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## AN OVERVIEW OF NATURAL GAS SUPPLY AND AVAILABILITY

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### ABSTRACT

Natural gas presently supplies almost one-third of the total U.S. energy supply--and like oil, has had its proven reserves reduced by ever-increasing production. The potential gas reserves of the United States are sufficient to maintain our present demand for a considerable period of time, if these reserves can be found. The exploration necessary has to be financed by increased gas cost. Additional technology will be necessary to increase the amounts of gas that can be produced from our present and future supplies. Several methods of obtaining the capital necessary to perform the additional drilling and areas of technical improvement are discussed.

### INTRODUCTION

The present energy crisis has focused attention on all hydrocarbons and has raised questions as to their future availability and supply. This report is an overview of the natural gas supply and availability which will discuss the present supply, the future potential gas supply, a suggestion on how the potential supply can be better developed to the good of our nation, and problems that will face the natural gas industry in reaching the goal of established gas supply.

### THE PRESENT NATURAL GAS SUPPLY

The United States, since the early 1930's, has had an ever-increasing need of energy to meet the industrial and domestic demands of its people. Probably the first energy crisis the nation faced many years ago was in whale oil, and Col. Drake's discovery of oil in Pennsylvania relieved the problem and launched the United States on its present course of industrial growth. The present energy crisis has been caused by a large, increasing consumption, which has not been countered by an even greater energy replacement effort. The per capita usage of energy in 1972 was approximately one million BTU's per day. With energy needs on the increase, this average consumption could rise to 1.3 million BTU's per day per person in 20 years; or, stated in an easier measure, a future energy requirement of 9.4 gallons of oil per person per day. In terms of natural gas, this equates to 1,300 SCF per person per day.

The petroleum industry has become the primary instrument necessary to meet this energy requirement. Today, the petroleum industry provides approximately 78% of the total U.S. energy needs. Coal, which has declined in its prorata share over the years, provides about 17% of the total U.S. energy needs. The other forms of energy sources, namely, hydro and nuclear, provide the remaining 5% of the energy. The natural gas industry, which provided 20% of the energy in 1950, now provides 32% of the total U.S. energy requirement. The majority of natural gas is transported by interstate pipeline companies who, in turn, are under direct regulation by the FPC. The remaining gas is transported by intrastate gas companies who are not under the control of the FPC.

The United States' proven gas supply inventory has been declining since 1967, with the exception of 1970 when the Alaskan activity proved successful. At year-end 1972, the remaining recoverable reserves of the U.S., including Alaska, were 266 Trillion cubic feet, as reported by the American Gas Association Reserve Committee. Considerable attention has been placed by the Washington investigators and the news media on the reliability of these reserve estimates. Claims have been placed that the reserves are being kept low to encourage a higher gas price. The majority of the natural gas industry is regulated by the FPC and by law must submit, on an annual basis, reports of all connected gas reserves and the production from the fields. In order to connect new supplies, an interstate company must submit a filing that reports the amount of reserves that a company plans to connect. Additionally, the FPC recently undertook an industry survey to verify by its own engineers and geologists the reserves that are presently connected. This FPC survey found that the reserves, as reported by the AGA, were reasonable--and, if anything, a bit optimistic.

Natural gas, from an environmental standpoint, is the cleanest fuel available. This fact, coupled with the low price, has driven annual production rates upward in an ever-increasing trend. The 1972 annual production was 22.6 Trillion cubic feet. The presently proven reserves would last less than 12 years if we continued at the 1972 depletion rate.

The nation has been producing reserves found during the past 30 years and has been fortunate that the fields had the producing capability of supplying gas as was needed, especially during winter months. The reservoir pressures of these connected fields have been declining due to depletion and we no longer can produce these fields on a peak or demand basis. We do not have the luxury of excess capacity.

Pipeline companies have traditionally produced large volumes in the winter to residential and industrial users, with peak days supplied by storage. The summer production was reduced to industrial usage and storage replenishment. Today, production from the fields is constant during the year; and during those times of peak demand, some customers who have interruptible sales are curtailed. Curtailments in the past two years have become more commonplace due to the nonreplacement of production with new natural gas reserves. Curtailments have also been brought about by insufficient facilities in the field to pump the gas into the pipeline. The Federal Power Commission estimates that from April, 1972, to March, 1974, we will have a total curtailment of 4.3 Trillion cubic feet. This represents roughly 10% of the total production over this same two-year-time period.

### THE FUTURE NATIONAL GAS SUPPLY

An industry group, the Potential Gas Agency at Colorado School of Mines, has made projections over the last several years as to the amount of gas reserves that might be found ultimately in the Continental United States, offshore, and Alaska. This committee

considers the latest recovery and drilling technology in arriving at its reserve estimate. The latest projection of reserves that are potentially available in the United States as of December 31, 1972, is 1,146 Trillion cubic feet. Of this total, 366 Trillion cubic feet has been attributed to Alaska. The presently proven reserves plus past production at December 31, 1972, for the 48 states, was 667 Trillion cubic feet; therefore, there is a strong possibility of finding additional supplies of gas that are almost twice as great as what we have seen to date. As recovery technology improves, the potential reserves and even the present reserves might be increased.

