Analysis of the Impacts of the Projected Natural Gas Curtailments for the Winter 1975-76

November 1975

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An Analysis of the Impacts of the Projected Natural Gas Curtailments for the Winter 1975-76

November 1975

UNITED STATES CONGRESS
Office of Technology Assessment

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DANIEL V. DeSIMONE
DEPUTY DIRECTOR

November 4, 1975

The Honorable Jack Brooks
Chairman, Committee on
Government Operations
U.S. House of Representatives
Washington, D. C. 20515 .

Dear Mr. Chairman:

On behalf of the Board of the Office of Technology Assessment, we are pleased to forward a report: An Analysis of the Impacts of the Projected Natural Gas Curtailments for the Winter 1975-76.

The report was prepared by the Office of Technology Assessment with the assistance of a task force of experts conversant with the problems facing the major consumers of natural gas and the gas utilities this winter as a result of the projected curtailments. In addition, it was reviewed by a panel representing public agencies and interest groups and their comments incorporated.

This report is being made available to your Committee in accordance with Public Law 92-484.

Sincerely,

OLIN E. TEAGUE
Chairman
of the Board

Sincerely,

CLIFFORD P. CASE
Vice Chairman
of the Board

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WASHINGTON, D.C. 20510

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DANIEL V. DE SIMONE
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November 4, 1975

The Honorable Olin E. Teague
Chairman of the Board
Office of Technology Assessment
Congress of the United States
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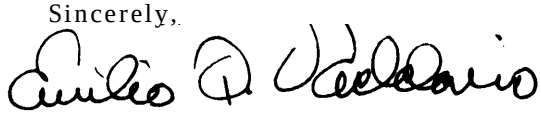
Dear Mr. Chairman:

In response to the request of the Chairman of the House Committee on Government Operations, I am pleased to submit a report entitled: An Analysis of the Impacts of the Projected Natural Gas Curtailments for the Winter 1975-76.

This report was prepared by the staff of the Office of Technology Assessment with the assistance of a task force of experts conversant with the problems facing the major consumers of natural gas and the gas utilities this winter as a result of the forecast natural gas shortage. In addition, the draft report was reviewed by a panel of representatives of public agencies and institutions and their comments incorporated in the report.

It is anticipated that this analysis, which identifies major impacts, determines important problem areas, analyzes short-term options for solution, and provides background data, will be of use to Congressional committees concerned with the problems associated with the projected natural gas shortage.

Sincerely,



EMILIO Q. DADDARIO
Director

PREFACE

On June 24, 1975, the Conservation, Energy, and Natural Resources Subcommittee of the House Committee on Government Operations requested from the Office of Technology Assessment (OTA) an analysis of the impacts of the projected natural gas shortage for this coming winter of 1975-76. At the time, OTA was performing a detailed assessment of the Plans and Programs of the Energy Research and Development Administration. The study of the natural gas problem complemented the ERDA effort by providing input to staff on near-term energy problems as part of the overall energy program of OTA. This report presents the results of the natural gas study.

Natural gas curtailments have been a continuing and growing phenomenon since 1970. Projections published by the Federal Power Commission for the winter period, November 1, 1975 to March 31, 1976, show that the supply of natural gas will be more than 18 percent below firm contract requirements. [1] Expressed another way, this curtailment represents about 40 percent of the estimated demand for natural gas by the industrial and electric utility sectors, in the interstate market, for this coming winter. [2] Therefore, if these projected curtailments are a true measure of the deficiency facing the Nation this winter, it seems unlkely that, at a minimum, severe constraints on economic activity can be avoided.

The objectives of this study are to determine the extent to which these projected curtailments reflect the actual situation and what the impacts and potential danger points might be as a result of the natural gas shortage. In this connection a list of important issues are presented which are intimately related to the overall problem of natural gas shortages and need be addressed in determining their solutions.

This study was carried out in two steps. In phase I, a task force composed of representatives from the trade associations of the major industrial consumers of natural gas and from the gas utilities was formed to provide data and information for the study. There were 13 industries represented which collectively consume over 75 percent of total natural gas use by industry and electric utilities. [3] There were four gas utilities represented which were selected from different geographical regions of the country. The task force was chaired by Mr. Jack O'Leary, Director of Energy and Environment of the MITRE Corporation. A meeting of this task force was held on August 28 and 29, 1975, and focused on the following:

Note: Footnotes appear on last page of this Report.

1-1: 10-7 - 2

- An overall view of the impacts of the gas shortage.
- An analysis of interaction among the industries and between the industries and gas utilities.
- The ways in which industry and the gas utilities are attempting to deal with the problems caused by the natural gas shortage.

Written analyses were also received from the task force members as well as from an additional 37 gas utilities. The latter were located in regions which are projected to be hardest hit by the curtailments. In addition, they represented a wide range in company size with varying degrees of resources at their disposal to deal with the shortage.

Phase II of the study consisted of a review of the draft report carried out by a panel of representatives of various public institutions and public interest groups. This meeting was held on October **29, 1975,** also chaired by Mr. O'Leary. This panel was requested to judge the effectiveness of the report, whether it had fairly represented and analyzed the problems, and whether there were issues missing from the analyses that needed to be addressed. The modifications and additions resulting from the deliberations of this panel are incorporated principally in the sections dealing with the issues related to the gas shortages and with the options proposed for short-term relief. Other comments are covered in the remainder of the report where appropriate.

The panels expressed the opinion that this report presented a fair and accurate forecast of the situation this coming winter. However, the review panel was concerned that the limited scope of the study as set by the Committee request, prevented a more complete discussion of several important points concerned with the entire natural gas problem. For this reason a list of issues which address those concerns is presented on pages 19-**20** to make interested parties aware of the principal issues raised by the panel.

OTA is indebted to Dr. James Stekert, presently with the Energy Research and Development Administration, and Mr. James Jensen and Dr. Carl Swanson of Jensen Associates who served as consultants to OTA on this study.

The OTA staff on this study are Dr. Richard E. Rowberg, gas curtailment project manager, Mr. Lionel S. Johns, Ms. Joanne M. Seder, and Ms. Linda M. Parker.

While the resulting report contains input from many task force and panel members, the findings should not be construed to be the opinion of any one individual. An effort has been made to present both sides of any controversial subject.

GLOSSARY

Firm Requirements—Volumes of gas which make up the contractual obligations of interstate pipelines for sale to direct consumers and to gas utilities for resale. These requirements are determined from an historical base period, usually between 1968 and 1973 and are adjusted each year for load growth. The firm requirements do not reflect changes in the demand for natural gas by the ultimate customers which are not incorporated in contract changes. These include year-to-year variations in weather and economic conditions, and immediate conversions to alternate fuels.

Curtailment—The difference between the volume of gas the interstate pipelines will actually deliver to their customers (i.e., the supply) and the firm requirements (i.e., contractual obligations) of these pipelines. These are the values reported by the Federal Power Commission for the period of April 1 of one year to March 31 of the next and for the heating season of November 1 to March 31.

Shortfall—The difference between the estimated real demand of the ultimate consumers of natural gas delivered by interstate pipelines and the gas supplied by those pipelines. Since this demand is less than the firm requirements (by about two trillion cubic feet) the shortfall will be correspondingly less than the curtailment.

Interruptible Natural Gas—Volumes of gas sold to some ultimate consumers under a contract which allows the supplier to cutoff the supply whenever the demand of the non-interruptible customers exceeds a certain value (usually as a result of severe cold weather). About 20 percent of the gas which is sold by interstate pipelines to gas utilities under firm requirements (i.e., non-interruptible) is resold by these gas utilities as interruptible gas. The deepening curtailments have manifested themselves in this instance in the form of longer periods during which the gas utilities' interruptible customers are cutoff.

Supplemental Gas—Gas from sources other than the flowing or stored natural gas delivered by interstate pipelines. These sources include imported liquefied natural gas (LNG), synthetic natural gas (SNG) derived from liquid hydrocarbons, and propane-air mixture injected into the gas utilities delivery system.

Alternate fuels (and energy)—Fuel oil (distillate and residual), coal, direct use of propane or butane, and electricity used in place of natural gas.

Units—For gas volumes the following symbols are used: Mcf, MMcf, Bcf, and Tcf for thousand, million, billion, and trillion cubic feet respectively.

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1. Summary

On June 6, 1975, the Federal Power Commission reported that over 18 percent, 1.3 trillion cubic feet, of the country's firm, interstate pipeline natural gas requirements will be curtailed during the winter period of November 1, 1975, to March 31, 1976. The size of this curtailment, a 35 percent increase over last winter, raises the serious possibility that there will be insufficient natural gas to fuel the Nation's economy this winter, and that these shortages could extend into the residential sector for the first time.

The situation is potentially very critical. If the winter is not more than 5 percent colder than normal, if the economy does not recover faster than projected, if natural gas supplies do not deteriorate any further this winter, and if the presently expected supplies of alternate fuels and gas supplements remain available, the natural gas shortage this coming winter, averaged over the country, may not constrain the Nation's economy. This set of conditions is very fragile, however, and dependence on them, alone, without new Federal action, carries substantial risk this winter of increased unemployment and economic impacts. A lack of action can have even greater consequences in the winter of **1976-77** with the continued decline anticipated from present production of existing gas supplies and continued recovery of the economy from the recession levels of 1974-75.

THE SITUATION THIS WINTER

. If the conditions described in the above paragraph hold, the incremental supply-demand deficiency of natural gas this winter will be about **300** billion cubic feet, most of which will be absorbed by the industrial and electric utility sectors.

- This volume is about 10 percent of this winter's estimated real demand by these consumers of natural gas in the interstate market. Taking account of past curtailments, **10** percent is probably as much as most of these curtailed users can absorb this winter, through 'self-help' measures (alternate and supplemental fuels, stored gas, conservation) and regional shifts in production, and still meet their projected demands for manufactured goods.

. Even in this case, there will be many instances of severe dislocations in certain parts of the country (Mid and South Atlantic and East North Central) due to the non-uniformity of the gas shortages. The lost production of goods in these regions would have to be made up in other parts of the country, if impact on the national economy is to be minimized.

. In addition, in most of the country, nearly all interruptible customers will be denied natural gas for the entire winter.

MAJOR IMPACTS OF THIS WINTER'S GAS SHORTAGE

- It is estimated that unemployment in hard hit regions could range as high as 100,000 people over periods ranging from **20** to **90** days,

- The demand for alternate fuels—No. 2 and No. **6** fuel oil, propane, and synthetic natural gas feedstocks (naphtha) —will increase imports and, therefore, be counter to the Nation's goal of greater energy independence.

- Solutions to the natural gas shortage are difficult to separate from solutions for the Nation's total energy problems.

. The unavailability of natural gas for a critical process use or feedstock, even if a relatively small volume, can shut down an entire plant.

- Regional shortages can have nationwide consequences if a manufacturer cannot get natural gas for a key product needed by a major portion of an industry and alternate fuels either cannot be used or are not available.

- Fuel costs for curtailed customers who must use supplemental and/or alternate fuels (fuel oil, propane, synthetic natural gas from naphtha, liquefied natural gas) will increase about $1.5 billion for this year over last.

- Distribution and storage problems can prevent these customers from obtaining a steady supply of alternate fuels even though the fuels, themselves, may be available.

- Environmental effects will not be significant on the average, but in some regions the conversion to fuel oil or coal could have substantial detrimental effects on local air quality.

