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SOCIOECONOMIC IMPACTS OF NATURAL GAS CURTAILMENTS:
A STUDY OF THE TEXTILE INDUSTRY IN THE SOUTHEASTERN
UNITED STATES

Final Report

By
Diana M. Jennings

January 1980

Work Performed Under Contract No. AC01-78CS30536

JBF Scientific Corporation
Arlington, Virginia

U. S. DEPARTMENT OF ENERGY

Division of Industrial Energy Conservation

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Final Report

by

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EXECUTIVE SUMMARY

The objective of this research is to assess the socioeconomic impacts of natural gas curtailments in the Southeastern United States and evaluate the link between pipeline service, plant type, geographic location and degree and type of impact. Also considered are the precautionary measures that have been taken since the gas curtailment by industry and the state to try to alleviate future economic dislocations related to the unavailability of natural gas supplies. The natural gas curtailments that occurred during the winter of 1976-77 had the most pronounced effect on production and employment in certain counties of South Carolina.

SOUTHERN, a main natural gas supplier for South Carolina, was unable to deliver gas fast enough from storage to meet all of the immediate needs of its customers during the peak demand period that winter. Therefore, large curtailments at the industrial level resulted. The textile industry, an intensive user of natural gas, was particularly affected. Seventy-six percent of the textile mills in South Carolina that underwent production losses received their gas from SOUTHERN. Textile firms which did not anticipate curtailments generally could not rapidly make emergency preparations for alternative fuels when the curtailment occurred. Many textile firms which did not receive alternate fuels fast enough to save them from production slowdowns or lacked the ability to use alternate fuels had to limit production or shutdown entirely for a period of time thereby furloughing workers temporarily.

Approximately 77,000 person-days of work were lost in the textile industry in South Carolina due to the curtailment. About 9,000 mill workers, 6% of the state's textile employees, were temporarily sent off the job. In monetary terms, this lost work equalled about \$2.5 million in lost wages and nearly \$4.7 million in estimated spendable money lost.

Production slowdowns and shutdowns within the textile industry took place intermittently over a three to four week period from mid-January to mid-February. Many textile workers were able to collect unemployment compensation and participate in the food stamp program during this time. These two income maintenance programs, although not equal to normal employee take-home pay, supplied households with most necessities. The cut in income, however, represented a significant (though limited) hardship for low income households.

The Unemployment Insurance Program and Food Stamp Program are funded by both the federal government and the state. Expenditures were increased during the gas curtailment period to pay the additional claims. The increase in amount paid to statistically significant "high textile unemployment areas" in South Carolina for February and March 1977, equalled \$680,000. Textile related counties that had significant increases in food stamp participation were provided extra funding of \$375,000. Hence, the gas curtailment placed an additional burden of over \$1 million upon state and federal governments in addition to the lost tax revenues associated with unemployment.

There were a number of significant socioeconomic impacts that occurred during the 1976-77 natural gas curtailment in South Carolina.

- o 9,000 textile mill workers were temporarily unemployed.
- o \$2.5 million of wages lost, which was the equivalent of \$4.7 million of spendable money.
- o \$680,000 was spent by the federal government and the state for textile unemployment claims (curtailment related).
- o An additional \$375,000 was provided by the state and federal governments for textile-related food stamp participation.
- o 28 textile plants suffered production losses.
- o 9 textile firms moved their plant locations because of the gas curtailment and the unavailability of fuel.
- o Numerous social and civil institutions were forced to close.
- o 11 out of the 46 counties were adversely affected by the curtailment.

The four primary effects (unemployment, food stamp participation, production losses and plant closings) were somewhat localized within the state. The map on page 4A illustrates the location of the nine most heavily impacted counties and the high correlation between these socioeconomic variables in terms of area of occurrence. The nine impacted counties were: Aiken, Chesterfield, Colleton, Florence, Greenville, Lancaster, Marlboro, Orangeburg and Union.* An impacted county was defined as an area that was significantly affected with respect to two or more socioeconomic variables.

*See Summary Table for quantitative data on the dollar value of unemployment claims, food stamp participation, spendable income lost and numbers of affected plants by impacted county.

Aiken appears to have been the most impacted county in South Carolina. It experienced the highest statewide textile unemployment and food stamp participation for February, 1977. As a whole, the county had the highest estimated spendable money lost. Greenville and Lancaster were also heavily impacted. Greenville, with its rather diverse economy, probably absorbed the impact the best. However, as an aftermath of the fuel shortage, five textile mills in Greenville County have closed since the curtailment. It is unlikely that these firms would voluntarily leave Greenville County which is known as the center of the South Atlantic textile industry. The difficulties associated with fuel availability undoubtedly played a role in this out-migration.

Because gas is cheaper per BTU than alternate fuels, curtailment of gas deliveries to textile firms led to higher energy costs. Textile plants which could obtain propane paid up to five times the price of natural gas. Transportation of the alternate fuels was also costly. These economic impacts on the textile industry have had a negative effect on bringing additional mills into the state.

It is true that the natural gas curtailment in the state of South Carolina, in relation to the textile industry, was not unduly severe. The short period of curtailment and the brevity of the work stoppages limited the socioeconomic impact. However, the empirical evidence presented, indicates that significant effects did occur in terms of economic dislocations to textile workers, adverse revenue and expenditure impacts to all levels of government, and reductions in industrial output.

SUMMARY TABLE

Counties	Statistically Significant High Textile Unemployment*	Extra Expenditure For Claims	Statistically Significant Food Stamp Participation (textile-related)	Increase In Amount Paid	Number Plants With Production Losses	Estimated Spendable Money Lost	Plant Closings
Aiken	X	\$ 98,549	X	\$107,005	2	\$1,025,411	-
Chesterfield					3	\$ 137,342	1
Colleton	X	\$ 72,836			1	\$ 583,680	-
Florence	X	\$ 73,799			2	\$ 358,887	-
Greenville	X	\$ 69,232	X	\$ 77,854	4	\$ 638,765	5
Lancaster	X	\$ 72,153			1	\$1,386,240	-
Marlboro			X	\$ 94,435	1	\$ 220,248	1
Orangeburg	X	\$ 91,454	X	\$ 95,676	1	\$ 154,174	1
Union	X	\$ 81,870			1	\$ 37,757	1
Totals		\$559,893		\$374,970	16	\$4,542,504	9

*half of the county or more must have experienced this high unemployment.

Summary Map

I. INTRODUCTION

JBF Scientific Corporation has undertaken a study for the U.S. Department of Energy to identify the effects on the regional economic and social structures of fuel curtailments in a particular industry. The fuel of interest in this study was natural gas. The curtailments were those experienced by the textile industry in South Carolina and North Carolina, during the winter of 1976-77.

The textile industry in this bi-state area is heavily dependent on natural gas for process heat. This industry was chosen for analysis because it suffered significant production losses as a result of the 1976-77 natural gas curtailment. In addition, according to Federal Energy Regulatory Commission (FERC) data, two of the interstate gas pipelines most susceptible to supply curtailments at the present time, serve the bi-state region.

There are three specific phases of the overall study. The first is to identify and assess the effects of production shutdowns on key social and economic variables in the regional community. This document presents the results of that aspect of the study. The second phase is to determine the prevailing industry attitudes toward potential natural gas curtailments in terms of the nature and extent of preventive strategies employed and the third phase aims to assess the state of the art of available longrange weather forecasting tools for realistically projecting probable curtailment scenarios.

The second and third phases will each be presented in a separate report. The output of each phase will provide a different perspective on the problems confronting industry officials and community leaders in the face of natural gas curtailments.

To obtain a better understanding of the fuel problems that confront communities and industry within the case study area, it is necessary to have background information on the pipelines that service the region. Chapter II of this report supplies a history of the pipeline requirements and deliveries. This type of information suggests the degree to which measures may need to be taken by industry and the community to alleviate potential economic dislocations. This chapter also compares original forecasts of industrial gas supply curtailments for the 1976-77 winter season to the curtailment actually encountered and indicates the areas in the study region which were hit the hardest and the reasons for these severe curtailments.

Several socioeconomic variables were identified and examined for possible use as indicators reflecting potential impacts due to production shutdowns or slowdowns in the textile industry. The only requirement imposed on these variables was that they had to

be able to be usefully applied in a variety of local situations. The selected primary variables were unemployment, food stamp participation and loss of production. Secondary effects resulting from unemployment and loss of production were wages lost and spendable money lost by county.

Community textile unemployment data and food stamp participation county data were collected. A confidence level test was performed to discover what areas experienced statistically significant increases in textile unemployment and food stamp participation during the curtailment. This approach allowed the identification of the most heavily impacted areas. Chapters III and IV describe the affected communities and the observed increase in governmental expenditures to counteract the impacts.

A list of impacted textile plants was developed to observe if relationships existed between plant shutdowns or slowdowns and areas that exhibited unique socioeconomic conditions during the curtailment. Chapter V contains a complete list of textile plants in the study area that had to either work under abbreviated schedules or close entirely during the winter of 1976-77. Described in this chapter are the characteristics of affected textile plants in terms of Standard Industrial Classification (SIC) code, pipeline supplier and county location. Secondary effects of the curtailment were investigated. Estimated wages lost, by plant, were calculated and led to the estimation of spendable money lost on a county basis. Suggestions were made as to societal elements which were most heavily impacted by these reductions in spendable money.

