

REPORT OF THE
NATIONAL PETROLEUM COUNCIL'S
COMMITTEE ON LIQUEFIED PETROLEUM GAS
JULY 29, 1948

LIQUEFIED PETROLEUM GAS COMMITTEE
OF THE NATIONAL PETROLEUM COUNCIL

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"Production" Subcommittee

C. R. Williams (Chairman), Natural Gasoline Association, Corpus Christi, Texas

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"Demand" Subcommittee

Louis Abramson, Jr., (Chairman), Petrolane Gas Company, New Orleans, Louisiana

Howard D. White, Liquefied Petroleum Gas Association, Chicago, Illinois

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"Transportation" Subcommittee

B. C. Graves (Chairman), Union Tank Car Company, Chicago, Illinois

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CONCLUSIONS AND RECOMMENDATIONS

The Committee on Liquefied Petroleum Gas, appointed by the National Petroleum Council "to study the liquefied petroleum gas situation, including a study of production and transportation facilities," herewith submits to the Council its report and recommendations.

The scope of the assignment was so broad, and in some respects would require such a large amount of original research because of scarcity of dependable data, that it was deemed advisable to divide the Committee membership into three subcommittees, each to handle a specific assignment.

One subcommittee was named to study "Production," another "Demand" and the third "Transportation."

The fact became very apparent as the Committee proceeded with its work that conditions within and affecting the liquefied petroleum gas industry have been and are continuing to change with such rapidity that any conclusions reached and recommendations made would have to be subject to numerous qualifications.

For example, the "Production" subcommittee could determine with reasonable accuracy the total capacity of new and expanded facilities underway or planned by the natural gasoline and cycling plant operators, but it could not, because of the steel and labor situations and other factors, predict with any degree of accuracy just when or in what order those facilities would begin manufacturing liquefied petroleum gases.

This subcommittee could not, therefore, estimate production for 1948 and 1949 on either a daily average or a total-for-the-year basis. It had to confine its estimates to the volumes the new and expanded facilities are expected to be producing at an annual rate by the end of each of the years 1948 and 1949.

This subcommittee also had to give serious consideration to the potential increase in liquefied refinery gases as a result of the current refinery improvement and expansion program.

While the Committee obtained estimates of increased production from refineries representing 63.3 per cent of the cracking capacity and 54.3 per cent of the crude capacity of the United States, it was unable to obtain estimates from a few large refineries known to be making and selling large quantities of liquefied refinery gases. Neither was the Committee able to obtain estimates of increased production from many small refineries which may either increase production or in which additional equipment for the production of liquefied refinery gases may be installed in the near future. This unreported potential production, therefore, becomes an unknown factor in the determination of total production.

The Committee feels, therefore, that it can go no further than to state that, on the basis of the information at hand, the minimum estimated total production at the end of 1948 and at the end of 1949 will be at a rate which will amount to an annual production total as reported by the subcommittee.

In other words, the total production figures must not be construed as being the Committee's estimate of total production that actually will be realized in each of the two years under consideration.

The "Demand" subcommittee was faced with much the same problems, and it will be noted that its report contains numerous qualifications.

This subcommittee also realized that, due to the uncertainty with reference to motor fuel demand and production; the effect of enlarged and new refining facilities on the requirements of liquefied petroleum gas; the enlargement of existing facilities or the installation of new facilities which would make some refineries more self-sufficient with respect to requirements of these light hydrocarbons, and many other unpredictable factors, it would be almost impossible to determine or estimate with any reasonable degree of accuracy the volume of liquefied petroleum gas that would be required by refineries in the United States during 1948 and 1949. The subcommittee accordingly excluded refinery requirements from its estimates of demand.

