

REPORT OF THE
NATIONAL PETROLEUM COUNCIL'S
COMMITTEE ON SYNTHETIC LIQUID
FUELS PRODUCTION COSTS

October 31, 1951

W. S. S. RODGERS, CHAIRMAN

HEADQUARTERS OFFICE

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REPORT OF NATIONAL PETROLEUM COUNCIL COMMITTEE
ON
SYNTHETIC LIQUID FUELS PRODUCTION COSTS

INTRODUCTION

Secretary of the Interior, Honorable Oscar L. Chapman, in his letter of April 21, 1950 to Mr. Walter S. Hallanan, Chairman of the National Petroleum Council, requested that the National Petroleum Council create a committee to:

1. Review estimates made by the Bureau of Mines of the cost of producing synthetic liquid fuels, and its estimates of comparative costs of producing liquid fuels from crude oil.
2. Prepare independent cost estimates.
3. Make recommendations as to ways and means, if any, for improvement of future cost estimates by the Bureau of Mines.

Secretary Chapman's request (Attachment 1) was favorably reported by the Agenda Committee of the National Petroleum Council, and the Council authorized the formation of a Committee on Synthetic Liquid Fuels Production Costs. On June 13, 1950 Mr. Walter S. Hallanan appointed the committee listed in Attachment 2.

In discussions of the project with personnel of the Bureau of Mines, Dr. James Boyd, Director, advised that the Bureau of

Mines was not prepared to offer estimates of the costs involved in the production of products from crude petroleum. It was therefore necessary, and the Bureau of Mines so agreed, to remove this phase from the project scope.

COMMITTEE ORGANIZATION

Your committee decided to establish a subcommittee made up of experts in the synthetic fuels field to assist in analyzing the technical aspects of this highly complicated problem. Contributing companies made available the services of a large number of qualified specialists in research, development, and engineering. The main subcommittee, in turn, found it desirable to organize in cooperative groups (Attachment 3) to carry out the assignment in the most effective and expeditious manner. An idea of the complexity of the problems and the thoroughness with which the project has been studied is indicated by the following:

Number of Subcommittee members	47
Additional Technical Personnel used	105
Total attendance at meetings (man-days)	590
Number of meetings	197
Number of man-trips	338
Total miles traveled	400,000
Total dollars spent	300,000
Outside companies consulted	115

The generous assistance of the outside companies consulted, listed in Attachment 4, is gratefully acknowledged.

SCOPE OF INVESTIGATION

The synthetic fuels work done by the Bureau of Mines falls into three categories:

1. Production of synthetic liquid fuels by hydrogenating coal.
2. Production of liquid fuels from oil shale.
3. Production of synthetic liquid fuels by gasifying coal and converting the resulting mixture of carbon monoxide and hydrogen to liquid fuels by some modification of the Fischer-Tropsch process.

This report includes work completed to date on only the first and second processes. When this work was started the Bureau of Mines did not have adequate information for the proper appraisal of the process identified in category 3. Only recently the Bureau of Mines has presented additional data on this process for review by the Subcommittee. Process design data representing modifications under categories 1 and 2 have also been prepared by the Bureau of Mines. The Committee plans to continue with these studies to embrace these additional data, on the assumption that the National Petroleum Council desires it to do so.

In accordance with the scope of the work assigned to the Committee, the investigation has been limited to the process steps upon which the Bureau of Mines cost data have been based. It is not the function of this committee to report upon comparative data based on alternative processes developed by industry and which have not been made available to the Bureau of Mines.

To increase the general usefulness of this study it was considered desirable to determine costs not only for possibly unique situations that might arise from a particularly favorable or unfavorable first-plant location, but also for a more nearly average case in which a number of plants would produce a combined total for each process of around 200,000 barrels of liquid fuels per day. Thus estimates of costs and of material requirements were determined for both single plant and multi-plant cases.

