Gas Utilization Today and in the Future

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Before beginning this discussion on the utilization of gas, let me provide some brief background on the present status of gas in the Nation's aggregate energy requirements. Subsequently, we will examine the future of gas utilization, some of the economic problems associated with this industry, and some challenges to research and technology within the industry.

The gas industry had its infancy in the early nineteenth century with the first limited distribution of low Btu gases manufactured from coal. As recently as 1940, nearly 60 percent of the industry's customers were still dependent either upon manufactured gases (from coal or oil) or mixtures of manufactured and natural gas. To be sure, substantial portions of the country had been using natural gas for many years before this, where the gas was produced more or less locally. However, the rapid growth of the gas industry, and the major extension of natural gas availability to all portions of the Nation which facilitated this growth, was initiated in 1931 with the construction of Natural Gas Pipeline Company from Texas and Oklahoma to the Chicago area. It accelerated substantially in subsequent years as the availability of high-strength steel pipe and effective welding techniques made long-distance transportation of natural gas economically and physically feasible.

Until after World War II, supplies of natural gas available for delivery substantially exceeded the ability of the pipeline network to market the gas. It was a buyer's market and natural gas in the field was sold, frequently as a by-product of oil production and under incremental pricing theories, at prices which in retrospect appear extremely low. Immediately after World War II, coal and oil prices rose substantially and suddenly natural gas became the cheapest source of energy for a multitude of purposes, in most parts of the country. Pipeline construction accelerated markedly, and transmission lines were built to virtually every corner of the country. The additional requirements created by these new pipelines affected the supply-demand relationship substantially. Producers soon realized that they no longer were marketing a troublesome and relatively undesirable by-product for which they would accept almost any price, but were the proud possessors of an extremely desirable commodity of substantial value. The average price of natural gas in the field rose from 4.9 cents in 1945 to 10.4 cents in 1955. In my own opinion, this is in the best American tradition, that a product available in limited supply should bring increasingly higher prices as the demand increases. This is the surest way to encourage the introduction of new producers, thus increasing the available supply, and bringing the price down. Since 1961, the average price of natural gas in the field has indeed stabilized, although whether this is primarily attributable to the forces of economics, or because of regulatory actions of the Federal Government is a question I shall not discuss here. And, at the present time, over 98 percent of the gas distributed by utilities in the United States is pure natural gas.

Let us now discuss the components of this nation-wide demand for natural gas-- the different types of consumers, and different types of applications. In the field of heating, the growth has been phenomenal. The total number of residential customers using natural gas for heating their homes has risen from 7.4 million in 1949 to 24.0 million in 1963. These totals exclude substantial numbers of families in multi-family structures where gas is used in central heating systems, and exclude significant numbers of households using liquefied petroleum gas for heating in areas beyond gas utility mains. The gas companies have been adding between one million and one and one-fourth million new residential heating customers each year for the past five years, and anticipate a continuation of this growth rate in the foreseeable future. In the preponderance of the Nation, natural gas is the cheapest heating fuel, not only for residential customers, but also for commercial and industrial establishments, to say nothing of its other desirable attributes. In our service area in northern Illinois, for instance, natural gas for residential use costs 35 percent less than oil, 15 percent less than coal, and 70 percent less than electric heating. These favorable economic circumstances are not unusual, and we expect that they will continue to prevail in the future. Ninety-nine percent of the new homes in our service area install gas heating in areas within reach of our mains, and we try vigorously to reach almost everyone.

In the residential market, basic household gas appliances have also shown marked growth, although not at the same rate as heating. For example, Chart 1 shows the growth of gas cooking as reported in the various United States Censuses of Housing. If Census data were available for years prior to 1960 for water heating, an even more rapid growth would be apparent. These growth rates have been lower than that for heating for one significant reason. To a major extent for cooking and clothes drying, and to a lesser extent for water heating, operating cost is not a crucial factor in consumer fuel decisions during decades of ever-higher economic activity. Annual operating costs are relatively small regardless of the fuel used, because of the modest energy requirements of these applications. Accordingly, although gas is the least costly form of energy, it must also compete in terms of qualitative and subjective features associated with the respective appliance. Some of our competitors produce attractive and well-designed equipment, and advertise it nationally on a massive scale. We welcome this kind of spirited competition, and we are confident that we will more than hold our own in the residential appliance market of the future.