This Committee accordingly approached that problem by comparing shipments to refineries for 1946 and 1947, as reported by the Bureau of Mines. This report indicated that shipments in the latter year were 7 per cent higher than in the previous year. By using 7 per cent as an arbitrary annual increase factor for 1948 and 1949, the Committee arrived at what it believes is a conservative estimate of liquefied petroleum gas requirements by refineries for those two years, namely, 436,002,000 gallons in 1948 and 466,720,000 gallons in 1949. The Committee has added these totals to the "Demand" subcommittee's estimated totals.

Tying the reports of the Production and Demand subcommittees together - keeping in mind the qualifications already stated - produces the following table:

	<u>1948</u>	<u>1949</u>
	(Gallons)	
Production (annual rate at end of Year)	3,263,881,600	3,771,886,600
Demand	<u>3,194,102,000</u>	<u>3,755,220,000</u>
Surplus on Annual Basis	69,780,000	16,667,000
Indicated Daily Average surplus at end of year	193,800	46,100

On their face, these figures indicate there is going to be sufficient liquefied petroleum gas produced in 1948 and 1949 to take care of demand.

For this reason the Committee re-emphasizes the qualifications previously made with reference to the production and demand figures, and, keeping those qualifications definitely in mind, has concluded that:

1. Production of liquefied petroleum gas by the end of both 1948 and 1949 will be at a rate which, on an annual basis, is likely to be ahead of annual demand but which, in seasonal periods of peak consumption in each of those two years, may not be at a current rate sufficient to meet the total current demand.

2. Tank car production for 1948 and 1949 should result in an adequate number of cars to meet requirements.

Production of liquefied petroleum gas at manufacturing points is a continuous and fairly constant volume operation. It cannot be increased or decreased to coincide with current demand.

Excess production in period of light demand, therefore, must be irrecoverably lost, or stored for future use.

In years past when current production was sufficient to supply the current demand, even in periods of peak consumption, expensive and large scale pressure storage was not considered an economic necessity.

Now that annual demand is creeping so close to annual production, the Committee is strongly of the opinion that only by saving excess production in periods of light demand can the industry cushion itself against those seasonal periods when demand on a current basis far outstrips current production.

The Committee accordingly recommends to the industry - both manufacturers and distributors - that it proceed with a storage program designed to save for ultimate utilization the maximum volume of liquefied petroleum gas produced annually. This Committee believes storage capacity not only should be increased at manufacturing plants and bulk plants of distributors, but also should be established at strategic points for short-haul distribution in order to obtain the maximum utilization of transportation equipment throughout the year. Particularly should distributors and consumers whose distribution or use is of a highly seasonal nature install ample storage to provide for their excess requirements during peak demand periods.

The Committee also recommends that distributors and equipment suppliers minimize the sale of tanks to consumers of a size which is insufficient to handle a peak load without refilling for at least 90 days; also to make every effort to convince consumers having insufficient storage capacity either to install larger or additional tanks.

The Committee strongly recommends to potential consumers that they do not purchase and have installed any new equipment for utilization of liquefied petroleum gas unless they first can make a firm contract with some reputable distributor for their entire fuel requirements.

REPORT OF "PRODUCTION" SUB-COMMITTEE

From the U.S. Bureau of Mines Report NGR-156, the Liquefied Petroleum Gas production of 1946 as compared with 1947 is shown in the following tabulation:

	<u>1947</u>	<u>GALLONS</u>	<u>1946</u>
<u>Liquefied Petroleum Gases</u>			
Commercial propane-butane mixture	477,711,000		420,521,000
Normal Butane	442,533,000		339,532,000
Propane	556,803,000		327,163,000
Other L.P.G. Mixture	166,025,000		121,879,000
Iso-Butane	206,184,000		164,015,000
Iso-Pentane	<u>40,268,000</u>		<u>36,235,000</u>
Total	1,889,524,000		1,409,345,000
Liquefied Refinery Gases produced for fuel and chemical purposes	<u>784,140,000</u>		<u>705,642,000</u>
Total	2,673,664,000		2,114,987,000
Increase	558,677,000	=	26.4%

It will be noted that in 1947, LPG production increased 26.4% with a total production of approximately 2,673,664,000 gallons, as compared with 2,114,987,000 gallons in 1946, or an increase of 558,677,000 gallons.

