

ILLINOIS STATE GEOLOGICAL SURVEY

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THE ENERGY CRISIS AND ITS
POTENTIAL IMPACT ON THE
ILLINOIS CLAY PRODUCTS INDUSTRY

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INTRODUCTION

According to a recent study, the "stone, clay and glass industries," which include structural clay products and pottery manufacturers, are second only to the primary metals industries in their use of energy. The cost of fuel as a percent of gross product amounted to 15.3 percent at the time of the study (Business Week, 1973). Because of its low cost and the ease of using it, clay products manufacturers have depended heavily on natural gas for fuel. However, with the growing nationwide shortages of natural gas, the Federal Power Commission and state regulatory agencies have been establishing end-use controls. Under such controls, industrial consumers (especially those on interruptible contracts) have been assigned very low priorities.

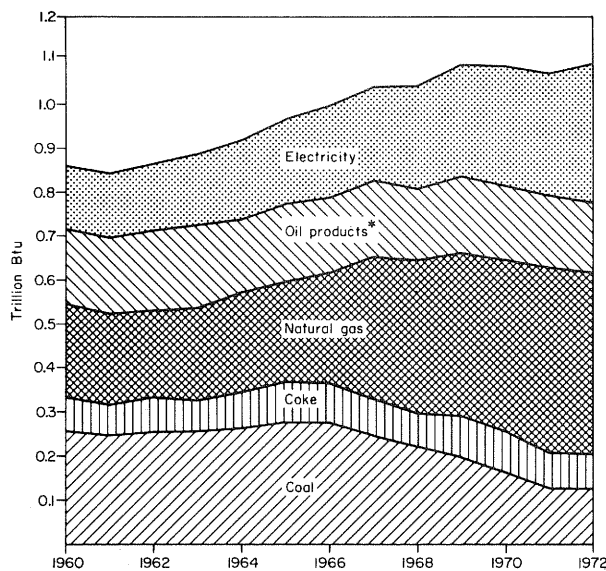
Although clay products manufacturers have in the past operated largely on "interruptible" gas in combination with supplemental standby fuels such as propane and distillate fuel oil, such an option is no longer open to many producers. Curtailments of gas deliveries have become longer, and propane and fuel oil are now in short supply as well.

In trying to deal with the shortages, government agencies are finding that they lack sufficient data. Although the United States Bureau of Mines publishes annual data on fuel consumption by "industry" in general, broken down as far as the state level, there are few data available on the current fuel requirements of specific industries in specific regions, states, or sub-state areas. The most detailed information on fuel usage and costs by individual industries in the various states is to be found in the Census of Mineral Industries and the Census of Manufactures. Unfortunately, the latest published data from these sources are already several years old and virtually worthless for planning purposes in light of the many rapid changes in fuel use in the last year or so.

Because it was learned that at least several of the clay products manufacturers in Illinois were experiencing difficulty in securing fuel supplies, the Illinois State Geological Survey undertook a canvass of the operators in the state to determine their fuels and energy situation, with special reference to the 1973-74 peak winter heating season. The remainder of this report includes: (a) a summary of the findings of this canvass; (b) an analysis of the current industrial fuels situation in Illinois and the Midwest; and (c) some suggested alternative courses of action to meet fuel shortages.

TRENDS IN INDUSTRIAL FUEL USE IN ILLINOIS

The industrial sector of the Illinois economy is a major consumer of energy. In 1972, the latest year for which data are available, industry consumed 1,089 trillion Btu, or 30.3 percent, of a total energy use in Illinois of 3,600 trillion Btu. Figure 1 indicates the trends in the use of various



* Oil products include residual oil, distillate oils, and LPG; residual oils account for 80 to 90 percent of the energy.

Fig. 1 - Industrial use of energy in Illinois, 1960-1972. Compiled from data supplied by U.S. Bureau of Mines and Federal Power Commission.

fuels and electricity consumed by industry in the state between 1960 and 1972; all quantities have been converted to a common equivalent Btu basis. From this it can be seen that the use of natural gas and electricity has increased at the expense of coal, while the use of coke and oil products has remained relatively constant. The indirect use of energy in the form of electricity increased from 17.2 percent of the total in 1960 to 28.5 percent in 1972.

Coal usage by industry has been declining for a number of years because of the low cost of gas and the relative ease of handling it. In addition, since Illinois coal generally has a medium to high sulfur content, industrial consumers with requirements for clean-burning fuels to maintain product quality control have tended to switch to natural gas. Lastly, the use of natural gas has enabled consumers to avoid potential air pollution problems associated with the use of Illinois coals and many fuel oils. As natural gas has become scarce, there has been an upsurge in the demand for supplemental or alternative fuels, especially propane and No. 2 distillate fuel oil. Also other consumers whose use of gas has been curtailed have entered the market at the same time to compete for existing supplies of these fuels. The result has been fuel shortages.

ILLINOIS CLAY PRODUCTS INDUSTRY

The manufacture of clay products is one of the oldest types of manufacturing done in Illinois. Although it is known that the Indians made pottery

prior to the arrival of the white settlers, the "modern" industry began around 1800 with the establishment of "commercial" potteries and brickyards in the Cahokia-Edwardsville-Alton area. As population spread across the state, new plants and operations were established in other areas to meet the expanding, spatially dispersed markets. Because of transportation difficulties, the normal pattern was one of many small plants, each serving its own restricted, local market. This pattern of dispersion reached a peak around 1900-1910, when there were approximately 700 clay products plants in the state, with operations in 96 of the 102 counties.

As transportation improved and economies of scale were introduced into the technology of clay products manufacturing, there was a redistribution and consolidation of the industry. Production became concentrated in the more favorably situated and more efficient plants, and part of the Illinois market began to be met by clay products manufactured outside the state. Despite retrenchment of the industry, clay products manufacturing has remained a significant sector in the state's economy.

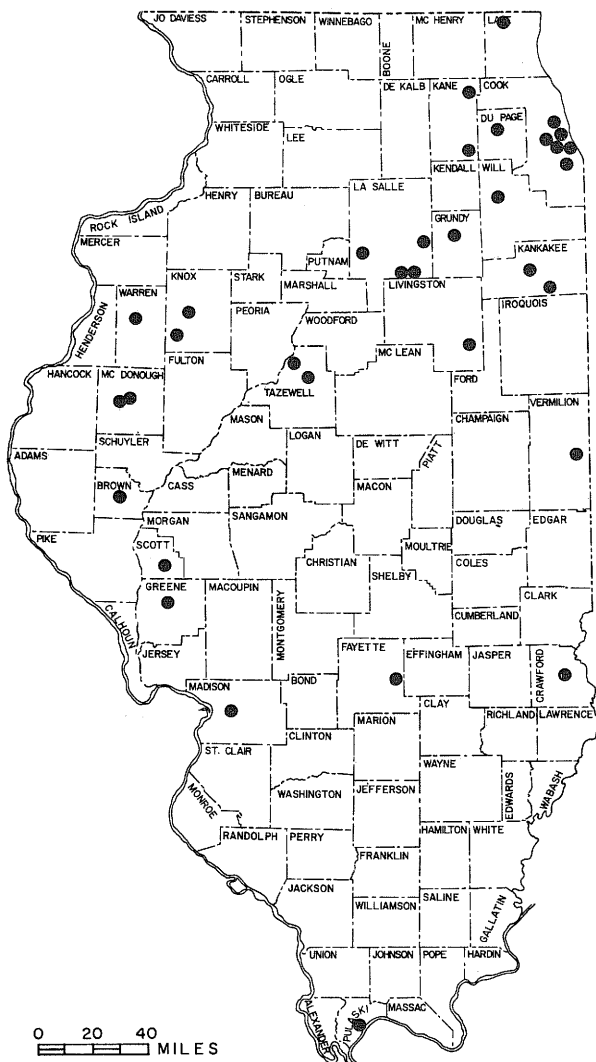


Figure 2 - Location of clay products plants in Illinois, 1973.

