to a small section of a State, usually in the more populous parts.

At the present time probably from 75 to 85 percent of the total quantity of gasoline consumed in the United States is sold to the retailer or ultimate consumer either by the company manufacturing it or by an affiliated or subsidiary concern. The remainder is purchased by wholesalers f. o. b. refinery from the smaller refiners, or from larger marketers and brokers at important seaports such as Jacksonville, Fla., Norfolk, Va., Baltimore, Md., or New York City. Gasoline is distributed in wholesale quantities in tank steamers, tank cars, barges, motor trucks, and horse-drawn tank wagons. The large refiners distribute gasoline from their refineries to the principal marketing centers in tank steamers and tank cars. Tank steamers are used extensively for coastwise shipments from Gulf coast refineries to the Atlantic seaboard, from refineries on San Francisco Bay and in southern California to the large markets of the Columbia River and Puget Sound regions; and for tank-ship shipments via the Panama Canal to the Atlantic seaboard. During the last three years millions of barrels of gasoline produced in California were transported by tank steamer via the Panama Canal to the Atlantic seaboard. Daily entire trainloads of gasoline in tank cars, destined for large consuming centers, leave the important refining regions of the Rocky Mountain and Mid-Continent oil fields and the large refineries in the East.

Extensive storage facilities are maintained in the large cities along the Atlantic, Gulf, and Pacific coasts and at important interior refining points from which the requirements of the retail dealer are supplied. Shipment is made from such points in tank cars and barges to bulk stations, from which point retail dealers are supplied by tank truck or tank wagons. The seasonal demand for gasoline necessitates the accumulation of large stocks during the winter months in order to meet the requirements of the heavier spring, summer, and autumn trade. The bulk of the retailers' supply of gasoline is distributed by tank trucks or tank wagons from storage tanks located near railroad sidings. Tank-truck and tank-wagon drivers usually sell at retail to anyone on the route who will buy 5 gallons or more at a single purchase.

Kerosene is distributed in the same way as gasoline but the quantities sold are much smaller. Sales of gas and fuel oil and road oils are largely made direct from the main sales offices of refining companies. These products move in large quantites. Lubricating oils and greases are sold in containers, such as barrels, cans, and cases. Transportation and manufacturing companies buy these products in large quantities. The motor-vehicle consumption is supplied through the gasoline and kerosene wholesale and retail marketing organization.

Retail marketing.—Gasoline is distributed to large consumers in barges, tank cars, tank trucks, and tank wagons, and to small consumers through service or filling stations, garages, repair shops, curb pumps, etc., and to a limited extent from tank wagons and tank trucks. Many large wholesale marketing companies operate a large number of service stations, and many small wholesalers are also engaged in the retail business. C. B. White, Chicago Manager of the Vacuum Oil Co., stated recently that whereas five years ago there were 12,000 gasoline service stations in the United States there are now "more than 250,000 outlets for oil and gasoline—only 80 cars per station."[1] This later total includes service stations, garages, curb pumps, etc. In the Standard Oil Co. (Indiana) territory, which covers 11 States, there were 19,393 service stations in 1926, as compared with 4,875 in 1921.

[Pages 99–100]

SECTION 1. Methods of marketing crude petroleum—*Running crude into gathering lines.*—As al-

[1] National Petroleum News, Apr. 20, 1927, p. 27.

ready pointed out, crude petroleum in all the oil fields of this country is collected or gathered from the thousands of oil wells by a system of pipe lines called gathering lines. When crude petroleum is brought from the oil pool to the surface of the earth through the tubing of an oil well, either by pumping or by gas pressure, there is mixed with it varying percentages of water, sand, and other sediment. In order to separate the water and sediment from the crude, it is run into tanks called settling tanks, where the water and other sediment is allowed to settle to the bottom of the tank before the crude is run into the gathering lines.

The crude run into the gathering lines also carries more or less sediment. Usually the purchasing company makes a deduction of 3 percent from the total quantity to cover any water or sediment remaining in the crude run from the producer's tanks. Particularly for purchases of large quantities and where the crude is known to contain a large proportion of water and sediment, additional deductions are based on centrifugal tests. As crude petroleum expands upon being heated, adjustments are made to cover changes in quantity due to difference in temperature.

When a producer first sells crude petroleum, or when new wells are brought in, the pipe-line company gathering the crude connects the producer's tanks with its gathering lines. The cost to a pipeline company of making a "connection" with a new producer or with a new lease varies widely from a few hundred dollars to $2,000, or even more. In some cases in a given oil pool a producer may have his tanks connected with two or more pipe-line systems, but in practice many small producers are limited to but one purchaser because only one pipe-line system is available. As a rule a producer is free to have his property disconnected from one pipe-line system and connected with another, and this may occur if the quantity he has to sell is sufficiently large to make it attractive for a rival pipe-line company to make a connection. In some cases, where the expense of making a connection is very large, the pipe-line company making it insists upon a contract guaranteeing to it the output of the well or lease for a specified time.

When a producer has a tank full of crude petroleum ready to deliver to the pipe-line company, he notifies the company's gauger, who, after gauging the contents of the tank, opens a valve that permits the crude to flow or to be pumped from the tank into the gathering lines. Later, after the tank has been emptied to a certain point, the valve is closed, thereby "cutting out" the tank from the gathering line; then the tank is gauged again and a ticket is issued showing the height of the crude in the tank at each measurement. This ticket also serves as a receipt for the producer. The quantity of crude petroleum taken is determined by the purchasing company by reference to tank tables, carefully computed from actual measurements, which show the cubic contents for every tank from which crude is purchased for every difference in height in graduations of a quarter of an inch. The quantities of crude petroleum gathered from an oil pool or an oil field are termed "pipe-line runs."

2. Department of Commerce, Bureau of Mines, *Mineral Market Reports* (No. M. M. S. 154, Nov. 16, 1932):

National distribution of gas oil and fuel oil, 1930–1931

[Figures in barrels of 42 gallons each]

Uses	1930 [1]	1931
Railroads	67, 900, 035	58, 150, 366
Steamships (including tankers)	94, 151, 823	83, 558, 580
Gas and electric-power plants	26, 768, 557	24, 490, 251
Smelters and mines	5, 936, 055	3, 626, 549
Iron and steel products	15, 210, 420	12, 855, 395
Chemicals and allied industries	3, 258, 156	2, 907, 773
Automotive industries	2, 225, 272	1, 783, 547
Textiles and their products	4, 474, 846	5, 683, 693
Paper and wood pulp	2, 235, 890	1, 833, 880
Logging and lumbering	2, 269, 346	1, 667, 377
Cement and lime plants	3, 007, 547	2, 434, 567
Ceramic industries	1, 992, 531	1, 598, 485
Food industries	7, 033, 361	5, 660, 080
Other manufacturing	11, 663, 906	9, 998, 329
Commercial heating	17, 508, 085	15, 731, 150
Domestic heating	10, 104. 792	10, 446, 139
United States Navy, Army transports, etc	8, 680, 929	9, 203, 243
Used as fuel by oil companies	53, 436, 945	51, 196, 684
Miscellaneous uses	11, 235, 312	10, 266, 692
Domestic deliveries	349, 093, 808	313, 092, 780
Exports and other shipments	36, 449, 884	29, 231, 049
Deliveries of furnace oils, etc., for domestic heating	15, 666, 000	14, 213, 000
Total distribution	401, 209, 692	356, 536, 829

[1] Revised figures.

3. H. R. Report No. 2192, 72nd Cong., 2d Sess., *Report on Pipe Lines:*

[Pages v–xxi]

THE OIL SITUATION

Petroleum, oil, and gas, like the metallic ores and other minerals, are a natural resource which, once exhausted, cannot be replaced. A sound national policy calls for careful conservation of all natural resources, but in the case of no other of like importance to our national life is the need so pressing.

Doubtless a time limit exists for the duration of our coal, iron, copper, and other mineral reserves, but the date is far in the future. It appears to be otherwise with petroleum. In the report of the Federal Oil Conservation Board to the President of the United States, published in 1926, it was stated that the total reserves in the known and proven wells were estimated at 4,500,000,000 barrels, or about six years' supply.[2] This figure has only admonitary significance.

The six years have passed. The public demand for petroleum has been supplied; indeed, in a sense, more than supplied, for the general complaint on all hands is of overproduction, and it would be rash to set any definite time limit to our supply even now. Since the report appeared petroleum production increased from 764,000,000 barrels in 1925 to 1,006,000,000 barrels in 1929. Since then production has fallen off to 898,000,000 barrels in 1930 and 845,000,000 barrels in 1931–32. This falling off, however, is not due to depletion or immediate prospect of depletion. It is estimated by experts that the potential production at the present time is

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[2] Report of the Federal Oil Conservation Board, Part 1, 1926, p. 6. It was obtained by dividing an estimate of the quantity of oil in proven sands accessible to wells already drilled and recoverable by methods then in use by the consumption for that year. On the one hand it was too generous. Recovery from the known and proven wells could not maintain the then existing rate of consumption without decline, because the yield of a well decreases steadily year by year. On the other hand, the figure of six years was not intended to fix the life of the oil industry. It made no attempt to allow for the finding of new fields or for improved methods of recovery from known and proven fields. However, the board's figure served to illustrate vividly the national dependence upon fortuitous discovery of new sources of supply and to call public attention to the urgency of conservation.

5,000,000 barrels a day if all wells were run to full capacity and that this rate could be maintained for a considerable number of months. The actual output is about 45 percent of the potential.[3] The falling off, then, is not due to depletion, it is rather due to the coercive measures of curtailment taken by the several conservation commissions of State authorities. With a return to prosperity the upward trend in production will doubtless be resumed. How rapid has been this upward trend in the past may be seen from the following table.

Production of crude petroleum in the United States

	Barrels		*Barrels*
1900	63,600,000	1917	335,300,000
1901	69,400,000	1918	355,900,000
1902	88,800,000	1919	378,400,000
1903	100,500,000	1920	442,900,000
1904	117,100,000	1921	472,200,000
1905	134,700,000	1922	557,500,000
1906	126,500,000	1923	732,400,000
1907	166,100,000	1924	713,900,000
1908	178,500,000	1925	763,700,000
1909	183,200,000	1926	775,000,000
1910	209,600,000	1927	903,800,000
1911	220,400,000	1928	901,500,000
1912	222,900,000	1929	1,007,300,000
1913	248,400,000	1930	898,000,000
1914	265,800,000	1931	845,800,000
1915	281,100,000	1932	
1916	300,800,000		

In its fourth report, issued in 1930, the Federal Oil Conservation Board commented further on the extent of the underground reserves. Its figures of 4,500,000,000 barrels in 1926 had not attempted to measure the total potential reserves of the country, but was intended to indicate the relatively small extent of known and proven reserves accessible to

[3] Anderson, W. F., The Oil and Gas Journal, Jan. 18, 1932.

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existing wells. Nevertheless, the progress of technology was operating to increase the reserve potentially available. "During the last decade", stated the board,[4] "every estimate that had been made of the recoverable oil remaining in underground storage has required revision in the light of later increased production factors." The reasons given for the changing viewpoint on reserves throw considerable light on the difficulties and uncertainty that must be reckoned with in estimating the duration of our petroleum resources. They are useful in tempering our judgment between alarm and complacency. A brief summary will be given in the following paragraphs.

It was pointed out:

(1) That great advances have been made in oil geology. Improved technique in determining the location, shape, and extent of structures favorable to the accumulation of oil have been developed, and as a result new and prolific oil sands have been tapped.

(2) That deep drilling has resulted in the recovery of oil at depths hitherto thought unattainable. In 1925 a depth of 5,000 feet had been thought an outstanding accomplishment. By 1930 practically all the problems for attaining a depth of 10,000 feet had been solved. Special steels and cements for enduring the high temperatures of the deep borings have been developed and improved engineering methods to meet the new conditions have been forthcoming.

(3) That improved methods have made it possible to recover a much larger proportion of the oil con-

[4] Federal Oil Conservation Board, Report IV, p. 6.

tained in known and proven sands. Large quantities of oil have been recovered from fields which had been abandoned or apparently exhausted. A "second crop" from the Bradford and Allegheny fields has added 600,000,000 barrels to the recoverable supply.

These discoveries in science and these improvements in technique had, therefore, greatly extended the limits which seemed closing in on the possibilities of oil recovery when President Coolidge appointed the board in 1924. Yet, as the report was careful to point out, lest the inadequacy of earlier estimates should lead to a too easy optimism for the future, none of these discoveries or improvements had added a barrel to the physical quantity of oil in the reserves. They merely meant that through them such reserves as there were had been depleted to a greater extent than had been deemed possible. They in no wise made it a matter of less national concern to conserve these resources and to avoid waste.

One thing is brought out forcibly by both reports. It is this: That maintenance of output sufficient to meet an existing, and probably increasing, demand involves in addition to whatever improvements may be made in engineering methods, constant recourse to new drilling and to new fields. The flow from a given well, however copious it may be at first gradually declines, and in spite of all improvement in technique must ultimately cease, simply because no more oil can be recovered. New borings must be made and new areas sought. For a quarter of a century, in order to meet the demand for oil, there have been completed an average of 15,000 new wells annually, and there is no reason for thinking that this will be less in the future under the existing law and present methods of production.[5]

This leads to the question, What is the prospect of discovery of new fields? At best it is uncertain. While in recent years great advance has been made in petroleum geology, the location of oil deposits from surface indications is still conjectural. Even more conjectural is the richness of the deposit when one is located. On this point these words from Thom may be quoted. "It is never possible for a geologist to say (honestly) that geologic evidence proves that oil is present beneath a particular locality in commercial quantities. Only actual drilling can prove the productivity or nonproductivity of a promising anticline or other structural feature. On the other hand * * * it is possible for a geologist to say that certain regions and areas are barren of valuable oil deposits because of the nature of the rocks occurring at the surface of those regions.[6] That is, a geologist can say of one region from surface indications, "No oil is here, it is useless to drill", of another from application of geo-

[5] McIntyre, James, Field Operation Suffered in 1931. The Oil and Gas Journal, Jan. 28, 1932, p. 15. The actual record, including oil wells, gas wells, and dry holes for the last 10 years was as follows: 1922, 24,658; 1923, 23,438; 1924, 21,894; 1925, 25,623; 1926, 29,319; 1927, 24,143; 1928, 22,331; 1929, 26,356; 1930, 21,240; 1931–32, 12,245. Of all the wells drilled an average of 62.3 percent were oil wells; 10.4 percent gas wells; and 27.3 percent dry holes. The falling off in 1930 and 1931 is doubtless due mainly to the depression, though the enormous yield of the east Texas field in 1931 (of which more will be said later) was probably a contributory factor.

[6] Thom, W. T., Jr., Petroleum and Coal: the Keys to the Future, 1929, p. 122.

physics, "Oil may be here, but you can't be sure till you try."

On this basis geologists tell us that 43 percent of the area of the United States is barren of oil, and that of the remaining 57 percent only a comparatively small portion is at all promising. However, 57 percent of the United States is a large area. About all that can be said on the basis of our present geological knowledge is that the duration of our oil reserves is very indefinite. Even with the most intelligent methods applied to their conservation their duration cannot be made to compare with that of our coal and iron reserves. The end may be postponed for a century or so. It is possible that it may come within a relatively short period.

Nor can we look forward with complacency to supplies from other regions of the world when our own reserves are exhausted. The United States now produces and consumes not far from two-thirds of the world output. Its reserves are among the richest in the world. When they prove insufficient to the need and the United States seeks other fields, its enormous rate of consumption, combined with the consumption of all other countries leaves little room for optimism for long duration of the world's reserves. Even assuming that other countries would grant free access to their reserves—a rather questionable assumption—the end would seem to be in sight. In 1920, Dr. David White published an estimate that the portion of the world's oil reserves recoverable by methods then in use amounted to 60,000,000,000 of barrels.[7]

[7] Ibid, p. 203.

This estimate, which it is to be observed, includes the reserves of the United States, may fairly be multiplied by two or three to make allowance for improved methods which have come into being since the estimate was made, but even then with a present world annual consumption of about 1,500,-000,000 barrels, to say nothing of a probable increase, a little over a century would seem to be the limit of our period of grace.

The prospect of the complete exhaustion of the world's oil reserves naturally raises the question of substitutes. What is to take the place of petroleum when the lean years set in? A disposition is manifested in some quarters to rely blindly on the progress of science and invention. There is here an unbounded field for speculation, and in view of the amazing achievements of science in the recent past, it would be foolish to assert that such blind faith is wholly vain. Such faith is fortified rather than weakened by the reflection that the end will not come suddenly. As the reserves approach exhaustion the price of all petroleum products will rise, and the rise in price will be the very thing needed to stimulate research and inventive genius. Petroleum is a form of stored energy, probably derived like practically all our other forms of energy, indirectly from the sun. The sun is still flooding the earth with light and heat, a theoretical horsepower to every three-eighths of a square yard receiving the vertical impact of its rays. It has been estimated that the energy received by the earth directly from the sun amounts to about 160,000 horsepower per capita of the earth's present population.[8]

Human ingenuity may yet harness some fraction of this inexhaustible store. Oil may be obtained from coal and from oil shale. Industrial alcohol may be used as a motor fuel. All things are possible in the unconfined spaces of the imagination. All that can now be said with assurance is that for petroleum in some of its uses no practical substitute is in sight except at price levels far above what we are accustomed to pay.

It might be supposed that rational beings intrusted with a definitely limited supply of a substance of such vital importance to their civilization would have displayed great economy in its production and use. In fact, as a result partly of indifference but partly of the legal rule of capture applicable to the development of oil and gas properties, the waste has been appalling. To understand the nature and sources of this waste a few

[8] Ibid, p. 214. The same author quotes from the Transactions of the First World Power Conference (Vol. IV, p. 1308) the following estimates made by Prof. Svante Arrhenius, of the comparative energy values of certain major sources of energy:

Total energy of world's oil reserves	1.00
Total energy of world's coal deposits	367.00
Energy of coal consumed annually	.08
Energy of air currents (annual figure)	275.00
Energy annually stored by growing plants	1.25
Energy of utilizable water power (annual figure)	.33
Solar radiation of heat to earth's surface (annual figure)	442.00

Thom thinks that in the light of recent improvements in geological and engineering methods the estimate for oil should be increased seven fold.

words must be said in regard to the geology of petroleum occurrence and the technique of its exploitation.

Petroleum, associated with natural gas, is found in what are called "oil sands" at varying distances below the earth's surface. It is a mixture of a considerable number of hydrocarbons of varying degrees of volatility, and is believed to have been elaborated under heat and pressure from substances of animal or vegetable origin in the process of decomposition. It first appeared as minute and scattered droplets, often in oil shales. Concentration in paying quantities required a combination of geologic factors: A porous reservoir rock, usually an "oil sand"; a local "fold" or "dome"; and an impervious cover, arresting escape of the oil to the surface. Such are the conditions essential to an oil pool, being source rock, porous formation for migration and accumulations and undulations, or a departure from horizontal in the earth's strata.

Recovery is effected by boring or drilling until the pool is tapped. A "derrick", familiar in picture of oil fields, is erected over the point of operation. As the drilling proceeds strings of pipe, known as "casing", are lowered for the purpose of lining the hole. When the oil sands are reached the natural gas with which the petroleum is usually associated is suddenly released from the high tension under which it has remained pent up for untold ages. It forces its way through the sands, carrying the petroleum with it, and rushes, often with great violence, upward to the surface.

The "flush flow", when the pool is first tapped, is often very vigorous and copious, sometimes spouting to a great height in the air. In this case the well is called a "gusher." After a time the pressure subsides and the flow becomes more gentle, or it may even require a pump to bring the oil to the surface. As time goes on the yield becomes less and less copious. Finally, the flow ceases and the well is abandoned. Abandonment, however, does not mean that all the petroleum in the pool has been recovered. Far from it. It is the general opinion that much more remains than is recovered. Estimates of the proportion left in the ground range from 25 to 90 percent, the commonest estimate being 80 percent.[9]

Such disparity in the estimates is to be expected, from the nature of the case, and undoubtedly the proportion recovered does in fact vary greatly with different geologic conditions and methods of operation. But from the standpoint of the present discussion, the fact that leading experts hold that only about a fifth of the oil is recovered from the sands by the methods of recovery in general use is of tremendous significance.

From this brief outline of the principles of petroleum geology and of the methods in use for recovering the oil it is possible to understand why more than in the exploitation of any other natural resource, the recovery of petroleum has been accompanied by enormous waste. These wastes will be discussed under the following heads: (1) Wastes connected with the flush flow. (2) Wastes from incomplete recovery. (3) Wastes from unrestricted competition.

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[9] Osgood, Wentworth, H., Increasing the Recovery of Petroleum, p. 5.

(1) Wastes connected with the flush flow: As just explained, when the pool is first tapped the natural gas which has been held back for ages rushes to the surface, carrying the oil with it. When the flow is very great, vast quantities of both oil and gas may escape into the air unless the well is promptly brought under control. In the past "gushers" have sometimes run wild for weeks before being brought under control, with an absolute waste of millions of barrels of oil. Sometimes the oil caught on fire, with great danger to life and property and with great money loss involved in extinguishing the fire or "killing" the well.

With the great advances in oil-field technology of the last few years, losses of oil through wells escaping from control and running wild are now seldom serious. Losses of natural gas from this cause, however, are still a grave problem under certain geologic conditions, as indicated by the wild "crater wells" in the Richland gas field of Louisiana.

Great as is the loss when wells are allowed to run wild, this is by no means the full extent of the waste. As we have seen, it is the pressure of the natural gas that brings the oil out of the sands into the well. Hence the oil when it reaches the surface is always accompanied by gas. But when the well is drilled primarily for oil, it often happens that no arrangements have been made for utilizing the gas. The oil is conserved but the gas is permitted to escape into the air. Yet the energy value of the gas thus lost may exceed that of the oil retained. In the Cushing field in Oklahoma the estimated waste from this source was 300,000,000 cubic feet per day or 100,000,000,000 cubic feet per year, a loss of energy equal to that embodied in 5,500,000 tons of coal.[10]

The fourth report of the Federal Oil Conservation Board cited two wells in Federal leases in California which had turned into pipe lines nearly $5,000,000 worth of oil, but which had meanwhile permitted gas to a value of $10,000,000 to escape into the air.[11] The same report also stated that in the Kettleman Hills area the gas which was allowed to escape, even without counting its gasoline content, was worth more at existing field prices than the high-grade oil which that gas brought to the surface.[12]

Other examples of the waste of natural gas are cited in the fifth report of the Federal Oil Conservation Board:

> In the Oklahoma City field alone, the wastage probably has averaged 300,000,000 cubic feet of natural gas per day for the past two years.[13]
>
> From January 1, 1920, to March 31, 1932, there has been produced in California a total of 3,527,309,000,000 cubic feet of natural gas. Of this amount 2,294,000,000,000 cubic feet, or 65 percent, has been utilized and the remaining, 1,233,309,000,000, or 35 percent, has been wasted.[14]

Another cause of loss associated with the flush flow is the practice of flowing oil into earthen pits

[10] Report of Federal Oil Conservation Board, pt. 1, p. 7.

[11] Ibid., Part IV, p. 25

[12] Ibid., Part IV, p. 16.

[13] Report V of the Federal Oil Conservation Board, p. 50.

[14] Ibid., p. 47.

in the absence of steel storage. As pointed out in a memorandum the committee has received from the United States Bureau of Mines—

> this practice has occurred many times in the development of new fields and always has caused physical waste of crude oil through evaporation and seepage into the ground. Operators are well aware of the wastefulness of earthen storage, but nevertheless it is often resorted to in the stress of overproduction.

(2) Wastes from incomplete recovery: Among the most serious of all causes of waste is the premature or irregular encroachment of salt water in the producing sands, brought about by hasty and unregulated competitive drilling. The salt water normally underlies the oil or encircles the margin of the pool, advancing upwards as the oil is removed. If drilling proceeds irregularly, large bodies of oil may be trapped by advancing bodies of water or the two may become so mingled that the oil is rendered valueless. The amount of oil so lost cannot be measured, but it is certainly very great.

A further and enormous loss of oil arises from the premature dissipation of the gas pressure. The comparatively small percentage of the total oil content of the sands which is actually recovered has already been referred to. The gas is frequently the chief propulsive agent which forces the oil out of the sands, and if this gas is allowed to escape, as it does when a well is permitted to run wild, even the small percentage of the total which can be recovered without resorting to artificial pressure is greatly reduced. Therefore, if gas is not conserved in the flush flow, there is loss not only from the gas that escapes but from the oil which might have been, but is not, recovered.

This latter loss, however, is not necessarily complete. Artificial pressure from air, gas, or water may be introduced into the sands and a second crop of oil extracted therefrom. However, this involves great expense, and heavy consumption of fuel to provide the necessary energy, and it is clearly good economy to recover as much oil as possible by means of the propulsive agent which nature has provided.

An illustration of increased recovery from oil fields by new methods is afforded by the Bradford field in McKean County, Pa. In 1922 the average daily production in the county was 5,195 barrels. Water flooding has greatly increased the recovery as is shown by the fact that in 1931 the daily average production in McKean County was 24,396 barrels.[15]

Just how great are the possibilities from the second crop of oil from abandoned wells is something of a matter of conjecture. Experience warrants the belief that a second crop equal to the first may be recovered, particularly in certain fields. Some oil men are so optimistic as to predict a recovery of from two to three times the first crop. A recent writer in a 2-volume work devoted exclusively to this subject makes this striking statement.

> The amount of oil left underground in fields that have been abandoned offers more attractive opportunities for increased production than wildcat territory.[16]

[15] Proceedings of the Pennsylvania Mineral and Forest Land Taxation Commission, December 1932.

[16] Osgood, Wentworth H., Increasing the Recovery of Petroleum, p. 77.

All such secondary recoveries, however, imply increasing cost of production and higher prices to the consumer.

(3) Wastes from unrestricted competition: To a great extent the wastes already discussed arise from this source. In other industries waste of natural resources is one of the black marks that must be set against competition. The eager haste and low prices which it induces compel competing owners, under penalty of being squeezed out, to "skim the cream" from their holdings and leave much valuable material which under a more rational system of industry might be utilized. But in no other field is the compulsion to waste so great.

The oil, as we have seen, is stored in a "pool" of considerable extent underground, but this "pool" may lie under the properties of many competing owners. The typical pool underlies the holdings of dozens or scores of farmers; and under conditions of town-lot drilling the number of surface owners may run into many hundreds. Consider the case at a section corner where four farms join. Obviously, if one owner drills a well near his corner, the other three owners are compelled also to drill under penalty of having the oil lying under their respective properties appropriated by the first owner. The law, generally so jealous of the rights of private property, has offered no protection to the owner of oil lying under his holding, if another owner can take it from him by drilling into the pool from an adjacent holding, and thus furtively drawing it away from him.

This situation has led to unseemly haste in the drilling and operation of wells. It has resulted in enormous wastes from "gushers" through the escape into the air of oil and natural gas in the manner already described, and it has resulted in waste of another sort arising from the effect of such unrestricted competition on the market. From what has been said it is evident that competition of the character described leads to production entirely independent of market conditions. Owners who would prefer to conserve their underground supplies for a better price feel themselves forced to produce and sell today, lest they have no oil to sell tomorrow. Hence, prices are forced down to ruinous figures, entailing not only money loss on all persons having oil to sell—those outside of the particular competitive field as well as those within it—but also the waste which always accompanies the utilization of commodities sold at an unnaturally low price.

A striking illustration of the wastes arising from unrestricted competition occurred in the east Texas field in 1931. This region, a vast area of 120,000 acres, was solidly leased up mostly to small operators and newcomers in the business and among them numerous promoters of stock-selling schemes. So much of the region was held in small parcels ranging from 1 acre up, and ownership was so diversified, that it was impossible to bring about coordinated action or orderly development. Production mounted rapidly. The average for February 1931 was 26,062 barrels per day; for March, 93,579; for April, 249,325. The peak was reached in August when for two days (August 15 and 16) the daily output was over 1,000,000 barrels. At this point Governor Sterling stepped in. Martial law was declared and National Guard troops were ordered into the field to shut in the wells. Since August 17, when the State government intervened, the output has been kept somewhat under control.