Attention was given to economic impacts at the industrial level that may have been attributable to the curtailment. An investigation was conducted to obtain information on alternate fuel costs for textile firms, their short term reactions, measures taken to conserve energy or obtain alternate supplies and production losses incurred. Chapter VI covers these topics. In some instances, textile mills have relocated their plant facilities because they could not be guaranteed continuous fuel service at their original site. These data are the main concern of Chapter VII.

The impacts discussed up to this point are mainly economic in nature. Chapter VIII concentrates on social impacts that resulted from the natural gas cutoff. Many facilities which provide services essential to human needs were subjected to gas curtailments so that the critical energy supplies could be diverted to industry. Chapter VIII also discusses an interesting geographic separation between social and economic impacts. This observed dichotomy is related to climatic conditions and pipeline service.

These are the highlights of the eight chapters which comprise this report. In summary, empirical evidence has been found to support the contention that the natural gas curtailment during the winter of 1976-77 did produce measurable effects on the social and economic structure of the Southeastern region of the United States.

II. TRANSCO AND SOUTHERN: CURTAILMENTS, STRATEGIES AND CUSTOMERS

In order to assess the socioeconomic impact that the natural gas curtailment had on the states of South Carolina and North Carolina in relation to the textile industry, it is important to have a working knowledge of the pipeline companies that serve the area. This is necessary because a history of pipeline requirements and deliveries suggest the degree to which measures may need to be taken by textile companies, to alleviate potential economic dislocation. The taking of precautionary measures can help prevent plant shutdowns which lead to social and economic impacts on the community.

The two pipelines that serve this bi-state area are Transcontinental Gas Pipe Line Company (TRANSCO) and Southern Natural Gas (SOUTHERN). North Carolina is entirely supplied by TRANSCO, while South Carolina receives about 75% of its natural gas supply from SOUTHERN and the remaining percentage from TRANSCO.* Like other pipeline companies, SOUTHERN and TRANSCO operate pursuant to an end-use curtailment plan established by FERC. The plan allocates gas to distributors based on the use to which the gas is put by the ultimate end user. The categories vary according to type of service and volume of gas consumed daily. Two types of service (firm and interruptible) are offered. Firm service contracts oblige the seller to deliver specific volumes of natural gas within a given time period and anticipate no interruptions, but may permit unexpected interruption in case the supply to higher priority customers is threatened. Interruptible natural gas represents volumes of gas sold to some ultimate customers under a contract that allows the supplier to cut off the supply whenever the demand of the non-interruptible customers exceed a certain value (usually as a result of severe cold weather).

TRANSCO has had natural gas supply problems for several years. Because it owns little supply and buys most of its gas from other producers, it is most vulnerable when shortages occur.** In 1974, New Jersey and North Carolina had their supplies curtailed leading to an emergency situation. From September 1975 - August 1976, the percentage of firm curtailments (shortages to firm service customers) reached about 38. TRANSCO was third highest in firm curtailments that year out of the 52 pipeline companies.***

*General Accounting Office, Economic & Environmental Impact of Natural Gas Curtailments During the Winter of 1975-76, October 31, 1975.

**Springs Mills, Inc., The Springs Bulletin, February 24, 1977.

***Federal Power Commission, 1976-77 Projected Natural Gas Pipeline Curtailments, December 6, 1976.

It therefore was almost no surprise when detailed staff reports, filed with FERC by 19 pipelines, projecting 20% curtailments for the 1976-77 winter, showed no unforeseen or unmanageable problems except for TRANSCO. The impact that these curtailments would have had upon end users was found to be inconclusive in these reports. The commission therefore chose to monitor TRANSCO's situation.

As early as October 8, 1976, a curtailment order was issued establishing a permanent curtailment plan for TRANSCO for the 1976-77 winter season. TRANSCO was allowed to purchase 30-40 Bcf of emergency gas for its distributors for delivery during that winter heating season.*

TRANSCO, anticipating a 37% curtailment for winter 1976-77, took measures to prepare customers for natural gas cutbacks. The measures** adopted were:

1. Additional temporary storage (of 6.4 Bcf) was obtained;
2. Individual consumers were assisted in locating supplies which they might purchase directly from producers for transportation by TRANSCO (ORDER NO. 533 gas);
3. Substantial volumes of emergency gas were located for purchase directly by customers;
4. Distributors (resale customers) were asked to formulate self help projects.

Because TRANSCO began warning its customers of the expected curtailment, they were able to seek and receive permission from the federal government to purchase propane. The Federal Energy Administration (FEA) at that time, regulated the use of propane and had a firm policy of restricting its use by industry. TRANSCO customers were therefore granted permission to begin stocking reserves of alternate fuel. Many industrial customers either switched entirely to alternate fuels or installed alternate fuel burning equipment. Still other industries took advantage of the measures listed in the previous paragraph.

*Hearing before the Subcommittee on Energy and Power, of the Committee on Interstate and Foreign Commerce, House of Representatives, Natural Gas Curtailment Outlook for this Winter of 1976-77, November 9, 1976.

**Federal Power Commission, Summary Impact of Winter Gas Curtailments, December 9, 1976.

SOUTHERN presents a different image and profile than TRANSCO. It projected no curtailment to firm customers for September 1975-August 1976 and was therefore excluded from surveys assessing impacts from curtailments. Statistics show however, that the percent of firm curtailments reached 13.0 during that year.

Projecting firm curtailments to be only 18.9% for the 1976-77 fiscal year, SOUTHERN had to promptly work out a plan of action as its service area began to experience some of the worst curtailments and work stoppages in the country during January and February, 1977. Depletion of underground storage reservoirs reduced the amount of gas in storage, reduced the pressure underground and the rate at which remaining gas could be delivered. The reason for this rapid withdrawal of natural gas was the abnormally low temperatures encountered. In the southeastern region, the weather was 21% colder than normal from November 1976 through February 1977 with the monthly differences shown below.

<u>% Colder Than Normal 1976-77*</u>				
<u>Region</u>	<u>Nov.</u>	<u>Dec.</u>	<u>Jan.</u>	<u>Feb.</u>
SE	47.9%	13.8%	54.6%	10.1%

Two successive cold waves in mid and late January were superimposed upon an already exceptionally cold winter and SOUTHERN was unable to deliver gas fast enough from storage to meet all of the immediate needs of its customers.

On January 9, 1977, SOUTHERN which had been distributing gas since October 25 to only priority 1, 2 and 3 customers (see Appendix 1) was forced to curtail priority 2. This priority category was subject to a 100% curtailment by January 11 and, at that time, SOUTHERN was allocating gas only for residential and small commercial requirements. By the evening of January 18, SOUTHERN's pipeline inventory had declined to the critical stages. Trying to avoid losing the pressure necessary to maintain deliverability, SOUTHERN curtailed 9% of its priority 1 customers.** With the temperatures becoming more moderate, SOUTHERN was able to serve 100% of priority 1 customers again by January 21. Its supplies were replenished somewhat as it received natural gas from five other interstate suppliers and one distribution company.

*Data from Platt's Oilgram News Service.

**Hearing before the Subcommittee on Energy and Power, of the Committee on Interstate and Foreign Commerce, House of Representatives, Emergency Natural Gas Act of 1977, January 28, 1977.

Large differences between projected weekly curtailments and actual weekly curtailments for the weeks of January 24 - March 27, 1977 were observed for several pipelines (see Table 1). The average percentage difference per week was 119% for SOUTHERN, the second largest deviation shown.

For the same time period, TRANSCO had an average difference per week of only 3%. What this suggests is that TRANSCO's customers were more aware of the crisis and possibly better prepared to handle it. TRANSCO, having had to operate with curtailments since 1971,* had taken productive measures to prepare its customers for the winter of 1976-77. On the other hand, SOUTHERN had not been subjected to serious curtailments and therefore was not as well equipped to prepare its customers for the shortage that occurred.

In the area under study both TRANSCO and SOUTHERN serve both direct sale and resale customers. Direct sale customers are usually industries which buy right from the pipeline. In the Carolinas, TRANSCO has only one such customer, the Owens-Corning Fiberglass Corp. (SIC 32). In this bi-state region SOUTHERN has four direct sale customer groups: (1) Graniteville Company (SIC 22); (2) J.M. Huber Corp. (SIC 32); (3) United Merchants and Manufacturing (SIC 22) and (4) other industries and businesses using under 10,000 Mcf per year. During periods of curtailment, direct sale customers are most significantly affected. For example, one of the industrial customers cited above, Graniteville, has both firm and interruptible service. In January, its supply was curtailed 50% while in February its firm requirements were entirely curtailed.**

Resale customers (distributors) are fortunate in that they often handle priority 1 gas receivers. They, therefore, have a regular gas supply and have the power to redirect natural gas within the community, county or region that they serve. A list of these distributors is found in Table 2.

Because SOUTHERN had such a high average net difference between projected and actual gas curtailments during the peak time of the winter season, it was hypothesized that its service area was more heavily impacted than that of TRANSCO. In terms of geographical impacts, this means that South Carolina was more severely affected by the 1976-77 natural gas curtailment than North Carolina.

*Inter-Agency Task Force, North Carolina Report on Natural Gas, November, 1976.

