PROVED DISCOVERIES AND PRODUCTIVE CAPACITY

OF CRUDE OIL, NATURAL GAS, AND NATURAL GAS LIQUIDS IN THE UNITED STATES

A REPORT OF

THE NATIONAL PETROLEUM COUNCIL

1965

REPORT OF THE NATIONAL PETROLEUM COUNCIL COMMITTEE ON PROVED PETROLEUM AND NATURAL GAS RESERVES AND AVAILABILITY (1964)

MARCH 25, 1965

CHAIRMAN OF THE COMMITTEE: L. F. McCOLLUM

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NATIONAL PETROLEUM COUNCIL

(Established by the Secretary of the Interior)

March 25, 1965

1625 K Street, N.W.
Washington, D. C. 20006

Mr. Jake L. Hamon, Chairman
National Petroleum Council
1625 K Street, N. W.
Washington, D. C. 20006

Dear Mr. Hamon:

A report on Proved Reserves and Productive Capacity of Crude Oil, Natural Gas, and Natural Gas Liquids in the United States, as of January 1, 1964, is presented herewith. This report was prepared at the request of Hon. John M. Kelly, Assistant Secretary of the Interior. In his letter of March 19, 1964, addressed to the Chairman of the National Petroleum Council, Mr. Kelly stated:

> "In response to a request from the Secretary of the Interior, the National Petroleum Council prepared a report in 1961 entitled 'Proved Discoveries and Productive Capacity of Crude Oil, Natural Gas and Natural Gas Liquids in the United States.' The data contained in this report have been of value to the Government in its efforts to appraise the domestic long-term petroleum supply.
>
> "It is requested that the National Petroleum Council prepare a report which will update as of January 1, 1964, the information presented in the earlier report. The report should be in a form similar to that of the earlier one, except that projections of productive capacity will not be required."

The Committee on Proved Petroleum and Natural Gas Reserves and Availability (1964) was appointed pursuant to the recommendation of the Agenda Committee, at its meeting on March 19, 1964, that a committee or committees be established to make the

study as requested by Secretary Kelly. To develop the requested information, two coordinating subcommittees were also appointed, one responsible for the data on crude oil and the other for natural gas and natural gas liquids. These groups were comprised of engineers and geologists with many years experience in their respective fields, many of whom took part, directly or indirectly, in the preceding study.

The Committee's studies are presented in the following pages. As was the case with the information in the 1961 report, the data presented herein should not be taken out of context with the accompanying comments and explanations concerning the significance and limitations of the data and their proper interpretation.

Respectfully submitted,

L. F. McCollum

L. F. McCollum, Chairman
NPC Committee on Proved Petroleum
and Natural Gas Reserves and
Availability (1964)

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SUMMARY

This report combines, in a series of separate sections, the results of studies made during the latter part of 1964 and early 1965 by the Coordinating Subcommittee for Proved Crude Oil Reserves and Availability and the Coordinating Subcommittee for Natural Gas and Natural Gas Liquids Reserves and Availability in response to a request by the U. S. Department of the Interior to the National Petroleum Council. Two main subjects are dealt with: first, historical tabulations of discoveries of crude oil, natural gas, and natural gas liquids in the United States and, second, estimates of the productive capacities of these materials as of January 1, 1964.

Discoveries

The historical tabulations of proved discoveries of crude oil, natural gas, and natural gas liquids are summarized for the United States and by PAD districts in Tables I, II, and III. These tabulations do not represent new and original findings by this Committee with respect to reserves in the United States, but are a recasting of already known reserves estimates as of December 31, 1963. United States reserves have been reported annually for some time by the American Petroleum Institute and the American Gas Association. Contrary, however, to the usual API and AGA practice, the estimates presented in this report have been arranged at the request of the Department of the Interior according to the discovery years of the fields* to which the reserves are attributed and the tabulations are carried only through the year 1958.

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* Because of the large number of individual reservoirs now recognized in many fields, there is always a question as to whether a new reservoir in an old field should be considered an extension of the old field and be given the discovery year of the old field, or whether, conversely, the new reservoir should be considered a later discovery. In this report, therefore, some new reservoirs have been treated as if discovered in earlier years and significant ones have been given later discovery dates. A check of the results assures this Committee that the treatment in individual cases has resulted in a sound answer. In general, reservoirs recognized at the time the 1961 report was prepared were assigned the same discovery dates as before unless later information showed the need to change. Reservoirs recognized after the 1961 study were assigned discovery dates on the basis of the best information currently available.

The discovery estimates given in this report represent the total expected recoveries, including both past production and remaining proved reserves, based upon field size and past performance as such factors were known on December 31, 1963. The usual practice of the industry in the determination of reserves is quite different; the interest normally lies in the remaining reserves.

In subsequent sections of this report, it is shown by comparisons of the present estimates of discoveries with prior estimates made by the NPC and others that the estimated recovery from the average field usually increases several fold over the estimate made at the end of the discovery year and continues to increase from various causes for a great many years. The tabulations presented are useful, therefore, in providing through such comparisons insight into the magnitude and rate of increase of recovery estimates. The available data show that the fields already discovered in the United States represent an enormous base for possible future additions to reserves through further extensions and revisions. It is evident, therefore, that studies of the long term future supply of oil and gas in the United States must give cognizance not only to the possible future discoveries of new fields but also to the future additions to reserves from existing fields.

Because of the growth in estimated recovery, as more is known about a field and technology improves, a proper analysis of discovery trends would require comparison of annual discoveries estimated by comparable methods at equal time intervals after discovery. It is important to recognize that the historical discovery tabulations presented in this report are not so constructed but represent, instead, a single set of estimates, all based on data available at the end of 1963. The fields discovered in 1958 have been credited with only five years' revisions, whereas those discovered in earlier years have been credited with revisions for progressively longer intervals ranging back to over 44 years for fields discovered prior to 1919. The resultant distortion is far too great to permit sound deductions with respect to discovery trends from this set of tabulations alone. The Committee wishes to emphasize, therefore, that the historical tabulations presented in Tables I, II, and III of this report do not by themselves provide a valid measure of either the amount discovered in prior years or of discovery trends.

Productive Capacity

The productive capacities of crude oil, natural gas liquids, and natural gas on January 1, 1964, were estimated to be:

Crude Oil:	11,590,000 barrels daily
Natural Gas Liquids:	2,802,700 barrels daily
Natural Gas:	97,584,100 thousand cubic feet daily

Details with respect to the estimates of productive capacity are reported in Tables IV, V and VI. The estimated productive capacity of crude oil is comparable with prior studies prepared for the National Petroleum Council. The estimated productive capacities of natural gas and natural gas liquids are comparable with those in the 1961 National Petroleum Council report. The estimate of the productive capacity of natural gas liquids is not comparable with estimates prepared for the National Petroleum Council prior to the 1961 report. It represents the natural gas liquids that would have been potentially recoverable if the production of crude oil and of natural gas on January 1, 1964, had been at the capacity rates shown.

