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.