As of 1973, there were 33 plants,* located in 21 counties in Illinois, which manufactured clay products of various types (fig. 2). The raw materials for these plants include both clays mined in Illinois and clays imported from outside the state. According to the latest annual canvass by the Illinois State Geological Survey, the value of clay products manufactured in Illinois in 1972 totaled \$69.2 million. To put this in perspective: among the values of Illinois-produced mineral materials, the 1972 value of clay products manufactured in Illinois was exceeded only by the 1972 values for the following materials: pig iron, coal, crude oil, coke, and stone.

QUESTIONNAIRE RESULTS

In mid-October, 1973, a two-page questionnaire was sent out to all firms thought to be producing clay products in Illinois. A copy of the questionnaire can be found in Appendix A at the end of this report. Of the 34* questionnaires sent out, 25 (74%) were returned. One of the operators indicated that his plant was

* Fuel requirements for one plant producing only non-clay refractories are also included in canvass results.

closed, leaving 24 returns "usable" for analysis. The 25 responses were from plants which accounted for approximately 68 percent of the estimated 1972 production by value. The quality of the responses was quite good, with only a minor number of questions left unanswered or in a form which made them unusable.

A notable feature of the results was that they confirmed the very high reliance on natural gas by firms in this industry—a reliance which is much higher than that of Illinois industry in general (82% vs. 53%). Fourteen of the 24 respondents were entirely dependent on natural gas for fuel; five used a combination of natural gas, propane, and fuel oil; four used a combination of gas and propane; and one used natural gas and fuel oil. The nine firms which reported being entirely dependent on natural gas to fuel their plants and which had no current capabilities for burning alternative fuels accounted for 25 percent of the state's output, based on 1972 value of product.

Fifteen (60%) of the firms using natural gas are on firm contracts. However, despite their firm contracts, three of these firms have been told that their gas service will be curtailed appreciably during the winter of 1973-74. Although the nine firms on "interruptible" contracts normally expect to be curtailed part of the year during peak demand periods, seven of them reported that their suppliers had indicated that their gas supplies would be curtailed more than normally this winter. Estimated curtailments for this winter ranged from a low of 30-60 days to a high of 179 days; three firms quoted the latter figure.

Because of the declining availability of natural gas in Illinois, increased use of alternative fuels must be considered. For ease of burning and cleanliness, propane normally would be the preferred supplemental fuel for most of these operations. However, because of the tight supply of propane and the low priority given structural clay products manufacturers in the mandatory allocation program, increased use of propane is not really a viable option at this time. Of the eight firms which indicated that they had considered using propane as a supplemental fuel, seven reported that they were unable to secure a firm contract from a supplier for the total amount of their estimated propane needs.

The next best alternative fuel would be distillate fuel oil. With two exceptions, all reporting firms use No. 2 distillate fuel oil as a second or supplemental oil fuel. Fourteen firms indicated that they were currently using, or were considering switching to, fuel oil. However, ten (71%) of these firms reported that they had been unable to secure firm contracts for all of their estimated needs for this coming winter. Even assuming that these firms could obtain an allotment of fuel oil, there still might be problems, because half of the firms responding to the questionnaire indicated that low-sulfur fuels were required to maintain the quality of their products. Much of the fuel oil available is higher in sulfur than the natural gas that they have been using.

Has the deteriorating fuel situation increased the likelihood of plant closings? According to the canvass, only three firms had to shut down their plants last winter (1972-1973) because of fuel shortages. The shutdowns

amounted to 10, 30, and 65 days, respectively. For this winter (1973-1974), eight firms indicated that they expect such plant closures due to fuel shortages. This number represents an increase of 167 percent. In addition, the closures in 1974 are predicted to be much longer than in 1973, with three plants expecting to be closed 100 days or more.

What is the economic importance of the clay products industry to the state of Illinois? According to the canvass, total employment in the responding firms amounts to 2,515 persons. Five firms reported that they are the largest employers in their respective towns. On a plant basis, employment ranges from a low of 8 to a high of 350 persons. Most of the firms have been in business a long time; the average age of the firms (or plants in the case of multiplant firms) is 58 years, with seven of the responding firms being more than 75 years old.

According to County Business Patterns 1972 for Illinois (U.S. Dept. Commerce, 1973), 3,663 persons were employed in the "structural clay products" (SIC 325) and the "pottery and related products" (SIC 326) industries in Illinois during 1972. If the employment total derived from the canvass is pro-rated on the basis that the reporting firms represented only 68 percent of the production in 1972, the adjusted employment total would be about 3,700 (2,515 divided by 0.68), assuming that employment is proportional to output. According to the County Business Patterns, the approximate payroll for persons employed in these industries in Illinois in 1972 was \$25.6 million.

How large are the fuel requirements of the Illinois clay products industry? Based on the results of the canvass, the approximate monthly requirements for fuels are as follows:

	<u>Canvass results</u>	<u>Pro-rated to full coverage</u>
Natural gas	228 million cubic ft.	362 million cubic ft.
Propane	5,200 gallons	8,254 gallons
Fuel oil	361,000 gallons	573,000 gallons

It should be pointed out that the "canvass results" represent the requirements for only 22 operations because two of the reporting operators did not indicate the quantities of fuel needed. In addition, there is some question about the reliability of the data reported by six of the operators because the equivalent heat values of the quantities reported indicate either that the natural gas needs are understated or that the fuel oil and/or propane needs are overstated. However, in the absence of other data, the figures are presented as given. The canvass results were pro-rated to full coverage on the assumption that fuel requirements are proportional to dollar value of output. Fuel requirement totals are based on data from 22 plants, whose output represented 63 percent of the output in 1972; adjusted quantities were derived by dividing the canvass results by 0.63. Lastly, the totals given represent the normal requirements before allowing for the use of supplemental or alternative fuels when gas is unavailable.

In a number of cases, producers indicated what their fuel requirements would be if all or part of their gas were shut off and they were forced to use propane and/or No. 2 distillate fuel oil. The total monthly requirements when adjusted for gas curtailments were as follows: 225 million cubic feet of natural gas (down 1.3 percent); 107,000 gallons of propane (up 1958 percent); and 453,000 gallons of fuel oil (up 25 percent).

Because U.S. Bureau of Mines data on fuel consumption by states is available only on a yearly basis, it is necessary to convert these estimated monthly requirements to a yearly basis so that they may be compared with over-all industrial fuel requirements in Illinois. In the absence of better data, it was assumed that these canvass figures represent requirements for an average month and that they could be multiplied by 12 to arrive at estimates for the yearly fuel requirements for the Illinois clay products industry as follows:

Natural gas	4,344 million cubic feet
Propane	99,048 gallons
Fuel oil (distillate)	6,876,000 gallons (164,000 barrels)

Since these numbers are meaningless out of context, the fuel requirements of the Illinois clay products industry in relation to the total fuel demands in the state must be examined. Table 1 indicates the 1972 consumption of natural gas, propane, and distillate-type fuel oils used in Illinois for all purposes and for industrial purposes and compares these amounts with the estimated requirements for these fuels obtained from the questionnaires and adjusted by the author (see page 5).

From this table it can be seen that although natural gas accounts for more than 82 percent of the fuel needs (on a heat content basis) of the Illinois clay products industry, the actual quantities involved represent only slightly more than 1 percent of the total gas used by industry in the state. Distillate-type fuel oil requirements are equivalent to 6.89 percent of the industrial use of this fuel in Illinois, but only 0.30 percent of the total use of this fuel in the state. Propane requirements represent 0.15 percent of the total industrial consumption of this fuel, but only 0.02 percent of the total demand for all purposes in Illinois.

The final section of the questionnaire solicited additional comments from the producers about their fuels difficulties and other information that might be pertinent to the study. The following are a selection of the more relevant comments:

...additional cost of fuel oil versus gas will result in an increase in fuel costs of 78%.

We changed from interruptible to firm gas in 1967. While we have capability of using propane and No. 2 fuel oil standby, with no recent purchase record, we are unable to buy either standby fuel. In addition, we cannot produce a satisfactory product with either standby fuel. Our natural gas supplier has assured us of continuous service unless Federal Regulations upset their present plans. Should our natural gas supply be cut off, we would have to shut down.