It should be noted that the productive capacity of crude oil cannot properly be compared with the production of crude oil and lease condensate as reported by the United States Bureau of Mines under the name "crude petroleum". Lease condensate, which occurs in gaseous form in the reservoir but is recovered at the surface by separation from natural gas, is included herein with natural gas liquids. Production of such condensate is becoming of increasing importance, particularly on the Gulf Coast.

The estimates given in the report for productive capacities represent the rates at which oil, gas, and natural gas liquids could be produced from existing fields and wells without regard to such limitations as lack of mechanical equipment or of surface facilities used in conjunction with producing, handling, processing, storage, or transportation. Also, governmental regulations under normal peacetime conditions, whether by agencies of the Federal Government or individual states, are another limitation. The productive capacity is therefore a measure of potential rather than actual availability. The difference between productive capacity as used in this report and actual availability may be quite large for crude oil, and even greater in the case of natural gas and natural gas liquids.

Because of the many qualifications and limitations pointed out in this report with respect to all of the attached tables, the Committee wishes to emphasize that a complete reading of the text is required for their proper understanding and use. It is requested, therefore, that these tables not be separated from or used independently of the text.

HISTORICAL DISCOVERY TABULATIONS

Basis of the Tabulations

In the 1961 Council report, estimates of discoveries based on past production and estimated remaining proved reserves as of December 31, 1959, were tabulated by years according to the discovery dates of the individual fields to which the reserves were attributed. The tabulations therein terminated with the year 1954.

In the present report, the tabulations have been brought forward on the same basis through the year 1958, the assigned discoveries being based on cumulative production and estimated remaining proved reserves as of December 31, 1963. The tabulations of discoveries do not represent new and original findings by this Committee, but are merely a recasting of discoveries based on estimates of proved reserves previously reported by the American Petroleum Institute and the American Gas Association.

Conversion from Remaining Reserves to Total Discoveries

In adherence to the well defined concepts of proved reserves used by the American Petroleum Institute and the American Gas Association, the Committee has included in its estimates only those quantities of oil, gas, and natural gas liquids known as of December 31, 1963, to be recoverable from existing fields. However, since the present study is concerned with past discoveries rather than an inventory of remaining reserves, the estimates have been expressed in terms of the total quantities now estimated to be recoverable from existing fields, including both past production and remaining reserves.

Growth in Recovery Estimates

When a new field is discovered it is customary to make a preliminary estimate of its expected recovery. At the end of the discovery year, the amount of oil or gas known to be recoverable may be only a small fraction of the amount that will ultimately be recovered. As drilling proceeds in subsequent years and as more information is gained, the estimates of recovery will usually increase until development is complete. Thereafter, the estimates may continue to change from time to time. Disappointing performance may cause a downward revision. More often, however, later appraisal will lead to upward revision. Further additions to he estimate may be made as a result of improved recovery measures, such as inauguration of pressure maintenance or secondary recovery in an oil field. Still further increases may result at any time through enlargement of a field by exploratory drilling, which may merely extend the field beyond its previously known limits or may find new pools. Thus each new field becomes the origin of a continuing stream of additions to reserves.

Through the reports issued annually since 1936 by the API Reserves Committee and since 1945 by the AGA Reserves Committee, the industry has grown accustomed to recognition of the aforementioned estimates of recoveries as an important factor in the continued growth of oil and gas reserves in the United States.

Limitations of Discovery-Year Tabulations

The method of tabulating the results in this report differs drastically from that used by the API and the AGA. As was done in the 1961 report, the total quantity of oil, gas, or gas liquids now considered to be proved recoverable from each field is assigned in this report to that field as if that amount had been proved recoverable at the time the field was discovered. The discoveries so attributed to the individual fields are then arranged according to the years in which the fields were discovered, instead of according to the API-AGA method by which additions to reserves are credited in the years in which the oil, gas, and gas liquids were proved to be recoverable. The method of tabulation employed in this report would indicate that the quantities shown were discovered in the years listed, which is not true.

Interpretation of Tabulation of Discoveries

It should be noted, in particular, that the quantities of hydrocarbons shown for the fields discovered in a listed year do not represent the amounts that were originally believed to have been discovered in that year; because of subsequent extensions and revisions the amounts now considered to be recoverable are much greater than the original estimates. For example, and with respect particularly to fields discovered in earlier years, quantities are now credited as recoverable by application of techniques that were not even known or in use at the time of discovery of the fields.

Correspondingly, future extensions and revisions may bring about further increases in the amount of recoverable hydrocarbons assigned to the fields listed in a given year. In fact, the full extent of the amounts that will ultimately be recovered from these fields will not be known until many years in the future when each of the fields will have been fully explored and finally depleted.

For those reasons, it is evident that caution must be used in interpreting the discovery tabulations included in this report. A series of such tabulations made over a period of years may provide useful information as to the growth in estimates of recovery. However, a single tabulation, standing alone, would not yield a complete and proper picture of the trend in discoveries.

HISTORICAL DISCOVERY RECORD FOR CRUDE OIL

The tabulation of crude oil discoveries presented in Table I was prepared by taking, for each individual oil field* in the United States (including abandoned fields), the total past production plus the remaining proved reserves of crude oil as estimated by the API Reserves Committee on December 31, 1963, to arrive at a total considered to represent the crude oil "discovered" in each field. These totals were then tabulated according to the years in which the individual fields were discovered.

As stated earlier, in this type of tabulation the total quantity of oil now considered to be proved recoverable from each field is assigned to that field as if that amount had been proved recoverable at the time the field was discovered, which was not true. Furthermore, when the quantities so attributed in hindsight to individual fields are arranged by years according to the initial discovery dates of the fields, instead of according to the years in which the oil was determined to be recoverable, the tabulation tends to indicate that the quantities of oil shown were discovered in the years listed, which is also not true.

Comparison with Prior Estimates

It is customary when a new field or pool is discovered to make a preliminary estimate of its expected recovery. Such estimates have been reported annually by the API since 1936 for proved reserves discovered in new fields and in new pools in old fields. As such new fields and pools undergo subsequent development and reappraisal the quantity of oil recognized as proved will usually increase. The quantity of oil recognized as proved subsequent to the discovery year is added to the total proved reserves as extensions and revisions. Over the period 1936 through 1963, the total additions to proved reserves by the API were about sixfold the amount assigned to new fields and new pools. It is evident, therefore, that the estimates of recoverable oil from new fields and new pools at the end of the discovery year represent only a small fraction of the oil that will ultimately be recovered from those fields.

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* See footnote on Page 1.

Some insight as to the growth in estimates of recovery from previously discovered fields is afforded by the following comparison between estimates reported by the API at the end of the discovery year for additions to reserves in new fields and new pools and the amount of oil now assigned to the fields discovered in those same years as reported in Table I.