In order to estimate the quantity of production to be expected in 1948 and 1949, this sub-committee worked with the Production Sub-Committee of the National Petroleum Council's Steel Requirements Committee, and questionnaires were circulated to determine the number and size of Natural Gasoline and Cycling plants that are either now under construction or authorized and planned through September 31, 1949. A summary of the data obtained from these questionnaires is tabulated in Table No. 2, indicating that 57 new projects are under consideration in 10 states. The two plants under construction in Pennsylvania and California did not report the volume of production, but for those reported it is shown that annual capacity for LPG is being installed as follows:

Butane	353,800,000	gallons per year
Propane	333,547,000	
LPG	<u>425,492,000</u>	
	1,112,847,000	gallons per year

It is estimated that approximately 60 per cent of this capacity will be installed in 1948, making an increased production capacity of 667,708,200 gallons by the end of the year. Assuming that this capacity is operated at 80 per cent of its designed capacity, it is estimated that additional production at the rate of 534,159,000 gallons annually will result by the end of 1948, and that by the end of 1949 the production will be up another 445,132,800 gallons.

These figures indicate that by the end of 1948, production of Liquefied Petroleum Gases from natural gasoline and cycling plants is likely to be at the rate of 2,423,690,000 gallons on an annual basis, while production on the same basis is likely to be in the order of 2,868,823,000 gallons by the end of 1949. These 1948 and 1949 figures represent increases over 1947 production of 28 per cent and 51 per cent respectively, with the increase in 1949 over 1948 amounting to 18 per cent.

The Bureau of Mines report indicated Liquefied Refinery Gases produced for fuel and chemical purposes, i.e., production available for use outside the plants, amounted to 784,140,000 gallons in 1947, or approximately 29 per cent of total production.

Telegraphic questionnaires accordingly were sent to refiners representing 79 per cent of the cracking capacity and 70 per cent of the crude capacity of the United States, requesting them to estimate the volume of new production of propane and butane which would be available from refinery sources for sale for fuel and chemical purposes during each of the years 1948 and 1949 over and above 1947.

Four companies known to be distributing sizeable quantities of Liquefied Refinery Gases in the domestic market failed to reply. Answers were received, however, from refineries representing 63.3 per cent of the cracking capacity and 54.3 per cent of the crude capacity of United States refineries as reported by the Oil and Gas Journal, issue of April 1, 1948. The Committee estimates, however, that these replies cover 80 to 90 per cent of the potential production of Liquefied Refinery Gases available for fuel and chemical purposes.

Totals obtained from these questionnaires are as follows:

Estimated Increase in Production

	Propane		Butane		Total*	
	1948 Over 1947	1949 Over 1948	1948 Over 1947	1949 Over 1948	1948 Over 1947	1949 Over 1948
Total	25,896,600	44,130,000	3,974,000	16,172,000	55,058,600	63,872,000
Daily Average						
Production (gallons.)					153,200	177,400

*(These totals are higher than the sum of the propane and butane totals due to the fact that some refiners reported total new production without segregating it.)