**Southern Natural Gas Company, Report of Gas Supply and Requirements (FORM 16), September 1, 1976 - August 31, 1977.

TABLE 1

Projected vs Actual Curtailments
Summary
January 24 - March 27, 1977

PIPELINE	PROJECTED PER WEEK AVERAGE Mcf/d JANUARY - MARCH	ACTUAL PER WEEK AVERAGE Mcf/d JANUARY - MARCH	AVERAGE NET DIFFERENCE PER WEEK JANUARY - MARCH	AVERAGE % DIFFERENCE PER WEEK JANUARY - MARCH
Alabama Tennessee	44,476	37,835	-6,641	-15%
Algonquin	81,333	78,333	-3,000	-4%
Arkansas-Louisiana	439,333	703,444	+264,111	60%
Cities Service	668,000	669,049	+1,049	1%
Colorado Interstate	22,933	22,316	-617	-3%
Columbia	1,449,660	1,294,530	-155,130	-11%
Consolidated	171,000	468,888	+297,888	174%
East Tennessee	113,568	131,444	+17,876	15%
Eastern Shore	12,630	16,200	+3,570	28%
El Paso	1,245,300	825,954	-419,346	-34%
Lawrenceburg	5,000	5,177	+177	4%
Louisiana-Nevada	3,648	5,400	+1,752	48%
Mid Louisiana	27,400	35,222	+7,822	29%
Midwestern	130,864	144,111	+13,247	10%
National Fuel	104,966	179,411	+74,445	71%
Natural Gas	206,000	218,000	+12,000	6%
Northern Natural	349,666	326,200	-23,466	-7%
Northwest	211,200	131,291	-79,909	-61%
Panhandle	625,000	602,777	-22,223	-4%
Southern	199,333	435,888	+236,555	119%
Tennessee Gas	597,666	672,318	+74,652	13%
Texas Eastern	735,666	546,391	-189,275	-26%
Texas Gas	560,000	560,000	0	0%
Transcontinental	1,244,330	1,279,830	+35,500	3%
Transwestern	301,866	302,145	+279	1%
Trunkline	626,666	523,222	-103,444	-17%
United	2,336,000	2,095,660	-204,340	-9%

SOURCE: House of Representatives, Subcommittee on Energy and Power, Committee on Interstate and Foreign Commerce, Long Term Natural Gas Issues; March 24, 1977.

TABLE 2

Pipeline and Customers

State	Pipeline	Customer Type	Customer Name
13 South Carolina	TRANSCO	Resale	Carolina Pipeline Company
			United Cities Gas NC/SC Division
			Blacksburg Gas and Water
	SOUTHERN	Direct sale Resale Direct sale	Clinton-Newberry Natural Gas Authority
			Fort Hill Natural Gas Authority
			Fountain Inn Natural Gas Authority
North Carolina	TRANSCO	Resale	Greenwood Commission of Public Works
			Greer Commission of Public Works
			Laurens Commission of Public Works
			Union Utility Dept., City of
			Owens-Corning Fiberglass
			Carolina Pipeline Company
			South Carolina Electric and Gas
			Graniteville Company
			J. M. Huber Corporation
			United Merchants & Manufacturers
			other (under 100,000 Mcf/yr.)
			Piedmont Natural Gas Co., Inc.
			N.C. Natural Gas Corporation
			N.C. Gas Service
			Public Service Co. of N.C., Inc.
			Bessemer Municipal Gas Co.
			Kings Mountain, City of
			Lexington Natural Gas Dept., City of
			Shelby Gas Dept., City of

SOURCE: Federal Power Commission, Report of Gas Supply and Requirements (FORM 16) for SOUTHERN and TRANSCO, August 31, 1977.

In order to validate this conclusion, research was conducted to identify areas in North Carolina that may have been hard hit by the curtailment. Potential impacts may have been observed in Cleveland, Gaston and Cabarrus. The Public Service Company of North Carolina, Inc. of Gastonia, North Carolina was contacted since it serves this tri-county area. There were no plant shutdowns in Public's supply area, not even those industries without alternate fuel capabilities.* When natural gas supplies were curtailed to impede plant operation, the FEA gave Public Service and Piedmont emergency provisions of alternate fuel, mainly propane. At the air plants of these two distributors, temporary fuel (i.e., propane) was manufactured into its natural gas equivalent. Due to this action, plant shutdowns were either minimal or non-existent.

It is interesting to point out that since North Carolina had been threatened by curtailments since 1971, it set up an Inter-Agency Task Force in the mid-seventies to deal with this problem. The Inter-Agency Natural Gas Task Force is comprised of seven representatives from the: (1) North Carolina Utilities Commission, Department of Commerce; (2) Energy Division, Department of Military and Veterans Affairs; and (3) Department of Natural and Economic Resources. This task force has the responsibility of investigating and analyzing the impact of natural gas curtailments so that comprehensive planning procedures and decision making techniques can be implemented to deal with the curtailment problems. The activities of this task force have been instrumental in recognizing impending energy shortages and in developing plans to counteract them.

The Natural Gas Task Force projected maximum curtailment for the 1976-77 winter to be in the 60-65% range. The critical nature of the situation was illustrated in their November, 1976, Inter-Agency Natural Gas Task Force Study. Recommendations proposed at the time were:

- (1) Make all state citizens aware of the gas situation and their conservation efforts;
- (2) Promote energy consumption reduction goals for state government facilities and universities;
- (3) Advise consumers in the industrial and commercial sectors of the curtailment;
- (4) Urge state petroleum suppliers to work with those customers converting to petroleum fuels;

*Telephone conversation with Mr. Henry, industrial manager of Public Service Company.

- (5) Conduct an updated in depth study of the primary fuel distribution patterns in North Carolina;
- (6) Develop a "gas sharing plan" among natural gas distributing companies;
- (7) Measure the projected impact that the reduction in natural gas supplies would have on the future demand for electric power and other alternate fuels;
- (8) Continue to develop feasible methods of acquiring natural gas supplies by distributing companies.

One can see the precautions and preparations that were made at the state level to ease the impact of the natural gas curtailment in North Carolina. South Carolina, on the other hand, was totally unprepared when the natural gas crunch hit and had not established any sort of energy agency to deal with these problems.

In addition to its direct sales within South Carolina, SOUTHERN provides Carolina Pipeline with 82% of its natural gas and South Carolina Electric and Gas (SCE&G) with 100% of its fuel. The Carolina Pipeline Company is an intrastate pipeline with 1429 miles of pipeline serving twenty-six counties.* SCE&G also has an intrastate pipeline and serves counties in the southeastern part of the state (see Figure 1). Both of these companies have played significant roles in attracting many new textile firms to their service area in the past twenty years.

The textile industry is important to the state's economy. Textiles provide one-third of South Carolina's total annual product value and textile industry wages account for more than 44 percent of all manufacturing payrolls in the state.** Therefore, any factor which adversely affects textile industry in South Carolina is a key problem for the entire state economy.

The natural gas shortage hit the textile industry particularly hard because many of the finishing processes depend on natural gas. It is universally used as the fuel for heat-set tenter-frames, because the flue gases come into contact with the fabric. Direct heating with oil cannot be used in most present equipment because sulfur compounds and other impurities would affect product quality. Direct heating with natural gas allows continuous combustion of lint particles which are removed from the fabric. In an indirectly heated system, these particulates would

*Data supplied by Ray Kightlinger, Executive Director of Carolina Pipeline.

**From a statement Robert Coleman (President of the South Carolina Textile Manufacturers Association) made before the Department of Interior at the Citadel on April 1, 1977.

Source: Federal Energy Regulatory Commission,
Annual Report of SOUTHERN, Form No. 2,
August 1977.

Figure 1. South Carolina Intrastate Pipelines

tend to build up in the unit and reduce operating efficiency. Other uses of natural gas are for the drying process for drying the cloth, fixing synthetic cloth colors and almost exclusively for applying finish.*

Some 40% of all textile dyeing, printing and finishing performed in the United States is done in South Carolina. This emphasizes how vital natural gas is to the state's operations. The next step in this analysis is to describe the socioeconomic impacts that were felt in South Carolina during the natural gas curtailment period.

*Little, Arthur. Environmental Considerations of Selected Energy Conserving Manufacturing Process Options: Volume 9 Textile Industry Report, Cambridge, Massachusetts, December 1976.

III. UNEMPLOYMENT ASSESSMENT

One of the primary socioeconomic impacts of a natural gas curtailment is unemployment. In order to identify the areas that were affected by the 1976 and 1977 curtailments, the South Carolina Employment Security Commission* was contacted for weekly unemployment compensation data. In using these data for the required evaluation and isolating the impact of the natural gas curtailment on the unemployment level, several factors had to be taken into account. First, unemployment shows a historical, seasonal pattern of increases in the textile industry during the months of January and February due to the traditional work lag during the post-Christmas period. Also, unemployment has been decreasing within South Carolina since 1975 and, in the unemployment figures obtained, employees filing for the first time are definitely incorporated into the statistics, but those people filing for the second time may be excluded because their names are already on the master file.

In order to assess the unemployment impacts, data were used which represented the difference between 1977 and 1976 weeks compensated for within the textile industry for February and March. These two months represented the "prime time" for energy related layoffs.** Seasonal effects were accounted by making comparisons of unemployment data for corresponding months. The tabulation of these monthly differences can be found in Table 3. To determine whether or not all employment offices were replacing wages within the textile industry at a normal rate, a confidence level test was performed on these data (see Appendix 2).

The analysis demonstrated that the local employment security commissions were not drawn from the same parent population and some offices did in fact experience an increase in wage replacement.

For the month of February (Table 4), Aiken exhibited the highest standard score, indicating that its unemployment level was greater than normal for that time of the year. Ninety-eight percent of the service centers had smaller standard scores suggesting how significantly different the Aiken employment security commission was from the normal population. Other local employment offices incurring a significant increase in unemployment for the month were Florence, Lancaster, Orangeburg, Union and Walterboro (Table 4).