COMPARISON OF PRESENT ESTIMATES OF DISCOVERIES WITH INITIAL API ESTIMATES FOR NEW FIELDS AND NEW POOLS
(Millions of Barrels)

FIELDS DISCOVERED DURING PERIOD	INITIAL API EST. OF DISCOVERIES	PRESENT EST. OF DISCOVERIES	RATIO: PRESENT TO INITIAL EST.
1939 thru 1943	1,600	9,686	6.1
1944 thru 1948	2,017	9,888	4.9
1949 thru 1953	2,933	9,525	3.2
1954 thru 1958	2,261	5,859	2.6

Further appreciation of the importance of the growth in estimates of recovery may be obtained from a comparison of the present estimates of discoveries with previous estimates prepared on a similar basis. The following tabulation compares the discoveries as listed in Table I of this report with those of the 1961 report and a similar tabulation prepared by the PAW in 1945:

COMPARISON WITH PREVIOUS ESTIMATES OF DISCOVERIES OF CRUDE OIL TABULATED ON SIMILAR BASIS
(Millions of Barrels)

FIELDS DISCOVERED DURING PERIOD	PAW ESTIMATE MADE IN 1945	NPC ESTIMATE MADE IN 1960	NPC ESTIMATE MADE IN 1964
Total thru 1919	14,640	17,367	18,591
1920 thru 1944	37,482	56,244	60,219
1945 thru 1954		17,815	18,949

It may be noted in the preceding comparison that the growth in estimated recovery is not confined to recent years. There has been an increase of 1.2 billion barrels during the last four years in the estimated recovery assigned to fields discovered prior to 1920. These fields were already 40 years old at the time of the prior NPC study. The comparison provides further support for the conclusions of the 1961 report that the aggregate of all fields heretofore discovered represents an enormous base for future additions to reserves through further extensions and revisions and that studies of the long term future supply of crude oil in the United States must recognize this source.

The temptation to consider the results of this study as indicating that additions to reserves of crude oil represent a simple time series should be avoided. Additions to reserves do not result simply from the passage of time. They result, instead, from a number of other factors, including exploration and development and the application of improved technology, all of which depend on economic incentives and are influenced by prevailing government policies and regulations at both state and federal levels.

HISTORICAL DISCOVERY RECORD FOR NATURAL GAS AND NATURAL GAS LIQUIDS

The same methods as were employed in obtaining the historical record of discoveries of crude oil were used in preparing the similar records for natural gas and natural gas liquids shown in Tables II and III. The proved reserves of these substances as estimated by the American Gas Association Committee on Reserves on December 31, 1963, were converted to total discoveries rather than remaining reserves and have been tabulated by years through 1958 according to the discovery years of the individual fields*.

Comparison with AGA Estimates for Gas

Insofar as the Committee is aware, the only previous study for gas and natural gas liquids in which estimated recoveries were tabulated according to discovery years of the individual fields and reservoirs was made by the NPC in 1960. Some insight into the growth in recovery estimates for these materials may be obtained by comparison of the present estimates with estimated recoveries assigned by the AGA to new fields and new pools. Some of the factors that have contributed to the continued large upward revisions of estimated recoveries of crude oil, such as secondary recovery methods, are not applicable to natural gas. Also, the natural expulsion forces are, in general, more efficient in recovery

* See footnote on Page 1.

of gas than oil. Thus the theoretical limit of gas-in-place would be reached sooner than in oil and would tend to restrict the magnitude of future upward revisions.

In spite of these limitations, upward revisions of recovery estimates for both natural gas and natural gas liquids have resulted from technological improvements. Such factors, for example, as well stimulation and well fracturing have contributed materially to greater recovery of natural gas, and advances are continuously being made in the recovery of natural gas liquids from the gas processed. Upward revisions stemming from extension drilling and more complete production history are equally applicable to gas and oil.

In addition to revisions of the reserve estimates due to additional production history or additional drilling, the discovery dates of fields or reservoirs may also change as a result of drilling. Two examples of a change in discovery dates as a result of drilling are:

1. Two fields discovered at different dates and later found, as a result of additional drilling, to be connected to form one field, would result in the reallocation of the reserves in the second field to the date of discovery of the older field.

2. Subsequent drilling which proved a major reserve in what was originally thought to be an insignificant reservoir discovered late in the life of an old field could result in the reallocation of reserves previously credited to the original discovery date of the field to the later date of discovery of the reservoir.

—Estimates reported annually by the American Gas Association beginning in 1947 show that the amount added to reserves of natural gas through extensions and revisions has, on the average, exceeded by slightly more than twofold the reserves credited annually to discoveries in new fields and new pools as estimated at the end of the discovery years. For the 17-year period 1947-63, inclusive, 92.8 trillion cubic feet of gas were credited to newly discovered fields and pools whereas, during the same interval, 193.3 trillion cubic feet were added to reserves through extensions and revisions. Although the amount added by extensions and revisions relative to the additions from new fields and new pools is not as great in the case of gas as in the case of crude oil, it has nevertheless been appreciable. For the years 1947-58, inclusive, the AGA showed a total of 61.5 trillion cubic feet of gas assigned to newly discovered fields and pools. The present NPC report, based on data available at the end of 1963, assigns 148.6 trillion cubic feet to the fields discovered in those years, an increase of 2.4 fold. It must be concluded, therefore, that the growth in estimated recovery from a field as heretofore described in detail for oil fields is applicable to

gas fields also, though perhaps not to so great a degree. A comparison of present estimates of discoveries with AGA estimates and the 1960 NPC estimate is summarized in the following tabulation:

COMPARISON OF ESTIMATES OF NATURAL GAS RESERVES
DISCOVERED FOR PERIODS SHOWN
(Trillions of Cubic Feet @ 14.65 psia and 60°F)

	AGA NEW FIELDS & RESERVOIRS	NPC ESTIMATE MADE IN 1960	NPC ESTIMATE MADE IN 1964	1960 RATIO NPC TO AGA	1964 RATIO NPC TO AGA
1947-54	35.5	95.8	103.5	2.7	2.9
1955-58	26.0	-	45.1	-	1.7
1947-58	61.5	-	148.6	-	2.4

The importance of the growth in estimates of recovery is emphasized by comparing the present estimates of discoveries with the previous estimate prepared on a similar basis. The following tabulation shows the comparison of discoveries as listed in Table II of this report with those of the 1961 report:

COMPARISON WITH PREVIOUS ESTIMATES
OF DISCOVERIES OF NATURAL GAS TABULATED
ON SIMILAR BASIS
(Trillions of Cubic Feet @ 14.65 psia and 60°F)

FIELDS DISCOVERED DURING PERIOD	NPC ESTIMATE MADE IN 1960	NPC ESTIMATE MADE IN 1964
Total thru 1919	75.8	83.0
1920 thru 1944	227.6	242.5
1945 thru 1954	115.7	127.0

It is to be noted that, as in the case of crude oil, the growth in estimated recovery is not confined to recent years. During the past four years, a growth of 7.2 trillion cubic feet has occurred in the estimated recovery assigned to fields discovered prior to 1920, despite the fact that these fields were not less than 40 years old at the time of the prior NPC study.

