

Displacing Imported Oil with Natural Gas

Researched for The INGAA Foundation, Inc., by:

ICF Resources Inc.

9300 Lee Highway

Fairfax, Va. 22031

and

Ed Pechan & Associates

5537 Hempstead Way

Springfield, Va. 22151

Displacing Imported Oil With Natural Gas

Executive Summary

Last year's invasion of Kuwait by Iraqi forces and the resulting Persian Gulf war have again thrown into question our degree of dependence on foreign oil. While the world oil market has adjusted to the Persian Gulf events and the U.S. is not in immediate danger of an oil shortage, it is incumbent upon the interstate natural gas pipeline industry to examine its ability to make up any energy shortfall which may result from future oil disruptions.

With these concerns in mind, INGAA conducted a survey of its membership to determine the extent to which natural gas could displace oil in certain electric utilities and industrial plants. Pipelines representing roughly half the market responded that use of 1.24 Bcf per day of natural gas in such utilities and plants could displace 236,000 barrels of oil per day, or 37% of the average daily crude oil imported to the U.S. from Iraq and Kuwait before economic sanctions were imposed. To supply the 1.24 Bcf of natural gas, pipelines would have to build facilities costing a minimum of \$1.29 billion. Included in this figure is the construction of \$541 million worth of lateral pipe, with each segment an average length of nine miles.

Although the survey results were necessarily incomplete to accommodate the fast-moving events in the Persian Gulf, they conservatively indicate that natural gas could make up a significant portion of imported oil. A more complete survey would doubtless show a greater potential for oil displacement.

PREFACE AND ACKNOWLEDGEMENTS

INGAA's Issue Analysis Reports analyze topical issues affecting the interstate natural gas pipeline industry. This study was funded by the INGAA Foundation, a non-profit organization made up of pipeline companies and pipeline suppliers which sponsors research on issues related to the expanded use of natural gas. ICF Resources in part designed and administered the survey, and had complete responsibility for preparing the responses and analyzing the results. ICF Resources was aided by E.H. Pechan and Associates, which performed an initial screening of the plant data base.

This report was prepared by Jamie Simler.

Introduction

Iraq's invasion of Kuwait underscores the instability of imported oil supplies and is prompting energy industry participants to reexamine U.S. dependence on foreign oil. Although the war concluded with little or no disruption to U.S. oil supplies, future international events might have more serious effects. Total U.S. net crude oil imports in 1990 were roughly 7.6 million barrels per day, the highest since 1979. Meanwhile, domestic field production of crude oil during 1990 averaged 7.3 million barrels per day, the lowest average reported since 1973.¹

While oil must be an essential part of any national energy strategy, natural gas can be substituted for oil in several applications, primarily industrial uses and electric generation. Yet pipeline capacity in periods of peak demand constrains the ability of many pipelines to substitute gas for oil. In order for natural gas to be able to supply the needs of some customers during periods of high demand, additions to the current interstate pipeline infrastructure are necessary.

This survey aggregates the individual responses of 14 interstate natural gas pipelines² to a recent³ survey undertaken by ICF Resources at the

¹ Source: DOE/EIA, *Petroleum Supply Monthly*, January 1991, Table S1.

² Fourteen pipelines, representing 46% of the surveyed market share, provided sufficiently complete responses.

request of the INGAA Foundation. The survey, designed to determine the extent to which pipelines could serve new and existing industrial and electric customers, incorporated industrial sites selected from the Environmental Protection Agency's National Acid Precipitation Assessment Program (NAPAP).⁴ Pipelines with more timely information on fuel use and boiler capacity than that contained in the NAPAP updated the data base to reflect these more recent additions.⁵ There were 3,148 plants included in the data base. However, 1,506 of these plants were in states or regions either excluded by the survey (Texas, Oklahoma, Louisiana) or without pipeline responses (New England and much of the South Atlantic). Pipelines provided responses for 811 of the 1,642 plants or utilities in regions covered by the survey. Pipelines currently serve 670 of the 811 plants.