The growth in commercial use of gas for non-heating applications has also been very substantial. Cost factors are important to a commercial establishment, which is more concerned with its own profit and loss than with advertising messages and subjective evaluation. Surveys done at periodic intervals among the best restaurants throughout the Nation confirm an overwhelming and consistent use of gas for cooking in excess of 90 percent. Further favorable evidence is available from the acceptance of gas at the New York World's Fair where gas is being used for 80 percent of the cooling, 90 percent of the heating and water heating, and 99 percent of the cooking. For all commercial sales by gas utilities, the compound annual growth rate in the past ten years has been 8.6 percent.

In the field of industrial processing applications, gas has also enjoyed rapid growth. The cost advantages enjoyed by natural gas are supplemented by other important considerations within the plant, such as ease of control, evenness and quality of heating, and dependability of supply. Industrial gas sales by utilities, including all applications of gas in such establishments, have shown an annual average growth rate of slightly over 6 percent. I do not anticipate any deceleration in this rate in the foreseeable future, unless industrial expansion declines markedly.

The story is somewhat different for air cooling. In the residential market, the operating cost advantages of natural gas have so far been more than offset by higher equipment costs. Our progress in gaining widespread acceptance and use has therefore been disappointingly slow. Substantial research is being devoted to this problem, and within the next few years we anticipate that several additional prominent appliance manufacturers will be marketing more efficient and less expensive residential air conditioning equipment using natural gas. This will enable our industry to obtain a substantial, if not major, share of this rapidly growing market. In commercial and industrial air conditioning applications, this problem is relatively minor. Many gas companies are competing favorably in both operating cost and equipment cost, and are obtaining substantial portions of the market with direct absorption equipment, gas-fired engines, and large-volume steam absorption units. We expect to improve our position even further in these markets in the future, partially through the concept of on-site total energy generation.

Significant consumer interest is already being expressed in the relatively new concept of on-site total energy generation, using natural gas in engines or turbines. In these applications the engine or turbine produces the required electricity on the customer's premises, and the waste heat is employed for heating, air conditioning, and hot water heating. Such installations are completely dependable, and offer important cost savings to consumers who have relatively level load requirements throughout the year. They are generally not feasible for a customer whose electric load fluctuates widely, because of the capital costs of equipment needed only to meet infrequent peaks. Under proper conditions they achieve total system efficiencies significantly in excess of 60 percent. Our new General Office building, nine miles northeast of Aurora, Illinois, has been successfully using this concept for over a year and a half, and is demonstrating dramatically what such installations can achieve for customers. Our market analyses indicate a very substantial potential for such applications, which we intend to exploit fully.

In the future, our industry will be selling fuel cells. These will convert natural gas directly to electricity, silently, efficiently, and reliably, on the premises of the customer. They will be designed primarily for residential and other small users, where engines are not applicable. Substantial funds are being spent, both by the gas industry and by individual manufacturers and research organizations, to hasten the day when such fuel cells will be widely available. We look forward with eager anticipation to the day when no customer, residential, commercial, or industrial, will require any form of energy on his premises other than that supplied through a gas line.

Perhaps the best way of summarizing the aggregate growth of natural gas in the Nation's economy is to provide a chart showing the increases in total energy used in the United States, and the way in which natural gas has contributed to those increases. I have taken the liberty of appending to the historical data a few projections of my own which I regard as "conservatively realistic." In 1940, natural gas provided 11.4 percent of the total; in 1950 it was 18.0 percent; in 1963 it was 29.7 percent; and in 1970 it will provide 32.3 percent.

Continued growth in demand for natural gas obviously raises the question of adequacy of future supply. Many experts have attempted to develop reasonable estimates of total future supplies of natural gas in the United States. I emphasize that they must be estimates, because no one can yet scientifically determine how much gas may exist in a given place and at a given depth before that place has been located and adequate drilling has occurred. The estimates of these experts have ranged between 600 trillion cubic feet and 1,800 trillion cubic feet, with recent estimates generally in the upper range. Even at the midpoint of this scale, some relatively simple arithmetic indicates that supplies will be completely adequate for a considerable number of decades. And we are not limited exclusively to the natural gas which will be found within the limits of the contiguous forty-eight states. Very substantial additional quantities of natural gas will be available to the U.S. by conventional pipeline importation from Canada and Mexico. Less significant, but still important, quantities will be available from tanker shipments in liquefied form from overseas points. Many nations produce large quantities of crude oil, which finds a ready market, and also produce substantial amounts of natural gas with limited local requirements. The development of fleets of refrigerated tankers to transport liquefied natural gas is inevitable, so that natural gas now being wasted in some nations can be effectively and economically delivered to market. For those areas with excess supplies of natural gas which are not too remote from large overseas markets, long-distance under-water pipelines anchored to the ocean floor will become feasible. Such a line across the Mediterranean from Algeria to Southern Europe, has already been discussed.