Comparison with AGA Estimates for Natural Gas Liquids

In the case of natural gas liquids, the annual reports of the American Gas Association show a total of 1.68 billion barrels added to reserves through discoveries in new fields and new pools over the

interval from 1947-63, inclusive. During the same interval, 8.28 billion barrels were added to reserves through extensions and revisions. The ratio of the amount added through extensions and revisions to the quantity attributed to new fields and new pools was 4.93. For the period 1947-58, the AGA showed a total of 1.01 billion barrels discovered in new fields and new pools. The present NPC report assigns 4.35 billion barrels to the fields discovered in those years, an increase of 4.3 fold. It may be concluded, therefore, that in the case of natural gas liquids, the magnitude and duration of the increase in estimated recoveries as a result of extensions and revisions are comparable to the experience for crude oil. The large increase undoubtedly reflects additional extraction plants, increased efficiency of existing plants, emphasis in recent years on pressure maintenance and cycling of gas condensate reservoirs, and increases in the estimated reserves of natural gas from which the liquids are extracted. A comparison of present estimates of discoveries with AGA estimates and the 1960 NPC estimate is summarized in the following tabulation:

COMPARISON OF ESTIMATES OF NATURAL GAS LIQUIDS RESERVES DISCOVERED FOR PERIODS SHOWN
(Millions of Barrels)

	AGA NEW FIELDS & RESERVOIRS	NPC ESTIMATE MADE IN 1960	NPC ESTIMATE MADE IN 1964	1960 RATIO NPC TO AGA	1964 RATIO NPC TO AGA
1947-54	614.3	2,579.8	3,126.4	4.2	5.1
1955-58	398.2	-	1,222.0	-	3.1
1947-58	1,012.5	-	4,348.4	-	4.3

The growth in estimated recovery of natural gas liquids is not confined to recent years any more than is the case for crude oil, as the following tabulation shows:

COMPARISON WITH PREVIOUS ESTIMATES OF DISCOVERIES OF NATURAL GAS LIQUIDS TABULATED ON SIMILAR BASIS
(Millions of Barrels)

FIELDS DISCOVERED DURING PERIOD	NPC ESTIMATE MADE IN 1960	NPC ESTIMATE MADE IN 1964
Total thru 1919	1,230.5	1,651.0
1920 thru 1944	6,046.4	7,331.4
1945 thru 1954	3,132.0	3,878.5

Historical Tabulations Do Not Show Discovery Trends

It may be concluded from the preceding considerations that future additions to estimated recoveries of natural gas and of natural gas liquids may be expected from fields already discovered. As in the case of crude oil, therefore, the historical tabulations presented in Tables II and III should not be construed as representing an accurate record of discovery trends. Furthermore, the conclusions heretofore reached with respect to crude oil may be considered applicable also to natural gas and natural gas liquids.

CRUDE OIL PRODUCTIVE CAPACITY

The productive capacity of crude oil in the United States on January 1, 1964, is estimated to have been 11,590,000 barrels a day, including 175,000 barrels a day in the Elk Hills field in California of which all but 8,000 barrels a day were shut-in. Estimates by PAD Districts were as follows:

PAD DISTRICT	CRUDE OIL PRODUCTIVE CAPACITY (THOUSAND BARRELS DAILY)
1. East Coast	30
2. Mid-Continent	1,473
3. Gulf Coast	8,399
4. Rocky Mountain	678
5. West Coast	1,010
Total United States	11,590

The present study indicates an increase in productive capacity since January 1, 1960, of one million barrels a day, substantially all of which occurred in District 3. Changes in other districts were not significant. A comparison of the present estimate by PAD districts with prior estimates by the National Petroleum Council is shown in Table IV.

As in prior NPC reports, it must be emphasized that the estimates of productive capacity deal only with the quantities that could be produced from known fields through existing wells without regard to possible limitations of transportation or other facilities. The known limitations of such additional facilities make it evident that the full amount of oil producible in the United States could not be made available on short notice.

Basis of Estimate

The productive capacity of crude oil estimated by this Committee is believed to be consistent both conceptually and numerically with estimates prepared by prior committees of the National Petroleum Council. However, there appears to exist some lack of understanding of the meaning of productive capacity and its conceptual basis. Accordingly, the matter is discussed more fully in this report than has heretofore been customary.

Productive capacity as used in this report represents an estimate of the aggregate capability of the various fields and reservoirs in the United States within the limitations of generally accepted production practices, but viewed primarily from the standpoint of the physical capabilities of the fields and reservoirs and not, in general, from the standpoint of the limitations that might be imposed by lack of markets, lack of transportation, inadequacy of mechanical equipment, lack of facilities for proper handling of gas or water produced with crude oil, or any other correctible impediments to production. It represents potential availability rather than immediate or actual availability. The purpose in making an estimate on this basis is to provide information on what might be produced should the need ever arise. It is presumed that deficiencies in equipment, related facilities, etc., could be corrected if necessary. On the other hand, if the estimate of productive capacity were limited to what could be produced currently under prevailing conditions with respect to equipment and related facilities, such an estimate could reflect, for some fields, primarily the capacity of mechanical equipment and would fail to reveal the additional amount of oil that could be made available by full utilization of the capabilities of the fields and reservoirs.

The difference between productive capacity and current availability is especially important in Louisiana and Texas. In both of these states, production of crude oil is restricted to market demand under regulations administered by state regulatory agencies. The drilling, completion, and production of wells is subject also, to many other regulations designed to promote conservation. For example, to prevent waste of natural gas, limitations may be imposed on the amount of gas that may be produced from an oil well, or regulations may require that all gas produced with oil in certain fields be gathered and put to an approved use. In order to prevent surface pollution, or to support reservoir pressure, water produced with crude oil may be collected and injected into underground reservoirs.

In both Louisiana and Texas, the prevailing levels of permitted production of crude oil have been, for a number of years, far less than the productive capacity. As a consequence, in many fields, the facilities and equipment for gathering and handling gas and water produced with crude oil are sized to conform with the prevailing or anticipated rates of oil production and not the productive capacity. The same may

be true in many wells with respect to the size of tubing or of pumping equipment. It is quite evident, therefore, that there is at present a substantial difference between productive capacity and immediate availability of crude oil.

On the other hand, it must be recognized that should a national emergency arise of such nature as to require extreme measures to attain maximum production of crude oil, some of the limitations discussed in this report could be set aside, particularly for the short term. For example, restrictions related to the conservation of gas produced with crude oil or to the concern for surface pollution from produced water could be waived in time of emergency.

Estimate is Based on Informed Judgment

Many of the oil fields in the United States are already producing at capacity. In such fields, the productive capacity is simply the actual production and there is no difference between productive capacity and current availability.