Displacement

Natural gas can displace oil at numerous industrial and electric utility locations through the enhancement of existing delivery systems. Enhancement is possible either through the addition of laterals to the existing system or expansion of the system (which may include looping or the addition of compression), or both.

With expansion of some facilities, natural gas can displace an average of 236,000 barrels per day of current oil use at 811 plants⁶ covered by the survey respondents. This displacement is roughly equivalent to 3% of the total U.S. average daily net imports of approximately 7.6 million barrels per day⁷ and 37% of the average daily crude oil imported⁸ to the U.S. from both Iraq and Kuwait before economic sanctions were imposed. In the 48 contiguous states, 126,000 of the 236,000 barrels of oil per day can be displaced with the expansion of current pipeline capacity and another 35,000

³ The survey was conducted from November 1990 through January 1991.

⁴ These data are from 1985.

⁵ Annual fuel use of natural gas was updated at 236 plants. Annual fuel use of oil was updated at 46 plants. Boiler capacity was updated at 19 plants.

⁶ Responding pipelines in total reported 971 plants, 160 of which were duplicate responses. Duplicates were eliminated based upon economics of the response. Four pipelines provided 686 of the 811 responses.

⁷ An average of the first three quarters of 1990. DOE/EIA, *Monthly Energy Review*, February 1991, Table 1.8.

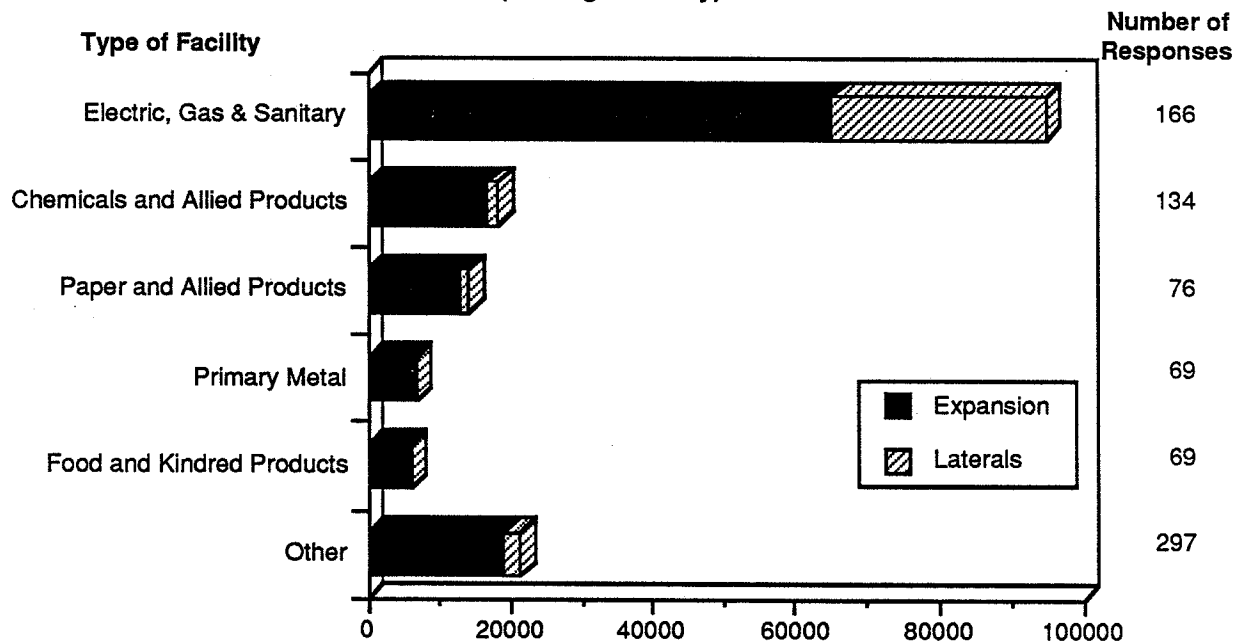
⁸ Based on January–November 1990 imports into the U.S. *Petroleum Supply Monthly*, January 1991, Table 40.

barrels of oil per day can be displaced with the construction of laterals. California, through such expansion projects as Pacific Gas Transmission, Kern River/Mojave, and Transwestern, may replace up to 75,000 of the 236,000 barrels per day of current oil use.