We are presently working on three Federal Housing Projects for brick and are unable to give the developers a delivery date due to the fuel situation. Due to EPA standards closing so many brick plants there is a critical shortage of brick and [it] will remain critical for at least 12 months.

TABLE 1 — COMPARISON OF ESTIMATED FUEL REQUIREMENTS OF THE ILLINOIS CLAY PRODUCTS INDUSTRY (1973-1974)
WITH TOTAL CONSUMPTION IN 1972 FOR ALL USES AND FOR ALL INDUSTRY

	Natural gas	Propane	Distillate-type fuel oils
Total consumption, Illinois, 1972	1,220,635 million cu. ft. ^a	644,123,000 gal. ^b	55,276,000 bbl. ^c
Total industrial sale, Illinois, 1972	398,617 million cu. ft. ^a	66,573,000 gal. ^b	2,380,000 bbl. ^c
Estimated fuel requirements* for Illinois clay products industry:			
Quantity	4,344 million cu. ft.	99,000 gal.	164,000 bbl.
Heat equivalent	4,478.66 billion Btu	9.46 billion Btu	955.30 billion Btu
Percent of total Btu	82.2%	0.2%	17.6%
Illinois clay products fuel requirements as percent of:			
Total Illinois consumption, all uses	0.36%	0.02%	0.30%
Total Illinois consumption, industrial uses	1.09%	0.15%	6.89%
Illinois industrial fuel demand as percent of total Illinois demand	32.66%	10.34%	4.31%

* Based on data from canvass of Illinois producers; see pages 3 - 6 for calculations.

^a U.S. Bureau of Mines, 1973, Natural Gas Production and Consumption: 1972: U.S. Bur. Mines Mineral Industry Surveys, Natural Gas, Annual, September 7, p. 7-8.

^b U.S. Bureau of Mines, 1973, Sales of Liquefied Petroleum Gases and Ethane in 1972: U.S. Bur. Mines Mineral Industry Surveys, Liquefied Petroleum Gas Sales, Annual, October 25, p. 7, 11.

^c U.S. Bureau of Mines, 1973, Sales of Fuel Oil and Kerosine in 1972: U.S. Bur. Mines Mineral Industry Surveys, Fuel Oil Sales, Annual, October 10, p. 6, 14.

The nature of our . . . manufacturing operations requires gas to start up our kilns, so [if there were] a shutdown of any of our kilns, which is not unusual, and [if we] had no gas available, that kiln would be shut down permanently. Oil may be used after startup, but can be used to fire only certain types of brick. . . . Also using fuel oil would result in an additional fuel cost increase of 272%.

. . . could purchase propane at such high price, it wouldn't be economically sound to use it. Price OK last year, but couldn't get propane in this area. We could use Illinois coal in the winter if environmental restrictions were relaxed.

. . . our first preference for fuel is natural gas which we can use for 100% of our operations. Our second choice is propane which we can also use 100%; however, when we get to fuel oil we can only substitute it for 50% of our operations and we must have either natural gas or propane for the other 50%. . . we cannot operate with only fuel oil.

STATUS OF FUEL SUPPLIES

In light of the findings of the canvass, it seems appropriate to examine the status of supplies for those fuels which are of critical importance to the clay products manufacturers in Illinois, namely natural gas, propane, and distillate fuel oil.

Natural Gas

Illinois is a major consumer of natural gas, but it must import more than 99 percent of its requirements. Consumption of gas in the state had been growing very rapidly until recently. However, in 1972 total gas consumption actually declined by 1.8 percent—the first decline in use since 1945. This decline did not reflect a reduction in demand, but rather a deteriorating supply situation nationally. Although residential and commercial sales increased substantially, industrial use declined because gas sales to industrial consumers were curtailed preferentially.

Traditionally, clay products manufacturers have tended to purchase gas on "interruptible" contracts, under which gas is sold at very low prices. Distribution companies have been phasing out these contracts in favor of firm contracts, which yield higher returns.

The Federal Power Commission has indicated that service to industrial customers on interruptible contracts will be curtailed this winter (1973-1974); service to some industrial consumers on firm contracts will be curtailed as well. These projected curtailments are equivalent to about 5 percent of the industrial gas used in the "Great Lakes" Region in 1972 (Fed. Power Comm., 1973c). Over the longer run, the American Gas Association has

forecast that gas sales to "industry and other" customers in the East North Central Region will decline at the rate of 2.2 percent per year for the duration of the 1971-1976 period because of supply deficiencies (Am. Gas Assoc., 1973). Therefore, it is unlikely that natural gas will be available in sufficient quantities to meet all of the requirements of the Illinois clay products manufacturers. See Appendix B for more details on the status of natural gas supplies.

Propane

Propane has traditionally been the preferred standby fuel for clay products plants because of its interchangeability with natural gas and because of its relatively low cost. Liquefied petroleum gases (LPG) are derived mostly from natural gas liquids, which themselves are extracted from natural gas. In 1972, 55 percent of the production of natural gas liquids was converted into LPG. The declining availability of natural gas has reduced the domestic supply of propane and other liquefied petroleum gases.

Widespread fuel switching by natural gas customers who have found their supplies inadequate has increased the demand for propane. Because domestic production has not kept pace with demand, increased imports of LPG have been required. The full impact of the Arab oil embargo has yet to be determined, but it is felt that propane will continue to be in very short supply for the near future. Over the longer run, the peaking of domestic natural gas supplies could have a serious impact on future availability of propane. See Appendix C for more details on the status of propane availability.

Distillate Fuel Oils

The current availability of distillate fuel oils is not clear. Although it had previously been predicted that such fuels would be in very short supply during the 1973-1974 winter, stocks as of February 1974 were at levels substantially above those of the same time a year earlier. This improved situation has been attributed to the combination of a relatively mild winter and public cooperation with energy conservation programs which has resulted in a significant lowering of demand. It appears that there has also been considerable "leakage" of refined products into this country despite the Arab oil embargo (Time, 1974).

Although imports of distillate fuel oil in February 1974 were running 30 percent above imports at the same time last year, they were down by 29 percent from the peak level attained in mid-November 1973. Prior to the embargo, imports of distillate fuel oil (January through September, 1973) accounted for 12 percent of demand whereas they accounted for only 5.5 percent in 1972.

Although the availability of distillate fuel oils is likely to improve markedly once the embargo is lifted, the almost three-fold increase in prices in the last year may make them too costly for use in ceramics plants. See Appendix D for a more detailed discussion of the status of distillate fuel oil supplies.

SHORT-TERM OPTIONS

In the short run, the clay products manufacturers in Illinois have relatively few options open to them to alleviate their current fuel shortages. One would be to obtain a higher priority gas allocation from the regulatory agencies under the "hardship case" provisions. A second line of action is energy conservation. A symposium held in Chicago last summer discussed this matter and various speakers indicated that there were a number of ways in which energy consumption could be reduced at ceramics products manufacturing installations (Jeffers, 1973). While such conservation actions will enable producers to "stretch" their available supplies, they probably will not be sufficient to meet long-term needs.

For those plants with multiple-fuel capabilities, curtailments of natural gas may not be as severe a problem as for those plants with capabilities for burning only natural gas. The severity of the problem will depend upon the availability of propane and/or distillate fuel oils in a given plant's area. However, since both of these types of fuels are also expected to be in short supply this winter, producers will probably find themselves again in the position of having to apply for allocations under the "hardship" provisions of the propane and middle distillates mandatory allocation program.

LONG-TERM OPTIONS

Despite the inherent advantages of natural gas as a fuel for clay products manufacturing operations, it is likely that the availability of natural gas for such industrial purposes will decline in the coming years. In fact, it has been proposed that all industrial consumers of gas be switched over to "interruptible" contracts (Wall St. Jour., 1973). Therefore, large-volume industrial consumers of natural gas will have to develop multiple-fuel capabilities and learn to live with longer interruptions in gas supplies.