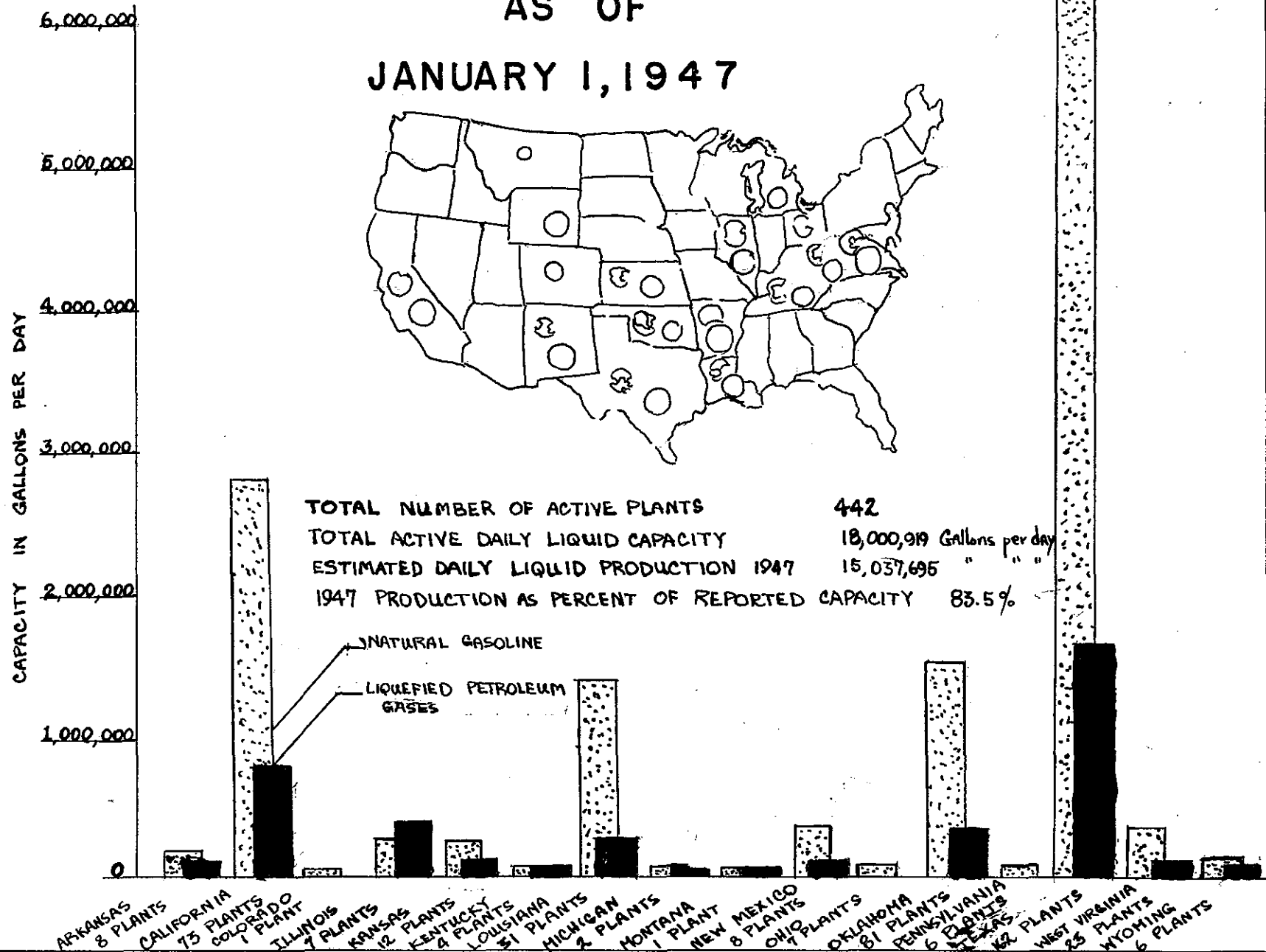
On the basis of these replies we can assume that the sum of the totals above plus the 1947 production reported by the Bureau of Mines represents the minimum volume of LPG from refinery sources as shown in the following table:

<u>1948</u>		<u>1949</u>	
1947 Production	784,140,000 Gal	1947 Production	784,140,000 Gal.
Total Increase 1948	<u>55,058,600</u>	Total Increase 1948	55,058,600
Est. total lique- fied refinery gas for fuel & chemical purposes	839,198,600 Gal.	Total Increase 1949	<u>63,872,000</u>
			903,070,600 Gal.