A group of operators met at Tyler on August 6, and again on August 14 and voiced an opinion in favor of a general shutdown. A committee waited on the governor and on August 17 the order for shutting the wells and calling out the National Guard was issued.

The whole matter was taken to the Supreme Court of the United States and the action of the Governor of Texas was held to be unconstitutional.[17]

All of the wastes which have been referred to as an incident to unrestricted competition developed in the east Texas field. There were many oil well fires and other serious accidents. Two of the fires cost a dozen lives. One well burned for 26 days before it was brought under control. As a result of the frantic struggle for precedence in oil recovery insecure construction and inferior equipment were inevitable. Many derricks were constructed of green lumber. In the drying process nails and bolts were pulled out and the derricks gave way under the stress of pulling casing or doing other heavy work. Improper completion of wells was the cause of a majority of the fires, and the railroad commission was compelled to issue rules and regulations in regard to completing wells, introducing safety features, and eliminating risks which operators were taking in order to save money. Millions of tons of secondhand material and equipment —some of it unusable—was moved into the district from other fields in Texas and other States, and

[17] Decided by Supreme Court. *Sterling* vs. *Constantin*, No. XI; October Term, 1932. U. S. Supreme Court, Lawyers Edition 77, page 254.

used in the place of new and safer equipment. This was a source of other accidents and fires. It was a boon to oil-field workers when operators were forced to start purchasing new equipment.[18]

The effects of unrestricted competition in the east Texas field did not end with the losses of the operators and the accidents to the workers. It meant a considerable depletion of our oil reserves, demoralization of the industry, and the wastes in utilization that accompany an unnaturally low price. The matter was clearly one of national concern. The importance of the east Texas oil field in relation to the total oil production of the United States can be inferred from the following table and diagram:

United States production of petroleum, 1924–1931, by States

[In thousands of barrels]

State	1924	1925	1926	1927	1928	1929	1930	1931	Number active wells, December 31, 1931	Daily average per well (barrels)
California	230, 063	230, 147	224, 117	230, 751	231, 983	292, 037	226, 092	188, 829	8, 911	58. 07
Oklahoma	176, 206	173, 270	177, 651	276, 022	247, 501	252, 229	216, 115	175, 704	58, 707	8. 20
Texas	135, 361	144, 783	172, 545	220, 031	255, 354	298, 713	292, 392	328, 609	22, 431	40. 14
Arkansas	48, 168	78, 407	58, 730	40, 411	32, 138	25, 444	20, 115	15, 626	3, 231	13, 25
Kansas	29, 672	38, 152	41, 347	41, 944	38, 150	40, 658	42, 123	38, 956	16, 708	5. 71
Wyoming	39, 251	29, 229	25, 466	20, 984	21, 403	19, 072	17, 740	14, 692	3, 536	11. 38
Louisiana	20, 638	21, 538	24, 283	24, 331	22, 863	21, 137	23, 881	22, 857	2, 976	21. 04
Illinois	8, 041	7, 862	7, 770	6, 873	6, 475	6, 356	5, 651	4, 717	15, 300	. 85
Pennsylvania	7, 529	7, 831	8, 971	9, 642	9, 914	11, 805	12, 918	11, 862	77, 300	. 42
Ohio	6, 797	7, 175	7, 307	7, 542	7, 105	6, 730	6, 483	5, 318	37, 250	. 40
Kentucky	7, 397	6, 770	6, 297	6, 590	7, 350	7, 821	7, 462	6, 490	15, 700	1. 13
West Virginia	5, 924	5, 780	5, 962	6, 033	5, 746	5, 609	5, 111	4, 477	15, 200	. 81
Montana	2, 786	4, 123	7, 745	5, 172	3, 999	3, 827	3, 204	2, 847	1, 429	5. 46
New York	1, 482	1, 660	1, 934	2, 237	2, 579	3, 346	3, 854	3, 395	14, 710	. 63
Colorado	392	1, 172	2, 776	2, 723	2, 744	2, 362	1, 624	1, 493	244	16. 76
New Mexico	82	1, 097	1, 696	1, 214	974	1, 803	10, 377	15, 360	441	95. 43
Indiana	936	828	785	852	1, 054	906	990	831	2, 480	. 92
Tennessee	6	23	44	62	50	20	20	7		
Michigan			103	436	613	4, 391	3, 589	7, 733	550	18. 59
Miscellaneous			31							
Total	720, 731	759, 847	775, 560	903, 850	897, 995	1, 004, 266	897, 741	845, 803	299, 104	7. 75

[18] Authority for statements about east Texas field, from Oil and Gas Journal, Jan. 28, 1932, McIntyre, James, East Texas Depressed Whole Industry, p. 56; and Bredberg, L. E. Year's Record of World's Greatest Oil Field, p. 58.

The table and chart are presented not only as throwing light on the point at present under discussion but as matters of general interest, showing, as they do, the relative position of the States in petroleum production and the upward or downward trends of the industry in each of them. It will be noted that the States upon which reliance for the great bulk of our oil supply must be placed are Texas, California, and Oklahoma, and that of these three Texas has shown the most rapid rate of increase and is at present furnishing by far the greatest output. The States standing next to the three giants are Arkansas, Wyoming, Kansas, Louisiana, Illinois, and New Mexico. However, the output of these and of all the other oil-producing States, individually or even collectively, is small compared with that of Texas alone. (The 1931 production of all of the States outside of Texas, California, and Oklahoma was 152,661,000 barrels; that of Texas alone 328,609,000 barrels.)

Referring now to the table and chart it will be seen that while nearly all the States showed a decline in output for 1931 as compared with 1930, Texas showed an increase of 36,217,000 barrels—an increase greater than the total production of any other State except California, Oklahoma, and Kansas. This increase came from the east Texas field, as production in other Texas fields was normal. Production in Texas rose from 48 percent of the production of all other States in 1930 to 63 percent in 1931.[19]

[19] The only States outside of Texas showing any increase in 1931 were New Mexico (10,377,000 to 15,360,000 barrels) and Michigan (3,589,000 to 3,733,000 barrels).

From these figures the national importance of the competitive situation in east Texas can easily be seen. Even in normal times such an increase could not have failed to have had far-reaching effects. Coming, as it did, in a period of general business depression, the effect was greatly augmented. The price of crude petroleum which had been about a dollar a barrel rapidly declined until August 12 when it touched low level of 13 cents a barrel and even lower.[20]

The low price, which was a loss to owners and operators, was a benefit to consumers. From a national standpoint and from the standpoint of the economic philosophy underlying the theory of competition it may seem a matter of no concern that one class of the community should gain at the expense of another. From the standpoint of conservation, however, it is a matter of concern. The throwing of such a vast quantity of petroleum on

[20] In a recent address before the Texas Oil and Gas Conservation Association at Forth Worth, Tex., Jan. 9, 1933, C. B. Ames, president of the American Petroleum Institute, said:

"There are approximatly 350,000 oil wells in the United States producing an average of one or two barrels a day. These may be referred to as wells of settled production. It is clear that in the public interest these wells should be preserved. They will continue to produce for many years, but if they are abandoned the oil they produce may be lost on account of the difficulty and expense of restoring the wells. A sound conservation program calls for the preservation of this supply, and these wells of settled production should be allowed to produce without restraint."

The institute made an analysis of crude oil production for the month of June 1931, "to show the number of wells required to produce certain approximate portions of and the

the market and the consequent slump in price meant a wasteful present use and a more speedy depletion of oil reserves. Another large pool may be discovered in one of the States at any time. If it should be in Texas, the waste would not be as great as in 1931, because of the increased power of

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total average production of the United States during the period covered." This tabulation follows:

Approximate daily production	Actual production	Number of producing wells	Average production per well per day
Barrels	*Barrels*		*Barrels*
500, 000	500, 649	1, 187	422
750, 000	737, 109	2, 212	333
1, 000, 000	1, 011, 063	3, 875	261
1, 100, 000	1, 105, 028	4, 637	238
1, 200, 000	1, 223, 061	5, 909	207
1, 300, 000	1, 292, 605	6, 758	191
1, 400, 000	1, 404, 965	8, 356	168
1, 500, 000	1, 504, 448	10, 000	150
1, 600, 000	1, 601, 365	11, 804	136
1, 700, 000	1, 709, 407	14, 593	117
1, 800, 000	1, 804, 558	17, 913	101
1, 900, 000	1, 899, 209	22, 875	83
2, 000, 000	1, 996, 325	30, 313	66
2, 100, 000	2, 100, 902	41, 546	51
2, 200, 000	2, 199, 761	56, 734	39
2, 300, 000	2, 297, 786	84, 891	27
2, 400, 000	2, 353, 156	137, 066	17
2, 500, 000	2, 462, 756	319, 385	8

Recent forecasts by two expert committees, appointed by the Federal Oil Conservation Board and by the American Petroleum Institute, indicate that during the first quarter of 1933, the total production of the United States should not exceed 2,000,000 barrels per day. A reference to the foregoing table shows that at the rate of production in June 1931, the requirements of 2,000,000 barrels per day could be met from the production of somewhat more than 30,000 wells. In the absence of control of production, through conservation measures, over any extended period it is evident that the uncontrolled flush production of about one-tenth of the wells would force the abandonment of a considerably greater number of pumping wells in the older fields. The preservation of the supply of oil from these smaller wells clearly indicates the importance of conservation control.

the Texas Railroad Commission to enforce conservation laws.

The wastes so far considered arise in connection with the production of petroleum. Wastes—or at least the possibility of a wiser conservation—arise in connection with its utilization.

Crude petroleum, as was stated, is a complex mixture of a considerable number of hydrocarbons of varying volatility. The most volatile is the natural gas which at once separates itself from the petroleum when the pressure is released by the tapping of the "pool." The liquid petroleum after recovery is run into stills where it is subjected to increasing heat. At a comparatively moderate temperature the most volatile component is expelled, and as the heat increases components of decreasing volatility are obtained. In this way the crude petroleum is made to yield several hundred distinct substances—gasoline, kerosene, lubricating oil, fuel oil, and other products—each having its appropriate use or uses.

By the process of straight distillation these components of the crude petroleum are thrown off in more or less stable proportions:[21] Hence, if the matter ended here, it would follow that a strong

[21] Crude petroleums from different regions vary considerably in their composition. Some are richer in the lighter and some in the heavier hydrocarbons. For example, the petroleums from the two principal Mexican fields are quite different, "The northern, or Panuco field, producing a heavy, viscous petroleum of 10° to 13° Baumé gravity; and the southern, or light oil field, producing a lighter petroleum of 19° to 22° Baumé gravity, more suitable for refining than the heavy crude of the northern field."—(Pogue, Joseph E., The Economics of Petroleum, 1921, p. 320.)

demand for one of the joint products would lead to the distillation of so great a quantity of crude oil as to yield a serious over-production of others. Fortunately, however, the several hydrocarbons have a family resemblance, and it has been found possible by a process known as "cracking" to break up the more complex molecules of which the heavier and less volatile components are composed and recompose them into the molecules of the lighter components. Hence, there is considerable range in proportions for practically all the components. This is shown by the following table:[22]

	Percent		*Percent*
Motor fuel	28. 7–60. 0	Wax	0. 2– 0. 5
Kerosene	7. 5–25. 0	Asphalt and road oil	2. 7–15. 0
Gas oils	3. 9–50. 0	Coke	0. 5
Diesel engine oils	1. 7–70. 0	Marine fuels	13. 4–80. 0
Lubricating oils	3. 7–20. 0	Land fuels	34. 5–80. 0

It is possible, therefore, so to apportion the components of the crude petroleum as to regulate the supply with reference to demand. If private business is left to its own devices, this adaptation will automatically adjust itself on a profit basis. That is, the refiner will so adjust his runs of crude oil through cracking units, at current prices, so to yield a maximum net income. If there were no acute problem of conservation, such an adjustment would be regarded as satisfactory. But since the problem of conservation is acute, a question of public interest as distinguished from private interest may arise. Fairly satisfactory substitutes are much more available for some of the components than for others. Marine and land boiler fuel can and

[22] Source of table, Davison, George S., President Gulf Refining Co., paper read at the Federal Oil Conservation Board Hearings. Feb. 10, 11, 1926.

will be replaced by coal when the petroleum supply is exhausted. Kerosene is already being rapidly replaced by electricity for lighting, and road oil by concrete. The problem of a satisfactory substitute for motor fuel is not so easily solved.

The question arises whether the conservation of our oil reserves is of sufficient moment to warrant Government intervention in the apportioning of products. For example, should the Government require that of the total output of petroleum the proportion allocated to the not easily replaceable gasoline should approach the maximum (60 percent) while the percentages of the more easily replaceable components should approach the minimum. The matter, however, does not end here. There would be no conservation if the Government simply fixed the proportion—rather the reverse. If the same total quantity of crude oil were taken from the reserves, such an allocation would have the effect of flooding the market with gasoline, which would then sell at a ruinously low price and be wastefully used. Moreover a great many of the smaller refineries are not equipped to utilize the more elaborate processes that such a high yield of gasoline implies. If conservation be the end in view of Government intervention, the total output as well as the allocation of components would have to be brought under control.

The subject is full of difficulties. Government intervention is likely to be cumbersome, irritating, and not always effective. In this case, if such intervention is to be of any avail, action by the Federal Government would seem to be called for; and questions of the constitutional powers of the Federal Government would at once arise. Doubtless, however, all these difficulties might be overcome. It is a case of balancing evils. Do the exigencies of the petroleum situation warrant the efforts necessary to secure effective Government control?

It is worthy of note that, to a certain extent, the allocation proposed has been self-adjusting under the action of ordinary economic forces. The following figures show the percentages of the total quantities of crude petroleum (domestic and imported) running to the stills, which have been allocated to the principal products for the years specified:

Allocation of crude petroleum to principal refined products, 1916–1930

[In millions of barrels and percentages]

Crude petroleum run to stills				Chief petroleum products							
				Gasoline		Kerosene		Gas and fuel oils		Lubricants	
Year	Domestic	Foreign	Total	Quantity	Per cent	Quantity	Per cent	Quantity	Per cent	Quantity	Percen
1918			326.0	85.0	26	43.5	10	174.3	53	20.0	6
1919			361.5	94.2	26	55.7	15	181.6	50	20.2	6
1920			433.9	116.2	27	55.2	13	211.0	49	24.9	6
1921			443.4	122.7	27	46.3	10	230.1	52	20.9	4
1922	435.0	65.7	500.7	147.7	29	54.9	11	254.9	51	23.3	5
1923	538.2	43.0	581.2	179.9	31	55.9	10	287.5	49	26.1	4
1924	598.0	45.8	643.8	213.3	33	60.0	9	320.5	50	27.5	4
1925	698.6	41.3	739.9	259.6	35	59.7	8	365.0	49	31.1	4
1926	734.3	45.0	779.3	299.7	38	61.8	8	365.2	47	32.3	4
1927	778.7	50.1	828.8	330.4	40	56.1	7	393.1	47	31.7	4
1928	835.7	77.6	913.3	376.9	41	59.3	6	427.2	46	34.7	4
1929	912.2	75.5	987.7	435.1	44	55.9	6	44.9	45	34.4	3
1930	866.6	60.8	927.4	436.2	47	49.2	5	373.2	40	34.2	3
1932					44		5		36		

Source: World Almanac, 1932, p. 358.

It will be seen that the percentages going to gasoline, the least replaceable of the products, have steadily and rapidly increased, while the percentages going to the more replaceable products, especially kerosene, have shown a marked downward trend. It is doubtful if a more satisfactory result would follow the most vigorous and irritating regulation by Government.

From the foregoing statement it would appear that the conservation of our petroleum reserves is a matter of serious national concern. What the future may have in store in the way of discovery and invention is conjectural. By hydrogenation, it is possible to make by volume more than 100 percent of gasoline from crude oil. Twenty percent of the motor fuel in Germany is now supplied by hydrogenation of low-temperature distillation of brown coal.

It is feasible to produce gasoline from coal in the United States at prices which the public would pay at perhaps as low as the prices of 10 years ago. The oil shales of the West contain large amounts of oil which can be recovered by distillation, and various processes are available for converting coal into oil, but these alternatives involve higher prices than we have been accustomed to pay. It is also conceivable that some other source of energy as well adapted to our needs as petroleum may be forthcoming. We do not know. But this we do know, that at the present time, with the present stage of advance of the arts and sciences, deprivation of petroleum would be a very serious blow to our national prosperity, if not to our national security. And this we further know, that the years of grace appear to be limited. Just how long it will be before the petroleum reserves of the United States are exhausted is uncertain. It will depend somewhat upon the care exercised in their conservation. But it will not be long, as time is reckoned in the history of nations. And when our own reserves are depleted, even if other countries, exercising more foresight, have husbanded theirs, we cannot expect them to be so simple as to surrender them to us for the strengthening of our air fleet and motor-truck service.

Conservation, therefore, should be prominent in the agenda of State legislatures and the Congress, and in the minds of the leaders of the industry. Their interest, at least their long-run interest, is at one with that of the Nation in this respect.

Two main lines of action are indicated—conservation in use and conservation in production.

CONSERVATION IN USE

One possibility for economy has already been suggested. The output may be restricted to the quantity necessary to supply the least replaceable uses. The process of cracking as was shown, makes possible a considerable range of choice in the final destinations to which the crude petroleum is put. How such restriction is to be put into effect is a difficult problem, but probably not insoluble, if the exigency of the situation be deemed sufficiently imminent. This line of action, if undertaken at all, would probably call for Federal intervention. Such legislation would regulate refinery operations rather than producing operations. Refining is done very largely in States which do not produce crude oil or which produce less crude oil than is refined. This is due to the practice of shipping crude oil by pipe lines and tankers to consuming centers rather than refining it locally where the crude oil is produced. State legislation would be insufficiently comprehensive, and the private interest of the owners and operators is not sufficiently apparent.

A second economy lies in the direction of scientific discovery and invention with a view to securing the maximum possible return in energy from every gallon of gasoline or oil consumed. It is estimated that the ordinary automobile utilizes only some 3½ percent of the energy theoretically lodged in the gasoline.[23] Even now devices have been invented which would considerably increase this percentage, and there would appear here to be an important field for further invention. Motor fuel is one of the most important and least replaceable of the derived products of petroleum. A doubling of the percentage of the theoretical energy actually utilized would be a long step in the direction of conservation.

CONSERVATION IN PRODUCTION

Attention has already been called to the enormous wastes of oil from premature and irregular encroachment of salt water and from the escape into the air of the natural gas that accompanies and causes the flow of petroleum from the sands. Such escape of gas, as was pointed out, is not only a direct loss of the energy embodied in it but is also an indirect loss from the oil which it might have propelled to the surface but did not, because it was permitted to escape. Barring accidents, the occasional occurrence of which seems a challenge to human foresight, all of these wastes should be eliminated.[24]

[23] Kettering, C. F., general manager research division, General Motors Corporation, Hearings, Federal Oil Conservation Board, p. 42.

[24] Suman, John R., Petroleum Production Methods. 1921, pp. 227–233.

The fourth report of the Federal Oil Conservation Board devotes considerable space to the subject of pipe lines for conveying natural gas. It is shown that gas can now be conveyed to such great distances and that it is of such value for heating and as a source of power that private interest would seem to dictate every effort to prevent the wasteful escape into the air. But if private interest cannot be relied on to eliminate these wastes from "gushers" and from the escape of natural gas there would seem to be here a field for Government intervention. I believe that the States can adequately police the fields within their respective jurisdictions. The Federal Government might cooperate by lending technical assistance upon request of a State authority.

In the fourth report, however, chief emphasis is given to the wastes from unrestricted competition. The wastes from this source in the east Texas field have already been described. In the judgment of the board unit operation is imperative; that is, that a number of owners whose properties lie over a "pool" should operate as a single owner in some manner sharing in the expense and profit of operation. In general it may be said that it is for the interest of the owners as well as for the public in conserving its oil reserves that such cooperation should be effected. Yet the situation is such that a single owner who refuses thus to cooperate is in a position to make cooperation by the others unavailing. He may lawfully drill a well on any part of his property and appropriate all the oil and gas that he can get from it, notwithstanding the fact that much of the oil and gas thus appropriated lay under his neighbors' property, and hence under the generally accepted definition of property in real estate would seem to be their property. The case is further complicated by the question of the legal right of the owners to cooperate. If the competitors are engaged in interstate commerce would such combination come under the condemnation of the Sherman Antitrust Act? If not, would the combination come under the condemnation of the common law as a conspiracy in restraint of trade? Can the Government intervene and compel unit operation, or, as in the Texas case, use military force to prevent wasteful competition without violating the constitutional provision against taking property without due process of law?

There are many legal difficulties, but undoubtedly they can be untangled. The powers that make laws or even constitutions can unmake them when the case seems sufficiently pressing. President Coolidge in his letter of December 19, 1924, constituting the Federal Oil Conservation Board, pointed out the impossibility of conserving "oil in the ground under our present leasing and royalty practices, if a neighboring owner or lessee desires to gain possession of his deposits."

In its fourth report the board urges that "The natural unit in oil deposits is a single pool, large or small, and that unit operation is nothing more than accepting nature's decree." It shows that the delimitation of property rights by fences, walls, and the like, however satisfactory in the case of fixed substances like ore or stone, is entirely unsatisfactory in the case of fluids, and concludes that "what is needed now to effect this conservation movement is specific recognition by the courts of the community of interests of all landowners in the control of the oil or gas pool, in the oil and gas as separate marketable commodities, and in the energy of the gas—the pressure so easily dissipated but so essential to an adequate recovery of the oil included in the minute pores of the sand or sandstone that forms the reservoir."

It points out that much progress has already been made in unit operation but shows that much yet remains to be done. It would seem desirable, in view of the gravity of the situation and the fact that irretrievable wastes of our oil reserves are likely to occur from competitive operation, that whatever is to be done be done quickly.

The facts brought out by this study show that the oil situation involves questions of deep national concern—questions which call for cooperation among leaders in the industry with representatives of the State and Federal Governments to secure conservation of this, one of our most important natural resources. They do not, however, suggest the need of panic or undue alarm. With cooperative action looking to conservation, with improving technique and advancing science in the matter of deeper drilling, more complete recovery of the deposits, and with continued progress in oil geology directed to the study of new deposits, it seems probable that our oil reserves will meet our requirements for many years.

It is possible to forecast for a year in advance the approximate market requirements of the United States as a whole for petroleum and petroleum products. Under present arrangements after such market requirements have been ascertained it remains for each oil-producing State to decide for itself what share of the total it should supply. After each State has decided what its share of the total should be, it then, under its proration and conservation laws, may allocate this amount to the various oil pools within its jurisdiction. If the individual oil-producing States are fair in their findings as to how much of the total market requirements of the country the given State is entitled to supply, it will be possible for the States to stabilize the production of the flush wells so as to enable the "stripper" wells to continue on pump. If the individual States with the largest producing oil pools substantially overestimate the proportion of the market requirements which a given State for a year should supply, then overproduction of the flush wells under conditions such as obtained in the years 1931–32 might bring down the price of crude oil below where it would be profitable to operate many "stripper" wells.

There are approximately 350,000 wells in the United States producing on an average of 1 to 2 barrels per day. These wells will continue to produce for many years unless they are abandoned. If they should be abandoned on account of the low price of crude oil, the difficulty and expense of restoring the most of them would be prohibitive. A sound conservation policy requires that these wells be permitted to operate continuously. Otherwise much oil would never be brought to the surface, which will be recovered if these "stripper" wells are permitted to run their course without premature abandonment. From 30,000 of the most productive wells the annual requirements of the United States can be supplied; but to run the newer and stronger wells at a full capacity would mean the abandonment of many of the wells which have to be pumped.

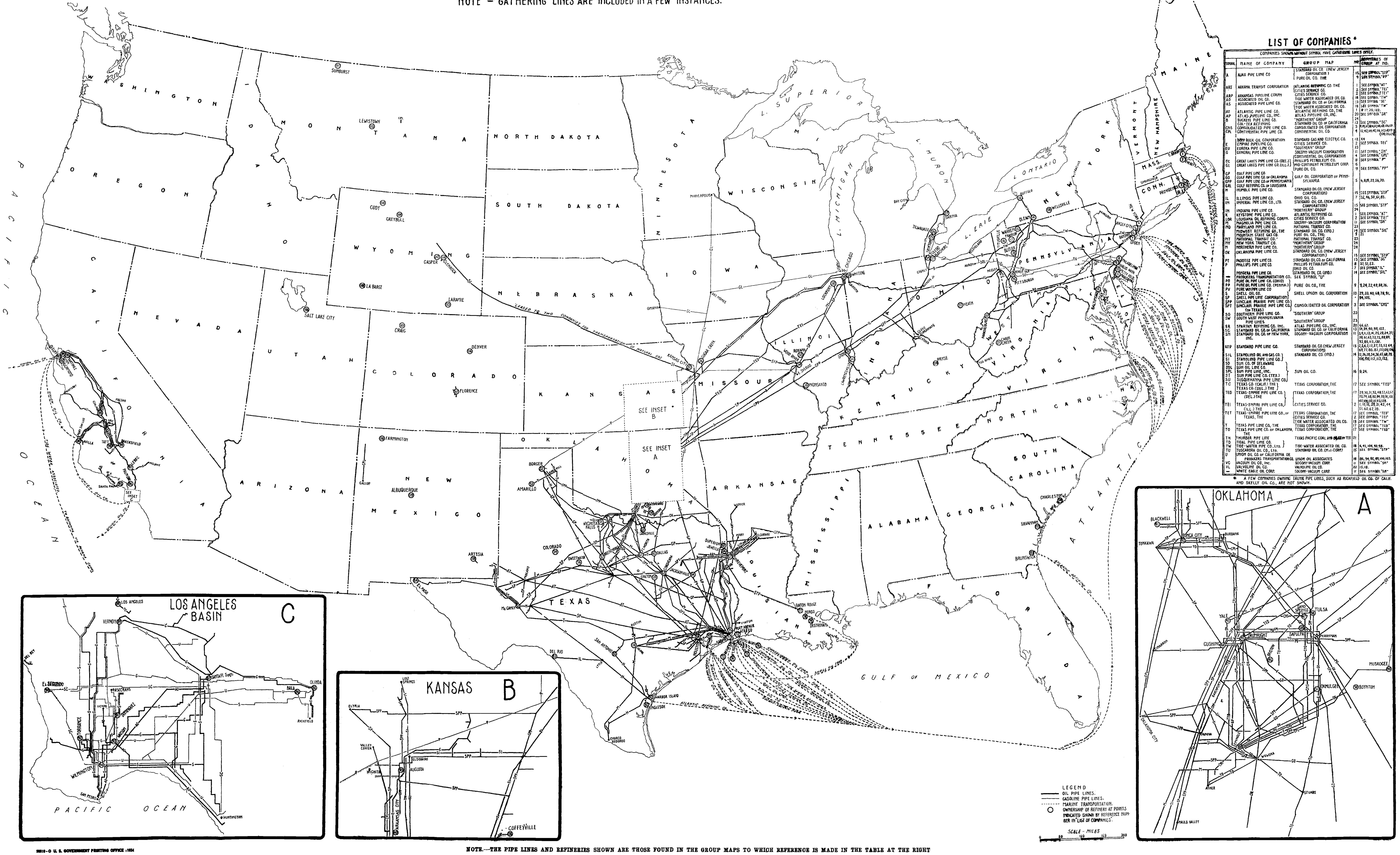
Proration measures are being passed in the States with a view to controlling the output of flush production so that there may be no interference with the wells that are being pumped. If the individual States fail to hold down production in new fields under present conditions, the price of crude oil will force the abandonment of thousands of "stripper" wells.

Compacts between the States with the most productive oil pools may be necessary. If the States will not enter such compacts, and if they persist in overestimating the amount of the annual market requirements which particular States should supply, then there is no way to control production and preserve the thousands of wells that are being pumped except by action of the Federal Government. The States can handle the problem if they will enact and enforce laws with a view to its solution. It remains to be seen how successful they will be in controlling producers within their respective jurisdictions in the interest of conservation throughout the oil-producing areas.

