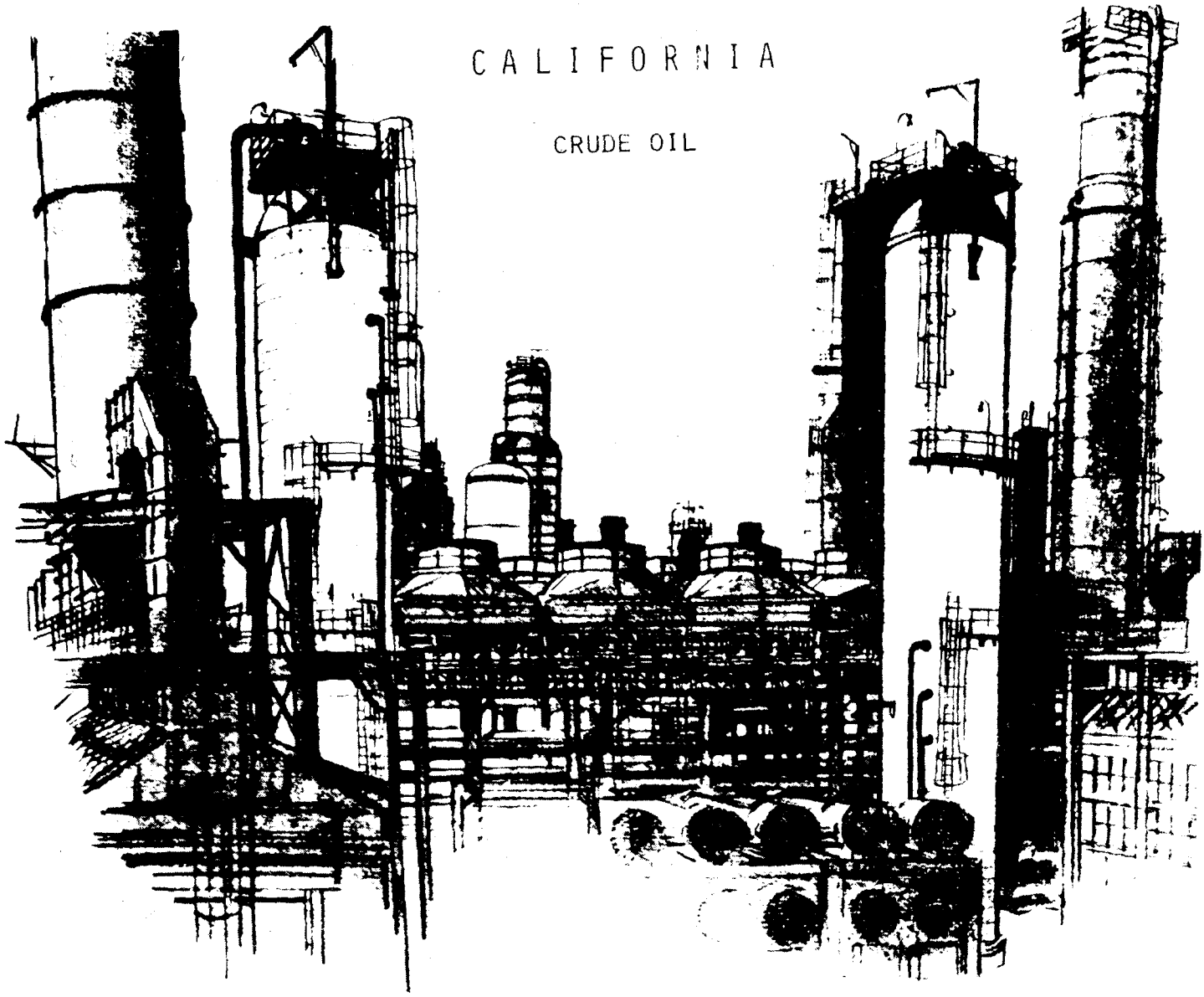
A Report of The Joint Committee on Public Domain

ON

COST OF REFINING

CALIFORNIA

CRUDE OIL



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OCTOBER 1974

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Joseph M. Kennick
James R. Mills

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BY

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The Honorable President of the Senate
The Honorable Speaker of the Assembly
The Honorable Members of the Senate and the
Assembly of the Legislature of California

Dear Members:

This is the fourth in a series of fact-finding reports on the pricing of California crude oil.

The hard facts in this report were taken from subpoenaed documents which publicly expose for the first time the cost of refining a barrel of crude oil.

This information becomes relevant when we recall the major integrated oil companies' rationale for refusing to pay a price for publicly-owned crude oil commensurate with the price they pay in other areas of the United States was the allegedly high cost of refining California crude.

It is the Committee's hope that this information, together with other facts outlined in this series, will provide the basis for meaningful action by which not only will future abuses be eliminated, but also steps can be taken to cure past inequities. Thus, the Joint Committee on Public Domain submits the "Cost of Refining California Crude Oil."

Respectfully submitted,

KENNETH CORY, Chairman
Joint Committee on Public Domain

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I. SUMMARY AND CONCLUSIONS

1. The major oil companies have publicly said that California oil is "lousy oil", is so expensive to refine that it must sell at low prices, that decline sharply as the oil becomes heavier.

2. The State of California owns the production of some 143,000 barrels of oil a day, which has been bringing low prices.

3. To discover the real value of this oil, the Joint Committee on Public Domain subpoenaed cost, value, and operating records from seven of the world's largest oil companies.

4. These documents showed that half of the large refineries in the State have operated in 1970, 1971, and 1972, at costs below $1.30 per barrel, and at least one ran below $1.00 per barrel.

5. Refineries in the Eastern states were operating around 95¢ per barrel in 1969.

6. Refining costs do not show any clear relationship with gravity: the 6.2¢ per degree price penalty is not supported by cost data.

7. Analysis of the refinery using the heaviest gravity crude charge, 20°, showed $5.96 per barrel value of products, $2.80 per barrel cost of crude, $1.18 per barrel refining cost, and $1.96 gross profit per barrel.

8. When evaluating crude oil for use in their own refineries, the companies showed gravity differentials averaging less than 1½ cents per degree, in contrast with the 6.2¢ penalty per degree in their buying price for crude.

9. Weighted average underpricing for 1971 was 88¢ per barrel. For the State's own oil, this amounted to some $45 million per year.

II. INTRODUCTION

The State of California owns 143,000 daily barrels of crude oil production. The East Wilmington field, just offshore from downtown Long Beach, lies wholly within the State tidelands. For fiscal year 1972-73, State-owned oil was produced by:

Powerine Oil Co., Parcel A	6,557	Barrels/day
Long Beach Oil Development Co.	27,446	" "
THUMS Long Beach Co.,		
Tract 1	97,828	" "
Tract 2	5,916	" "
Harbor Uplands	981	" "
	138,728	

This oil was produced for the account of the State. In addition, the State's royalty share of oil produced from tidelands areas leased to oil companies amounted to 4,223 barrels per day.

Over a year's time, this amounts to more than 52 million barrels.

All this oil is sold to oil refiners, mostly very large companies. There have been strong indications that the State of California has been underpaid by as much as one dollar per barrel, or more than $52 million a year - a million dollars a week.

The prices paid the State are not the result of bargaining or negotiating, nor of open market sale to the highest current bidder. On the contrary, the prices are unilaterally established by the buyers. The State does not even have the option of withholding its oil from the market.

This report is the fourth in a series designed to analyze the returns to the State from the management and exploitation of its crude oil resources. The first, "The Administration of State-owned Tidelands," showed that the handling of these resources by the State Lands Commission and the State Lands Division has been unacceptable, and very costly in loss of revenue.

The second report, "Crude Oil Exchanges - 'The Other Currency'," showed that the major oil companies, in dealing

with each other, place a much higher value on crude oil than the price they pay the State for it.

The third report, "Crude Oil Pipelines in California," shows how private control of the lowest-cost method of transportation throttles a free market in the sale of crude oil, whether owned by the State or by independent producers. The complete private control is peculiar to California. In other states, pipelines are common carriers, open to all producers.

In the absence of a true competitive open market price system for crude oil in California, it is necessary to attempt to assess value by other methods. The purpose of this report is, by different methods of analysis of their own data, to arrive at an appraisal of the worth of the oil to the companies in terms of their refinery realizations and costs.

III. BUYING AND REFINING

To understand the pattern of prices and sales for State-owned oil, it is necessary to consider briefly several diverse factors. These are, first, the oil production contracts; second, the pricing provisions; third, the nature of crude oil; and finally, a short description of refining.

The East Wilmington oil field was developed and is produced under a set of contracts with three private operators, the two largest of which are consortiums of major oil companies. In each case, the operator made an advance payment to the City of Long Beach (in its capacity as Trustee for the State), produced and sold the oil (to themselves), recovered costs and advances, and received some additional allowances for overhead and profit. The details of the contracts differ, but the general pattern is consistent.

The bulk of this oil is sold under the contracts specifying valuation to be determined by prices posted in the field or in certain named adjacent fields, or by the average of prices actually paid in the field or named fields for oil of like gravity.

Key words here are "prices posted" and "gravity." These terms, as well as crude oil itself, may need some exposition.

Crude oil is a mixture of several liquid compounds of carbon and hydrogen, called hydrocarbons. There are two or three families of hydrocarbons, with differing characteristics. Each family consists of light and thin liquids, thick and heavy liquids and others of intermediate weight.

"Gravity" is a measure of density or weight per unit volume. On a scale devised years ago by the American Petroleum Institute, oil at ten degrees gravity (10^{o}API) weighs the same as water, 351 pounds per barrel of 42 gallons. Gasoline at 60^{o}API is very thin and light, weighing 259 pounds per barrel. Most of the world's crude oil will fall between 26^{o} and 36^{o}. In California, the crude is heavier, half of it being below 20^{o}.

Crude oil is not usable directly as fuel or power source except in heavy industrial equipment, and then can be dangerous. To yield gasoline for automobiles, diesel fuel for trucks and

railroad locomotives, jet fuel for aircraft, and other oils for heating, lubricants and chemicals, the crude must be refined.

Refining is the process of sorting out the light, medium and heavy hydrocarbons, and breaking apart and reforming some of the heavier compounds into light fuels with special characteristics, including the addition of extraneous hydrogen. It also involves removing sulfur and other impurities, at least from the lighter products.

The simplest type of refining (and still the first step in complex refineries) is separating the various hydrocarbons by boiling. The lightest fractions, which boil off first, are the components from which gasoline is made. Jet fuel, kerosene, diesel, and heating oil stock have successively higher boiling temperatures. The heaviest fractions, such as residual fuel oil, are left after all the lighter components are distilled off.

The higher the gravity of the crude, the greater proportion of gasoline it contains. The lower the gravity the greater amount of residual oil is left from the boiling process.

Light products, because of their ease of use and clean-burning qualities, have been higher valued than the heavier products. In consequence, high gravity crudes, yielding more high-valued products, have been priced higher than the low-gravity heavy crudes.

For many years, in a simpler world, refiners would put up a signboard at the refinery gate, offering to pay a given price for crude oil delivered. Delivery was by wagon, and the driver could drive on to another refinery if he did not care to accept that "posted" price. As pipelines and crude oil gathering systems developed, they largely displaced the tank-wagon transportation. Competition among refiners could still exist, however, as pipelines could deliver to any one of several refineries.

Posted prices began to distinguish between light and heavy oil, since the straight-run, or boil-off, refineries could make more of the valuable light products from high gravity crude than from low gravity crudes. With the proliferation of oil fields, with oil of different gravities and other characteristics, the "posted price" became a complicated table showing different prices for different fields, as well as different prices for

various gravities from the same field.

Refinery technology has changed greatly in recent years, becoming much more complex and much more productive of light products. Through processes known as cracking, reforming, alkylation, and coking, the chemical composition of heavy hydrocarbons is changed. With the addition of hydrogen, heavy hydrocarbons can be converted to light hydrocarbons, with a gain in volume. Additional details of modern refining processes may be found in Appendix D.

IV. GRAVITY DIFFERENTIALS

The fact of gravity price differentials has long been established and now permeates the world-wide crude oil markets, although many fields are still posted "flat", or a single price per barrel regardless of gravity.

The amount of gravity differential is quite a separate proposition.

The vast majority of the posted prices for crude east of California carry a penalty of 2¢ per degree API, from above 40° to below 20°. The most prevalent range in Texas and Louisiana (the two largest oil producers) is $5.35 to $4.93, although the East Texas field, currently the largest oil field in the United States, is posted flat at $5.20 by ten major oil companies.

Until the summer of 1973, well after this Committee began considering the effect of gravity differentials, the prices in the huge Middle East oil region were on a 2¢ per degree schedule.

By contrast, the gravity differentials in California run 5, 6, and 7¢ per degree, averaging about 6.2¢.

The next four pages consist of the current posting for crude oil by Standard Oil Company of California, Table 1. Gravity is shown in the right-hand and left-hand column of the three tables. The numbered columns correspond to the fields named in the indexes on the fourth page.

For example, find 18° Wilmington to be posted at $4.21. From the Alphabetical Index, the last line gives Wilmington as column 4. The Column Index shows column 4 to include both Wilmington and Richfield. In the upper table on the second page, column 4 begins with $3.85 for 12°-12.9° gravity API. Six lines down, against 18°-18.9°, trace over to column 4, and read $4.21.

This shows a difference of 6¢ for each degree from 12° to 18°. From there on down the column (up the gravity scale) to 26°-26.9° gravity, the difference is 7¢ per degree. It is 6¢ for the next degree, and 5¢ for each of the next 4 degrees.

From $5.03 at 31° gravity down to $3.85 at 12°, the drop is $1.18 for 19°, or an average of 6.2¢ per degree.

Standard Oil Company of California

Standard Oil Company of California,
Western Operations, Inc.

TABLE 1

(4 Pages)

Crude Oil Posted Prices

Chevron

Schedule No. 154
December 19, 1973

Crude Oil Prices • Schedule Number 154 • Effective 7:00 a.m. • December 19, 1973

The following are the prices offered by Standard Oil Company of California and by Standard Oil Company of California, Western Operations, Inc., for their respective current purchases of crude oil. Price is per barrel in fields indicated. All gravities above those quoted take highest price offered herein for that field.