From these data, it is indicated that, on an annual basis, the minimum total production of liquefied petroleum gas by the end of the years 1948 and 1949 will be at the following rate:

Production Sources	<u>1948</u>	<u>1949</u>
1947 Production (other than refineries)	1,889,524,000	1,889,524,000
New Production (other than refineries)	534,159,000	979,292,000
Refineries	<u>839,198,600</u>	<u>903,070,600</u>
	3,263,881,600	3,771,886,600
% Change over 1947	22%	41%
% Change over 1948		15%

CAPACITIES OF NATURAL GASOLINE PLANTS IN THE U.S. AS OF JANUARY 1, 1947



SOURCE: The Petroleum Data Book, U.S. Bureau of Mines
Report NGR 155 (Estimated from)

FIGURE 5 1

REPORT OF "DEMAND" SUB-COMMITTEE

On February 5, 1948, the National Petroleum Council appointed a Committee to study the liquefied petroleum gas situation, including production and transportation facilities. Three sub-committees were appointed to make a study of "Production", "Transportation", and "Demand". The "Demand" sub-committee was instructed to "make a study of all possible phases pertaining to domestic and industrial demand currently, as well as the potential increase in demand in the foreseeable future".

The "Demand" sub-committee submits its report herewith:

SOURCES: 1. A Sub-Committee of the Marketing Division of the National Petroleum Council, under the chairmanship of Mr. K. W. Rugh, assigned the task of determining the forecastable steel requirements of the liquefied petroleum gas industry, met one day prior to our initial meeting, which was February 25th. This Sub-Committee was composed of the best informed personnel of the industry, producing and marketing, at all levels. Since the group included about twenty representatives, drawn from every geographic section of the country, we feel that the estimates resulting from the meeting of this Sub-Committee are well within limits of allowable error.

Although our Sub-Committee does not wish to plagiarize nor precede the report of Mr. Rugh's Sub-Committee on steel requirements, we recognize that the conclusions reached in reference to the steel requirements were necessarily based on the same information as to forecastable gallonage of demand that it is the function of our committee to investigate. It was the considered opinion of our sub-committee that a cross-section of well-informed individuals in the industry could prognosticate, from their comprehensive knowledge of the various factors involved, within acceptable limits of accuracy, and with as high a degree of reliability as could be attained by detailed and laborious calculation, in which errors are often multiplied and extended. Therefore, in order to avoid duplication and confusion, our sub-committee has utilized the estimates of Mr. Rugh's Committee with reference to gallonage forecast for the industrial, chemical manufacturing utility and gas manufacturing, and synthetic rubber production requirements.

SOURCES: 2. With reference to domestic demand, our sub-committee has found it possible to verify from independent sources the estimates of the Steel Requirements Sub-Committee. In our analysis, we have made reference to the data compiled by the U. S. Department of Commerce Librarian, New York City; the U. S. Department of Labor Statistics Department; "Gas Age" issue of February 19, 1948; Report of G.A.M.A. based on G.A.M.A. records, A.G.A. records, U. S. Census Bureau, Electrical Merchandising, Fuel Oil and Oil Heat.

We believe that we have carefully verified, by several methods, the conclusions reached by Mr. Rugh's Sub-Committee as to the forecastable demand in the domestic field.

SOURCES: 3. The basis for the 1947 demand was the 1947 report, published in February, 1948, by Messrs. R. W. Thomas and K. W. Rugh of Phillips Petroleum Company. For several years past, Messrs. Oberfell, Thomas, Benz, Rugh, etc. have published reports which the U. S. Bureau of Mines has invariably confirmed about one year later. We, therefore, feel that the authenticity of the Thomas-Rugh report for 1947 is fully reliable.