As a further supplement to natural gas supplies in the United States, we have highly favorable prospects of manufacturing synthetic methane from oil shales, low-grade bituminous coal deposits, lignite, and tar sands. Substantial industry funds have been spent in recent years in researching the processes necessary for such conversion, including the development of small-scale pilot plants. Recently, plans were announced by several Gas Boards in Great Britain to produce a synthetic, high Btu gas from refined petroleum products (primarily naphtha) at a price per therm which even today, before further research, is within hailing distance of natural gas prices in the U.S.

To date, importation of liquefied natural gas and production of synthetic natural gas have not occurred in the United States because they cost more than naturally-occurring methane. However, two factors will gradually eliminate this economic differential. Natural gas (in common with all other mineral and energy resources) will gradually increase in price, as demand increases and natural supplies diminish. The synthetic product, or the natural product from unusual sources, will gradually decline in price as technology improves the applicable manufacturing or marketing processes.

Now that I have reviewed the magnitude of the markets and the adequacy of supplies to meet those demands, let me turn to the economics of utilization. In the first place, I believe that utilization (or sales) is the essential factor in any industry. Unless a product is eventually used and a profit derived, all else is meaningless. The factor which determines the utilization of any given product is its overall economics, both to the manufacturer and/or distributor, and to the consumer. Costs at all levels, for research, production, and marketing, obviously affect consumer economics.

Let me start at the beginning, and discuss some of the economic characteristics of natural gas exploration. This activity is obviously necessary to locate new sources which will replace gas being produced and used, and thus maintain adequate supplies and deliverability for future demands. Exploration for natural gas (or crude oil) is financially hazardous; among those wells drilled in completely new areas (wildcats), only one in ten finds commercial deposits of gas or oil, and only about one in one hundred proves profitable, in spite of all the research on techniques for identifying likely production sites. News accounts often discuss those who have struck it rich, but no one hears about the hundreds of people who have lost their investments completely. The hazards of this business emphasize the need, for the good of the country, to provide adequate incentives to those who risk their money in exploratory activities, and I shall return to this point shortly. Also remember that a disproportionately large percentage of exploration is undertaken by individuals and small independent operators, rather than the giant, integrated oil companies who might be able to spread their risks more effectively. Furthermore, exploration is becoming more costly rather than less, because of increasing concentration on offshore areas and deeper horizons where the possible rewards may be greater, but where drilling costs per foot are very much higher. It is almost axiomatic in any extractive industry that the shallower and more accessible deposits will be found sooner, and that as the industry matures it requires more ingenuity and technological progress to maintain the pace of new discoveries.

Production of natural gas entails a wide variety of complex economic problems. No one knows how much it costs to locate and produce a unit of natural gas. In the exploration phase, it is usually extremely difficult to know whether you will find gas or oil or both if successful; and impossible to know if the hole will be dry or productive before you start drilling. For the 90 percent of exploration which is unsuccessful, how shall the cost be apportioned between gas and oil, remembering that unsuccessful exploration is an integral part of the search to develop new sources of natural gas. For a producing well, where both gas and oil are obtained, how shall the operating costs be allocated between the two products. The Federal Power Commission has been struggling with these basic problems for substantially more than five years in their attempts to regulate the price of natural gas at the wellhead, as the Supreme Court required after the famous Phillips Petroleum decision of 1954. On cost allocations, I don't think they are much closer to a defensible and economically justifiable answer than they were five years ago. An alternative is to ignore cost allocations and cost determination, and set a price for natural gas at the wellhead based on its value as determined by arm's-length negotiation between producer and purchaser. This is the so-called commodity value concept, which the Federal Power Commission has not as yet adopted, preferring instead to explore the cost determination procedure.