*South Carolina Employment Security Commission, FORM ES-217: Benefit Payment Activities by Industry, First Quarters of 1976 and 1977.

**Personal interview with Ray Drafts, chief of research and statistics for the South Carolina Employment Security Commission.

TABLE 3

Weeks Compensated - Textile Industry

Difference Between 1977 and 1976 Statistics for Two
Prime Months During the Natural Gas Curtailment

Location of Local Employment Security Commission	February*	March**
Abbeville	254	348
Aiken	1033	467
Anderson	-494	527
Barnwell	31	-169
Beaufort	6	3
Bennettsville	-202	-294
Camden	33	-113
Charleston	-21	110
Chester	-53	-95
Clinton	-163	-293
Columbia	-346	-282
Conway	39	58
Florence	901	231
Gaffney	-283	-286
Georgetown	85	44
Greenville	-338	583
Greenwood	-182	-337
Hampton	-63	-16
Hartsville	-210	-970
Lancaster	799	-76
Liberty	-334	-330
Marion	284	409
Newberry	206	306
Orangeburg	736	677
Rock Hill	-206	160
Spartanburg	-1080	165
Sumter	-72	-61
Union	969	1710
Walterboro	969	63

* Descriptive statistics: mean ($\bar{X}$) = 62.1; variance (S^2) = 241, 406.4; Standard Deviation (S) = 491.3

**Descriptive statistics: $\bar{X}$ = 68.7; S^2 = 212, 389.9; S = 460.9

TABLE 4

Local Employment Security Commissions With
Values Outside of the Confidence Band

Service Town	Standard Deviation	Percent of service towns having smaller standard scores
February		
Aiken	1.98	98
Florence	1.7	94
Lancaster	1.5	89
Orangeburg	1.4	87
Union	1.8	95
Walterboro	1.8	95
March		
Greenville	1.1	75
Orangeburg	1.3	83
Union	3.56	99.96

March statistics showed a decline in the number of employment security commissions having higher than normal employment. This suggests that the largest incidence of unemployment due to natural gas curtailment occurred during February. From Table 4, it can be seen that Greenville, Orangeburg and Union were significantly different from the parent population.

There was an increase in the amount paid to local employment security commissions by the federal and state governments during the winter of 1976-77 due to the higher unemployment rates observed. Table 5 indicates the increased amounts paid to each of the town offices that exhibited significant increases in unemployment. For February, the extra expenditures totaled nearly \$450,000 and for March an extra \$235,000.

The Unemployment Insurance Program is funded by both the federal government and the state. In South Carolina, the employer pays two taxes for this program. One tax (or contribution) goes to the Secretary of Labor, explicitly for use by the U.S. Department of Labor. The money is sent back to the states in the specific allocations dependent upon a state formula. The second tax goes to the state for a trust fund used only for unemployment insurance benefits. If a situation occurs which is characterized by high unemployment and the trust fund stands in danger of being depleted, the state automatically increases the taxes paid by the employer. The increased amount paid to the 9,000 unemployed textile workers the winter of 1976-77 came from the textile firms themselves.

In South Carolina, local employment security commissions are located in service towns that may encompass only part of a county or even a multi-county area. Unemployment filing requirements do not specify that the employee supply his county residence. He is therefore free to file anywhere in the state (or even out of state).

It will be assumed that the employee is an "economic man" and will frequent the nearest service area to his home. It has been shown by the central place theory, that a consumer is willing to travel only a certain distance to purchase or acquire a particular good or service.* The maximum range for the local employment security commission has been defined in Figure 2. These boundaries are ideal limits and indicate that beyond the limits defined a particular facility would not be favored by a specific consumer. In determining these limits several variables were taken into account. They are mass of the center (number of types of goods offered and population), transportation arteries and distance from other service centers.

*Hurst, Elliot. A Geography of Economic Behavior, Auxbury Press, 1972.

TABLE 5

Increase in Amount Paid to Local Employment Security
Commissions for Unemployment in the Textile Industry

<u>Service Town</u>	<u>February 1977</u>
Aiken	\$ 98,549
Florence	73,799
Lancaster	72,153
Orangeburg	46,784
Union	81,870
Walterboro	72,836
Total =	\$ 445,991

<u>Service Town</u>	<u>March 1977</u>
Greenville	\$ 69,232
Orangeburg	44,670
Union	120,708
Total =	\$ 234,610

Figure 2. Hypothetical Service Areas of Local Employment Security Commissions

If unemployment lasts for an extended period of time, an individual may find it necessary to apply for other income maintenance programs. The Food Stamp Program aids households with low monthly incomes. However, it can take as long as 30 days for local welfare departments to determine an individual's eligibility for food stamps. This time period may somewhat discourage application and participation, but it is hypothesized that there were more recipients than normal in some counties, during February and March 1977. The aspect of food stamp participation in South Carolina is discussed in the next chapter.

IV. FOOD STAMP PARTICIPATION

The Food Stamp Program is a joint federal and state program. Most of the money comes from the United States Department of Agriculture (USDA), which is appropriated a certain sum of money annually by Congress. The state must supply about 20% of its food stamp expenditures.

The USDA establishes the rules for running the Food Stamp Program. The issuance of food stamps and eligibility determination is accomplished by local welfare departments. In order to receive food stamps, an individual should have a low monthly income and only up to \$1,500 in resources.*

In order to assess whether or not food stamp participation was higher in certain counties during curtailment months, statistics were taken from the South Carolina Department of Social Services Statistical Report. This is a monthly publication that describes a wide range of rehabilitative services and financial aid for the needy by county. The difference between February and March 1977 food stamp participation data, and mean monthly data for those months in 1977, was computed and is given in Table 6. The methodology utilized to assess potential impact on an area was similar to that which was used on the unemployment data (see Appendix 2).

The null hypothesis for this analysis states that there is no difference between two or more counties which implies that food stamp participation was about average for the month(s) being considered in all counties under investigation.

For February and March, five different counties had standard deviations of 1.0 or greater (Table 7). The null hypothesis was rejected confirming that this set did not belong to the parent population.

In comparing Table 7 with Table 4, a correspondence is seen to exist between high unemployment areas and areas showing significant increases in income maintenance programs. During February, Aiken, Marlboro and Orangeburg counties showed an increase in total number of people receiving food stamps. These counties correspond to the employment office service towns of Aiken, Florence and Orangeburg (Figure 2). Thus it appears that unemployed textile workers not only applied for unemployment insurance but for food stamps as well.

Greenville and Orangeburg are two counties and service towns that showed significant increases in textile unemployment as well as

*Resources include money in checking and savings account, U.S. Savings Bonds, stocks and bonds, property, second cars and pleasure craft.

TABLE 6

Food Stamp Participation - Total Recipients by County

Difference Between February/March 1977 Data and Mean Monthly Data for 1977

<u>County</u>	<u>February*</u>	<u>March**</u>
Abbeville	480	438
Aiken	3287	1310
Allendale	213	204
Anderson	777	1122
Bamberg	589	352
Barnwell	509	214
Beaufort	838	972
Berkeley	514	566
Calhoun	442	418
Charleston	1019	1184
Cherokee	498	213
Chester	510	440
Chesterfield	746	525
Clarendon	963	980
Colleton	1403	664
Darlington	1383	1348
Dillon	880	795
Dorchester	521	683
Edgefield	384	130
Fairfield	427	279
Florence	1234	1732
Georgetown	2496	2788
Greenville	2899	3097
Greenwood	446	450
Hampton	407	311
Horry	1063	1523
Jasper	921	615
Kershaw	613	506
Lancaster	1208	759
Laurens	653	469
Lee	164	123
Lexington	1360	1242
McCormick	258	133
Marion	1125	999
Marlboro	2975	2561
Newberry	304	308
Oconee	1281	880
Orangeburg	1932	1857
Pickens	580	657
Richland	2224	2243

<u>County</u>	<u>February*</u>	<u>March**</u>
Saluda	439	415
Spartanburg	2603	2094
Sumter	1104	1772
Union	230	226
Williamsburg	1034	962
York	1594	1434

* Descriptive Statistics: $\bar{X} = 1033$; $S^2 = 609,610$; $S = 8$

**Descriptive Statistics: $\bar{X} = 939$; $S^2 = 562,196$; $S = 750$

TABLE 7

Counties With Food Stamp Participation Outside
of the Confidence Band

<u>County</u>	<u>Standard Deviation</u>	<u>Percent of counties having smaller standard scores</u>
February		
Aiken	2.9	99.6
Georgetown	1.9	97
Greenville	2.4	98.4
Marlboro	2.5	98
Orangeburg	1.2	79
Richland	1.5	89
Spartanburg	2.0	95
March		
Florence	1.1	75
Georgetown	2.5	98
Greenville	2.9	99.6
Marlboro	2.2	97
Orangeburg	1.2	79
Richland	2.0	95
Spartanburg	1.5	89
Sumter	1.1	75

food stamp participation in March. Once again, the data suggest these events are related to temporary textile plant slowdowns and shutdowns.

There was an increase in funding from both the state and federal governments for the increase in program recipients. Table 8 shows the increased amount paid to counties that showed significant increases in participation. For the textile related counties there was an increase in expenditures of about \$250,000 for February and \$125,000 for March.

February once again represented a greater emergency situation than did March. Figure 3 illustrates total food stamp participation by month for the entire state of South Carolina. The peak in the graph occurs in February, lending additional credence to this idea.