<u>D E M A N D</u>	<u>E S T I M A T E D</u>	
	<u>D E M A N D</u>	
<u>1947</u>	<u>1948</u>	<u>1949</u>

(From the Thomas-Rugh Report,
Up 30% from 1946)

(a) Domestic	1,000,000,000	1,300,000,000	1,560,000,000
(b) Industrial	285,000,000	342,000,000	410,400,000
(c) Chemical Manufacturing	415,000,000	556,100,000	695,100,000
(d) Utility and Gas Manufacturing	135,000,000	210,000,000	273,000,000
(e) Synthetic Rubber Production	<u>350,000,000</u>	<u>350,000,000</u>	<u>350,000,000</u>
	2,185,000,000	2,758,100,000	3,288,500,000

- (a) It is important to point out that the annual domestic consumption figure is not divisible into 12 equal parts. Because of the wide use of liquefied petroleum gases for house heating, particularly in the south, there is a considerable fluctuation between monthly summer demand and the monthly winter demand. For example, in three typical southern states the fluctuation is at the rate of 5 to 1; that is, the domestic consumer uses five times as much in each winter month as in each summer month, under normal conditions, where the fuel is used for house heating. This is not true to any considerable extent where liquefied petroleum gas is used for cooking, hot water, etc., and not for house heating.
- (b) The increase in demand for industrial fuel in 1948 and 1949 over 1947 is based on our information as to the number of additional large storage tanks ordered for delivery in 1948 by industrial users, as compared to those in use in 1947.
- (c) The increase in demand for chemical manufacturing purposes in 1948 and 1949 over 1947 is based on known new construction of and in chemical manufacturing plants.

gas for additions to their supply when the winter peak demands arise. Simultaneously, it is normal practice for many utilities to cut down or eliminate supplying their pipe line gas to industrial accounts during the peak winter months, in order to make more fuel available for their domestic consumers. This results in two dislocations:

- (1) The utility uses more liquefied petroleum gas in its own operation during the cold months, compared to the summer.
- (2) The industrial consumers of the utility must turn to other fuels (in many cases liquefied petroleum gases) for their power during peak periods in winter months, when the utility cuts them off from pipe line gas.

(e) The figure given represents present operation of Rubber Reserve Plants, changes in whose operations we cannot properly evaluate since such changes would be based on factors beyond our reasonable forecasting ability.

Notes: I. All figures given are in U. S. Gallons.

II. We have not included in these figures any aviation or other refinery uses of LP gas.

III. The domestic increase in 1948-1949, over 1947, presupposes no radical changes in the economic cycle in 1948, compared to 1947.

IV. The potential market for liquefied petroleum gas in the United States presents the possibility of a definite decrease in the rate of expansion.

Our reasoning is based on the following:

Total U. S. dwellings, April, 1947	41,747,000
Dwellings constructed since April, 1947	<u>644,250</u>
U. S. dwellings December 31, 1947	42,391,250
Total ranges December 31, 1947	<u>29,375,000</u>
Potential range market as of December 31, 1947	13,016,250
Contemplated 1948 construction	<u>950,000</u>
Total 1948 potential available (All ranges - gas, electric and all other fuels)	13,966,250

There will be, in our opinion, an increase in domestic business of 30% in 1948 and a smaller increase (about 20%) in 1949. The synthetic rubber usage will remain static. The industrial, utility, domestic and chemical usages will increase about 20% in 1949, over 1948.

REPORT OF "TRANSPORTATION" SUB-COMMITTEE

Based on a reported production of Liquefied Petroleum Gas, for all uses, of 2,673,644,000 gallons for the year 1947, it was estimated with reasonable accuracy, that the L.P.G. tank cars available to the Petroleum Industry in 1947, including Modified Cars, Class 104-A cars, Class 105-A-300 and Class 105-A-400, moved about 50% of the production, or 1,336,664,000 gallons. It is assumed that the balance, or the other 50%, either moved by pipe line, by tank trucks, by water, or in containers, or was disposed of in some other manner.

Based on an estimated production of 3,263,881,600 gallons for 1948, or an increase of 590,217,600 gallons over 1947, it is estimated that if this entire increased production was to be moved in tank cars, 2676 additional cars would be required. If 75% of the increased production moved by tank cars then 2007 additional tank cars would be required. If 50% of the increased production is to move in tank cars than 1338 additional tank cars would be required.