The consumers of oil products for the most part reside in States in which the oil pools are not located. It is to their interest that oil be produced under such conditions as will ultimately lead to recovery of as much oil as possible. If the oil-pro-

OIL AND GASOLINE TRUNK PIPE LINES AND REFINERIES, 1932

NOTE — GATHERING LINES ARE INCLUDED IN A FEW INSTANCES.



LIST OF COMPANIES *

COMPANIES SHOWN WITHOUT SYMBOL HAVE GATHERING LINES ONLY.

SYMBOL	NAME OF COMPANY	GROUP MAP	NO.	REFINERIES OF GROUP AT NO.
A	AJAX PIPE LINE CO	STANDARD OIL CO. (NEW JERSEY CORPORATION)	15	SEE SYMBOL "STP"
		PURE OIL CO. THE	9	SEE SYMBOL "PP"
ART	ARKANA TRANSIT CORPORATION	ATLANTIC REFINING CO. THE	1	SEE SYMBOL "AT"
		CITIES SERVICE CO.	2	SEE SYMBOL "TEI"
ARP	ARKANSAS PIPELINE CORPN	CITIES SERVICE CO.	2	SEE SYMBOL "TEI"
AO	ASSOCIATED OIL CO.	TIDE WATER ASSOCIATED OIL CO.	18	SEE SYMBOL "TW"
AS	ASSOCIATED PIPE LINE CO.	STANDARD OIL CO. OF CALIFORNIA	13	SEE SYMBOL "SC"
		TIDE WATER ASSOCIATED OIL CO.	18	SEE SYMBOL "TW"
AT	ATLANTIC PIPE LINE CO.	ATLANTIC REFINING CO., THE	1	8, 17, 20, 122.
AP	ATLAS PIPELINE CO., INC.	ATLAS PIPELINE CO., INC.	20	SEE SYMBOL "SR"
B	BUCKEYE PIPE LINE CO.	"NORTHERN" GROUP	24	
	COL-TEX REFINING	STANDARD OIL CO. OF CALIFORNIA	13	SEE SYMBOL "SC"
CNS	CONSOLIDATED PIPE LINE CO.	CONSOLIDATED OIL CORPORATION	3	9, 29, 37, 38, 41, 47, 48, 48, 126, 131.
CPL	CONTINENTAL PIPE LINE CO.	CONTINENTAL OIL CO.	4	12, 42, 114, 115, 116, 117, 118, 119 (120, 121, 125)
	DEEP ROCK OIL CORPORATION	STANDARD GAS AND ELECTRIC CO.	12	44
E	EMPIRE PIPELINE CO.	CITIES SERVICE CO.	2	SEE SYMBOL "TEI"
EU	EUREKA PIPE LINE CO.	"SOUTHERN" GROUP	23	
G	GENERAL PIPE LINE CO.	SOCONY-VACUUM CORPORATION	11	SEE SYMBOL "SN"
GL	GREAT LAKES PIPE LINE CO. (DEL.)	CONTINENTAL OIL CORPORATION	4	SEE SYMBOL "CPL"
GL	GREAT LAKES PIPE LINE CO. (ILL.)	PHILLIPS PETROLEUM CO.	8	SEE SYMBOL "P"
		MID-CONTINENT PETROLEUM CORP.	6	
		PURE OIL CO.	9	SEE SYMBOL "PP"
GP	GULF PIPE LINE CO.	GULF OIL CORPORATION OF PENNSYLVANIA	5	6, 8, 19, 23, 56, 70.
GO	GULF PIPE LINE CO. OF OKLAHOMA			
GPP	GULF PIPE LINE CO. OF PENNSYLVANIA			
GRL	GULF REFINING CO. OF LOUISIANA			
H	HUMBLE PIPE LINE CO.	STANDARD OIL CO. (NEW JERSEY CORPORATION)	15	SEE SYMBOL "STP"
IL	ILLINOIS PIPE LINE CO.	OHIO OIL CO.	7	32, 46, 50, 61, 83.
IM	IMPERIAL PIPE LINE CO., LTD.	STANDARD OIL CO. (NEW JERSEY CORPORATION)	15	SEE SYMBOL "STP"
IN	INDIANA PIPE LINE CO.	"NORTHERN" GROUP	24	
K	KEYSTONE PIPE LINE CO.	ATLANTIC REFINING CO.	1	SEE SYMBOL "AT"
LOR	LOUISIANA OIL REFINING CORPN.	CITIES SERVICE CO.	2	SEE SYMBOL "TEI"
M	MAGNOLIA PIPE LINE CO.	SOCONY-VACUUM CORPORATION	11	SEE SYMBOL "SN"
MD	MARYLAND PIPE LINE CO.	NATIONAL TRANSIT CO.	23	
	MIDWEST REFINING CO., THE	STANDARD OIL CO. (IND.)	14	SEE SYMBOL "SIL"
	MOUNTAIN STATE GAS CO.	PURE OIL CO., THE	9	21
NT	NATIONAL TRANSIT CO.	NATIONAL TRANSIT CO.	23	
NY	NEW YORK TRANSIT CO.	"NORTHERN" GROUP	24	
N	NORTHERN PIPE LINE CO.	"NORTHERN" GROUP	24	
OK	OKLAHOMA PIPE LINE CO.	STANDARD OIL CO. (NEW JERSEY CORPORATION)	15	SEE SYMBOL "STP"
PT	PASOTEX PIPE LINE CO.	STANDARD OIL CO. OF CALIFORNIA	13	SEE SYMBOL "SC"
P	PHILLIPS PIPE LINE CO.	PHILLIPS PETROLEUM CO.	8	37, 51, 52.
	PONDERA PIPE LINE CO.	OHIO OIL CO.	7	SEE SYMBOL "IL"
		STANDARD OIL CO. (IND.)	14	SEE SYMBOL "SIL"
—	PRODUCERS TRANSPORTATION CO.	SEE SYMBOL "U"		
PO	PURE OIL PIPE LINE CO. (OHIO)	PURE OIL CO., THE	9	9, 24, 22, 49, 58, 76.
PP	PURE OIL PIPE LINE CO. (PENNA.)			
PV	PURE VAN PIPE LINE CO			
S	SHELL OIL CO.	SHELL UNION OIL CORPORATION	10	29, 33, 40, 68, 78, 91, 94, 105.
SP	SHELL PIPE LINE CORPORATION			
SPP	SINCLAIR PRAIRIE PIPE LINE CO.	CONSOLIDATED OIL CORPORATION	3	SEE SYMBOL "CNS"
SPT	SINCLAIR PRAIRIE PIPE LINE CO. (OF TEXAS)			
SO	SOUTHERN PIPE LINE CO.	"SOUTHERN" GROUP	23	
SW	SOUTH WEST PENNSYLVANIA PIPE LINES	"SOUTHERN" GROUP	23	
SR	SPARTAN REFINING CO. INC.	ATLAS PIPELINE CO., INC.	20	66, 67.
SC	STANDARD OIL CO. OF CALIFORNIA	STANDARD OIL CO. OF CALIFORNIA	13	54, 84, 90, 99, 102.
SN	STANDARD OIL CO. OF NEW YORK, INC.	SOCONY-VACUUM CORPORATION	11	3, 4, 11, 13, 14, 25, 29, 34, 35, 39, 61, 63, 73, 75, 88, 89, 92, 85, 112, 130.
STP	STANDARD PIPE LINE CO.	STANDARD OIL CO. (NEW JERSEY CORPORATION)	15	2, 5, 6, 7, 12, 27, 55, 57, 64, 69, 77, 80, 82, 127, 129, 124
SIL	STANOLIND OIL AND GAS CO.	STANDARD OIL CO. (IND.)	14	12, 26, 28, 34, 36, 65, 68, 79, 106, 109, 112, 113, 123.
SI	STANOLIND PIPE LINE CO.			
SD	SUN CO. OF DELAWARE	SUN OIL CO.	16	9, 24.
SOL	SUN OIL LINE CO.			
SPL	SUN PIPE LINE, INC.			
ST	SUN PIPE LINE CO. (TEX.)			
SU	SUSQUEHANNA PIPE LINE CO.			
TC	TEXAS CO. (CALIF.) THE	TEXAS CORPORATION, THE	17	SEE SYMBOL "TED"
	TEXAS CO. (DEL.) THE			
TED	TEXAS-EMPIRE PIPE LINE CO. (DEL.) THE	TEXAS CORPORATION, THE	17	29, 30, 31, 32, 48, 53, 62, 67, 70, 74, 68, 82, 84, 88, 96, 101, 107, 108, 110, 111, 112, 128.
TEI	TEXAS-EMPIRE PIPE LINE CO. (ILL.) THE	CITIES SERVICE CO.	2	1, 10, 16, 29, 31, 42, 44, 51, 60, 67, 70.
TET	TEXAS-EMPIRE PIPE LINE CO., OF TEXAS, THE	TEXAS CORPORATION, THE	17	SEE SYMBOL "TED"
		CITIES SERVICE CO.	2	SEE SYMBOL "TEI"
		TIDE WATER ASSOCIATED OIL CO.	18	SEE SYMBOL "TW"
T	TEXAS PIPE LINE CO., THE	TEXAS CORPORATION, THE	17	SEE SYMBOL "TED"
TO	TEXAS PIPE LINE CO. OF OKLAHOMA, THE	TEXAS CORPORATION, THE	17	SEE SYMBOL "TED"
TH	THURBER PIPE LINE	TEXAS PACIFIC COAL AND OIL CO. OF TEX	21	
TD	TIDAL PIPE LINE CO.	TIDE-WATER ASSOCIATED OIL CO.	18	6, 45, 104, 93, 98.
TW	TIDE-WATER PIPE CO., LTD.			
TU	TUSCARORA OIL CO., LTD.	STANDARD OIL CO. (N.J. CORP.)	15	SEE SYMBOL "STP"
U	UNION OIL CO. OF CALIFORNIA OR PRODUCERS TRANSPORTATION CO.	UNION OIL ASSOCIATES	19	86, 94, 95, 99, 100, 103.
VC	VACUUM OIL CO., INC.	SOCONY-VACUUM CORP.	11	SEE SYMBOL "SN"
VL	VALVOLINE OIL CO.	VALVOLINE OIL CO.	22	15, 18.
—	WHITE EAGLE OIL CORP.	SOCONY-VACUUM CORP.	11	SEE SYMBOL "SN"

* A FEW COMPANIES OWNING TRUNK PIPE LINES, SUCH AS RICHFIELD OIL CO. OF CALIF. AND SKELLY OIL CO., ARE NOT SHOWN.

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NOTE.—THE PIPE LINES AND REFINERIES SHOWN ARE THOSE FOUND IN THE GROUP MAPS TO WHICH REFERENCE IS MADE IN THE TABLE AT THE RIGHT ducing States fail in their efforts at conservation, then the oil-consuming States may have to act through the Federal Government to stabilize oil production and conserve oil resources.

[Pages lviii–lix]

RECENT CHANGES IN PIPE-LINE FACILITIES

At the present time three States—Oklahoma, Texas, and California—produce approximately 82 percent of all crude oil taken out of the ground in the United States. In 1930 the Midcontinent output was 66 percent of the total, the California 25 percent, and the Rocky Mountain 4 percent. There is left only 5 percent of the total production to occur in all States east of the Mississippi River, though in this area are found 70 percent of the population, 70 percent of the automobile registrations, and 70 percent of the gasoline consumption.[25] A leading problem confronting the oil industry is therefore that of finding the most economical means of laying down in the great middle west and eastern markets refined products derived from Midcontinent crude. The alternatives are to bring the crude oil by pipe line or by a combination of pipe line and tankers to refining points in the market areas or to refine the oil in the area of its production and move the refined products to the distant markets.

There are many questions other than those of transportation to be faced in choosing between

[25] These figures are taken from the testimony of Chas. E. Bowles at hearing on H. R. 16695, Pipe Lines, Feb. 17 and 18, 1931, pp. 11 to 14.

these alternatives. The relative refining costs in the different areas and the disposition to be made of certain of the refinery by-products, where refining is done at points remote from the large manufacturing or consuming centers, illustrate such questions. For the purpose of this report, however, attention can be confined to the transportation aspects of the problem.

The factors entering into transportation costs have materially changed in recent years, particularly with the development of pipe lines suited to the transportation of gasoline and other refined products and of more economical methods of pipeline construction. Companies whose transportation program was based on earlier cost factors have therefore had to effect adjustments to the changed situation, as by relocating their refineries or changing their refinery schedules, by constructing gasoline lines or converting oil lines to gasoline lines, or otherwise. The accompanying general pipe-line map shows the collective layout of oil and gasoline pipe lines at the present time and the use made of boats from the Gulf to East Coast points, between points within the Gulf area, and from California. The individual maps which accompany the group reports, by isolating the lines and refineries of each group, indicate the choice now in evidence between the alternatives indicated. This choice is not clear-cut in the case of certain of the companies whose field of operation is so large that their transportation program is a composite of types. A brief characterization of some of the leading cases will clarify the discussion.

Mention should first be made of lines in the old eastern field. Many of the lines constructed in the early period when the Appalachian field, especially Pennsylvania, contributed the bulk of the oil of the country, are still in operation. These lines were extended westward as the area of production shifted in that direction, making connection with lines constructed from the Midcontinent field as that area emerged as the most important area of supply. With the development of tanker movements of crude oil and refined products from the Gulf to the East and subsequently from California came a period of difficulty for the lines holding themselves out as parties to the movement of oil from the Midcontinent fields to the east coast and to refinery centers in western Pennsylvania and New York. The present rates of such lines reflect the absorptions they have had to make to prevent further diversions of oil.[26] As is pointed out shortly, the lines embraced in the so-called "Northern" and "Southern" groups, together with the National Transit Co., are not attached to any group of oil companies and hence are practically unique in the pipe-line field to-day.[27]

[26] P. LXXIII. One or two such lines now transport crude oil to interior refineries, which has been moved to the east coast by tanker, and others are used for the movements of refined products.

[27] The explanation lies in the fact that these lines were separated from Standard Oil properties in the dissolution of 1911. P. XXXVI.

4. Bureau of Mines, Monthly Petroleum Statement, January, 1934:

[Page 4]

Production of crude petroleum by States and principal fields

(Thousands of barrels of 42 gallons)

	January 1934		December 1933		January 1933	
	Total	Daily average	Total	Daily average	Total	Daily average
Arkansas	956	31	942	30	943	30
California:						
Kettleman Hills	1,597	52	1,656	54	1,795	58
Long Beach	1,806	58	1,896	61	2,125	69
Santa Fe Springs	1,283	41	1,307	42	1,694	55
Rest of State	9,477	306	9,867	318	8,846	284
Total California	14,163	457	14,726	475	14,460	466
Colorado	87	3	77	3	88	3
Illinois	393	13	378	12	297	9
Indiana:						
Southwestern	72	2	69	2	48	2
Northeastern					1	
Total Indiana	72	2	69	2	49	2
Kansas	3,407	110	3,470	112	2,933	95
Kentucky	362	12	385	12	438	14
Louisiana:						
Gulf coast	1,351	44	1,358	44	1,036	33
Rest of State	852	27	768	25	876	29
Total Louisiana	2,203	71	2,126	69	1,912	62
Michigan	822	27	945	30	4 47	14
Montana	222	7	199	6	169	5
New Mexico	1,319	42	1,277	41	1,003	32
New York	306	10	298	10	253	8
Ohio:						
Central and eastern	269	8	255	8	273	9
Northwestern	89	3	79	3	86	3
Total Ohio	358	11	334	11	359	12
Oklahoma:						
Oklahoma City	5,589	180	5,932	191	3,221	104
Seminole	3,311	107	3,308	107	3,404	110
Rest of State	6,318	204	5,968	193	5,857	189
Total Oklahoma	15,218	491	15,208	491	12,482	403
Pennsylvania	1,152	37	1,077	35	974	32
Tennessee	1				1	
Texas:						
Gulf coast	4,913	158	4,873	157	3,814	123
West Texas	3,994	129	3,931	126	4,960	160
East Texas	13,989	451	13,901	449	10,447	337
Rest of State	6,790	219	6,619	214	6,665	215
Total Texas	29,686	957	29,324	946	25,886	835
West Virginia	340	11	326	11	294	9
Wyoming:						
Salt Creek	524	17	558	18	666	22
Rest of State	385	12	341	11	344	11
Total Wyoming	909	29	899	29	1,010	33
United States total	71,976	2,321	72,060	2,325	63,998	2,064

5. Minerals Yearbook 1932–1933, Statistical Appendix:

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Producing oil wells

State	Approximate number, Dec. 31, 1932	Average production per well per day (barrels)
Arkansas	2,880	10.7
California	8,900	54.7
Colorado	190	15.9
Illinois	15,170	.8
Indiana:		
Southwestern	1,140	1.9
Northeastern	365	.2
Total Indiana	1,505	1.4
Kansas	18,300	5.1
Kentucky	13,510	1.3
Louisiana:		
Gulf Coast	390	83.5
Northern	2,660	10.2
Total Louisiana	3,050	19.1
Michigan	645	29.6
Montana	1,420	4.7
New Mexico	490	74.0
New York	17,680	.5
Ohio:		
Central and eastern	20,640	.5
Northwestern	13,890	.2
Total Ohio	34,530	.4
Oklahoma	57,100	7.4
Pennsylvania	80,380	.4
Texas:		
Gulf Coast	2,740	42.9
East Texas proper	9,400	51.3
West Texas	3,090	57.0
Rest of State	28,400	8.2
Total Texas	43,630	21.0
West Virginia	18,850	.6
Wyoming	3,200	11.1
Other	(1) 70	
	321,500	6.7

[1] Alaska, Missouri, Tennessee, and Utah.

6. American Institute of Mining and Metallurgical Engineers, *Petroleum Development and Technology, 1931,* Swensrud, Economics of Distribution in the Oil Industry:

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The economics of distribution in the oil industry cannot be regarded apart from the general economics of the industry as a whole. The attempt to regard them as separate has led many people into the fallacy of believing that the responsibility for the apparent evils in the marketing end of the business lay entirely at the door of the marketing end. Such a view fails to take cognizance of many underlying factors; we can only expect to understand the distribution economics of the industry if we understand its general economics. We must realize also that the oil industry today is essentially the gasoline industry.

The oil industry may be said to have begun about 60 years ago. At the outset it was concerned chiefly with the manufacture and sale of kerosene, lubricating oils, and greases. Gasoline was then a most obnoxious byproduct. The early oil-marketing company was engaged almost exclusively in refining and marketing—it did not concern itself with production but bore the relation to it merely of a purchaser. It may be said that the urge of marketing development in those days, therefore, came from the refining and marketing end of the business. The raw material had not yet begun to exert its enormous pressure, nor had the producer of crude oil acquired a direct interest in the sale of the ultimate finished products.

Since then great changes have taken place. With the development of the automobile came a vast new demand for the raw material from which gasoline could be made. No longer could the refining and marketing companies be indifferent to the source of that raw material, particularly in view of the pessimistic outlook then presented as to the probable quantity of oil in existence. And despite the complete overturning of those early estimates, made before the bounty of nature and the skill of geologists and mining engineers had revealed themselves in undreamed of reserves of crude oil, the motive of the large marketer to integrate back to the crude still constitutes a strong force. The need of uniform and assured quality, made the more necessary by intensive advertising, tends to force him into refining. Then it may seem expedient for him to secure production in order to protect his refining and marketing position, although often he is merely attracted by the hope of reaping a profit on the raw material for which the sale of his finished product and his refining position give him a justifiable use.

The production of crude, however, was not in the beginning and never has been confined to refining and marketing companies. Many companies began at the production end. The abundance of crude of which many of these companies found themselves possessed has in turn, however, exerted upon them a powerful pressure to engage in refining and marketing activities in order to obtain for their production a more assured outlet. It is sometimes difficult or impossible to sell crude oil as such, but there is almost always a possibility of selling gasoline, at some price. So the producer of crude becomes a refiner; then, as he still finds it difficult to dispose of all his gasoline at wholesale for a decent price, he tends to push on into the retail marketing end in order to obtain that final utopia of assured outlets.

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For few commodities probably are prices less understood than for gasoline. Legislators and editors frequently feel that laws should be passed about them, apparently on the general theory that what is a mystery to them ought to be dealt with by law. People express great amazement that the price of gasoline at one point should differ sharply from that at a nearby point. Likewise, they see something mysterious if not sinister when practically all major companies raise or lower their posted prices simultaneously. Beneath these surface indications regarding price are some simple and some rather complicated economic factors.

The general level of gasoline price is fundamentally determined by the interaction of gasoline demand and crude-oil supply. In a very narrow and short-term sense, the price of gasoline reacts to the supply and demand factors for gasoline alone, but in our industry the rapidity with which crude oil can be converted into gasoline makes the supply of crude the dominant factor. The facts bear out this statement, for over a period of the last 12 years there never has been a major change in the trend of wholesale gasoline prices that was not followed shortly by a change in the same direction in crude oil. The statement just made that changes in crude-oil prices follow changes in wholesale gasoline prices is a true statement of the actual sequence. It is a logical sequence because the wholesale gasoline market is an extremely sensitive one, whereas the market for crude oil is rather sluggish, owing to the physical necessity, in general, of pipe-line connections with a specific buyer. It is not a market in which buyers and sellers can meet openly on equal terms and engage in that "higgling and bargaining" which are the essentials of a market in which the forces of supply and demand can rapidly and continuously be balanced in terms of price. This simply means that the wholesale gasoline price, being more sensitive, tends to reflect sooner those supply and demand factors to which the price of crude must later respond.

The retail price of gasoline, as has been mentioned, tends to lag behind the wholesale price because there is less higgling and bargaining by the retail buyer, and perhaps also because the inconvenience of fractional cent retail prices tends to cause a postponement of retail price changes until enough change in wholesale prices has accumulated to warrant a change of convenient amount in the retail price.

The close correspondence of retail gasoline prices and price changes among leading companies is the result of economic necessity and not of collusion. The commodity gasoline, to be sure, is bought to a considerable extent on the basis of brand, but the normally small differences in quality which usually have existed between the products of good companies, and the difficulty of readily apprehending the differences in a motor car, have made the customer, as a general rule, unwilling to pay more for his preferred brand than for the comparable brand of another company. Suppose, therefore, that today a certain leading marketer cuts the price 2 cents. No other representative company could afford not to cut, unless it were willing to risk losing much of its business. Likewise, on the upside, a leading company raises its price, say, 1 or 2 cents. In this case, if its competitors do not follow its lead it would have no option but to reduce its price back to their level or lose business. These factors practically compel all companies having reasonably comparable products and service to sell at the same retail price—the same thing is true of most other products we buy, with this difference however: A large portion of the public buys gasoline frequently; those buyers are mobile—being in their automobiles they can readily drive a little out of their way if any price advantage makes that desirable.

Then, too, gasoline is the principal product sold at a gasoline station, and prices usually are posted very conspicuously, especially if they are lower than the prevailing level, so that the opportunities for price comparison by the customers are almost unparalleled. These factors simply narrow down the time limit the various companies have in which to adjust their prices to prevailing levels, and any oil marketer knows that if a cut price is suddenly posted by a nearby competitor he begins to suffer serious and immediate loss of gallonage. The result is what may be called a follow-the-leader price custom among gasoline companies marketing on a comparable basis.

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It is usually accepted that there is nothing the oil marketer can do materially to affect the total gasoline consumption. His only hope is to secure a greater proportion of the existing demand.

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We may summarize the economics of gasoline marketing by reiterating that through it all the motivating force of crude oil pressing for a market can be seen. We have watched the mechanism for the exertion of that pressure develop from the stage when the pressure was relatively indirect, because production was not linked with refining and marketing,—to the present stage when a high degree of integration has made for an exceedingly direct conduit of the pressure, and when in addition the jobber and the tank-car service station have been developed to a point where they quickly adjust any unduly wide margins between delivered cost and retail prices.

We see the pressure for sales of gasoline breaking out in increased outlets, in various forms of price cutting and in increased marketing costs. With the growing integration of oil companies, more and more of the profits of other ends of the business are, the author believes, being pushed over into the marketing end, to be used there in the struggle for outlets.

7. National Petroleum News, June 1, 1932.—Holliday, *Narrower Margins Essential:*

[Pages 25–28]

The marketing end of the business cannot separate itself from the production and refining parts as though it were a separate industry. All three departments constitute one single industry, and economic effects usually are manifested first in the marketing end. Gasoline prices have been the barometer of fundamental economic conditions and reflect conditions not only in the marketing department but in the refining and producing ends.

It does not lie within the power of the marketing branch of the industry to control prices of finished products. In the absence of monopoly or governmental control or assistance, prices are made by markets and not by individuals, and markets reflect all of the subtle economic forces that are at work. * * *

Gasoline prices have been reflecting the fundamental overproduction: Overproduction of potential supply of crude oil, overproduction of potential refinery capacity, and overproduction of marketing facilities which resulted from overproduction of crude oil and refining capacity.

The production and refining ends of the business have not put their house in order, and cannot do so as long as the present law of oil and gas remains unchanged. The fundamental supply factor is not aboveground storage alone, but the total inventory of all products including the crude oil which lies below the ground and can be brought to the surface by the turning of a valve.

* * * * *

On account of the liquid nature of crude oil and the character of modern continuous refinery process, the potential supply of crude oil below the earth is part of the gasoline supply, and so long as the fear exists as to the possibility of the dam breaking which holds back that supply, the sensitive tank-car gasoline market will continue to be low. Even the supply of crude oil above ground is sufficient to keep prices depressed.

We lay so much stress upon the statistics of gasoline inventory, and seem to ignore the fact that crude-oil inventory stored above ground, to the extent of its gasoline yield, is practically the equivalent of a gasoline inventory, since it can be so quickly converted into gasoline. Even if we ignore potential supply, the inventory of crude oil above ground is approximately six times the total gasoline inventory, so that our real gasoline supply above ground is approximately four times as large as our gasoline inventory statistics would indicate.

In a time of scarcity or anticipated scarcity of potential production, or in a time when potential production is reasonably in balance with current demand, the crude-oil inventories above ground would constitute a reasonable reserve which would not necessarily enter into the supply factor; but at a time like the present, even if we ignore the potential supply below ground, the actual crude inventories in storage are in essence a part of our gasoline inventory and indicate a supply factor so large as to necessitate low prices in a free and open market. I do not mean to disparage the worthy effort to reduce gasoline inventory but merely am trying to emphasize that it is only one part of the supply factor.

This, in my judgment, is why, no matter what is done in the producing States in the way of maintenance of crude oil prices, the gasoline market continues to be low. Any company which attempts to take the high ground of ignoring markets and basing its gasoline prices upon posted crude oil prices may do so if it pleases, but in doing so it will surrender the market to others; and a market once lost is not easily regained.

Gasoline prices have been the barometer of fundamental economic conditions because they are in a market which is open and free, and when crude oil prices have not synchronized with gasoline prices it has been because the crude-oil market is by nature more sluggish and subject to control, and has not reflected fundamental conditions.

In the last analysis the battle ground of this industry is in the marketing end, because the only purpose of producing a raw material is to supply the finished products which the marketing department can sell; and, therefore, the fundamental economic conditions of production must have their logical effect out on the marketing firing line.

* * * Gasoline produced from low-priced crude oil, however, and distress gasoline resulting from overproduction, forced itself upon the market in such quantity at price-cuts below these companies' cost, based on posted crude-oil prices, until in the last few years it has come to be recognized and practiced that retail prices must be based, not

upon current cost, but upon the wholesale tank car or cargo markets.