Another policy matter involving economic theory is the depletion concept. When a producer sells natural gas he is selling his asset, and part of the price he gets is a return of capital rather than a return on capital. Under our tax laws, the latter is taxable, but the former is not. Contrary to some impressions, depletion is not unique to natural gas and crude oil. The rates may vary, but depletion is available to the smallest property owner growing evergreens for Christmas trees on his property, and to the largest industrial corporation extracting any kind of mineral. Another economic problem is the maintenance of relatively even rates of flow from natural gas wells, to maximize ultimate recovery of the resource in spite of substantial seasonal load variations at the consumer level. Producers have attempted to protect themselves against this problem by institution of take-or-pay provisions in their sales contracts; I shall refer again to this concept when I discuss the economic problems of pipelines.

It should be kept in mind that, to some extent, producers of natural gas have the alternative of selling their product in intrastate commerce, which would free them of the Federal regulatory problems I have discussed. There are substantial intrastate markets for natural gas, consisting of petrochemical plants, other industrial establishments, electric power generation, and local natural gas distributors. When available supplies significantly exceeded interstate market demands, these intrastate markets were insufficient to offer an effective alternative. Now that supply and demand have become more nearly balanced, "excess" supplies have become substantially lower, and intrastate markets have grown substantially, these intrastate markets may assume greater relative importance as an effective alternative for the producer. Such a condition could deprive markets in consuming states located at some distance from producing areas of their needed incremental supplies, unless these economic factors are effectively recognized by regulatory bodies.

The transportation or pipeline segment has some of its own unique economic problems. As alluded to previously, they are faced with take-or-pay provisions in their gas purchase contracts. This means that they must accept some relatively high percentage of the maximum amount of gas available to them, on each and every day of the year, or pay for it anyway. To protect themselves against such provisions, the pipelines generally impose comparable take-or-pay provisions on their distributing utility customers. Pipeline rates almost universally contain two components. The demand charge is a fixed obligation on the customers of the pipeline, to pay a specific amount each month to cover the fixed costs of providing a definite amount of daily capacity for the individual customer. The commodity charge, which varies directly with the quantity of gas sold to the customer, is intended to cover variable costs attributable to volumes transported. The most common take-or-pay provision in pipeline contracts with distributors is that the distributor must take or pay for 75 percent of the maximum amount to which he is entitled each month (daily contract amount times the number of days in the month times the commodity charge). At least one pipeline company is currently attempting to lessen the impact of its take-or-pay provisions in purchase contracts with producers, by developing potential underground storage fields near the producing area. This would permit them to purchase gas from the producers at a relatively even daily rate, and to vary their deliveries to distribution company customers, depending upon market demands, by injections and withdrawals from their own storage field.

Although the demand charge paid by distributors to the pipeline is intended to cover the fixed costs of the pipeline, it does not accomplish this objective under current regulatory practice. Under the so-called Seaboard Formula, the Federal Power Commission allocated 50 percent of fixed charges to demand and 50 percent to commodity, and all of the variable charges to commodity. This policy penalized distribution companies with high load factors, and rewarded those with poor load factors. This phenomenon is demonstrated in Chart 3. I shall not take the time to explain the philosophy under which the Federal Power Commission has employed this allocation method, with its inherent deviation from proper economic principles. Happily, they are currently showing signs of reversing their direction partially, and reverting to a more realistic economic interpretation of cost causation.

Another interesting characteristic of many regulatory agencies is the retention of original cost as the basis for determining allowable return (or earnings). In such cases, no recognition is generally accorded to inflation, replacement cost, or market value of facilities. The pipelines and utilities are permitted to earn a specified percentage of their depreciated original property cost. There are many other ramifications of how this so-called "rate base" is determined, and another equally lengthy paper could be readily written on this subject.

As gas demands continue to grow, particularly in built-up residential and commercial areas, it will be far more practical and economical for utilities to increase operating pressures rather than construct numerous new distributing lines. This will require pipelines to increase their operating pressures to the extent possible, through addition of substantial compressor facilities. Already some pipelines are giving serious attention to this forthcoming problem. I should remind you that underground pipeline transportation of natural gas is one of the most efficient and least expensive methods of energy transportation yet devised. Natural gas pipelines transport 10 percent of the Nation's aggregate inter-city tonnage of freight movements, compared with 20 percent for the entire trucking industry.