Another income "supplement" which showed an increase in January, February and March of 1977 was medicaid payments (Figure 4). There is more than a significant rise in the graph for the first quarter of 1977. South Carolina, like certain other states, has a medicaid plan which provides Aid to Families with Dependent Children (AFDC). If a family does not have an adequate income or support and has dependent children, it may file for financial assistance under this plan. Like food stamps there is an income and resource requirement. This particular program is about 90% funded by the state and 10% county and federally funded.

The information already presented has provided some insight as to the socioeconomic impact of natural gas curtailment on textile industry employees in South Carolina. At this point in the analysis, we will provide a complete list of textile plant closings during the curtailment period to see if a relationship can be drawn between closings and the increased use of income maintenance programs.

TABLE 8

Increase in Amount Paid to Counties for
Food Stamp Program

County	February 1977
Aiken	\$ 107,005 *
Georgetown	68,210
Greenville	83,850
Marlboro	94,435 *
Orangeburg	48,620 *
Richland	74,941
Spartanburg	69,158
Total = \$ 546,219	

County	March 1977
Florence	37,298
Georgetown	65,004
Greenville	77,854 *
Marlboro	82,728
Orangeburg	47,056 *
Richland	69,461
Spartanburg	56,508
Sumter	31,981
Total = \$ 467,890	

*Textile related counties impacted by curtailment.

Source: South Carolina Department of Social Services, Statistical Report: South Carolina Department of Social Services, Columbia, South Carolina, October 1972.

Figure 3. Food Stamp Participation
Total Per Month for South Carolina
1976-1977

Source: South Carolina Department of Social Services, Statistical Report: South Carolina Department of Social Services, Columbia, South Carolina, December 1977.

Figure 4. Medicaid Dollars
Monthly Average by Quarter for South Carolina

V. IMPACTED TEXTILE PLANTS: TRENDS AND EFFECT ON THE COMMUNITY

To obtain information on the extent of the impacts on textile firms, data was obtained from the natural gas companies of South Carolina concerning textile plants that were forced to close or to temporarily reduce employment during the curtailment period. The names of the distributing companies providing data are listed in Table 9.

Two categories of affected textile firms emerged from this investigation: (1) textile companies and plants that directly experienced layoffs; and (2) textile companies with indirect layoffs. A direct layoff was defined as one in which employees were laid off as a result of a reduction in fuel availability leading to a decrease in production. The second category described a layoff which resulted from a loss in production and which was attributed to the inability of suppliers to furnish goods because of their energy related problems.

Direct layoffs were found to be the larger category of the two with a total of eighteen plants involved. Table 10 describes these textile plants in detail supplying Standard Industrial Classification (SIC) codes, natural gas supplier, county, town and nearest employment security commission. Only three plants were indirectly affected; these are shown in Table 11.

A synthesis of these two tables helps to begin the process of identifying trends. The first trend to be examined is the similarity of impacted mills by SIC codes. There are thirty different textile mill product codes but only eleven types represent plants that were affected by the curtailment. The frequency with which each category was affected is listed in Table 12.

TABLE 12

Number and Type of Representative SIC Codes of Affected Plants

<u>Key to Classification</u>	<u>SIC</u>	<u>Number of Observations</u>
Weaving Mills, Cotton	2211	2
Weaving Mills, Synthetics	2221	3
Narrow Fabric Mills	2241	1
Wrap Knit Fabric Mills	2258	3
Finishing Plants, Cotton	2261	8
Finishing Plants, Synthetics	2262	6
Woven Carpets, Rugs	2271	1
Yarn Mills Except Wool	2281	1
Coated Fabrics Not Rubberized	2295	1
Nonwoven Fabrics	2297	1
Textile Goods, n.e.c.	2299	1

TABLE 9

Natural Gas Distributing Companies in South Carolina

Bamberg Board of Public Works Natural Gas Department

City of Bennetsville

Blacksburg Gas and Water

Carolina Pipeline Company

Chester County Natural Gas Authority

Clinton-Newberry Natural Gas Authority

Fort Hill Natural Gas Authority

Fountain Inn Natural Gas Authority

Greenwood Commission of Public Works

Greer Commission of Public Works

Lancaster County Natural Gas Authority

Laurens Commission of Public Works

Orangeburg Department of Public Utilities

Peoples Natural Gas Authority

Piedmont Natural Gas

South Carolina Electric and Gas

SOUTHERN

TRANSCO

United Cities Gas

Union Utility Department, City of

Town of Winnsboro

York County Natural Gas Authority

Textile Companies and Plants that Directly Experienced Layoffs
Due to the 1976-1977 Natural Gas Curtailment

Company	Plant Name	SIC Code	Natural Gas Supplier	County/Town	Nearest Town with Employment Security Commission*
Abney Mills	Pageland Screen Printers	2261	Carolina Pipeline	Chesterfield/Pageland	Lancaster
	Renfrew Plant	2261; 2295	Piedmont	Greenville/Travelers Rest	Greenville
Brookline Carpets		2271	Piedmont	Greenville/Greenville	Greenville
Cone Mills	Cheraw Dyeing and Finishing Co., Inc.	2261; 2262	Carolina Pipeline	Chesterfield/Cheraw	Florence
Graniteville	Gregg Finishing Plant	2261; 2262	Southern	Aiken/Graniteville	Aiken
Greenwood Mills	Orangeburg Plant	2261	SCE&G	Orangeburg/Orangeburg	Orangeburg
J.P. Stevens	Delta II Plant	2262	Carolina Pipeline	Marlboro/Wallace	Florence
	Walterboro Plant	2221	SCE&G	Colleton/Walterboro	Walterboro
Miliken and Company	Gayley Mill	2221	Piedmont	Greenville/Marietta	Greenville
Raytex Corporation		2211	Carolina Pipeline	Marion/Marion	Marion
Spartan Mills	Powell Knitting	2258; 2297	Piedmont	Spartanburg/Spartanburg	Spartanburg
Spring Mills	Grace Finishing Plant	2261; 2262	Lancaster County Natural Gas Authority	Lancaster/Lancaster	Lancaster
	Grace Sewing Plant	2211			
	Grace Screen Printing Plant	2261	Carolina Pipeline	Marion/Marion	Marion
	Wallace Plant	2258			

(Table Continued)

Company	Plant Name	SIC Code	Natural Gas Supplier	County/Town	Nearest Town with a Employment Security Commission*
Ti-Caro	Caro Knit Inc.	2258	Carolina Pipeline	Chesterfield/Jefferson	Lancaster
United Merchants and Manufacturers, Inc.	Clearwater Finishing Plant	2262	Southern	Aiken/Clearwater	Aiken
Wellman Industries		2299	Carolina Pipeline	Florence/Johnsonville	Florence

*The 'Nearest Town with an Employment Security Commission' was derived by setting up hypothetical service areas for towns that have Employment offices. This hypothetical service area was constructed by using concepts belonging to the nearest neighbor analysis. The attraction of these towns by unemployed textile workers was based upon: traveling distance, road networks and town size.

TABLE 11

Textile Companies and Plants That Indirectly Experienced
Layoffs Due to the 1976-77 Natural Gas Curtailment

Company	Plant Name	SIC Code	Natural Gas Supplier	County/Town	Nearest Town With An Employ- ment Security Commission
Cone Mills	Carlisle Finishing Company	2261; 2262	Carolina Pipeline	Union/Carlisle	Union
J.P. Stevens	Pamplico Plant	2221; 2281	Carolina Pipeline	Florence/Pamplico	Florence
Southern Weaving Company		2241	Piedmont	Greenville/Greenville	Greenville

A comparison of the data in Table 12 with information on the quantity of natural gas consumed by SIC classification per establishment, shows distinct similarities. Table 13 portrays the top ten consumers of natural gas in the textile industry and the number of plants of that code type in South Carolina which were affected by the curtailment. Eighty-six percent of the affected mills are in the top ten fuel consuming categories; 68% are in the top five. This suggests that the largest textile industry natural gas consumers were more likely to be affected by the curtailment.

TABLE 13

SIC 22: Consumption of Natural Gas

<u>Key to Classification</u>	<u>SIC</u>	<u>Quantity (Bcf)</u>	<u>Plant Number Affected in South Carolina</u>
Tufted Carpet, Rugs	2272	14.1	-
Finishing Plants, Synthetics	2262	9.7	6
Weaving Mills, Synthetics	2221	8.9	3
Finishing Plants, Cotton	2211	7.5	8
Weaving Mills, Cotton	2211	7.1	2
Circle Knit Fabric Mills	2257	4.8	-
Yarn Mills Except Wool	2281	3.4	1
Coated Fabrics Not Rubberized	2295	3.0	1
Wrap Knit Fabric Mills	2258	2.7	3
Finishing Plants, n.e.c.	2269	2.4	-

Source: Bureau of the Census, U.S. Department of Commerce, 1976 Census of Manufacturers: Fuels and Electric Energy Consumed, Washington, D.C., March 1978.

There is also a pattern of curtailment which relates to the natural gas supplier. Carolina Pipeline supplied nine plants that experienced a loss in production. Piedmont served five affected plants. SCE&G distributed to two closing plants; Lancaster County Natural Gas Authority serviced three and SOUTHERN supplied two.