In other fields, however, production is restricted because of lack of sufficient markets to require production at capacity, or because state regulatory authorities restrict production to prevent waste. In such fields, the productive capacity or potential availability may far exceed the actual production.

In short, then, the estimated productive capacity as reported represents the total production of crude oil in the United States plus an estimate of the total additional quantity of oil which could have been produced from the existing fields on January 1, 1964, under generally accepted production practices, had the requirements for crude oil made such production necessary, and had there been no limitations resulting from the previously described lack of related facilites.

The number of oil fields and reservoirs in the United States has grown to such a large total as to preclude individual appraisal based on geologic and engineering analysis of each oil reservoir. This Committee makes no representation that such analysis has been made. Rather, the estimate of productive capacity has been based on the performance of fields and wells under prevailing conditions and through comparison, where possible, with the behavior of the same or similar fields or wells under other conditions that might have prevailed previously. The figures reported represent estimates based on informed and experienced judgment.

Productive Capacity Continuously Changes

The productive capacity is in a continual state of flux. Production of old wells declines continuously, and capacity in restricted fields declines as oil reserves are depleted. On the other hand, the capacity is augmented by the completion of new wells, by inauguration of secondary recovery projects in old fields, or by pressure maintenance or stimulation procedures.

The productive capacity in this report represents an estimate of the capacity as of January 1, 1964. This estimate contains no assumptions as to future rates of drilling, or of the decline in capacity that might result should drilling cease. It should be noted that this estimate of productive capacity relates to crude oil only, and does not include condensate. For this reason, the estimate is not directly comparable with the statistics on production of crude petroleum, including lease condensate, published by the United States Bureau of Mines. Productive capacity of condensate, which is produced from gas wells rather than oil wells, is included with natural gas liquids.

PRODUCTIVE CAPACITY OF NATURAL GAS

The productive capacity of natural gas in the United States on January 1, 1964, is estimated to have been 97,584 million cubic feet per day. A summary by PAD districts is shown below:

DISTRICT	NATURAL GAS PRODUCTIVE CAPACITY (THOUSANDS OF CUBIC FEET DAILY @ 14.65 PSIA AND 60°F)
1. East Coast	930,200
2. Mid-Continent	14,708,000
3. Gulf Coast	77,324,000
4. Rocky Mountain	2,228,900
5. West Coast	2,393,000
Total United States	97,584,100

Natural gas commonly occurs in solution in crude oil or associated with crude oil as well as in reservoirs that contain no oil. The above estimate of productive capacity is the total of the individually estimated productive capacities of non-associated, associated, and dissolved gas.* Productive capacities by PAD districts by type of gas are shown in Table V.

The present study indicates an increase in productive capacity since January 1, 1960, of 26,080 million cubic feet per day, nearly all of which occurred in the Mid-Continent and Gulf Coast States, with respective increases of 6,504 and 19,203 million cubic feet. Table V shows the 1960 estimates, in total, by PAD districts.

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* The Subcommittee has adopted the definitions used by the Committee on Natural Gas Reserves of the American Gas Association, as follows:

(a) Non-associated gas: free gas not in contact with crude oil in the reservoir; and free gas in contact with oil where the production of such gas is not significantly affected by the production of crude oil.

(b) Associated gas: free gas in contact with crude oil in the reservoir where the production of such gas is significantly affected by the production of crude oil.

(c) Dissolved gas: gas in solution with crude oil in the reservoir.

Maximum Requirement for Natural Gas

The Subcommittee, as a part of its study, made a determination of the peak requirement for natural gas from all sources other than underground storage during the year 1963. This was found to be 56,292 million cubic feet per day.* This figure should be kept in mind in considering the productive capacity of natural gas from the various sources as set out hereafter. It should be noted that approximately one-fourth of the gas produced to supply the peak requirement in 1963 was produced along with crude oil, and the remainder came from non-associated reservoirs. The productive capacity of natural gas from non-associated reservoirs alone is in excess of the estimated peak requirements for both non-associated gas and gas produced with oil.

Gas from Non-Associated Reservoirs

The productive capacity of natural gas from non-associated reservoirs was defined by the Coordinating Subcommittee for Natural Gas and Natural Gas Liquids Reserves and Availability as follows:

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* The peak requirement for natural gas from underground storage reservoirs approximates 20,000 million cubic feet per day. It should be noted that this is not the day of peak requirement from all underground storage reservoirs taken as a whole, but is the summation of the individual peak days supplied by each respective storage reservoir. Likewise, the figure of 56,292 million cubic feet requirement of non-associated, dissolved and associated gas is not the coincidental peak day of requirement for all such sources as a whole, but is the summation of the peak day requirements of each respective source. In other words, neither figure represents a coincidental peak day, and the sum of the two does not represent the coincidental peak day requirement for natural gas in the United States. In each case, the coincidental peak day requirement was considerably less.

"The maximum sustainable rate at which a field can be produced under present conditions without specific regard to production equipment, pipe line capacities, or established allowables."

The productive capacity of all gas wells completed in non-associated reservoirs in the United States on January 1, 1964, was estimated to be 74,930 million cubic feet per day. This was greater than the peak requirement in 1963, estimated by the Subcommittee to total 56,292 million cubic feet from all sources. In the prior NPC report, the comparable productive capacity was estimated at 50,791 million cubic feet per day.

Gas Produced With Oil

The productive capacity of natural gas produced with oil depends on the rate of oil production. The Subcommittee has estimated that if crude oil were produced at the estimated January 1, 1964, capacity rate of 11,590,000 barrels a day, the quantity of gas produced with that oil would have been 22,655 million cubic feet per day, of which 15,899 million cubic feet would have been gas dissolved in the oil. The remaining 6,756 million cubic feet represents gas that would have been produced from associated gas reservoirs. It should be particularly noted that the rate of production of dissolved and associated gas depends on the rate of oil production. In Table V, which shows the productive capacity for the three types of gas, all estimates of productive capacity for associated and dissolved gas are based on the supposition that oil is being produced at the capacity rates shown in Table IV.

The present estimates of productive capacity of natural gas produced with oil reflect the growth in crude oil productive capacity. In the prior NPC report, it was estimated that if crude oil had been produced at the estimated January 1, 1960, capacity rate of 10,585,000 barrels a day, the quantity of natural gas produced with that oil would have been 20,713 million cubic feet per day. Thus, the present estimates represent an increase of 1,942 million cubic feet, in total, consisting of increases of 493 million cubic feet of gas dissolved in the oil and of 1,449 million cubic feet of gas that would have been produced from associated gas reservoirs.

Gas in Cycled, Shut-In, and Storage Reservoirs

The estimated productive capacity includes gas from fields which are now being cycled, as well as gas from fields which are not at present producing but are capable of production. The estimated productive capacity does not, however, include any gas which may be available from storage reservoirs.