Section A – Non-Exempt Crude Oil

Gravity (°API)	1	1A	2	3	4	5	5A	6	7	8	9	9A	10	Gravity (°API)
10-10.9		$3.70						$3.62						10-10.9
11-11.9	$3.82	3.75						3.70						11-11.9
12-12.9	3.86	3.80			$3.85			3.78						12-12.9
13-13.9	3.90	3.85			3.91			3.86						13-13.9
14-14.9	3.95	3.91	$3.68		3.97	$3.97	$3.93	3.93			$4.04	$4.00		14-14.9
15-15.9	4.01	3.98	3.75		4.03	4.03	4.00	4.01			4.11	4.08		15-15.9
16-16.9	4.07	4.05	3.82		4.09	4.08	4.06	4.08			4.17	4.15		16-16.9
17-17.9	4.12	4.11	3.89		4.15	4.14	4.13	4.15			4.23	4.22		17-17.9
18-18.9	4.18	4.18	3.96		4.21	4.20	4.19	4.23			4.29	4.29	$4.09	18-18.9
19-19.9	$4.25		4.03		4.28	$4.26		4.30			$4.36		4.17	19-19.9
20-20.9	4.32		4.10		4.35	4.32		4.37	$4.39		4.43		4.25	20-20.9
21-21.9	4.38		4.16		4.42	4.38		4.44	4.45		4.50		4.33	21-21.9
22-22.9	4.45		4.23	$4.35	4.49	4.44		4.51	4.53	$4.45	4.57		4.41	22-22.9
23-23.9	4.51		4.30	4.42	4.56	4.50		4.58	4.61	4.51	4.64		4.48	23-23.9
24-24.9	4.58		4.37	4.50	4.63	4.56		4.65	4.67	4.57	4.71		4.56	24-24.9
25-25.9	4.65		4.43	4.59	4.70	4.62		4.72	4.72	4.63	4.77		4.64	25-25.9
26-26.9	4.72			4.67	4.77	4.68		4.78	4.77	4.69	4.82		4.71	26-26.9
27-27.9	4.79			4.74	4.83	4.74		4.83	4.82	4.75	4.87		4.78	27-27.9
28-28.9	4.86			4.81	4.88	4.80		4.88	4.87	4.81	4.92		4.85	28-28.9
29-29.9	4.92			4.87	4.93			4.93	4.92	4.87	4.96		4.91	29-29.9
30-30.9	4.98			4.93	4.98			4.97	4.97	4.92	5.00		4.96	30-30.9
31-31.9	5.05			5.00	5.03			5.00	5.02	4.97	5.04		5.01	31-31.9
32-32.9	5.11			5.06				5.04	5.07	5.02	5.07		5.06	32-32.9
33-33.9	5.17			5.13				5.08	5.12	5.07	5.11		5.11	33-33.9
34-34.9	5.22			5.19				5.12	5.17	5.12	5.15		5.16	34-34.9
35-35.9	5.27			5.25				5.16	5.22	5.17			5.21	35-35.9
36-36.9	5.32							5.20	5.26				5.25	36-36.9
37-37.9	5.36							5.24	5.31				5.29	37-37.9
38-38.9								5.28	5.35				5.33	38-38.9
39-39.9								5.32	5.40				5.37	39-39.9
40&Above								5.36	5.45				5.41	40&Above

Gravity (°API)	11	12	12A	13	14	15	16	17	17A	18	19	19A		Gravity (°API)
10-10.9	$3.39						$3.27	$3.40	$3.32					10-10.9
11-11.9	3.43						3.38	3.50	3.43					11-11.9
12-12.9	3.48						3.48	3.61	3.53	$3.62	$3.81	$3.77		12-12.9
13-13.9	3.54						3.58	3.68	3.63	3.71	3.87	3.83		13-13.9
14-14.9	3.61			$3.92			3.67	3.76	3.72	3.79	3.93	3.89		14-14.9
15-15.9	3.69	$3.86	$3.83	4.02			3.73	3.80	3.77	3.83	3.99	3.96		15-15.9
16-16.9	3.77	3.93	3.91	4.11			3.77	3.83	3.81	3.86	4.05	4.03		16-16.9
17-17.9	3.85	3.98	3.97	4.20			3.80	3.86	3.85	3.90	4.11	4.10		17-17.9
18-18.9	3.94	4.05	4.05	4.29			3.83	3.90	3.90	3.93	4.18	4.18		18-18.9
19-19.9	4.03	$4.13		4.38				$3.94		3.98	$4.26			19-19.9
20-20.9	4.11	4.20		4.46				3.99		4.02	4.33			20-20.9
21-21.9	4.19	4.27		4.56				4.04		4.07	4.40			21-21.9
22-22.9	4.27	4.34		4.64				4.10			4.48			22-22.9
23-23.9	4.35	4.41		4.73		F.O.B.		4.16			4.55			23-23.9
24-24.9	4.43	4.49		4.80		Ship		4.22			4.62			24-24.9
25-25.9	4.52	4.56		4.89	$4.59			4.27			4.69			25-25.9
26-26.9	4.60	4.62		4.96	4.65			4.33			4.76			26-26.9
27-27.9	4.67	4.68		5.03	4.72	$4.79					4.84			27-27.9
28-28.9	4.73	4.74		5.11	4.79	4.85					4.91			28-28.9
29-29.9	4.79	4.80		5.17	4.86	4.91					4.97			29-29.9
30-30.9	4.85	4.86		5.26	4.92	4.97					5.02			30-30.9
31-31.9	4.91	4.92			4.98	5.03					5.07			31-31.9
32-32.9	4.97	4.97			5.04	5.09					5.11			32-32.9
33-33.9	5.03	5.03			5.10	5.14					5.14			33-33.9
34-34.9		5.09			5.15	5.19					5.18			34-34.9
35-35.9		5.15			5.20	5.24					5.22			35-35.9
36-36.9		5.21			5.25	5.29					5.25			36-36.9
37-37.9		5.27									5.28			37-37.9
38-38.9		5.33									5.32			38-38.9
39-39.9		5.39									5.36			39-39.9
40&Above		5.45									5.40			40&Above

Gravity (°API)	20	20A	21	21A	22	23	24	24A	25	25A				Gravity (°API)
10-10.9				$3.60			$3.77	$3.69						10-10.9
11-11.9	$3.64	$3.57	$3.72	3.65			3.82	3.75		$3.76				11-11.9
12-12.9	3.73	3.67	3.76	3.70			3.87	3.81	$3.88	3.82				12-12.9
13-13.9	3.82	3.77	3.80	3.75			3.92	3.87	3.92	3.87				13-13.9
14-14.9	3.91	3.87	3.86	3.82			3.97	3.92	3.97	3.93				14-14.9
15-15.9	3.97	3.94	3.92	3.89			4.02	3.99	4.03	4.00				15-15.9
16-16.9	4.03	4.01	3.98	3.96			4.08	4.06	4.08	4.06				16-16.9
17-17.9	4.09	4.08	4.04	4.03			4.14	4.13	4.14	4.13				17-17.9
18-18.9	4.15	4.15	4.10	4.09			4.21	4.20	4.20	4.19				18-18.9
19-19.9	$4.23		$4.16				$4.28		$4.26					19-19.9
20-20.9	4.30		4.23			$4.12	4.35		4.32					20-20.9
21-21.9	4.38		4.29			4.21	4.42		4.39					21-21.9
22-22.9	4.45		4.36		$4.24	4.29	4.49		4.45					22-22.9
23-23.9	4.53		4.42		4.31	4.37	4.56		4.51					23-23.9
24-24.9	4.60		4.49		4.38	4.46	4.63		4.58					24-24.9
25-25.9	4.67		4.55		4.45	4.53	4.70		4.64					25-25.9
26-26.9	4.75		4.62		4.52	4.61	4.77		4.70					26-26.9
27-27.9	4.83		4.69		4.59	4.68	4.84		4.76					27-27.9
28-28.9	4.88		4.75		4.65	4.74	4.91		4.81					28-28.9
29-29.9	4.93		4.81		4.71	4.80	4.97		4.86					29-29.9
30-30.9	4.97		4.87		4.77	4.86	5.03		4.91					30-30.9
31-31.9	5.02		4.93		4.83	4.92	5.08		4.96					31-31.9
32-32.9	5.07		4.99		4.89	4.98	5.13		5.01					32-32.9
33-33.9	5.12		5.04		4.95	5.04	5.17		5.06					33-33.9
34-34.9	5.17		5.09		5.01	5.10	5.21		5.11					34-34.9
35-35.9	5.21		5.14		5.07	5.16	5.25		5.16					35-35.9
36-36.9	5.25		5.19		5.12		5.29		5.21					36-36.9
37-37.9	5.29		5.24		5.17		5.33		5.26					37-37.9
38-38.9	5.33		5.29		5.22		5.37		5.31					38-38.9
39-39.9	5.37		5.34		5.27		5.41		5.36					39-39.9
40&Above	5.42		5.39		5.32		5.45		5.41					40&Above

The above prices apply to our purchases of crude oil which are subject to ceiling prices under applicable Federal regulations.

Section B. Exempt Crude Oil

This applies to our purchases of crude oil which are exempt from ceiling prices under applicable Federal regulations.

The general policy of Standard Oil Company of California and Standard Oil Company of California, Western Operations, Inc., will be to offer to pay competitive prices for exempt oil.

The above prices apply to quantities measured by approved automatic custody transfer facilities or 100% tank table with customary adjustment of volume and gravity for temperature and full deduction for basic sediment and water.

NOTICE: Each seller of crude oil certifies to Standard Oil Company of California and Standard Oil Company of California, Western Operations, Inc., by acceptance of payment that the prices paid do not exceed the maximum prices the seller may lawfully receive under the Economic Stabilization Act of 1970, as amended, and all applicable orders, regulations and rulings issued thereunder. In the event a seller may not lawfully accept the prices indicated in this bulletin, it shall be his responsibility to certify in writing to Standard Oil Company of California and Standard Oil Company of California, Western Operations, Inc., the price he may lawfully accept.

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Column Index to Price Schedule

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LONG BEACH (SIGNAL HILL)

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Column 2
NEWPORT (ANAHEIM SUGAR TYPE)

Column 3
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SEAL BEACH

Column 4
RICHFIELD
WILMINGTON

Column 5
TORRANCE

Column 5A
EL SEGUNDO
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Column 19
TEJON GRAPEVINE
TEJON HILLS

Column 19A
NORTH TEJON
ROSEDALE RANCH

Column 20
ALFERITZ ANTICLINE
BELGIAN ANTICLINE (MAIN & NW)
BELRIDGE
CYMRIC
PYRAMID HILLS

Column 20A
ANTELOPE HILLS
McDONALD ANTICLINE
WHEELER RIDGE

Column 21
EDISON
FRUITVALE
KERN FRONT
KERN RIVER
McKITTRICK
ROUND MOUNTAIN

Column 21A
ANT HILL – OLCESE
KERN BLUFF
PLEITO CREEK
POSO CREEK

Column 22
ASPHALTO
BELLEVUE WEST
CANAL
COLES LEVEE
ELK HILLS (STEVENS)
GREELEY
MORALES CANYON
PALOMA
RAILROAD GAP
ROSEDALE
SEMITROPIC
STRAND

Column 23
MOUNTAIN VIEW

Column 24
BUENA VISTA HILLS
LOST HILLS
MIDWAY – SUNSET

Column 24A
BLACKWELL'S CORNER
ELK HILLS (SHALLOW)

Column 25
COALINGA
KETTLEMAN HILLS

Column 25A
GUIJARRAL HILLS
JACALITOS
PLEASANT VALLEY
RAISIN CITY

This pattern is of long standing. Standard's "Crude Oil Posted Prices, Schedule No. 127, December 12, 1950," shows the Wilmington field posted at $2.65 for 31°-31.9°, declining by steps of 4¢ and 5¢ to $1.88 for 14° gravity. This is 77¢ differential for 17 degrees, averaging 4.5¢ per degree.

For the high gravity crudes, the posted prices in California are quite comparable with those in the other important oil producing states. Ten of the columns in the current Standard posting run to 40° and above, and range $5.32 to $5.45, for an average of $5.41. This is even slightly above the going 40° figure elsewhere of $5.35.

The bite comes when we compare the actual gravity of oil as produced. The American Petroleum Institute cites the gravity of crude petroleum (domestic) as 36.0°, with a footnote saying, "For Each Product The Gravity Listed Is Assumed To Be Representative Of The Average."[1] With a 40° posting in Texas and Louisiana of $5.35, the representative gravity of 36° would be discounted only 8¢ to $5.27.

In California, where half the production for the past 10 years has been under 20° gravity - and is getting heavier,[2] typical crude oil will be about 18°. The drop from 40° to 18° amounts to $1.13 to $1.40 in the seven columns that have entries for both gravities in the Standard posting. That is, prices run from $4.09 to $4.19 for 18°, more than one dollar below the representative price elsewhere.