As mentioned in Chapter 1, SOUTHERN supplies Carolina Pipeline with over 80% of its gas and is the sole supplier of SCE&G's gas. Lancaster County Natural is serviced by Carolina Pipeline; thus most of its gas also comes from the SOUTHERN system. Therefore, 76% of the plants adversely affected by the curtailment were directly or indirectly receiving gas from SOUTHERN. Only 5 plants (24%) were supplied by TRANSCO. These results illustrate the gravity of SOUTHERN's curtailment and impact on its service area during the winter period under investigation.

Eleven out of the 46 counties in South Carolina were affected by the curtailment as shown in Figure 5. This map indicates that the eastern coastal region was harder hit than the western, piedmont area. The coastal region is usually characterized by mild weather. Many plants had no standby source of fuel in this area because they hadn't anticipated a need based on their normal climatic patterns. This map correlates well with Figure 1. Eight of the eleven counties are served by distributing companies supplied by SOUTHREN.

The nearest town with an employment security commission was also recorded during the investigation. A frequency count of these data produces the results in Table 14.

TABLE 14

Impacted Plants and Nearest Employment Security Commission

<u>Local Employment Security Commission</u>	<u>Number of Plants Experiencing Layoffs</u>
Aiken	2
Florence	4
Greenville	4
Lancaster	5
Marion	2
Orangeburg	1
Spartanburg	1
Union	1
Walterboro	1

In comparing this table with Table 4, one sees that all of the service towns which showed higher than normal textile unemployment during this period, are represented here. The textile plants listed in Tables 10 and 11 were probably the source areas of this increased unemployment. This adds support to the identifying technique used in Chapter 2 and brings us closer to a complete list of impacted areas.

Table 8 contains similar observations. Unlike the unemployment data, the food stamp participation data does not specifically reflect the textile industry. However, the increases noted for Aiken, Florence, Greenville, Marlboro and Orangeburg are apparently related to temporary textile unemployment because of their recurring nature in the data developed to date.

Figure 5. Textile Counties Affected by the Gas Curtailment

The natural gas curtailment impact was observed in varying degrees in different areas of the state. In order to examine the areas that were hardest hit, it became necessary to gather statistics on production loss and number of employees affected. Table 15 summarizes the data.

The period of curtailment was observed mainly during late January and early February. About 70% of the textile firms affected lost all of their production capabilities during this time period. The number of days, in which production was less than normal, ranged from 1 to 23 days, with 10 days as average.

About 9,000 textile employees were affected throughout the course of the curtailment. To comprehend what this means in terms of dollars an estimation of lost wages was made by plant by multiplying man-hours lost by average hourly earnings for each specific SIC code.* The total lost wages amounted to about \$2.5 million. The last column of Table 15, indicates that the Grace Complex of Springs Mills and the Gregg Finishing Plant of Graniteville experienced the greatest incidence of lost wages, as much as \$730,000 per plant.

Carrying this one step further leads to a translation from estimated wages lost to spendable money lost. Fluctuations in wages received may lead to fluctuations in buying power or available spendable money. Individuals are not economically isolated units, they belong to the mosaic economy. Changes in basic salaries received may have a multiplier effect which concerns the way in which a rise or fall in income, production, or employment in one group of economic activities in a region stimulates the expansion or contraction of services produced by another group.

The Economic Department of the Bureau of Statistics and Research of South Carolina has determined that the wage multiplier effect factor in the state is 1.9. Table 16 indicates the estimated spendable money lost by county, where the values presented were obtained by multiplying wages lost by the multiplier effect factor. Lancaster and Aiken exhibited heavy impacts; both counties lost over \$1.0 million of spendable money. The total of estimated spendable money lost by affected counties in South Carolina was \$4.7 million.

The impact of this loss in spendable money was heavily felt at finance bureaus located near affected textile plants. Employees had their everyday needs taken care of through food stamp programs and unemployment insurance but problems with their credit obligations were apparent.

*Obtained from South Carolina Textile Manufacturers Association.

Plant Slowdowns/Shutdowns and Related Unemployment

Company	Plant Name	Production Loss		Number of Employees Affected		Estimated Wage: Lost
		Percent	Dates	Total number of days		
Abney Mills	Pageland Screen Printers	100	Jan. 31 - Feb. 10.	10	100	\$ 33,120
	Renfrew Plant	100	Jan. 20 - Feb. 1	10	300	\$ 99,360
Brookline Carpets	Brookline Carpets	100	Jan. 20 - Feb. 1	10	30	\$ 9,552
Cone Mills	Carlisle Finishing Company	15	Jan. 29 - Feb. 4	6	100	\$ 19,872
42	Cheraw Dyeing and Finishing Co., Inc.	100	Jan. 29 - Feb. 4	6	125	\$ 24,840
Graniteville	Gregg Finishing Plant	100	Jan. 15	1	600	\$ 19,872
		100	Jan. 21 - Feb. 6	14	800	\$370,944
Greenwood Mills	Orangeburg Plant	100	Jan. 31 - Feb. 7	7	350	\$ 81,144
J.P. Stevens	Delta II Plant	100	Jan. 31 - Feb. 7	7	500	\$115,920
	Walterboro Plant	100	Jan. 19 - Feb. 6	16	600	\$307,200
	Pamplico Plant	100	Jan. 20 - Feb. 7	7	400	\$ 89,600
Miliken and Company	Gayley Mill	100	Jan. 20 -	15	375	\$180,000

(Table Continued)

Company	Plant Name	Production Loss		Number of Employees Affected		Estimated Wage: Lost
		Percent	Dates	Total number of days		
Raytex Corporation	Raytex Corporation	100	Jan. 29 - Feb. 4	6	150	\$ 28,584
Southern Weaving	Southern Weaving Company	25	Jan. 31 - Feb. 12	12	125	\$ 47,280
Spartan Mills	Powell Knitting	100	Jan. 24	1	175	\$ 5,222
Springs Mills 43	Grace Complex	100	Jan. 31 - Feb. 6	6	3800	\$729,600
	Mullins Plant	100	Jan. 31 - Feb. 6	6	350	\$ 62,644
Ti-Caro Inc.	Caro Knit Inc.	30	Jan. 29 - Feb. 4	6	80	\$ 14,325
United Merchants and Manufacturers Inc.	Clearwater Finishing Plant	60	Jan. 15 - Feb. 10	23	125	\$ 95,220
		62	Jan. 21 - Feb. 10	18	25	\$ 14,904
		30	Feb. 10 - Feb. 23	13	90	\$ 38,750
Wellman Industries	Wellman Industries	40	Jan. 31 - Feb. 7	7	450	\$ 99,288
Total = 9050					Total = \$2,487,241	

TABLE 1C

Estimated Spendable Money Lost by County's
With Textile Plant Layoffs

<u>County</u>	<u>Estimated Wages Lost</u>	<u>Estimated Spendable Money Lost</u>
Aiken	\$ 539,690	\$1,025,411
Chesterfield	\$ 72,285	\$ 137,342
Colleton	\$ 307,200	\$ 583,680
Florence	\$ 188,888	\$ 358,887
Greenville	\$ 336,192	\$ 638,765
Lancaster	\$ 729,600	\$1,386,240
Marion	\$ 91,228	\$ 173,333
Marlboro	\$ 115,902	\$ 220,248
Spartenberg	\$ 5,222	\$ 9,922
Orangeburg	\$ 81,144	\$ 154,174
Union	\$ 19,872	\$ 37,757
Total =	\$2,487,241	\$4,725,762

Several loan bureaus in affected towns were contacted to try to gauge the magnitude of the credit problems. The questions asked of these agencies are shown in Figure 6. Examples of responses are printed below.

Provident Financial Corporation of Lancaster provided the following information. In January of 1977, the bureau suffered a loss of \$3,000 and in February, the loss totaled \$4,000. For the first quarter of 1977, the normal loss per month due to the holiday lag, should have been only \$1,500. Delinquent accounts during this time rose from 9% to 33%. In addition, there were "numerous" bad checks issued that month by clients of the bureau.

The Credit Union of Springs Mills, Grace Complex, also responded and indicated that, during the first quarter of 1977, delinquency was 10% greater than normal. In dealing with the unemployed, a series of reduced monthly payments were derived.

This chapter has illustrated the impact that the curtailment had at the community level. The next step in the research involves an analysis of the impact that the curtailment had on textile plants. This topic will be discussed in Chapter 5 in terms of short term reaction, alternative energy measures taken, alternate fuel costs and production losses.

1. Does the majority of your customers work for a particular industry?
 Yes _____ No _____
 What one? _____
2. Is there a local company that employs a large percentage of your customers?
 Yes _____ No _____
 Name of company: _____
3. Was there a decrease in the number of collections in:
 January 1977 Yes _____ No _____
 February 1977 Yes _____ No _____
 March 1977 Yes _____ No _____
4. For each month could you list: (1) the number of RECEIVED collections and (2) the number of collections that were DUE.

	<u>Received</u>	<u>Due</u>
December 1976	_____	_____
January 1977	_____	_____
February 1977	_____	_____
March 1977	_____	_____
5. What was: (1) the actual percent of delinquent accounts and (2) the norm for:

	<u>Actual</u>	<u>Norm</u>
December 1976	_____	_____
January 1977	_____	_____
February 1977	_____	_____
March 1977	_____	_____
6. Did your finance bureau undergo a loss and what was the monetary value?

Yes _____	No _____	December 1976	\$ _____
Yes _____	No _____	January 1977	\$ _____
Yes _____	No _____	February 1977	\$ _____
Yes _____	No _____	March 1977	\$ _____
7. Did you receive an increased amount of bad checks during this period?
 Yes _____ No _____
 If yes, how many more than normally? _____
8. Did you arrive at some way of working with your customers during this critical time period? Yes _____ No _____
 Explain briefly: _____
9. If you can briefly summarize what went on during this time period in your town it would be extremely helpful. If you would list any impact that you feel your community felt, please include it in the space below.