Productive Capacity is Not Availability

The productive capacity of natural gas was estimated on the same conceptual basis as was used to estimate the productive capacity of crude oil. That is, it reflects the capacity of the gas and oil reservoirs and is a measure of the amount that could be produced from existing wells without regard to limitations of markets, transportation, and processing facilities.

It is evident from the foregoing considerations that the productive capacity of natural gas, as used in this report, is in no sense a measure of the current availability of gas for consumption, and it should not be so construed. Presently available facilities limit the use of gas that could be produced. Any increase in daily production would require adequate markets and the installation of additional pipeline, compressor, and other facilities, with allowance for the time and material required for such installation.

The productive capacity of natural gas must be viewed in an entirely different light from the productive capacity of crude oil. Oil can be stored in tanks near the area of production and can then be moved to refinery or market when needed. On the other hand, gas after leaving the well can only be carried through pipelines to the market. The storage of gas is quite expensive and requires much advance planning and construction since the principal containers are underground reservoirs. In actual practice, the storage of gas has been largely confined to the storage of limited quantities in natural underground reservoirs near the market to improve the load factor of the pipelines. This basic difference must be kept in mind in evaluating the estimate of productive capacity contained herein.

As pointed out above, part of the total productive capacity of natural gas is gas that would be produced with oil if oil were being produced at capacity. If oil were ever to be produced at such rates, additional facilities and markets would have to be provided to avoid venting part of this gas.

Another limitation on the full use of the daily volumes of natural gas estimated as producible is the load factor of the existing or additional markets to be served. In other words, one cannot multiply the estimated capacity of 97,584 million cubic feet as of January 1, 1964, by 365 and thereby obtain the annual amount that could be produced from this daily quantity. Such a quantity must be miltiplied by the load factor of the market to obtain the annual amount. The Subcommittee found that the overall load factor (the ratio of the average daily production to the peak day production) of gas production in the United States is about 70%.

The producibility of gas from a reservoir is not directly proportional to the volume of gas contained in the reservoir, but depends on the underground physical characteristics. Gas could not be produced indefinitely at the maximum rates estimated in this report because those reservoirs that have higher productive capacities per unit of gas reserve would be rapidly depleted.

* * * * * *

In summation, the Subcommittee finds that while the productive capacity of natural gas from non-associated reservoirs appears to be sufficient to supply the current demand, there is available in addition a large quantity of gas produced with crude oil. At 1963 rates of oil production, there was produced along with the oil some 12,923 million cubic feet per day of gas. The difference between this value (12,923) and the value of 22,655 for January 1, 1964, consists of gas which can only be produced by increasing the rate of oil production throughout the United States to the maximums set out in Table IV. Under these circumstances, no value of productive capacity of natural gas should be taken from or deduced from this report, unless the quantity of gas produced with oil is separately determined and related to the contemporaneous rate of oil production.

A further aspect of the productive capacity of natural gas should be kept in mind. The fact that this report shows that total productive capacity exceeds the current demand does not mean that this excess is distributed uniformly throughout the United States or is uniformly available to all gas companies and customers or that no section of the United States will experience any shortage. To illustrate, on January 1, 1964, the productive capacity from non-associated reservoirs in District 3 was 58,828 million cubic feet. When there is added to this 9,743 million cubic feet currently being produced with oil, the total current capacity is found to be 68,571 million cubic feet per day. The peak day production in District 3 for 1963 was approximately 43,697 million cubic feet. This indicates an excess, in District 3, as of January 1, 1964, of 24,874 million cubic feet per day with the oil wells being produced at 1963 rates. The comparable excess for the United States is 31,561 million cubic feet per day. This indicates that substantially all of the current excess capacity is located in District 3.

Such excess, to supply increased demands or to offset anticipated decline in other areas, would have to be transported to such areas by pipelines either existing or to be provided.

PRODUCTIVE CAPACITY OF NATURAL GAS LIQUIDS

Natural gas liquids are those hydrocarbon liquids that, in the reservoir, are either in gaseous form or in solution in crude oil. At the surface, they are recovered as liquids by separation from natural gas by such processes as condensation or absorption, in field separators, scrubbers, gasoline plants, or cycling plants. Natural gasoline, condensate, and liquefied petroleum gases fall in this category. Since natural gas liquids are not produced as such from underground reservoirs but become available solely by separation from natural gas, their availability depends directly on the rate of production of gas and oil and requires the existence of adequate separation or extraction equipment to effect their removal from the produced gas.

In reports prepared prior to the 1960 study for the National Petroleum Council, the estimated availability of natural gas liquids was restricted to the volumes that could be recovered through existing plants and other equipment from the gas actually being produced. Such was not the case in the 1961 report nor in the present study. In an effort to appraise more fully the total potential productive capacity of petroleum liquids in the United States, the Committee has estimated the capacity of natural gas liquids on the basis of the volumes that could be recovered if both crude oil and natural gas were being produced at the full capacity rates shown elsewhere in this report. On this basis, the maximum productive capacity of natural gas liquids has been estimated as shown in the following tabulation, which also includes the estimates from the prior NPC study:

MAXIMUM PRODUCTIVE CAPACITY OF NATURAL GAS LIQUIDS
(Barrels Daily)

	FROM GAS FROM NON-ASSOCIATED RESERVOIRS	FROM DISSOLVED GAS AND GAS FROM ASSOCIATED RESERVOIRS PRODUCED WITH CRUDE OIL	TOTAL
January 1, 1964	1,697,900	1,104,800	2,802,700
January 1, 1960	938,800	860,800	1,799,600

The present estimates of productive capacities are shown in Table VI by PAD districts and by types of gas from which separated. The district totals from the prior NPC study are also shown.

Productive Capacity is Not Availability

It must be recognized that the preceding estimate is not an actual availability, for the plants do not now exist that would be required to recover these liquids, and neither gas nor oil is being produced at rates even closely approaching capacity production. However, as a measure of the volume that could be made available under all-out conditions, the estimate should be useful in appraisal of this country's total hydrocarbon resources. The actual future quantity of natural gas liquids producible at any given time will depend on the volumes of gas and oil being produced and on the installation of the necessary extraction facilities. The remarks previously made with respect to natural gas productive capacity concerning market, load factor, and the interrelation of a large part of the capacity to the rate of oil production are also applicable to natural gas liquids.

TABLES

NOTE: These six tables should be used only after a review and full understanding of the text on discoveries and productive capacity of crude oil, natural gas, and natural gas liquids.