Chart 1 graphically depicts the gravity penalty on heavy California crude oil. The California stairstep line is plotted from column 6 of the current Standard of California posting, the only single column that covers the entire gravity range from 10° to 40° and above. The steps range from 8¢ to 4¢ with one of 3¢. Fields covered are: Inglewood, Salt Lake (San Vicente) and Crescent Heights. Atlantic Richfield and Union also post the Inglewood field; while neither goes as low as 10°

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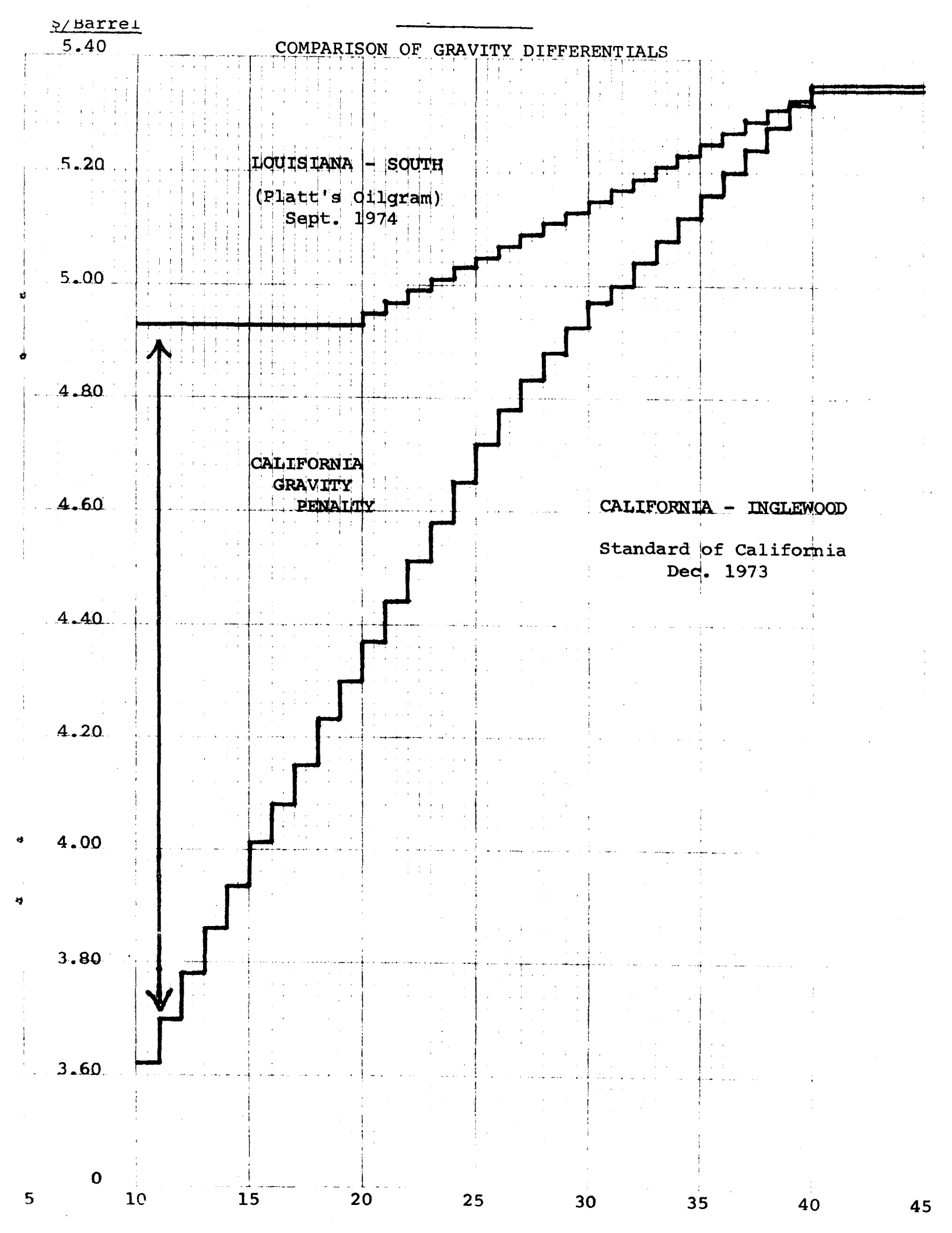
1 API, Annual Statistical Review, April 1973, page 60, citing as source the American Society for Testing Materials.

2 Conservation Committee of California Oil Producers, "Annual Review of California Oil and Gas Production, 1973," Section I, pages 10 and 11.


$/Barrel
COMPARISON OF GRAVITY DIFFERENTIALS
5.40
5.20
5.00
4.80
4.60
4.40
4.20
4.00
3.80
3.60
0
LOUISIANA - SOUTH
(Platt's Oilgram)
Sept. 1974
CALIFORNIA
GRAVITY
PENALTY
CALIFORNIA - INGLEWOOD
Standard of California
Dec. 1973
5
10
15
20
25
30
35
40
45

nor as high as 40°, the gravities they do post are identical with Standard.

The Louisiana - South posting, taken from Platt's Oilgram Crude Oil Supplement for September 15, 1974, covers many fields onshore Louisiana as well as offshore in the Gulf of Mexico, and reports postings by the following oil companies:

Standard of Indiana	Gulf
Standard of California	Shell
Continental	Sun

The steps are 2¢ per degree, between the flat ends.

The format of the California posting tables has remained substantially unchanged for at least the past 45 years. The size of the steps widened a bit, after 1950, but they have been consistently much larger than in the rest of the country. (There was a two-year period here between 1933 and 1935 when the gravity differential was inverted, with the highest posted price at 14°, but this was a special situation, attributable to the adverse effect of the giant East Texas oil field on crude oil prices, a situation long since permanently reversed.)

Refining technology, on the other hand, has made great advances since World War II, increasing the value of heavy crude to a refiner. One would think that competition for the now more valuable heavy crude would have forced the refiners to share the benefits of technological progress with the crude oil producers. To the contrary, as the technology for using heavy crudes has grown and expanded through the industry, the gravity differentials in California have increased.

V. FAIR PRICE

The question arises,

> is the State of California receiving a fair price for the crude oil produced from the State-owned tidelands?

Should the low-gravity penalties be reduced, or eliminated altogether? In time of shortage of crude supply should the highest-cost oil sell for so little?

These questions have been asked in public hearings of the Joint Committee on Public Domain, and no satisfactory answers have been forthcoming.

The Federal Government has laid various mandatory price and supply controls on the oil industry over the past fifteen years, but the benefits have gone to producers in other areas and to the refiners throughout the United States. Producers in California, both State and private, have been frozen by Federal regulations into the adverse pattern of large gravity penalties.

The Committee has attempted to investigate the problem with a view to pointing out operational remedies.

Spokesmen for the industry have said that California crude oil brings low prices because it is low grade, and more expensive to refine than most of the other crudes in the United States. Mr. Fred L. Hartley, President and Chief Executive Officer of Union Oil Co., testifying before the Subcommittee on Crude Oil Pricing of this Committee on April 23, 1974, said:

> "Another thing, of course, this oil is lousy oil by any definition of today's quality requirements. It cannot be used in power plants. I think you're aware of that. The sulfur limitations prevent it. We have to make tremendous refining investments to be able to refine this oil into salable products for the transportation industry, from gasoline to turbine fuel for aircraft and diesel fuel for trucks, and the marketplace, in effect, is the final test as to what that oil is worth."
>
> (Transcript, pages 28 and 29)

Mr. T. M. Powell, Vice President, Refining and Supplies, Standard Oil Co. of California, testifying before the Joint Committee on April 23, 1973, - one year earlier - said:

> "Apparently you are not persuaded by the statements that I have made or the statements that Mr. Hopkins[1] made before me that it costs a lot of money, more money, to convert heavy crude into the products than it does light crude. In other words in my considered opinion, 2¢ a degree is ludicrous.
>
> CHAIRMAN CORY: "Try me again.
>
> MR. POWELL: "Two cents a degree gravity differential from 40 degrees down to 11 or 12 degrees in California would be ludicrous. It is too low and it costs a lot of money to simply convert the heavier crudes into the products we can market ...."
>
> (Transcript, pages 108 and 109)

How much more money does it cost to refine heavy California crude oil into salable products? Mr. Powell refused to say. Mr. Hopkins didn't say. Mr. Hartley didn't say. The industry wouldn't say. The petroleum industry's reason for a low price level for California crude oil is a trade secret, not to be told to the independent producers, or to the State of California.

At that point, it appeared to the Joint Committee on Public Domain that the only course open to it was to subpoena cost, price, production, refining, transportation, marketing, and reserves data from the industry. We should find out what it really does cost to refine heavy crude oil, how much refined products can be made from a barrel of crude oil, and what effect gravity has on refinery cost and value of products.

---

1 Mr. John Hopkins, Vice President, Refining and Marketing, Western Region, Union Oil Company of California, testifying just before Mr. Powell.

VI. THE SUBPOENA

The question can be posed simply enough: What does it cost to refine crude oil into salable products; how much product do you get per barrel of crude; and what effect does gravity have on cost and output? The legal problems of getting usable answers to straightforward questions from recalcitrant companies are greater than you might think. A subpoena may demand the presentation of records and documents, but may not legally require the companies to prepare answers to questions.

The Committee caused a 100-question draft of a subpoena to be prepared, and had it discussed informally with lawyers and operating officials of each of the seven major oil companies involved in the development and operation of the State-owned East Wilmington field in Long Beach harbor.

The purpose of the discussions was to make sure the right questions were asked, in such a way as to elicit the essential information with the least burden on the companies. Staff explained the questions, modified them to make their meanings clear, cut the number to 53, and exerted every effort to make the subpoena operational if not palatable.

The subpoenas were issued on August 27, 1973, and promptly served on:

Atlantic Richfield
Exxon, U.S.A.
Mobil
Shell
Standard of California
Texaco
Union

The response was predictable: all seven companies objected. Some filed answers to those questions which were substantially public knowledge, but fought over the others. Other companies refused to give any information, and fought the entire subpoena.

Arco and Shell agreed to furnish data, but held out for court orders restricting the use the Subcommittee and the Joint Committee might make of the data.

The other five companies refused to comply on the stated ground that the Committee did not have the authority to compel production of such documents. They were cited for contempt of the Legislature, and were brought before the Superior Court for Sacramento County. In a last-minute settlement, they agreed to supply data on a basis which would not reveal the identity of the company responding to 10 of the questions unless the Committee decided it was essential to the legislative purpose to identify the information.

Through failure to comprehend the questions, or inability to locate documents, or inability to make legible copies, or what can only be taken as plain footdragging, no company was in full compliance by Tuesday, September 10, 1974, a year and two weeks after the subpoenas were issued.

A copy of the subpoena, and two letters from the Chairman modifying certain requirements, are set out in full in Appendix A, with the 10 questions the companies objected to most marked with an asterisk.

These companies were selected because they are the major oil corporations involved in the Tract 1 section of the East Wilmington field. Five of them formed a consortium to bid on the operation of that tract, and won the contract. The joint venture was called THUMS, from the initials of the companies:

Texaco
Humble (now Exxon, U.S.A.)
Union
Mobil
Shell

The operating company is THUMS Long Beach Company; it produces the field and sells the oil. The five members constitute the bulk of the buyers, under the same contract. Initially, they contracted to buy 80 per cent of the production.

Ten per cent was bid in by a joint venture of Atlantic Richfield and Standard and the remaining 10% was bid by a joint venture of Pauley Petroleum Co. and Allied Chemical Co. Allied has since dropped out and Pauley is not a significant factor in the refinery business.

The City of Long Beach and the State of California reserved the right to call 12½% of the total production (to

come out of the 80% held by THUMS) for sell-off to other buyers. This was accomplished in November 1971, the sale bringing successful bids of 15.6¢ to 21.4¢ above posted price.

The size of these seven oil companies among world-wide industrial corporations, is set out in Appendix C.

The documents supplied by the seven companies under the subpoena have been carefully sorted, collated, and analyzed. Discrepancies have been referred to the individual companies for explanation or correction. The following sections on refining value, refining costs, and charges to competitors for refining services, are based solidly on the companies' own data.

VII. REFINING VALUE

In analyzing their own internal economics, several of the companies use the terms "refining value," or "refinery index" as a measure of the value of a particular crude oil to a particular refinery. While the subpoenaed documents rarely come with explanations, glossaries or underlying formulas or assumptions, we think we understand the general meaning of these refining values and indexes. To put it succinctly, they show the positive spread between refinery value to the company and posted price to the producer. This is done by comparing the value of other crudes to a standard reference crude.

One de-identified document consisted of a five page table in response to Question 14, showing refining indexes which compare a large number of California crudes to 34° Alaskan at $3.70, and to 38° Berri at $4.35 plus .27. The table was dated in early 1971, when 34° Alaskan crude was posted at Kenai Peninsula at $3.15. Transportation cost from Alaska to Los Angeles was approximately 50 cents. The presumption is that the purpose of the table is to display the gravity of the California crude which closely approximates the product mix yielded by the Alaskan oil. Similarly, the same crudes are compared with Berri (Arabian) 38° oil at $4.62 at the refinery.

The entire table is reproduced as Appendix B, with the addition of the current posted prices for the listed crudes and gravities, and the differences between posted prices and refining indexes.

Four California crudes are shown with a refinery index of $3.70, the base given for 34° Alaskan Drift River:

Midway Sunset	27.6°
Pleasant Valley	26.0°
Signal Hill	27.3°
Torrance	24.9°

Two other gravities of Torrance crude are also given:

16.7°	at	$3.58 and
20.7°	at	$3.63

The Torrance comparison shows that 4° of gravity from 16°

to 20° are equated to only 5¢ difference in value, and 4° from 20° to 24° to only 7¢ difference in value.

Standard Oil Co. of California's "Crude Oil Posted Prices Schedule No. 149, November 24, 1970," lists Torrance:

16° - 16.9° at $2.46, and
20° - 20.9° at $2.72, a difference of 26 cents, and

24° - 24.9° at $2.96, a further difference of 24 cents.

Thus, 8° of gravity penalize the producer by 50 cents, while the difference to the refinery is only 12 cents.

Midway Sunset also is shown with two other gravities:

14.0° at $3.59
20.7° at $3.69

or a 10 cent difference for 6°, and only a 1 cent difference for the 7° difference in gravity between 20.7° and 27.6°.

The Standard Oil Co. posting for Midway Sunset was:

14° - 14.9°	$2.32
20° - 20.9°	$2.75 and
27° - 27.9°	$3.24

In the posted price sheet, 13 degrees gravity spread shows a price spread of $3.24 - $2.32, or 92 cents, whereas the refinery index shows a total spread for this crude of only 11 cents.

Three other fields were shown with three different gravities, and 14 others with 2 different gravities. These are set out in detail in Table 2, following, with price and value comparisons.

In one single instance, that of the high gravity Summerland Offshore, 38.8°, the posted price was above the refining index - by one cent. In two other instances, shown in Appendix B, Bandini 39.2° gravity was posted at the refining index of $3.80, and McDonald Anticline 37.5° was posted at the index, $3.69. In all the 71 other cases, refining index exceeded posted price by amounts ranging from 8 cents, 9 cents and 10 cents up to $1.71 and $1.76.

TABLE 2

COMPARISON OF GRAVITY DIFFERENTIALS IN REFINING INDEXES AND POSTED PRICES

FIELD	GRAVITY °API	POSTED PRICE	REFINING INDEX	INDEX ABOVE POSTED
Midway Sunset	27.6	$3.24	$3.70	$ .46
	20.7	2.75	3.69	.94
	14.0	2.32	3.59	1.27
Difference, full range	13°	.92	.11	
Difference 1°	1°	.071	.008	
Torrance	24.9	$2.96	$3.70	$ .74
	20.7	2.72	3.63	.91
	16.7	2.46	3.58	1.12
	8°	.50	.12	
	1°	.062	.015	
Coalinga	30.9	$3.31	$3.72	$ .41
	25.3	3.04	3.72	.68
	14.7	2.33	3.61	1.28
	16°	.98	.11	
	1°	.061	.007	
Cymric	34.2	$3.57	$3.83	$ .26
	32.1	3.47	3.81	.34
	12.4	2.07	3.57	1.50
	22°	1.50	.26	
	1°	.068	.012	
Montebello	33.3	$3.52	$3.75	$ .23
	30.7	3.37	3.79*	.42
	22.9	2.93	3.69	.76
	11°	.59	.10	
	1°	.054	.009	
Bellevue West	34.8	$3.41	$3.73	$ .32
	33.7	3.35	3.71	.26
	1°	.06	.02	
Edison	38.9	$3.69	$3.78	$ .09
	20.6	2.63	3.67	1.04
	18°	1.06	.11	
	1°	.058	.006	

* 30.7 gravity has higher index than 33.3 gravity.