The work of the committee has required considerably more time than originally anticipated because it was found that necessary process design data had not been sufficiently developed by the Bureau of Mines. Consequently, subcommittee members were required to spend much time with the Bureau of Mines personnel to develop additional process design data and to arrive at suitable bases for cost estimates. It was also necessary for the subcommittee to develop information on the cost of offsite facilities such as water supplies, rail and pipe-line transportation, and housing for construction and permanent employees. The Bureau of Mines personnel at all levels were most cooperative in assisting the subcommittee in its work.

DESCRIPTION OF OPERATIONS

COAL HYDROGENATION

The estimates for the coal hydrogenation operation are based on procedures which were developed in Germany and on the assumption that coal is available in sufficient quantity, at a mineable depth and thickness and at a location having water required for the operations. The coal is prepared for hydrogenation by cleaning and crushing operations which reduce the ash content to as low a value as is practical and which bring the coal to a size suitable for the hydrogenation operation. In the cleaning and crushing operations a large amount of higher ash content and other off grade coal is produced and this is used for steam generation and other heat duty.

The clean, fine coal is mixed with heavy oil recycled from the process to produce a paste. This paste is charged to the liquid phase hydrogenation operation along with a small amount of catalyst. At approximately 10,000 pounds per square inch and at a temperature of 900° F. a large portion of the coal is liquefied. The material leaving this stage of the process is distilled to obtain a light oil and a heavy oil. Part of the heavy oil is recycled to the pasting operation and the remainder is coked to provide a means of rejecting the ash and used catalyst. In a second stage the light oil is hydrogenated over a fixed bed of catalyst at 10,000 pounds per square inch and 900° F. to yield gasoline and liquefied petroleum gas. Certain chemicals (phenol, cresols, xylenols) can be recovered from the first stage product,

as was assumed in the coal hydrogenation single plant case in the summary, as presented herein. If not disposed of as chemicals, these products can be processed in the second stage to yield gasoline and liquefied petroleum gas, as was assumed in the multi (eight) plant case. Conventional petroleum refining procedures are used for the final treatment of the products from the coal hydrogenation operation.

OIL SHALE OPERATIONS

The estimates for the oil shale operation are based on the assumption that shale is mined in large scale operations according to techniques developed by the Bureau of Mines. The shale from the mines is then crushed to a suitable size and charged to a retort in which the oil is broken out by the action of high temperatures. The necessary heat is obtained by burning - in a separate part of the retort - the carbon remaining in the shale after the oil has been driven out.

The crude shale oil thus obtained contains sulphur and nitrogen compounds and is highly unstable. The oil is subjected to coking operation and the resulting coker distillate is catalytically **hydrogenated** under moderate conditions (1100#/sq. in. and 835° F.). This hydrogenated distillate yields materials which are processed by conventional means to recover finished and semi-finished products which are transported by pipe line from the plant to a major consuming area. Finishing operations as required are carried on at the pipe line terminus.

In each of the coal hydrogenation and oil shale cases a raw material reserve of 20 years has been set as a minimum. Costs have been based upon operations conducted predominantly for production of gasoline and diesel fuel conforming to present market specifications. All labor, material, and equipment costs were adjusted to January 1951 levels. The derived product costs do not include allowance for marketing expense. Chemicals and liquefied petroleum gas have been credited as by-products in developing primary products costs.

DISCUSSION OF RESULTS

As stated above, Secretary Chapman requested that the committee "1. Review estimates made by the Bureau of Mines of the cost of producing synthetic liquid fuels---." When this study was started the only data available from the Bureau of Mines on the cost of producing synthetic liquid fuels from coal was its Report of Investigation 4564 which was issued in 1949. To make these data realistic it was necessary to escalate these cost estimates to adjust for inflation of material and labor costs. After this adjustment and on the basis of comparable facilities, the Bureau of Mines investment cost estimates were approximately 20% below the cost estimates prepared by this committee. However, the Bureau of Mines estimates omitted such items as certain off-site facilities, necessary interest on borrowed capital, income taxes, reasonable profit on investment and treatment of other important capital cost items which must be considered. Detailed

analysis of these differences is presented in the subcommittee reports made available to the Bureau of Mines. It should be emphasized that costs developed by the subcommittee are as authoritative as can be obtained without actual commercial operating experience of the processes considered.