TABLE I
SUMMARY OF ESTIMATED DISCOVERIES
OF CRUDE OIL NOW ASSIGNED TO
FIELDS DISCOVERED IN YEARS SHOWN
(Thousands of Barrels)

FIELDS AND RESERVOIRS DISCOVERED		DISTRICT 1	DISTRICT 2	DISTRICT 3	DISTRICT 4	DISTRICT 5	TOTAL U.S.
Through	1919	2,006,106	6,232,032	3,922,944	787,435	5,642,781	18,591,298
In	1920	3,654	701,225	203,447	41,270	1,514,350	2,463,946
	1921	3,327	435,103	1,633,717	85,050	879,000	3,036,197
	1922	2,756	169,606	937,022	190,592	188,600	1,488,576
	1923	1,858	588,551	329,109	43,073	279,000	1,241,591
	1924	2,223	314,719	264,640	53,063	306,600	941,245
	1925	2,368	76,494	735,509	61,141	155.700	1,031,212
	1926	3,376	748,858	2,116,271	7,306	363,850	3,239,661
	1927	4,000	578,889	508,018	206,148	169,496	1,466,551
	1928	2,361	873,520	830,341	95,768	632,061	2,434,051
	1929	4,500	525,675	2,245,285	14,650	66,435	2,856,545
	1930	2,195	272,756	6,653,876	157,344	21,100	7,107,271
	1931	730	270,357	1,619,602	6,300	537,404	2,434,393
	1932	460	81,535	312,773	197,056	115,630	707,454
	1933	740	304,780	375,306	602,254	86,040	1,369,120
	1934	1,000	278,264	1,709,435	720	238,300	2,227,719
	1935	1,500	674,669	2,692,781	25,830	44,610	3,439,390
	1936	2,119	108,579	1,071,294	6,351	1,481,911	2,670,254
	1937	8,900	1,006,185	3,477,135	54,450	284,016	4,830,686
	1938	1,360	797,862	1,658,732	73,339	922,296	3,453,589
	1939	990	325,138	975,135	0	111,614	1,412,877
	1940	1,120	567,260	2,534,446	9,200	36,643	3,148,669
	1941	,230	592,153	1,101,859	0	487,561	2,182,803
	1942	1,210	180,588	903,570	338,822	30,268	1,454,458
	1943	13,769	304,675	907,142	167,053	49,340	1,441,979
	1944	700	241,623	1,302,700	355,845	162,875	2,063,743
	1945	2,365	129,741	1,567,300	16,100	206,941	1,922,447
	1946	910	630,538	662,282	174,416	68,968	1,537,114
	1947	2,262	258,438	599,328	37,466	265,835	1,163,329
	1948	1,440	145,831	2,703,799	184,457	171,966	3,207,493
	1949	900	198,702	2,054,073	191,924	279,039	2,724,638
	1950	1,400	159,612	1,905,651	120,278	50,395	2,237,336
	1951	860	236,095	785,928	187,802	69,758	1,280,443
	1952	870	418,823	808,231	214,269	98,066	1,540,259
	1953	740	163,446	1,262,014	243,833	56,692	1,726,725
	1954	913	231,572	1,170,680	169,638	68,236	1,641,039
	1955	980	193,258	848,527	81,162	88,969	1,212,896
	1956	1,445	199,141	609,838	199,055	28,615	1,038,094
	1957	1,340	268,669	623,612	169,913	196,951	1,260,485
	1958	1,750	222,459	389,351	66,570	78,397	758,527
Total		2,092,727	20,707,421	57,012,703	5,636,943	16,536,309	101,986,103

TABLE II

SUMMARY OF ESTIMATED DISCOVERIES
OF NATURAL GAS NOW ASSIGNED TO
FIELDS DISCOVERED IN YEARS SHOWN
(Millions of Cubic Feet @ 14.65 psia and 60°F)

FIELDS AND RESERVOIRS DISCOVERED		DISTRICT 1	DISTRICT 2	DISTRICT 3	DISTRICT 4	DISTRICT 5	TOTAL U.S.
Through	1920	15,238,385	13,300,936	47,252,408	1,307,925	5,868,245	82,967,899
In	1920	365,421	1,445,231	87,462	37,567	1,095,818	3,031,499
	1921	177,877	895,598	2,783,021	44,799	1,084,809	4,986,104
	1922	98,322	28,373,183	5,361,533	239,887	131,370	34,204,295
	1923	125,108	1,417,991	407,136	20,844	393,265	2,364,344
	1924	74,288	653,245	664,978	41,656	313,800	1,747,967
	1925	152,540	521,784	850,102	64,271	38,708	1,627,405
	1926	396,515	1,368,540	2,324,582	681,105	264,400	5,035,142
	1927	137,564	1,539,868	12,631,681	242,065	108,381	14,659,559
	1928	755,015	2,405,712	1,207,825	240,109	2,011,692	6,620,353
	1929	32,784	568,545	10,424,661	27,845	64,324	11,118,159
	1930	228,835	600,121	5,936,368	189,355	60,332	7,015,011
	1931	71,149	320,994	2,555,703	93,127	1,217,427	4,258,400
	1932	106,924	237,042	3,183,276	133,029	470,181	4,130,452
	1933	206,462	572,242	2,838,958	755,030	193,943	4,566,635
	1934	57,180	526,466	6,015,224	175	495,496	7,094,541
	1935	136,983	677,457	13,939,956	155,945	52,826	14,963,167
	1936	906,722	244,653	17,525,286	1,823	4,401,502	23,079,986
	1937	87,747	783,151	15,043,029	61,301	1,684,294	17,659,522
	1938	51,368	591,647	12,328,673	911,723	1,166,063	15,049,474
	1939	69,707	431,513	13,445,353	0	1,218,571	15,165,144
	1940	65,196	792,894	10,851,760	2,127	103,583	11,815,560
	1941	101,324	947,915	6,887,855	21,779	596,937	8,555,810
	1942	115,868	442,338	6,328,416	86,919	119,987	7,093,528
	1943	129,515	842,554	6,636,001	43,491	244,919	7,896,480
	1944	133,570	411,811	7,674,735	223,431	298,973	8,742,520
	1945	650,005	1,512,621	12,839,746	62,878	328,186	15,393,436
	1946	155,137	2,109,884	5,028,005	597,380	192,932	8,083,338
	1947	149,125	1,473,119	9,134,369	119,738	207,202	11,083,553
	1948	158,099	252,075	7,802,345	427,521	191,210	8,831,250
	1949	163,864	1,106,012	20,157,890	345,684	310,289	22,083,739
	1950	208,143	466,111	7,331,874	501,209	267,082	8,774,419
	1951	328,464	1,614,764	7,516,392	809,277	216,449	10,485,346
	1952	118,174	4,555,908	10,546,440	172,631	381,868	15,775,021
	1953	189,212	468,893	10,716,730	717,711	388,975	12,481,521
	1954	165,148	2,002,931	11,210,288	432,551	184,034	13,994,952
	1955	160,671	948,155	7,269,997	696,594	257,340	9,332,757
	1956	134,222	1,606,402	7,528,548	595,831	347,675	10,212,678
	1957	191,848	1,268,092	11,691,871	1,039,079	182,559	14,373,449
	1958	247,064	979,917	8,776,286	653,398	526,137	11,182,802
Total		23,041,545	81,278,315	352,736,763	12,798,810	27,681,784	497,537,217