In light of this development, it appears likely that Illinois clay products manufacturing operations will have to plan to convert to multiple-fuel capabilities or else switch to other fuels entirely. Propane supplies are unlikely to be sufficient in quantity and low enough in cost to be an option as a supplemental fuel in the future. Therefore, distillate fuel oils probably will be used increasingly in place of natural gas and/or propane.

Some producers may decide to investigate the possibilities of using residual fuel oil and/or coal. With regard to residual oils, there are two problems which must be resolved before such use is feasible. First, residual fuel oils are very viscous and, therefore, are difficult to transport, handle, store, and burn. They require special pre-heating procedures. Whereas in the past such residual oils were very cheap and their high sulfur contents were not considered a particular problem, such is not the case at present. Under the impact of the current oil shortages and increased posted prices for imported oils, residual oil prices in Chicago increased by 45 percent during 1973; posted price for No. 6 residual oil (maximum sulfur of 1%) in February 1974 was \$9.03 per barrel or 144 cents per million Btu. Second, the high

sulfur content in these oils may be detrimental to the quality of the clay products produced and/or cause air pollution problems. Although desulfurization facilities to treat high-sulfur residual fuel oils are being added to refineries, a premium must be paid for such desulfurized oil, which is in short supply at present. For the first nine months of 1973, only about half of the residual fuel oil produced in U.S. refineries was under 1 percent in sulfur, and 38 percent of the residual imported into the United States during that period contained sulfur exceeding 1 percent (U.S. Bur. Mines, 1973g, p. 4, 7).

Illinois has abundant coal resources, but the industrial use of coal (exclusive of electricity generation) has been declining for more than a decade. Initially, this decline in use was the result of price competition from low-cost natural gas. Later, large-scale fuel switching from high-sulfur coals to natural gas and low-sulfur oils in order to comply with air quality standards contributed further to the decline.

At one time coal was widely used to fire brick kilns both in the United States and overseas, but natural gas and propane have displaced coal as the prime fuel in recent years. Ironically, the one brick plant in Indiana which is still using coal is the only plant in the state which currently is not experiencing fuel problems (U.S. Dept. Interior, 1973, p. 16). At a new brick plant now under construction in Wisconsin, provisions are being made for using coal as the standby fuel when natural gas supplies are curtailed (U.S. Dept. Interior, 1973, p. 51).

Because of the abundance of Illinois' coal resources, it seems worthwhile to investigate the possibilities of converting some of the clay products plants to directly burn local coal as a supplementary fuel. Recently, a number of experiments have been initiated to test the feasibility of using coal as a fuel in ceramics plants. There are several major problems that must be overcome before such conversions would be possible. First, because most Illinois coals are high in sulfur, their use would require a variance from the Illinois Pollution Control Board and such a variance could only be considered as a short-term solution. Second, the use of coal probably would require mechanical alterations of the boilers and burners. Third, the use of coal might cause a deterioration in the quality of the finished clay product. Fourth, even if the coal were converted to a low-Btu gas, scrubbing of the flue gases to remove sulfur and other pollutants would be required unless imported low-sulfur coals can be obtained.

The General Shale Products Corporation has reported that it has successfully adapted the tunnel kilns at its plant in Johnson City, Tennessee, to burn coal. After adaptation, coal can supply about 65 percent of the Btu required (Brick and Clay Record, 1973). Coal to fire the kiln is used at the rate of 800 pounds per 1,000 brick. Natural gas is still the prime fuel and is used whenever it is available. Conversion from gas to coal and vice versa can be completed in about half an hour with this system. The coal must be dried and finely ground (1/8 inch with fines) before firing the kiln; earlier experiments with larger sized coal were unsuccessful. Although gas is still used in the preheat section of the kiln, experiments are underway to use coal in that section also (Jeffers, 1974).

Another coal option that may be open to Illinois clay products manufacturers would be to import low-sulfur coals from Appalachia or the western states. Although this would eliminate the sulfur emissions problems, there are difficulties in obtaining supply and the high delivered prices may make it uneconomic.

A third coal option would be to convert to "producer gas." This would involve the installation of on-site gasifiers to convert locally available coals into a low-Btu gas (160 Btu/cu. ft.) for burning in kilns (Jeffers, 1973, p. 39). The process involves an air-steam reaction with specially sized coke or coal, and the gas produced must be scrubbed to remove the tar and soot. A unit 10 feet in diameter burning 7,000 ~~tons~~^{lb} of coal per hour would produce 66 million Btu per hour of clean gas. Coke is the best raw material, followed by anthracite; but bituminous coal can also be used (Jeffers, 1973, p. 39). Recently, a brick company in Pennsylvania ordered a "producer gas" unit run on anthracite to be installed at one of its brick plants as a source of supplemental fuel (Mutch, 1974). The cost of low-Btu gas, assuming coal costs of 30 cents per million Btu, has been estimated at from \$0.70 to more than \$1.00 per million Btu (National Acad. Engineering, 1973, p. 7). The coal costs assumed are equivalent to \$6.60 per ton for Illinois coals.

The cost of each of these coal options is likely to be greater than previous fuel costs, especially if these options are used in place of interruptible natural gas. However, because natural gas is unlikely to be available in sufficient quantities or at the bargain prices of the past, a reassessment of alternative fuel costs over the longer run may indicate that one or more of these coal options is viable for Illinois clay products manufacturers.

No matter which option is chosen (with the exception of continued use of natural gas), operators are likely to find that there will be a delay in obtaining and installing the necessary equipment needed to burn alternative fuels because of the backlog of orders at suppliers resulting from thousands of other industries attempting to switch fuels or to add multiple-fuel-burning capabilities.

SUMMARY AND CONCLUSIONS

(1) The clay products industry of Illinois is an old and important sector of the state's economy; it employs more than 3,500 persons and has an annual payroll of \$25 million.

(2) Clay products manufacturing is an energy-intensive industry, which currently depends upon natural gas for more than three-quarters of its fuel needs; distillate fuel oils supply the bulk of the remainder.

(3) Under current regulations, natural gas deliveries to industrial consumers, particularly those on interruptible contracts, are being curtailed for increasingly longer periods of time each year; Illinois clay products manufacturers can be expected to be seriously affected by this trend.

(4) Many of the Illinois producers at present lack the capability to burn fuels other than natural gas.

(5) Although some producers do have capabilities to burn propane and/or distillate fuel oils, under current mandatory allocation programs clay products manufacturers are in a low-priority category. In addition, since many of them were not consumers of these fuels in past years, they do not have an established "base load demand" on which to get a 90 percent allocation.

(6) At least two clay products plants in Illinois have already had to shut down because of fuel shortages, and a number of others have indicated that they expect to have to do so before the winter is over.

(7) Although Illinois possesses abundant coal reserves, coal is not now being used by any of the clay products plants in the state; there are serious technical and environmental problems to be solved before coal can be considered as a viable alternative fuel. One possibility would be to convert the coal into low-Btu "producer gas" in gasifiers located on site at the plant.

(8) The fuels problems of the Illinois clay products industry represent only a small part of the overall fuels problem, since this industry uses less than 1 percent of the natural gas and propane and less than 5 percent of the distillate fuel oil consumed in Illinois; but assuring adequate fuel supplies to this industry is essential if this old and important sector of the Illinois economy is to be preserved.

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APPENDIX A

QUESTIONNAIRE

Fuels and Energy Situation in the Illinois Clay Products Industry, 1973-1974

- (1) What fuel(s) do you use at your plant?

Natural gas _____ %
Propane _____ %
Fuel oil _____ %
Coal _____ %
Other (specify) _____ %

- (2) Do you at present have the capability of burning fuels other than the ones which you currently are using? Yes _____ No _____ (please check)

If yes, from _____ to _____

- (3) How much of each of the following fuels do you expect to use during an average month this coming winter?

Natural gas: _____ cubic feet
Propane: _____ gallons
Fuel oil: _____ gallons (barrels)
Coal: _____ tons

- (4) If you use oil, please indicate which type(s) is (are) burned at your plant?