TABLE 2

FIELD	GRAVITY °API	POSTED PRICE	REFINING INDEX	INDEX ABOVE POSTED
Greeley	35.0	$3.47	$3.74	$ .27
	33.1	3.35	3.68	.33
	2°	.12	.06	
	1°	.06	.03	
Huntington Beach	23.2	$2.91	$3.68	$ .77
	15.9	2.38	3.56	1.18
	8°	.53	.12	
	1°	.066	.015	
Lost Hills	21.5	$2.82	$3.68	$ .86
	13.2	2.27	3.58	1.31
	8°	.55	.10	
	1°	.069	.012	
McKittrick	18.8	$2.49	$3.66	$1.17
	14.1	2.22	3.60	1.38
	4°	.27	.06	
	1°	.068	.015	
McKittrick N.E.	35.4	$3.54	$3.74	$ .20
	34.0	3.49	3.75	.26
	1°	.05	(-.01)	
Mission	28.3	$3.14	$3.73	$ .59
	24.3	2.89	3.72	.83
	4°	.25	.01	
	1°	.062	.002	
Mountain View	32.9	$3.38	$3.69	$ .31
	27.3	3.08	3.72	.64
	5°	.30	(-.03)	
	1°	.06	(-.006)	
Railroad Gap	38.7	$3.62	$3.81	$ .91
	34.3	3.41	3.72	.31
	4°	.21	.09	
	1°	.052	.022	
Seal Beach	31.0	$3.40	$3.68	$ .28
	26.7	3.07	3.71	.64
	5°	.33	(-.03)	
	1°	.066	(-.006)	

TABLE 2

FIELD	GRAVITY °API	POSTED PRICE	REFINING INDEX	INDEX ABOVE POSTED
Summerland Offshore	38.8	$3.73	$3.72	$(-.01)
	28.8	3.14	3.58	.44
	10°	.59	.14	
	1°	.059	.014	
Ventura	30.1	$3.32	$3.66	$ .34
	27.8	3.12	3.65	.53
	3°	.20	.01	
	1°	.067	.003	
Wilmington	20.7	$2.75	$3.63	$ .88
	16.5	2.47	3.57	1.10
	4°	.28	.06	
	1°	.07	.015	

From 10° gravity to 18° gravity, the refining index exceeded the posted price by $1.00 to $1.76.

At 20° gravity, the spread varied between 88 cents and $1.11, and averaged 97 cents.

For gravities from 21° to 36°, the spread ranged downward from 86 cents to ten cents.

The total range in refining index for all these crudes was just 40 cents, from Zaca Creek 6.2° at $3.43 to Cymric 34.2° at $3.83.

The only conclusion that can be drawn from analysis of this table is that gravity is vastly over-rated as a measure of the value of crude oil to a modern refinery in California. Forty cents for twenty-eight degrees of gravity API average out to only 1.43 cents per degree. For the 19 cases of two or three different gravities from the same field shown in Table 2, the average difference in refining index per degree is $0.0096 - not quite one penny per degree.

Perhaps Mr. T. M. Powell, Vice President of Standard Oil Co. of California did not realize how correct he was when he said, "... in my considered opinion, 2¢ a degree is ludicrous."

A subsequent de-identified document entitled, "Refining Indices Relative to 27.6°API Santa Barbara Crude at $3.25/Bbl.," dated October 24, 1972, carries a footnote for five of the crudes, reading:

> "(1) Adjustment to index for gravity differing from D-1 analysis at 0.35¢/°API."

By the company's own internal calculations, for gravities on the table from 12° to 33°, 3 degrees difference change refining value only 1.05 cents, not 18 to 20¢.

This comparison of crude oil values has been going on for some years, at least. Another de-identified table dated June 28, 1960, compared 35.0° Kettleman with two Canadian crudes. Kettleman fell between the others for crude value, but its field price was so much higher than the other two that it had the lowest net value.

"Crude value - $/Bbl." was footnoted, "(1) Based on Crude Distillation Cat Cracking and Cat Reforming, 8% Rate of Return on Investment, with following Product Values:

Motor Gasoline	$5.88/Bbl.	(14.0¢/Gal.)
Gas Oil	$4.20/" "	(10.0¢/Gal.)
Fuel Oil	$1.90/" "	."

CORROBORATION

James McDonald Associates prepared for the California Independent Producers Association (CIPRO) in 1973, a report "A Study of California Crude Oil Price Differential (Heavy Versus Light)." An engineer, Mr. McDonald has been in the oil business since 1940, with considerable experience in operating and managing refineries for both major and independent oil companies.

McDonald analyzed the value of the basic refinery cuts in light crude and in heavy crude, in terms of their use in the downstream[1] facilities of a complex modern refinery. He concluded that the value of products from the heavy crude ran a few cents less than from the light crude, and the cost of refining was a few cents more - but the spread was much less than the price differential for the crudes. With a crude price differential of $1.01 per barrel, (34° Signal Hill or Light Arabian at $3.87, 18° Wilmington at $2.86), a 40¢ combination of lower value of products and higher cost of refining still left a margin of 61¢ per barrel in favor of using 18° crude.

To put it another way, a refinery that could pay $3.87 for 34° crude and make a profit could pay $3.47 for 18° crude and make the same profit per barrel. With 16 degrees difference between 34° and 18°, a 40¢ differential amounts to 2½¢ per degree.

This is about double the figure to be drawn from the Refining Index table but the latter reflects a much wider range of crude oils analyzed by that company.

The McDonald study points out that hydrogen is cheaper than crude oil, but up-grades it remarkably. Rather than paraphrase an engineering report, it is better to quote it directly. In Section VII, "Relative Values to Large, Sophisticated Refiners," it says:

---

1 "Downstream" refers to the cracking and reforming units beyond the crude distillation unit.

"If one shifts to the newest technology outlined in Section IX, then the case for higher prices for heavy crudes improves markedly. The product values from the two crudes get closer together, and the added capital cost diminishes. Considering the current and forecasted higher prices for very low-sulfur fuels, it is possible that Chevron[2] could show that the value of crude oil processed in a refinery using their newest process for the bottoms would be the same for 18° gravity and 34° gravity crudes. Technology has been creating a move in this direction. Chevron may have pushed it to a point where heavier crudes with better chemistry for fuels will become more valuable than lighter crudes."

(Emphasis supplied)

Additional material from the McDonald Report is quoted in Appendix D.

2 Chevron Research Co., a wholly-owned subsidiary of Standard Oil Company of California.

VIII. REFINERIES AND REFINING COSTS

The following table shows the ownership, location and size of each of the twelve refineries included in this report. The source publication is prepared annually by the Bureau of Mines from data furnished by the companies. In addition, it shows type and capacity of downstream facilities, that is, the cracking, reforming, coking and alkylation units which produce the gasoline stocks. Except for the two smallest, each of the other ten California refineries has 3 to 6 of these types of downstream facilities.

Refineries run continuously, twenty-four hours a day, seven days a week and frequently 52 weeks a year. When possible, maintenance is handled a segment at a time, leaving the rest of the plant working. Complete shutdowns are infrequent.

The volumes of crude oil going through refineries are immense. The El Segundo plant of Standard Oil Co. of California, the largest in the state, had in 1973 a daily input capacity of 220,000 barrels, or 9,240,000 gallons. In the course of a year, it can consume over 80,000,000 barrels of crude oil, and, through the addition of hydrogen, produce close to 80,000,000 barrels of refined products.

The seven companies had combined daily capacity of 1,272,500 B/D, or over 464,000,000 barrels per year. Grand total of all refineries in California was 1,755,800 B/D, or 640,000,000 barrels per year.

At something over 300 pounds per barrel, California capacity is equivalent to nearly 100,000,000 tons a year.

T A B L E 3

LOCATION AND CAPACITY OF REFINERIES
INCLUDED IN THIS REPORT
JANUARY 1, 1973

CAPACITY OF CRUDE OIL DISTILLATION UNIT
IN BARRELS PER CALENDAR DAY

COMPANY	LOCATION	CAPACITY
Atlantic Richfield Co.	Carson	165,000
Exxon Co., U.S.A.	Benicia	86,000
Mobil Oil Corporation	Torrance	123,500
Shell Oil Co.	Martinez	100,000
Shell Oil Co.	Wilmington	86,000
Standard Oil Co. of Calif.	Bakersfield	26,000
Standard Oil Co. of Calif.	El Segundo	220,000
Standard Oil Co. of Calif.	Richmond	190,000
Texaco, Inc.	Wilmington	77,000
Union Oil Co. of California	Arroyo Grande	35,000
Union Oil Co. of California	Rodeo	60,000
Union Oil Co. of California	Wilmington	104,000
	TOTAL CAPACITY:	1,272,500

Source of data: U.S. Department of the Interior, Bureau of Mines, "Petroleum Refineries in the United States and Puerto Rico, January 1, 1973--Crude Oil Capacity--," prepared July 24, 1973.

REFINERY COSTS

What does it cost to run a refinery? Items 30 and 31 of the subpoena ask that question in detail, including both a listing of all direct costs and allocation of company overhead to the refinery. The data are in dollars per year.

What did they put into the refinery? Item 23 asks for refinery input capacity, a standard industry number. Items 24 and 25 call for inputs of crude oil and of re-run unfinished oils, also standard concepts. Item 26 asks for the gravity of the combined input charge into the refinery.

What did the refinery produce? Item 27 asks for the output of finished products.

When these figures are expressed as dollars per year, and as barrels per year, we can divide dollars by barrels to get average cost of refining the barrels of crude and unfinished oils put in, or the average cost of refining the finished products made. Average cost per barrel can be compared with percentage of capacity utilized, and the effect of API gravity can be inferred.

The Joint Committee on Public Domain agreed with the seven companies that certain subpoenaed data would not be published in such manner as to permit identification of the company. While the Committee believes it is clearly in the public interest of the citizens of California to know the actual costs of producing gasoline and other refined petroleum products, we conclude that it is possible to provide this information without disclosing the individual costs of the several companies. Accordingly, the information has been blinded.

The refineries were shuffled in a random manner, and then numbered without regard to ownership. Location and capacity have been deleted, and certain peculiarities have been suppressed. The costs per barrel were obtained by dividing total dollar costs for the refinery by total inputs of crude and unfinished oils for the year, and the average cost per barrel is shown. Percentage of capacity utilized was obtained by dividing total inputs for the year by crude distillation unit capacity. Average gravity of the inputs was as stated by the company. For leap year, 1972, daily barrels were multiplied by 366.

The companies did not uniformly supply data for the years 1968 through 1972. Some used the period 1969 through 1973, and one or two had gaps in the availability of data for various reasons.

Some companies pool refining facilities of more than one plant. In these cases, we have combined costs, inputs, gravities, capacities, and products, and have adjusted for the transfer of unfinished oils from one refinery to another, so as not to double count inputs.

As a further step in preventing disclosure of identity, the two years 1968 and 1969 were dropped from the presentation here.

For one refinery for one year, No. 1 for 1972, we have been able to price out the inputs and the products. These figures, together with the other cost, capacity, and gravity data shown in Table #4, yield a refinery gross income per barrel.

The company furnished the amount and value of imported crude charged into the refinery. Considering the low average gravity of the entire slate, California crude was priced at the posted price for Wilmington 18^{o}, $2.61. Estimates were made for a small amount of unfinished oils and a very small amount of other domestic crude.

Output of refined products was priced, product for product, at the company's average realization on sales within California. The company did not report sales in California of two minor product lines; for these, bulk prices of another company were used.

Total value of products averaged out at $5.96 per barrel. Total crude and unfinished oils averaged $2.80 per barrel of input. Cost per barrel of refined products was $1.18. Gross profit at the refinery level was $1.98 per barrel, running at 95.6% of capacity:

Value of products	$5.96
Less cost of inputs	-2.80
	$3.16
Less cost of refining	-1.18
Gross profit per barrel	$1.98

T A B L E 4

REFINERY NO. 1

REFINING COSTS, INPUT GRAVITY, CAPACITY UTILIZATION, AVERAGE VALUE PER BARREL OF PRODUCTS, MATERIALS COST PER BARREL OF INPUTS, AND GROSS PROFIT PER BARREL OF PRODUCTS

	1972	1971	1970
Refining Cost Per Barrel of Inputs	$1.2675	$1.2593	$1.1854
Input Gravity	19.6°	19.8°	20.6°
Capacity Utilization	93.57	85.43	90.00
Refining Cost Per Barrel of Products	$1.1794	$1.1736	$1.1129
Average Value Per Barrel of Products	$5.96	$5.79	$5.69
Materials Cost Per Barrel of Inputs	$2.80		
Gross Profit Per Barrel of Products	$1.98		

Adjusting the refinery cost (but not the other figures) to full-capacity operation, cost would drop by 5 cents, leaving a gross profit of $2.03 per barrel.

Any profit made by the crude oil production department of the company would be an addition to the company profit, since producing and transporting margins on the above inputs are not here calculated.

A medium-sized refinery will run around 100,000 barrels per day, both by average and by median. Such a refinery capable of generating $200,000 per day gross profit, every day, after depreciation, property taxes, and direct costs, cannot be said to support the industry's claim that refining costs for heavy California crude are excessive or that $2.61 is as high a price for the crude as the industry can pay.

If the economics of this refinery are as typical as the following tables demonstrate, they could well afford to pay higher prices for crude in the period under consideration without raising the prices for gasoline, diesel and other finished oils.

The following tables 5 through 8 show the available cost, capacity, and value data for the remaining companies and refineries.

Table 9 shows the refineries ranked by increasing cost per barrel in each year. The upper half shows cost per barrel of inputs, and the lower half shows cost per barrel of products.