FIGURE 6. Selected Questions Posed to Loan Bureaus

VI. TEXTILE FIRM'S RESPONSE TO THE CURTAILMENT

Textile firms that underwent a natural gas curtailment in January and February of 1977, quite often had their gas supplies terminated without warning. On the average, they had three days warning of an impending gas curtailment. Because of the very short duration of the warning period, the affected companies could not make any meaningful preparations.

Briefly, described below are the circumstances that kept textile plants from stockpiling propane gas to meet the emergency. Until a few days before January 28, 1977, when Governor James Edwards of South Carolina issued a proclamation declaring a state of emergency, and natural gas for industrial use was curtailed by the South Carolina Public Service Commission, textile plants had assurances there would be plenty of natural gas throughout 1978. Even if textile firms had suspected there would be a curtailment, they would have been powerless to do much about it. Unless an industrial user can demonstrate potential curtailment of natural gas, it cannot get authorization to buy, store or use a substitute such as propane gas. The U.S. Department of Energy* regulates the use of propane and has a firm policy of restricting its use by industry. Therefore, textile plants in South Carolina had no legal way to do any effective advance planning.

Crisis situations resulted. Firms had to draft petitions to the FEA asking permission to buy and transport surplus propane following which, the propane surpluses had to be located, transported and stored. In certain cases, fuel systems had to be converted.

Several plants affected by natural gas curtailments were contacted to obtain first hand information on their approach for solving the gas crisis. Perhaps the largest undertaking and most organized approach was carried out by Springs Mills. In order to reopen the Grace Complex and Mullins Plant, which were the hardest hit in the state, tankers were purchased and permission from the FEA to buy propane was secured. Propane storage facilities were located in Mississippi, Louisiana and Minnesota. Propane was hauled via tractor trailer from these three states to Lancaster, S.C., between February 1 to February 21, 1977. This propane transport involved a total of 40,000 trip miles.

The cost of obtaining this propane was high. Springs Mills had been paying about \$25,000 a week for the natural gas used at the Grace Finishing Plant. The propane that Springs purchased as a substitute after the natural gas cutoff escalated their weekly cost up to about \$122,000. The cost of transporting propane was expensive, too. Springs Mills was paying more just to transport propane than it had been paying for equivalent supplies of natural gas before the emergency.

*At that time, the FEA, now a part of DOE, had responsibility for regulating propane use.

The Graniteville Company, a direct sales customer of SOUTHERN, lost 3-1/2 weeks of production during the curtailment. Employees were asked to take their paid vacations during this time. Once operation was resumed, it took six weeks of catch up time, to put production back on schedule. For the first quarter of the year, gross profit for the company had been estimated at about \$12 million. During the first quarter of 1977, gross profits dropped to \$9.7 million*, indicating a significant impact due to fuel availability problems.

In the aftermath of the 1977 gas curtailment, propane tanks were installed at Graniteville, in the Spring of 1977, to protect operating schedules during future periods of severe winter weather. They were installed near the Gregg Dyeing and Finishing Division to provide an additional six weeks supply of fuel. This propane can be piped directly to the finishing operations should another curtailment of natural gas occur.

United Merchants and Manufacturers, of Aiken, reassigned production employees to other duties during their period of curtailment to avert layoffs. Extra painting, housekeeping and maintenance jobs were performed during those weeks while production could not be maintained. About one month of seven day work shifts was required to regain the normal production index for the quarter after the curtailment ended.

At the time of curtailment, no alternate fuel capabilities were available to United Merchants and Manufacturers. Fuel conversion capabilities were instituted and propane was purchased immediately. The company now keeps enough propane in storage for 15 days of operation.

Further case study information has been tabulated in Table 17. It describes various short-term measures taken by textile plants located throughout the state of South Carolina. The cost of these measures is also given. The high costs are mainly the result of higher alternate fuel costs and transportation of these alternate fuels.

Illustrating the cutback in natural gas due to lack of availability of supplies to industry, gas consumption in South Carolina decreased 19.2% from the fiscal year 1975-76 with textile curtailing consumption by 28.7%**. The increase in alternate fuel consumption cost South Carolina an extra \$12 million during the 1976-77 fiscal year*** (see Appendix 3).

*Graniteville Company's Annual Report, 1977.

**South Carolina Department of Labor, South Carolina Department of Labor, 42nd Annual Report, June 30, 1977.

***Energy and Environment Analysis, Inc., The Economic Impact of Gas Curtailments on Industrial End Users, October 7, 1977.

TABLE 17
Cost of Short Term Energy Measures During
the 1976-1977 Natural Gas Curtailment

Company	Plant Name	SIC Code	Estimated Total Cost	Description of Expenditures
Abney Mills	Pageland Screen Printers	2261	\$ 100,000	o Higher natural gas prices
	Renfrew Plant	2261; 2295	\$ 100,000	o Mixing and storage of gas
Carisbrook Industries	Franklin Dyed Yarns	2269; 2281	\$ 25,000	o Higher alternate fuel costs (fuel oil #6)
Collins and Aikman Corporation	Bangor Division	2258	< \$ 100,000	o Transportation of propane o Higher alternate fuel costs
49 Fab-Tex Finishing	Fab-Tex Finishing	2258	\$ 5,000	o Higher alternate fuel costs (fuel oil #6)
J.P. Stevens	Clemson Complex	2261	\$ 500,000	o Installation of alternate fuel system o Higher alternate fuel costs (propane)
	Walterboro Plant	2221	\$ 150,000	o Installation of 2 propane tanks o Rental of an oil-fired boiler o Higher alternate fuel costs
Lowenstein, M and Sons	Lyman Print and Finishing	2211; 2221	\$ 200,000	o Extra storage sites o Tanker for propane o Higher alternate fuel costs

(Table Continued)

Company	Plant Name	SIC Code	Estimated Total Cost	Description of Expenditures
Piedmont Plush Mill	Piedmont Plush Mill	2211	\$ 60,000	o Transportation of propane and butane o Higher alternate fuel costs
Spartan Mills	Powell Knitting	2258; 2297	\$ 1,000	o Transportation of propane o Higher alternate fuel costs
	Startex Division	2211; 2221; 2261	< \$ 100,000	o Propane storage o Higher alternate fuel costs
50 Spring Mills	Grace Complex	2211; 2261; 2262	\$ 235,000	o Purchase of 3 tankers o Higher alternate fuel costs o Transportation of propane o Emergency gas purchase
Ti-Caro Inc.	Caro-Knit Inc.	2258	\$ 130,000	o Conversion of fuel system from natural gas to propane

The severe winter of 1976-77 suggested the need for a larger propane storage cavern in South Carolina. Subsidiaries of TRANSCO formed cooperative ventures with Carolina Energies, Inc. subsidiaries in order to undertake a \$20 million expansion of the storage cavern near Tirzah in York county. Construction of this 50 million gallon extension and 62-mile propane pipeline from an interstate pipeline (Dixie) to the cavern has been started. This will be the largest underground propane storage on the east coast and will be completed during the first half of 1979. When complete, this facility will provide South Carolina industries and utilities with over 66 million gallons of storage space that may be serviced by truck transports, rail and pipeline. Industries and utilities can purchase propane in the summer and store it for winter use or just store it for insurance purposes, thereby reducing the possibility of future plant shutdowns.*

This cavern represents an important component in the long term energy strategy for the state of South Carolina. It may alleviate future economic dislocation because of its storage capabilities. In reference to Table 17, one can see that a large percentage of extra expenditures went for the location and transportation of propane and storage sites for alternate fuel. In this cavern, textile firms that are large users of natural gas will be able to store back-up supplies for emergency use. The only extra expense during a future curtailment will be the higher cost for alternate fuel.

Since textile firms experienced curtailments and may anticipate future ones, the stockpiling of propane has been authorized by DOE. Emergency preparations can now be made by South Carolina industry supplied by SOUTHERN.

Textile mills were impacted to varying degrees depending on their size.** Many larger mills had the capital available to obtain and use alternate fuels. The smaller textile plants were not always as fortunate and had to shut down temporarily. A few textile firms were forced to permanently close. This topic will be discussed in the next chapter.

*Greater Columbia Magazine Company, Columbia, Volume 2, October, 1978.

**Bureau of Domestic Commerce Staff Study, U.S. Department of Commerce, Assessment of January - February 1977 Severe Winter Weather and Fuels Curtailment on Selected Industries in Manufacturing, February, 1977.

VII. LOCATIONAL DECISION-MAKING OF TEXTILE MILLS

One of the important constituents of the site selection process for an industrial plant is the availability and dependability of fuel supplies. An area which is unable to supply a type of energy needed by a particular industry, is not likely to attract new development. The South Carolina State Development Board was contacted to obtain information regarding the effect that the natural gas curtailment had on attracting new textile companies.*

In the view of the Board, the natural gas curtailment had a negative effect on bringing industry into the state. The adverse publicity generated led to the erroneous belief that South Carolina was in the same status as other eastern seaboard states that were serviced by only one pipeline. Actually, South Carolina is at an advantage since it is serviced by two major interstate pipelines and one intrastate pipeline. The curtailment also emphasized that South Carolina is not an energy producing state. Some industrial prospects have been lost within the past two years, because managers and owners have wanted to locate in a state that had natural gas reserves.