II. COSTS OF PRODUCTION AND AVERAGE PRICES RECEIVED

1. United States Tariff Commission Report to the House of Representatives on *Crude Petroleum and its Liquid Refined Products,* Report No. 30, Second Series [pp. 158–163]:

TABLE 86.—*Crude petroleum: Unit cost of production and unit sales price, by districts, 1927–1930*

GROUP I. LARGE COMPANIES

District	1927			1928			1929			1930			4-year weighted average	
	Production	Unit cost including interest on investment	Unit sales price	Production	Unit cost including interest on investment	Unit sales price	Production	Unit cost including interest on investment	Unit sales price	Production	Unit cost including interest on investment	Unit sales price	Unit cost including interest on investment	Unit sales price
California:	*Barrels*			*Barrels*			*Barrels*			*Barrels*				
Long Beach, Seal Beach, Signal Hill	18,962,688	$0.60	$1.05	33,266,829	$0.62	$1.00	35,030,137	$0.55	$1.13	19,319,393	$0.65	$1.24	$0.60	$1.11
Santa Fe Springs	5,081,385	.71	1.18	6,223,159	1.59	1.22	49,583,200	.92	1.32	31,563,779	.88	1.42	.94	1.37
Redonda-Torrance	3,732,717	.89	1.11	2,825,232	.90	1.08	2,388,467	1.06	.87	2,864,138	1.18	.88	.99	1.00
Coalinga (light)	1,231,736	1.06	.83	482,082	2.05	.76	119,508	5.91	.60	1,673,197	1.55	.57	1.59	.64
Coalinga (heavy)	1,009,920	1.06	.76	997,334	1.15	.77	1,802,137	1.07	.54	864,769	1.10	.54	1.09	.63
Huntington Beach	5,026,280	.70	1.02	3,476,154	.82	.90	2,721,460	.92	.89	7,546,325	.57	1.10	.70	1.01
Kern River, Kern River Front, Mount Poso, Round Mountain	2,286,905	1.87	.79	2,021,495	1.78	.68	4,338,078	1.02	.51	6,035,868	.91	.54	1.21	.59
Elks Hills, McKittrick	1,310,503	.40	.81	1,234,808	.37	.80	1,087,598	.42	.66	4,373,375	.39	.73	.39	.74
Lawndale, Potreto, Rosecrans	1,105,752	1.06	1.57	857,593	1.68	1.52	1,100,388	1.53	1.70	1,177,085	1.20	1.84	1.35	1.67
Dominquez	3,481,436	.59	1.18	2,438,057	.87	1.12	1,983,329	.84	1.25	2,056,467	.72	1.34	.74	1.21
Beldridge, Lost Hills	1,197,385	1.09	.93	1,128,535	.96	.86	1,240,581		.83	1,037,204	1.18	1.20	.73	.95
Ventura (Avenue)	13,649,364	.25	1.10	14,065,679	.50	.99	18,180,025	.60	1.14	15,349,756	.57	1.26	.49	1.13
Buena Vista, Maricopa, Midway, Sunset, Wheeler Ridge	10,769,904	.75	.71	8,857,218	.88	.89	8,313,770	.79	.79	14,246,210	.99	.99	.86	.86
Culver City, Inglewood, Montebello, Whittier	2,169,047	.63	.96	1,691,413	.76	.72	1,356,601	.95	.86	4,724,817	.53	.86	.65	.88
Arro Grande, Casmalia, Cat Canyon, Lompoc, Santa Maria	210,443	1.36	.95	195,788	1.33	.91	169,896	1.73	.91	182,424	2.34	.97	1.67	.93
Bardsdale, Conejo, Newhall, Ojai, Peru, Santa Paula	14,908	.98	.87	25,540	2.72	.85	70,957	1.48	.86	169,622	1.49	.97	1.57	.93
Brea-Olinda, Coyote Hills, East Coyote, West Coyote, Olinda, Richfield	6,418,932	.71	1.03	5,287,967	.74	.96	4,698,572	.85	.99	3,630,081	1.05	1.04	.81	1.01
Alamitos	256,143	2.83	.95	178,683	.72	1.01	1,144,396	.59	1.19	347,097	.95	1.30	.96	1.16
Kettleman Hills				2,663	.26	1.00	639,204	1.50	1.50	4,891,885	.06	1.51	.23	1.51
Baldwin Hills, La Habra, Merced Hills, and all other	3,170,538	1.18	.93	2,472,406	1.18	.91	4,163,123	1.09	.83	8,843,356	1.03	.95	1.09	.92
Santa Barbara Beach fields				572,174	1.20	1.44	7,896,239	.34	1.44	10,843,435	.38	1.40	.38	1.42
Total	81,085,986	.69	1.00	88,300,809	.81	1.01	148,027,656	.76	1.14	141,740,283	.75	1.18	.75	1.10

Texas:													
Panhandle	17, 920, 123	1. 52	1. 00	11, 635, 267	1. 30	1. 00	16, 999. 774	1. 00	1. 30	14, 100, 547	1. 01	1. 15	1. 21	1. 12
West Texas	25, 270, 941	. 89	. 76	71, 303, 584	. 59	. 63	78, 568, 927	. 46	. 78	69, 968, 787	. 56	. 79	. 57	. 73
North Texas	11, 613, 698	1. 77	1. 43	10, 986, 866	1. 50	1. 37	14, 813, 151	1. 25	1. 41	9, 740, 364	1. 31	1. 25	1. 45	1. 37
Mexia	8, 498, 240	1. 87	1. 45	5, 724, 868	2. 23	1. 38	4, 966, 783	2. 18	1. 43	10, 633, 184	1. 35	1. 16	1. 81	1. 33
Luling	5, 627, 182	1. 14	1. 10	4, 887, 200	1. 35	1. 04	13, 654, 963	. 93	1. 07	11, 578, 812	. 90	1. 02	1. 01	1. 05
North Central Texas	10, 735, 960	[1]1. 66	1. 53	11, 851, 836	1. 29	1. 37	14, 134, 885	1. 23	1. 74	10, 339, 413	1. 19	1. 23	1. 33	1. 49
East Texas	29, 729	. 64	1. 45	30, 048	14. 27	1. 43	28, 113	7. 93	1. 47	26, 594	4. 07	1. 30	8. 30	1. 41
Southwest Texas	1, 014, 517	1. 57	1. 07	1, 213, 504	1. 35	1. 01	1, 350, 281	1. 40	. 87	3, 890, 967	. 96	1. 06	1. 18	1. 02
Iatan	510, 240	1. 34	1. 08	1, 060, 534	. 91	. 71	1, 022, 638	. 91	. 76	611, 444	1. 05	. 71	1. 00	. 79
Gulf coast	36, 532, 871	. 86	1. 41	32, 486, 052	. 93	1. 18	37, 681, 123	1. 03	1. 25	41, 307, 760	1. 02	1. 14	. 97	1. 24
Big Lake	5, 751, 665	. 64	1. 26	4, 612, 982	. 84	1. 16	3, 911, 725	. 68	1. 28	4, 036, 556	. 68	1. 21	. 71	1. 23
Corsicana (heavy)	107, 987	2. 44	1. 09	88, 450	1. 46	1. 01	80, 435	1. 06	. 82	144, 794	1. 39	1. 13	1. 61	1. 04
Mixed districts and others in Texas	5, 051, 133	. 98	. 99	6, 429, 652	. 80	. 78	7, 281, 079	. 72	1. 15	7, 348, 354	. 80	1. 00	. 81	. 98
Total	128, 663, 286	1. 19	1. 20	162, 310, 843	. 93	. 93	194, 493, 877	. 81	1. 12	183, 727, 576	. 87	1. 00	. 93	1. 06
Oklahoma:													
Bartlesville and Nowata, Rogers, Craig, Dewey, and Washington Counties	1, 126, 292	2. 82	1. 30	1, 163, 458	2. 35	1. 19	1, 339, 591	2. 31	1. 26	1, 101, 842	1. 82	1. 12	2. 33	1. 22
Tulsa and Creek Counties	4, 607, 378	1. 59	1. 37	3, 887, 704	1. 63	1. 28	4, 116, 021	1. 52	1. 30	3, 197, 036	1. 64	1. 22	1. 59	1. 30
Wagoner, Muskogee, and McIntosh Counties	87, 089	2. 55	1. 37	81, 357	3. 76	1. 32	257, 379	1. 64	1. 43	175, 042	1. 17	1. 35	1. 75	1. 38
Okmulgee, Okfuskee, and Hughes Counties	2, 443, 299	1. 62	1. 45	1, 936, 805	1. 80	1. 45	1, 821, 696	1. 96	1. 53	1, 305, 534	3. 00	1. 28	1. 99	1. 44
Seminole and Pottowatomie Counties	5, 150, 183	1. 24	1. 58	5, 594, 250	1. 27	1. 59	4, 740, 482	1. 48	1. 49	6, 873, 809	1. 41	1. 31	1. 35	1. 39
Osage County	7, 052, 016	1. 64	1. 43	6, 368, 412	1. 72	1. 37	4, 648, 835	1. 80	1. 40	4, 193, 603	1. 75	1. 26	1. 72	1. 37
Pawnee, Payne, and Lincoln Counties	3, 450, 762	1. 72	1. 47	2, 520, 862	1. 71	1. 43	2, 238, 700	1. 82	1. 50	2, 776, 511	1. 91	1. 35	1. 78	1. 44
Kay, Noble, Garfield, and Grant Counties	14, 247, 343	1. 14	1. 58	8, 731, 266	1. 24	1. 57	6, 708, 519	1. 23	1. 49	4, 930, 396	1. 25	1. 45	1. 20	1. 54
Caddo, Grady, Comanche, and Garvin Counties	255, 612	1. 70	1. 31	205, 110	2. 10	1. 18	347, 390	1. 47	1. 12	881, 906	1. 32	1. 05	1. 50	1. 12
Stephens, Cotton, Carter, and Jefferson Counties	5, 771, 004	1. 41	1. 30	5, 442, 718	1. 40	1. 18	11, 600, 101	1. 23	1. 33	5, 539, 264	1. 22	1. 08	1. 30	1. 24
Burbank field	5, 195, 551	1. 51	1. 47	3, 154, 364	1. 64	1. 36	2, 169, 859	1. 38	1. 41	1, 553, 273	1. 47	1. 28	1. 51	1. 39
Cushing field	5, 343, 123	1. 23	1. 48	4, 448, 530	1. 24	1. 48	3, 903, 137	1. 36	1. 54	3, 363, 905	1. 53	1. 36	1. 32	1. 47
Oklahoma City field				74, 071	. 71	1. 41	3, 879, 039	. 91	1. 52	19, 746, 013	1. 20	1. 30	1. 15	1. 34
Healdon field	4, 530, 975	1. 09	1. 20	4, 882, 073	1. 09	1. 23	4, 213, 848	. 99	1. 09	3, 895, 882	. 90	1. 01	1. 02	1. 09
Seminole field	84, 499, 153	1. 01	1. 41	81, 405, 249	. 94	1. 43	85, 635, 218	1. 04	1. 49	60, 974, 109	1. 05	1. 36	1. 01	1. 42
All other districts in Oklahoma	41, 740, 249	1. 30	1. 43	35, 046, 425	1. 11	1. 29	33, 585, 048	1. 13	1. 42	15, 079, 830	1. 31	1. 28	1. 21	1. 37
Total	185, 500, 029	1. 20	1. 42	164, 942, 654	1. 12	1. 38	171, 204, 863	1. 16	1. 45	135, 587, 955	1. 22	1. 31	1. 18	1. 39
Kansas:													
Eldorado-Augusta	7, 705, 644	1. 63	1. 39	7, 376, 871	1. 61	1. 32	9, 926, 928	1. 45	1. 46	10, 314, 482	1. 56	1. 29	1. 56	1. 37
Greenwood and Woodson Counties	3, 975, 872	1. 43	1. 47	3, 827, 837	1. 60	1. 43	3, 902, 746	1. 59	1. 53	3, 749, 119	1. 54	1. 36	1. 54	1. 45
East Kansas	727, 562	1. 90	1. 39	788, 973	1. 68	1. 30	1, 132, 869	1. 39	1. 36	1, 541, 305	1. 21	1. 23	1. 46	1. 31
Russell County	426, 520	1. 40	1. 50	277, 930	1. 93	1. 40	266, 861	1. 98	1. 42	147, 714	2. 46	1. 06	1. 81	1. 40
Wichita	92, 330	1. 56	1. 47	612, 024	. 98	1. 44	3, 791, 663	1. 03	1. 65	3, 714, 779	1. 06	1. 45	1. 05	1. 54
Sumner County	6, 871, 003	1. 22	1. 37	6, 146, 755	1. 09	1. 35	1, 297, 787	1. 30	1. 48	1, 736, 201	1. 34	1. 35	1. 19	1. 37

TABLE 86.—*Crude petroleum: Unit cost of production and unit sales price, by districts, 1927–1930*—Continued

GROUP I. LARGE COMPANIES—Continued

District	1927			1928			1929			1930			4-year weighted average	
	Production	Unit cost including interest on investment	Unit sales price	Production	Unit cost including interest on investment	Unit sales price	Production	Unit cost including interest on investment	Unit sales price	Production	Unit cost including interest on investment	Unit sales price	Unit cost including interest on investment	Unit sales price
Kansas—Continued.	*Barrels*			*Barrels*			*Barrels*			*Barrels*				
Lyon County	37, 556	$1. 04	$1. 51	20, 295	$1. 70	$1. 45	12, 767	$1. 39	$1. 52	9, 024	$2. 48	$1. 36	$1. 43	$1. 48
Rice County and Hutchinson district	105, 592	2. 67	1. 32	70, 687	2. 22	1. 19	2, 236, 690	. 49	1. 41	1, 642, 301	1. 15	1. 26	. 85	1. 34
Total	19, 942, 079	1. 46	1. 40	19, 121, 372	1. 43	1. 35	22, 568, 311	1. 30	1. 49	22, 854, 925	1. 41	1. 33	1. 40	1. 40
Arkansas:														
Eldorado	8, 281, 913	. 93	1. 07	7, 127, 189	1. 03	. 89	5, 805, 872	1. 54	. 94	4, 857, 676	1. 22	. 93	1. 11	. 96
Smackover	11, 658, 430	. 91	1. 02	8, 983, 288	. 95	. 79	7, 520, 511	. 96	. 84	5, 969, 449	1. 06	. 87	. 96	. 89
Total	19, 940, 343	. 92	1. 04	16, 110, 477	. 99	. 83	13, 326, 383	1. 14	. 88	10, 827, 125	1. 13	. 90	1. 02	. 92
Louisiana:														
Bull Bayou	499, 568	2. 14	1. 46	664, 779	1. 50	1. 39	668, 254	1. 85	1. 42	598, 290	2. 67	1. 59	2. 02	1. 41
Haynesville	11, 280, 897	1. 30	1. 18	9, 011, 244	1. 37	1. 09	7, 188, 880	1. 59	1. 14	8, 288, 498	1. 47	1. 14	1. 42	1. 14
Caddo	2, 616, 598	1. 59	1. 45	2, 135, 185	1. 63	1. 39	2, 057, 655	1. 59	1. 48	1, 095, 650	1. 64	1. 23	1. 61	1. 41
Gulf coast	2, 198, 727	1. 48	1. 12	3, 779, 954	1. 17	1. 12	3, 601, 472	1. 38	1. 22	4, 583, 606	1. 30	1. 06	1. 32	1. 13
Total	16, 595, 790	1. 40	1. 22	15, 591, 182	1. 36	1. 15	13, 516, 261	1. 55	1. 23	14, 566, 044	1. 48	1. 13	1. 44	1. 18
Wyoming:														
Salt Creek	193, 375	1. 89	1. 40	197, 228	1. 94	1. 29	316, 794	2. 60	1. 43	442, 294	4. 84	1. 28	3. 23	1. 34
Big Muddy	151, 043	. 74	1. 35	129, 101	. 64	1. 29	368, 777	1. 77	1. 41	91, 918	. 48	1. 31	1. 21	1. 37
Grass Creek	574, 651	. 72	1. 44	514, 849	. 58	1. 39	483, 000	. 70	1. 54	433, 013	. 61	1. 48	. 65	1. 46
Rock River	530, 762	. 78	1. 35	504, 870	. 71	1. 29	528, 706	. 66	1. 33	423, 819	. 36	1. 28	. 64	1. 31
All other districts	1, 152, 925	1. 21	1. 14	1, 525, 473	. 82	1. 04	1, 653, 580	. 89	1. 05	2, 196, 907	1. 23	. 97	1. 05	1. 03
Total	2, 602, 756	1. 03	1. 28	2, 871, 521	. 83	1. 17	3, 350, 857	1. 08	1. 24	3, 587, 951	1. 58	1. 19	1. 16	1. 22

TABLE 87.—*Crude petroleum: Unit cost of production and unit sales price, by districts, 1927–1930*

GROUP II. SMALL COMPANIES

District	1927			1928			1929			1930			4-year weighted average	
	Production	Unit cost including interest on investment	Unit sales price	Production	Unit cost including interest on investment	Unit sales price	Production	Unit cost including interest on investment	Unit sales price	Production	Unit cost including interest on investment	Unit sales price	Unit cost including interest on investment	Unit sales price
California:	*Barrels*			*Barrels*			*Barrels*			*Barrels*				
Long Beach, Seal Beach, Signal Hill	1, 648, 326	$0. 97	$1. 05	3, 712, 096	$1. 05	$1. 06	4, 955, 792	$0. 99	$1. 08	3, 953, 593	$1. 00	$1. 27	$1. 01	$1. 12
Santa Fe Springs	432, 203	. 73	. 98	362, 953	1. 86	1. 26	1, 171, 947	1. 95	1. 29	1, 394, 852	1. 04	1. 37	1. 41	1. 26
Redonda-Torrance	323, 906	1. 28	. 93	215, 331	1. 26	. 84	247, 636	1. 37	. 40	155, 601	1. 53	. 82	1. 34	. 82
Coalinga (light)	190, 344	. 86	. 78	156, 821	. 71	. 74	145, 641	. 62	. 56	189, 777	. 68	. 55	. 72	. 66
Coalinga (heavy)	188, 005	. 83	. 91	170, 191	. 83	. 74	163, 735	. 77	. 60	100, 295	. 67	. 53	. 79	. 72
Huntington Beach	871, 763	1. 06	1. 09	592, 361	. 87	. 87	516, 994	1. 43	. 96	606, 622	1. 50	. 97	1. 19	. 99
Kern River, Kern River Front, Mount Poso, Round Mountain	831, 389	. 90	. 77	942, 827	. 83	. 73	762, 922	1. 17	. 68	490, 790	1. 12	. 54	. 98	. 70
Elk Hills, McKittrick				102, 633	1. 38	. 75	120, 389	. 98	. 53	117, 465	. 90	. 54	1. 07	. 60
Lawndale Potrero, Rosecrans	100	179. 44	1. 92	1, 256	34. 91	1. 59	49, 772	. 95	1. 02	173, 775	2. 52	1. 78	2. 43	1. 61
Belridge, Lost Hills										93, 829	. 34	. 55	. 34	. 55
Ventura (Avenue)	220, 503	1. 30	1. 41	179, 859	. 72	1. 13	348, 095	2. 57	1. 18	315, 739	1. 28	1. 21	1. 61	1. 23
Buena Vista, Maricopa, Midway Sunset, Wheeler Ridge	1, 342, 517	1. 32	. 81	1, 581, 598	1. 09	. 78	1, 843, 531	1. 04	. 66	1, 549, 341	. 97	. 71	1. 10	. 73
Culver City, Inglewood, Montebella, Whittier	24, 910	. 89	. 85	23, 411	. 91	. 85	22, 226	. 83	. 71	22, 293	. 86	. 67	. 87	. 77
Arro Grande, Casmalia, Cat Canyon, Lompoc, Santa Maria	472, 079	. 97	. 81	408, 812	1. 17	. 77	158, 159	1. 96	. 63	87, 441	2. 04	. 49	1. 26	. 74
Bardsdale, Conejo, Newhall, Ojai, Peru, Santa Paula	39, 268	1. 76	1. 14	62, 737	1. 06	. 77	37, 000	2. 04	1. 08	34, 329	2. 41	. 97	1. 70	. 96
Brea-Olinda, Coyote Hills, East Coyote, West Coyote, Olinda, Richfield	1, 073, 742	1. 03	1. 01	1, 294, 808	1. 09	. 98	1, 416, 333	. 78	1. 04	1, 241, 410	. 66	1. 06	. 88	1. 02
Baldwin Hills, La Habra, Merced Hills, and all other	292, 050	. 26	. 85	800, 536	. 64	. 81	696, 850	. 46	. 90	265, 739	1. 22	. 75	. 60	. 84
Santa Barbara Beach fields				178, 488	1. 61	1. 08	236, 886	. 90	1. 07	534, 416	. 38	1. 37	. 74	1. 24
Total	7, 951, 105	1. 02	. 95	10, 786, 718	1. 04	. 92	12, 893, 908	1. 12	. 96	11, 327, 307	1. 01	1. 09	1. 05	. 98

TABLE 87.—*Crude petroleum: Unit cost of production and unit sales price, by districts, 1927–1930*—Continued

GROUP II. SMALL COMPANIES—Continued

District	1927			1928			1929			1930			4-year weighted average	
	Production	Unit cost including interest on investment	Unit sales price	Production	Unit cost including interest on investment	Unit sales price	Production	Unit cost including interest on investment	Unit sales price	Production	Unit cost including interest on investment	Unit sales price	Unit cost including interest on investment	Unit sales price
Texas:	*Barrels*			*Barrels*			*Barrels*			*Barrels*				
Panhandle	2,429,736	$0.84	$0.90	1,641,178	$0.91	$1.01	1,508,442	$0.97	$1.24	1,623,081	$1.51	$1.00	$1.03	$1.02
West Texas	2,136,351	.32	.35	2,783,203	.47	.58	1,618,178	1.10	.96	2,347,937	1.42	.78	.80	.64
North Texas	1,822,058	1.30	1.45	1,414,138	1.76	1.42	1,833,667	1.59	1.45	1,753,532	1.36	1.22	1.49	1.38
Mexia, Wortham	205,596	.98	1.39	296,539	1.36	1.27	301,523	1.34	1.35	152,550	1.20	1.29	1.24	1.33
Luling, Bruner	97,697	1.61	1.41	65,459	1.58	1.29	52,999	1.64	1.34	46,766	1.62	1.20	1.61	1.33
North Central Texas	449,005	1.95	1.39	435,977	1.72	1.40	376,880	1.72	1.47	1,076,666	1.34	1.28	1.59	1.35
East Texas	34,536	1.52	1.61	24,181	1.57	1.58	25,257	1.59	1.69	20,810	1.61	1.41	1.56	1.58
Southwest Texas	57,871	.64	1.10	48,100	.89	1.00	41,882	.82	.84	190,215	.88	.79	.83	.88
Gulf Coast	569,621	1.20	1.16	526,807	1.59	1.27	450,347	1.64	1.21	692,506	1.35	.95	1.43	1.13
All others	92,443	1.74	1.75	109,205	1.61	1.34	202,342	1.67	1.13	309,814	1.18	.94	1.46	1.16
Total	7,894,914	.92	.96	7,344,787	1.04	.99	6,411,517	1.32	1.24	8,213,877	1.39	1.02	1.16	1.04
Oklahoma:														
Bartlesville and Nowata, Rogers, Craig, Dewey, and Washington Counties	6,888	1.41	1.31	611,854	1.34	1.22	592,920	1.26	1.28	808,145	1.13	1.13	1.27	1.23
Tulsa and Creek Counties	389,410	1.61	1.37	330,197	1.37	1.25	360,754	1.26	1.26	246,232	1.46	1.17	1.43	1.27
Wagoner, Muskogee, and McIntosh Counties	11,623	2.02	1.55	10,559	1.96	1.43	10,335	1.76	1.52	16,420	1.71	.96	1.85	1.32
Okmulgee, Okfuskee, and Hughes Counties	93,889	.73	1.70	90,227	1.35	1.42	96,477	.14	1.43	94,956	1.51	1.35	.92	1.48
Seminole and Pottawatomie Counties	9,920	2.16	1.71	36,412	2.56	1.42	171,909	1.42	1.53	80,088	1.64	1.31	1.65	1.46
Osage County	450,206	1.16	1.36	552,511	1.07	1.24	571,496	.96	1.28	525,242	.92	1.16	1.02	1.26
Pawnee, Payne, and Lincoln Counties	238,112	2.25	1.50	190,679	2.19	1.39	47,197	2.36	1.45	134,861	1.98	1.34	2.18	1.43
Kay, Noble, Garfield, and Grant Counties	67,085	1.36	1.55	51,227	.34	1.56	152,164	.83	1.61	268,141	1.33	1.37	1.10	1.48
Caddo, Grady, Commanche, and Harvin Counties	32,132	2.58	1.14	40,448	1.60	.74	33,181	.57	.75	17,934	1.58	.62	1.57	.83
Stephens, Cotton, Carter, and Jefferson Counties	230,844	1.61	1.30	201,594	1.55	1.18	273,063	1.56	1.24	175,087	1.08	1.11	1.47	1.22
Cushing field	557,078	.88	1.71	526,287	1.10	1.48	589,802	1.06	1.55	596,559	.84	1.44	.96	1.53

Oklahoma City field							657,606	1.09	1.62	2,216,371	1.66	1.31	1.53	1.38
Healdton field	546,388	1.08	1.25	497,997	.85	1.13	454,813	.76	1.14	421,117	.66	1.05	.85	1.15
Seminole field	1,105,702	.88	1.41	452,572	1.03	1.44	674,654	1.09	1.42	313,472	1.11	1.36	.99	1.41
All others	117,990	1.67	1.49	193,158	1.49	1.47	102,357	1.82	1.46	120,600	2.41	1.61	1.80	1.51
Total	4,417,267	1.22	1.41	3,785,722	1.23	1.30	4,788,728	1.11	1.39	6,035,225	1.33	1.27	1.23	1.34
Kansas:														
Eldorado-Augusta, Butler County	71,546	.82	1.38	51,691	.92	1.26	44,485	1.09	1.31	52,191	1.47	1.16	1.05	1.29
Greenwood and Woodson Counties	256,644	.85	1.53	166,968	1.07	1.45	114,346	1.59	1.51	98,709	1.72	1.36	1.18	1.48
East Kansas	179,620	1.98	1.27	210,517	1.65	1.20	226,148	1.43	1.23	208,283	1.28	1.12	1.57	1.20
Cowley and Sumner Counties	365,602	1.34	1.48	229,532	1.42	1.47	243,665	1.29	1.54	194,101	1.30	1.39	1.34	1.47
Lyon and Chase Counties										3,763	9.11	1.35	9.11	1.35
Rice and Reno Counties, Hutchinson district	9,989	2.29	1.51	7,653	2.35	1.47	6,386	2.41	1.55	7,214	1.96	1.37	2.25	1.48
Total	883,401	1.29	1.44	666,361	1.38	1.36	635,030	1.39	1.41	564,261	1.44	1.26	1.37	1.38
Arkansas:														
Eldorado	497,133	.84	1.16	339,061	.89	.95	340,345	.76	1.13	335,643	1.25	1.19	.92	1.11
Smackover	1,483,694	.76	1.05	721,858	1.17	.81	670,677	1.16	.82	562,861	1.35	.83	1.02	.92
Total	1,980,827	.78	1.08	1,060,919	1.08	.86	1,011,022	1.02	.92	898,504	1.31	.96	.99	.98
Louisiana:														
Bull Bayou, Red River, and Sabine Parishes	97,105	1.15	1.12										1.15	1.12
Haynesville, Homer	435,753	1.77	1.43	403,761	1.82	1.18	370,697	1.33	1.30	332,675	1.47	1.27	1.61	1.30
De Soto, Mansfield, Caddo	262,655	1.28	1.39	158,473	1.62	1.32	270,556	1.26	1.47	324,077	1.47	1.30	1.39	1.37
Gulf coast	221,729	.71	1.14	202,000	.71	1.12	336,453	1.00	1.23	389,527	.86	1.06	.84	1.14
Total	1,017,242	1.35	1.33	764,234	1.49	1.20	977,706	1.20	1.32	1,046,279	1.23	1.20	1.31	1.26
Wyoming:														
Salt Creek	1,730,934	1.17	1.39	1,532,193	1.09	1.30	1,287,788	1.05	1.33	1,355,270	.86	1.25	1.05	1.32
Grass Creek	135,125	1.91	1.56	132,234	2.03	1.36	119,095	.82	1.50				1.62	1.47
All others	197,808	.99	.84	211,002	1.36	.77	505,178	1.35	.89	400,833	1.35	.83	1.30	.84
Total	2,063,867	1.20	1.35	1,875,429	1.18	1.24	1,912,061	1.11	1.22	1,756,103	.97	1.15	1.12	1.25