In the case of shale oil operations, the Bureau of Mines had no formal report as a basis of reference for the study made, however, the committee's representatives worked with the Bureau of Mines people in setting up a processing basis for the oil shale case. The Bureau of Mines personnel have generally agreed to accept the Subcommittee's estimate of investment and operating costs of producing liquid fuels from oil shale according to the processes reported on at this time. Therefore, the only large difference between the Subcommittee and Bureau of Mines estimates in this case will be that resulting from capital cost treatment such as interest, taxes and profit.

Secretary Chapman requested that the committee "2. Prepare independent cost estimates." Such estimates have been prepared and the conclusions reached represent the combined effort of the most qualified people in the petroleum and coal industries. As an independent check, the committee retained the services of Price Waterhouse & Co. to review the procedures and basic accounting data used by the committee in the determination of the estimated operating costs for the two processes. Price Waterhouse & Co. necessarily had to accept certain engineering data used in the determination of these cost figures, but insofar as the estimates used could be

tested by the experience of the petroleum industry in refining operations, it is their opinion that the basic accounting data used have been computed in accordance with generally accepted accounting principles and that the estimated cost figures developed from such basic accounting data are reasonable.

A summary of the data developed in the study by the Council's committee follows:

	Coal Hydrogenation		Oil Shale	
	<u>Single Plant</u>	<u>Multi Plant (8)</u>	<u>Single Plant</u>	<u>Multi Plant (5)</u>
Coal or Shale: Tons/ Calendar Day	12,960	112,590	76,800	384,000
Products: Barrels (42 Gals) /CD				
Gasoline	19,490	163,830	25,380	126,900
Diesel Fuel			12,200	62,360
Liquefied Petroleum Gas	6,390	52,170	1,780	8,920
Residual Fuel			<u>340</u>	<u>3,050</u>
Total Liquid Fuels, B/CD	25,880	216,000	39,700	201,230
Coke: Tons/CD			1,180	5,900
Fuel Gas, 1060 Btu/cu. ft.: Thousand Standard Cubic Feet/CD			24,830	124,150
Chemicals:				
Phenol, Barrels/CD	229			
Cresols, " "	383			
Xylenols, " "	508			
Ammonia, Tons/CD			92	460
Sulfur, Tons/CD			43	215
Manpower: Total including supervision and admini- stration	5,900	53,800	3,420	15,750

	<u>Coal Hydrogenation</u>		<u>Oil Shale</u>	
	<u>Single Plant</u>	<u>Multi Plant (8)</u>	<u>Single Plant</u>	<u>Multi Plant (5)</u>
Construction Materials				
Steel: Thousand Tons	220	1,710	178	694
Per daily barrel of Total Liquid Fuel Production: Tons	8.5	7.9	4.5	3.5
Construction Labor				
Man hours x 1,000	51	355	26	123
Investment				
Total-Millions of Dollars	533	4,074	333	1,518
Dollars per daily barrel product	20,600	18,900	8,400	7,500
Cost of Gasoline with 6% Return on Investment after Income Tax Cents per gallon	41.4	43.5	16.2	14.7

In this study, the income tax rate has been taken at 50% of income before taxes. No effect has been given to excess profits taxes.

Although a figure of 6 per cent return on the investment was employed in computing the gasoline cost, it is regarded as highly doubtful that capital could be attracted to so speculative an enterprise at so low a return. Price Waterhouse & Co. in its letter dated September 27, 1951 (Attachment 5) stated the "opinion that an annual rate of earnings of not less than 15% on the total capital invested in or retained in a business subject to the risks of a highly competitive and speculative enterprise would be necessary and reasonable in order to attract investment of private capital."