The last branch of the gas industry is the one with which I am most personally familiar--the distribution companies. One principal problem is load factor, defined as the ratio between average daily requirements and peak day requirements. In the climatic conditions prevailing in my company's service area, this ratio is 26 percent for residential heating; a residential heating customer uses four times as much gas on the coldest winter day as his average daily use. With the substantial growth in gas heating described previously, this means that distribution companies have substantially lower summer gas requirements than in winter. Unless some method is employed to use this unrequired summer gas profitably, since they must pay fixed demand charges to the pipeline throughout the year, the financial picture of most gas distributors suffers substantially. There are three general approaches to this problem. First, we try to sell gas on a firm basis for applications which have their greatest requirement in the summer, such as air conditioning and swimming pool heating. Unfortunately, this is generally only a very partial answer at present. Secondly, many companies, including my own, have developed underground storage facilities near their markets, into which we inject gas in the summer and withdraw it in the winter to meet the peak requirements. This serves the dual purpose of permitting us to take summer gas from the pipeline at high load factors, and to meet winter peaks without commiting ourselves to substantial new increments of pipeline flow gas with additional fixed demand payments and take-or-pay provisions.

The third alternative is to sell gas to large commercial and industrial establishments on an interruptible or off-peak basis. Such customers utilize coal, oil, propane, or other alternatives when they are interrupted and cannot have natural gas. Since our payments to the pipelines under the demand component of the rate are fixed, the only measurable incremental cost of gas for supplying these customers is the commodity cost. Any revenue obtained from such customers over and above the commodity cost of the gas which they use represents a contribution to pre-tax earnings.

Interruptible and off-peak gas is generally sold in vigorous price competition with other fuels. If regulatory policy followed economic principles, and assigned only variable costs to the commodity component of pipeline rates, the commodity charges would be lower, and our competitive position in this market would be improved. Let me emphasize clearly that our company sells gas to interruptible users only when excess gas is available for which no more desirable alternative exists, and the daily amounts of gas for which we contract with our pipeline suppliers are determined exclusively by the demands of year-round customers.

For distributing companies, operating costs can also be distinguished between fixed and variable components. Certain costs are constant regardless of the amount of gas used by the customers. Other costs are variable depending upon customer usage. This is the economic justification for the typical block rates used by gas utilities, under which large users earn progressively lower charges per unit of consumption. Unfortunately, in many parts of the country the differential levels of these various blocks cannot reflect realistically the proper application of economic and cost principles. To do so would require the imposition of substantially higher charges in the initial block of consumption, and require higher minimum bills per month, than is ordinarily palatable for regulatory bodies sensitive to the social pressures of the vast numbers of small users.

Much regulatory attention, but little action so far, is also being accorded to the question of managerial efficiency. Presumably, a utility which is efficient in providing superior service at low costs to the maximum number of potential customers should be entitled to higher earnings (rate of return times rate base) than a company which fulfills these desirable objectives less satisfactorily. I hope and anticipate that this concept will be more generally recognized and employed in regulatory decisions in the future.

Another significant economic problem for many gas distributing companies is the impact of inflation upon their investments, where state regulatory commissions still employ original cost for a past period as the basis for determining allowable earnings for the future. The trends toward suburbanization and less dense customer concentration, combined with higher unit investment costs because of inflation, have generally increased the average investment per customer of gas companies. This necessitated (until relatively recently) relatively frequent rate increases to consumers. The best solution to this problem is vigorous and effective sales promotion to increase the amounts of gas used by each customer, so that the higher investments will be utilized more fully throughout the year, thus providing more satisfactory contributions to earnings.

What are the challenges to research and technology in the economic problems of the gas industry? What research advances will improve the industry's efficiency, offer greater economies to consumers, and provide more effective resource utilization for the entire Nation?

Let me start again with exploration and production. At present, we can, through seismological, geological and geophysical procedures, locate presumably favorable underground structures, but we can not tell (other than by drilling an expensive hole) whether there will be hydrocarbon accumulations encountered. Research is continuing using geochemical approaches, and some experiments with laser beams, but it would be a massive step forward if a method existed to determine whether there were indeed hydrocarbons located many thousand feet beneath the earth's surface.