Distillate No. 1 _____
Distillate No. 2 _____
Distillate No. 4 _____
Residual No. 5 _____
Residual No. 6 _____

Other (please specify): _____

- (5) If you use natural gas, are you on "firm" _____ or on "interruptible" _____ contract with your supplier?

- (6) If you are on "firm" contract, have you had indication that your gas service will be curtailed to any appreciable degree this coming winter?

Yes _____ No _____

- (7) If you are on "interruptible" gas, has your supplier indicated that your gas service will be curtailed (more than normal) this winter? Yes _____ No _____

- (8) If your supplier has indicated that your gas supply will be curtailed, by what percentage is it likely to be reduced? _____ %
(Or, how many days are you likely to be without gas service? _____ days)

- (9) If you are considering using propane as a supplemental fuel, have you been able to secure a contract with a supplier for the total amount of your estimated needs? Yes _____ No _____

- (10) Is it necessary for your plant to use a low-sulfur fuel in order to maintain the quality of your product; i.e., would a high-sulfur fuel contaminate your product? Yes_____ No_____
- (11) If you are currently using (or considering switching to) fuel oil, have you been able to secure firm contracts for all of your estimated needs for this coming winter? Yes_____ No_____
- (12) Did you have to shut down your plant last winter at any time because of a shortage of fuels? Yes_____ No_____ If yes, for how many days? _____
- (13) Do you expect plant shutdowns due to fuel shortages this winter?
Yes_____ No_____ If yes, for how many days?_____

It is intended to include a section in the report giving a brief description of the size and importance of the clay products industry in relation to the total economy of Illinois and to the economy of various regions within the State. With this in mind, we would appreciate it if you could supply us with the following information:

- (14) What is the average number of persons on the monthly payroll at your clay products plant? _____
- (15) Are you the largest employer in your town? Yes_____ No_____
- (16) How long has your plant been in operation at its present site? _____years.
- (17) Other comments and/or suggestions which might be pertinent to the present study:

PLEASE RETURN IN THE ENCLOSED STAMPED, PRE-ADDRESSED ENVELOPE

Illinois State Geological Survey
200 Natural Resources Building
Urbana, Illinois 61801

October, 1973

APPENDIX B

STATUS OF NATURAL GAS SUPPLIES

Illinois is a major consumer of natural gas, ranking fourth in 1972 after Texas, California, and Louisiana. More than 99 percent of this gas was imported from other states. Between 1960 and 1972, total gas consumption in Illinois grew from 537 billion cubic feet to 1,221 billion cubic feet, an increase of 128 percent. During the same period, industrial use of natural gas in Illinois increased from 196 billion cubic feet to 399 billion cubic feet, an increase of 104 percent (U.S. Bur. Mines, 1961; 1973b, p. 7-8). Prior to 1972 the consumption of natural gas in Illinois had increased substantially every year as gas invaded new markets and increased its share of the total energy used in Illinois from 25 percent in 1960 to 38 percent in 1972.

However, natural gas consumption in the United States has exceeded new discoveries since 1967, and total reserves have begun to decline. As a result, production has essentially peaked. During 1968, 1969, and 1970, total natural gas supply increased by more than 7 percent per year; in 1971 the rate of growth declined to only a little more than 3 percent and in 1972 to 1.5 percent. Since marketed production of gas from domestic wells has failed to keep up with demand, imports, mainly from Canada, have made up the difference. For the years 1968 through 1972, the annual rate of growth in imports was between 9 and 15 percent per year (U.S. Bur. Mines, 1973b, p. 2; 1972, p. 2).

During 1972, the tightening of the gas supply nationally was reflected in reduced consumption in Illinois. Total consumption of gas in the state (including extraction loss, lease and plant fuel, and pipeline fuel) in 1972 declined by 1.8 percent—the first decline in gas usage in Illinois since 1945. Industrial sales declined by 1.98 percent, sales to electric utilities declined by 42.17 percent, and sales to "other customers" declined by 7.57 percent. These declines were offset by increases in residential sales of 5.45 percent and in commercial sales of 7.16 percent (U.S. Bur. Mines, 1973b, p. 8; 1972, p. 8; 1951). Preliminary data for the first nine months of 1973 (through September) indicate that the supply situation has not improved. Although "marketed production" increased by 1.64 percent during the period, net imports of natural gas declined by 25.84 percent. The result is that it appears that total supply was essentially unchanged from 1972 (U.S. Bur. Mines, 1973e). Since demand for gas has been growing, it is obvious that some customers will not get all of the gas that they want or need. So far, regulatory agencies have given priority to residential and commercial customers and made industry and the utilities absorb the bulk of the curtailments.

Figure B-1 indicates the trends in gas sales in Illinois between 1963 and 1972 by class of service. In the early years of the gas industry, when supplies were very abundant and in excess of existing demand, "interruptible" contracts were signed with large-scale users, mostly industrial. These contracts were designed to allow the distribution companies to even out their sales of gas and keep pipelines operating all year long at optimum levels. At that time, there was no way to store gas near the market to meet peak heating demands in the winter. Therefore, the gas companies offered gas on an interruptible basis to these customers; this meant that service could be

cut off for various lengths of time during the winter. In return, the customers received very low rates (fig. B-2). This practice allowed the gas companies to even out their sales.

However, with the development of underground storage for natural gas, it became economic for the gas companies to store gas for the peak periods, when they could sell it at the higher, "firm" rates. Therefore, they began to cut back on "interruptible" sales (fig. B-1); in 1963, interruptible sales accounted for 46.1 percent of industrial and commercial sales and for 22.5 percent of total gas sales in Illinois (Illinois Commerce Comm., 1965). By 1972, such sales had declined to 8.2 percent of industrial

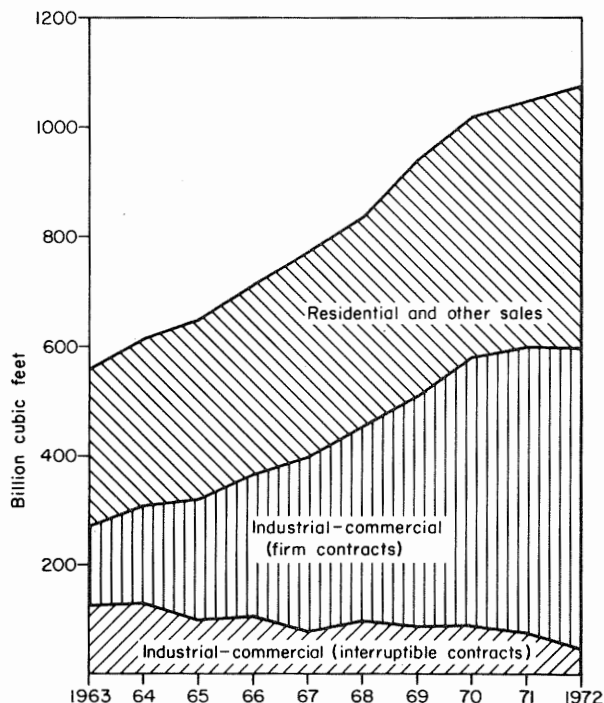


Fig. B-1 - Natural gas sales in Illinois, 1963-1972, by class of customer. (Source: annual gas utilities reports, Illinois Commerce Commission, 1963-1972.)