Provision has been made in the estimates for housing for construction workers and permanent employees to the extent necessitated by the prevailing conditions at the individual plant sites.

The net contribution of this housing expense to product cost has been determined with due consideration of money returned to the enterprise through rentals.

As pointed out previously, the Bureau of Mines was not prepared to offer estimates of the costs involved in the production of products from crude petroleum. The following are price quotations (October 1, 1951) for gasoline at refinery, terminal, or purchaser's bulk plant for 4 locations in the United States. These are the prices which synthetically produced gasoline would have to meet in free competition today:

	<u>Regular</u>	<u>Premium</u>
Los Angeles	12.00	13.30
Denver	12.30	13.30
Salt Lake City	12.625	13.625
St. Louis	12.50	13.50

Secretary Chapman further requested that the committee "3. Make recommendations as to ways and means, if any, for improvement of future cost estimates by the Bureau of Mines." From the figures presented above on the extent of the work done on this project it is evident that the preparation of reliable cost estimates is a most complicated and extensive undertaking. During the course of this study Bureau of Mines representatives have had numerous opportunities to review in detail the methods employed by the industry organizations. With this experience to supplement their own backgrounds and with the information which is contained in the technical reports made available to them by the subcommittees, the Bureau of Mines experts should now be in a position to prepare comparable cost estimates for any known or new process combination.

CONCLUSIONS

The information presented in this report which is, in turn, based on detailed technical studies, leads to the conclusion that coal hydrogenation for the production of synthetic liquid fuels is uneconomical.

It has been noted that an effort is being made to promote the installation of a coal hydrogenation plant as a source of chemicals, the most important of which are benzene, toluene and xylene. Study of this proposal is not within the scope of the committee's assignment. Attention is directed, however, to the fact that the disadvantages of high investment cost involved in the basic coal hydrogenation step will still be present and that additional investment will be required for the further processing, recovery and purification of the chemicals. We are advised that such chemicals can be produced from petroleum at much lower cost.

The oil shale phase of the synthetic fuels program is in a much more favorable position as to steel requirements, capital cost, and operating costs. It is estimated that known oil shale reserves will yield in excess of 100 billion barrels of oil. Excellent work has been done by the Bureau of Mines in the development of shale mining on a large scale. Although it is apparent that the resulting product costs are still significantly higher than those from petroleum the levels are such that this source of fuel warrants continued attention by the petroleum industry. The future trend of oil shale development will, of course, be affected by the trend in cost of gasoline from crude petroleum.

Respectfully submitted,

W. S. S. Rodgers, Chairman

K. S. Adams	R. S. Shannon
H. H. Baker	R. H. Taylor
M. W. Ball	J. E. Warren
R. L. Foree	L. S. Wescoat
J. M. Lovejoy	R. E. Wilson

Attachment 1

UNITED STATES
DEPARTMENT OF THE INTERIOR
OFFICE OF THE SECRETARY
Washington 25, D.C.

C
O
P
Y

April 21, 1950

My dear Mr. Hallanan:

During and immediately after World War II when the problem of adequate supplies of liquid fuels was uppermost in the minds of Government and industry and while there was uncertainty as to whether this country possessed an adequate supply of petroleum in the event of another emergency, the Bureau of Mines, of the Department of the Interior, was charged by Congress with the responsibility for investigating and developing processes for producing synthetic liquid fuels from oil shale and coal.

One of the requirements was to construct and operate demonstration plants to enable Government to furnish industry with the necessary cost and engineering data for the development of a synthetic liquid fuels industry.

Since the Bureau of Mines experimental work is sufficiently advanced to enable it to furnish some of the data called for, the Bureau would now welcome a critical study of its cost data by the National Petroleum Council and will cooperate fully in furnishing its data for such a study.