TABLE 5

REFINERY NO. 2

REFINING COSTS, INPUT GRAVITY, AND CAPACITY UTILIZATION

	1972	1971	1970
Refining Cost Per Barrel of Inputs	$1.7407	$1.4267	$1.3373
Input Gravity	22.4°	23.2°	26.4°
Capacity Utilization	74.60	86.60	94.20
Refining Cost Per Barrel of Products	$1.6313	$1.3158	$1.2290
Average Value Per Barrel of Products	$7.01	$6.58	$6.13

REFINERY NO. 3

REFINING COSTS, INPUT GRAVITY, AND CAPACITY UTILIZATION

	1972	1971	1970
Refining Cost Per Barrel of Inputs	$1.6293	$1.5387	$1.6103
Input Gravity	26.4°	26.5°	25.8°
Capacity Utilization	98.15	96.58	99.49
Refining Cost Per Barrel of Products	$1.5984	$1.5227	$1.5925
Average Value Per Barrel of Products	$5.78	$5.69	$5.66

T A B L E 6

REFINERY NO. 4

REFINING COSTS, INPUT GRAVITY, AND CAPACITY UTILIZATION

	1973*	1972	1971	1970
Refining Cost Per Barrel of Inputs	$1.3392	$1.6345	$1.4660	$1.4952
Input Gravity	21.8°	20.4°	21.2°	20.5°
Capacity Utilization	115.82	94.40	97.75	113.41
Refining Cost Per Barrel of Products	$1.3126	$1.4952	$1.3991	$1.4676
Average Value Per Barrel of Products	$6.03	$5.33	$5.40	$4.79

* First half of 1973

REFINERY NO. 5

REFINING COSTS, INPUT GRAVITY, AND CAPACITY UTILIZATION

	1972	1971	1970
Refining Cost Per Barrel of Inputs	$1.1973	$1.0562	$ .9727
Input Gravity	24.9°	24.1°	24.1°
Capacity Utilization	103.31	103.10	97.33
Refining Cost Per Barrel of Products	$1.2219	$1.0827	$1.0003
Average Value Per Barrel of Products	$6.15	$5.91	N.A.

T A B L E 7

REFINERY NO. 6

REFINING COSTS, INPUT GRAVITY, AND CAPACITY UTILIZATION

	1972	1971	1970
Refining Cost Per Barrel of Inputs	$1.2373	$1.3463	$1.2955
Input Gravity	26.3°	26.2°	26.2°
Capacity Utilization	102.21	94.77	97.79
Refining Cost Per Barrel of Products	$1.2207	$1.3172	$1.1960
Average Value Per Barrel of Products	$6.34	$6.36	$5.74

REFINERY NO. 7

REFINING COSTS, INPUT GRAVITY, AND CAPACITY UTILIZATION

	1973*	1972	1971	1970
Refining Cost Per Barrel of Inputs	$1.8716	$1.9160	$1.7959	$2.0421
Input Gravity	27.0°	28.5°	27.2°	29.5°
Capacity Utilization	100.53	96.44	99.73	96.04
Refining Cost Per Barrel of Products	$1.9369	$2.0328	$1.8608	$2.1508
Average Value Per Barrel of Products	$7.25	$6.50	$6.38	$6.17

* First half of 1973

T A B L E 8

REFINERY NO. 8

REFINING COSTS, INPUT GRAVITY, AND CAPACITY UTILIZATION

	1972	1971	1970
Refining Cost Per Barrel of Inputs	$1.1158	$1.2849	$1.2577
Input Gravity	26.1°	26.1°	23.6°
Capacity Utilization	94.82	83.77	78.41
Refining Cost Per Barrel of Products	$1.0938	$1.2530	$1.2497
Average Value Per Barrel of Products	$5.71	$5.56	$5.63

REFINERY NO. 9

REFINING COSTS, INPUT GRAVITY, AND CAPACITY UTILIZATION

	1973	1972	1971	1970
Refining Cost Per Barrel of Inputs	$1.0546	$1.0144	$ .8991	$ .9951
Input Gravity	28.7°	28.0°	28.5°	26.2°
Capacity Utilization	103.57%	95.03%	110.00%	100.00%
Refining Cost Per Barrel of Products	$1.0497	$ .9892	$ .8736	$ .9663
Average Value Per Barrel of Products	$6.02	$5.31	$5.06	$4.83

TABLE 9

REFINERIES RANKED BY INCREASING COST PER BARREL OF INPUT

RANK	1973	1972	1971	1970
1	(9) $1.0546	(9) $1.0144	(9) $ .8991	(5) $ .9727
2	(4) 1.3392	(8) 1.1158	(5) 1.0562	(9) .9951
3	(7) 1.8716	(5) 1.1973	(1) 1.2593	(1) 1.1854
4		(6) 1.2373	(8) 1.2849	(8) 1.2577
5		(1) 1.2675	(6) 1.3463	(6) 1.2955
6		(3) 1.6293	(2) 1.4267	(2) 1.3373
7		(4) 1.6345	(4) 1.4660	(4) 1.4952
8		(2) 1.7407	(3) 1.5387	(3) 1.6103
9		(7) 1.9160	(7) 1.7959	(7) 2.0421

PER BARREL OF PRODUCTS

1	(9) $1.0497	(9) $ .9892	(9) $ .8736	(9) $ .9663
2	(4) 1.3126	(8) 1.0938	(5) 1.0827	(5) 1.0003
3	(7) 1.9369	(1) 1.1794	(1) 1.1736	(1) 1.1129
4		(6) 1.2207	(8) 1.2530	(6) 1.1960
5		(5) 1.2219	(2) 1.3158	(2) 1.2290
6		(4) 1.4952	(6) 1.3172	(8) 1.2497
7		(3) 1.5984	(4) 1.3991	(4) 1.4676
8		(2) 1.6313	(3) 1.5227	(3) 1.5925
9		(7) 2.0328	(7) 1.8608	(7) 2.1508

Refinery #9 is distinctly the lowest cost plant in this study. The figures were carefully checked, and management was queried on several points. Even after corrections in data, this refinery remained the lowest cost. It averaged less than $1.00 per barrel, whether figured on inputs of crude and unfinished oils, or on outputs of refined products.

For the four years, 1970 through 1973, there is solid cost data for 30 plant years: nine for each of three years, and 3 for 1973. Figured on input barrels, 15 of the thirty were below $1.30. Figured on barrels of product, 16 were below $1.30.

On inputs, 9 were above $1.50, and on products, 8 were over $1.50.

In 1970 and 1971, only refineries nos. 3 and 7 ran above $1.50. Refinery #7 is in a class by itself. Its costs are consistently much higher than the next highest cost plant, and approximately double those of the lowest cost plant. The costs and operations were queried, and management specifically confirmed the $2.00 cost level - but did not provide explanation.

It can't be a question of company size and efficiency; remember, we are dealing with behemoths whose assets scale upward from $2.9 billion.

By rights, in a competitive market, this refinery should be running in the red for the past four years. If it is not a loss operation, its high cost clearly underscores the proposition that the spread between products prices and crude oil prices is much too great in California.

When we compare costs with gravity of inputs, the results are mixed. The highest cost refinery, #7, ran the highest gravity, 28^{o} average. Right behind it, with 27.9^{o} average was the lowest cost plant.

Refinery #1, with the lowest gravity crude, was distinctly low cost, running third on cost per barrel of products, and fifth, third and third on cost per barrel of inputs. It was a fairly close third.

Nos. 3 and 6 ran the same average gravity, 26.2^{o}. No. 3 ranked seventh, eighth and eighth on the products comparison and sixth, eighth and eighth on inputs. No. 6 was below average

in cost, running fourth, sixth and fourth on products, and fourth, fifth and fifth on inputs. It averaged about 30¢ per barrel lower cost than did no. 3.

No. 4, running 21° crude, was one of the higher cost plants, placing sixth and seventh position in the three years 1970-1972, and being above $1.30 in every year. At the same time, it showed the highest average rate of capacity utilization.

No. 5, a low cost plant, ran on an average of 24.4° gravity oil, at slightly above rated capacity. No. 8, with a degree higher average gravity, 25.3°, but running well below capacity, showed below average cost.

On the basis of the cost, gravity, and capacity-utilization figures here, no justification for a steep gravity price differential can be found.

CORROBORATION

A further de-identified document dated February 9, 1973, presented in detail, including processing costs, a re-evaluation of analysis for Equadorian crude 28.6°API. It says in part:

> "Equadorian (sic) crude, sometimes referred to as Esmeralda or Oriente (as we understand it), is essentially a replacement crude for Arabian Light. As such, it makes about 3% more light products than Arabian Light and thus has a $.21 higher refining index when these additional light products are valued relative to 14¢/gallon Pool Mogas (due to limited refining capacity).
>
> "Consequently, if Arabian Light lays in for $3.68 including a 50¢ quota ticket, then we can afford to buy Equadorian crude if it lays in for less than $3.89 including a 50¢ ticket."

Clearly, refining index is the delivered price the refinery can afford to pay for a crude of a stated gravity, given the price for the prime products to be made from it.

Arabian Light is 34° gravity, 6° higher than the Equadorian, yet the Equadorian is worth 21¢ barrel premium to this refinery.

Value of products, costs of processing, and sulfur penalties are set out in a computer printout attached to the foregoing memoranda, based on input of 100 barrels of 28.6° Equadorian crude.

Salable products, mostly finished goods and jet fuel, were valued at $405.59 for 100 barrels.

Total processing amounted to $56.97 including costs for crude distillation unit, coker, fluid catalytic cracker, catalytic reformer, alkylation plant, one de-identified process, gasoline blender, and octane adjustment cost. Hydrogen required was valued at $18.57, and sulfur penalties were shown as $4.36 for handling and $5.41 for residual oil. Other costs were stated to be zero.

Total costs, processing, hydrogen, and penalties, add to $85.31 for refining 100 barrels of 28.6° crude.

Total index was $320.29 at the time of the computer run.

It is obvious that the computer run was made at an earlier date than February 1973, because finished Pool Mogas was valued at $3.89 per barrel, 9¼¢ per gallon.

By the date of the 1973 memo, the Pool Mogas was valued at 14¢ per gallon, or $5.88 per barrel, this being a factor in raising the index to $3.89.

The refining cost per barrel had also presumably gone up from the date of the computation, but it would be hard to project it beyond $1.25, a figure compatible with those in the refinery cost tables.

The memo and attached paper are stamped, "Incremental Economics." The parenthetical phrase "(due to limited refining capacity)" in the memo, however, suggests there wasn't much room left for declining marginal cost in the refinery.

DEPRECIATION COSTS

As a final comparison of cost elements, we computed depreciation charge per barrel of inputs. Leaving out the highest-cost refinery, and eliminating the individual designations, Table 10 shows depreciation per barrel, ranked from low to high for the period 1968 through 1969.

Over half of the figures in the table are under 16 cents. Only four are over 20¢. Seven are under 9 cents.

Table 10 does not support the industry claim that processing California crude oil requires heavy investment in special-purpose refining equipment. No justification for a 6.2¢ gravity penalty can be found here.

T A B L E 10

DEPRECIATION CHARGES IN CENTS
PER BARREL OF INPUTS, RANKED
IN ORDER FROM LOW TO HIGH*
1968 - 1973

1973	1972	1971	1970	1969	1968
11.27	11.34	10.44	5.18	4.39	3.74
14.14	11.91	12.11	6.95	8.68	7.77
	12.96	12.77	12.36	10.92	8.25
	16.11	13.59	14.97	12.37	16.07
	17.13	17.83	16.56	13.83	24.73
	18.31	18.88	17.85	16.22	24.84
	18.42	19.42	18.97	19.83	
	27.53	22.70	19.97	20.00	

* The highest-cost refinery omitted from this table.

What should it cost to refine a barrel of crude oil? We cannot tell, for lack of prior public information on actual processing costs. Five years ago, the Antitrust and Monopoly Subcommittee of the U. S. Senate used an estimate of 95 cents per barrel for refinery spread in the Eastern refineries.[1] For operations of oil companies who made their profits in crude oil production, a calculation of well-head price for oil, plus transportation to the refinery, plus 95¢ per barrel processing cost, was taken to give a reasonable refinery price per barrel of products.

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1 Hearings before the Subcommittee on Antitrust and Monopoly of the Committee on the Judiciary United States, Ninety-first Congress, "Governmental Intervention in the Market Mechanism, - The Petroleum Industry," part 3, July 24, 1969, page 1277.

IX. WHAT DO THEY CHARGE THEIR COMPETITORS?

We presume charges by one company to another for custom refining would be the most likely candidate for an arms-length bargain.

One company with some excess capacity has been refining oil for another company for several years. The party of the second part furnishes the crude delivered to the refinery, paid $1.13 per barrel in 1972, and received refined products.

In another company in 1971, calculations to support a processing charge came up with $1.12 per barrel on a no-profit basis; the use of heavy crude was recommended, on the assumption that it could yield a greater margin for profit above a bare cost basis.

Reference to a custom refining charge of 89¢ per barrel, by one of the seven companies for a smaller company outside the group was also found.

Such charges as these may or may not represent full average cost of refining in the plants doing the processing, but they clearly give no support to the claims that refining heavy California crude is a high-cost operation.

X. ECONOMIC NOTE

It is possible to design a refinery to operate at maximum efficiency (that is, lowest-cost) on a single crude oil or single blend. The equipment and processes can be tailored to the properties of the crude and to a single product mix. Given a large enough supply of unchanging crude and a long enough demand for the output, this would be the ideal refinery.

On the other hand, with firm expectations of variations in the crude supply, and in the nature of the demand, it is essential to design a refinery with considerable flexibility. Both investment cost and operating cost of the general-purpose plant would be higher than for the hand tailored plant.

Given the flexible refinery, however, the expectation is that its dollar cost of operation will be substantially flat across the year, regardless of normal variations in crude input, or in product mix. Depreciation, property taxes, interest on borrowed money, plant security, are functions of time rather than of rate of operations.

Once the refinery is in operation, "variable costs" rapidly approach their maximum. It takes a full crew to run it, seven days and nights a week. Maintenance must go on, and fuel, power, water, catalysts, communications, transport, won't vary much with variations in type or volume of inputs.

In consequence, refining cost per barrel of inputs can be expected to decline as volume approaches - and passes - design capacity. This furnishes the basis for the concept of the "incremental barrel"; that is, at any level of operations (up to full physical capacity) processing costs per barrel continue to decline. The next barrel will cost less to refine than did the previous barrel.

Declining cost with increasing volume has led to gasoline price wars in the past; it also helps explain how profits rise as demand overtakes supply.

The rest of the explanation for high profits in times of shortage lies in the fact that demand for petroleum products is highly inelastic. High prices don't choke off demand, nor, here lately, do they bring forth more product. They just

produce higher profits, by increasing revenues, and decreasing refining costs.

In the planning stage, or while playing games with a mathematical "model" of a refinery in a computer, it may be perfectly possible to "prove" that low-gravity oil is much more costly to process than is high gravity crude. The extra cost of building the refinery capable of handling heavy crude, as well as light crude, can be shown, and the result translated into gravity differentials.