- As demand increases because of economic recovery, and existing natural gas supplies continue to decline, it is very probable that in the winter of **1976-77,** there will be significant economic disruption and, in some instances, insufficient gas to meet all firm commercial and residential demands even under normal weather conditions.

- Any measures to supplement natural gas for this winter **(1975-76),** from gas in inventory, such as drawing down on reserve storage in greater volumes than presently anticipated will increase the problem beginning in the summer of 1976.

These above points focus on the immediate problem. However, there are several issues which, although they are not directly related to the impacts this coming winter, are, nevertheless, very important and are intimately connected with the entire natural gas problem. These issues cannot be ignored in dealing with the problem, even in the short-term, and are expressed in this report.

II. Description of the Problem

AN OVERVIEW OF NATURAL GAS CURTAILMENTS

In **1970,** the supply of natural gas for the interstate market, began to be curtailed.[4] These curtailments have subsequently increased to where the current projections for the year April **1975** to March 1976 total 2.9 trillion cubic feet (Tcf), or 19.4 percent of firm interstate natural gas requirements.[1] For the heating season, November 1975 to March 1976, the curtailments total 1.3 Tcf or 18 percent of the firm requirements. The situation will continue to deteriorate as estimates for the following year **(1976-77)** project still greater supply deficiencies. The curtailment levels are shown in Table 1 for the years **1971-72** through **1975 -76. S**

Table 1

Total **Curtailment Volumes Interstate Pipelines$**

Year (April 1 to March 31)	Curtailment (Trillion cubic feet)
1971-72	0.48
1972-73	0.82
1973-74	1.19
1974-75	2.01
1975-76 (Projected]	2.92

The increase in curtailment volumes since 1971-72 for interstate pipelines reporting to the Federal Power Commission.

As straightforward as the above figures appear, the situation they reflect is complex and care must be exercised in their interpretation. The curtailment volumes which are reported in Federal Power Commission Form **16** data and are shown in Table 1, are derived by relating the actual gas supplied that year by each of the interstate pipelines to the pipelines' firm requirements. The latter are contractual obligations determined from an historical base period, typically 1968 to 1973, adjusted for changing loads. The firm requirements are not determined from the actual demand for the coming year. Therefore, it is possible that the curtailment volumes could misrepresent the actual shortfall.

A portion (up to **20%)** of a pipelines' firm requirements which are sold to the gas utilities, are resold by these gas utilities as interruptible gas. Interruptible gas is sold with the understanding that the buyer could be cut off at anytime by the gas supplier. During those periods for which gas delivery is halted, the consumer must have his own supply of alternate fuel (usually oil) to continue operation. The advantage of such contracts in most cases is lower priced natural gas. When it was plentiful, these consumers usually needed to use alternate fuels only during short periods of unusually cold weather and were able to keep sufficient alternate fuel capability on hand. The increase in curtailments, however, has changed this picture drastically. Since interruptible customers are the first to be cut off when supplies drop below demand, these consumers are now being fully curtailed for most of the cold weather months, In many areas of the country this has been the case for the last few years. As a result, the quantity of alternate fuels required and the problems associated with delivery and storage have strained some interruptible gas consumers to the point where they have had great difficulty in meeting all their energy needs.

EFFECTS OF INDUSTRY AND ELECTRIC UTILITIES

The allocation of natural gas to consumers in a period of gas shortages is based on priority plans established by the various regulatory commissions. Those schedules which govern the gas utilities are usually set up by the State

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regulatory commissions. These plans are similar, although not always identical, to the priority system established for deliveries by interstate pipelines by the FPC (Table 2), although exceptions to the FPC plan may be permitted under extraordinary circumstances. b Further, a given pipeline plan does not necessarily correspond to those schedules put into effect by the various gas utilities which purchase natural gas from that pipeline. Although these variations exist, the general result is the same, namely, residential and small commercial consumers receive priority over firm industrial and large commercial consumers and, finally, interruptible consumers (Table 2). As a result, the primary effects of the curtailment of firm contract volumes of natural gas will be in the industrial and electric utility sectors. For interruptible customers, who will usually be curtailed before firm customers, the burden is spread amongst large commercial, industrial, and electric utility users.

Table 2

Priority System Established by Federal Power Commission

(1) Residential, small commercial (less than 50 Mcf on a peak day).

(2) Large commercial requirements (50 Mcf or more on a peak day), firm industrial requirements for plant protection, feedstock and process needs, and pipeline customer storage injection requirements.

(3) **All industrial requirements not specified in** (2), (4), (5), (6), (7), (8), or (9).

(4) **Firm industrial requirements for boiler fuel use at less than 3,000 Mcf per day, but more than 1,500 Mcf per day, where alternate fuel capabilities can meet such requirements.**

(5) Firm industrial requirements for large volume (3,000 **Mcf or more per day) boiler fuel use where alternate fuel capabilities can meet such requirements.**

(6) **Interruptible requirements of more than 300 Mcf per day, but less than 1,500 Mcf per day, where alternate fuel capabilities can meet such requirements.**

(7) Interruptible requirements of intermediate volumes (from 1,500 Mcf per day through 3,000 Mcf per day), where alternate fuel capabilities can meet such requirements.

(8) Interruptible requirements of more than 3,000 Mcf per day, but less than 10,000 Mcf per day, where alternate fuel capabilities can meet such requirements.

(9) Interruptible requirements of more than 10,000 Mcf per day, where alternate fuel capabilities can meet such requirements.

The curtailment priority system established in FPC Order 467-B to be applied to interstate pipeline companies under FPC jurisdiction. The high-priority items are the last to be curtailed in the event of a deficiency of natural gas supplies.

The effect of the growing gas shortage on the industrial and electric utilities as a result of the priorities is indicated in Table 3, which compares total industrial and electric utility consumption of natural gas for the years 1970 through 1974 to total energy use for these sectors. T These figures include both inter- and intra-state natural gas, and firm and interruptible contract volumes. Note that the contribution of natural gas to the total energy supply of industry and electric utilities remained essentially constant from 1970 to 1972 and then began to decline sharply in 1973. This clearly shows the effect of the decreasing natural gas supplies on these customers. It indicates that significant conversion from natural gas to alternate fuels, primarily oil, has and is taking place. Based on the figures in Table 3, over one trillion cubic feet of gas have been displaced by alternate fuels since 1972.

Table 3

Energy and Natural Gas Use
Industry and Electric Utility Sectors
Total United States[7]

Year	Natural Gas		Energy—All Sources	Percent
	Trillion Cubic Feet	Quadrillion BTU	Quadrillion BTU	Natural Gas
1970	13.8	14.0	36.5	38.4
1971	14.1	14.5	37.2	38.0
1972	14.7	15.0	39.1	38.4
1973	14.4	14.7	41.2	35.7
1974	13.8	14.1	40.3	34.0

Total natural gas consumption and total energy use by the industrial and electric utility sectors for the years 1970 to 1974. These figures include both interstate and intrastate natural gas. They demonstrate the declining contribution of natural gas to the total energy supply for these sectors, nearly all of which has occurred in the interstate market,

NATIONAL DISTRIBUTION OF NATURAL GAS CURTAILMENTS

The gas supply problems in the interstate market are not uniformly distributed throughout the country nor, indeed, within individual states. The cause of this problem is that the interstate pipelines are in differing supply positions as shown in Table 4.[8] This is a result of the historic acquisition patterns by pipelines of natural gas reserves. Some, such as Michigan-Wisconsin Pipeline, Co., have purchased reserves sufficient to result in minimal curtailments. Companies like Transcontinental Gas Pipeline Co., on the other hand, have not developed natural gas supplies as large and, therefore, are curtailing heavily. The net result is those regions of the country depending on pipelines in a poor supply position are in much worse shape to meet demands than those depending on pipelines in good supply positions. A list of the states whose projected curtailment percentages for this winter are

Table 4

April 30, 1975 Report of Projected Firm Requirements and Curtailments for Heating Season November 1975-March 1976[8]

	April 30, 1975 Report Heating Season Nov. 1975-March 1976 Projected		
	Firm Requirements[1] (Mcf)	Deficiency	Percent Deficient
Alabama-Tennessee Natural Gas Company	15,927,000	5,183,000	32.54
Algonquin Gas Transmission Company	92,702,000	14,711,000	15.87
Arkansas-Louisiana Gas Company	235,401,000	66,708,000	28.34
Bluefield Gas Company	750,000	-o-	-o-
Cities Service Gas Company	299,405,000	81,423,000	27.19
Colorado Interstate Gas Company	203,024,000	13,600,000	6.70
Columbia Gas Transmission Corporation	848,726,000	235,177,000	27.71
Commercial Pipeline Company, Inc.	345,000	-o-	-o-
Consolidated Gas Supply Corporation	431,900,000	18,979,000	4.39
East Tennessee Natural Gas Company	39,611,000	13,343,000	33.69
Eastern Shore Natural Gas Company	3,361,000	1,644,000	48.91
El Paso Natural Gas Company	605,814,000	148,568,000	24.52
Florida Gas Transmission Company	19,965,000	-o-	–o–
Grand Gas Corporation	[2]		
Granite State Gas Transmission, Inc.	2,356,000	-o-	–o-
Great Lakes Gas Transmission Company	37,063,000	–o-	–o–
Kansas-Nebraska Natural Gas Company	41,395,000	-o-	-o-
Kentucky-West Virginia Gas Company	11,887,000	-o-	-o-
Lawrenceburg Gas Transmission Corporation	2,299,000	642,000	27.93
Louisiana-Nevada Transit Company	2,363,000	369,000	15.62
McCulloch Interstate Gas Corporation	5,036,000	-o–	–0–
Michigan Wisconsin Pipe Line Company	505,022,000	17,000,000	3.37
Mid Louisiana Gas Company	15,461,000	2,097,000	13.56
Midwestern Gas Transmission Company	150,900,000	13,695,000	9.08
Mississippi River Transmission Corporation	131,693,000	997,000	0.76
Montana-Dakota Utilities Company	25,852,000	-o-	-o-
National Fuel Gas Supply Corporation	139,612,000	5,198,000	3.72
Natural Gas Pipeline Company of America	526,616,000	-o–	-o-
North Penn Gas Company	17,499,000	1,258,000	7.19
Northern Natural Gas Company	392,944,000	18,050,000	4.59
Northwest Pipe Line Corporation	215,822,000	32,384,000	15.00
Ohio River Pipeline Corporation	5,649,000	259,000	4.58
Pacific Gas Transmission Company	130,765,000	-o-	–0–
Panhandle Eastern Pipeline Company	360,975,000	85,646,000	23.73
South Georgia Natural Gas Company	8,415,000	27,000	0.32
Southern Natural Gas Company	282,298,000	-o-	-o–
Tennessee Gas Pipeline Co., A Division of Tenneco, Inc.	592,035,()()0	70,139,000	11.85
Tennessee Natural Gas Lines, Inc.	16,231,000	-o-	-o-
Texas Eastern Transmission Corporation	501,370,000	117,491,000	23.43
Texas Gas Pipe Line Corporation	1,484,000	-o-	-o–
Texas Gas Transmission Corporation	353,408,000	44,987,000	12.73
Transcontinental Gas Pipe Line Corporation	496,700,000	180,426,000	36.32
Transwestern Pipeline Company	194,905,000	43,572,000	22.36
Trunkline Gas Company	249,312,000	120,483,000	48.33
United Gas Pipe Line Company	709,971,000	320,182,000	45.10
West Texas Gathering Company	36,785,000	-o-	–o–
Western Gas Interstate Company	3,355,000	-o–	–o–
Western Transmission Corporation	923,000	-o–	-o–
Totals	8,965,302,000	1,674,238,000	18.67
Net Curtailments[4]		1,326,733,000	

[1] Requirement volumes reported in the April 30, 1975 Form 16's have been adjusted to eliminate volumes transported for others and volumes exchanged with others.