Technological improvements are continually needed on drilling techniques and well completion methods, as exploration goes deeper. Exploration increasingly involves wells 20,000 feet deep or more. At such depths, we need greater strength in drill pipe, more efficient and longer-lasting bits, and cement which will not set too quickly and with sufficient permanent strength at high temperatures (400°+). The entire science of mud formulation is amenable to further research and technological advance. Mud serves three basic purposes: it lubricates and cools the drill bit, it removes pieces of ground-up rock formation from the hole, and it seals off any formations through which drilling has penetrated. In many formations, existing muds do not always satisfactorily perform these three functions. More efficient means of fracturing formations are needed, to facilitate extraction of hydrocarbons without damaging the rock structure.

It appears that foreseeable advances in gas transportation are largely problems of extending existing technology, rather than developing new techniques or conducting additional research. It is likely that larger diameter line pipe (perhaps 42" or 48") might be desirable. More likely is the probability of using existing pipe sizes at higher pressures, which may require higher strength steels and more efficient compressors. The use of gas turbines for compressor stations, now becoming increasingly common, may be an answer to one part of this problem. There will also be considerable extension of the concept of complete automation of long-distance pipeline systems, with electronic data gathering and controls at one central point, automatically correcting pressures and gas movements for varying load conditions at any point along the line.

In the field of gas distribution and customer utilization, there are many areas where research will be important. Much remains to be done in developing more effective and less costly techniques for synthesizing natural gas from coal, oil shale, tar sands and other materials. The development of reliable and marketable fuel cells, to convert natural gas directly into electricity on residential premises, is still in its infancy, and major new advances are anticipated. The future will undoubtedly provide us with new types of plastic pipe with extremely long life, inexpensive installation, freedom from corrosion and chemical attack, and able to withstand intermediate, or even high, pressures. The development of more efficient thermoelectric corrosion prevention techniques for steel pipe is needed.

More research is required to develop residential absorption gas air conditioning with greater efficiency and lower first cost. This may possibly involve the development of better chemical systems than the present lithium bromide medium. Greater combustion efficiency in residential applicances, particularly gas furnaces, would be a major step forward in true conservation of a vital natural resource. Gas furnaces which now operate at 75 percent efficiency are the most efficient overall way of heating homes, but if they operated at 85 percent it would significantly extend the life of our available natural gas reserves. More research is needed on thermoelectric devices to convert the waste heat of furnaces directly into electric power to operate the fans and blowers on warm air systems, so they may be independent of outside electric power and be free of outages during storms or catastrophe.

Further advances will occur in developing less costly gas engines and turbines, and in providing more efficient automatic instrumentation and control panels for such units. Initial experimentation is already being conducted on remote meter reading using telephone lines, but I foresee further advances, possibly using radio transmitters and receivers in gas company patrol cars driving through neighborhoods.

I hope I have provided you a reasonably comprehensive picture of the current and future status of gas utilization in the United States, and of some of the economic problems affecting all phases of the industry from wellhead to consumer. I also trust that some of the challenges to research and technology which I have mentioned will excite your imagination. We need the assistance of all types of scientists throughout the country so that, in the consumer interest, we can improve the performance and efficiency, and lower the costs, of our Nation's fifth largest industry, the natural gas industry.

Chart 1

Cooking Fuel in the U.S., 1940-1960

	Gas(a)	Other or None	Total Occupied Dwelling Units
Number (000's)			
1940	17,026	17,828	34,854
1950	25,502	17,324	42,826
1960	33,730	19,082	52,812
Percent			
1940	49	51	100
1950	60	40	100
1960	64	36	100