TABLE III

SUMMARY OF ESTIMATED DISCOVERIES
OF NATURAL GAS LIQUIDS NOW ASSIGNED TO
FIELDS DISCOVERED IN YEARS SHOWN

(Thousands of Barrels)

FIELDS AND RESERVOIRS DISCOVERED		DISTRICT 1	DISTRICT 2	DISTRICT 3	DISTRICT 4	DISTRICT 5	TOTAL U.S.
Through	1920	111,073	408,796	778,347	42,726	310,082	1,651,024
In	1920	3,659	62,176	424	0	65,581	131,840
	1921	1,667	34,278	151,087	0	76,210	263,242
	1922	558	451,862	96,552	0	4,509	553,481
	1923	879	47,685	10,427	980	18,486	78,457
	1924	391	23,986	6,827	0	15,043	46,247
	1925	1,260	5,769	8,221	0	1,489	16,739
	1926	502	57,909	56,694	6,840	9,971	131,916
	1927	1,258	56,733	307,765	283	5,303	371,342
	1928	7,760	89,555	29,386	0	82,702	209,403
	1929	228	11,646	247,636	0	1,509	261,019
	1930	1,839	14,875	720,549	481	2,144	739,888
	1931	160	3,080	100,568	1,200	61,891	166,899
	1932	999	8,027	80,114	8,000	17,418	114,558
	1933	152	20,996	28,207	19,100	2,552	71,007
	1934	195	11,574	132,057	0	18,598	162,424
	1935	975	19,276	475,148	10,688	573	506,660
	1936	10,322	4,885	440,570	0	66,002	521,779
	1937	184	29,720	427,060	0	81,569	538,533
	1938	156	38,395	324,962	25,643	78,551	467,707
	1939	546	16,356	392,127	0	113,923	522,952
	1940	189	30,263	414,189	0	6,048	450,689
	1941	439	45,652	189,747	0	13,959	249,797
	1942	631	15,772	239,054	22,662	3,284	281,403
	1943	641	33,920	171,911	0	3,200	209,672
	1944	800	17,647	239,530	80	5,656	263,713
	1945	8,356	27,738	432,524	8	11,341	479,967
	1946	862	79,647	170,879	11,462	8,469	271,319
	1947	1,687	39,650	274,742	120	2,492	318,691
	1948	1,430	8,897	496,609	5,129	11,048	523,113
	1949	981	29,497	527,275	3,994	22,065	583,812
	1950	860	16,521	221,809	21,948	4,007	265,145
	1951	777	40,978	255,617	22,924	2,055	322,351
	1952	822	73,881	254,222	5,482	5,482	339,889
	1953	762	18,383	393,536	22,631	2,231	437,543
	1954	1,700	38,469	283,126	7,336	6,083	336,714
	1955	1,353	36,430	209,283	3,423	8,770	259,259
	1956	851	34,550	168,286	25,535	8,577	237,799
	1957	956	29,508	348,170	24,042	1,742	404,418
	1958	39,989	19,281	252,196	6,116	2,634	320,216
Total		208,849	2,054,263	10,357,433	298,833	1,163,249	14,082,627

TABLE IV

CRUDE OIL PRODUCTIVE CAPACITY IN THE UNITED STATES

(Thousand Barrels Daily)

DISTRICT	JAN. 1 1951	JAN. 1 1953	JULY 1 1954	JAN. 1 1957	JAN. 1 1960	JAN. 1 1964
East Coast	54	49	43	37	29	30
Mid-Continent	1,083	1,238	1,380	1,591	1,555	1,473
Gulf Coast	4,161	4,686	5,224	6,613	7,331	8,399
Rocky Mountain	350	394	561	615	664	678
West Coast *	1,079	1,098	1,123	1,011	1,006	1,010
Total	6,727	7,465	8,331	9,867	10,585	11,590

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* Including Elk Hills. The estimates for January 1, 1960, and January 1, 1964, included Elk Hills at a total of 175,000 barrels daily. See prior reports for previous estimates for Elk Hills.

TABLE V

MAXIMUM PRODUCTIVE CAPACITY OF NATURAL GAS
IN THE UNITED STATES

(Thousand Cubic Feet Daily @ 14.65 psia and 60°F)

DISTRICT	JANUARY 1, 1964 NON-ASSOCIATED	ASSOCIATED	DISSOLVED	TOTAL	JANUARY 1, 1960 TOTAL
East Coast	919,000	0	11,200	930,200	990,300
Mid-Continent	12,176,300	1,083,600	1,448,100	14,708,000	8,203,600
Gulf Coast	58,828,300	5,532,000	12,963,700	77,324,000	58,121,200
Rocky Mountain	1,789,000	140,400	299,500	2,228,900	2,327,000
West Coast	1,217,000	0	1,176,000	2,393,000	1,862,000
Total	74,929,600	6,756,000	15,898,500	97,584,100	71,504,100

NOTES: 1. This statement does not include any gas available from storage reservoirs.

2. This statement does include gas available from reservoirs being cycled.

3. In some cases, associated gas production cannot be distinguished from dissolved gas production. In these cases, all such gas is tabulated as dissolved.

TABLE VI

MAXIMUM PRODUCTIVE CAPACITY OF NATURAL GAS LIQUIDS IN THE UNITED STATES

(Thousand Barrels Daily)

DISTRICT	JANUARY 1, 1964 NON-ASSOCIATED	ASSOCIATED	DISSOLVED	TOTAL	JANUARY 1, 1960 TOTAL
East Coast	22.3	0	0	22.3	10.2
Mid-Continent	92.4	23.1	53.7	169.2	162.6
Gulf Coast	1,564.2	219.2	701.8	2,485.2	1,501.8
Rocky Mountain	16.0	1.3	26.7	44.0	37.0
West Coast	3.0	0	79.0	82.0	88.0
Total	1,697.9	243.6	861.2	2,802.7	1,799.6

EXHIBIT

UNITED STATES
DEPARTMENT OF THE INTERIOR
OFFICE OF THE SECRETARY
WASHINGTON, D. C. 20240

C
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March 19, 1964

Dear Mr. Follis:

In response to a request from the Secretary of the Interior, the National Petroleum Council prepared a report in 1961 entitled "Proved Discoveries and Productive Capacity of Crude Oil, Natural Gas and Natural Gas Liquids in the United States". The data contained in this report have been of value to the Government in its efforts to appraise the domestic long-term petroleum supply.

It is requested that the National Petroleum Council prepare a report which will update as of January 1, 1964 the information presented in the earlier report. The report should be in a form similar to that of the earlier one, except that projections of productive capacity will not be required.

The Office of Oil and Gas will supply further information as desired on the scope and details of the study. I am grateful for the Council's consideration of this request and I will appreciate receiving such a report together with appropriate comments and recommendations of the Council.

Sincerely yours,

/S/ JOHN M. KELLY

Assistant Secretary of the Interior

Mr. R. G. Follis
Chairman
National Petroleum Council
1625 K Street, N. W.
Washington, D. C. 20006