[2] Reported all sales to Northwest Pipeline Corporation and no curtailments.

[3] Sales deliveries were added to curtailments to obtain requirements.

[4] After elimination of pipeline-to-pipeline curtailments.

Firm requirements and curtailment volumes of interstate pipeline companies reporting to the Federal Power Commission for the heating season 1975-76. The firm requirements are determined from an historical base period and do not necessarily reflect real demand for the coming heating season.

equal to or greater than the national figure is shown in Table 5.[8] Again, these figures must be interpreted with caution. For one thing, the firm requirements may not reflect actual demand as discussed above. Another potential pitfall is that in some states a high percentage of the gas may be used for purposes which are relatively easily convertible to alternate fuels, such as electric utility boiler fuel.

Table 5

Projected Curtailments-winter 1975-76°

(Nov. 1, 1975-Mar. 31, 1976)

State	Firm Requirements " (MMCF)	Projected Curtailment (MMCF)	Percent
Arizona	93,042	32,818	35
California	553,280	118,694	21
Delaware	2,640	1,603	61
Indiana	360,788	91,595	25
Kentucky	131,359	22,946	17
Maryland	69,224	19,124	28
Nevada	20,088	12,153	60
New Jersey	176,424	45,982	26
North Carolina	88,470	46,207	52
Ohio	617,895	138,575	22
Pennsylvania	411,067	89,919	22
Tennessee	137,832	25,410	18
Virginia	73,873	24,112	33
West Virginia	83,472	17,447	21

Firm requirements and curtailment volumes in millions of cubic feet (MMcf) for the 1975-76 heating season for states whose percent curtailment equals or exceed the national average. The firm requirements are determined from an historical base period and do not necessarily reflect the actual demand this winter. For this and other reasons given within the text, these figures may not truly represent the level of difficulty these states will face this winter.

Therefore, a high curtailment percentage may not be indicative of the degree of difficulty that states will face this winter. On the other hand a lower curtailment percentage may be more serious than implied simply because a high fraction of the industrial natural gas use is for processes and/or feedstock which can only be converted to alternate fuels at great difficulty and expense or not at all. In this context, the pipelines themselves, in addition to having different curtailment percentages, also have a wide variance in the percentage of customers in the various priorities. Therefore, a pipeline with a lower percentage curtailment but a high percentage of customers in priorities one and two (Table 4) could be worse off than the raw curtailment volumes indicate.

Within the states, themselves, there are regions where the supply situation will be worse than the state average. A case in point is Pennsylvania, whose statewide curtailment this winter is projected at **23.5** percent. However, the hard-hit Columbia, Texas Eastern, and Transcontinental interstate pipelines, which feed the heavily industrial southeastern portion of the State, could cause local curtailments in excess of 31 percent, while the northwestern portion may actually experience an increase of supply.

Therefore, the actual situation in these regions and within the various states cannot be determined solely from curtailment data. It is necessary to investigate further by inquiring into the situation by seeking specific information from those people who will have to deal with the problems. The following section describes the results of this inquiry.

DISCUSSION OF IMPACTS

Introduction

If the impacts of the natural gas shortage for this coming winter were predicted solely from the magnitude of the projected curtailment volumes, one would conclude that widespread, long-term (greater than 30 days) plant closings and production loss would result. This would cause increased unemployment and seriously threaten the Nation's recovery from the economic recession. Indeed, some statements have been made to the effect that the projected level of curtailments maybe sufficient to extend to commercial and residential customers, particularly if the winter is more severe than normal.

Upon examination of the situation from the point of view of those industries which are the principal consumers of natural gas, the best estimates are that, the shortage of natural gas presently forecast, would not constrain the ability of these industries to satisfy the demands they project for their manufactured goods provided:

1) The winter is no more than 5 percent colder than normal;

2) Demand for goods does not increase faster than expected;

3) There is no unforeseen deterioration of present natural gas supplies;

4) Expected alternate fuel and supplemental gas supplies are not reduced,

In certain regions of the country, problems would be greater and some plant closings for more than 30 days might occur unless action is taken. The gas utilities presented a similar assessment. Of the 37 providing responses, nearly all estimated that they would be able to meet the firm requirements (non-interruptible) of their customers throughout the heating season under the same set of conditions. On the other hand, the interruptible customers of most of these same utilities would be curtailed 100 percent for periods ranging from 70 to 1.50 days. These utilities pointed out, although many of these customers were cut off in previous winters, the curtailment periods would be longer this year. In addition, temperature-dependent interruptible loads (those who are curtailed only during the coldest weather) may be cut off for extended periods.

The Situation This Winter

There are several reasons for these observations.

- Much of industry has planned ahead for increasing shortages of natural gas and consequently has installed extensive alternative fuel capabilities.
- Natural gas has been diverted away from uses, such as power generation or the generation of steam and electricity within industrial plants, where conversion is relatively less costly and easy. The use of gas for electric energy production has declined by 7 percent since 1971 while electric energy generation has increased 15 percent over the same period.[27]
- Many gas utilities, whose own supplies do not show up in the curtailment estimates published by the Federal Power Commission, have obtained natural gas supplements such as propane, imported liquefied natural gas (LNG), and synthetic natural gas (SNG), The development of these supplies has been typical in most areas outside the gas producing states. g
- Several gas utilities and long-distance interstate transmission pipelines have developed both underground gas storage fields and liquefied natural gas storage tanks. Natural gas storage increased by nearly 50 percent from **1967** to 1973 although a 10 percent decline occurred in 1974.2,7
- The economic recession has reduced the demand for natural gas by industry. It is important to remember that industry and electrical power generation in 1974 used 49.5 percent of all natural gas delivered to

the interstate market to consumers in the United States.

The impact of these points can be seen more clearly by estimating the expected natural gas consumption in the interstate market, from April 1, 1975 to March 31, 1976 (FPC reporting year), and comparing it to the projected interstate supplies. For the period April 1, 1975 to March 31, 1976, the projected supply is 12.1 Tcf.[1] The real demand for natural gas for that period is not precisely known, but it can be estimated to be about 13.1 Tcf. This represents about a 2 percent increase over the April 1, 1974—March 31, 1975 period **(12.8** Tcf) which exceeds the yearly rate of increase for any year since 1970.[7] With this assumption, the shortfall during the present FPC reporting year will be about 1.0 Tcf. This is considerably less than the projected curtailments of 2.9 Tcf demonstrating that the firm contract requirements, on which the curtailment figure is based, greatly exceed the actual demand this year. It is this fact which establishes the difference between shortfall and curtailments.

Because of the priority schedules discussed above, most of this deficiency will have to be absorbed by the industrial and electric utility sectors. Some of it will be made up by continuing the conversion to fuel oil. As seen in Table 3, the consumption of gas by these sectors, in both the interstate and intrastate market, decreased from 1973 to 1974 by 0.55 Tcf or nearly 4 percent. Total energy used by these sectors, however, decreased by only 1.0 percent. If we assume that the difference was a result of conversion to alternate fuel (primarily fuel oil) and that this rate of conversion will continue into this year, users of an additional 0.4 Tcf will convert to fuel oil for 1975-76. These are reasonable assumptions since a substantial portion of the decline in gas consumption over the last two years occurred in the electric utility sector, which has been converting many of their boilers to fuel oil. Further, one can expect that during this coming year, many industrial boiler and direct heat furnaces will be completing the switch to fuel oil initiated last year. Although the figures in Table 3 represent both the interstate and intrastate markets, the volumes converted from natural gas to oil can be expected to occur almost completely in the interstate market as that is where the shortfall occurs. Therefore, the incremental natural gas shortfall for the year **1975-76** will be about 0.6 Tcf, This is an incremental value since it also represents an increase in the deficiency over last year when, of course, supply and consumption were in balance. About 0.3 Tcf of this shortfall will occur during the five winter months, taking into account the colder weather. Some of this deficiency will fall into the interruptible market in that **it** represents the increase in the length of time, between this year and last, that gas will be cut off from interruptible customers. The 300 billion cubic feet shortfall is also equal to the net increase in projected winter curtailments as reported by the FPC (Table 5).[1] This is the volume that most likely will either have to be made up by some type of alternate fuel or otherwise go unfulfilled.

An example of this situation is provided by a large gas utility in the East North Central region. Their curtailment projection for this year is about 18 percent for firm industrial customers. For a base volume of **150** BCF for the year, this represents a delivery of 122 BCF. The demand, however, is forecast to be **132** BCF due to economic conditions and some fuel switching. Therefore, the shortfall is about 8 percent which, as long as these conditions are stable is manageable.

Regional and Industrial Variations

As indicated in Table 4, the distribution of gas curtailments among the various states is far from uniform. In particular, the Mid and South Atlantic States served by Transcontinental Gas Pipeline Corp. and Columbia Gas Transmission Corp., and the East North Central States served by Columbia and the Panhandle Eastern Pipe Line, Co., will be curtailed more heavily than the national average (see Table 4). The industrial groups represented on the task force indicated that as a result, they anticipated plant closings and unemployment in these regions,

In addition, parts of Florida, Alabama, and Mississippi served by United Gas Pipeline Co. face large curtailments. Here, however, the growth of curtailments has been of longer duration and the recent increase has not been as rapid as in the regions cited above permitting adjustments to have been made including purchase of intrastate gas. However, Florida has had a large increase in curtailments of interruptible gas that may cause problems and plant closings if there are bottlenecks in the distribution of alternative fuel supplies. In this connection, similar logistics problems may exist in most other areas of the country where there has been an increase in the curtailment periods for interruptible customers.

The impact of natural gas shortages on industry will vary over the different regions of the country. The textile industry will have several plants closed in the North Carolina-Virginia region unless a sufficient supply of propane and/or emergency deliveries of natural gas can be obtained. The brick industry projects unemployment of at least 3,500 by plant closings in North Carolina. In addition to direct unemployment in these industries, a much larger number of workers could be affected in some manner due to ripple effects caused by certain plant closings. With regard to the brick and structural clay industries, for instance, a total of 375,ooo workers could be affected to some degree by plant closings in the North Carolina-Virginia area. The duration of these closings is undetermined but it could be as long as the entire heating season of 1.50 days. The brick industry also indicated that over 86 percent of their plants throughout the country will receive 50 percent or greater curtailments, including both interruptible and firm gas. As a result, output limitations are foreseen, especially if the construction industry was to recover more rapidly than expected from the recession. The cement industry also expects production shortages to occur due to natural gas curtailments in the Mountain, West South Central, and Pacific regions where **67** percent of the natural gas used by the entire industry is consumed. Arizona and Nevada are States where curtailment percentages are particularly high and where cement manufacturers are particularly vulnerable. The steel industry forecast plant closings of 2-4 weeks in the Ohio-Pennsylvania-Maryland area resulting in unemployment of **5,000-10,000,** However, they expect to be able to meet their product demand by production from plants in other regions.