Plants Served

The responding pipelines currently serve 670 of the 811 plants covered by the survey,⁹ which include electric and gas utilities, chemical facilities and paper facilities. To serve the remaining 141 plants, laterals would have to be constructed. Electric generation facilities offered the greatest opportunity for oil displacement, followed by chemical and allied products plants. (See Figure 1.) Electric generation continues to grow, up almost 50% from its early-1970s level to slightly over 29 quads in 1989. The potential for gas to displace oil in these plants could increase natural gas's contribution to electric generation, which has dropped in recent years.

Figure 1
Oil Displacement by SIC Code
(Average bbl/day)



Source: Interstate natural gas pipeline survey.

⁹ In those states where pipelines provided responses, almost half of the plants (811 of 1,642) were represented.

Cost

The cost associated with displacing oil with natural gas depends upon whether the construction of laterals is necessary or whether capacity of existing systems requires expansion. For the 141 plants, most of which are electric power plants, where the construction of laterals would be necessary, the total estimated cost is approximately \$541 million. On average, laterals to serve these plants would be about nine miles long and cost approximately \$3.8 million each to build.¹⁰

The estimated total cost of serving all 670 plants in which expansion to existing facilities is necessary ranges from \$750 million to almost \$13 billion, depending on the individual plant's current use of natural gas. The low estimate is based on the assumption that plants are currently served by natural gas on an interruptible basis. That is, plants operate on natural gas for part of the year, switching to oil at times of peak demand, when interruptible gas service is interrupted. If all 670 plants operate with natural gas at least part of the year, as assumed above, an additional system capacity of 533,000 MMBtu/day would be required to provide gas to these plants year-round. The cost for this additional capacity is approximately \$750 million. The higher cost estimate derives from the assumption that gas would continuously fuel all 670 of these plants' boilers. In order to displace all of the oil in current boiler use by these plants, an additional system capacity of 7.3 Bcf/day would be required at a cost of about \$13 billion. This level of use may not be realistic, but serves as an upper bound on the cost of the given level of displacement possible.

Regional Distribution

Importantly, in three of the four most active industrial census regions,¹¹ nearly 40% of the facilities were currently connected to or within an average of nine miles of the system. As expected, pipelines reported little or no potential to displace oil in the West South Central and New England regions (see Figure 2). The West South Central area, dominated by intrastate and