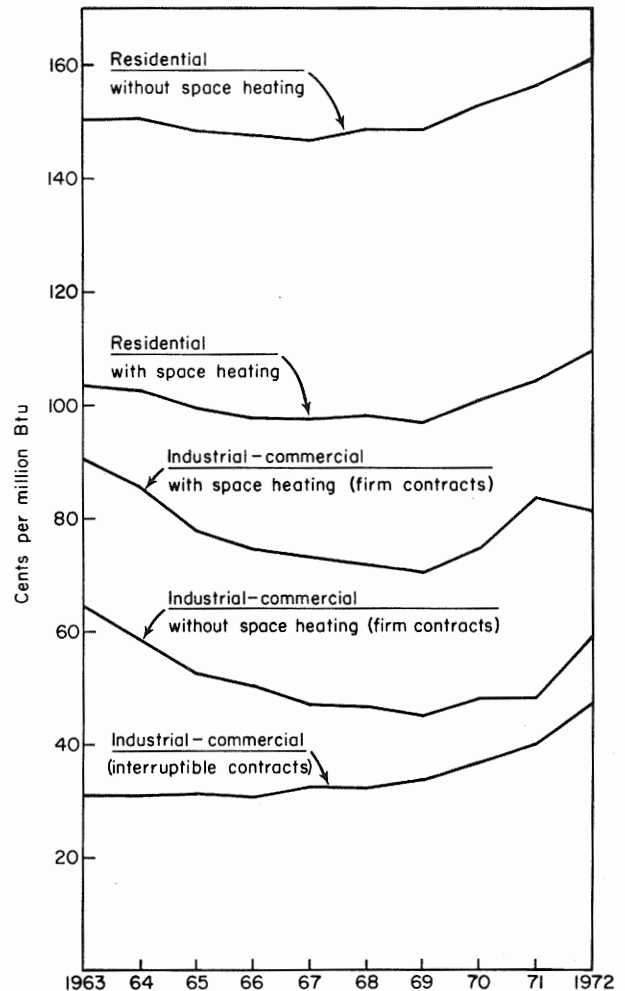


Fig. B-2 - Average prices for natural gas sold in Illinois, 1963-1972, by class of customer. (Source: annual gas utilities reports, Illinois Commerce Commission, 1963-1972.)

and commercial sales and to 4.5 percent of total gas sales in Illinois (Ill. Commerce Comm., 1973).

The impact of this trend has been to put customers on "interruptible" contracts in the position of having to switch to firm contracts at higher rates or to convert to other fuels. Although the firm rates are higher than the interruptible rates, they still represent a bargain compared with alternative fuels prices. The current shortages

have stimulated an increase in the rate of elimination of interruptible contracts because gas consumers with such contracts are considered to be low-priority users for the most part. Unfortunately, even those industrial consumers on firm contracts are not immune to curtailment in service, because of the higher priority given to residential and commercial users. According to a recent study by the Federal Power Commission, curtailments of gas service during the winter of 1973-1974 are estimated to be 629.0 billion cubic feet (Fed. Power Comm., 1973c), or 4 percent higher than the 423.2 billion cubic feet (Fed. Power Comm., 1973a) curtailed during the 1972-73 winter. Although the data are not broken down into state level data, they are given on a regional basis. Illinois falls in the "Great Lakes" Region, which includes the states of Illinois, Indiana, Michigan, and Wisconsin. Projected curtailments (Fed. Power Comm., 1973c) in this region, by class of service, are as follows:

<u>Type of customer</u>	<u>Firm</u> ¹	<u>Interruptible</u> ¹	<u>Total</u> ¹
Commercial	0.4		0.4
Industrial	19.0	34.9 ²	53.9
Electric utility	<u>3.5</u>	<u>8.3</u>	<u>11.8</u>
Total:	22.9	43.2	66.1

¹Billions of cubic feet.

²Includes minor volumes of curtailments to commercial consumers.

These curtailments are equivalent to 0.1 percent of the commercial sales of gas in the Great Lakes Region in 1972; to 4.9 percent of the industrial sales; and to 6.6 percent of the electric utility sales (U.S. Bur. Mines, 1973b, p. 8).

The longer term picture for natural gas does not look much better. According to a study issued by the American Gas Association, gas sales to "industry and other" customers in the East North Central Region* will decline at the rate of 2.2 percent per year for the duration of the 1971-1976 period because of supply deficiencies. The study further predicted that "normal growth patterns" will re-emerge in the next decade; the projected rate of annual growth between 1976 and 1990 was set at 6.2 percent (Am. Gas Assoc., 1973, p. 5-10). It should be noted that this optimistic growth rate was postulated on the assumption that supplemental sources of gas, such as gas from the Alaskan and Canadian Arctic regions, liquefied natural gas (LNG), and synthetic natural gas (SNG) from coal, will be available in large quantities. If such new sources fail to materialize in sufficient quantities, the projected increased industrial use of gas over the longer run may never occur.

* Includes states of Illinois, Indiana, Ohio, Michigan, and Wisconsin.

APPENDIX C

STATUS OF PROPANE AVAILABILITY

Liquefied petroleum gases include propane, butane, butane-propane mixture, and isobutane. These materials are used both as fuels and as chemical raw materials. Propane accounts for approximately 65 percent of LPG produced. Traditionally, propane has been used as a supplementary fuel in conjunction with natural gas or as the only fuel where natural gas is not available. Because of the similarity of burning characteristics of natural gas and LPG, users who have had their natural gas supplies curtailed have attempted to switch to propane or other LPG. The result of this massive switchover has been to cause a sudden upsurge in demand.

Preliminary data for the first nine months of 1973 (through September) reveal that production of LPG increased by only 0.8 percent while domestic demand increased by 4.7 percent. Imports were increased by 54.9 percent and stocks were drawn down by 7.2 percent in order to meet demand. During the same period, the demand for propane increased by 3.4 percent while production was essentially unchanged (+0.7%). To meet demand, propane stocks were reduced (-8.8%) and imports were sharply increased (75.1%) (U.S. Bur. Mines, 1973d, p. 4). As a result, the propane supply situation prior to the Arab oil embargo in October 1973 was already poor (fig. C-1). The result was that the "days' supply"* of propane was lower for each month of 1973 than it was in the comparable month in 1972. An estimate made by the nation's largest suppliers of propane in September at a public hearing instituted by the White House Energy Policy Office indicated that the supplies for the 1973-74 heating season would be 15 to 25 percent less than the amount available for the 1972-73 season (Fed. Power Comm., 1973c, p. 6).

Although data on the last three months of 1973, during which the Arab oil embargo was in effect, are only sketchy at this time, the embargo is bound to have some effect on LPG supplies. Imports as a percent of total demand for the first nine months of 1972 amounted to 7.8 percent; during the same period in 1973 they amounted to 11.6 percent (U.S. Bur. Mines, 1973f, p. 4). In other words, imports were being used to take up most of the slack caused by inadequate domestic production. To make matters worse, a forecast (prepared prior to the embargo and implementation of subsequent energy conservation measures) indicated that demand for LPG, if not constrained, was expected to increase by 29.7 percent during the first quarter of 1974 from the demand at the same period a year earlier (U.S. Bur. Mines, 1973a, p. 4; Oil and Gas Jour., 1973, p. 65). Although LPG stocks were up slightly at the end of November (+2.5%) from those a year earlier (Am. Petroleum Inst., 1973b), the increase probably will not be sufficient to avoid shortages this winter. As a result, propane has been under mandatory allocation schemes since November 1, 1973. Under this program, industrial consumers, such as clay products manufacturers, are currently being allocated 90 percent of their base period supply (October 3, 1972 - April 30, 1973) if no substitute

*Stocks in a given month divided by the daily demand for that month, i.e., how long stocks would last at constant demand and with no increases in supplies.