Therefore, I request that the National Petroleum Council create a committee to: (1) review the estimates made by the Bureau of Mines for the cost of producing synthetic liquid fuels and its estimates of comparative costs of producing liquid fuels from crude oils, (2) prepare independent cost estimates, and (3) make recommendations as to ways and means, if any, for improvement of future cost estimates by the Bureau of Mines.

Sincerely,

/s/ Oscar L. Chapman

Secretary of the Interior

Mr. Walter S. Hallanan, Chairman
National Petroleum Council
1625 K Street, N. W.
Washington 6, D. C.

Attachment 2

NATIONAL PETROLEUM COUNCIL COMMITTEE ON
SYNTHETIC LIQUID FUELS PRODUCTION COSTS

W. S. S. RODGERS Chairman	The Texas Company, New York
K. S. ADAMS	Phillips Petroleum Company, Bartlesville Oklahoma
HINES H. BAKER	Humble Oil & Refining Company, Houston
MAX W. BALL	Room 1001, 1025 Vermont Avenue, N. W. Washington, D. C.
*BRUCE K. BROWN	Military Petroleum Advisory Board, c/o Pan American Southern Corporation, P. O. Box 2, New Orleans 6, Louisiana
ROBERT L. FOREE	Texas Independent Producers & Royalty Owners Association, Dallas
JOHN M. LOVEJOY	Seaboard Oil Company of Delaware, New York
R. S. SHANNON	Pioneer Oil Corporation, Denver
REESE H. TAYLOR	Union Oil Company of California, Los Angeles
J. ED WARREN	Independent Petroleum Association of America, c/o Carl B. King Drilling Company Midland, Texas
L. S. WESCOAT	The Pure Oil Company, Chicago
ROBERT E. WILSON	Standard Oil Company (Indiana), Chicago
J. W. FOLEY Secretary	The Texas Company, New York

* Mr. Brown resigned from the committee on November 22, 1950.

NATIONAL PETROLEUM COUNCIL SUBCOMMITTEE ON
SYNTHETIC LIQUID FUELS PRODUCTION COSTS

*A. P. FRAME Chairman	Cities Service Research and Development Company 60 Wall Tower, New York 5, N. Y.
E. AYRES	Gulf Research and Development Company P. O. Drawer 2038, Pittsburgh 30, Pennsylvania
F. E. FREY	Phillips Petroleum Company Bartlesville, Oklahoma
**L. C. KEMP, JR.	The Texas Company 135 East 42nd Street, New York 17, N. Y.
E. V. MURPHREE	Standard Oil Development Company 15 West 51st Street New York 19, New York
A. C. RUBEL	Union Oil Company of California Union Oil Building, Los Angeles 17, California
A. L. SOLLIDAY	Stanolind Oil and Gas Company Stanolind Building, Tulsa 2, Oklahoma
***H. G. VESPER	California Research Corporation 200 Bush Street San Francisco 4, California

*Mr. Frame resigned from the committee on March 1, 1951

**Mr. Kemp was appointed chairman on March 1, 1951

***Mr. Vesper joined the committee on July 11, 1951

NATIONAL PETROLEUM COUNCIL SUBCOMMITTEE ON
SYNTHETIC LIQUID FUELS PRODUCTION COSTS

RAW MATERIALS SUBCOMMITTEE

A. L. SOLLIDAY, Chairman
P. R. SCHULTZ, Alternate

Stanolind Oil and Gas Company
Stanolind Building
Tulsa 2, Okla.

Oil Shale

TELL ERTL, Chairman

Department of Mine Engineering
214 Lord Hall,
The Ohio State University,
Columbus 10, Ohio

I. N. BAYLESS

Union Pacific Coal Company
1416 Dodge Street
Omaha, Nebraska

P. R. SCHULTZ

Stanolind Oil and Gas Company
Stanolind Building
Tulsa 2, Okla.

Eastern Coal

JOSEPH PURSGLOVE, JR.
Chairman

Pittsburgh Consolidation
Coal Co.
Koppers Building
Pittsburgh 19, Pa.