2. Department of the Interior, Petroleum Administrative Board, *Preliminary Report on a Survey of Crude Petroleum, Cost of Production for the Years* 1931–1933 [pp. 5, 10–33]:

TABLE 1.—*Crude petroleum—Average cost per barrel (company interest oil) at wells and sales value by groups of States, 1931–33*

[Group A, California; group B, Texas, Oklahoma, Kansas, Arkansas, Louisiana, and New Mexico; group C, Colorado, Montana, and Wyoming; group D, Illinois, Indiana, Ohio, Michigan, Kentucky, West Virginia, Pennsylvania, and New York]

	1931					1932				
	Group A	Group B	Group C	Group D	Total all groups	Group A	Group B	Group C	Group D	Total all groups
Production	125, 536, 923	398, 774, 351	12, 421, 279	21, 564, 280	558, 296, 833	121, 941, 496	361, 733, 693	10, 453, 984	23, 457, 765	517, 586, 938
Expenses:										
Depletion	$0. 063	$0. 082	$0. 237	$0. 162	$0. 084	$0. 070	$0. 076	$0. 233	$0. 160	$0. 081
Depreciation	. 190	. 140	. 221	. 311	. 160	. 170	. 135	. 222	. 281	. 152
Amortization of intangible development costs	. 023	. 036	. 051	. 148	. 037	. 025	. 041	. 060	. 148	. 043
Operating cost	. 233	. 190	. 340	. 643	. 220	. 208	. 189	. 347	. 556	. 213
General overhead and administration	. 207	. 397	. 215	. 303	. 347	. 188	. 293	. 201	. 236	. 264
Total	. 716	. 845	1. 064	1. 567	. 848	. 661	. 734	1. 063	1. 381	. 753
Less gas sales and miscellaneous revenue	. 165	. 029	. 049	. 103	. 063	. 148	. 027	. 052	. 084	. 059
Net cost	. 551	. 816	1. 015	1. 464	. 785	. 513	. 707	1. 011	1. 297	. 694
Interest at 6 percent on investment	. 138	. 085	. 179	. 343	. 109	. 137	. 093	. 174	. 296	. 114
Net cost, including interest	. 689	. 901	1. 194	1. 807	. 894	. 650	. 800	1. 185	1. 593	. 808
Average sales value at well	. 705	. 576	. 878	1. 396	. 643	. 799	. 840	. 972	1. 387	. 858

	Jan. 1 to Sept. 30, 1933					Oct. 1 to Dec. 31, 1933				
	Group A	Group B	Group C	Group D	Total all groups	Group A	Group B	Group C	Group D	Total all groups
Production	85, 936, 231	313, 090, 484	6, 569, 548	15, 995, 948	421, 592, 211	28, 039, 308	97, 296, 901	2, 716, 840	6, 098, 359	134, 151, 408
Expenses:										
Depletion	$0. 072	$0. 065	$0. 235	$0. 158	$0. 073	$0. 073	$0. 067	$0. 221	$0. 155	$0. 076
Depreciation	. 158	. 115	. 235	. 288	. 132	. 162	. 123	. 223	. 260	. 139
Amortization of intangible development costs	. 030	. 055	. 062	. 152	. 054	. 032	. 055	. 048	. 200	. 056
Operating cost	. 193	. 149	. 334	. 524	. 175	. 215	. 198	. 339	. 559	. 221
General overhead and administration	. 161	. 225	. 170	. 222	. 211	. 184	. 260	. 170	. 228	. 241
Total	. 614	. 609	1. 036	1. 344	. 645	. 666	. 763	1. 001	1. 402	. 733
Less gas sales and miscellaneous revenue	. 150	. 022	. 036	. 081	. 051	. 201	. 037	. 065	. 077	. 074
Net cost	. 464	. 587	1. 000	1. 263	. 594	. 465	. 666	. 936	1. 325	. 659
Interest at 6 percent on investment	. 137	. 086	. 180	. 293	. 105	. 150	. 092	. 147	. 255	. 113
Net cost, including interest	. 601	. 673	1. 180	1. 556	. 699	. 615	. 758	1. 083	1. 580	. 772
Average sales value at well	. 792	. 481	. 770	1. 239	. 578	. 924	. 965	. 918	1. 770	. 992

TABLE 3.—*Crude petroleum: Unit cost of production and sales value by pools and districts, 1931–33*

Cost period	Range of gravity	Range of production per well per day (barrels)	Production—(company interest, barrels)	Expenses: Depletion	Expenses: Depreciation	Expenses: Amortization of intangible development costs	Expenses: Operating cost	Expenses: General overhead and administrative	Expenses: Total cost	Deduct gas sales and miscellaneous revenue	Net cost	Interest on invested capital	Net cost including interest	Average selling price	Range of costs: Lowest	Range of costs: Highest
CALIFORNIA																
Long Beach (Signal Hill), Seal Beach, including Alamitos Heights, pools																
1931	19–32	27.2–501.0	16,353,684	$0.043	$0.271	$0.037	$0.263	$0.226	$0.840	$0.169	$0.671	$0.113	$0.784	$0.756	$0.18	$2.54
1932	19–30	25.0–585.0	14,666,903	.039	.234	.048	.259	.212	.792	.144	.648	.108	.756	.839	.41	2.69
First 9 months of 1933	19–32	15.0–209.7	9,804,611	.060	.175	.041	.259	.196	.731	.119	.612	.112	.724	.824	.30	3.42
Last 3 months of 1933	19–32	15.5–209.7	2,843,224	.049	.195	.038	.326	.212	.820	.168	.652	.120	.772	.956	.28	2.59
1933	19–32	14.0–209.7	12,740,041	.058	.180	.040	.275	.200	.753	.131	.622	.114	.736	.855	.28	3.42
3-year weighted average			14,586,876	.046	.232	.042	.265	.214	.799	.150	.649	.111	.760	.812		
Santa Fe Springs pool																
1931	32–35	44.5–947.8	12,325,632	.069	.345	.004	.242	.248	.908	.146	.762	.073	.835	.836	.29	2.57
1932	32–35	38.3–718.5	11,763,354	.070	.275	.001	.227	.208	.781	.126	.655	.062	.717	.977	.32	3.85
First 9 months of 1933	30–35	32.9–488.3	7,446,479	.059	.247	.003	.231	.157	.697	.106	.591	.054	.645	.980	.31	3.05
Last 3 months of 1933	30–35	32.9–488.3	2,058,229	.058	.277	.004	.247	.191	.777	.142	.635	.090	.725	1.174	.33	4.99
1933	30–35	32.9–488.3	9,637,131	.058	.255	.003	.235	.164	.715	.115	.600	.063	.663	1.021	.27	3.05
3-year weighted average			11,242,039	.066	.295	.003	.235	.209	.808	.130	.678	.066	.744	.938		
Torrance (Redondo) pool																
1931	15–20	5.0– 60.0	1,306,512	.060	.311	.001	.613	.202	1.187	.044	1.143	.350	1.493	.668	.78	2.58
1932	15–20	4.6– 49.1	1,374,296	.067	.321	.001	.483	.167	1.039	.027	1.012	.313	1.325	.679	.59	3.34
First 9 months of 1933	15–22	4.2– 45.8	1,061,492	.065	.264	.002	.429	.150	.910	.029	.881	.284	1.165	.655	.52	3.38
Last 3 months of 1933	15–20	4.2– 45.8	387,354	.061	.278	.001	.446	.164	.950	.030	.920	.259	1.179	.761	.40	3.33
1933	15–22	4.2– 45.8	1,459,963	.063	.266	.002	.434	.156	.921	.029	.892	.276	1.168	.681	.40	3.38
3-year weighted average			1,380,257	.063	.299	.001	.507	.174	1.044	.033	1.011	.312	1.323	.676		

Huntington Beach and Newport pools																
1931	14–30	11. 3–152. 3	4, 020, 282	. 078	. 218	. 007	. 377	. 196	. 876	. 076	. 800	. 157	. 957	. 724	. 49	1. 99
1932	14–30	14. 5–149. 9	4, 103, 484	. 098	. 179	. 009	. 264	. 177	. 727	. 054	. 673	. 139	. 812	. 787	. 52	2. 68
First 9 months of 1933	14–26	12. 0–190. 0	3, 308, 670	. 104	. 116	. 023	. 218	. 167	. 628	. 052	. 576	. 117	. 693	. 792	. 11	2. 82
Last 3 months of 1933	14–28	12. 0–248. 0	1, 198, 860	. 091	. 155	. 030	. 233	. 173	. 682	. 069	. 613	. 113	. 726	. 920	. 15	3. 25
1933	14–28	12. 0–248. 0	4, 520, 764	. 101	. 127	. 025	. 222	. 169	. 644	. 057	. 587	. 117	. 704	. 826	. 11	3. 25
3-year weighted average			4, 214, 843	. 093	. 173	. 014	. 285	. 180	. 745	. 062	. 683	. 137	. 820	. 781		
Lawndale, Potrero, and Rosecrans pools																
1931	23–45	8. 0–217. 0	768, 989	. 191	. 441	. 022	. 428	. 126	1. 208	. 303	. 905	. 250	1. 155	. 951	. 36	14. 67
1932	23–45	8. 5– 83. 3	573, 813	. 435	. 291	. 002	. 355	. 105	1. 188	. 338	. 850	. 203	1. 053	1. 006	. 23	11. 74
First 9 months of 1933	27–45	9. 0–183. 0	366, 167	. 111	. 238	. 004	. 323	. 100	. 776	. 398	. 378	. 179	. 557	1. 034	. 10	19. 98
Last 3 months of 1933	27–45	9. 0–183. 0	129, 168	. 108	. 228	. 007	. 279	. 060	. 682	. 422	. 260	. 226	. 486	1. 190	. 10	2. 95
1933	27–45	9. 0–183. 0	500, 933	. 110	. 233	. 005	. 314	. 090	. 752	. 400	. 352	. 189	. 541	1. 074	. 10	19. 98
3-year weighted average			614, 578	. 245	. 337	. 011	. 375	. 110	1. 078	. 340	. 738	. 219	. 957	1. 002		
Inglewood and Playa Del Rey pools																
1931	19–38	13. 8–178. 5	5, 892, 382	. 056	. 179	. 036	. 181	. 200	. 652	. 041	. 611	. 060	. 671	. 646	. 13	2. 61
1932	17–38	12. 9–231. 0	4, 785, 568	. 057	. 169	. 019	. 185	. 170	. 600	. 045	. 555	. 055	. 610	. 678	. 23	1. 83
First 9 months of 1933	14–23	6. 0–132. 4	2, 867, 689	. 067	. 168	. 024	. 167	. 159	. 585	. 054	. 531	. 051	. 582	. 711	. 25	1. 81
Last 3 months of 1933	14–24	6. 0–132. 4	746, 860	. 067	. 202	. 021	. 208	. 185	. 683	. 049	. 634	. 061	. 695	. 870	. 32	7. 90
1933	14–24	6. 0–132. 4	3, 779, 803	. 064	. 173	. 023	. 177	. 165	. 602	. 052	. 550	. 054	. 604	. 741	. 25	7. 90
3-year weighted average			4, 819, 251	. 058	. 174	. 027	. 182	. 181	. 622	. 045	. 577	. 057	. 634	. 681		
Dominguez pool																
1931	27–31	57. 2–270. 4	2, 290, 110	. 086	. 195	. 011	. 142	. 147	. 581	. 206	. 375	. 138	. 513	. 794	. 37	. 60
1932	27–31	63. 8–268. 8	3, 738, 433	. 075	. 124	. 013	. 091	. 116	. 419	. 182	. 237	. 127	. 364	. 952	. 20	. 61
First 9 months of 1933	27–32	86. 3–200. 5	2, 737, 616	. 062	. 124	. 007	. 087	. 114	. 394	. 198	. 196	. 193	. 389	. 938	. 17	. 58
Last 3 months of 1933	27–32	86. 3–200. 5	838, 893	. 071	. 132	. 017	. 097	. 094	. 411	. 277	. 134	. 210	. 344	1. 081	. 13	. 82
1933	27–32	86. 3–200. 5	3, 576, 509	. 064	. 126	. 010	. 089	. 109	. 398	. 216	. 182	. 196	. 378	. 971	. 13	. 82
3-year weighted average			3, 201, 684	. 073	. 142	. 011	. 103	. 121	. 450	. 201	. 249	. 156	. 405	. 921		
Brea-Olinda, Coyote Hills, Richfield, Montebello, Whittier, La Habra, Merced Hills and Baldwin Hills pools																
1931	16–31	1. 0–153. 4	9, 666, 300	. 081	. 175	. 015	. 295	. 183	. 749	. 092	. 657	. 166	. 823	. 728	. 49	6. 29
1932	16–31	1. 0–293. 9	8, 858, 702	. 077	. 149	. 021	. 263	. 165	. 675	. 084	. 591	. 175	. 766	. 771	. 47	1. 92
First 9 months of 1933	16–31	1. 0–190. 5	5, 885, 085	. 102	. 162	. 021	. 236	. 150	. 671	. 071	. 600	. 134	. 734	. 790	. 50	2. 99
Last 3 months of 1933	16–31	1. 0–190. 5	2, 293, 603	. 096	. 150	. 018	. 229	. 156	. 649	. 099	. 550	. 168	. 718	. 939	. 42	2. 00
1933	16–31	1. 0–190. 5	8, 612, 069	. 097	. 166	. 019	. 241	. 164	. 687	. 078	. 609	. 147	. 756	. 828	. 42	2. 99
3-year weighted average			9, 045, 690	. 085	. 163	. 018	. 268	. 171	. 705	. 085	. 620	. 163	. 783	. 774		

TABLE 3.—*Crude petroleum: Unit cost of production and sales value by pools and districts, 1931–33*—Continued

Cost period	Range of gravity	Range of production per well per day (barrels)	Production—(company interest, barrels)	Expenses: Depletion	Expenses: Depreciation	Expenses: Amortization of intangible development costs	Expenses: Operating cost	Expenses: General overhead and administrative	Expenses: Total cost	Deduct gas sales and miscellaneous revenue	Net cost	Interest on invested capital	Net cost including interest	Average selling price	Range of costs: Lowest	Range of costs: Highest
CALIFORNIA—Continued																
Other Los Angeles Basin [1]																
1931	15–35	8.4– 99.5	5,498,541	$0.037	$0.225	$0.001	$0.208	$0.202	$0.673	$0.112	$0.561	$0.121	$0.682	$0.772	$0.67	$1.26
1932	15–35	21.2– 91.0	5,320,721	.041	.213	.006	.193	.118	.571	.084	.487	.108	.595	.842	.55	.69
First 9 months of 1933	17–35	24.9– 43.0	3,540,915	.047	.233	.022	.204	.120	.626	.092	.534	.103	.637	.830	.44	.66
Last 3 months of 1933	17–35	24.9– 43.0	971,944	.046	.270	.012	.267	.162	.757	.117	.640	.125	.765	.976	.44	.78
1933	17–35	24.9– 43.0	4,512,859	.047	.241	.020	.217	.129	.654	.097	.557	.108	.665	.861	.44	.78
3-year weighted average			5,110,707	.041	.225	.008	.206	.152	.632	.098	.534	.112	.646	.822		
Ventura Avenue pool																
1931	23–30	3.0–194.8	13,378,512	.033	.190	.028	.159	.177	.587	.255	.332	.089	.421	.753	.24	15.77
1932	23–30	3.4–336.5	10,823,708	.030	.246	.046	.156	.175	.653	.283	.370	.105	.475	.899	.35	1.61
First 9 months of 1933	13–30	3.1–264.6	8,238,355	.025	.237	.066	.130	.160	.618	.269	.349	.103	.452	.878	.34	5.97
Last 3 months of 1933	23–30	3.1–246.6	2,693,541	.032	.227	.093	.154	.130	.636	.346	.290	.105	.395	1.025	.19	6.07
1933	13–30	3.1–264.6	10,931,896	.027	.234	.073	.136	.152	.622	.288	.334	.104	.438	.915	.19	6.07
3-year weighted average			11,711,372	.030	.221	.048	.151	.169	.619	.274	.345	.098	.443	.848		
Bardsdale, Conejo, Newhall, Ojai, Piru, Santa Paula, Simi, and Sespe pools																
1931	13–36	1.2– 64.0	116,846	.035	.220	.030	.373	.236	.894	.002	.892	.354	1.246	.635	.51	11.54
1932	13–35	1.7– 52.3	166,054	.078	.179	.028	.326	.221	.832	.026	.806	.259	1.065	.647	.68	3.31
First 9 months of 1933	22–36	1.6– 35.0	90,110	.116	.197	.054	.315	.147	.829	.024	.805	.363	1.168	.700	1.00	1.92
Last 3 months of 1933	22–36	1.6– 35.0	28,320	.108	.248	.059	.339	.125	.879	.043	.836	.382	1.218	.728	1.00	1.36
1933	22–36	1.6– 35.0	139,425	.097	.221	.047	.312	.144	.821	.024	.797	.315	1.112	.695	.73	1.92
3-year weighted average			140,775	.073	.204	.035	.334	.200	.846	.019	.827	.304	1.131	.659		

Santa Barbara beach fields [2]																
1931	22–36	14.0–1,044.5	8,009,688	.049	.138	.015	.145	.192	.539	.062	.477	.053	.530	.757	.35	1.61
1932	15–36	16.0– 577.0	4,310,847	.063	.182	.029	.192	.233	.699	.054	.645	.083	.728	.930	.54	15.99
First 9 months of 1933	27–36	17.0– 460.8	2,961,955	.077	.198	.054	.181	.179	.689	.041	.648	.076	.724	.916	.55	2.26
Last 3 months of 1933	23–36	17.0– 460.8	930,928	.038	.237	.065	.212	.253	.805	.048	.757	.081	.838	1.019	.19	2.83
1933	23–36	17.0– 460.8	3,892,883	.067	.207	.057	.188	.197	.716	.043	.673	.078	.751	.941	.19	2.83
3-year weighted average			5,404,473	.057	.166	.029	.168	.204	.624	.055	.569	.067	.636	.847		
Arroyo Grande, Casmalia, Cat Canyon, Lompoc, and Santa Maria pools																
1931	12–23	6.5– 17.0	670,135	.136	.313		.342	.128	.919	.103	.816	.474	1.290	.595	.64	1.49
1932	12–23	6.4– 68.7	776,458	.170	.117	.001	.308	.100	.696	.093	.603	.508	1.111	.599	.67	2.27
First 9 months of 1933	12–23	3.0– 71.8	599,769	.170	.173	.001	.242	.107	.693	.093	.600	.595	1.195	.613	.75	2.32
Last 3 months of 1933	12–23	3.0– 71.8	342,247	.154	.154		.177	.055	.540	.090	.450	.346	.796	.727	.67	2.09
1933	12–23	3.0– 71.8	942,016	.164	.166		.219	.088	.637	.092	.545	.505	1.050	.655	.67	2.32
3-year weighted average			796,203	.158	.192		.282	.103	.735	.095	.640	.497	1.137	.620		
Coalinga pool																
1931	14–23	2.7– 224.9	2,277,564	.113	.103	.001	.416	.170	.803	.040	.763	.541	1.304	.558	.19	185.61
1932	13–23	4.6– 60.6	2,945,786	.132	.093		.310	.145	.680	.020	.660	.394	1.054	.575	.19	2.08
First 9 months of 1933	14–23	4.3– 47.0	2,485,842	.130	.095		.232	.136	.593	.012	.581	.328	.909	.557	.16	1.52
Last 3 months of 1933	14–23	4.3– 47.0	1,274,830	.141	.070		.217	.160	.588	.009	.579	.213	.792	.700	.17	1.32
1933	14–23	4.3– 47.0	3,804,715	.133	.086		.228	.143	.590	.011	.579	.286	.865	.604	.16	1.35
3-year weighted average			3,009,355	.127	.092		.303	.151	.673	.021	.652	.386	1.038	.583		
Kern River, Mount Poso, Round Mountain, and Fruitvale pools																
1931	13–22	.8– 233.3	6,644,579	.053	.143	.006	.216	.349	.767	.007	.760	.166	.926	.533	.43	8.08
1932	13–22	2.1– 132.0	7,322,869	.060	.137	.020	.205	.276	.698	.009	.689	.144	.833	.533	.14	3.51
First 9 months of 1933	13–22	.4– 122.0	5,323,196	.056	.190	.021	.201	.202	.670	.006	.664	.133	.797	.518	.19	3.37
Last 3 months of 1933	13–22	.4– 122.0	1,686,053	.064	.139	.015	.185	.220	.623	.015	.608	.205	.813	.574	.31	68.81
1933	13–22	.4– 122.2	7,310,974	.060	.175	.019	.201	.201	.656	.008	.648	.152	.800	.530	.19	68.81
3-year weighted average			7,092,807	.058	.152	.015	.207	.273	.705	.008	.697	.154	.851	.532		

[1] Beverly Hills, Salt Lake, and Los Angeles pools.
[2] Includes Capitan, Elwood, Goleta, Santa Barbara, Rincon, and Summerland pools.

TABLE 3.—*Crude petroleum: Unit cost of production and sales value by pools and districts, 1931–33*—Continued

Cost period	Range of gravity	Range of production per well per day (barrels)	Production—(company interest, barrels)	Expenses						Deduct gas sales and miscellaneous revenue	Net cost	Interest on invested capital	Net cost including interest	Average selling price	Range of costs	
				Depletion	Depreciation	Amortization of intangible development costs	Operating cost	General overhead and administrative	Total cost						Lowest	Highest
CALIFORNIA—Continued																
Elk Hills, McKittrick and Wheeler Ridge pools																
1931	14–23	12.0– 110.7	4,613,281	$0.065	$0.119		$0.251	$0.197	$0.632	$0.031	$0.601	$0.159	$0.760	$0.593	$0.45	$1.65
1932	14–23	11.0– 70.4	4,191,404	.060	.084		.214	.179	.537	.017	.520	.161	.681	.597	.43	1.04
First 9 months of 1933	14–23	9.2– 58.0	3,314,668	.063	.077		.194	.174	.508	.008	.500	.146	.646	.573	.38	1.42
Last 3 months of 1933	14–23	7.3– 58.0	1,016,943	.069	.100		.219	.200	.588	.019	.569	.165	.734	.658	.37	1.97
1933	14–23	7.3– 58.0	4,331,611	.064	.083		.200	.180	.527	.011	.516	.150	.666	.593	.37	1.97
3-year weighted average			4,378,766	.063	.096		.222	.186	.567	.020	.547	.157	.704	.594		
Belridge and Lost Hills pools																
1931	14–40	1.1–1,863.2	2,729,300	.052	.048	$0.192	.126	.053	.471	.053	.418	.096	.514	.766	.17	3.96
1932	14–40	1.4–1,820.5	3,058,465	.049	.054	.175	.128	.051	.457	.083	.374	.081	.455	.868	.10	2.57
First 9 months of 1933	15–40	5.0– 284.7	2,075,438	.054	.069	.105	.164	.067	.459	.118	.341	.087	.428	.857	.27	2.53
Last 3 months of 1933	15–40	4.8– 284.7	804,473	.069	.072	.140	.280	.095	.656	.091	.565	.096	.661	.970	.29	4.89
1933	15–40	4.8– 284.7	2,879,911	.058	.070	.115	.196	.075	.514	.110	.404	.089	.493	.889	.27	4.89
3-year weighted average			2,889,225	.053	.057	.161	.150	.060	.481	.083	.398	.088	.486	.842		
Midway-Sunset pool [3]																
1931	11–27	2.9– 392.0	15,474,198	.094	.146	.007	.317	.169	.733	.044	.689	.246	.935	.608	.27	3.64
1932	11–27	2.7– 356.0	14,745,997	.092	.139	.008	.278	.159	.676	.051	.625	.239	.864	.656	.27	3.57
First 9 months of 1933	11–27	2.7– 99.0	9,910,314	.091	.105	.007	.258	.139	.600	.063	.537	.237	.774	.669	.23	3.92
Last 3 months of 1933	11–27	2.7– 99.0	3,574,187	.087	.118	.006	.267	.199	.677	.070	.607	.219	.826	.756	.18	3.64
1933	11–27	2.7– 184.0	14,571,597	.091	.114	.006	.262	.149	.622	.063	.559	.231	.790	.694	.18	3.92
3-year weighted average			14,930,598	.092	.133	.007	.286	.160	.678	.052	.626	.239	.865	.652		

Kettleman Hills pool																
1931	35–59	1,116.5–4,060.0	12,249,164	.058	.064	.048	.093	.237	.500	.669	–.169	.083	–.086	.649	–0	1.60
1932	35–59	904.0–2,435.0	17,379,916	.084	.075	.023	.082	.238	.502	.424	.078	.100	.178	.879	–0	6.50
First 9 months of 1933	37–58	545.0–1,586.2	13,289,899	.084	.087	.046	.079	.174	.470	.435	.035	.118	.153	.865	–0	1.48
Last 3 months of 1933	35–58	545.0–1,586.2	4,025,130	.088	.092	.038	.088	.230	.536	.676	–.140	.130	–.010	1.092	–0	1.69
1933	35–38	545.0–1,586.2	17,420,522	.085	.092	.044	.082	.187	.490	.488	.002	.121	.123	.918	–0	1.69
3-year weighted average			15,683,201	.078	.079	.037	.085	.219	.498	.512	–.014	.103	.089	.834		
Other and unclassified																
1931	16–30	4.2– 389.0	1,251,224	.175	.254	.024	.358	.330	1.141	.038	1.103	.131	1.234	.600	.95	17.57
1932	16–30	19.9– 901.0	1,034,718	.108	.226	.117	.365	.210	1.026	.042	.984	.136	1.120	.735	.80	3.35
First 9 months of 1933	21–30	18.0– 449.5	627,961	.083	.240	.173	.351	.233	1.080	.028	1.052	.166	1.218	.763	.80	63.64
Last 3 months of 1933	16–30	18.0– 449.5	194,521	.079	.258	.195	.372	.261	1.165	.036	1.129	.178	1.307	.913	.78	4.84
1933	16–30	18.0– 449.5	1,017,160	.088	.227	.144	.334	.215	1.008	.040	.968	.156	1.124	.794	.64	63.64
3-year weighted average			1,101,034	.128	.237	.090	.353	.256	1.064	.040	1.024	.141	1.165	.702		
TOTAL CALIFORNIA																
1931			125,536,923	.063	.190	.023	.233	.207	.716	.165	.551	.138	.689	.705		
1932			121,941,496	.070	.170	.025	.208	.188	.661	.148	.513	.137	.650	.799		
First 9 months of 1933			85,936,231	.072	.158	.030	.193	.161	.614	.150	.464	.137	.601	.792		
Last 3 months of 1933			28,039,308	.073	.162	.032	.215	.184	.666	.201	.465	.150	.615	.924		
1933			116,582,782	.073	.160	.030	.201	.166	.630	.160	.470	.141	.611	.822		
3-year weighted average			121,353,734	.068	.173	.026	.215	.188	.670	.158	.512	.139	.651	.774		
TEXAS																
Panhandle [4]																
1931	31–44	3.3– 112.7	13,121,898	.090	.254	.034	.231	.425	1.034	.122	.912	.134	1.046	.515	.18	4.88
1932	30–44	4.0– 128.3	12,012,762	.091	.238	.038	.230	.306	.903	.099	.804	.135	.939	.779	.20	2.85
First 9 months of 1933	31–44	5.0– 119.5	8,284,153	.116	.233	.050	.217	.243	.859	.087	.772	.128	.900	.436	–0	3.08
Last 3 months of 1933	31–44	5.0– 150.4	2,511,474	.125	.243	.050	.257	.246	.921	.147	.774	.141	.915	.864	–0	3.77
1933	30–44	5.0– 150.4	11,121,274	.117	.232	.049	.226	.250	.874	.104	.770	.132	.902	.536	–0	3.77
3-year weighted average			12,085,311	.098	.242	.040	.229	.332	.941	.109	.832	.134	.966	.609		
West Texas [5]																
1931	23–40	2.0– 242.9	49,259,615	.040	.091	.010	.117	.379	.637	.009	.628	.045	.673	.438	.19	21.09
1932	23–40	1.0– 251.6	39,989,292	.038	.088	.024	.128	.264	.542	.009	.533	.051	.584	.671	.24	10.68
First 9 months of 1933	23–40	2.6– 156.6	25,970,560	.035	.087	.031	.114	.206	.473	.009	.464	.052	.516	.354	–0	10.94
Last 3 months of 1933	24–40	2.6– 156.6	6,846,154	.046	.101	.032	.150	.293	.622	.029	.593	.065	.658	.773	.27	6.28
1933	23–40	2.6– 156.6	33,084,922	.037	.090	.031	.121	.223	.502	.013	.489	.055	.544	.441	–0	10.94
3 year weighted average			40,777,943	.038	.090	.021	.122	.299	.570	.010	.560	.049	.609	.515		

[3] Includes Maricopa.
[4] Includes Hutchinson, Carson, Gray, Moore, and Wheeler Counties.
[5] Includes Howard, Ector, Mitchell, Irion, Pecos, Fisher, Loving, Winkler, Ward, Reeves, Glasscock, Crane, Upton, Midland, Reagan, and Crockett Counties.