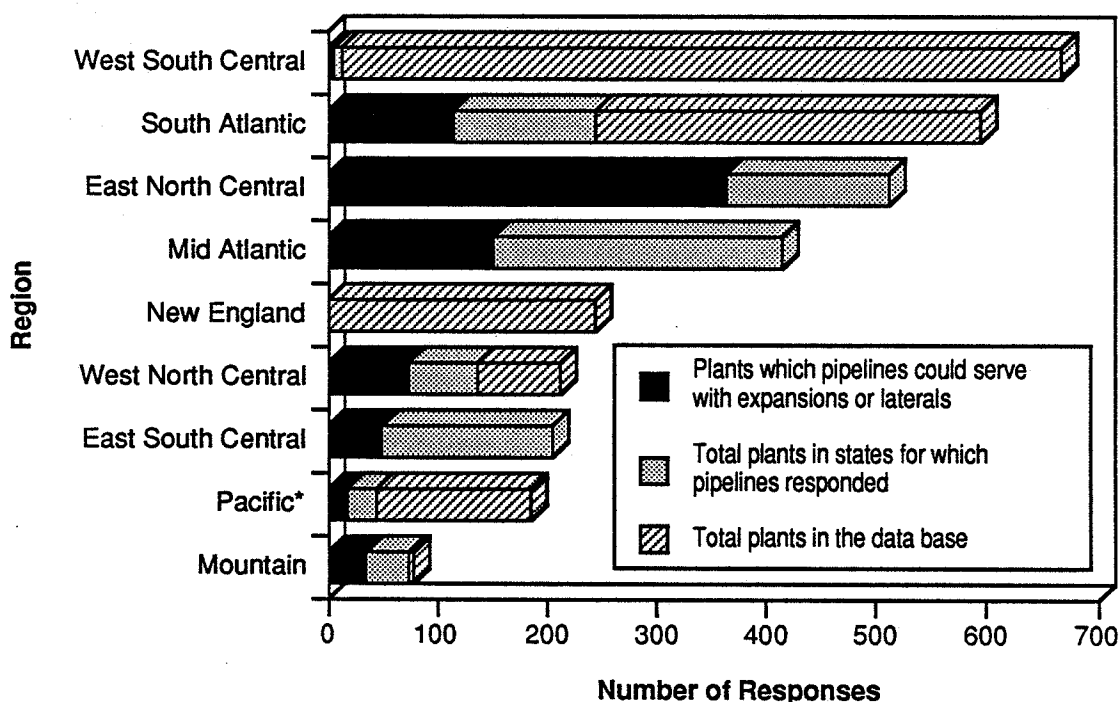
¹⁰ The number of laterals may be overstated because pipelines that did not respond may already be serving these plants.

¹¹ Based upon the total number of plants.

interstate¹² pipelines, was largely excluded from the survey because it already enjoys access to natural gas. As for the New England region, very few pipelines currently serve the area; none responded to the survey.

A closer look at the regional distribution of responses reveals that the majority of responses was from pipelines serving the East North Central census region.¹³ Specifically, six pipelines reported that natural gas could displace oil in 362 plants in this region either immediately, by way of capacity expansion, or within a construction season if construction of a lateral is necessary. The East North Central Region relies on oil for about one-third of its energy mix.

Figure 2
Regional Distribution of Responses



*Excluding California, Hawaii and Alaska.

Source: Interstate natural gas pipeline survey. The total number of plants in the survey was 3,142. Plants in states for which pipelines responded totaled 1,642. Of the 1,642 plants, pipelines provided responses for 811.

¹² Texas alone is served by 22 interstate natural gas pipelines. DOE/EIA, *Statistics of Interstate Natural Gas Pipelines 1988*.

¹³ Each facility for which pipelines provided detailed estimates constituted a response.

The Mid- and South Atlantic regions also exhibit the potential to displace oil with natural gas. Currently, the use of natural gas in these regions is limited, accounting for only 12 and 21%, respectively, of each region's energy mix. Oil and to a lesser extent coal are relied upon for roughly 70 to 75% of the combined regional energy mix. Importantly, the South Atlantic region alone accounts for approximately 49% of the total oil used in electric generation.¹⁴ Given these considerations, it is not surprising that pipelines serving these regions and responding to the survey reported the potential to displace oil in 266 plants, mostly through capacity expansions.