CLAYTON BALL

Paul Weir Coal Company
20 North Wacker Drive
Chicago, Illinois

STEPHEN KRICKOVIC

Eastern Gas and Fuel Associate
Koppers Building
Pittsburgh 19, Pa.

I. S. SALNIKOV

Standard Oil Company
(New Jersey)
30 Rockefeller Plaza
New York, N. Y.

Western Coal

I. N. BAYLESS, Chairman

Union Pacific Coal Company
1416 Dodge Street
Omaha, Nebraska

R. L. BALDNER

Stanolind Oil and Gas Company
Stanolind Building
Tulsa 2, Okla.

J. H. POORE

Northern Pacific Railway Co.
St. Paul 1, Minnesota

NATIONAL PETROLEUM COUNCIL SUBCOMMITTEE ON
SYNTHETIC LIQUID FUELS PRODUCTION COSTS

PROCESS SUBCOMMITTEE

E. V. MURPHREE, Chairman
E. J. GOHR, Alternate

Standard Oil Development Company
15 West 51st St.,
New York 19, N. Y.

Coal Hydrogenation

L. E. CARLSMITH, Chairman

Standard Oil Development Company
P. O. Box 51,
Linden, New Jersey

F. T. BARR

Standard Oil Development Company
P. O. Box 51,
Linden, New Jersey

C. HOLLOWAY

Gulf Research and Development Co.
P. O. Box Drawer 2038
Pittsburgh 30, Pa.

B. J. MAYLAND

Phillips Petroleum Company
Bartlesville, Oklahoma

J. SEEBOLD

Standard Oil Company (Indiana)
Whiting, Indiana

Coal Synthesis

L. P. GAUCHER, Chairman

The Texas Company
135 East 42nd Street
New York 17, N. Y.

R. H. CROSBY

Shell Oil Company
50 West 50th Street
New York, N. Y.

*K. J. NELSON
E. J. GORNOWSKI

Standard Oil Development Company
P. O. Box 51
Linden, New Jersey

S. WALKER

Stanolind Oil and Gas Company
Research Department
Tulsa, Oklahoma

H. L. MALAKOFF

Cities Service Research
& Development Company
New York, N. Y.

*Resigned

NATIONAL PETROLEUM COUNCIL SUBCOMMITTEE ON
SYNTHETIC LIQUID FUELS PRODUCTION COSTS

PROCESS SUBCOMMITTEE (Cont'd)

Shale Oil

C. BERG, Chairman	Union Oil Company of California P. O. Box 758 Wilmington, California
J. HIRSCH	Gulf Research and Development Co. P. O. Drawer 2038 Pittsburgh 30, Pennsylvania
J. E. LATTA	Stanolind Oil and Gas Company Research Department Tulsa 2, Oklahoma
H. J. OGORZALY	Standard Oil Development Company P. O. Box 51 Linden, New Jersey

NATIONAL PETROLEUM COUNCIL SUBCOMMITTEE ON
SYNTHETIC LIQUID FUELS PRODUCTION COSTS

ENGINEERING SUBCOMMITTEE

L. C. KEMP, JR., Chairman	The Texas Company 135 East 42nd Street New York 17, N. Y.
L. C. NEYLAND, JR., Alternate	
<u>Coal Hydrogenation</u>	
J. S. CLARKE	Esso Engineering Department Standard Oil Development Company P. O. Box 121, Linden, New Jersey
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WARREN A. ROE, JR.	Gulf Oil Corporation Gulf Building, Pittsburgh, Pa.
O. L. WHITE	Esso Engineering Department
*G. J. Doll	Standard Oil Development Company P. O. Box 121, Linden, New Jersey

*Resigned

NATIONAL PETROLEUM COUNCIL SUBCOMMITTEE ON
SYNTHETIC LIQUID FUELS PRODUCTION COSTS

ENGINEERING SUBCOMMITTEE (Cont')

Coal Synthesis

R. G. ATKINSON

Phillips Petroleum Company
Bartlesville, Oklahoma

J. C. NEYLAND, JR.

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Off-Site Facilities

E. H. ROY

Cities Service
60 Wall Tower
New York 5, N. Y.