This latter situation is typical of most of the industrial groups as reported in the task group meeting. The only representatives which felt their industries would have a difficult time meeting production demands were textile, brick, and cement. Even here, however, this depended heavily on how rapidly the economy recovered, particularly the construction industry for the brick and cement groups,

It is important to differentiate between plant closings as a result of loss of natural gas and resulting from inventory selloff. Because of depressed economic conditions, it is possible that inventory buildup last summer may be sufficient to cause production to be shut down in some plants this winter in order to reduce the inventory. Such plant closings which, of course, bring about job loss could be attributed to the natural gas shortage when in fact this is not the case.

The fertilizer industry is especially dependent on natural gas, both as a feedstock and process fuel. Because of its key role in the Nation's food industry, the natural gas supply situation of the fertilizer industry deserves special attention. This coming year the industry expects the natural gas shortfall will result in a reduction of ammonia production of 200,000 to 300,000 tons as compared to last year. This will result in a loss of 550,000 to 650,000 tons of ammonia below 100 percent capacity. The potential effect of this loss can be estimated by noting that one ton of ammonia is used to grow about eight tons of grain. Therefore, a loss of 600,000 tons of ammonia translates to 4.8 million tons of grain or about 2 percent of the total United States production in 1974. These figures should be regarded with caution, however, as it is not clear, at present, whether the total ammonia production capacity will actually be required. Therefore, the impact of such losses would have to be judged in light of domestic crop demand, export demand, and other factors influencing crop production. The ammonia loss, however, will continue to grow as natural gas supplies continue to decrease over the next few years.

The gas curtailments in the fertilizer industry have thus far only affected process fuel and not feedstock. The former is convertible to fuel oil but only at great cost and technical difficulty. Conversion to alternate feedstocks is also technically possible but is not seriously contemplated at present. Indeed, the claim has been made that ammonia plants will be built in countries with plentiful natural gas supplies rather than attempt to use other feedstocks such as naphtha or gasified coal, [10]This is principally an economic motivation.

The impact on the fertilizer industry will be the greatest in the Middle Atlantic and Southeast regions. In particular, the three-State area of North Carolina, Virginia, and South Carolina, served by Transcontinental Gas Pipeline, Co., which produced about 25 percent of all nitrogen fertilizer in the United States, will receive the largest curtailments of any ammonia producing region.

Another view of the uneven distribution of the impacts of the curtailment is given by the gas utilities. Piedmont Natural Gas Co. in North and South Carolina indicates that all firm industrial

customers using 300 Mcf per day will be curtailed 100 percent for the duration of the winter. A 40-percent curtailment will occur for those using less than 300 Mcf per day, assuming the winter is no more extreme than 5 percent colder than normal. Therefore, unless these customers can get alternate fuels they will not be able to operate. North Carolina Natural Gas reports that a total of 338 industrial and commercial customers, both interruptible and non-interruptible, will receive no gas this entire winter. This represents all but 3 percent of their total load outside of residential and small commercial (less than 50 Mcf per day) users. The utility as a whole will receive only 32 percent of its contract entitlements. East Ohio Gas Co. of Cleveland, Ohio, has projected a curtailment of 15 to 35 percent of its customers in category 3 (FPC Order 467-B) which are made up of non-interruptible customers.

Although they are firm customers, their classification in category 3 supposedly indicates that they are able to use oil as an alternate fuel without extensive and costly modifications. However, this is not always so, and the potential for some spot closings of plants exists. The Columbia Gas Distribution Companies serving seven states in heavily affected regions all report large curtailment percentages (greater than 60 percent) of their industrial customers, Further, commercial user curtailments are also projected in these States. The most seriously affected States are Ohio, Pennsylvania, and West Virginia, in terms of curtailed volumes. Nearly all of the customers are firm so their continuous operation throughout the entire winter is doubtful. Several other utilities have indicated they will be able to serve all their firm customers by using supplemental gas such as LNG and/or underground storage, SNG from liquid hydrocarbons, and propane-air mixtures for peak shaving. If any of these supplies should become unavailable, however, firm customer curtailment will result.

The effect on employment of the gas curtailments will also fluctuate regionally. The total impact is expected to be small, relative to the total employment; however, if weather is cold or industrial production surges this winter, it could be expected that during peak cold days, when residential and commercial needs for space heating are high, additional plants would be forced to close. This unemployment would be for a short duration, perhaps 2 to 10 days at a stretch, accumulating over a cold winter to 15 to 30 days. Based upon the estimates by the industries on the task force, it can be assumed that in the critically affected states, natural gas shortages would create unemployment of up to 100,000. This unemployment will last somewhere between 20 to 90 working days. With the Nation's economy operating below capacity, the lost productivity, for most industries, can be made up in other parts of the country where supplies of natural gas and other forms of energy are sufficient. An exception may be the cement industry which cannot economically transfer products beyond 175 to 200 miles. Within the States, where unemployment is created, it is possible that there will be a short run, multiplier effect upon unemployment on both supply and customer industries within the local area.

Increased Demand for Other Fuels

With the declining production of crude oil and natural gas liquids in the United States, the falling production of natural gas increases the demand for imported fuel. The alternative fuels to natural gas are No. 2 and No. 6 fuel oil, propane, or, in special cases, butane. There appear to be ample supplies of both crude oil and petroleum products on world markets [11, 12] and, depending upon Government regulations, propane imports possibly could be increased this coming winter.

A critical point to note, however, is that while use of fuel oil relieves the problems caused by the natural gas shortage, it worsens the problem of reliance on imported fuel. This is obviously counter to the Nation's stated goal of energy independence. For example, it will require 70 million barrels of oil to replace the 400 Bcf as estimated on p. 9 to be converted this year. A similar situation of increasing dependence on foreign sources will occur if there is a substantial increase in the use of propane as a substitute since, as will be discussed below, the only serious hope of expanding our propane supply is through imports. Widespread use of synthetic natural gas, based on liquid hydrocarbons, would also worsen the Nation's import position. Therefore, the question of natural gas shortages goes beyond just this fuel to encompass the entire national fuel situation.

The other alternative fuels that could be used to replace curtailed natural gas are coal and electricity. However, electricity tends to be expensive compared to regulated natural gas and requires a substantial change in the equipment or processes which use natural gas. Significant

costs are also required to change from natural gas to coal. Electric utility boilers are potential candidates for conversion, although none have been to date. The problems are very severe and a complete rebuilding is probably required. [13] Other candidates for coal conversion are the numerous boilers used for industrial process steam. Most of these, however, are package boilers which cannot be converted to coal and, therefore, must be replaced if coal is to be used. In addition, there is considerable uncertainty about mining legislation and the ability to sign long-term contracts for coal. Coupled with sulfur emission regulations, industry finds it difficult to spend substantial amounts of capital in order to convert their fuel facilities to coal when supply, price, and air pollution regulations are so uncertain. Despite these difficulties, however, conversion to coal in the cement industry is now beginning to take place, and the electrical power industry is also expanding its use of coal. These actions will eventually reduce the demand for natural gas.

Effects of Fuel Costs

As natural gas curtailments deepened, both the electric power industry and manufacturing have had to convert to alternate fuels. Natural gas prices are below the price for alternative fuels on an equivalent heating value basis. As users switch to alternative fuels, their costs increase. Some of the increased costs will be absorbed by the industries themselves but it is more likely that most of the cost increase will be passed on to customers.

An estimate of the cost increase for this year compared to last year can be made by taking a look at the amount of alternate fuel needed and its costs. These range from about **$2.oo** per Mcf equivalent for fuel oil to about **$4.oo** for SNG. [14] The total cost increase for fuel alone for this coming winter over last can be estimated from the size of the natural gas shortfall as calculated on pp. **8-9.** This was 1.0 Tcf with an estimated **0.4** Tcf being made up by fuel oil at about **$2.oo** per Mcf equivalent (Costs of **$2.50** per Mcf equivalent are reported in the East North Central area for barge delivery of fuel oil.) and the **0.6** Tcf incremental shortfall by SNG, LNG, propane, additional No. 2 or No, **6** fuel oil, and energy conservation. The prices of SNG, LNG, and propane range from about **$2.50** to **$4.oo** per Mcf equivalent. g Therefore, a conservative average price for the fuel to replace the **0.6** Tcf component of the deficiency is **$2.50** per Mcf. The net increase in fuel price to make up the entire 1.0 Tcf will be about $1.5 billion. A price of **$.72** per Mcf was used for the natural gas which must be replaced, this year, by alternate fuels, [2]

Several of the gas utilities reported estimates of increased fuel costs for their service area. For example, Southern California Gas Company has estimated an increase in costs of **$184** million to the southern California economy over last year due to the added volumes of alternate fuels. Philadelphia Gas Works estimates additional costs of over **$2o** million this year due to the increased amount of SNG, propane-air, and LNG it will require, Although no figures were available from the industrial representatives, they all indicated that higher costs are resulting from the decline in natural gas supplies. These increased costs are indicative of the 'self-help' efforts industry has undertaken to avoid shutting down this winter because of the shortage of natural gas.

Another problem that arises is that there may be old or inefficient plants which have been able to remain profitable only because of low cost natural gas, By being required to convert to a more expensive fuel, it is possible that certain of these plants will become uneconomic. These may well close, either because their competitors continue to receive a supply of cheap natural gas or because the plant is, itself, only marginally profitable and the increased fuel cost in itself is sufficient to make it unprofitable.

Environmental Effects

The environmental impact of the gas shortage will not be large on the average. The principal effect will be increased air pollution brought about by the burning of fuel oil and, in some cases, coal in place of natural gas. Although conversions of this type could account for up to **400** Bcf of natural gas, the increase in fuel oil and coal and, as a consequence, the increase in pollution levels, will be small compared to the total quantities of oil and coal now used. However, in localized regions, there could be noticeable impacts as a result of conversion of a plant or facility on the margin. In such an instance the air quality for that locale would shift from an acceptable to unacceptable quality. The question then becomes one of whether this cost is worth the benefits accrued by keeping that facility operating. Such problems will occur wherever fuel oil or coal is the alternate fuel and they cannot be readily obtained with a sulfur content at or below the levels prescribed by local

or State regulations. Although these instances may not be extensive this year, as natural gas supplies continue to decrease, they will increase in number and environmental quality will become a major factor to deal within the years to come. This is most evident in the case of electric power plants where conversion away from natural gas is being accelerated.

Direct use of propane will have no environmental consequences beyond those of the natural gas it may replace. The use of SNG and LNG will not add to air quality problems at the point of use, but there are significant health and safety considerations with regard to LNG facilities and environmental quality problems associated with SNG plants. These, too, will become increasingly important if imported LNG and SNG are relied upon to replace a growing portion of the Nation's natural gas requirements.

THE FRAGILE STRUCTURE OF FUEL SUPPLY THIS COMING WINTER

Introduction

The system which is attempting to deal with this winter's natural gas shortages is quite fragile. The natural gas industry will probably not be able to effectively deal with a rapid surge in industrial production, or emergencies such as severe damage to gas production or transmission facilities, or a very cold winter. If any of these occur, additional plant shutdowns, if only for a few days, should be expected. The extent of the shutdowns will depend upon the availability of alternate fuels, the length of the emergency, the portion of the winter in which it occurs, and the coincidence of these events.