Regional Expansions and Laterals

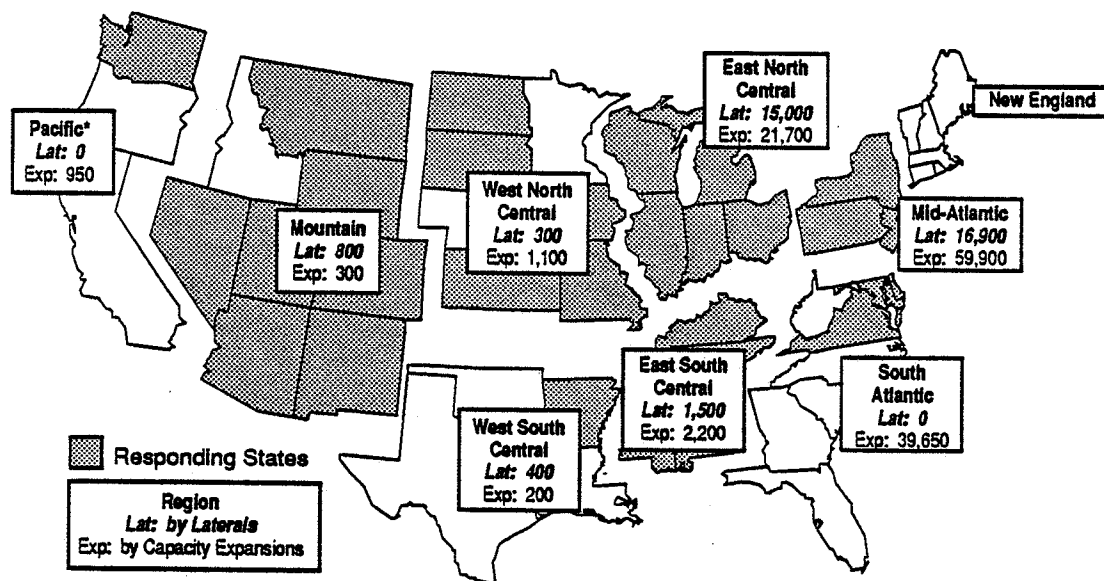
The survey results reveal that the greatest potential for oil displacement is in the Mid- and South Atlantic states, where on a per-Btu basis oil is used to a greater degree than gas in electrics and industrials. States in these regions, on average, are served by two to four pipelines. Some states are served by only one pipeline, while a few others enjoy the service of as many as seven.

Three regions—the Mid- and South Atlantic and the East North Central—account for 96% of the oil displaced through expansions and more than 90% of the potential oil displaced through construction of laterals. The Mid- and South Atlantic regions account for 79% (99,550 barrels per day) of the survey's total 126,000-barrels-per-day potential displacement of oil through expansions,¹⁵ and the East North Central for 17%. The other six regions comprise the remaining 4% of displaceable oil via capacity expansion. (See Figure 3.)

¹⁴ Oil used in electric generation for the total U.S. is about 4% of the U.S. total consumption of oil.

¹⁵ Excluding the 75 MMBtu/day of potential capacity expansion to California only.

Figure 3
Potential Displacement of Oil
(bbl/day)



Source: Interstate natural gas pipeline survey.

*Note: There were no pipeline responses for the California market because it is currently not directly served by an interstate pipeline. However, several projects are planned to build capacity into California and these projects have been incorporated into survey results. Also, numbers may not add due to rounding.

With respect to California, recent determinations by the California Public Utilities Commission (CPUC) indicate that 1.6 to 2.1 Bcf/day of additional capacity will be required to serve the California gas market in the next 10 to 20 years.¹⁶ Natural gas pipeline projects currently in the works should add that much capacity, helping to curb gas curtailments and replace crude oil used in enhanced oil recovery (EOR) projects. Of the 75,000 barrels per day of current oil use that may be displaced, a year-round average of 44,000 barrels per day is burned due to curtailments because of the lack of pipeline capacity and another 31,000 barrels per day is used by EOR producers.

¹⁶ CPUC Order Instituting Investigation, February 16, 1990.

Conclusion

Based upon the responses of nearly 50% of the interstate natural gas pipeline market, interstate pipelines, with some modifications, could displace 236,000 barrels of oil per day in electric and industrial plants throughout the U.S. Regions such as the Mid-Atlantic and South, which, in general, have had limited access to natural gas for use in electric and industrial plants, may benefit from as much as 79% of the potential displacement through capacity expansions possible for the facilities in the survey. Undoubtedly, a more complete survey sample would show that the potential for natural gas to displace oil is greater than that reported here.