The current natural gas shortage situation is a case of misoperation of the laws of supply and demand. The federal government created an impossible situation when the "Phillips" decision placed the production of natural gas in a regulated position. By placing price ceilings that do not recognize competitive operations and increased costs, the public was treated to an ideal fuel at an artificially low cost. This created an accelerated demand, but at the same time did not provide an economic incentive to replace.

To replace gas faster than we produce it will require more drilling than the peak drilling year of 1956 when 18 Trillion cubic feet of new gas reserves were discovered. In the last five years, we have added only 20.6 Trillion cubic feet to our natural gas inventory; while, at the same time, we have depleted our reserves by 106.6 Trillion cubic feet.

A stagnation of the United States' petroleum industry has been reflected in the decline of the number of wildcat wells drilled in the last eleven years in the United States. There were 38% less wildcats drilled in 1973 than in 1962. It is encouraging to note, however, that there were more gas wells drilled in 1973 than 1972. A producer presently runs the risk that only one wildcat in eight drilled will be successful in finding hydrocarbons. In addition, the American Association of Petroleum Geologists states that only one in every 60 wildcat wells will find a field containing more than a million barrels of oil or its equivalent in gas. Since it is not known for certain prior to drilling whether one will find oil or gas, the technology, expertise, risks and costs that are involved in drilling for oil are also associated in drilling for gas. In the last ten years, the costs to drill per foot have increased 50%. This price increase does not include the recent increases in pipe costs, which have jumped in some instances as much as 200%. The price received for the wellhead product has increased only 16% for oil and 20% for gas during these same ten years. Gas wells, as a rule, will cost more than oil wells because the gas being found today is deeper than oil.

The demand for gas is being projected to nearly double to 40 Trillion cubic feet per year by 1985. The National Petroleum Council, who has made the prediction used here, estimated that only 30 Trillion cubic feet will be available in 1985, or a deficiency of 10 Trillion cubic feet. The total production includes a projection of only 20.4 Trillion cubic feet from conventional domestic supplies and 9.8 Trillion cubic feet from supplemental gas. The basis of these projections is found in Case Study III of their 1972 report.

## SUGGESTIONS TO IMPROVE OUR SUPPLY AND AVAILABILITY

There has to be improvements in the present economical and technical environments of the natural gas industry if our domestic gas supply position is to improve or even hold its own. Like our present oil situation, we cannot allow ourselves to become dependent on a foreign supply. The producing companies that exist today are fully capable of doing the increased exploratory effort. A new producing entity financed through tax dollars does not seem reasonable due to the vast experience, technical knowledge, and number of people that are needed. The incentive to actively search for those reserves, which the Potential Gas Committee and our entire industry believe are there to be found and to increase the amounts of gas, needs to be initiated. Steps that might be taken to accomplish this quest are:

1. Deregulate the wellhead price of new gas. The FPC has attempted in the past several years to allow increases in the amount that an interstate pipeline can pay for new gas; however, the Natural Gas Act and certain court decisions have handicapped the FPC in allowing the higher prices. A competitive market will certainly increase our present exploratory efforts. The burden of paying for this new gas will not hit the consuming public immediately--but over several years.

2. Allow old gas to reach commodity price over a seven-year period, with the differential income applied to drilling. The commodity price would be that price a competitive fuel would bring to the consumer on a BTU or heating basis. It makes sense that the price to boil water or to heat should be competitive regardless of the fuel, if the fuels require the same costs to find and produce. The differential income between the new and old prices should be plowed back into exploratory drilling in the Continental United States. This would assure the using public of a concerted effort to replace the natural gas. The revenue brought in by this legislation would be large, but the capital expenditure necessary to finance the total petroleum industry effort in the next 15 years is gigantic. It is estimated that an additional \$1,350 billion will be necessary to finance the capital requirements of industry.

3. Replace cash bonus basis of federal lease sale with royalty payment system. Since 1970, the federal government has received approximately \$7 billion from five lease sales of offshore properties. In a recent oil shale lease sale, a total of \$210 million, or \$41,300 per acre, was paid. Not one cent of this money has been earmarked for helping the energy problem by explorative drilling. The successful bidder for the lease also places considerable economic strain through payment of the bonus even before the first foot of hole is drilled. The government should consider a royalty base of leasing with the successful bidder paying the government out of production. Thus, the government would be guaranteed of income without expense, but would be sharing a gamble with industry. The royalty payments to the government should be earmarked expressly for energy research.

4. A national commitment to energy research should be made. The research of energy should be dealt with on two fronts; creation and utilization. The federal government has already this year earmarked major funds toward nuclear and coal research. The involvement will have to be a continuing effort by both industry and government rather than a one-year shot. The conversion

of energy into work has considerable study remaining. Energy conversion efficiency varies from very low in the creation of light to reasonably high in space heaters. Technical ingenuity will be needed in every phase of this usage spectrum.