Availability of Alternative Fuels and Supplemental Gas

There should be little problem obtaining oil for those who can utilize it. Ample amounts of crude oil, No. 6 fuel oil, and No. 2 heating oil appear to exist both in the world market and in the United States, even though U.S. crude oil production has declined slightly from a year ago. [11 12 15] Problems may arise where distribution of fuel oil has not been traditional in those areas that are also heavily affected by natural gas shortages, such as Ohio and parts of Kentucky. Distribution problems should be overcome, however, especially for fuel oil, since, for the first half of 1975, No. 6 fuel oil consumption has been about 7 percent less than for the same period in 1974.12

Some natural gas users are relying upon propane, [17] or in some cases butane, as an alternate fuel. As discussed below, there are applications of natural gas where propane is the only economically justified fuel with current technology and fuel prices. Examples are milk and food drying, textile finishing, paint drying, heat treating of metals, crop drying, and direct-fired food baking ovens. In addition, propane-air mixtures are used extensively by gas utilities during periods of particularly high demand brought about by very cold weather. Such peak shaving supplies are often installed to provide for immediate response to 3-day periods and overall supplies are arranged for the needs expected over the winter season.

To get an indication of the potential contribution of propane to alleviate this winter's estimated natural gas shortage, it is useful to examine domestic production levels. propane production in the U.S. in 1974 was 293,992,000 barrels, and this plus imports of 21,464,000 barrels provided a total supply of 315,456,000 barrels. [18] In 1974, 19.1 trillion cubic feet of natural gas was delivered to all consumers in the United States. z On a heating value basis, the total propane supply is slightly more than 6 percent of the natural gas delivered to consumers and slightly more than 14 percent of natural gas delivered to industry in 1974.

The 300 billion cubic feet incremental shortfall projected for this coming winter is almost 26 percent of the equivalent Btu total propane supply, i.e., United States production plus imports, in 1974. Most of this propane supply is already allocated to traditional markets, however, such as residential, rural, peak shaving, chemical feedstock, and agriculture uses. About 2.7 percent of the 1974 total U.S. propane consumption was used by gas utilities for peak shaving, Therefore, present domestic supplies of propane in excess of that already allocated are probably not sufficient to make up the increased natural gas deficiency for this winter.

An additional problem is that propane requires special equipment for transportation to and storage at the point of use. Normally, during a cold winter, the propane pipelines, railcars, and trucks become fully utilized and distribution is rationed. This occurred during the past winter with the Dixie pipeline, which serves the Southeast. If the propane distribution system is

stressed by cold weather and a significant increase in industrial demand, the logistics system possibly might not be able to meet the demand and some plant closings for 1 to 3 weeks would probably occur, even for these plants which are able to secure propane contracts.

Upon examination of the potential for increased propane this coming winter, it appears that some assistance is possible, although not nearly enough to make up the shortfall. Propane production in the United States has been declining since 1972 due to a combination of declining natural gas production (approximately 67 percent of domestic propane is extracted from natural gas streams), reducing refinery runs, and price controls. Further, propane imports in 1974 were 5 million barrels less than 1973.[18] There are estimates that propane imports could be increased by as much as 5 million barrels this coming year, but this would just make up last year's reduction and amounts to only about 6 percent of the projected natural gas shortfall this coming winter. [19]

Synthetic natural gas from liquid hydrocarbons (primarily naphtha) is a source of supplemental natural gas for many gas utilities, primarily along the Atlantic Coast. There are 10 operational plants in the United States which produced 145 billion cubic feet of SNG in the 1974-75 heating season. g The design capacity of these plants is 194 billion cubic feet which indicates that, at most, about 50 billion cubic feet of SNG could be available to help offset this coming winter's shortage. g It is also to be noted that about 50 percent of the feedstock of these plants is imported.

Interest has also been expressed in the volumes of natural gas burned under electric utility boilers. In Texas, Louisiana, and Oklahoma, 1.97 Tcf was used in 1974[20] of which about 30 percent is used during the heating season (600 Bcf). Up to 80 percent of this, or 480 Bcf, can be replaced by fuel oil for varying periods of time. These utilities report that the present state of these boilers is such that only about 30 to 60 Bcf can be replaced for periods longer than 2 to 3 weeks before boiler corrosion begins to appear. Beyond this period, they indicate that continued operation of these boilers carries the risk that some will be forced out of operation, causing a certain amount of load shedding. However, these boilers were built or converted for dual fuel firing (oil and natural gas) and they are designed to be able to burn fuel oil longer than these 2 to 3 week periods. Therefore, modification to eliminate these problems may not need to be significant and larger volumes than the 30 to 60 Bcf presently claimed could be available.

Critical Uses of Natural Gas

There are industrial applications for natural gas or similar gaseous fuels, for which the use of other fuels would be extremely difficult this coming winter. They are applications in which the unique characteristics of gaseous fuels—chemical composition, precise temperature control, flame geometry, and/or burning—is essential for production. Specific examples of such applications are:

- Feedstocks for petrochemicals (e.g. ammonia).
- Drying milk and food products.
- Direct-fired baking of food products.
- Heat treating metals.
- Removal of protruding fibers in textile manufacture by singeing.
- Annealing metal foil in a rolling mill.
- Drying ink in a high-speed printing press.
- Electric utility boiler ignition and flame stabilization.

Even if alternate fuels can be used for some of these processes, the cost of conversion will be a substantial fraction of the total cost of the facility.[10] In these applications industrial customers are willing to pay large premiums for natural gas in order to minimize total fuel costs and maintain their competitive position. Other uses exist for which conversion is less costly and less difficult technically, but where continued use of low-priced natural gas is necessary for the economic survival of the user. This occurs with users who operate on a small profit margin where increased fuel and capital costs associated with conversion to oil (or possibly electricity) could not be absorbed or where the cost of gas is small and the cost of conversion per Mcf of gas consumed is large. A particular case in point is the widespread use of natural gas to drive engines for pumping irrigation water in west Texas, New Mexico, and Arizona. [21] The farmers using such equipment were threatened with curtailment by El Paso Natural Gas this year, because the engines were classified as convertible to alternate fuels by El Paso (hence FPC priority 3). Indeed, they are convertible to diesel oil, gasoline, or to electric motors. The cost of

doing so, however, along with the increased energy costs (in many cases their natural gas was given as rent by El Paso for using their land as a pipeline right-of-way) was sufficiently large so that many farmers testified that they would become hardpressed financially and possibly put out of business.

From the standpoint of society, use of natural gas for these special applications is sensible because the cost of production will be minimized if natural gas is diverted from some other uses where conversion to alternate fuels is much less expensive. Fortunately, many of these special purpose uses generally do not consume substantial amounts of natural gas. They usually amount to less than 15 percent of the total gas used by a given industry, although some critical uses such as feedstock uses of methane or natural gas in firing many existing ethylene cracking furnaces, consume a much higher fraction of the natural gas (over **50** percent) used by that industry.

The danger for this coming winter is that if natural gas is completely cut off to a plant which has a few critical uses such as those cited, the entire plant may be closed, even though a sufficient supply of fuel oil may be available for the other uses in the plant. The problem can become even more acute if the curtailed plant is a manufacturer of a critical part or if it is a principal customer of another industry. Thus, forward and reverse ripple effects could bring about plant closings and loss of jobs for major portions of entire industries. In this manner the regional problems described on page 9 could easily become national problems. For example, in Delaware City, Del., the Stauffer Chemical Company produced **50** percent of the carbon disulfide needs of the United States. If this plant is shut down by curtailment, it may be difficult to find alternate carbon disulfide supplies. Metal fabrication plants in the East North Central region which manufacture critical metal parts for automobile and railcar manufacturers are relatively small-volume gas users themselves. Yet, if these plants were to be shut down for more than 2 to 3 weeks, the industries depending on these parts might have to stop production, putting tens of thousands of people out of work.

The Federal Power Commission Order No. **467-B,** Curtailment Priority Scheme, was intended to ensure that high priority uses of gas such as these, would be served even though pipelines curtailed their deliveries. However, when natural gas supplies were relatively plentiful, industrial users, who have critical but small volume uses of natural gas relative to their total gas needs, often purchased gas under interruptible contracts. Such contracts are in a Priority 3 or lower classification, even though the critical end-uses would be in Priority 2 if the gas were bought under a firm contract. For example, a plant which used large volumes of natural gas for boiler fuel but only a small amount of it for critical uses, might normally have an interruptible contract and alternative fuel capabilities. For the critical use, propane-air would be the standby fuel while fuel oil would usually be the standby for the boilers. Because gas was purchased under an interruptible contract the critical uses may not get gas, unless proper propane storage and FEA allocations are obtained, it may not have sufficient propane to last out a **100** percent natural gas curtailment for the entire winter. In the heavily curtailed regions of the country, even firm contract customers are experiencing difficulties in obtaining gas for their critical needs. The problem is even more acute here because these consumers have usually made no provisions for using propane (i.e., storage and handling facilities).

There are a number of ways that industries which have a critical need for a gaseous fuel can attempt to obtain supplies when they are curtailed. They are:

- Seek extraordinary relief from a curtailment from the Federal Power Commission. The result can bean order from the Federal Power Commission to a jurisdictional pipeline to serve specific direct customers of the pipeline, or to deliver an equivalent amount to gas utilities in expectation that the gas will be delivered to the customers seeking extraordinary relief.

- Seek extraordinary relief from State regulatory commissions which regulate gas utility companies not under FPC jurisdiction. Some distribution companies have said that they will be able to supply limited emergency quantities of natural gas to users for critical uses even though the formal administration of pipeline curtailment plans by the FPC would not entitle such users to gas.

- Purchase propane, or in some cases butane, as an alternative clean-burning gaseous fuel. The purchase of propane or butane may require granting of an allocation by the FEA. At present, this is uncertain

depending upon the outcome of legislation.[22]

Reduced Safety Margins

There is very little, if any, margin if abnormal occurrences were to affect gas supplies and/or demand this winter. In particular, it is highly probable that industrial output would be affected if the Nation had a colder than normal winter and/or a disaster or major accident closed down gas production and/or transmission facilities.

The effect of a severe winter is not precisely known, but it would increase hardship, the extent of which depends on a number of factors:

- The length and intensity of the cold spells.
- The portion of the winter in which they occur.
- The extent to which the specific gas utility has been able to prepare for a cold spell.
- The availability of propane, SNG, and/or stored gas.

Most gas utilities polled have designed for a winter which is normal or slightly (5 to 10 percent in degree days) colder. Some, such as Bay State Gas Co., have been able to prepare for a 'design' winter (usually one year in 30) which increases their gas requirements about 20 percent. On the other hand, South Jersey Gas Co., is constrained to a normal winter, if they are to meet all firm requirements, whereas in the past they were able to prepare for winters 10 percent colder than normal. On the average, it appears the economy will not be measurably affected if up to a 5 percent colder than normal winter occurs, provided no other problems occur which would worsen the supply-demand deficiency. Should a period of particularly cold weather occur early in the winter, however, there could be widespread unemployment and plant closings. The reason is that the gas utilities which rely on storage to cover cold spells will have to refill storage facilities to prepare for possible cold periods later in the winter. This can be done only by curtailing firm industrial customers. Since such an occurrence cannot be planned for, the likelihood of plant closings is very high for the periods needed to refill (2-4 weeks). Therefore, the impact of a cold spell can extend well beyond its duration. In this connection, storage volumes held by most utilities are necessarily lower than last year, decreasing the duration of abnormally cold weather that can be tolerated.