It is well to keep in mind, however, the difference between models and reality. Several of the refiners use linear programing models, which will yield an optimum or best, solution to a problem consisting of several variable inputs and several variable outputs. In this connection, a quotation from one of the experts is in order. Dr. William J. Baumol, Professor of Economics at Princeton, wrote in "Economic Theory and Operations Analysis" the following warning:

> "... Here is another duality symmetry.
>
> "It is now easy to prove the following very useful theorem:
>
> If it is feasible to find any value P', of the variable P, which is to be maximized and any value, C', of the dual variable which is to be minimized, P' will never exceed C'. In the present illustrative case the reason is obvious. P is total profit and C is total inputed cost and <u>we have constructed inputed costs so that it will never fail to eat up profits....</u>"[1]
>
> (Emphasis supplied)

In the real world of California oil refining, the refineries have been built or modified to handle heavy California crudes. Given such refining capability, the cost of operation is not

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1 Baumol, W. J., "Economic Theory and Operations Analysis," Prentice-Hall, Inc., Englewood Cliffs, New Jersey, first edition, 1961, page 93.

going to vary much, whether heavy crudes or light crudes are run through them.

The problem now is not how much more it costs to build the right kind of refinery. That decision has been made and the investment sunk. The question is, how many times are the companies going to be allowed to recover the extra investment before they share the benefits with the producers of the crude and the consumers of the refined products?

XI. A RATIONALE: CALIFORNIA IS DIFFERENT

An industry made up of vertically integrated corporations is in a position to select the stage or stages at which it takes its profits. Favorable tax arrangements may help in the selection.

The major oil companies operating in the prolific oil fields of Louisiana and Texas have long found it most remunerative to take their profits in the production stage. They produced oil and gas for their own account, and had a surplus to sell into other states, either as crude or as refined products.

Production costs in the South are relatively low, because in the main the oil is light and thin, and the deep wells flow from the pressure of natural gas or the pressure of overlying rocks which forces the oil up the wells. Pumping wells, as a rule, tend to be shallow, and their lifting cost is small.

The percentage depletion allowance in the Federal tax laws has been most favorable for the producers in that area. This provision permits the producer to deduct from gross income 22% (formerly 27½%) of that income before calculating income tax on the balance. There is one proviso, that the amount of the deduction may not exceed 50% of the net income.

Taking a 1972 price of $3.50 in that area, the depletion allowance of 22% would be 77 cents per barrel. Three fifty less 77 cents is $2.73, the amount of gross income from which costs were to be subtracted in figuring net income for tax purposes. The real profit per barrel would be the computed net after taxes plus that 77¢, which was free and clear.

The 50% limitation would not come into play so long as net before taxes was as much as $1.54. So long as production cost was below $1.96 per barrel, and the price was $3.50, the full 22% depletion allowance could be taken. Production costs for most production weren't that high.

One further advantage to the integrated companies of taking their profits in the oil fields is that the refinery margin can be kept low. Independent refiners, who might be tempted to cause competition in the markets for refined products

can be kept under control. By definition, they are the refiners who have no crude production of their own. They have to buy crude at the comfortably profitable field prices, buttressed by the depletion allowance, and then have very little margin to work with between crude prices and gasoline and fuel oil prices.

The situation in California is quite different in several important respects. The oil is thick, heavy, and viscous; it does not flow readily. There is very little gas in California to provide drive. The wells are not particularly deep, so the rock pressure does not lift the oil. It takes pumps, or water, steam or fire flood, to produce oil here.

The production costs can be measured and they run high. It costs money to produce oil, probably more money than in any other important supply area in the United States.

California is a deficit state for oil, using far more than it produces. Oil and refined products have to be imported from somewhere else and the geographical isolation of California from other large producing areas interposes a significant transportation charge.

Half the production here is in the hands of independents who do not refine. They have to sell their oil, mostly to the majors.

The high production cost activates the "50% of net" limitation in the percentage depletion calculation, resulting in a very low depletion allowance for most California crude oil production.

It may fairly be said that the percentage depletion allowance, like too many other governmental incentives, works the wrong way. The incentive is at its greatest in the low-cost fields, where it isn't really needed, and at its least in the high-cost fields where, if at all, incentives are needed.

Here in California where the majors have to buy oil, and where percentage depletion doesn't do much, the incentives to the majors are to keep the price of crude low, and to take their profits in the refining stage.

In addition the federal mandatory oil import control program operated quite differently in California than for the rest of the country east of the Rockies. In Petroleum

Administration for Defense (PAD) Districts 1, 2, 3, and 4, from the Atlantic to the Rockies, imports of crude oil and light refined products were sharply restricted to about 12% of the total demand. From 1959 to 1973, while foreign crude oil was cheaper than domestic crude, the program supported crude oil prices in Districts 1-4. Only residual fuel oil was importable in large quantities and that only for District 1, the Atlantic Coast.

The rule was quite different in District 5, the five states on the Pacific plus Nevada and Arizona. Imports were licensed in the amount of the difference between demand and domestic supply. Existing refiners at salt water ports were permitted to import the amounts of crude they needed. It wasn't so easy for the refiners in Bakersfield, but they got some benefits, through exchanges. In District 5, the import control program did not provide much support, if any, for domestic crude oil prices.

As we have pointed out elsewhere, here again the effect of federal programs relating to oil has been to freeze into regulations unsatisfactory conditions existing in California.

As set forth in the Pipeline Report, earlier in this series, control of the pipelines in California by the majors prevents the independent refiners from taking much advantage of the high refining margins the majors have arranged for themselves.

This analysis may help explain to the reader why the major oil companies have stressed so much the line that heavy oil costs more to refine. It makes a nice cover for the real profit center.

LEGISLATIVE DEPARTMENT
STATE OF CALIFORNIA

SUBPENA

BEFORE THE
SUBCOMMITTEE ON CRUDE OIL PRICING OF THE
JOINT COMMITTEE ON PUBLIC DOMAIN
OF THE LEGISLATURE

OF THE STATE OF CALIFORNIA

The People of the State of California send greetings to:

Texaco, Inc. (Deliver to Mr. Miles Newby)

3350 Wilshire Boulevard

Los Angeles, California

YOU AND EACH OF YOU, are hereby commanded to attend before the

Subcommittee on Crude Oil Pricing of the Joint Committee on Public Domain

of the Legislature of California, created by Assembly Concurrent Resolution No. 34, 1971 Regular legislative session (as continued by Assembly Concurrent Resolution Nos. 8, and 63, 1973-74 Regular legislative session), at Room 2170, in the State Capitol, Sacramento, California, at 9:30 o'clock, a.m., on Monday, the 24th day of September, 19 73, to testify as a witness in an investigation by the said committee, and you are hereby commanded to remain until said investigation is completed, unless sooner discharged, and to bring with you the following now in your possession or under your control, to wit:

The documents described in the attached annex.

For failure so to attend you shall be liable to punishment as prescribed by law and the practice of legislative bodies.

By order of the Chairman of the said sub committee, this 27th day of August, 19 73.

/s/ KENNETH CORY
Chairman

As used in this subpoena, the following terms have the meanings indicated:

1. "California" includes the land areas of the State of California, the California State tidelands and the United States Outer Continental Shelf off the shores of the State of California.
2. "Company" indicates the petroleum company by which you are employed, and all of its domestic parents, subsidiaries, divisions and affiliates.
3. "Crude Oil" means all liquid hydrocarbons produced from oil wells, including crude oil and lease condensate.
4. "Exchange" means any agreement for the purchase, receipt, sale or delivery of crude oil or unfinished oils which provides for consideration other than money, including the execution or performance of a reciprocal agreement for sale, delivery, purchase or receipt of other crude oil, unfinished oils, or petroleum products. This includes but is not limited to "3-cut exchanges," "value exchanges," "posted price exchanges," and "phantom exchanges."
5. "Indicated Additional Reserves" means additional recoveries in known reservoirs (in excess of proved

reserves) which engineering knowledge and judgment indicate will be economically available by application of fluid injection, whether or not such program is currently installed. (A.P.I. definition)

6. "Long Beach Unit" shall mean the Long Beach Unit of the Wilmington oil field.

7. "Production" means gross production of crude oil, including royalty interests.

8. "Proved Reserves" shall mean the estimated quantities of all liquids statistically defined as crude oil, which geological and engineering data demonstrate with reasonable certainty to be recoverable in future years from known reservoirs under existing economic and operating conditions. (A.P.I. definition)

9. "Unfinished Oils" means all hydrocarbon substances, other than crude oil, acquired for further processing in a refinery.

such documents under your control or custody as will indicate:

1. The amount, in barrels per day, of Company's sole production of crude oil in California during each of the past five years, other than from units, joint operations and the Long Beach Unit;
2. The amount, in barrels per day, of Company's production of crude oil from units in California during each of the past five years;
3. The amount, in barrels per day, of Company's production of crude oil from joint operations in California during each of the past five years;
4. For each unit and joint operation of which Company has been the operator during any period in the past five years:
   (a) the identities of all other working interest owners in each such unit and joint operation;
   (b) the distribution of crude oil to each working interest owner in each such unit and joint operation;
   (c) all contracts and other documents which set forth the manner of determining the actual rate of production from each such unit and joint operation;

(d) the records of all meetings and other communications with or from working interest owners concerning decisions about the rate of production from each such unit and joint venture;

5. The amounts, in barrels per day, of Company's share of crude oil from the Long Beach Unit during each of past five years;

* 6. Company's evaluations of test data relating to the Long Beach Unit and other factors leading to the submission of bids in 1965 on the various increments, including communications with other persons;

7. Contractual arrangements of any nature, other than purchases, sales and exchanges of crude oil, with any other party or parties to the contractors' agreement in the Long Beach Unit, relating in whole or in part to the Long Beach Unit, to which the State of California is not a party;

* 8. Company's proved reserves and indicated additional reserves in each of the following three areas as of December 31, 1972:

(a) California onshore;

(b) California offshore - State tidelands;

(c) California offshore - Federal Outer Continental Shelf;

9. All contracts, letters of agreement and other memoranda relating to agreements to sell crude oil at the lease in California, and all modifications thereof, in effect at any time during the past five years;

10. All contracts, letters of agreement and other memoranda relating to agreements to purchase crude oil at the lease in California, and all modifications thereof, in effect at any time during the past five years;

11. All contracts, letters of agreement and other memoranda relating to any sale or purchase of crude oil or unfinished oils in California at places other than the lease, and all modifications thereof, in effect at any time during the past five years;

12. All contracts, letters of agreement and other memoranda relating to agreements to acquire or dispose of crude oil or unfinished oils in California by exchange, and all modifications thereof, in effect at any time during the past five years;

13. Records of receipts and deliveries of crude oil and unfinished oils under the agreements referred to in response to demands 9 through 12 above;

* 14. All documents analyzing the value, benefits and detriments to Company of each purchase, sale or exchange agreement, or

prospective purchase, sale or exchange agreement, in effect or proposed at any time during the past five years;

15. All current exchange digests and all year-end summaries of exchanges reported in response to demand 12 for each of the past five years;

16. With respect to all three-cut exchanges in effect at any time during the past five years, the records of all transactions by which any imbalance in the delivery of any of the three cuts was settled, in whole or in part, by physical or "book" transfer of any quantity of any other cut, or of any refined product, or of crude oil, or of cash, and the pricing basis for each such settlement;

17. The amount of foreign crude oil and unfinished oils landed in California during each of the past five years under Company's oil import allocations for PAD District V;

18. The amount of foreign crude oil and unfinished oils landed in California during each of the past five years under any other company's oil import allocation for PAD District V and subsequently acquired by Company;

19. Total actual cost to Company of tanker delivery of foreign crude oil and unfinished oils to Company's California

refineries by tankers owned or chartered by Company, and total quantities of foreign crude oil and unfinished oils so delivered during each of the past five years;

20. Total billings to Company's operating divisions in California (however denominated) by affiliates or Company for tanker delivery of foreign crude oil and unfinished oils to Company's California refineries, and the total quantities so delivered during each of the past five years;

21. The amount of Canadian crude oil brought into California by Company during each of the past five years;

22. The amount of other United States crude oil brought into California during each of the past five years;

23. The crude oil and unfinished oil input capacity of each of Company's refineries in California for each of the past five years;

24. The amounts, in barrels per day, of inputs of crude oil into each of Company's California refineries during each of the past five years;

25. The amounts, in barrels per day, of inputs of unfinished oils into each of Company's California refineries during each of the past five years;

26. The average gravity of crude charge, including crude oil and unfinished oils, into each of Company's California refineries during each of the past five years;

27. The amount, in barrels per day, of each finished product produced by each of Company's California refineries during each of the past five years;

* 28. The total quantities sold in California of each finished product produced at Company's California refineries during each of the preceding five years, and the invoice prices (exclusive of tax), to each of the following categories of purchasers,

(a) wholesale jobbers or distributors;

(b) dealer tankwagon purchasers;

(c) commercial/industrial customers; and

(d) federal, state, county and municipal contract purchasers;

* 29. The refinery realization or netback values of each of Company's refineries used for financial accounting, economic analysis, or operations planning within Company for each of the past five years;

* 30. The costs of operating each of Company's refineries in California for each of the past five years, including

(a) amortization

(b) depreciation

(c) maintenance

(d) salaries and wages

(e) electricity and fuel purchased for the refinery operations and not generated by the refinery

(f) costs of chemicals and catalysts purchased and costs of catalyst regeneration

(g) overhead incurred by the refinery

(h) property taxes

(i) other direct refining costs;

* 31. The Company overhead, other than refinery overhead, allocated to each refinery in California for each of the past five years;

* 32. All economic or financial studies or planning analyses showing investment in Company's California refining facilities, the cumulative depreciation on such refining facilities, and the cash flow received by operation;

* 33. All economic or financial studies or planning analyses relating to plans for expansion of Company's refining facilities in California which have been implemented in the past five years (limited to facilities costing $1,000,000 or more), including the actual investment in

such facilities, the expense of operation thereof, the cash flow received therefrom, and the calculated years to payout;

34. The location of all crude oil pipelines in California owned by Company and showing connections to:

(a) gathering systems

(b) pipelines owned by any other company

(c) refineries

(d) tank terminals, and

copies of any "throughput" maps or schematic diagrams filed with any federal agency, showing average capacity and throughput of segments of California pipelines for emergency planning purposes;

35. The daily throughput capacity of each such pipeline;

36. The existence of jointly owned or jointly operated crude oil pipelines in California in which Company holds any interest and the share of ownership or control held by Company, and copies of any agreements among the joint owners concerning the division or transfer of ownership or rights of use in such pipeline;

37. If Company is the operator of any pipeline described in Item 36 above, the identities of the other parties and their shares, and the location of each pipeline, showing connections to:

(a) gathering systems

(b) pipelines owned by any organization other than the joint organization

(c) refineries, and

(d) tank terminals;

38. The dates of initial construction and completion of each crude oil pipeline in California owned solely or jointly by Company;

39. The dates of all expansions of such pipelines;

40. Any communication by Company with, or orders to Company by, the California Public Utilities Commission or California Railroad Commission exempting any such pipeline from public utility status, and copies of any right-of-way permits or easements granted by any federal agency with respect to any pipeline in California;

41. All county permits and conditions for building or operating any crude oil pipeline or refined products pipelines in California, issued to Company since 1944;

42. The amount of crude oil actually pumped through each of Company's crude oil pipelines, or any segment thereof, for each of the past five years;

43. The amounts of crude oil pumped through each such pipeline or any segment thereof produced or purchased by Company at

the wellhead and transported to Company's refineries during each of the past five years;

44. The amounts of crude oil pumped through Company's crude oil pipelines or any segment thereof, produced or purchased by Company at the wellhead but delivered elsewhere than to its own refineries;

45. All contracts relating to said deliveries;

46. The amounts of crude oil produced or purchased by Company but delivered into the pipelines of any other company;

47. All contracts relating to the above deliveries;

48. The amounts of crude oil delivered to Company from any other company's pipelines;

49. All contracts relating to the above deliveries;

50. The fields in which Company owns or shares joint ownership or control of crude oil gathering systems;

51. All charges to others for, or contracts for the acquisition of crude oil for purposes of, transportation of crude oil through such crude oil gathering systems;

52. All connections of crude oil gathering systems owned by Company to pipelines, shore terminals or other facilities owned by other companies;

* 53. All economic analyses, including computer print-outs or other studies relating to the relative values to each of Company's refineries in California of each of the identifiable crude oils produced in California, Alaska, and those coming through the Four Corners pipeline.