(a) Includes bottled gas.
Source: 1960 U.S. Census of Housing

CHART 2

Energy Used in the U. S. by Principal Sources
1940-1970

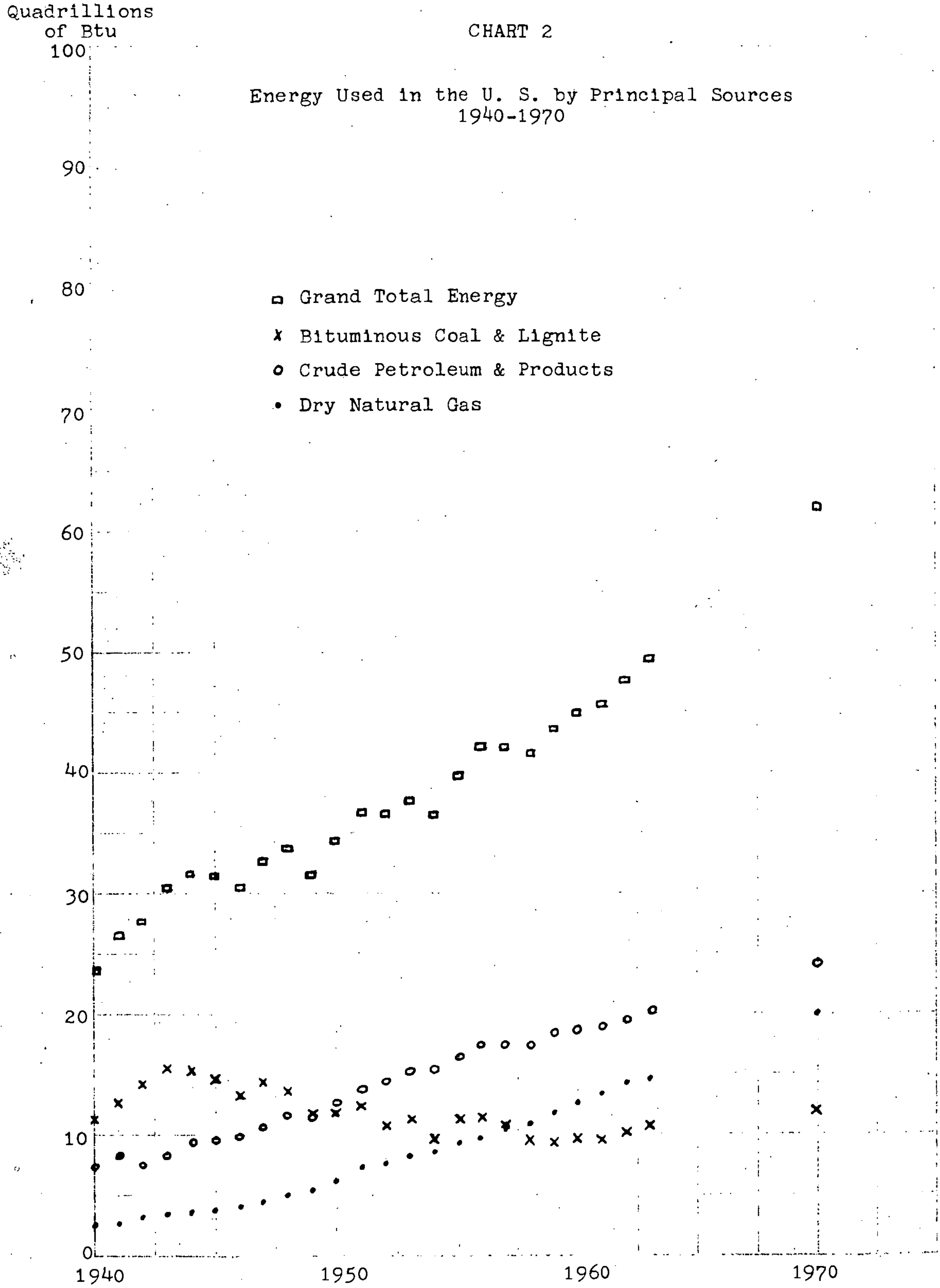

Chart 3

Effect of Two-Part Rates and Seaboard Formula on Average Cost of Gas

1. Assume a fictitious pipeline with:

   maximum daily capacity of 2,000,000 MCF
   annual sales of 500,000,000 MCF
   fixed costs of $80,000,000
   variable costs of $70,000,000

"True Economic" Rate		"Seaboard" Rate
$3.333/MCF/mo.	demand	$1.667/MCF/mo.
plus 14.0¢/MCF	commodity	plus 22.0¢/MCF

2. Assume two distributing utility customers with:

A		B
200,000 MCF/day demand 90% load factor		200,000 MCF/day demand 50% load factor
	"True Economic" Rate	
$ 8,000.000	Demand	$ 8,000,000
9,184,000	Commodity	5,096,000
$17,184,000	Total Cost	$13,096,000
65,600,000	Total Purchases	36,400,000
26.15	¢/MCF	35.95
	"Seaboard" Rate	
$ 4,000,000	Demand	$ 4,000,000
14,432,000	Commodity	8,008,000
$18,432,000	Total Cost	$12,008,000
65,600,000	Total Purchases	36,400,000
28.15	¢/MCF	33.00