Disasters which affect gas production would also reduce supply below the levels needed to maintain projected economic output. The hurricane that hit the Gulf Coast region last year affected the Tennessee Gas Pipeline Co., to a degree that produced 40 percent curtailments in the East Tennessee area during most of the winter.[23] The total curtailment on the Tennessee gas system increased from 5 percent to 15 percent for the last 3 months of the 1974-75 winter. A duplication this winter would cause plant closings, loss of production, and unemployment in those areas dependent on gas from that pipeline. The duration and extent cannot be determined at this time, but the consensus of the panel was that such a disaster will be detrimental to economic activity.

THE WINTER OF 1976-77

Introduction

One of the major conclusions of the panel was that the natural gas shortage will be worse in the winter of 1976-77 than it will be in the coming winter (November 1975-March 1976). Fifteen months from now, economic activity is expected by most to have considerably increased, as the economy continues its recovery from the recession. In addition, natural gas supplies, especially in the interstate pipelines, will continue to decline. Consequently, the supply-demand deficit will be much greater in the winter of 1976-77 than this coming winter.

Short-Term Natural Gas Supplies

Indication of the worsening situation is seen from short-term supply projections. Projected annual deliveries of natural gas from existing reserves as of December 31, 1973, will decline by about 1 trillion cubic feet per year (Table 6). Over the past 4 years, production under new long-term contracts each year has averaged about 59o Bcf which is only 60 percent of this expected annual decline,[24] Only when production from all new sources is included (limited-term emergency, and long-term contracts) has production from new sources over the last 3 years equalled the decline in deliveries from existing reserves projected over the next 2 to 3 years.

Deliveries of gas under emergency and limited term sales, however, have been considerably reduced by the expiration of these contracts and

Table6

Gas Supply and Deliverability Summary
Volumes Dedicated to Interstate Pipeline Companies As of Year End 1973
(Thousand Mcf at 14.73 Psia @ 60° F.)

	Gas Supply 12-31-73	Produced and/or Purchased	Projected Deliveries 1974	1975	1976	1977	1978
A. Domestic Gas Supply							
1. Company Owned and Long Term Producer Contracts	129,979,335	13,094,261	12,593,463	12,014,629	10,687,841	9,696,461	8,717,315
2. Warranty Contracts	4,132,827	294,325	297,486	297,438	291,745	296,461	284,925
3. Emergency/ Limited Term Contracts	205,111	291,797	171,317	33,794			
Total Domestic	134,317,273	13,680,383	13,062,266	12,345,861	10,979,586	9,992,922	9,002,240
B. Pipeline Imports							
1. Canada	14,715,992	966,898	936,266	953,786	970,648	969,444	969,444
2. Mexico	117,714	1,632	1,632	1,632	1,632	1,632	1,632
Total Pipeline Imports	14,833,706	968,530	937,898	955,418	972,280	971,076	971,076
C. LNG Imports							
1. Algeria	8,665,747	–0–	–0–	–0–	44,788	253,227	343,627
Total All Sources	157,809,890	14,648,913	14,000,164	13,301,279	11,996,654	11,217,325	10,316,943

SOURCE: **Copied from the Federal Power Commission, "The Gas Supplies of Interstate Pipelines 1973", p. 10.**

they have not been replaced due to court actions and FPC decisions which have restricted emergency sales of gas. [24] Therefore, the average production from new long-term contracts is a better measure of what can be expected in the way of new interstate supplies.

Total additions to reserves in the lower 48 States over the past 5 years have averaged 9 Tcf per year while production has averaged 22 Tcf per year.[25] If the 9 Tcf of added reserves are produced over a period of 15 years, the average annual production is approximately 600 Bcf. (The period to produce a natural gas field varies. Many extend over the life of contracts lasting 20 years while others are produced more rapidly. The typical production period, however, is 15 years.) Even if all of the gas flowed to the interstate market and none to the intrastate market, this is insufficient to overcome the projected 1,000 Bcf annual decline in production from existing reserves committed to the interstate pipelines.

Projected Situation for the 1976-77 Winter

With an expected increase in economic activity and the steadily deteriorating supply situation, there could be sizable constraints on the Nation's economic activity during the winter of 1976-77. The consensus of the task force was that despite continuing 'self-help' on the part of industry and the gas utilities, manufacturing demand would probably not be met even if normal weather conditions were to prevail and no unforeseen events interrupt supplies. The task group expressed the view that the effects resulting from continued conversion to alternate fuels would probably be more than negated by the increased demand for gas as the economy reaches normal levels. Coupled with the

deteriorating supply situation described on page 16, there will probably be a supply-demand deficit too great to be madeup with SNG, LNG, and propane without substantial increases in the supplies of these fuels, primarily through imports. Such an increase does not now seem likely.

An example of the impending problem is given by the East North Central gas utility. Their previously referred to industrial gas demand is estimated to be 146 Bcf next year (1976-77) while their industrial gas supply will total 99 Bcf. Therefore, a much greater volume of alternate fuel must be available and usable if the energy requirements of that service area are to be met.

To compound the problem for the winter of 1976-77, any policy action, such as drawing-down storage and taking 'cushion' gas or increasing the production from existing gas wells more rapidly than currently planned, will simply borrow gas from the winter of 1976-77, thus making curtailments then even worse than they are already destined to be. In this connection, if it is necessary to draw on storage this winter to meet an abnormally cold period, refilling during the summer of 1976 will decrease the supply available for the winter of 1976-77. For example, the gas utility mentioned above has access to about 25 to 35 Bcf of stored gas this winter. If they were to use all of this gas this winter, refilling would decrease industrial supply from 100 Bcf to 70 Bcf in 1976-77, resulting in a 50 percent actual curtailment for all firm industrial customers based on expected demand.

IV. Issues Related to the Natural Gas Problem

This section presents several issues which the review panel felt should be addressed in any attempt to deal with the natural gas problem. The limited scope of the study as requested by the Committee did not permit a detailed analysis of these issues. Nevertheless, they should be considered in resolving the issues related to future U.S. gas supply and demand problems.

In this list, we have not included those issues which are presently under widespread discussion, such as changes in the Natural Gas Act and possible irregularities in natural gas production. The review panel indicated that these items belong in any list of issues relevant to the natural gas question, however, we have given here those panel choices which may not have been considered in debate in Congress.

ISSUE 1

An examination of the worst-case situation, that could result from natural gas curtailments in the future, could define the limits of the potential problems.

Summary

This report deals with the most probable impacts this winter as determined from the data. However, as expressed in the report, this is a highly fragile situation and more severe impacts could occur. In addition, it is likely that in succeeding years the worst case for the **1975-76** winter may be the most probable case for those winters. Under these circumstances it would be useful to estimate what the 'worst-case' situation would be and what contingency plans for such cases exist on the part of the consumers, the gas utilities, and the relevant State and local agencies.

ISSUE 2

Public perception of the energy problem appears to be a barrier in developing lasting solutions.

Summary

A large portion of the public believes that there is no real energy problem. This is heightened by the many symbols of apparently wasteful natural gas consumption such as ornamental gas lighting. Programs to eliminate these symbols and intensify Federal efforts such as requirements on Federal contractors to reduce energy waste could be significant in awakening public perception of the problem.

ISSUE 3

The potential for State and local action in managing the natural gas shortage is often not fully considered.

Summary

If adequate consideration is not given to State and local actions and mechanisms for dealing with the gas shortage, there is the distinct possibility that Federal options will be developed which reduce the flexibility of the Nation to deal with the problem. To this end there appears to be inadequate communication between States themselves on the natural gas problem and attempts to manage it. In all the options considered in chapter V there is the potential for a large State role in determining the ways in which that option can most effectively be applied to the unique problems of the individual States. It appears that in the past the State role has been crucial to reducing the impact of gas and oil shortages.

ISSUE 4

Have contingency plans been sought with Canada and/or Mexico as a means for dealing with emergencies?

Summary

Presently the United States imports about **0.95** trillion cubic feet per year from Canada

which is used mostly in the Northern States.[2] These imports are expected to be phased out over the next few years. Presently no gas is imported from Mexico. However, both countries have the potential for delivery to the United States, and the possibility that emergency deliveries could be made may be worth exploring.

ISSUE 5

The long-term impacts of the immediate gas shortage and private and public responses to it will greatly affect the Nation's economic stability over the next several years.

Summary

This report has attempted to point out some of these impacts, particularly with regard to the increased use of imported fuel (oil and propane) as natural gas supplies continue to decline. There is a wide range of long-term impacts, including increased energy costs, environmental effects, transfer of manufacturing facilities, etc., which could not be adequately discussed due to the limited scope of this study. Consideration of these impacts to the extent possible is desirable in order to formulate policies which minimize adverse effects.

ISSUE 6

The research and development activities of the natural gas industry, particularly in increasing end-use efficiency, are at significantly lower levels than other energy sectors.

Summary

The natural gas industry appears to be lagging in efforts to set up a strong energy research program when compared to the electric power industry. Research and development expenditures on the part of the interstate pipeline companies and encouraged by the FPC are allowed as costs to be included in their rates. Yet, in 1973, R&D expenditures on the part of the interstate pipelines amounted to only 0.55 percent of their total revenues and only a small fraction of this (probably less than .03 percent of the total) was for end-use conservation programs. z" Finally, the gas industry has not yet established a research organization similar to the Electric Power Research Institute. The gas industry should be an important element in the Nation's total energy R&D structure.

V. Options for Dealing With Natural Gas Shortage on an Interim Basis During 1975-76

INTRODUCTION

The long-term direction to be taken by the Nation's natural gas policy depends upon the way in which Congress amends the Natural Gas Act. However, there are a number of legislative and administrative options open to deal with the natural gas shortage of the winter of **1975-76 on** an interim basis if necessary, in the event Congress has not passed legislation dealing with the long-term problem. Most of these interim options will have longer term implications which will need to be identified, and some of them may be relatively incompatible with certain forms that amendments to the Natural Gas Act may take.

Natural gas shortages have developed over a number of years and even if new long-term legislation were to be passed tomorrow, some imbalance between supply and demand would likely persist for some period into the future. This implies that even after a long-term natural gas policy is put in place, transitional procedures still will be desired to deal with the period during which balance is being restored. Most of these transitional procedures are related to the interim approaches which the Congress could use to deal with the natural gas shortage this winter. The purpose of this analysis is to focus on interim measures to deal with the coming winter. It will not deal with the amendment of the Natural Gas Act since the character of that amendment is unknown.

Although these options are principally Federal actions the various States and localities can play an important role since they are most experienced in dealing with their differing supply and demand characteristics. Options concerned with conservation, fuel allocation procedures, and restructuring of curtailment priorities may be particularly appropriate in this context and utilization of their agencies in helping to carry out such measures may substantially enhance their effectiveness.

The interim options which can have some practical impact on the shortage during the winter of 1975-76 can be grouped into four broad categories. They are:

1. Options which increase gas supply;
2. Options which reduce the demand for gas;
3. Options which redistribute the available gas within the United States in order to reduce severe regional shortages; and
4. Options which lessen the impact of the shortages on users.

A number of options which would appear, initially at least, to fall into one of these four categories may not be practical options for the winter of 1975-76, since they require sufficiently long lead times for implementation and hence cannot reasonably be expected to be effective during this period of time. This is particularly true of many of the proposals for increasing the supply of gas such as additional import of liquefied natural gas by tanker or the installation of liquid hydrocarbon based, synthetic natural gas facilities. These options are best dealt within the context of the longer term natural gas policy.