According to the information available to your committee there were available to the Petroleum Industry for L.P.G. on January 1, 1948, including all the types referred to above, a total number of 6571 cars.

The figures of the car builders for new cars delivered since January 1, 1948, reveal that for the four months 973 cars were actually constructed and delivered, or an average of 243 cars per month. From the best estimates available it is expected that for the remaining eight months an average of not less than 250 cars per month will be constructed, or a total of approximately 3,000 new cars for the year 1948.

It, therefore, appears that the tank car production for 1948 is more than adequate to meet the increased production of L.P.G.

As previously indicated, Modified cars are included in the L.P.G. tank car equipment available. As will be recollected, these Modified cars (1194 still in service) were constructed as a war emergency and their efficiency is deteriorating rapidly and these cars will eventually have to be retired from the L.P.G. service. This factor must be taken into consideration in future tank car construction. It is estimated that the backlog of orders for new L.P.G. cars remaining on the books of the car builders, as of December 31, 1948, will be sufficient to retire if not all, then at least a large portion of these cars from L.P.G. service in 1949.

The transportation requirements by water, pipe line, and highway were also considered and it was concluded that these transportation facilities would be developed principally on economic grounds. No estimates as to facilities required will be submitted, although it was indicated that 24 tank trucks would need to be constructed during 1948 and 1949.

It is, of course, important at this point to recognize that if any of the present or anticipated rail transportation is diverted to these other transportation agencies, or if the distances travelled are shorter,

then a temporary surplus of tank cars may develop, unless of course the production and the demand for L.P.G. increases to take up the slack.

It is apparent to your committee in the study before it that unless adequate storage is provided in the field of consumption for the surplus production of L.P.G. in the late spring and until early fall, economic losses will occur either by a loss of material or a loss of transportation efficiency, or both.

It was also the opinion of your committee that many delays to tank cars at points of loading and points of unloading can be corrected and thereby increase the efficiency of the present equipment.

The estimated production of 1949 is 3,771,886,600 gallons of an increase over 1948 or 508,005,000 gallons. If this increase goes 100% by tank car 2304 cars will be required; if 75% 1728 cars; if 50% 1152 cars. Sufficient old unfilled orders on the books of the car builders plus new orders placed this year should result in an adequate number of cars being produced in 1949 to meet 1949 requirements.

Of course, it will be appreciated that the foregoing analysis represents estimated consolidated needs of the industry on a national scale without regard to the tank car situation as it affects the individual companies. In the competitive economy in which the petroleum industry operates, tank car construction must be continued until each member of the industry has had made available to it the tank cars needed for the development of its individual business and on the most favorable conditions obtainable.

TABLE NO. 2
SUMMARY BY STATES
(Barrels Per Day)

<u>State</u>	<u>No. of Plants</u>	<u>Butane</u>	<u>Propane</u>	<u>L.P.G.</u>	<u>Total</u>	<u>Gasoline & Heavier</u>	<u>Grand Total</u>	<u>Per Cent</u>
California	1	*	*	*	*	*	*	*
Colorado	1	400	300	-	700	1,300	2,000	1.24
Kansas	2	1,120	1,200	-	2,320	1,520	3,840	2.38
Louisiana	7	3,071	2,700	4,833	10,604	8,679	19,283	11.95
Mississippi	1	160	120	-	280	520	800	.50
New Mexico	4	-	-	2,607	2,607	2,250	4,857	3.01
Oklahoma	2	200	150	-	350	750	1,100	.68
Pennsylvania	1	*	*	*	*	*	*	*
Texas	37	18,259	17,176	20,701	56,136	72,107	128,243	79.45
Wyoming	1	280	410	-	690	590	1,280	.79
Total	57	23,490	22,056	28,141	73,687	87,716	161,403	100.00
Per Cent		14.55	13.67	17.43	45.35	54.35	100.00	

NOTE: * Not Reported