California Legislature

Joint Committee on Public Domain

KENNETH CORY
CHAIRMAN

JOHN A. NEJEDLY
VICE CHAIRMAN

COMMITTEE CONSULTANT
WILLIAM E. NORTHROP
ROOM 5016, STATE CAPITOL
SACRAMENTO 95814
TEL. 916 445-7446

August 31, 1973

By now you have probably received a subpoena commanding your attendance at a meeting of the Joint Committee on Public Domain. The Committee does not want to cause any more inconvenience to you than is absolutely necessary for the pursuit of its investigation and the efficient use of government time. We therefore make the following proposals which may simplify your efforts:

1. Compilations, or other schedules, the accuracy of which is attested to by the person who makes them, may be submitted in lieu of providing the documents called for by items 1, 2, 3, 4(a), 4(b), 5, 8, 13, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 30, 31, 38, 39, 42, 43, 44, 46, 48, 50 and 51.

2. Maps, indicating throughputs, capacities, connections, and other requested data may be submitted in response to questions 34, 35, 37, 42, 50 and 51 in lieu of other documents describing the requested data.

3. My staff will be glad to meet with you to determine whether it will be possible to shorten the responses to questions 4(c), 9, 10, 12, 45, 47 and 49. If the specific clauses in which the Committee is interested are "boilerplate," it may be possible to receive just one sample

contract representing each clause of a given type, and list the other contracts to which it is applicable.

4. Since my staff informs me that you manufacture innumerable products, we will accept, in response to questions 27 and 28, responses with respect to the following items:

(a) gasoline - all grades
(b) jet fuel - all types
(c) kerosine, including stove distillate (PS 100)
(d) diesel fuel, including motor diesel and railroad diesel (PS 200)
(e) light fuel, including #2 fuel oil and heating oil (PS 300)
(f) heavy fuel, including #6 fuel oil and Bunker C (PS 400)
(g) low sulphur residual fuel oil (less than 0.5% by weight)
(h) coke
(i) all other finished products sold or transferred out of your refinery, listing each such product which constitutes more than five per cent by volume of each refinery's output

5. Since there are probably too many minor pipeline expansions to consider, we will be glad to limit them to all expansions which change the throughput capacity of the pipeline, or any segment thereof and all expansions which cost more than $50,000. If this still leaves an insuperable amount of paperwork, meet with my staff and tell them of the specific problems and solutions as you see them.

On any other matter with which you have specific problems, feel free to confer with my staff. I have instructed them to be reasonable, but to keep in mind the urgency of this matter.

Sincerely,

KENNETH CORY

KC:Nj

California Legislature

Joint Committee on Public Domain

September 20, 1973

Mr. David Latchford, Regional Counsel
Mobil Oil Corporation
612 South Flower Street
Los Angeles, California

Dear Mr. Latchford:

...

In considering the objections of various companies to subpoena item 8 relating to the reserves, we have determined that our purposes will be served if, for each of the proved reserves and indicated additional reserves, only two figures are submitted: the reserves on the State tidelands areas and the combined reserves for the State on-shore areas and the Outer Continental Shelf areas.

Sincerely yours,

KENNETH CORY

KC:Nr

APPENDIX B

REFINING INDEXES - PROCESSING - EXCLUDES LUB OIL PREMIUM
EXCLUDES SULFUR PENALTY OR PREMIUM

CRUDE (1)	D-1 °API GRAVITY (2)	POSTED PRICE (3)	REFINING INDEX 34° ALASKAN @ 3.70 (4)	INDEX ABOVE POSTED (5)	REFINING INDEX 38° BERRI @ 4.35 + .27 (6)	INDEX ABOVE POSTED (7)
Alferitz (Devil's Den)	25.7	3.23	3.72	.49	4.82	1.59
Aliso Canyon	21.7	2.96	3.67	.71	4.73	1.77
Alondra	27.4	N.A.	3.69	N.A.	4.78	N.A.
Ant Hill	15.3	2.29	3.58	1.29	4.67	2.38
Antelope Hills	24.0	3.00	3.71	.71	4.83	1.83
Asphalto	36.4	3.52	3.71	.19	4.82	1.30
Bakersfield Midway Lt. Seg.	25.3	N.A.	3.72	N.A.	4.84	N.A.
Bandini	39.2	3.80	3.80	-0-	4.91	1.11
Bardsdale	35.3	3.55	3.75	.20	4.86	1.31
Belgian Anticline	36.3	3.65	3.78	.13	4.88	1.23
Bellevue (Union)*	34.8	3.41	3.71	.30	4.82	1.41
Bellevue West	33.7	3.35	3.71	.36	4.83	1.48
Bellevue West	34.8	3.41	3.73	.32	4.85	1.44
Belmont Offshore (Seal Beach)	31.0	3.40	3.68	.28	4.76	1.36
Belridge	14.0	2.27	3.59	1.32	4.68	2.41
Belridge North	35.4	3.61	3.79	.18	4.91	1.30
Beverly Hills (Crescent Heights)	28.8	3.28	3.71	.43	4.81	1.53
Blackwell's Corner	13.7	2.27	3.62	1.35	4.73	2.46
Bradley Canyon	10.1	1.72	3.48	1.76	4.46	2.74
Buena Vista	29.9	3.37	3.69	.32	4.80	1.43
Burrel (Mobil)*	32.4	3.41	3.78	.37	4.89	1.48

* See Notes on Page No. 75

CRUDE	D-1 °API GRAVITY	POSTED PRICE	REFINING INDEX 34° ALASKAN @ 3.70	INDEX ABOVE POSTED	REFINING INDEX 38° BERRI @ 4.35 + .27	INDEX ABOVE POSTED
Carpinteria Offshore(Parcel 21)	25.8	2.96	3.62	.66	4.68	1.72
Casmalia(Union posts 9° @ $1.52)*	8.3	N.A.	3.46	N.A.	4.45	N.A.
Castaic Junction	17.2	2.37	3.56	1.19	4.60	2.23
Castaic Hills (Honor Rancho)	30.6	3.26	3.76	.50	4.86	1.60
Cat Canyon West	13.9	2.03	3.50	1.47	4.51	2.46
Coalinga	30.9	3.31	3.72	.41	4.83	1.52
Coalinga	25.3	3.04	3.72	.68	4.84	1.80
Coalinga	14.7	2.33	3.61	1.28	4.71	2.38
Coles Levee North (Approx.)	32.2	3.29	3.77	.48	4.87	1.58
Coyote East	24.5	3.11	3.66	.55	4.74	1.63
Coyote West	27.0	3.15	3.69	.54	4.79	1.64
Cymric	12.4	2.07	3.57	1.50	4.64	2.57
Cymric	32.1	3.47	3.81	.34	4.96	1.49
Cymric	34.2	3.57	3.83	.26	4.96	1.39
Del Valle	29.7	3.20	3.71	.51	4.81	1.61
Devil's Den (Union)*	18.3	2.49	3.63	1.14	4.77	2.28
Edison	20.6	2.63	3.67	1.04	4.80	2.17
Edison	38.9	3.69	3.78	.09	4.91	1.22
El Segundo	18.3	2.59	3.67	1.08	4.80	2.21
Elwood	33.3	3.54	3.78	.24	4.88	1.34
Fillmore	33.6	3.43	3.65	.22	4.73	1.30
Fruitvale	16.9	2.36	3.58	1.22	4.67	2.31
Gato Ridge	11.1	1.78	3.49	1.71	4.48	2.70
Greeley	33.1	3.35	3.68	.33	4.78	1.43
Greeley	35.0	3.47	3.74	.27	4.86	1.39
Guijarral Hills	35.0	3.56	3.73	.17	4.84	1.28

* See Notes on Page No. 75

CRUDE	D-1 °API GRAVITY	POSTED PRICE	REFINING INDEX 34° ALASKAN @ 3.70	INDEX ABOVE POSTED	REFINING INDEX 38° BERRI @ 4.35 + .27	INDEX ABOVE POSTED
Helm (Mobil)*	31.3	3.37	3.67	.30	4.78	1.41
Holser Canyon	27.5	3.08	3.68	.60	4.75	1.67
Honor Rancho	35.2	3.55	3.72	.17	4.85	1.30
Huntington Beach	15.9	2.38	3.56	1.18	4.61	2.23
Huntington Beach	23.2	2.91	3.68	.77	4.76	1.85
Inglewood	21.5	2.84	3.65	.81	4.72	1.88
Jacalitos	35.3	3.56	3.66	.10	4.79	1.23
Kern	14.0	2.22	3.56	1.34	4.65	2.43
Kern Front	12.7	2.10	3.52	1.42	4.57	2.47
Kern River	13.4	2.15	3.58	1.43	4.68	2.53
Kettleman North Dome (Kettleman Hills)	35.9	3.56	3.78	.22	4.90	1.34
Lanare	35.5	N.A.	3.78	N.A.	4.90	N.A.
Las Cienegas	27.8	3.22	3.73	.51	4.85	1.63
Lawndale	29.1	N.A.	3.71	N.A.	4.80	N.A.
Los Angeles Downtown Brdwy.	35.8	3.62	3.74	.12	4.86	1.24
Lost Hills	13.2	2.27	3.58	1.31	4.68	2.41
Lost Hills	21.5	2.82	3.68	.86	4.77	1.95
McDonald Anticline	37.5	3.69	3.69	-0-	4.79	1.10
McKittrick	14.1	2.22	3.60	1.38	4.73	2.51
McKittrick	18.8	2.49	3.66	1.17	4.78	2.29
McKittrick N.E.	34.0	3.49	3.75	.26	4.87	1.38
McKittrick N.E.	35.4	3.54	3.74	.20	4.86	1.32
Midway Sunset	14.0	2.32	3.59	1.27	4.67	2.35
Midway Sunset	20.7	2.75	3.69	.94	4.79	2.04
Midway Sunset	27.6	3.24	3.70	.46	4.80	1.56

* See Notes on Page No. 75

CRUDE	D-1 °API GRAVITY	POSTED PRICE	REFINING INDEX 34° ALASKAN @ 3.70	INDEX ABOVE POSTED	REFINING INDEX 38° BERRI @ 4.35 + .27	INDEX ABOVE POSTED
Mission	24.3	2.89	3.72	.83	4.85	1.96
Mission	28.3	3.14	3.73	.59	4.82	1.68
Montalvo West	16.1	N.A.	3.51	N.A.	4.49	N.A.
Montalvo West Colonia	29.6	3.19	3.60	.41	4.64	1.45
Montalvo West McGrath	29.2	3.31	3.71	.40	4.83	1.52
Montebello	22.9	2.93	3.69	.76	4.82	1.89
Montebello	30.7	3.37	3.79	.42	4.92	1.55
Montebello	33.3	3.52	3.75	.23	4.88	1.36
Mountain View	27.3	3.08	3.72	.64	4.81	1.73
Mountain View	32.9	3.38	3.69	.31	4.77	1.39
Newhall - Potrero (Union)*	33.9	3.43	3.75	.32	4.86	1.43
New Port West	17.5	N.A.	3.62	N.A.	4.71	N.A.
Oxnard	27.2	3.18	3.65	.47	4.72	1.54
Paloma Condensate	62.1	N.A.	3.54	N.A.	4.59	N.A.
Paloma (DE C4 Condensate)	38.8	3.62	3.80	.18	4.93	1.31
Playa Del Rey (Union)*	20.9	2.55	3.66	1.11	4.73	2.18
Pleasant Valley	26.0	3.10	3.70	.60	4.80	1.70
Pleito Creek	18.0	2.49	3.65	1.16	4.74	2.25
Poso Creek	13.4	2.15	3.56	1.41	4.62	2.47
Pyramid Hills	15.8	2.34	3.62	1.28	4.75	2.41
Railroad Gap	34.3	3.41	3.72	.31	4.84	1.43
Railroad Gap	38.7	3.62	3.81	.19	4.92	1.30
Raisin City	20.6	2.72	3.65	.93	4.78	2.06
Ramona Field	20.7	2.60	3.63	1.03	4.69	2.09
Richfield	22.0	2.89	3.64	.75	4.69	1.80
Rio Bravo (Mobil)*	35.4	3.47	3.72	.25	4.84	1.37