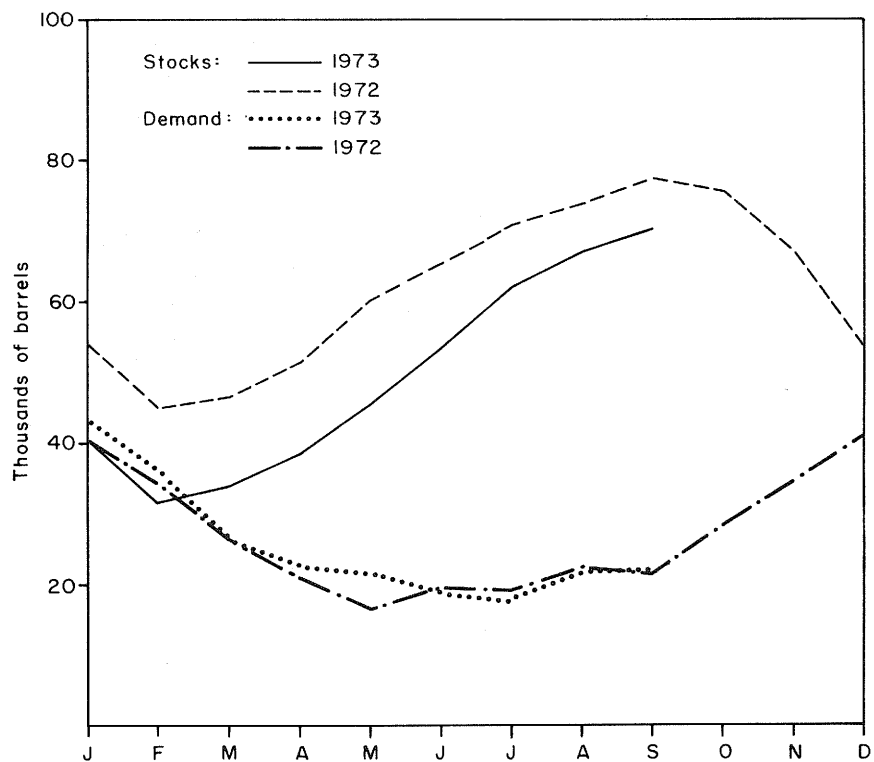
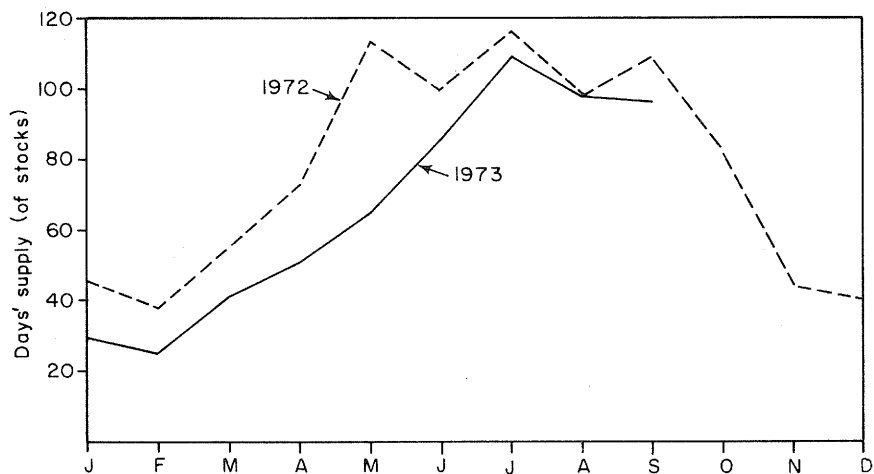


Fig. C-1 - Demand, stocks, and "days' supply" for propane, 1972-1973. (Based on data from U.S. Bureau of Mines Petroleum Statement, Monthly, January 1972 through September 1973.)

fuel is available. Firms which consume propane on a standby basis (as a substitute for curtailed natural gas) get 90 percent of the volume used in the base period, or 210,000 gallons per year, whichever is less* (Industry Week, 1974). Therefore, it is unlikely that additional supplies of propane will be available to take up the slack caused by shortages of natural gas. In addition, a number of operators did not use propane during the base period and therefore do not have an established supplier or a record of consumption on which an allotment can be based. In this case, a potential consumer can petition for an allotment as a "hardship case."

* Regulations from the Federal Energy Office have changed several times since November 1 as adjustments have been made in the original regulations; the ones cited here were in effect as of mid-January, 1974.

APPENDIX D

STATUS OF DISTILLATE FUEL OIL SUPPLIES

Information about the current availability of distillate fuel oils presents a cloudy picture. Shortly after the beginning of the oil embargo, it was predicted that such fuels would be in short supply. However, the picture at the present time does not appear as bleak as predicted. Several factors altered the original projections. First, the relatively mild winter and public cooperation with energy conservation programs have lessened the demand (Wall St. Jour., 1974). Second, it appears that there has been considerable "leakage" of products into the country despite the Arab oil embargo (Time, 1974).

Data for the first nine months of 1973, prior to the embargo, indicate the following picture. Domestic demand for distillate fuel oil was up by 8.9 percent while production, having increased by only 6.9 percent, trailed demand. The deficiency was met by a 134.1 percent increase in imports; imports increased from 5.5 percent of demand during the first nine months of 1972 to 11.9 percent during the first nine months of 1973. Despite the increased demand, stocks were at essentially the same level (-0.04%) (U.S. Bur. Mines, 1973f, p. 5).

Preliminary data for the fourth quarter of 1973 indicate that the Arab oil embargo has been more effective in curtailing imports of crude oil than it has been in reducing the flow of imported refined products. Because of the time involved before the last of the tankers which left the Middle East before the embargo was imposed could reach the United States, the impact of the embargo did not begin to be felt until late October. Total oil imports (including crude and refined products) "peaked" at 7.22 million barrels per day during the week ending October 26. Individually, crude oil imports peaked at 4.25 million barrels per day during the week of November 2 while imports of refined products peaked at 3.17 million barrels per day during the week of November 16.

Because there is a considerable variation in the weekly flow of imports, it is more representative to use moving 4-week averages to smooth out these fluctuations. On this basis, imports of crude oil and products peaked at 6.89 million barrels per day for the week of November 16. Table D-1 indicates the changes in imports of crude oil, refined products, and distillate fuel oil, on the basis of 4-week moving averages, for selected dates between January 5, 1973 and January 4, 1974.

By the first week of February 1974, the effects of the Arab oil embargo were quite evident. Not only were the levels of imports substantially below the November peaks, but they were also below the levels of the same time a year earlier. Between November 16, 1973 and February 1, 1974, the 4-week average level for crude oil imports had declined by 38.3 percent while the level for all refined products was down by only 12.0 percent and distillate fuel oil imports were down by 28.6 percent.

On the other hand, stocks of distillate fuel oils, as of February 1, 1974, showed substantial increases over those at the same time a

TABLE D-1 — TRENDS IN IMPORTS OF CRUDE OIL AND REFINED PETROLEUM PRODUCTS INTO THE UNITED STATES BETWEEN FEBRUARY 2, 1973 AND FEBRUARY 1, 1974

Imports	Average in millions of barrels per day for the 4-week period ending on the specified date				Percent change		
	Feb. 2, 1973	Oct. 5, 1973	Nov. 16, 1973	Feb. 1, 1974	Oct. - Nov.	Nov. - Feb.	Feb. - Feb.
<u>TOTAL U.S.</u>							
Crude oil: Total	2707	3606	3774	2328	+ 4.7	- 38.3	- 14.0
Canada	1014	1041	1026	887	- 1.4	- 13.6	- 12.5
Other	1693	2565	2748	1441	+ 7.1	- 47.6	- 14.9
Refined products total	3242	2881	3117	2742	+ 8.2	- 12.0	- 15.4
Distillate fuel oil	201	247	367	262	+ 48.6	- 28.6	+ 30.4
<u>P.A.D. 1-4*</u>							
Crude oil: Total	2063	2645	2870	1893	+ 8.5	- 34.0	- 8.2
Canada	760	805	786	679	- 2.4	- 13.6	- 10.7
Other	1303	1840	2084	1214	+ 13.3	- 41.8	- 6.8
Refined products total	3063	2762	2959	2548	+ 7.1	- 13.9	- 16.8
Distillate fuel oil	201	243	347	252	+ 42.8	- 27.4	+ 25.4
<u>P.A.D. 5*</u>							
Crude oil: Total	644	961	904	435	- 5.9	- 51.9	- 32.5
Canada	254	236	240	208	+ 1.7	- 13.3	- 18.1
Other	390	725	664	227	- 8.4	- 65.8	- 41.8
Refined products total	179	119	158	194	+ 32.8	+ 22.8	+ 8.4
Distillate fuel oil	—	4	20	10	+ 400.0	- 50.0	+ 100.0
Source: American Petroleum Institute, Division of Statistics and Economics, Weekly Statistical Bulletin: Am. Petroleum Inst., Div. Stat. and Economics, issues for weeks ending February 2, 1973, October 5, 1973, November 16, 1973, and February 1, 1974.							