J. D. SNAKENBURG

**G. B. BURLESON

Stanolind Oil and Gas Co.
Tulsa 2, Oklahoma

Shale Oil

H. REED, Chairman

Union Oil Company of California
617 West 7th Street
Los Angeles 17, California

A. K. BRUMBAUGH, JR.

General Petroleum Corporation
P. O. Box 2122, Terminal Annex
Los Angeles 54, California

F. W. CURTIS

Shell Oil Company
Wilmington-Dominguez Refinery
Wilmington, California

L. P. ELLIOTT

California Research Corporation
200 Bush Street
San Francisco 4, California

FRANK FONTANA

Richfield Oil Corporation
Richfield Building
Los Angeles 17, California

G. K. VILAND

Tidewater Associated Oil Company
79 New Montgomery Street
San Francisco 20, California

** Deceased

NATIONAL PETROLEUM COUNCIL SUBCOMMITTEE ON
SYNTHETIC LIQUID FUELS PRODUCTION COSTS

ECONOMICS SUBCOMMITTEE

P. SCHULTZ, Chairman

Stanolind Oil and Gas Company
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R. G. ATKINSON

Phillips Petroleum Co.
Bartlesville, Oklahoma

F. T. BARR

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J. HIRSCH

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C. F. PARKER

Union Oil Company
Union Oil Building
Los Angeles 17, California

J. D. SNAKENBURG

Cities Service
60 Wall Tower
New York 5, N. Y.

Attachment 4

NPC Subcommittee on Synthetic Liquid Fuel Costs
Outside Companies Contacted for Information

1. Alabama Power Co.
2. Allis-Chalmers Mfg. Co.
3. American Air Filter Co.
4. American Blower Co.
5. American Cyanamid Co.
6. American Locomotive Co.
7. American Pipe and Construction Co.
8. Anaconda Copper Co.
9. Armco, Inc.
10. Automatic Electric Sales Co.
11. Babcock & Wilcox Co.
12. Baldwin Lima-Hamilton Corp.
13. Bechtel Corporation
14. Bell and Zoller Coal & Mining Co.
15. Bingham Pump Co.
16. Blaw-Knox Co.
17. C. F. Braun & Co.
18. Buell Engineering Co., Inc.
19. Burndy Equipment Co.
20. Caney Creek Mining Co.
21. Carthage Hydrocol, Inc.
22. Central Ohio Coal Co.
23. Chain Belt Co.
24. Chicago Bridge and Iron
25. Chicago, Wilmington & Franklin Coal Co.
26. Clark Bros. Co., Inc.
27. Combustion Engineering-Superheater, Inc.
28. Concrete Conduit Co.
29. Consolidated Western Steel
30. Cooper-Bessemer Corporation
31. Crane Co.
32. Duncan Coal Co.
33. Elliott Co.
34. Engineering Associates
35. Enco Collieries Co.
36. Equitable Life Insurance Co.
37. Ethyl Corporation
38. Farrell Birmingham Co.
39. Ford, Bacon and Davis
40. Foster Wheeler Corporation
41. Fluor Corporation
42. Gamewell Company
43. General Cable Company
44. General Electric Co.
45. The Girdler Corporation
46. F. W. Glitsch & Sons
47. B. F. Goodrich Co.
48. Graham Manufacturing Co.
49. V. Grinnell Co.
50. Hanna Coal Co.
51. Haskel Engineering & Supply Co.
52. Homestead Coal Co.
53. Hydrocarbon Research Corp.
54. Ingersoll-Rand Co.
55. Jeffrey Manufacturing Co.
56. Johns-Manville Corp.
57. The M. W. Kellogg Co.
58. Kennecott Copper Co.
59. Key Co.
60. Koppers Co., Inc.
61. Linde Air Products Co.
62. Link-Belt Co.
63. Lock Joint Concrete Pipe Co.
64. Lummus Co.
65. Maaco Corporation
66. Marley Co., The
67. Morgan Construction Co.
68. Morrison-Knudsen Co., Inc.
69. Nashville Coal Co.
70. National Valve & Mfg. Co.
71. Pacific Pumps, Inc.
72. R. M. Parsons Co.
73. Peabody Coal Co.
74. Peerless Pump Division-Food Machine & Chemical Corp.
75. Perlite Aggregates, Inc.
76. Permutit Co.
77. Petrochem Development Co.
78. Philadelphia Gear Co.
79. M. Pirnie, Engineers
80. Polymer Corp. of Canada
81. C. F. Pritchard Co.
82. Republic Flowmeter Co.
83. H. H. Robertson Co.
84. Rust Engineering
85. Semet-Solvay Co.
86. A. O. Smith Corp.
87. Snow Hill Coal Corp.
88. Southern California Edison Co.
89. Spaco Inc.
90. Sprout-Waldron Co.
91. Stacey Bros. Gas Const. Co.