* See Notes on Page No. 75

CRUDE	D-1 °API GRAVITY	POSTED PRICE	REFINING INDEX 34° ALASKAN @ 3.70	INDEX ABOVE POSTED	REFINING INDEX 38° BERRI @ 4.35 + .27	INDEX ABOVE POSTED
Rosecrans - Athens	31.8	3.42	3.74	.32	4.85	1.43
Rosedale (Posting Starts at 22° $2.04)	20.2	N.A.	3.64	N.A.	4.75	N.A.
Round Mountain	16.1	2.36	3.59	1.23	4.69	2.33
San Ardo (Mobil)*	11.8	2.05	3.52	1.47	4.55	2.50
San Miguelito	30.7	N.A.	3.67	N.A.	4.75	N.A.
Santa Barbara Mix (Ventura Posted Price)	27.8	3.12	3.73	.61	4.85	1.73
Santa Fe Springs	28.4	3.27	3.75	.48	4.87	1.60
Santa Maria	14.3	2.15	3.56	1.41	4.60	2.45
Saticoy	32.1	3.37	3.74	.37	4.78	1.41
Seal Beach	26.7	3.07	3.71	.64	4.80	1.80
Seal Beach	31.0	3.40	3.68	.28	4.76	1.36
Seventh Standard	27.1	N.A.	3.65	N.A.	4.74	N.A.
Signal Hill (Union)*	27.3	3.19	3.70	.51	4.81	1.62
Signal Hill (Long Beach)	24.3	2.98	3.67	.69	4.76	1.78
South Mountain	18.2	2.45	3.51	1.06	4.53	2.08
Strand	35.2	3.47	3.75	.28	4.84	1.37
Summerland Offshore	28.8	3.14	3.58	.44	4.67	1.53
Summerland Offshore	38.8	3.73	3.72	(-.01)	4.83	1.10
Tejon - Grapevine	29.9	3.37	3.81	.44	4.96	1.59
Tejon - Hills	28.6	3.31	3.74	.43	4.87	1.56
Tejon - North	37.3	N.A.	3.75	N.A.	4.87	N.A.
Ten Section	35.5	N.A.	3.74	N.A.	4.85	N.A.
Torrance	16.7	2.46	3.58	1.12	4.65	2.19
Torrance	20.7	2.72	3.63	.91	4.73	2.01
Torrance	24.9	2.96	3.70	.74	4.78	1.82
Torry Stream (Union-Torrey Canyon)*	32.0	3.37	3.69	.32	4.79	1.42

* See Notes on Page No. 75

CRUDE	D-1 °API GRAVITY	POSTED PRICE	REFINING INDEX 34° ALASKAN @ 3.70	INDEX ABOVE POSTED	REFINING INDEX 38° BERRI @ 4.35 + .27	INDEX ABOVE POSTED
Venice	23.0	2.90	3.66	.76	4.74	1.84
Ventura	27.8	3.12	3.65	.53	4.74	1.62
Ventura	30.1	3.32	3.66	.34	4.74	1.42
Wheeler Ridge	24.6	3.00	3.75	.75	4.89	1.89
Wilmington	16.5	2.47	3.57	1.10	4.64	2.17
Wilmington	20.7	2.75	3.63	.88	4.71	1.96
Zaca Creek	11.6	N.A.	3.50	N.A.	4.48	N.A.
Zaca Creek (Approx.)	6.2	N.A.	3.43	N.A.	4.38	N.A.
Alaskan	38.0	N.A.	3.68	N.A.	4.79	N.A.
Alaskan - Drift River	34.3	N.A.	3.70	N.A.	4.79	N.A.
Four Corners Ex. Lub Prem.	39.7	N.A.	3.71	N.A.	4.84	N.A.

1-29-71

Original table consisted of columns: 1, 2, 4, and 6.

Joint Committee added columns 3, Posted Price, 5, and 7, Index Above Posted.

Columns 3 - 7, Dollars per Barrel.

Posted price from Standard Oil Company of California, "Crude Oil Posted Prices, Schedule No. 149, November 24, 1970," except as noted for Union Oil Co. of California, "Crude Oil Price Schedule No. 95, effective November 30, 1970," and Mobil Oil Corporation, "Crude Oil Price Bulletin, West Coast, Bulletin No. 98, effective January 1, 1971."

These posted price tables show no change for tenths of a degree:
Wilmington 20-20.9, $2.75.

N.A.: Not Available.

APPENDIX C: COMPANY SIZE

Fortune magazine for twenty years has been publishing ranked lists of the 500 largest industrial corporations in the United States, and other similar listings. This year, in the August 1974 issue, Fortune compiled a list of "The Fifty Largest Industrial Companies in the World," ranked by money value of sales for 1973. In Fortune's words,

> "Of the world's fifty largest industrials,
> it turns out, twenty-four are based in the U.S."
>
> (Page 184)

The word "based" does no violence to the concept of multi-national corporations - a concept that is of some interest to those worrying about the social control of the behemoths of the world.

Eight of these 50 are petroleum companies based in the United States. They are:

#2	Exxon	New York	$25,724	mil. sales
7	Texaco	New York	11,406	" "
8	Mobil	New York	11,390	" "
12	Gulf	Pittsburgh	8,417	" "
14	Standard of California	San Francisco	7,761	" "
26	Standard of Indiana	Chicago	5,415	" "
33	Shell	Houston	4,883	" "
44	Continental	Stamford, Conn.	4,224	""(pg.185)

Four others are based abroad:

#4	Royal Dutch/Shell Group	London/The Hague	$18,672	mil. sales
15	British Petroleum	London	7,725	" "
41	ENI	Rome	4,280	" "
50	Cie Francaise de Petroles	Paris	4,060	""(pg.185)

These four are believed to be substantially owned by the Dutch, British, Italian and French governments, respectively.

While Fortune cut off its world-wide list at 50 companies, other data published in the May and August 1974 issues enable us to extend the list. So extended, Atlantic Richfield would

have placed 54th, with sales of $3,983 million, and Union Oil Co. of California would have been No. 100, with sales of $2,552 million.

Out of this list of world heavyweight champions, the Joint Committee on Public Domain called upon seven to produce under subpoena information relating to the price of crude oil in California. These seven are:

WORLD SALES RANK		ASSETS MILLION $
2	Exxon	$25,079
7	Texaco	13,595
8	Mobil	10,690
14	Standard of California	9,082
33	Shell	5,381
(54)	Atlantic Richfield	5,109
(100)	Union	2,909
		$71,865

That figure is 71 billion dollars.

APPENDIX D

CARBONS, HYDROGENS, AND BTUs

In the not too distant past, the simpler refineries bought crude oil, boiled out the gasoline and other light products, and sold the residual oil to electric companies in competition with low priced natural gas. Gas was cheap, largely because it was a (frequently unwanted) by-product of oil wells. Fantastic quantities of natural gas were blown to the air, or put to very low-valued use as sources for carbon black and ammonia.

Even after gas became established as a high-value fuel, because of its clean-burning quality, and ease of handling, its price to the electric utilities remained low, partly from long-term contracts, partly from the favorable load-factor aspect of the utilities. This kept the market low for residual fuel oil, which in turn kept the price low for heavy crudes in California which had a high yield of resid.

Many far-reaching changes have occurred in recent years. First, great advances were made in the technology of oil refining which has now become a complex chemical operation, instead of merely a boiling-point separation. Then gas became scarce and the Federal Power Commission began restricting its lower value use as boiler fuel, and allowing the price to rise substantially. Finally, world demand for oil outstripped world surplus supply and prices for crude oil skyrocketed.

Some observers think the huge multinational oil companies not only let the genie out of the bottle in the Middle East, but also taught it a number of clever tricks on pricing, and on production and transportation control.

As a direct result of all these changes, our view of refining must be refocused.

It may reasonably be said that the modern advanced-technology, refinery buys carbons, generates hydrogens, and sells BTUs.

The carbon in a hydrocarbon supplies most of the heat value (BTUs). The hydrogen, in sufficient volume, provides the ease of handling, the fluidity, and the low flash-point required

by the internal combustion engine. The BTUs are the measure of the energy delivered.

In an effort to relate the value of heavy crude to the capabilities of the modern refinery, the California Independent Producers Association (CIPRO) engaged James McDonald Associates in 1973 to undertake a professional analysis. A graduate engineer with degrees in both mechanical and chemical engineering, Mr. McDonald has had over 30 years experience in designing, operating, and managing refineries on the East Coast and in California. His report, "A Study of California Crude Oil Price Differential (Heavy Versus Light)," was completed in July 1973.

The McDonald study points out that hydrogen is cheaper than crude oil, but up-grades it remarkably. Rather than paraphrase an engineering report, it is better to quote it directly. In Section VII, "Relative Values to Large, Sophisticated Refiners," it says:

> "If one shifts to the newest technology outlined in Section IX, then the case for higher prices for heavy crudes improves markedly. The product values from the two crudes get closer together, and the added capital cost diminishes. Considering the current and forecasted higher prices for very low-sulfur fuels, it is possible that Chevron could show that the value of crude oil processed in a refinery using their newest process for the bottoms would be the same for 18° gravity and 34° gravity crudes. Technology has been creating a move in this direction. Chevron may have pushed it to a point where heavier crudes with better chemistry for fuels will become more valuable than lighter crudes.
>
> "A barrel of 18° crude weighs 331 pounds. A barrel of 34° crude weighs 299 pounds. Thus, you get 32 pounds per barrel, or 11.7 percent more weight when you buy the heavier crude oils. At a difference now of $1.01 per barrel, we have the following values: 34° crude is $3.87 ÷ 299 = 1.294¢ per pound. 18° crude is $2.86 ÷ 331 = 0.864¢ per pound. Therefore, the lighter crudes are about 50 percent more expensive per pound than the heavier crudes.

"If we assume that the lighter crudes tend to be C_nH_{2n+2} or paraffins, and the heavier crudes C_nH_{2n} or naphthenes, it is obvious that the heavier crudes have a lower hydrogen content. The latter is an advantage as a feed to a reformer, but a disadvantage to a cat cracker or coker, but far less so to a hydrocracker.

"This leads to the following consideration: Let's compare one barrel of 34° crude with one barrel of 18° crude with some hydrogen added to "upgrade" it.

1 barrel of 34° = 299 pounds = \$3.87
or 1.294¢ per pound

1 barrel of 18° = 331 pounds = \$2.86
or 0.864¢ per pound

Assume the price of the 18° crude goes up 61¢ per barrel. Then one barrel of 18° = 331 pounds = \$3.47, or 1.048¢ per barrel.

"If we assume that hydrogen costs \$0.80 per 1000 ft.^{3}, we could throw in 1000 ft.^{3} with each barrel of heavy crude. We would then have

1 barrel of 18° = 331 pounds = \$3.47

1000 ft.^{3} of H_2 = (6) pounds = \$0.80

\$4.27

Cost per pound of crude = \$4.27 ÷ 331 = 1.290¢/lb.
Similar to lighter crude

"Considering today's technology and changing chemistry of products, it is entirely possible that one barrel of 18° crude and 1000 ft.^{3} of hydrogen is worth more to a refiner than 1 barrel of 34° crude when the prices are 40¢ per barrel apart.

"13° Kern River crude is quite naphthenic. The cracking stock from this crude oil makes excellent hydrocracker feedstock. The following is a comparison of hydrocracker yields:

	Paraffinic Gas Oil From Signal Hill/Lt. Arabian	Naphthenic Gas Oil From Kern River
Light gasoline C_5-180°	30%	27%
octane RON clear	87	87
Heavy gasoline 180-400°	74%	79%
octane RON clear	54	78
91 octane gasoline blend after reforming heavy gasoline	106%	109%
Lead content ml/gallon	1.0	0

"It is easier to make low-lead gasolines when hydrocracking the naphthenic stocks found in crudes like Kern River and Midway-Sunset. This is one of the reasons for the major oil companies finding these crudes valuable in their refineries.

"Most gasolines today are nearly all synthetic. The naturally-occurring gasolines in lighter crude oils made them more valuable because of the fact that the gasoline distilled out was readily convertible into finished gasoline. The 60-octane material was upgraded to 80 octane by using 3 ml. of lead per gallon. As compression ratios went up and the octane race gained momentum, it became necessary to upgrade (reform) the heavy gasolines boiling between 180° and 400°F. These naphthas could be raised from as low as 40 octane up to 90-to-100 octane at the sacrifice of yield (as low as 80 percent with severe reforming).

"The lighter gasolines boiling between 80° and 180° usually have octanes in the 70s, and were raised to the 90s by lead. As lead is restricted, it will be necessary to process the light gasoline by isomerization to higher octanes. Thus, the finished motor gasolines will become 100 percent synthetic.

"Consider then what happens if you start with 13° Kern River crude or 13° Midway-Sunset. There are no gasolines in the crude which have to be processed. All the gasoline made is created by conversion of

heavier fractions. The chemistry is excellent to create high octane gasolines with the minimum use of lead.* Thus, the heavy crudes actually have an advantage in this regard. It is true that hydrocrackers cost more than isomizers and reformers, but this is offset by better chemistry, and a lower price for the heavier crudes (again, 2.5¢ per degree is ample to provide good economics)."

The "newest technology outlines in Section IX" is a new process for desulfurizing heavy fuel oils, developed by the Chevron Research Co., a subsidiary of Standard Oil Co. of California.

McDonald discusses BTUs in Section VIII, "Relative Values to Small, Unsophisticated Refiners":

> "Most sophisticated users of fuels like power companies evaluate the BTU content of their fuels. If we consider the case of just making raw gasoline and fuel oil out of crude oil, let us see how the values work out to a small, unsophisticated refiner.
>
> "34° Signal Hill/Light Arabian crude would produce 1.5 percent gas, 29.0 percent raw gasoline stocks, and 69.5 percent fuel oil. The fuel oil is approximately 25° gravity and would have a BTU content of 6.112 million per barrel.
>
> "13° Kern River crude has no gasoline in it and has a BTU content of 6.397 million per barrel.
>
> "If fuels with sulfur contents of 1.0 to 1.7 percent are evaluated at 70¢ per million BTU, and raw gasoline stocks are worth $5.00 per barrel, we then have the following:

	13° Kern	34° Kern
Gas at $3.50	---	$0.05
Gasoline at $5.00	---	1.45
Fuel at 70¢/MM BTU	$4.48	2.98
Value	$4.48	$4.48

* (EDITOR'S NOTE: With 1975 requirements of no lead gasoline, this factor will further increase the value of low gravity crude oil.)

"On this basis, the crudes have the same value. If one assumes that they would be priced 2.5¢ X 21° difference apart, or about 53¢, then the following would result:

	13° Kern	34° Crude
Gas at $3.50	---	$0.05
Gasoline at $5.00	---	1.45
Fuel at 45¢/MM BTU	$2.88	1.91
Value	$2.88	$3.41

"Utilities are now paying 70¢ per million BTUs for these types of fuels. So from the fuels' point of view, there is no logic at all for the large spread in price between light and heavy crude."