TABLE 3.—*Crude petroleum: Unit cost of production and sales value by pools and districts, 1931–33*—Continued

Cost period	Range of gravity	Range of production per well per day (barrels)	Production—(company interest, barrels)	Expenses: Depletion	Expenses: Depreciation	Expenses: Amortization of intangible development costs	Expenses: Operating cost	Expenses: General overhead and administrative	Expenses: Total cost	Deduct gas sales and miscellaneous revenue	Net cost	Interest on invested capital	Net cost including interest	Average selling price	Range of costs: Lowest	Range of costs: Highest
TEXAS—Continued																
North Texas [6]																
1931	23–42	0.3– 71.0	12,743,213	$0.240	$0.237	$0.026	$0.391	$0.353	$1.247	$0.078	$1.169	$0.176	$1.345	$0.630	$0.20	$7.39
1932	23–42	.4– 65.6	11,541,129	.206	.229	.030	.340	.259	1.064	.068	.996	.161	1.157	.916	.15	3.57
First 9 months of 1933	23–42	.4– 87.6	7,665,816	.196	.212	.030	.332	.221	.991	.067	.924	.147	1.071	.513	.23	4.86
Last 3 months of 1933	23–47	.4–503.0	2,730,965	.179	.204	.038	.378	.232	1.031	.106	.925	.139	1.064	.984	.24	5.56
1933	23–47	.4–503.0	11,446,881	.185	.204	.031	.336	.217	.973	.073	.900	.143	1.043	.637	.22	5.56
3-year weighted average			11,910,408	.211	.224	.029	.357	.279	1.100	.073	1.027	.160	1.187	.725		
Central Texas [7]																
1931	28–42	.7– 39.6	2,722,394	.107	.128	.003	.382	.529	1.149	.095	1.054	.056	1.110	.589	.45	2.77
1932	28–42	.5– 42.8	1,667,534	.072	.140	.010	.317	.413	.952	.128	.824	.057	.881	.782	.21	5.30
First 9 months of 1933	28–42	.6– 34.1	1,084,955	.055	.132	.023	.298	.343	.851	.082	.769	.048	.817	.440	.41	2.13
Last 3 months of 1933	29–42	.6– 34.1	314,716	.057	.117	.019	.326	.439	.958	.162	.796	.055	.851	.906	.38	1.55
1933	28–42	.6– 34.1	1,399,671	.056	.128	.022	.304	.365	.875	.100	.775	.049	.824	.545	.38	2.13
3-year weighted average			1,929,866	.085	.131	.009	.345	.456	1.026	.106	.920	.055	.975	.634		
Caldwell, Bastrop, and Guadalupe Counties																
1931	27–38	2.4– 68.4	12,077,607	.071	.102	.002	.253	.349	.777	.004	.773	.051	.824	.567	.46	2.99
1932	27–38	4.7– 56.8	8,885,632	.066	.095	.004	.235	.249	.649	.003	.646	.055	.701	.688	.50	2.72
First 9 months of 1933	27–38	1.6– 72.9	5,298,695	.074	.084	.006	.234	.195	.593	.004	.589	.058	.647	.401	.44	1.92
Last 3 months of 1933	27–37	1.6– 72.9	1,515,062	.074	.096	.006	.271	.233	.680	.004	.676	.067	.743	.834	–0	4.10
1933	27–38	1.6– 72.9	7,096,488	.073	.085	.006	.244	.200	.608	.004	.604	.058	.662	.497	–0	4.10
3-year weighted average			9,353,242	.069	.096	.004	.245	.280	.694	.003	.691	.053	.744	.588		
Other Central Texas [8]																
1931	18–46	1.0–183.4	1,881,446	.269	.144	.002	.092	.226	.733	.021	.712	.052	.764	.786	.33	11.99
1932	18–46	.9–178.0	1,482,193	.184	.112	.033	.165	.260	.754	.033	.721	.065	.786	.911	.29	7.13
First 9 months of 1933	22–48	.6– 59.0	746,990	.147	.111	.028	.187	.217	.690	.045	.645	.077	.722	.539	.31	6.51
Last 3 months of 1933	22–49	.6– 59.0	181,286	.133	.120	.021	.239	.268	.781	.104	.677	.104	.781	.947	.01	2.57
1933	22–49	.6– 59.0	982,415	.151	.112	.025	.201	.232	.721	.054	.667	.081	.748	.613	.01	6.51
3-year weighted average			1,448,685	.213	.126	.018	.142	.239	.738	.033	.705	.063	.768	.789		

Southwest Texas [9]																
1931	18–46	1.2– 81.0	2,091,077	.087	.115	.037	.243	.171	.653	.032	.621	.093	.714	.626	.29	12.53
1932	18–49	1.0–113.3	2,372,270	.072	.089	.042	.249	.154	.606	.030	.576	.082	.658	.802	.35	5.36
First 9 months of 1933	18–49	.5– 60.0	2,346,775	.043	.079	.063	.162	.160	.507	.023	.484	.065	.549	.425	.28	5.06
Last 3 months of 1933	18–49	.5– 60.0	596,497	.033	.078	.060	.256	.187	.614	.029	.585	.080	.665	.794	.32	52.50
1933	18–49	.5– 60.0	3,025,786	.040	.081	.063	.178	.169	.531	.023	.508	.067	.575	.501	.28	52.50
3-year weighted average			2,496,378	.063	.093	.049	.219	.165	.589	.028	.561	.079	.640	.631		
Government Wells Pool																
1931	18–23	12.2–820.6	663,078	.076	.097	.027	.146	.181	.527	.075	.452	.031	.483	.661	.22	1.11
1932	18–24	1.6–147.3	1,251,333	.050	.055	.042	.119	.180	.446	.030	.416	.028	.444	.789	.21	1.11
First 9 months of 1933	18–24	9.5– 34.0	903,143	.053	.058	.039	.123	.142	.415	.029	.386	.087	.473	.426	.19	2.67
Last 3 months of 1933	18–24	9.5– 34.0	287,480	.008	.048	.027	.175	.188	.446	.034	.412	.051	.463	.797	.23	1.30
1933	18–24	9.5– 34.0	1,303,092	.043	.057	.040	.135	.150	.425	.033	.392	.077	.469	.512	.19	2.67
3-year weighted average			1,072,501	.052	.065	.038	.131	.168	.454	.040	.414	.048	.462	.650		
Texas Gulf Coast [10]																
1931	17–62	1.0–504.0	32,776,222	.070	.123	.020	.204	.318	.735	.045	.690	.061	.751	.688	.37	23.17
1932	17–62	2.8–600.0	29,359,159	.068	.119	.033	.199	.272	.691	.075	.616	.077	.693	.815	.30	20.03
First 9 months of 1933	17–41	.8–412.3	28,607,853	.043	.095	.047	.156	.215	.556	.056	.500	.080	.580	.532	.17	6.25
Last 3 months of 1933	17–41	.8–620.0	8,868,921	.052	.116	.066	.198	.284	.716	.066	.650	.089	.739	1.023	.19	8.95
1933	17–41	.8–620.0	38,368,659	.045	.100	.051	.166	.229	.591	.057	.534	.081	.615	.655	.17	8.95
3-year weighted average			33,501,347	.060	.113	.035	.188	.271	.667	.058	.609	.073	.682	.713		
East Texas proper [11]																
1931	37–42	10.8–175.9	58,347,999	.030	.044	.032	.074	.344	.524	.020	.504	.041	.545	.478	.11	2.96
1932	37–42	9.0–245.4	66,709,650	.034	.071	.053	.107	.281	.546	.017	.529	.080	.609	.945	.07	3.77
First 9 months of 1933	35–42	17.5– 54.2	76,951,245	.031	.064	.059	.065	.211	.430	.009	.421	.075	.496	.474	.11	1.41
Last 3 months of 1933	36–42	17.5– 54.2	22,721,552	.036	.077	.056	.086	.245	.500	.019	.481	.085	.566	.997	.10	1.54
1933	35–42	10.0– 96.6	102,240,415	.033	.067	.059	.070	.215	.444	.012	.432	.078	.510	.592	.10	1.59
3-year weighted average			75,766,021	.032	.063	.050	.082	.267	.494	.015	.479	.069	.548	.666		
Other east Texas [12]																
1931	32–41	1.8–198.4	14,276,496	.001	.028	.032	.054	.479	.594	.007	.587	.016	.603	.571	.49	13.06
1932	33–41	1.7–140.8	14,501,059	.002	.026	.035	.050	.327	.440	.006	.434	.025	.459	.857	.39	.89
First 9 months of 1933	33–41	2.9–139.5	11,917,017	.001	.025	.035	.031	.248	.340	.009	.331	.023	.354	.455	.30	.93
Last 3 months of 1933	33–41	2.9–139.5	3,028,338	.001	.028	.037	.051	.300	.417	.023	.394	.030	.424	.956	.33	1.04
1933	33–41	2.9–139.5	14,962,645	.001	.026	.036	.035	.258	.356	.012	.344	.024	.368	.556	.30	1.04
3-year weighted average			14,580,067	.001	.027	.034	.046	.353	.461	.008	.453	.022	.475	.661		

[6] Includes Wilbarger, Wichita, Clay, Montague, Foard, Haskell, Jones, Taylor, Baylor, Archer, Jack, Throckmorton, Young, Shackelford, Stephens, Palo Pinto, Runnels, Callahan, Eastland, Erath, Coleman, Brown, and Comanche Counties.

[7] Includes Limestone, Freestone, and Navarro Counties.

[8] Includes Williamson, Milan, Bexar, Atascosa, and McLennan Counties.

[9] Includes Duval (excluding Government wells), Webb, Zapata, Jim Hogg, and Starr Counties.

[10] Includes Kleberg, Refugio, Jackson, Wharton, Matagorda, Fort Bend, Brazoria, Montgomery, Harris, Liberty, Chambers, Hardin, Orange, and Jefferson Counties.

[11] Includes Upshur, Cherokee, Gregg, Rusk, and Smith Counties.

[12] Includes Van Zandt, Nacogdoches, Shelby, Panola, Harrison, Marion, and San Augustine Counties.

TABLE 3.—*Crude petroleum: Unit cost of production and sales value by pools and districts, 1931–33*—Continued

Cost period	Range of gravity	Range of production per well per day (barrels)	Production—(company interest, barrels)	Expenses: Depletion	Expenses: Depreciation	Expenses: Amortization of intangible development costs	Expenses: Operating cost	Expenses: General overhead and administrative	Expenses: Total cost	Deduct gas sales and miscellaneous revenue	Net cost	Interest on invested capital	Net cost including interest	Average selling price	Range of costs: Lowest	Range of costs: Highest
TEXAS—Continued																
Other and unclassified																
1931	18–63	2.2–128.7	14,185,944	$0.071	$0.031	$0.057	$0.157	$0.371	$0.687	$0.006	$0.681	$0.182	$0.863	$0.454	$2.43	$202.96
1932	18–63	1.9– 77.8	13,138,638	.090	.030	.028	.128	.206	.482	.004	.478	.190	.668	.679	.28	5.57
First 9 months of 1933	17–63	1.0–531.9	10,999,451	.096	.053	.046	.128	.195	.518	.005	.513	.263	.776	.384	.34	89.19
Last 3 months of 1933	17–63	1.0–531.9	2,919,619	.096	.066	.062	.177	.234	.635	.011	.624	.330	.954	.854	.32	13.18
1933	17–63	1.0–531.9	13,934,620	.096	.056	.049	.139	.203	.543	.007	.536	.277	.813	.482	.25	89.19
3-year weighted average			13,753,067	.085	.039	.045	.142	.262	.573	.005	.568	.216	.784	.535		
TOTAL TEXAS																
1931			214,146,989	.061	.096	.024	.152	.364	.697	.029	.668	.068	.736	.528		
1932			202,910,651	.058	.097	.036	.152	.272	.615	.031	.584	.083	.667	.822		
First 9 months of 1933			180,776,653	.048	.085	.047	.115	.213	.508	.023	.485	.085	.570	.456		
Last 3 months of 1933			52,522,064	.054	.099	.051	.149	.260	.613	.040	.573	.098	.671	.946		
1933			238,966,868	.050	.088	.048	.123	.222	.531	.027	.504	.088	.592	.568		
3-year weighted average			218,674,836	.056	.093	.037	.142	.283	.611	.029	.582	.080	.662	.633		
OKLAHOMA																
Nowata, Rogers, Craig, and Washington Counties																
1931	24–37	.1– 6.5	1,798,099	.117	.157	.008	.344	.208	.834	.025	.809	.093	.902	.588	.13	4.88
1932	24–37	.1– 5.0	2,157,355	.105	.151	.008	.357	.142	.763	.022	.741	.076	.817	.825	.15	3.25
First 9 months of 1933	29–37	.2– 5.0	1,426,651	.112	.164	.010	.313	.145	.744	.019	.725	.073	.798	.460	.15	4.03
Last 3 months of 1933	28–37	.2– 5.0	470,059	.106	.150	.010	.476	.166	.908	.039	.869	.076	.945	.923	–0	2.74
1933	24–37	.2– 5.0	2,008,650	.106	.154	.009	.346	.146	.761	.023	.738	.072	.810	.576	–0	4.03
3-year weighted average			1,988,035	.109	.154	.008	.350	.163	.784	.023	.761	.079	.840	.670		

Tulsa and Creek Counties [13]															
1931	25–44	.1– 74.4	4,945,965	.120	.242	.022	.331	.467	1.182	.067	1.115	.128	1.243	.639	.22	4.47
1932	25–43	.2– 48.0	4,457,325	.115	.233	.033	.330	.328	1.039	.045	.994	.118	1.112	.877	.03	44.47
First 9 months of 1933	25–43	.2– 42.2	2,946,740	.107	.215	.037	.313	.272	.944	.040	.904	.102	1.006	.500	.18	8.76
Last 3 months of 1933	25–43	.2–105.5	1,013,520	.095	.197	.032	.405	.295	1.024	.062	.962	.099	1.061	.994	–0	6.43
1933	25–43	.2–105.5	4,199,510	.103	.211	.036	.332	.267	.949	.044	.905	.099	1.004	.627	–0	8.76
3-year weighted average			4,534,267	.113	.230	.029	.331	.360	1.063	.053	1.010	.116	1.126	.713		
Wagoner, Muskogee, and McIntosh Counties																
1931	28–42	.1– 18.4	141,617	.131	.157	.006	.467	.307	1.068	.061	1.007	.080	1.087	.635	.52	3.85
1932	34–42	.3– 45.0	132,715	.113	.268	.011	.494	.293	1.179	.027	1.152	.074	1.226	.885	.53	3.69
First 9 months of 1933	34–42	.3– 50.7	103,696	.063	.106	.005	.372	.260	.806	.037	.769	.067	.836	.529	.48	2.64
Last 3 months of 1933	34–42	.3– 50.7	29,729	.058	.084	.008	.492	.382	1.024	.036	.988	.061	1.049	1.035	.03	3.79
1933	34–42	.3– 50.7	135,095	.061	.100	.006	.403	.285	.855	.036	.819	.065	.884	.643	.03	3.79
3-year weighted average			136,476	.102	.174	.008	.455	.295	1.034	.042	.992	.073	1.065	.718		
Okmulgee, Okfuskee, and Hughes Counties																
1931	25–42	.5– 51.0	1,850,178	.246	.262	.008	.423	.398	1.337	.038	1.299	.201	1.500	.652	.26	13.55
1932	28–42	.2– 56.9	1,918,656	.358	.261	.023	.355	.292	1.289	.030	1.259	.168	1.427	.899	.16	11.72
First 9 months of 1933	29–41	.6– 67.2	1,350,404	.245	.209	.033	.317	.251	1.055	.026	1.029	.138	1.167	.518	.21	7.10
Last 3 months of 1933	29–41	.6–231.4	429,185	.246	.185	.022	.413	.263	1.129	.041	1.088	.128	1.216	1.002	–0	6.25
1933	28–41	.4–231.4	1,870,322	.233	.212	.029	.348	.246	1.068	.031	1.037	.135	1.172	.633	–0	7.10
3-year weighted average			1,879,719	.280	.245	.020	.375	.311	1.231	.032	1.199	.167	1.366	.730		
Osage County [14]																
1931	29–41	.4– 19.0	4,957,816	.299	.310	.039	.304	.415	1.367	.033	1.329	.209	1.538	.640	.48	7.83
1932	29–41	.3– 50.7	4,676,731	.248	.307	.035	.324	.292	1.206	.024	1.182	.176	1.358	.894	.02	10.24
First 9 months of 1933	29–41	.3–230.0	3,419,038	.220	.227	.043	.307	.244	1.041	.073	.968	.171	1.139	.513	–0	64.39
Last 3 months of 1933	29–41	.3–230.0	1,370,708	.181	.201	.034	.330	.234	.980	.070	.910	.142	1.052	1.013	–0	4.09
1933	29–41	.3–230.0	4,833,682	.208	.218	.040	.313	.240	1.019	.071	.948	.162	1.110	.655	–0	64.39
3-year weighted average			4,822,743	.253	.278	.038	.313	.317	1.199	.045	1.154	.183	1.337	.728		
Pawnee, Payne, and Lincoln Counties																
1931	33–41	.7–355.0	2,191,390	.236	.310	.025	.341	.351	1.263	.032	1.231	.155	1.386	.685	.38	3.87
1932	32–42	.6–277.0	2,631,316	.209	.248	.029	.242	.272	1.000	.019	.981	.101	1.082	.936	.41	4.19
First 9 months of 1933	33–43	.6–110.0	1,615,047	.182	.208	.044	.270	.212	.916	.015	.901	.097	.998	.546	.27	3.17
Last 3 months of 1933	33–41	.6–110.0	573,550	.214	.189	.045	.275	.236	.959	.025	.934	.091	1.025	1.052	.37	4.63
1933	33–43	.6–110.0	2,188,597	.190	.203	.044	.271	.219	.927	.017	.910	.095	1.005	.679	.27	4.63
3-year weighted average			2,337,101	.212	.253	.032	.282	.280	1.059	.022	1.037	.116	1.153	.777		

[13] Excludes Cushing pool.
[14] Excludes Burbank pool.

TABLE 3.—*Crude petroleum: Unit cost of production and sales value by pools and districts, 1931–33*—Continued

Cost period	Range of gravity	Range of production per well per day (barrels)	Production—(company interest, barrels)	Expenses: Depletion	Expenses: Depreciation	Expenses: Amortization of intangible development costs	Expenses: Operating cost	Expenses: General overhead and administrative	Expenses: Total cost	Deduct gas sales and miscellaneous revenue	Net cost	Interest on invested capital	Net cost including interest	Average selling price	Range of costs: Lowest	Range of costs: Highest
OKLAHOMA—Continued																
Noble, Kay, Logan, Garfield, and Grant Counties																
1931	37–47	1.7– 121.5	5,882,545	$0.104	$0.305	$0.052	$0.319	$0.513	$1.293	$0.054	$1.239	$0.123	$01.362	$0.709	–0	$10.47
1932	37–47	1.3– 127.0	4,712,650	.112	.261	.024	.337	.409	1.143	.034	1.109	.112	1.221	.953	–0	7.10
First 9 months of 1933	37–47	1.3– 563.3	3,399,381	.105	.242	.036	.284	.332	.999	.034	.965	.103	1.068	.586	$0.26	3.39
Last 3 months of 1933	37–47	1.3– 563.3	1,410,927	.071	.171	.034	.314	.360	.950	.041	.909	.033	.992	1.081	.31	4.27
1933	37–47	1.3– 563.3	4,875,361	.094	.223	.035	.294	.336	.982	.035	.947	.100	1.047	.731	.26	4.27
3-year weighted average			5,156,852	.103	.266	.038	.317	.426	1.150	.042	1.108	.112	1.220	.790		
Burbank pool																
1931	36–39	1.5– 21.0	2,216,525	.306	.291	.001	.271	.487	1.356	.082	1.274	.288	1.562	.663	.42	2.88
1932	36–39	1.8– 29.9	2,126,753	.364	.279	.009	.274	.351	1.277	.038	1.239	.300	1.539	.906	.30	2.70
First 9 months of 1933	35–39	1.2– 22.6	1,488,086	.362	.260	.020	.275	.262	1.179	.038	1.141	.295	1.436	.525	.40	2.56
Last 3 months of 1933	36–39	1.2– 22.6	483,182	.314	.266	.022	.358	.319	1.279	.094	1.185	.303	1.488	1.015	.25	2.93
1933	35–39	1.2– 22.6	1,971,268	.350	.261	.021	.295	.276	1.203	.052	1.151	.297	1.448	.645	.25	2.93
3-year weighted average			2,104,849	.339	.278	.010	.280	.375	1.282	.058	1.224	.295	1.519	.739		
Cushing pool																
1931	34–42	1.9– 26.2	5,337,474	.251	.203	.036	.370	.467	1.327	.069	1.258	.142	1.400	.677	.43	4.23
1932	34–42	1.4– 20.8	4,960,874	.207	.169	.031	.351	.341	1.099	.042	1.057	.111	1.168	.937	.44	18.53
First 9 months of 1933	35–42	1.0– 24.3	3,640,299	.199	.149	.033	.333	.282	.996	.040	.956	.107	1.063	.551	.41	2.43
Last 3 months of 1933	35–42	1.0– 24.3	1,209,631	.193	.158	.032	.408	.270	1.061	.087	.974	.108	1.082	1.051	.41	2.63
1933	35–42	1.0– 24.3	4,863,071	.198	.151	.033	.352	.278	1.012	.052	.960	.107	1.067	.676	.41	2.63
3-year weighted average			5,053,806	.220	.175	.033	.358	.365	1.151	.055	1.096	.121	1.217	.762		
Oklahoma City pool																
1931	36–41	24.5–1,032.0	25,778,791	.079	.103	.107	.112	.411	.812	.020	.792	.142	.934	.648	.24	51.26
1932	36–42	11.6– 275.0	17,728,513	.074	.140	.132	.172	.304	.822	.019	.803	.222	1.025	.910	.31	14.34
First 9 months of 1933	34–42	15.6– 736.6	29,274,070	.073	.122	.127	.095	.189	.606	.014	.592	.107	.699	.558	.10	1.87
Last 3 months of 1933	36–42	15.6– 736.6	9,202,110	.079	.113	.123	.152	.182	.649	.034	.615	.105	.720	1.033	.23	2.86
1933	34–42	15.6– 736.6	38,476,180	.075	.120	.126	.108	.187	.616	.018	.598	.106	.704	.671	.10	2.86
3-year weighted average			27,327,828	.076	.119	.121	.123	.283	.722	.019	.703	.143	.846	.716		

Healdton and Hewitt pools																
1931	29–34	1.5– 15.0	5,160,545	.104	.109	.005	.197	.430	.845	.018	.827	.082	.909	.528	.19	2.23
1932	29–35	1.5– 14.0	4,816,588	.100	.107	.010	.187	.299	.703	.010	.693	.077	.770	.806	.29	1.87
First 9 months of 1933	29–35	1.0– 13.0	3,351,588	.099	.098	.005	.178	.237	.617	.012	.605	.073	.678	.432	.25	1.56
Last 3 months of 1933	29–35	1.0– 13.0	1,073,380	.086	.092	.006	.233	.279	.696	.027	.669	.076	.745	.910	.34	1.58
1933	29–35	1.0– 13.0	4,426,963	.096	.097	.005	.191	.248	.637	.016	.621	.074	.695	.548	.25	1.63
3-year weighted average			4,801,365	.100	.104	.007	.192	.330	.733	.014	.719	.078	.797	.627		
Seminole pool[14]																
1931	29–41	2.2– 776.0	49,293,145	.094	.193	.039	.187	.488	1.001	.029	.972	.084	1.056	.687	.23	35.17
1932	29–41	1.7– 471.0	42,477,314	.081	.185	.035	.172	.375	.848	.016	.832	.071	.903	.924	.32	9.18
First 9 months of 1933	29–41	1.5–1,383.8	27,874,333	.070	.164	.029	.166	.305	.734	.017	.717	.065	.782	.551	.27	11.68
Last 3 months of 1933	29–41	1.5–1,383.8	9,388,634	.069	.163	.039	.214	.320	.805	.035	.770	.073	.843	1.047	.33	13.70
1933	29–41	1.5–1,383.8	37,612,987	.069	.165	.031	.178	.307	.750	.021	.729	.067	.796	.676	.27	24.60
3-year weighted average			43,127,815	.082	.182	.035	.179	.399	.877	.022	.855	.075	.930	.762		
Other pools in Stephens, Cotton, Murray, Carter, Pontotoc, Garvin, Grady, Caddo, Marshall, Comanche, and Jefferson Counties																
1931	18–42	.5– 86.7	7,556,597	.088	.186	.014	.243	.317	.848	.028	.820	.072	.892	.514	.16	33.55
1932	18–42	.3– 69.0	6,835,285	.085	.178	.022	.226	.265	.776	.016	.760	.064	.824	.767	.16	8.69
First 9 months of 1933	18–42	.6– 54.5	4,459,596	.080	.172	.019	.223	.214	.708	.015	.693	.061	.754	.423	.28	15.14
Last 3 months of 1933	18–42	.4– 54.5	1,532,041	.075	.153	.021	.276	.275	.800	.022	.778	.059	.837	.873	.34	5.02
1933	18–42	.4– 145.4	6,213,809	.078	.164	.019	.235	.223	.719	.017	.702	.060	.762	.536	.21	15.14
3-year weighted average			6,868,563	.084	.177	.018	.235	.271	.785	.021	.764	.066	.830	.605		
Other[15] *and unclassified*																
1931	33–40	.6– 16.3	4,837,539	.168	.411	.105	.348	.434	1.466	.046	1.420	.164	1.584	.637	.30	15.06
1932	33–40	.5– 10.2	3,342,968	.169	.348	.154	.354	.318	1.343	.040	1.303	.171	1.474	.885	.49	2.98
First 9 months of 1933	34–40	.3– 10.1	2,182,284	.174	.353	.212	.307	.265	1.311	.069	1.242	.160	1.402	.520	.44	2.60
Last 3 months of 1933	34–40	.3– 18.1	727,955	.182	.339	.110	.383	.323	1.337	.050	1.287	.161	1.448	1.017	.35	2.56
1933	34–40	.3– 18.1	2,910,239	.176	.349	.187	.326	.279	1.317	.064	1.253	.161	1.414	.644	.85	2.60
3-year weighted average			3,696,915	.170	.376	.141	.344	.359	1.390	.049	1.341	.165	1.506	.714		
TOTAL OKLAHOMA																
1931			121,948,226	.120	.196	.050	.216	.445	1.027	.033	.994	.117	1.111	.653		
1932			102,975,043	.115	.193	.051	.224	.335	.918	.022	.896	.118	1.014	.901		
First 9 months of 1933			86,531,213	.100	.162	.066	.180	.248	.756	.022	.734	.096	.830	.537		
Last 3 months of 1933			28,914,611	.098	.154	.063	.239	.262	.816	.040	.776	.096	.872	1.023		
1933			116,585,734	.099	.160	.065	.195	.250	.769	.026	.743	.096	.839	.658		
3-year weighted average			113,836,334	.111	.183	.058	.212	.345	.909	.027	.882	.110	.992	.729		

[14] Includes Pottawatomie and Seminole Counties.