There are few short-term options which attempt to increase the total supply of gas which do not deal with alleged irregularities in natural gas production. One such action—an acceleration of the certificate approval process by the Federal Power Commission to connect offshore gas reserves—is already a part of the Federal Power Commission's existing jurisdiction under law and needs no legislation for its implementation. There are, however, other options (which are classified in the category of redistribution of available gas) which would have a secondary effect of increasing gas production for the winter since in some cases geographically scattered pockets of surplus have developed and more may be created. These surpluses might be drawn on for some increased production if such surplus gas could be effectively distributed,

A second group of options—those designed to reduce the demand for gas—could respond to legislative and administrative initiatives. These would include mandatory limitations on the utilization of natural gas whether in specified applications, such as boiler fuel or in installations having dual fuel capability, or more general limitations such as strong measures devoted to the conservation of gas.

The third group of options are designed to more effectively distribute the available gas.

They can be further subdivided into those options which alter distribution by means of price and those that do so by administrative allocation. That natural gas shortages in the interstate market are not uniformly distributed was documented in Chapter II. In the intrastate market, shortages which appeared for a time within the past 2 years now seem to have become short-term surpluses. As a result some proposals for reallocation of gas to eliminate shortages tend to look to the intrastate market to provide some relief. This is true for both price-oriented options and those which feature administrative allocation. The latter also tends to look on those interstate pipelines whose supply position is better than average.

Among the price-oriented options are those which would permit either the interstate pipelines or industrial users to enter the intrastate market and compete freely for intrastate supplies on a price basis. The reinstatement of 180-day limited term sales to interstate pipelines is one such proposal. Another, which the FPC has proposed is rulemaking RM 75-25 which would permit industrial users in certain categories to buy intrastate gas free of price control and have it transported to facilities by way of interstate pipelines,

Reallocation schemes which depend upon administrative intervention rather than the use of price include the institution of pipeline to pipeline allocation procedures, short-term preemption of intrastate gas supplies for the interstate market, or suggestions for substantial modification to national curtailment priority schedules.

The fourth category of options are those which are designed to lessen the impact of the shortage on users. Among suggestions in this category are improvements in availability of alternative fuel—especially propane which has been under FEA allocation procedures. These procedures have provided disincentives for the importation of propane. Another group of options would include approahces providing either capital or tax incentives to speed the conversion of existing gas-using facilities to alternative fuels. Other proposals are designed to provide temporary relief from environmental restrictions to increase the flexibility of using alternative fuels.

These four categories appear to include the principal options which are available to reduce the shortage and/or its impacts for the coming winter, although the list is not meant to be exhaustive. Each of these options is discussed in the following text. A description of the option is given, its relative effectiveness in dealing with the shortage is discussed, and its usefulness at various depths of shortage is indicated. Finally, the effect each option may have on potential long-term solutions is outlined.

CONSERVATION

Description

The goal of this option is to encourage by the most effective means possible, the reduction of natural gas consumption by residential, commercial, and industrial consumers.

Discussion

The potential of energy conservation in reducing the gap between supply and demand of natural gas is quite large. For example, the total volume of natural gas used by residential and commercial consumers during the winter of 1974-75 was about 4.5 trillion cubic feet. z A **10** percent reduction would yield **45o** billion cubic feet which would exceed this coming winter's projected incremental shortfall. Although the nonuniformity of the gas shortage may not permit full use of a volume this size if it were available, there would still be significant impact on reducing the shortfall.

Conservation can be effective within all time frames. It can have short-term effects through cutbacks in gas consumption by action such as reduction in thermostat settings, relatively easy housekeeping measures, and elimination of ornamental gas lighting. It can have an impact within the next 12 months by such things as increased insulation in existing structures and pipes transmitting hot gases and fluids and sealing up heat leaks in buildings. It can have longer term impacts through such actions as utilization of more efficient gas consuming equipment and industrial processes, and recovery of waste heat from gas fired furnaces.

In the immediate future the principal emphasis will probably have to be measures to curtail gas consumption, particularly in the high priority residential and commercial uses, rather than measures to increase energy efficiency. The difficulty here is in convincing these consumers to curtail their use. One method demonstrated to overcome this difficulty has been by using economic penalties to restrict gas consumption. Another method has been through collective action on the part of a community in order to have enough gas to maintain jobs. An example of the latter occurred in Danville, Va., in 1974-75.

These actions appear to be useful for short run emergencies but they will become less effective as curtailments deepen as there is a limit on how much a person is able to cut back.

The most lasting conservation programs seem to be based on more efficient uses of energy, since virtually no economic or social pressure exists to return to less efficient practices. To bring this about, particularly in the residential sector, will probably require a series of incentives dealing with economic and institutional factors. An effective program in this context requires a clear understanding of existing institutional, jurisdictional, economic, and other barriers, however, it is possible that some measures, such as tax incentives for insulation, could have a significant effect for the winter of 1976-77.

In the industrial area, capital or tax incentives can be useful in accelerating the installation of more efficient equipment, heat recovery devices, and other fuel-saving measures. There is a potential pitfall, however, in that decisions may have to made as to whether particular equipment changes made under this plan are primarily for conservation or to replace old equipment. Since a number of motives can be present for any equipment change or modification, care should be taken to see that such a program is not abused.

Conservation is one of the few options which can be effective even if curtailment levels deepen over the next several years since most other options depend on redistribution of gas. As gas supply decreases less is available for redistribution.

Finally, conservation appears to be compatible with any of the approaches to long-term changes in the Natural Gas Act. In any event, conservation was judged by many members of both panels to be one of the more promising options in dealing with both the short- and long-term gas shortage.

180-DAY EMERGENCY SALES OF NATURAL GAS

Description

This alternative would allow interstate pipelines to purchase natural gas on the intrastate market, either from producers directly or from intrastate pipelines. The purchase would be limited to 180 days with automatic abandonment of the sale and transportation of **gas at the end of the period.**

Discussion

This option, in any of a number of variations, appears to be one of the more favored methods of dealing with this winter's emergency. One such variation is to allow the parties involved to set the price and allow the pipeline to pass-through the price to the ultimate purchaser. Another variation which is receiving considerable attention is to set a ceiling price which would correspond in some manner to prevailing intrastate prices.

Currently, there is gas available from intrastate markets and it is expected to be available this coming winter. The quantities are uncertain but some of the more optimistic estimates are that 1 billion cubic feet per day maybe available. This volume is about 50 percent of the 300 billion cubic feet incremental gas shortage estimated for this winter. Surplus natural gas in the intrastate market could be sufficient to help alleviate the most serious shortages. For example, Transcontinental Gas Pipe Line Company estimates its curtailments have increased by 300-400 million cubic feet per day for the forthcoming winter. Thus, if gas estimated to be available from the intrastate market were directed to this pipeline, many of the problems which are likely to occur on the Transco system could be solved. Analysis of FPC data shows that about 1 billion cubic feet per day of natural gas was purchased by interstate pipelines from intrastate markets during the winter of 1973-74, when 180-day emergency purchases were allowed. In this connection a recent U.S. Supreme Court action (October 14, 1975) has left unchanged a lower court decision which denies the FPC the power to grant 180-day emergency purchase at essentially unregulated prices. In effect, the courts state that this is deregulation which is beyond the present authority of the Commission.

Emergency purchases and transportation for 180 days could also be structured to allow gas utilities to trade with one another. This can be quite useful in stimulating short-term distribution of natural gas to areas needing it most. Such arrangements would be useful in providing a means to take advantage of weather diversity among various areas. Contracts between gas utilities must be made on very short notice because the availability of excess gas is uncertain.

If curtailments were to deepen, the 180-day purchase option would become relatively less effective if the total volume of excess gas is fixed. Under the variation which does not set a ceiling on prices, the cost of the excess gas will probably

rise in some relation to the diminishing supply. If the price is fixed, it would seem that other incentives to move the excess gas would have to be applied. If the shortage deepened, producers may be increasingly less inclined to sell excess gas under a ceiling price (in hopes of future changes in these prices) and the incentives may have to be strengthened.

The ultimate consumer of gas under this plan would see some increase in the price of natural gas although not to the full extent of the intrastate prices since these would be rolled into the lower-priced flowing gas. It is quite possible that the fuel costs to the consumer purchasing gas in this manner, even at intrastate prices of **$2.00** per Mcf, would be less than if the user had to purchase equivalent amounts of SNG, LNG, and/or propane to make up for gas deficiencies. This would depend on the prices of these supplements to a given buyer and the transportation and distribution costs of the emergency intrastate gas.

Finally, emergency sales for the case where a ceiling price is not set are compatible with a long-term solution that tends toward deregulation, since it is limited deregulation. In addition, they would not necessarily prove harmful, because of their limited duration, if legislation dealing with the long-term problem tightens or extends regulation over the natural gas industry. For the case that price ceilings are set as a provision for emergency sales, a natural transition for legislation maintaining or extending regulation is provided.

DIRECT PURCHASE OF NATURAL GAS

Description

This options permits the direct purchase of natural g-as by the utlimate consumer from gas producers at prices comparable to those paid for new, intrastate gas. The pipelines and gas utilities would serve only as common carriers and not purchase the gas themselves.

Discussion

On August **28, 1975,** in Order No. **533,** the Federal Power Commission issued a policy statement which encouraged a modified form of direct purchase. These purchase arrangements are to be certified by the Commission who would not reexamine the contract price set by the parties but would determine whether the ultimate use of the natural gas was of a high priority. In addition, the volumes of gas purchased under this order could not exceed the amount curtailed. The Commission also stated that gas utilities could not act as agents for a group of purchasers such as small commercial and/or residential consumers.

The Task Force felt that the direct purchase plan was an option that could have a positive impact in relieving some of this winters gas shortage. Several reservations were expressed, however, as to the plan as it now exists. The primary difficulty seems to be the limitations on who could purchase the gas. Because high initial costs might be required, only the largest users could effectively take advantage of this option. Further, the exclusion of gas utilities would probably remove altogether most of the small industrial customers from taking advantage of this plan. There is the possibility, however, of the emergence of brokers entering the intrastate market for direct purchase of natural gas on behalf of a number of these small customers. This assumes that restrictions would not prohibit such activities and that the brokers could be regulated in the same manner as other direct purchasers. Another difficulty is potential delays in approving certification of these contracts. The Commission has expressed the belief that they will be able to expedite these matters in a timely fashion.

With regard to deepening levels of curtailment, the effectiveness will be similar to that of the 180-day purchase plan.

Since the volumes to be purchased directly are unlikely to be large, this policy is unlikely to influence significantly any of the long-term solutions to the natural gas shortage. Issues of equity may be raised depending upon the processes that obtain the volume of gas that becomes available after new natural gas legislation is passed, but, because, FPC Order No. 533 limits the purchase contract to 2 years, any inequity will be short lived.

Even with these possibilities, it is likely that Order No. 533 will have some positive benefit although the extent to which it will help this winter is unknown. If those companies which face plant shutdowns are most active in pursuing gas, which one would expect them to be, and the FPC expedites their applications, then some plant shutdowns are likely to be avoided. In this context, direct purchase may serve as an effective means of allocating emergency gas for critical uses.

MANDATORY PIPELINE-TO-PIPELINE ALLOCATION

Description

This would provide legislation to grant authority to the Federal Government to instruct pipelines with adequate supplies of natural gas to deliver that gas to pipelines where serious and potentially disruptive shortages appear imminent.