92. Stevens Adamson Co.
93. Struthers Wells Co.
94. Sunny Hill Coal Co.
95. Truax-Traer Coal Co.
96. Turbine Equipment Co.
97. Ultrasonic Corporation
98. Union Diesel Engine Co.
99. Union Steam Pump Co.
100. Vickers, Inc.
101. Vogue Coal Co.
102. Wallace and Tierman Co.
103. Wellman Engineering Co.
104. Wierton Steel Co.
105. Westinghouse Electric Corp.
106. Wilson-Snyder Mfg. Div.
107. Worthington Pump & Mach. Co.

PRICE WATERHOUSE & CO.

56 Pine Street
New York 5
September 27, 1951

Mr. P. R. Schultz
Economics Subcommittee,
National Petroleum Council Committee on
Synthetic Liquid Fuels Production Cost,
Stanolind Oil and Gas Company
Stanolind Building
Tulsa, Oklahoma.

Dear Sir:

In connection with the estimates of costs of the production of gasoline from coal and from oil shale you have asked us to state what in our opinion would be a reasonable rate of return on the capital invested in the proposed enterprises.

It is our viewpoint that "capital invested" means total capital, whether equity or borrowed, invested or retained in the business.

The preliminary figures which you submitted to us include for the purpose of discussion a nominal rate of return of 6%. Even with such an obviously low rate the resultant price of gasoline in both cases is so high as to make both projects unsuitable for development on a commercial unsubsidized basis. It, therefore, might appear that any discussion in support of a higher rate of return is purely academic. However, we understand that the Committee may be called upon in the future to prepare estimates of costs of improved processes which, it is contended, may more nearly approach a competitive market price for gasoline. It is, therefore, important in presenting the two cases now under consideration, to establish a reasonable rate of return on capital invested in the synthetic fuels industry, irrespective of whether the ultimate objective is the production of gasoline with relatively minor chemical by-products or the production of chemicals with gasoline as a by-product.

It should be understood that a rate of return means net earnings, computed on generally accepted principles of accounting, which include as expense provisions for income taxes and allowances for normal depreciation and obsolescence but that such net earnings do not contemplate the possible obsolescence of the enterprise as a whole. It should also be understood that in dealing with a net earnings percentage on total capital invested no consideration is given to any possible guarantee of minimum earnings.

Mr. P. R. Schultz

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September 27, 1951

Based upon our experience in examinations, reviews and investigations of financial affairs of varying fields of industry and commerce and giving due consideration to the factors of risks involved in this proposed enterprise, it is our opinion that an annual rate of earnings of not less than 15% on the total capital invested in or retained in a business subject to the risks of a highly competitive and speculative enterprise would be necessary and reasonable in order to attract investment of private capital.

Yours very truly,

(Signed) Price Waterhouse & Co.