[15] Includes Kiowa, Beckham, and Cimarron pools.

TABLE 3.—*Crude petroleum: Unit cost of production and sales value by pools and districts, 1931–33*—Continued

Cost period	Range of gravity	Range of production per well per day (barrels)	Production—(company interest, barrels)	Expenses						Deduct gas sales and miscellaneous revenue	Net cost	Interest on invested capital	Net cost including interest	Average selling price	Range of costs	
				Depletion	Depreciation	Amortization of intangible development costs	Operating cost	General overhead and administrative	Total cost						Lowest	Highest
KANSAS																
Butler and Harvey Counties																
1931	30–40	0.7– 75.0	5,374,530	$0.086	$0.277	$0.041	$0.338	$0.406	$1.148	$0.010	$1.188	$0.090	$1.228	$0.625	$0.23	$21.08
1932	28–41	.7–349.0	4,754,788	.074	.312	.039	.328	.300	1.053	.010	1.043	.091	1.134	.871	.02	15.64
First 9 months of 1933	33–42	1.0–292.0	4,195,537	.065	.262	.054	.270	.201	.852	.008	.844	.061	.905	.525	.24	9.13
Last 3 months of 1933	33–42	1.0–292.0	1,456,202	.061	.264	.056	.355	.199	.935	.008	.927	.058	.985	.994	.26	11.49
1933	33–42	1.0–292.0	5,656,809	.064	.263	.054	.292	.201	.874	.009	.865	.060	.925	.646	.24	11.49
3-year weighted average			5,262,042	.074	.282	.045	.319	.301	1.021	.009	1.012	.079	1.091	.707		
Greenwood and Woodson Counties																
1931	29–41	.9– 25.0	2,065,779	.147	.282	.013	.258	.385	1.085	.020	1.065	.146	1.211	.713	.27	6.54
1932	29–41	.5– 15.0	1,803,042	.147	.249	.022	.276	.299	.993	.011	.982	.143	1.125	.934	.31	2.75
First 9 months of 1933	29–41	.5– 36.4	1,190,266	.166	.268	.040	.272	.260	1.006	.044	.962	.131	1.093	.561	.32	2.94
Last 3 months of 1933	29–41	.5– 36.4	434,410	.134	.262	.032	.331	.269	1.028	.042	.986	.122	1.108	1.026	.61	3.77
1933	29–41	.5– 36.4	1,650,620	.157	.264	.038	.288	.259	1.006	.043	.963	.128	1.091	.685	.61	3.77
3-year weighted average			1,839,814	.150	.266	.023	.273	.319	1.031	.024	1.007	.140	1.147	.777		
East Kansas [17]																
1931	18–37	.2– 58.0	2,315,433	.169	.262	.050	.322	.423	1.226	.024	1.202	.156	1.358	.625	.35	4.01
1932	18–37	.3– 41.8	1,959,693	.168	.281	.021	.339	.281	1.090	.022	1.068	.114	1.182	.862	.01	1.85
First 9 months of 1933	18–37	.1– 26.8	1,595,012	.130	.232	.042	.261	.244	.909	.020	.889	.123	1.012	.520	.40	2.22
Last 3 months of 1933	18–42	.1–125.0	609,108	.106	.192	.038	.300	.249	.885	.025	.860	.108	.968	1.002	.42	2.09
1933	18–42	.1–125.0	2,270,629	.119	.217	.040	.271	.240	.887	.021	.866	.116	.982	.652	.36	2.22
3-year weighted average			2,181,918	.152	.252	.038	.309	.317	1.068	.023	1.045	.129	1.174	.705		

Sedgwick County															
1931	38-42	8.9-304.5	3,502,495	.046	.138	.044	.230	.551	1.009	.026	.983	.065	1.048	.709	.29	4.45
1932	38-42	7.9-147.5	2,731,009	.060	.132	.070	.248	.408	.918	.029	.889	.074	.963	.978	.36	1.78
First 9 months of 1933	38-42	6.1-122.0	2,000,483	.044	.127	.058	.227	.347	.803	.025	.778	.068	.846	.562	.38	1.91
Last 3 months of 1933	36-42	6.1-122.0	483,467	.051	.123	.061	.278	.336	.849	.047	.802	.095	.897	1.074	.42	1.88
1933	36-42	6.1-122.0	2,483,950	.045	.126	.059	.237	.345	.812	.029	.783	.073	.856	.662	.38	1.91
3-year weighted average	------	--------------	2,905,818	.050	.133	.056	.238	.447	.924	.027	.897	.070	.967	.780	-------	-------
Sumner and Cowley Counties															
1931	34-41	2.6-126.0	2,611,415	.113	.296	.011	.222	.642	1.284	.018	1.266	.115	1.381	.664	.35	10.92
1932	34-42	2.1- 70.2	2,637,776	.096	.249	.033	.201	.324	.903	.010	.893	.098	.991	.922	.31	7.27
First 9 months of 1933	34-41	3.0- 68.0	1,654,470	.178	.217	.216	.200	.253	1.064	.008	1.056	.101	1.157	.542	.32	6.66
Last 3 months of 1933	34-41	3.0- 68.0	435,556	.097	.287	.030	.307	.286	1.007	.025	.982	.124	1.106	1.060	.45	5.05
1933	34-41	3.0- 68.0	2,090,026	.161	.232	.177	.222	.260	1.052	.012	1.040	.106	1.146	.650	.32	6.66
3-year weighted average	------	--------------	2,446,406	.120	.261	.066	.215	.419	1.081	.013	1.068	.106	1.174	.753	-------	-------
Rice, Reno, Ellsworth, Kingman, Rush, Barton, Russell, Trego, Ellis, and Rooks Counties															
1931	22-43	4.5-134.0	1,525,052	.084	.174	.069	.171	.391	.889	.022	.867	.096	.963	.649	.53	5.21
1932	22-48	.8-580.7	2,074,635	.078	.140	.076	.161	.261	.716	.014	.702	.090	.792	.904	.19	30.32
First 9 months of 1933	28-47	1.0-291.8	1,849,630	.072	.132	.083	.158	.194	.639	.016	.623	.076	.699	.550	.30	28.43
Last 3 months of 1933	28-47	1.0-291.8	815,310	.074	.116	.059	.209	.233	.691	.015	.676	.058	.734	1.040	.33	16.98
1933	28-47	1.0-291.8	2,664,940	.073	.127	.075	.174	.206	.655	.016	.639	.070	.709	.700	.30	28.43
3-year weighted average	------	--------------	2,088,209	.077	.143	.074	.169	.269	.732	.017	.715	.083	.798	.755	-------	-------
McPherson County															
1931	33-42	2.9-385.0	3,432,647	.033	.120	.046	.145	.506	.850	.026	.824	.048	.872	.685	.24	11.59
1932	33-42	5.5-145.0	3,603,946	.044	.126	.066	.152	.275	.663	.031	.632	.073	.705	.926	.24	2.43
First 9 months of 1933	33-42	4.2-319.0	4,092,969	.071	.103	.124	.123	.223	.644	.012	.632	.056	.688	.556	.23	3.17
Last 3 months of 1933	33-42	4.2-319.0	1,169,487	.052	.126	.099	.216	.290	.783	.019	.764	.066	.830	1.038	.24	4.85
1933	33-42	4.2-319.0	5,342,004	.069	.107	.121	.143	.234	.674	.013	.661	.057	.718	.664	.23	4.85
3-year weighted average	------	--------------	4,126,199	.052	.116	.084	.146	.321	.719	.022	.697	.060	.757	.746	-------	-------
Other and unclassified															
1931	34-40	1.6- 15.3	4,493,622	.074	.279	.113	.219	.385	1.070	.014	1.056	.131	1.187	.685	.54	36.13
1932	34-40	1.7- 76.7	2,853,664	.087	.301	.142	.285	.288	1.103	.022	1.081	.172	1.253	.931	.34	7.33
First 9 months of 1933	31-40	3.6-201.8	2,469,763	.079	.306	.131	.231	.210	.957	.030	.927	.133	1.060	.549	.25	5.82
Last 3 months of 1933	35-40	3.6-201.8	870,585	.077	.309	.133	.275	.233	1.027	.036	.991	.126	1.117	1.047	−0	2.39
1933	31-40	3.6-201.8	3,340,348	.078	.307	.131	.243	.216	.975	.031	.944	.131	1.075	.679	−0	5.82
3-year weighted average	------	--------------	3,562,545	.079	.294	.126	.244	.306	1.049	.021	1.028	.142	1.170	.749	-------	-------

[17] Includes Douglas, Franklin, Miami, Anderson, Linn, Chase, Chautauqua, Elk, Allen, Bourbon, Neosho, LaBette, Crawford, Wilson, Marion, and Montgomery Counties.

TABLE 3.—*Crude petroleum: Unit cost of production and sales value by pools and districts, 1931–33*—Continued

Cost period	Range of gravity	Range of production per well per day (barrels)	Production—(company interest, barrels)	Expenses: Depletion	Expenses: Depreciation	Expenses: Amortization of intangible development costs	Expenses: Operating cost	Expenses: General overhead and administrative	Expenses: Total cost	Deduct gas sales and miscellaneous revenue	Net cost	Interest on invested capital	Net cost including interest	Average selling price	Range of costs: Lowest	Range of costs: Highest
KANSAS—Continued																
TOTAL KANSAS																
1931			25,320,973	$0.086	$0.232	$0.052	$0.246	$0.459	$1.075	$0.019	$1.056	$0.102	$1.158	$0.668		
1932			22,418,553	.086	.228	.060	.251	.305	.930	.019	.911	.104	1.015	.914		
First 9 months of 1933			19,048,130	.088	.201	.095	.211	.233	.828	.017	.811	.084	.895	.545		
Last 3 months of 1933			6,274,125	.074	.209	.070	.283	.252	.888	.023	.865	.085	.950	1.029		
1933			25,499,326	.085	.202	.089	.229	.236	.841	.019	.822	.084	.906	.665		
3-year weighted average			24,412,951	.086	.220	.067	.241	.335	.949	.019	.930	.096	1.026	.742		
ARKANSAS																
El Dorado pool																
1931	27–33	2.0– 15.6	588,067	.241	.250		.490	.300	1.281	.116	1.165	.084	1.249	.554	$0.38	$05.03
1932	27–34	1.7– 15.7	474,893	.131	.178	.002	.529	.206	1.046	.082	.964	.068	1.032	.774	.31	4.48
First 9 months of 1933	27–34	1.7– 15.2	305,884	.040	.154		.506	.168	.868	.088	.780	.057	.837	.414	.45	1.10
Last 3 months of 1933	20–34	1.7– 15.2	119,237	.039	.148	.002	.661	.186	1.036	.155	.881	.071	.952	.859	.32	1.17
1933	20–34	1.7– 15.7	425,121	.040	.152	.001	.549	.173	.915	.107	.808	.061	.869	.539	.32	1.17
3-year weighted average			496,027	.148	.199	.001	.519	.234	1.101	.102	.999	.072	1.071	.620		
Smackover pool																
1931	19–27	1.9– 20.8	6,209,927	.061	.193	.003	.387	.348	.992	.016	.976	.063	1.039	.488	.63	2.07
1932	19–27	3.2– 17.8	4,985,347	.056	.171	.010	.406	.227	.870	.008	.862	.060	.922	.618	.45	1.87
First 9 months of 1933	19–33	3.5– 15.8	3,847,099	.066	.183	.016	.416	.166	.847	.022	.825	.053	.878	.307	.50	2.87
Last 3 months of 1933	20–38	3.5– 15.8	1,070,656	.080	.165	.017	.511	.184	.957	.012	.945	.052	.997	.709	.62	2.66
1933	19–38	1.9– 20.8	4,917,755	.069	.179	.016	.437	.170	.871	.020	.851	.052	.903	.394	.50	2.87
3-year weighted average			5,371,010	.062	.182	.009	.408	.256	.917	.015	.902	.059	.961	.500		
Other pools																
1931	13–35	1.0– 25.0	2,990,185	.111	.287	.023	.438	.379	1.238	.027	1.211	.095	1.306	.483	.57	9.81
1932	13–36	1.5– 38.9	2,520,907	.129	.273	.026	.434	.245	1.107	.027	1.080	.079	1.159	.614	.29	3.72
First 9 months of 1933	17–36	1.4– 23.0	1,171,747	.052	.152	.011	.355	.235	.805	.016	.789	.059	.848	.375	.36	2.49
Last 3 months of 1933	17–36	1.4– 23.0	496,915	.080	.185	.024	.545	.221	1.055	.024	1.031	.066	1.097	.715	.48	2.41
1933	13–36	1.0– 38.9	1,720,436	.060	.157	.015	.407	.226	.865	.018	.847	.061	.908	.478	.36	2.49
3-year weighted average			2,410,509	.106	.251	.022	.429	.296	1.104	.025	1.079	.081	1.160	.528		

TOTAL ARKANSAS																
1931			9, 788, 179	.088	.225	.009	.408	.355	1.085	.026	1.059	.074	1.133	.491		
1932			7, 981, 147	.084	.204	.014	.422	.231	.955	.018	.937	.067	1.004	.626		
First 9 months of 1933			5, 324, 730	.061	.175	.014	.408	.181	.839	.025	.814	.055	.869	.328		
Last 3 months of 1933			1, 686, 808	.077	.170	.019	.531	.195	.992	.026	.966	.057	1.023	.722		
1933			7, 063, 312	.065	.172	.015	.437	.184	.873	.025	.848	.055	.903	.424		
3-year weighted average			8, 277, 546	.080	.203	.012	.421	.267	.983	.023	.960	.066	1.026	.515		
LOUISIANA																
Red River, De Soto, Elm Grove, Pleasant Hill, Zwolle, and Urania pools																
1931	18–42	5.7– 149.5	3, 430, 431	.274	.135	.010	.377	.267	1.063	.018	1.045	.100	1.145	.643	.28	5.92
1932	18–42	6.9– 138.3	2, 491, 271	.169	.153	.016	.423	.242	1.003	.016	.987	.114	1.101	.801	.23	14.94
First 9 months of 1933	21–42	2.6– 277.5	1, 875, 750	.131	.119	.022	.368	.164	.804	.011	.793	.096	.889	.464	.20	3.11
Last 3 months of 1933	21–42	2.6– 277.5	611, 750	.063	.139	.026	.480	.198	.906	.013	.893	.097	.990	.887	.36	4.18
1933	21–42	2.6– 277.5	2, 579, 205	.112	.121	.026	.393	.170	.822	.012	.810	.096	.906	.572	.20	4.18
3-year weighted average			2, 833, 636	.194	.136	.016	.396	.230	.972	.015	.957	.103	1.060	.668		
Haynesville, Homer, Cotton Valley, Sarepta, and Carterville pools																
1931	20–43	1.6– 49.1	2, 854, 527	.148	.262	.034	.486	.368	1.298	.053	1.245	.093	1.338	.642	.28	8.46
1932	20–43	2.0– 36.8	2, 227, 892	.109	.173	.022	.407	.281	.992	.033	.959	.083	1.042	.856	.38	14.43
First 9 months of 1933	20–43	1.9– 17.0	1, 357, 504	.074	.135	.025	.417	.215	.866	.028	.838	.074	.912	.444	.43	5.27
Last 3 months of 1933	20–43	1.9– 17.0	435, 741	.053	.126	.021	.484	.222	.906	.051	.855	.076	.931	.915	.45	5.51
1933	20–43	1.9– 19.0	1, 887, 380	.069	.133	.023	.427	.211	.863	.032	.831	.075	.906	.559	.30	5.51
3-year weighted average			2, 323, 266	.114	.199	.027	.445	.298	1.083	.041	1.042	.085	1.127	.688		
Caddo pool																
1931	24–41	3.1– 145.7	1, 278, 443	.057	.183		.577	.318	1.135	.057	1.078	.073	1.151	.659	.76	4.76
1932	24–41	2.6– 140.7	1, 017, 588	.047	.158		.601	.230	1.036	.065	.971	.072	1.044	.863	.75	1.62
First 9 months of 1933	27–41	2.6– 102.6	687, 658	.028	.145		.625	.206	1.004	.074	.930	.066	.996	.449	.70	1.28
Last 3 months of 1933	27–41	2.9– 102.6	224, 132	.018	.126		.787	.223	1.154	.086	1.068	.066	1.134	.920	.81	1.88
1933	27–41	2.6– 102.6	911, 790	.025	.141		.665	.210	1.041	.077	.964	.066	1.030	.565	.70	1.88
3-year weighted average			1, 069, 274	.044	.163		.610	.260	1.077	.065	1.012	.070	1.082	.689		
Louisiana Gulf coast [18]																
1931	17–39	3.1– 557.5	7, 815, 570	.060	.163	.027	.289	.342	.881	.016	.865	.070	.935	.653	.16	30.73
1932	17–41	2.0– 527.4	9, 840, 301	.030	.118	.037	.241	.250	.676	.037	.639	.057	.696	.835	.39	37.21
First 9 months of 1933	17–41	.4–1, 183.5	9, 315, 814	.035	.085	.058	.201	.226	.605	.023	.582	.052	.634	.540	.32	10.18
Last 3 months of 1933	17–41	.4–1, 183.5	3, 590, 762	.043	.108	.050	.245	.251	.697	.015	.682	.045	.727	.988	.27	4.99
1933	17–41	.4–1, 183.5	13, 015, 610	.037	.091	.056	.215	.231	.630	.020	.610	.049	.659	.665	.27	10.18
3-year weighted average			10, 223, 827	.041	.118	.0	42.242	.266	.709	.025	.684	.057	.741	.716		

[18] Includes Black Bayou, Choctaw, Edgerly, Hackberry, Jennings, Lake Barre, Leesville, Lockport, Port Barre, Sorrento, Starks, Sulphur, Sweetlake, Vinton, White Castle, Cameron Meadows, Gueydan, Iowa, Lake Washington, Lake Pelto, and Caillow Island pools.

TABLE 3.—*Crude petroleum: Unit cost of production and sales value by pools and districts, 1931–33*—Continued

Cost period	Range of gravity	Range of production per well per day (barrels)	Production—(company interest, barrels)	Expenses: Depletion	Expenses: Depreciation	Expenses: Amortization of intangible development costs	Expenses: Operating cost	Expenses: General overhead and administrative	Expenses: Total cost	Deduct gas sales and miscellaneous revenue	Net cost	Interest on invested capital	Net cost including interest	Average selling price	Range of costs: Lowest	Range of costs: Highest
LOUISIANA—Continued																
TOTAL LOUISIANA																
1931			15, 378, 971	$0. 124	$0. 177	$0. 022	$0. 369	$0. 328	$1. 020	$0. 027	$0. 993	$0. 082	$1. 075	$0. 648		
1932			15, 577, 052	. 065	. 134	. 029	. 317	. 252	. 797	. 035	. 762	. 071	. 833	. 834		
First 9 months of 1933			13, 236, 726	. 052	. 098	. 047	. 269	. 215	. 681	. 025	. 656	. 061	. 717	. 515		
Last 3 months of 1933			4, 862, 385	. 045	. 114	. 042	. 321	. 241	. 763	. 021	. 742	. 056	. 798	. 965		
1933			18, 393, 985	. 050	. 102	. 045	. 284	. 220	. 701	. 023	. 678	. 060	. 738	. 636		
3-year weighted average			16, 450, 003	. 077	. 136	. 033	. 321	. 264	. 831	. 028	. 803	. 070	. 873	. 702		
NEW MEXICO																
Hobbs pool																
1931	33–36	104. 6–365. 3	9, 023, 097	. 012	. 053	. 015	. 039	. 521	. 640	. 014	. 626	. 034	. 660	. 410	$0. 47	$1. 28
1932	32–36	36. 3–176. 6	7, 480, 761	. 007	. 065	. 023	. 042	. 381	. 518	. 015	. 503	. 040	. 543	. 605	. 24	1. 17
First 9 months of 1933	32–36	64. 1–256. 8	6, 169. 542	. 007	. 061	. 041	. 067	. 290	. 466	. 014	. 452	. 039	. 491	. 337	. 36	1. 06
Last 3 months of 1933	32–36	64. 1–256. 8	2, 298, 818	. 011	. 057	. 038	. 084	. 330	. 520	. 026	. 494	. 035	. 529	. 750	. 40	1. 57
1933	32–36	64. 1–256. 8	8, 468, 360	. 008	. 060	. 040	. 072	. 300	. 480	. 017	. 463	. 038	. 501	. 449	. 36	1. 57
3-year weighted average			8, 324, 073	. 009	. 059	. 026	. 051	. 404	. 549	. 015	. 534	. 037	. 571	. 481		
Other pools in Eddy and Lea Counties																
1931	26–60	1. 3–564. 0	1, 375, 209	. 027	. 110	. 026	. 102	. 445	. 710	. 046	. 664	. 056	. 720	. 412	. 28	9. 15
1932	26–60	1. 1–418. 2	1, 192, 104	. 034	. 093	. 033	. 106	. 296	. 562	. 025	. 537	. 063	. 600	. 616	. 34	3. 73
First 9 months of 1933	26–60	1. 2–221. 6	1, 069, 336	. 034	. 085	. 044	. 123	. 254	. 540	. 034	. 506	. 055	. 561	. 331	. 35	3. 06
Last 3 months of 1933	26–60	1. 2–221. 6	399, 738	. 031	. 083	. 056	. 190	. 239	. 599	. 044	. 555	. 049	. 604	. 745	. 35	2. 81
1933	26–60	1. 2–221. 6	1, 469, 074	. 033	. 084	. 047	. 142	. 250	. 556	. 037	. 519	. 053	. 572	. 443	. 35	3. 06
3-year weighted average			1, 345, 462	. 031	. 096	. 036	. 117	. 330	. 610	. 037	. 573	. 057	. 630	. 484		

San Juan and McKinley Counties																	
1931	31-61	35.0-348.5	1,792,707	.086	.103	.061	.074	.462	.786	.014	.772	.144	.916	.479	.40	2.75
1932	31-61	24.4-100.5	1,198,382	.099	.119	.102	.094	.308	.722	.014	.708	.199	.907	.654	.19	3.34
First 9 months of 1933	31-61	4.6-248.5	934,154	.094	.105	.096	.099	.264	.658	.012	.646	.179	.825	.384	.50	3.13
Last 3 months of 1933	31-61	4.6-248.5	338,352	.102	.105	.095	.105	.319	.726	.017	.709	.164	.873	.805	.50	2.88
1933	31-61	4.6-248.5	1,272,506	.096	.105	.096	.101	.279	.677	.014	.663	.175	.838	.496	.50	3.13
3-year weighted average			1,421,198	.093	.108	.083	.088	.363	.735	.014	.721	.169	.890	.533		
TOTAL NEW MEXICO																
1931			12,191,013	.025	.067	.023	.051	.504	.670	.018	.652	.052	.704	.420		
1932			9,871,247	.021	.075	.034	.056	.362	.548	.016	.532	.062	.594	.612		
First 9 months of 1933			8,173,032	.021	.069	.048	.078	.282	.498	.017	.481	.057	.538	.341		
Last 3 months of 1933			3,036,908	.024	.065	.047	.100	.317	.553	.027	.526	.051	.577	.755		
1933			11,209,940	.022	.068	.047	.084	.292	.513	.019	.494	.055	.549	.453		
3-year weighted average			11,090,733	.023	.070	.034	.064	.390	.581	.018	.563	.056	.619	.488		
TEXAS, OKLAHOMA, KANSAS, ARKANSAS, LOUISIANA, AND NEW MEXICO COMBINED																
1931			398,774,351	.082	.140	.036	.190	.397	.845	.029	.816	.085	.901	.576		
1932			361,733,693	.076	.135	.041	.189	.293	.734	.027	.707	.093	.800	.840		
First 9 months of 1933			313,090,484	.065	.115	.055	.149	.225	.609	.022	.587	.086	.673	.481		
Last 3 months of 1933			97,296,901	.067	.123	.055	.198	.260	.703	.037	.666	.092	.758	.965		
1933			417,719,165	.065	.117	.055	.161	.231	.629	.026	.603	.087	.690	.596		
3-year weighted average			392,742,403	.074	.130	.044	.179	.307	.734	.027	.707	.088	.795	.664		
WYOMING																
Salt Creek pool																
1931	30-37	1.9- 61.0	6,252,600	.374	.233	.078	.296	.144	1.125	.062	1.063	.210	1.273	1.047	.32	5.22
1932	30-37	.8- 63.0	5,361,952	.359	.197	.078	.282	.131	1.047	.066	.981	.193	1.174	1.134	.23	1.96
First 9 months of 1933	30-37	1.5- 64.0	3,554,815	.357	.178	.078	.277	.134	1.024	.039	.985	.178	1.163	.955	.26	2.40
Last 3 months of 1933	30-37	1.5- 64.0	1,682,890	.287	.177	.055	.274	.134	.927	.074	.853	.131	.984	.903	.22	2.31
1933	30-37	1.5- 64.0	5,351,297	.331	.179	.069	.275	.133	.987	.050	.937	.165	1.102	.931	.22	2.40
3-year weighted average			5,655,283	.356	.204	.074	.285	.137	1.056	.059	.997	.190	1.187	1.038		
Lost Soldier pool																
1931	29-29	53.7- 77.7	1,222,797	.033	.086	.001	.106	.178	.404	.010	.394	.051	.445	.564	.29	.45
1932	29-29	14.6- 49.6	755,543	.032	.274	.001	.133	.348	.788	.030	.758	.033	.791	.800	.27	.81
First 9 months of 1933	29-29	24.7- 35.0	394,286	.033	.590	.002	.141	.273	1.039	.010	1.029	.072	1.101	.382	.28	1.13
Last 3 months of 1933	29-29	24.7- 35.0	130,886	.030	.546	.003	.162	.268	1.009	.016	.993	.072	1.065	.864	.35	1.09
1933	29-29	24.7- 35.0	525,172	.032	.579	.002	.146	.272	1.031	.011	1.020	.072	1.092	.502	.28	1.13
3-year weighted average			801,171	.038	.253	.001	.123	.252	.662	.017	.645	.050	.695	.625		

TABLE 3.—*Crude petroleum: Unit cost of production and sales value by pools and districts, 1931–33*—Continued