* P.A.D. - Petroleum Administration for Defense District. P.A.D. District 5 includes Washington, Oregon, California, Nevada, Arizona, Alaska, and Hawaii. All other states are in Districts 1 - 4.

year earlier. Total U.S. stocks were up by 38.4 percent and stocks in the Midwest (P.A.D. District 2) were even higher, being 52.7 percent higher than those of a year before. Some people have assumed that because stocks are greatly in excess of those of the year before, there is no shortage of middle distillates. This may or may not be so, depending on winter weather conditions and the effectiveness of energy conservation programs.

Prior to the oil embargo, the demand for distillate fuel oils for the fourth quarter of 1973 had been forecast at 3,538,000 barrels per day (Bachman, 1973, p. 29). However, based on estimates by the author, using preliminary data from the American Petroleum Institute's Weekly Statistical Bulletins (1973), it appears that the actual demand for distillates during the fourth quarter of 1973 was only 3,217,000 barrels per day, or about 9 percent lower than previously forecast (fig. D-1). For the month of

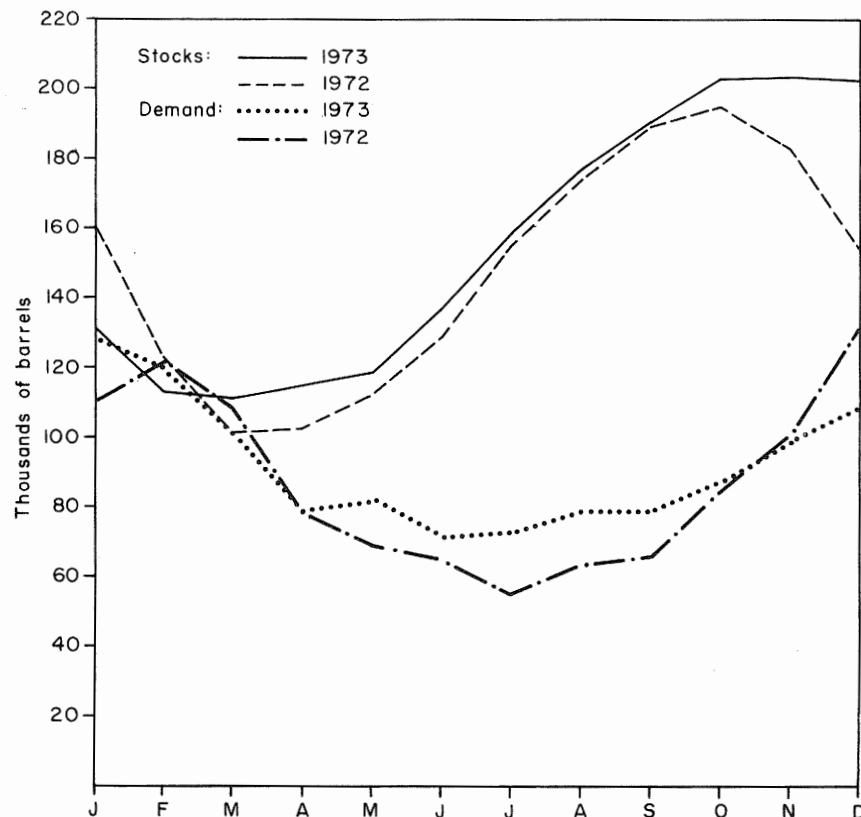
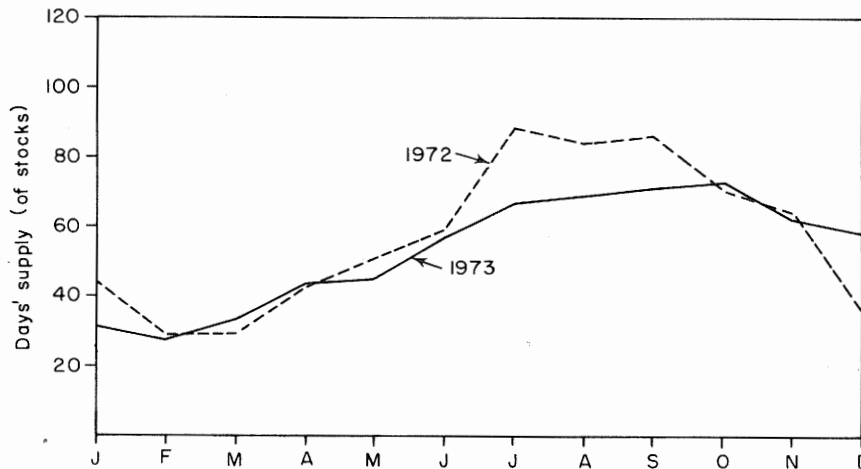


Fig. D-1 - Demand, stocks, and "days' supply" for distillate fuel oil, 1972-1973. (Based on data from U.S. Bureau of Mines Petroleum Statement, Monthly, January 1972 through September 1973; October through December 1973 data estimated from API Weekly Statistical Bulletins.)

December 1973, demand for distillate was 16.8 percent lower than in December 1972; in contrast, the demand for distillates in December 1972 had increased by 15.8 percent over the demand in December 1971. Therefore, it does appear that warmer weather and energy conservation measures have had a profound effect in lowering the demand for distillates.

It is imperative that conservation efforts be maintained, because the unconstrained demand for distillates during the first quarter of 1974 has been projected at from 4.57 million barrels per day (Bachman, 1973, p. 29) to 4.63 million barrels per day (Oil and Gas Jour., 1973, p. 65), or 18 to 19 percent higher than the demand at the same period a year earlier. The "enlarged" stocks of distillate fuel oil as of February 1, 1974, represented 55 days' supply, or less than two months' supply—a better margin than we have maintained during the past two winters, but possibly not enough to meet all demands if we have an extra cold late winter.

Because distillate fuel oils were expected to be in short supply during the winter of 1973-1974, these fuels were also placed under the fuel allocation regulations of the Federal Energy Office. As of mid-January 1974, manufacturers using distillate fuel oil were being allotted 110 percent of the supply (for purposes other than space heating) that they received during the corresponding month of 1972 (Industry Week, 1974, p. 16). For those clay products plants which used distillate last winter, reasonably adequate supplies probably will be available. However, a plant which either did not use distillate fuel oil during the 1972-1973 season or would like to substantially increase use of it this year must petition for an allotment on the basis of being a "hardship case."

As was pointed out earlier, the clay products industry is energy-intensive and fuel costs are a significant portion of its total costs. If energy prices become too high, Illinois producers may find their products priced out of the market in competition with those of producers in other states with more favorable energy prices and more reliable supplies. During 1971, the posted price in Chicago for No. 2 distillate oil ranged from 10.5 cents to 11.8 cents per gallon; during 1972, the price freeze stabilized the price at 11 cents per gallon. However, in 1973 under the pressure of inflation and higher prices for imported crude oil, the posted price for No. 2 distillate in Chicago had increased by 55-90 percent to 17-21 cents per gallon in December 1973. The upward pressure on prices continued in early 1974 and the posted price for No. 2 distillate fuel oil in Chicago as of February 4, 1974 was 31.25 cents per gallon.* To put this in perspective, this is equivalent to 225 cents per million Btu. By contrast, the average 1972 price for natural gas used by industry in Illinois ranged from 47 to 81 cents per million Btu (Illinois Commerce Comm., 1973) and the average cost per million Btu for coal used by Illinois utilities during the first quarter of 1973 was 32-39 cents for local coal and 64-65 cents for imported, low-sulfur western coal (Fed. Power Comm., 1973b, p. 16). Therefore, it is obvious that switching to fuel oil, assuming that supplies are available, would be very expensive.

* Weekly posted prices for selected refined petroleum products are given in each issue of Oil and Gas Journal; data compiled by the author.

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