5. Improved completion methods will increase the future gas recovered from those fields which are classified as low permeability or "tight" reservoirs. These fields are characterized as having properties that do not allow the gas to flow from the edge of the reservoir to the well bore; hence, the recovery percentage of 20-30 years of productive life might be as low as 30%-40% of the initial gas in place. There are estimated 600 Trillion cubic feet of gas in place in three geological basins of the Rocky Mountains that are considered unrecoverable using present, proven technology. A well completion process called fracturing aids in improving recovery efficiencies. Fracturing creates cracks in the producing formation from the well bore outward, thus providing avenues of production to the well bore. The cracks are created by injecting a fluid under high pressure carrying a proppent to help keep the created fracture open after the injection pressure is reduced. An unfractured gas well in a low permeability reservoir has rates of production that make this well uneconomical even at higher gas prices. If the well can be treated to allow higher production rates, then the project might become economical enough to be sought by a producing company. Improvements are needed in the conventional methods of fracturing in the fluids and the proppents that are used. The most common problem found with the present fluid systems used today is that the injected fluids react unfavorably with the rock that is being fractured. The bad reactions tend to reduce the permeability of the rock rather than improve it. An additional problem is once the crack is created, it will heal with time unless properly propped open.

Another method of creating fractures is by injecting explosive mixtures into the formation and then detonating the mixture. This method has proven very unstable and presently is not being used. Further technology might provide a means of establishing a stable method of handling. A third method of improving the productivity of a formation is through a nuclear device. Projects Gasbuggy, Rulison, and Rio Blanco have proved that the technique of nuclear stimulation can be safely accomplished; however, the flow rates that have been measured are not as high as anticipated. The federal government still has not made any policies concerning the use of atomic devices for development rather than on an experimental basis.

6. Gas fields can be discovered and developed, but before they can become marketable, the gas must be gathered and produced through pipelines. Pipelining has to be considered when making an overview of gas supply. The construction of pipelines has had vast mechanical improvements, but one of the primary construction ingredients is still done by hand--welding. An automatic welding and inspection process should speed up and improve the pipeline construction process.

Consideration should be made toward utilizing a nonmetal pipeline that can be constructed on site without joints. The new innovations in epoxies and plastics should find application in areas where high pressure pipelines have traditionally been steel. The petroleum industry today is facing a tubular goods shortage and it should be expected that this same shortage would be carried over to the pipeline groups.

Pipeline laying problems in difficult surroundings, i.e., Arctic and offshore, have and will continue to plague any attempts for quick connections to main gathering systems. Over 34% of the potential gas to be found is located either in Alaska or in water depths greater than 600 feet. Development research in these two areas will have to continue if we are to market the gas that will be found.

7. The majority of the major pipeline companies today should continue increased programs to investigate and experiment in fields of supplemental gas supply. Coal gasification has probably received the greatest attention due to it being a domestic supply alternative. LNG depends on foreign supply, and in the absence of additional U.S. gas supply, this form of energy acquisition must be exploited. The impact of all supplemental gas on our total gas supply, as projected by the National Petroleum Council, however, is minor in 1975 and only slightly over 20% in 1980.

#### PROBLEMS IN OBTAINING IMPROVEMENT

The public image of the gas industry has been influenced by the present energy shortage--and particularly the oil shortage. Whereas the oil industry obtains large quantities of fuel from foreign sources, the gas industry does not, but relies almost totally on domestic supply. As pointed out previously, the same technology, engineering, and drilling procedures are used to find oil and gas. The economic incentive to search for oil has been lacking, and it should be reasonable that a search for a product that a producer can receive even less money for on a commodity basis would not be sought. The American public who uses gas or who uses electricity produced from gas-fired systems will not want to pay higher prices for their fuel. To find new gas, the price of new gas has to go up to provide the capital necessary for finance. Pipeline companies who are regulated as to their rate of return cannot make windfall profits. The producers who receive a higher price for their gas will need the additional capital to continue in the drilling and exploration business. The competition for leases will increase and the landowner will benefit from higher lease costs, who in turn will pay higher taxes. The selling of this logic to government and customers is our largest task.

The second problem that must be faced is time of development. A new prospect is not worked and developed overnight. It takes years to wildcat, develop, and build a pipeline to gather gas. The industry also finds that the natural gas often has to be treated prior to being pipeline quality. Treatment plants are not shelf items at the hardware store.

Our present gathering systems are producing from fields whose pressures are declining due to heavy production demands. Compression requirements in the field are going to start climbing at an alarming rate. The supply of these compressors might become critical if steel shortages develop.

#### SUMMARY

The need to develop additional gas reserves has no argument from those who presently use natural gas as a fuel. The present escalating demand for this fuel cannot be met from presently known supplies. The likelihood of finding additional gas through exploration and new recovery processes is excellent if proper price incentive can be established.

#### ACKNOWLEDGEMENT OF SOURCE MATERIAL

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