Cost period	Range of gravity	Range of production per well per day (barrels)	Production—(company interest, barrels)	Expenses: Depletion	Expenses: Depreciation	Expenses: Amortization of intangible development costs	Expenses: Operating cost	Expenses: General overhead and administrative	Expenses: Total cost	Deduct gas sales and miscellaneous revenue	Net cost	Interest on invested capital	Net cost including interest	Average selling price	Range of costs: Lowest	Range of costs: Highest
WYOMING—Continued																
Other pools																
1931	14–43	0.9–304.9	2,625,774	$0.110	$0.200	$0.007	$0.522	$0.264	$1.103	$0.037	$1.066	$0.160	$1.226	$0.715	—0	$3.50
1932	14–43	.7–205.4	2,415,221	.100	.180	.017	.504	.236	1.037	.027	1.010	.139	1.149	.709	$0.35	2.61
First 9 months of 1933	14–40	.8–127.6	1,448,292	.108	.197	.020	.476	.174	.975	.028	.947	.158	1.105	.490	.33	5.82
Last 3 months of 1933	14–40	.8–127.6	497,129	.145	.205	.011	.568	.190	1.119	.042	1.077	.139	1.216	.788	.21	2.95
1933	14–40	.8–127.6	2,128,034	.113	.199	.024	.490	.170	.996	.038	.958	.163	1.121	.569	.21	5.82
3-year weighted average			2,389,676	.108	.193	.015	.506	.227	1.049	.034	1.015	.154	1.169	.669		
TOTAL WYOMING																
1931			10,001,171	.266	.208	.050	.333	.181	1.038	.049	.989	.179	1.168	.906		
1932			8,532,716	.256	.199	.054	.332	.180	1.021	.052	.969	.163	1.132	.984		
First 9 months of 1933			5,397,393	.266	.213	.057	.321	.155	1.012	.034	.978	.165	1.143	.788		
Last 3 months of 1933			2,310,905	.242	.204	.043	.331	.153	.973	.064	.909	.129	1.038	.876		
1933			8,004,503	.253	.211	.053	.324	.151	.992	.044	.948	.159	1.107	.807		
3-year weighted average			8,846,130	.259	.205	.053	.330	.172	1.019	.048	.971	.167	1.138	.901		
MONTANA																
Cat Creek pool																
1931	50–50	7.0– 8.1	93,795	.001	.112		.404	.266	.783	.017	.766	.027	.793	1.375	.74	.85
1932	50–50	7.0– 7.0	74,817	.002	.132		.364	.339	.837	.022	.815	.024	.839	1.310	.83	.85
1933	50–50	6.8– 6.8	39,569	.004	.235		.246	.260	.745	.045	.700	.030	.730	1.371	.73	.73
3-year weighted average			69,394	.003	.142		.359	.291	.795	.024	.771	.026	.797	1.351		
Pondera pool																
1931	28–35	3.1– 16.2	518,690	.097	.266	.011	.390	.351	1.115	.023	1.092	.134	1.226	.814	.78	1.89
1932	28–35	2.7– 50.0	410,297	.139	.308	.017	.381	.302	1.147	.038	1.109	.137	1.246	.906	.80	1.74
First 9 months of 1933	28–35	2.0– 11.4	262,790	.154	.290	.017	.364	.218	1.043	.036	1.007	.125	1.132	.779	.48	1.73
Last 3 months of 1933	28–35	2.0– 11.4	80,784	.161	.305	.012	.436	.233	1.147	.023	1.124	.136	1.260	1.188	.63	1.68
1933	28–35	2.0– 11.4	357,088	.160	.291	.015	.375	.222	1.063	.031	1.032	.127	1.159	.872	.48	1.73
3-year weighted average			428,692	.128	.286	.014	.383	.300	1.111	.030	1.081	.133	1.214	.860		

Kevin-Sunburst pool																
1931	29-36	1.9- 10.0	366,400	.127	.198	.044	.447	.269	1.085	.092	.993	.248	1.241	.984	.32	1.75
1932	29-36	1.9- 7.0	284,383	.124	.246	.045	.467	.260	1.142	.072	1.070	.288	1.358	1.002	.49	2.39
First 9 months of 1933	29-33	1.3- 6.2	179,131	.078	.217	.045	.430	.177	.947	.072	.875	.287	1.162	.841	.42	2.45
Last 3 months of 1933	29-33	1.3- 6.2	55,284	.151	.333	.046	.634	.343	1.507	.211	1.296	.310	1.606	1.341	.62	2.48
1933	29-36	1.3- 6.2	248,821	.100	.237	.042	.466	.219	1.064	.100	.964	.288	1.247	.965	.42	2.48
3-year weighted average			299,868	.119	.224	.044	.459	.252	1.098	.088	1.010	.270	1.280	.985		
Other pools																
1931	44-52	6.4- 19.0	253,680	.065	.383	.137	.666	.373	1.624	.028	1.596	.208	1.804	.966	1.74	2.72
1932	40-52	3.7- 18.0	283,494	.033	.304	.246	.757	.208	1.548	.085	1.463	.350	1.813	1.163	1.03	3.58
First 9 months of 1933	30-52	5.1- 43.0	209,099	.037	.281	.276	.628	.176	1.398	.092	1.306	.519	1.825	.945	.16	3.07
Last 3 months of 1933	30-52	5.1- 43.0	100,151	.025	.227	.194	.370	.198	1.014	.124	.890	.368	1.258	1.368	-0	2.94
1933	30-52	5.1- 43.0	309,250	.033	.263	.250	.544	.184	1.274	.102	1.172	.470	1.642	1.082	-0	3.07
3-year weighted average			282,141	.043	.313	.215	.652	.248	1.471	.074	1.397	.351	1.748	1.074		
TOTAL MONTANA																
1931			1,232,565	.092	.258	.046	.465	.325	1.186	.044	1.142	.175	1.317	.939		
1932			1,052,991	.097	.278	.085	.504	.268	1.232	.059	1.173	.227	1.400	1.030		
First 9 months of 1933			651,020	.096	.267	.108	.467	.193	1.131	.064	1.067	.296	1.363	.850		
Last 3 months of 1933			236,219	.101	.279	.097	.454	.244	1.175	.110	1.065	.275	1.340	1.300		
1933			954,728	.097	.266	.098	.448	.210	1.119	.073	1.046	.275	1.321	.985		
3-year weighted average			1,080,095	.095	.266	.074	.473	.273	1.181	.057	1.124	.221	1.345	.982		
COLORADO																
Fort Collins and Wellington pools																
1931	33-37	14.7- 28.9	289,525	.277	.565	.158	.344	.386	1.730	.180	1.550	.424	1.974	.553	1.75	5.50
1932	33-37	18.7- 23.9	236,228	.351	.669	.191	.353	.307	1.871	.097	1.774	.459	2.233	.777	2.02	5.95
First 9 months of 1933	33-37	20.9- 22.1	138,084	.014	.812	.092	.338	.288	1.544	.037	1.507	.393	1.900	.413	1.64	2.88
Last 3 months of 1933	33-37	20.9- 22.1	43,830	.025	.838		.289	.302	1.454	.042	1.412	.412	1.824	.893	1.71	2.14
1933	33-37	20.9- 22.1	181,914	.017	.818	.070	.326	.291	1.522	.038	1.484	.398	1.882	.528	1.64	2.88
3-year weighted average			235,889	.235	.665	.147	.342	.335	1.724	.116	1.608	.429	2.037	.621		
Iles pool																
1931	31-31	48.0- 64.0	286,721	.052	.214		.120	.377	.763	.008	.755	.077	.832	.505	.74	1.22
1932	31-31	31.9- 40.8	178,269	.092	.307		.161	.368	.928	.017	.911	.095	1.006	.582	.98	1.08
First 9 months of 1933	31-33	40.3- 52.4	98,248	.102	.219		.198	.281	.800	.014	.786	.105	.891	.422	.81	1.06
Last 3 months of 1933	31-33	40.3- 52.4	44,193	.093	.169	.073	.179	.287	.801	.016	.785	.078	.863	.898	.87	.87
1933	31-33	40.3- 52.4	142,441	.099	.204	.023	.192	.283	.801	.015	.786	.096	.882	.570	.75	1.01
3-year weighted average			202,477	.074	.239	.005	.149	.353	.820	.012	.808	.087	.895	.543		

TABLF 3.—*Crude petroleum: Unit cost of production and sales value by pools and districts, 1931–33*—Continued

Cost period	Range of gravity	Range of production per well per day (barrels)	Production—(company interest, barrels)	Expenses						Deduct gas sales and miscellaneous revenue	Net cost	Interest on invested capital	Net cost including interest	Average selling price	Range of costs	
				Depletion	Depreciation	Amortization of intangible development costs	Operating cost	General overhead and administrative	Total cost						Lowest	Highest
COLORADO—Continued																
Moffat pool																
1931	39–39	62.0– 62.0	190,096	$0.008	$0.157	$0.040	$0.243	$0.494	$0.942	$0.004	$0.938	$0.080	$1.018	$0.557	$1.02	$1.02
1932	39–39	52.0– 52.0	139,718	.011	.221	.041	.266	.322	.861	.015	.846	.102	.948	.892	.95	.95
First 9 months of 1933	39–39	35.5– 35.5	95,925	.003	.211	.045	.242	.279	.780	.003	.777	.090	.867	.534	.87	.87
Last 3 months of 1933	39–39	35.5– 35.5	28,435	.007	.212	.047	.290	.279	.835	.012	.823	.102	.925	1.054	.92	.92
1933	39–39	35.5– 35.5	124,360	.004	.211	.046	.252	.279	.792	.005	.787	.093	.880	.653	.87	.92
3-year weighted average			151,391	.008	.191	.042	.253	.382	.876	.007	.869	.090	.959	.686		
Other pools																
1931	30–51	3.6–369.1	421,201	.171	.211	.069	.327	.372	1.150	.032	1.118	.137	1.255	.664	.81	4.45
1932	30–41	1.6–124.3	314,062	.150	.259	.100	.377	.325	1.211	.041	1.170	.154	1.324	.846	.74	2.39
First 9 months of 1933	30–43	2.3– 64.2	188,878	.183	.350	.085	.355	.296	1.269	.022	1.247	.161	1.408	.554	.36	3.01
Last 3 months of 1933	30–43	2.6– 64.2	53,258	.213	.378	.090	.372	.276	1.329	.030	1.299	.191	1.490	1.004	.32	7.96
1933	30–43	2.3– 64.2	242,136	.190	.356	.086	.359	.292	1.283	.024	1.259	.168	1.427	.653	.32	7.96
3-year weighted average			325,800	.169	.262	.083	.351	.337	1.202	.033	1.169	.150	1.319	.720		
TOTAL COLORADO																
1931			1,187,543	.142	.290	.069	.267	.396	1.164	.057	1.107	.183	1.290	.581		
1932			868,277	.170	.374	.095	.308	.329	1.276	.047	1.229	.217	1.446	.781		
First 9 months of 1933			521,135	.090	.422	.064	.300	.288	1.164	.021	1.143	.199	1.342	.488		
Last 3 months of 1933			169,716	.098	.415	.055	.287	.286	1.141	.027	1.114	.204	1.318	.956		
1933			690,851	.092	.420	.061	.297	.288	1.158	.022	1.136	.200	1.336	.603		
3-year weighted average			915,557	.139	.349	.075	.288	.347	1.198	.045	1.153	.198	1.351	.650		
TOTAL ROCKY MOUNTAIN																
1931			12,421,279	.237	.221	.051	.340	.215	1.064	.049	1.015	.179	1.194	.878		
1932			10,453,984	.222	.222	.060	.347	.201	1.063	.052	1.011	.174	1.185	.972		
First 9 months of 1933			6,569,548	.235	.235	.062	.334	.170	1.036	.036	1.000	.180	1.180	.770		
Last 3 months of 1933			2,716,840	.221	.223	.048	.339	.170	1.001	.065	.936	.147	1.080	.918		
1933			9,650,082	.227	.231	.058	.334	.167	1.017	.045	.972	.172	1.144	.810		
3-year weighted average			10,841,782	.233	.224	.056	.340	.197	1.050	.049	1.001	.175	1.176	.888		

TOTAL ILLINOIS																
1931	28–45	.2– 4.4	3, 438, 421	.051	.236	.016	.771	.331	1.405	.025	1.380	.100	1.480	.848	.35	2.05
1932	28–45	.1– 4.8	3, 212, 393	.057	.213	.019	.708	.195	1.192	.024	1.168	.093	1.261	1.016	.50	2.47
First 9 months of 1933	28–45	.1– 3.2	2, 088, 245	.057	.262	.014	.591	.179	1.103	.021	1.082	.106	1.188	.745	.62	2.40
Last 3 months of 1933	28–45	.1– 3.2	803, 555	.059	.250	.016	.663	.216	1.204	.024	1.180	.091	1.271	1.203	.63	2.31
1933	28–45	.1– 3.2	2, 921, 527	.057	.257	.014	.613	.189	1.130	.022	1.108	.101	1.209	.873	.62	2.40
3-year weighted average			3, 190, 780	.055	.235	.017	.702	.241	1.250	.023	1.226	.098	1.324	.912		
TOTAL INDIANA																
1931	30–46	.4– 15.0	469, 131	.051	.389	.138	.509	.269	1.356	.038	1.318	.148	1.466	.909	.70	2.02
1932	30–46	.3– 24.0	488, 022	.046	.305	.126	.468	.200	1.145	.034	1.111	.112	1.223	1.057	.37	1.80
First 9 months of 1933	30–46	.5– 22.0	285, 093	.044	.354	.088	.437	.168	1.091	.024	1.067	.119	1.186	.781	.19	1.99
Last 3 months of 1933	30–46	.5– 22.0	132, 298	.044	.259	.156	.473	.147	1.079	.019	1.060	.085	1.145	1.204	.24	2.77
1933	30–46	.5– 22.0	443, 300	.053	.323	.107	.441	.162	1.086	.026	1.060	.112	1.172	.915	.19	2.77
3-year weighted average			466, 818	.050	.339	.124	.473	.212	1.198	.033	1.165	.124	1.289	.963		
OHIO																
1931	36–48	.2– 4.7	2, 313, 207	.132	.336	.337	.657	.352	1.814	.156	1.658	.375	2.033	1.040	.77	6.37
1932	36–48	.1– 11.4	1, 981, 612	.125	.326	.331	.610	.273	1.665	.159	1.506	.390	1.896	1.138	.51	4.28
First 9 months of 1933	36–48	.2– 7.9	1, 308, 941	.122	.329	.316	.659	.255	1.681	.164	1.517	.397	1.914	.939	.68	5.29
Last 3 months of 1933	36–48	.2– 7.9	434, 063	.132	.344	.428	.727	.241	1.872	.204	1.668	.400	2.068	1.486	.25	4.86
1933	36–48	.2– 7.9	1, 756, 776	.128	.330	.341	.675	.252	1.726	.176	1.550	.398	1.948	1.074	.25	5.29
3-year weighted average			2, 017, 198	.129	.331	.336	.647	.297	1.740	.163	1.577	.387	1.964	1.082		
MICHIGAN																
1931	33–44	.7–143.7	1, 854, 823	.017	.217	.142	.101	.454	.931	.006	.925	.084	1.009	.713	.20	5.70
1932	33–44	.6– 58.9	3, 500, 685	.004	.123	.095	.081	.309	.612	.004	.608	.038	.646	.744	.39	5.32
First 9 months of 1933	33–44	.4–160.0	2, 500, 107	.004	.139	.130	.111	.236	.620	.004	.616	.041	.657	.864	.20	4.10
Last 3 months of 1933	33–44	.4–200.0	1, 241, 160	.004	.073	.111	.088	.269	.545	.005	.540	.028	.568	1.003	.16	7.56
1933	33–44	.4–200.0	3, 745, 816	.004	.117	.124	.104	.247	.596	.005	.591	.037	.628	.910	.16	7.56
3-year weighted average			3, 033, 775	.007	.140	.116	.095	.313	.671	.004	.666	.046	.712	.806		
KENTUCKY																
Western																
1931	33–42	.2– 17.2	871, 451	.104	.117	.145	.266	.300	.932	.008	.924	.099	1.023	.708	.13	3.71
1932	33–42	.2– 13.1	965, 724	.093	.180	.155	.337	.263	1.028	.025	1.003	.131	1.134	.904	.21	3.16
First 9 months of 1933	33–42	.1– 5.8	538, 392	.095	.248	.086	.318	.254	1.001	.026	.975	.164	1.139	.732	.37	2.98
Last 3 months of 1933	33–42	.1– 5.8	148, 215	.114	.282	.159	.461	.282	1.298	.012	1.286	.187	1.473	1.133	.76	4.10
1933	33–42	.1– 5.8	697, 783	.097	.260	.100	.350	.256	1.063	.022	1.041	.168	1.209	.815	.37	4.10
3-year weighted average			844, 986	.098	.180	.137	.316	.274	1.005	.019	.986	.131	1.117	.812		

TABLE 3.—*Crude petroleum: Unit cost of production and sales value by pools and districts, 1931–33*

Cost period	Range of gravity	Range of production per well per day (barrels)	Production—(company interest, barrels)	Expenses: Depletion	Expenses: Depreciation	Expenses: Amortization of intangible development costs	Expenses: Operating cost	Expenses: General overhead and administrative	Expenses: Total cost	Deduct gas sales and miscellaneous revenue	Net cost	Interest on invested capital	Net cost including interest	Average selling price	Range of costs: Lowest	Range of costs: Highes
KENTUCKY—Continued																
Eastern																
1931	35-41	.1- 3.5	1,559,910	$0.369	$0.231	$0.021	$0.334	$0.253	$1.208	$0.016	$1.192	$0.286	$1.478	$0.852	$0.77	$3.79
1932	36-41	.1- 2.7	1,212,345	.401	.206	.003	.326	.195	1.131	.023	1.108	.315	1.423	.908	.52	4.20
First 9 months of 1933	36-41	.3- 3.1	791,838	.375	.208	.007	.306	.173	1.069	.017	1.052	.321	1.373	.668	.46	1.87
Last 3 months of 1933	36-41	.3- 3.1	253,048	.391	.237	.008	.393	.201	1.230	.038	1.192	.335	1.527	1.227	.50	1.98
1933	36-41	.3- 3.1	1,078,060	.376	.220	.007	.330	.175	1.108	.023	1.085	.321	1.406	.805	.46	1.98
3-year weighted average			1,283,438	.381	.220	.012	.330	.213	1.156	.020	1.136	.304	1.440	.857		
TOTAL KENTUCKY																
1931			2,431,361	.274	.190	.065	.310	.270	1.109	.013	1.096	.219	1.315	.800		
1932			2,178,069	.264	.195	.070	.331	.225	1.085	.023	1.062	.233	1.295	.906		
First 9 months of 1933			1,330,230	.262	.224	.039	.311	.206	1.042	.020	1.022	.257	1.279	.694		
Last 3 months of 1933			401,263	.289	.254	.064	.418	.230	1.255	.028	1.227	.280	1.507	1.192		
1933			1,775,843	.266	.236	.044	.338	.207	1.091	.023	1.068	.260	1.328	.809		
3-year weighted average			2,128,424	.269	.204	.061	.325	.237	1.096	.019	1.077	.235	1.312	.839		
WEST VIRGINIA																
1931	35-48	.1- 3.7	2,724,241	.091	.422	.123	1.182	.433	2.251	.477	1.774	.394	2.168	1.575	1.26	8.07
1932	35-48	.1- 3.3	2,436,616	.087	.429	.110	1.218	.360	2.204	.467	1.737	.393	2.130	1.572	1.18	4.82
First 9 months of 1933	35-48	.1- 3.0	1,669,525	.063	.376	.105	1.138	.383	2.065	.445	1.620	.386	2.006	1.384	1.08	4.42
Last 3 months of 1933	35-47	.1- 3.9	577,444	.068	.376	.093	1.293	.374	2.204	.433	1.771	.371	2.142	2.113	.64	5.48
1933	35-48	.1- 3.9	2,246,969	.064	.376	.102	1.178	.381	2.101	.442	1.659	.382	2.041	1.571	.64	5.48
3-year weighted average			2,469,275	.081	.411	.112	1.193	.393	2.190	.463	1.727	.390	2.117	1.573		

PENNSYLVANIA																
1931	32-49	.03- 3.6	7,485,843	.234	.351	.198	.648	.209	1.640	.055	1.585	.522	2.107	2.001	.42	8.94
1932	32-49	.04- 2.9	8,654,518	.251	.332	.211	.562	.188	1.544	.041	1.503	.431	1.934	1.870	.42	9.78
First 9 months of 1933	36-46	.05- 3.6	6,273,726	.256	.332	.215	.530	.189	1.522	.039	1.483	.402	1.885	1.675	.78	101.76
Last 3 months of 1933	32-47	.05- 3.6	2,337,788	.265	.317	.319	.589	.174	1.664	.037	1.627	.363	1.990	2.426	.51	13.59
1933	32-47	.05- 5.0	8,813,987	.259	.327	.241	.546	.181	1.554	.039	1.515	.393	1.908	1.878	.51	101.76
3-year weighted average			8,318,116	.249	.336	.217	.582	.192	1.576	.044	1.532	.445	1.977	1.912		
NEW YORK																
1931	42-45	.3- 1.5	847,253	.341	.341	.076	.511	.253	1.522	.008	1.514	.535	2.049	2.140	.65	5.25
1932	42-45	.2- 1.9	1,005,850	.323	.337	.121	.485	.184	1.450	.009	1.441	.490	1.931	1.896	.78	4.15
First 9 months of 1933	42-45	.2- 1.6	540,081	.318	.325	.098	.450	.194	1.385	.008	1.377	.549	1.926	1.679	.49	6.29
Last 3 months of 1933	42-45	.2- 1.6	170,788	.315	.287	.237	.562	.246	1.647	.017	1.630	.524	2.154	2.393	.42	5.59
1933	42-45	.2- 1.6	792,417	.327	.321	.127	.479	.196	1.450	.009	1.441	.541	1.982	1.834	.42	6.29
3-year weighted average			881,840	.330	.333	.108	.491	.211	1.473	.009	1.464	.520	1.984	1.955		
TOTAL EASTERN AREA																
1931			21,564,280	.162	.311	.148	.643	.303	1.567	.103	1.464	.343	1.807	1.396		
1932			23,457,765	.160	.281	.148	.556	.236	1.381	.085	1.296	.296	1.592	1.387		
First 9 months of 1933			15,995,948	.158	.288	.152	.524	.222	1.344	.081	1.263	.293	1.556	1.239		
Last 3 months of 1933			6,098,359	.155	.260	.201	.558	.228	1.402	.077	1.325	.255	1.580	1.770		
1933			22,496,635	.159	.280	.164	.534	.221	1.358	.079	1.279	.284	1.563	1.388		
3-year weighted average			22,506,227	.160	.291	.154	.576	.252	1.433	.089	1.344	.307	1.651	1.390		
TOTAL ALL STATES																
1931			558,296,833	.084	.160	.037	.220	.347	.848	.063	.785	.109	.894	.643		
1932			517,586,938	.081	.152	.043	.213	.264	.753	.059	.694	.114	.808	.858		
First 9 months of 1933			421,592,211	.073	.132	.054	.175	.211	.645	.051	.594	.105	.699	.578		
Last 3 months of 1933			134,151,408	.076	.139	.056	.221	.241	.733	.074	.659	.113	.772	.992		
1933			566,448,664	.073	.134	.054	.187	.217	.665	.056	.609	.108	.717	.678		
3-year weighted average			547,444,145	.079	.148	.045	.207	.276	.755	.059	.696	.110	.806	.723		

III. PHYSICAL LAWS CAUSING MIGRATION AND DRAINAGE IN AN OIL FIELD

1. Federal Oil Conservation Board, *Report III,* 1929:

[Page 21 et seq.]

VALUE OF ORIGINAL GAS

Gas in an oil sand should be looked on primarily as a source of energy rather than as a substance. This stored energy is the prime motive force for the extraction of the oil from the reservoir. It drives the oil through the minute pore spaces of the reservoir rock to the well and lifts or helps to lift it to the surface.

Gas has a second and almost equally important value—its value in increasing the fluidity of the oil. As already noted, part of the gas in an oil sand may be in liquid form; part may be dissolved in the oil. The amount that may be dissolved depends upon the character of the oil and the character of the gas and is proportional to the temperature and the pressure.

The greater the amount of dissolved and liquid gas in an oil, the lighter the oil, the less viscous, and the lower its surface tension. Specific gravity viscosity and surface tension of the oil are all lessened by the solution of the gas, and as these are lessened the mobility of the oil is increased. Rendered more fluid by the gas, the oil can pass through the intricate, tortuous interstices of the reservoir and find its way to the area of lower pressure at the well. Greater fluidity, greater mobility, greater ease of movement—these represent the solution value of gas in oil.

It will be noted how these two values supplement one another. The gas makes the oil easier to move; the energy in the gas moves it. These two properties of gas are of prime importance in the production of oil.

When a well penetrates a petroleum reservoir theretofore untouched gas pressure is released about the well, and oil and gas begin to flow through the reservoir spaces toward the point of lowered pressure. As the fluid moves toward the well there is a progressive drop in pressure. With the drop in pressure the free gas expands and drives the oil through the sand; the dissolved gas comes out of solution and becomes free gas; the liquified gas vaporizes and becomes free gas; and the additional free gas also helps to drive the oil to the well. The progressive liberation of energy increases the velocity of the fluids and overcomes friction as they move through the rock voids toward the point of egress.

It is logical to assume that those winding pore channels which have the greater and more uniform cross section will carry a more mobile fluid, a fluid with a greater proportion of gas, than the other channels, and that this gas portion is augmented by distillation from neighboring channels. The natural gas in endeavoring to escape from the reservoir in such a way as to reduce the stored energy attempts to clear those larger and more uniform pore channels of petroleum, which, when cleared, will permit the free egress of the remaining gas to and out of the well, leaving a maximum of petroleum in the reservoir. If the pressure is too rapidly reduced by permitting too rapid escape of gas from

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the well the proportion of oil left in the reservoir is increased.

As the pressure is lowered and the dissolved and liquid gas leave the oil, the oil becomes more viscous and increasingly difficult to move, and this augments the tendency to leave more oil in the reservoir if the pressure is too rapidly exhausted.

As the production declines the proportion of gas produced with the oil—the gas-oil ratio—increases, and the gas energy declines below the point necessary to flow the well. Thus the flush or flowing period of the field passes.

As the field declines pressures are lower than during the flush period and is not so plentiful or so mobile. Gradually oil accumulates in the bottom of the well and the surrounding sand and obstructs the passage of the gas. Pressure is built up behind the oil and when this pressure is great enough the well again flows, the sand near the well is again depleted, and the cycle is repeated. This is the period of intermittent flow.

Finally the amount of oil reaching the well and the amount of gas and gas pressure behind it are not great enough to cause even intermittent flow. Gravity begins to play a more important part in the movement of the oil, especially if the reservoir body be thick. The oil is less mobile, all the gas energy is utilized in bringing the oil to the well, and artificial means must be employed for lifting it. The well has reached the pumping stage.

It is readily seen that throughout the well history the gas present in the oil has facilitated movement toward the well, and that, except for the part that may have been played by other forces such as water and gravity, movement has depended entirely on the gas energy.

In many fields the gas pressure has played a third important role in holding back edge or bottom water or both and preventing its encroachment into the productive parts of the sand. When the gas pressure declines below the hydrostatic head of the water, friction alone delays the water in flooding the field.

2. Ely, *Oil Conservation through Interstate Agreement* (Federal Oil Conservation Board):

[Page 3, et seq.]

THE DOCTRINE OF CAPTURE

An oil pool is a reservoir of oil, gas, and gas in solution. It becomes also a gas and hydraulic engine when the first well disturbs the equilibrium of hydraulic, gas, and rock pressures which was necessary for the retention of the pool in that particular place. Wells drilled into various parts of the field will produce gas or oil or both; or water, or oil and water; or will strike dry strata, all depending on their location. The maximum ultimate recovery of oil can be effected only by control of spacing, drilling, and producing of wells so as to utilize these reservoir forces for the production of oil, rather than permitting the dissipation of gas or the "channeling" of water through the oil sands to the wells. All this is now elementary, but the decisions which shaped our law ignored it.

The single oil pool is the natural unit of property, but not the common-law unit. Instead, on early and fanciful analogies to wild game, supplemented later by equally erroneous analogies to solid minerals, and by an unfortunate early example of harsh logic from the English law of percolating waters, our courts have universally recognized that whatever one landowner could withdraw (by natural means at least) from the common pool he could take and keep, regardless of the effect on his neighbors; and that their only defense was to "do likewise"; that is, drill and produce. * * *

This unfortunate rule originated in Pennsylvania at a time when that State was a recent convert to the harsh English rule of percolating waters, which protects no well owner against the withdrawals of another. It is now entrenched in the law of oil and gas even in those States which have established the American doctrine of correlative rights and reasonable use as to percolating waters, with the possible but not very probable exception of California. In its broadest phase, the rule of capture recognized no right to protection against even the malicious waste of gas; the law of oil and gas took root when even engineers knew but little of the forces with which they were dealing, and the lawyers less. * * * The rule, however, must be dealt with as it exists, as even the most advanced conservation cases recognize. In *Champlin Ref. Co.* v. *Corpn. Comm.,* cited below, the United States Supreme Court said: "Where proportional taking from the wells in flush pools is not enforced, operators who do not have physical or market outlets are forced to produce to capacity in order to prevent draining to others having adequate outlets."

In practical application the capture rule, recognizing no right in a landowner to retain his oil and