Discussion

It is presently envisioned that pipeline-to-pipeline allocation will primarily cope with shortages in the interstate market by drawing on other supplies dedicated to the interstate market. This can be done without joining the major issue of preempting intrastate gas supplies for interstate use. Where interstate pipelines have some potential surplus delivery capacity going into the winter, allocating their gas to deficit pipelines in shortage areas could redistribute the total supply over this winter without causing any serious hardships on any other legitimate customers. However, to the extent that most pipelines will be in some curtailment this winter, the principal effect of such an authorization would be to permit the Government to authorize deeper curtailments on pipelines where curtailments were not in high-priority categories in order to protect the high-priority customers of another pipeline. This raises complex issues since the pipeline that has been able to protect some of its lower-priority customers through its own efforts would now have to deny those customers gas in order to provide it to a more severely affected pipeline. In addition, it should be noted that these transfers could increase the depletion rate of fields supplying the stronger pipelines as the latter attempt to make up natural gas transferred to weaker pipelines. This will affect future years by decreasing supplies faster than is now expected, making the situation even more severe for the winter of **1976-77.** Therefore, while the effectiveness of this option would probably remain constant in the short-term if the curtailment deepened, it is likely to drop sharply and even become negative beyond this winter.

Pipeline-to-pipeline allocation has been highly controversial. Those who favor the ultimate Federal system of end-use controls for energy sources tend to favor pipeline-to-pipeline allocation to make sure the shortages are concentrated in low-priority customers and that high-priority customers are protected by Federal regulation regardless of the accident of which pipeline system they are served by. On the other hand, a high percentage of the private industrial segment opposes pipeline allocation on the grounds that it strikes at some of the fundamental issues of Government control in the private sector of the economy.

A variation of this proposal concerns gas on Federal lands, primarily offshore. Presently the Federal Government takes a **16-2/3** percent royalty in cash payments. However, the possibility exists of taking the royalty "in kind" and allocating this gas to those pipelines in greatest need. This minimizes some of the issues raised above since now the Federal Government is dealing with its own gas and would not be allocating gas owned by the pipeline. One difficulty would be that such moves might tend to act as a disincentive for offshore exploration if the companies perceived the product value of the gas greater than the cash value of the royalty.

The extent to which mandatory allocations are compatible with various forms a new natural gas act could take depends on the extent of new supplies generated by that act. If they were not forthcoming, it may be necessary to retain mandatory allocation to manage a short supply of gas, regardless of whether it was deregulated or regulation extended into the intrastate market, until demand and supply come into balance,

MODIFY CURTAILMENT PRIORITIES

Description

This establishes a set of curtailment priorities which will better protect critical uses of natural gas than presently exists. The Federal Power Commission now has the authority to set curtailment priorities. This proposed remedy could presumably be accomplished now by FPC action without the necessity of emergency legislation.

Discussion

The argument for revising curtailment priorities to better protect uses of natural gas which cannot be converted to alternate fuels is commonly voiced by those who have been threatened by loss of gas. This has been argued extensively in Federal Power Commission curtailment hearings and has been expressed by the industry representatives to the panel. One problem with suggested modifications of curtail-

ment programs is that they are usually proposed by advocates of a particular industry which view the recommended change as one which would protect them. Since elevation of one use into priority status can only be achieved by downgrading some other use, however, it is extremely difficult to get common agreement as to how to improve curtailment priorities in a just and equitable manner. Curtailment priorities designed initially to deal with large volume, low priority uses of natural gas are increasingly being applied to small volume, higher priority uses with the result that administration is more complex.

The issues raised in establishing curtailment priorities are perhaps some of the most complex in the entire natural gas situation. In determining who gets a limited supply of natural gas you often have advanced conflicting evidence to support a claim that one use is superior to another. Two of the important issues that must be dealt with are as follows:

1. What factors are to be used in determining priorities? Some of these include the value of the manufactured product (e.g., ammonia, goods for national defense), the immediate impact of a cutoff in gas (e.g., the size of the job loss), the feasibility of conversion to an alternate fuel (e.g., the cost), and the technical efficiency of the use of gas.
2. What are the long-term impacts of reserving gas for a particular use? Some of these include the effect a conversion will have on the use of other fuels (particularly imports), whether or not allowing a particular use will inhibit the most effective conservation options[27], and whether eventual conversion has just been postponed to a point where it will be even more difficult and have even greater impacts.

The resolution of these issues is beyond the scope of this report. It is important that they be considered, however, so as not to create more problems than are solved in making a choice of curtailment priorities.

It would appear at this time that some improvement in curtailment priorities for the high-priority customers would be valuable. This, by itself, would help for only a limited period of time **since curtailment** levels have been steadily deepening. Such actions, however, if carried out in an effective manner could have long-term benefits even if supplies continue to decrease as natural gas would be increasingly reserved for those purposes for which it is best suited. As far as new natural gas legislation is concerned, the same comments made in regard to the mandatory allocation apply here. One exception would be if deregulation were accompanied by a complete freeing-up of how gas is distributed. In this case the price mechanism would probably set the priorities.

PREEMPTION OF INTRASTATE GAS

Description

This would provide legislation to authorize the Federal Government to exert authority over intrastate gas currently being sold in the intrastate market, and order its delivery to deficit interstate pipelines.

Discussion

The ability of the intrastate market, which is not regulated by the FPC, to outbid the interstate pipelines for natural gas has tended to concentrate the shortage in the interstate market. This has been one of the major identifiable results of current Federal regulation.

Of particular interest in this context is the very large volume of natural gas burned under electric utility boilers in the intrastate market, which was discussed in Chapter III, p. 13. It was noted there that a fraction of this gas which could be reliably counted on this winter, if preemption were to occur , depends on the claimed technical problems of these boilers, It is also necessary to assure oil availability which is a problem that would extend beyond this year. If all the boilers with dual-fuel capability could be modified to burn oil this entire winter and assuming no change in efficiency, the **480** billion cubic feet is equivalent to **85** million barrels of fuel oil. For the winter **1976-77** it is probable that the corrosion problems of many more boilers could be cleared up so that they may be able to operate on oil the entire winter. A critical consideration here may not be the time factor but the availability of sufficient generating capacity for units to be taken out of service for conversion. It could be expected, however, that preemption of natural gas from utility boilers could be more effective in **1976-77 than** for this coming winter. Finally, if it is true that over the long-term, use of natural gas in a boiler is an inferior use of this fuel, then mechanisms to transfer this gas would assist in reserving natural gas solely for critical uses.

Preempting intrastate gas to solve this winter's problems might prove to be ad-

ministratively highly complex. Although there are a limited number of interstate pipelines whose curtailment practices are subject to FPC regulation, there are far more sellers of intrastate gas—in many cases to geographically adjacent purchasers—and it would require that a larger administrative machinery be put in place to accomplish such intrastate preemption.

A serious question that must be answered by a preemption scheme is compensation to the user who loses the gas. This could be determined rather directly if preemption was for a limited duration, but the calculation would be quite complex if it were permanent. In addition, there is the question of the price paid for the preempted gas by the new consumer. If it is allowed to rise to new gas prices (interstate or intrastate), large windfall profits would accrue to the seller. If it is not allowed to increase over the level paid the preempted customer, then mechanisms would have to be established to ensure that the gas is not held back from the market. The question of existing contracts is deeply connected with this price question. In this context, if the preemption is set to last only the length of the emergency, the question of how the original contract should be reinstated must be answered.

Preemption would likely have the largest environmental impact of any of the short-term measures. Air pollution will increase as more oil is used in place of natural gas and the potential magnitude of this conversion is greater than any other type for the next few winters.

With regard to potential forms of a new natural gas act, preemption would have much the same impacts as mandatory allocation and redefinition of priority schedules. Since preemption would place the intrastate market in the regulatory framework, it would tend to be more compatible with a long-term solution which extended price regulation in this market.

CAPITAL OR TAX INCENTIVES FOR CONVERSION

Description

This measure would provide financial assistance to users faced with the necessity to convert to alternative fuels and/or who desire to install conservation equipment. Tax incentives or capital might be made available on favorable terms.

Discussion

Conversion to alternate fuels in many instances requires considerable capital and installation time. The principal limitation on effectiveness appears to be the time needed for installation, although capital availability is a serious, but not limiting restraint. If this is the case, the effectiveness of this option would likely be greater for periods after this winter. Indeed if curtailments increase, the incentive for carrying out conversion grows, and this option could have substantial long-term benefits by rapidly accelerating this measure. It is important to consider the effects of conversions financed under this plan. Exchanging one scarce fuel for another may not be the most effective way to carry out this option.

This approach seems to be compatible with any of the long-term methods of solving the natural gas problem and, as a result, might be considered as transitional procedures to be put into effect in any long-term amendment to the Natural Gas Act.

TEMPORARY STAY OF ENVIRONMENTAL RESTRICTIONS

Description

High-sulfur coal and high-sulfur oil are more freely available than some of the lower-sulfur fuels. Customers whose natural gas supplies are curtailed might find it easier to convert if they had the ability to use higher-sulfur fuels on an emergency basis when gas was curtailed.

Discussion

Most of the users who could burn coal can also burn heavy low-sulfur fuel oil, to some extent. Unless the local logistics of refineries, distribution systems, and pipelines has not developed a supply capability in a particular region, therefore, it is unlikely that elimination of the environmental restrictions will have a very significant effect on the number of users who would have to shut down altogether. It would, however, have a significant price effect. For example, high-sulfur oil is much cheaper than low-sulfur fuel oil for those users who have to convert from natural gas and are able to use coal.

The principal impact with this options, however, is the effect on air quality. It is quite important to carefully evaluate the tradeoff of increasing air pollution with the benefits of

being able to use a wider range of alternate fuels before environmental controls are adequately developed.

The effectiveness of this option as it relates to the depth of curtailment is primarily dependent on the potential for conversion to alternate fuels which may not meet local environmental standards. As shortages grow, the need for conversion will increase, and if high-sulfur fuel can be used it will be less difficult to counter the effects of curtailment.

IMPROVE PROPANE, LNG, AND SNG SUPPLIES

Description

This option involves removal of those barriers which hinder the development of fuel supplies which can directly substitute for natural gas.

Discussion

The potential for dealing with the projected shortfall this winter by alternate gaseous fuels is limited due to the time required to secure the supplies and build the facilities to handle or produce them. The most likely candidate is propane, which was discussed in some detail in Chapter III. The task force expressed the view that the use of propane much beyond that already scheduled this year is unlikely due to the lack of onsite storage and transportation facilities. While SNG and LNG have a longer-term potential, they will not be able to add much this year over that already online. However, plants producing SNG from naptha have a 1-to 3-year lead time and could have substantial impact in the winters following this one.

The principal difficulty with all these sources is that they depend primarily on imported fuel. In addition, the costs of SNG plants and LNG terminals are high which is also quite important with regard to SNG and LNG facilities. Conversion of liquid hydrocarbons to SNG involves some waste in that the conversion efficiency is about **80** to **90** percent. Therefore, the value of SNG must be weighed against the value of the liquid hydrocarbon feedstock, including the losses, as an additional factor in determining whether to proceed with an expanded SNG program of this type. Finally, the costs of these alternatives are quite high, **$2.50** to **$4.oo** per Mcf equivalent, which will add substantially to industrial energy costs.

The use of these fuels is expected to increase over the next several years as natural gas supplies decline. Their effectiveness in providing relief to the natural gas shortages will depend on the ability to overcome the problems outlined in the previous paragraph.

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