Besides investigating new prospects, it is of importance to monitor the movements of established industry. In some instances an industry may leave an area because it cannot be assured of continuous fuel service. The South Carolina Department of Labor was contacted for data on the changes in the number of textile firms that occurred by county from 1975-1978. These data have been summarized in Table 18.

During this three year time period, South Carolina experienced a decrease in the number of textile plants within the state. For this study, the main interest lies in the number of plants that have left the area since the natural gas curtailment time period (fiscal year 1976-1977). Decreases in the number of textile plants were observed in focus counties such as: Chesterfield, Greenville, Marlboro, Orangeburg and Union. Because some of these counties experienced high textile unemployment, increased food stamp participation, temporary plant shutdowns and production losses, it appears that the fuel curtailment could have contributed, at least in part, to the movement of plants. Within the focus county area, there was a total loss of nine plants. Greenville and Chesterfield were the more heavily impacted focus counties. About a half dozen textile plants were forced to permanently close because of extended fuel curtailment.** These data support the findings of the study.

*Bob Glover, director of new industrial prospects, was interviewed.

**Information obtained from an interview with Ray Drafts, chief of research and statistics for the South Carolina Employment Security Commission.

TABLE 18

South Carolina Textile Firms By County From 1975-1978

County	Number Of Textile Firms By Fiscal Year			Changes In Number Of Textile Plants From 1975-1978		
	1975-1976	1976-1977	1977-1978	No Change	Decrease	Increase
Abbeville	9	9	9	x		
Aiken	12	11	11		-1	
Allendale	3	3	3	x		
Anderson	34	35	30		-4	
Bamberg	3	3	3	x		
Barnwell	3	3	3	x		
Beaufort	0	0	0	x		
Berkeley	-----	confidential	-----			
Calhoun	0	0	0	x		
Charleston	-----	confidential	-----			
Cherokee	14	15	17			+3
Chester	12	12	12	x		
Chesterfield	15	14	13		-2	
Clarendon	0	0	0	x		
Colleton	-----	confidential	-----			
Darlington	5	5	5	x		
Dillon	7	7	7	x		
Dorchester	4	3	3		-1	
Edgefield	3	5	5			+2
Fairfield	-----	confidential	-----			
Florence	7	6	6		-1	
Georgetown	-----	confidential	-----			
Greenville	54	55	50		-4	
Greenwood	18	20	20			+2
Hampton	0	0	0	x		
Horry	-----	confidential	-----			
Jasper	0	0	0	x		
Kershaw	4	4	4	x		
Lancaster	7	confidential	-----			
Laurens	18	18	18	x		
Lee	3	confidential	-----			
Lexington	4	5	5			+1
McCormick	-----	confidential	-----			
Marion	4	4	4	x		
Marlboro	11	11	10		-1	
Newberry	7	7	7	x		
Oconee	8	8	8	x		
Orangeburg	4	4	3		-1	
Pickens	19	18	19	x		
Richland	5	4	4		-1	

(Table Continued)

County	Number Of Textile Firms By Fiscal Year			Changes In Number Of Textile Plants From 1975-1978		
	1975-1976	1976-1977	1977-1978	No Change	Decrease	Increase
Saluda	3	confidential	-----	x		
Spartanburg	61	62	62			+1
Sumter	3	3	3			
Union	16	16	15		-1	
Williamsburg	4	3	3		-1	
York	31	33	33			+2
				Total =	-18	+11

The impacts that have already been discussed have been mainly economic in nature. Chapter 8 concentrates on social impacts that resulted from the natural gas cutoff.

VIII. SOCIAL IMPACTS

In addition to the economic impacts already described, several areas of South Carolina were subjected to social impacts as a result of the natural gas curtailment. Many facilities which provide services essential to human needs had their gas curtailed so that the critical energy supplies could be redirected to South Carolina industry. The South Carolina House of Representatives unanimously approved a resolution February 1, 1977, to suspend all public schools and nonessential state services so that fuel could be utilized by industry.

Three natural gas distributors within the state took special action for carrying out this resolution in their service area. They were the: (1) Fort Hill Natural Gas Authority; (2) Greenwood Commission of Public Works; and (3) Piedmont Natural Gas. Their supply area includes the Piedmont counties in the northwest portion of the state.

Fort Hill Natural Gas Authority was the most conservative and cautious of the group. It spread curtailments far into the social network in order to guarantee industry its needed natural gas. Fort Hill serves the tri-county area of Oconee, Anderson and Pickens (refer to Figure 1 for county location). Fifty-six percent of the labor force is employed by the textile industry in Pickens; 50% in Anderson; and 25% in Oconee.

Public schools closed for one or two weeks in the Fort-Hill service area. One hundred and seventy two churches cancelled Sunday and weekly services during the latter part of January. Supermarkets even closed temporarily or shortened their operating schedules.

Governor Edwards allowed Savings and Loan Institutions to close January 20-24 to conserve natural gas throughout the state. These institutions are lawfully required to stay open five days a week unless an executive order to close is issued.

Municipal buildings, libraries and the National Guard Armory were forced to close in Greenwood county, as the Greenwood Commission of Public Works redirected gas to industry. Forty percent of the industry found in this county is of the textile type.

Schools in Greenwood closed for one week along with other school districts in the counties of Cherokee, Edgefield, Newberry, York and Greenville. Some colleges also closed temporarily during the curtailment. Greenville Technical College shut down for eight days and the University of South Carolina closed for a four day weekend.

An interesting dichotomy which resulted was the actual geographic separation between social and economic impacts. Upon inspection of Figure 7, two distinct regions can be identified. The first is the Piedmont Plateau, which is mainly comprised of counties that were socially affected by the natural gas curtailment. The Coastal Plain is the second region and can be described by economically impacted counties. The Piedmont district is the textile center of the state.* Many company headquarters are located within the region and a higher percentage of the labor force is employed by the textile industry.

This separation may be interpreted in two ways. First of all, the Piedmont is largely supplied by TRANSCO; the Coastal Plain by SOUTHERN. This well supports the already established assumption that TRANSCO customers were more adequately prepared to meet the natural gas curtailment.

The second explanation is climatological in nature. During the average winter, the Piedmont is about 10-15% colder than the Plain. Many Plain plants had no standby source of fuel because the companies located there never anticipated a need based on climatic patterns.

The Piedmont experienced significant snowfall and below freezing temperatures as the 1976-77 winter brought temperatures 21% colder than normal. Natural gas was limited and distributing companies in an attempt to give homes and industry their needed gas, curtailed schools, churches and nonessential state services. The Plains, starting from a higher temperature base, did not have to shutdown such service areas.

In summary, schools, churches and banks were adversely impacted by the natural gas curtailment in certain areas of the state. Pipeline service and climate played an important role in identifying areas that were subject to social impacts. It is impossible to assess the dollars that were lost due to these closings. However, it should be pointed out that even if calculable, the money lost would be small compared to the human necessities provided by these facilities.

*Davison Publishing Company, Davison's Textile Blue Book, Ridgewood New Jersey, 1977.

Figure 7. Geographical Separation Between Social and Economic Impacts

APPENDIX 1

Curtailement Priorities*

The Federal Power Commission in its General Policy Orders 467 and 467B, set up nine priorities of service for policy use during periods of curtailed deliveries by pipeline companies. Located in descending order of priority they are as follows:

1. Residential, small commercial (less than 50 Mcf on a peak day).
2. Large commercial requirement (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 other categories listed here.
4. Firm industrial requirements for boiler 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.

*U.S. Department of Commerce, Staff Handbook on Natural Gas, August 1976.

APPENDIX 2

In the preliminary steps of a confidence level test, a null hypothesis and research hypothesis must be established. A null hypothesis usually implies that there is no relation or no difference between the observations being analyzed. This suggests that observations are drawn from the same parent population, and are subject to no outstanding or unique events. The research hypothesis, on the other hand, states the exact aim of the research.

In the case of the employment office, the null hypothesis states that there is no difference between two or more local employment security commissions' wage replacing rates. The research hypothesis specifies that differences in textile unemployment existed for different areas within the state. In performing the analysis, one does not try to prove that a research hypothesis is true; one tries, instead, to reject the null hypothesis which produces the equivalent result.

The next step is to develop descriptive statistics of the data. The standard score for each observation for each month under investigation was determined.

A standard score (deviation) which is statistically accepted as a value for the confidence level boundary is .67.* In order to be confident that observations were in fact experiencing unique situations, the confidence level was arbitrarily increased by one half of the defined value to a standard deviation of 1.0.

For the null hypothesis to be accepted, all employment office measures for each month in question should have smaller standard scores than the confidence level value of 1.0. Values which are greater suggest that differences between employment security commissions exist and the null hypothesis can be rejected.

Six observations for February and three observations for March had standard deviations of 1.0 or greater (Table 4); therefore, the null hypothesis was rejected.

*Yeates, Maurice, An Introduction To Quantitative Analysis in Human Geography, McGraw-Hill, 1974.

APPENDIX 3

Alternate fuel is about 90% composed of distillate and residual oil.* Since oil consumed usually comes from foreign sources, increased use of alternate fuels led to increased imports by the United States the winter of 1976-77. The natural gas shortage that winter caused an increase of \$1.3 billion in oil imports compared to the previous winter.**

*Oil and Gas Journal, Oil Fuels Adequate in U.S., But Gas Situation is Grim, January 31, 1977.

**American Petroleum Institute, Monthly Statistical Report, March, 1977.