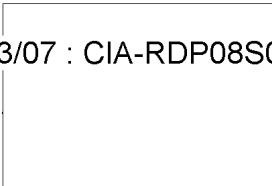




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Natural Gas: International Trade and Pricing Issues

An Intelligence Assessment

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*ER 81-10177
May 1981*

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Natural Gas: International Trade and Pricing Issues

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An Intelligence Assessment

*Information available as of 1 April 1981
has been used in the preparation of this report.*

This assessment was prepared by [redacted]
International Energy Branch, International Materials
Division, Office of Economic Research. Comments
and queries are welcome and should be directed to
the Chief, International Energy Branch, OER, on

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This paper was coordinated with the Office of
Political Analysis. [redacted]

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**Natural Gas:
International Trade
and Pricing Issues**

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Key Judgments

International shipments of natural gas have more than doubled since 1973 to about 7.1 trillion cubic feet, representing 12 percent of marketable gas production and the equivalent of 3.4 million barrels of crude oil per day. The rapid expansion in trade largely reflects two factors: the favorable price of gas relative to oil, although gas prices have increased sharply in the past two years; and the growth of the liquefied natural gas (LNG) industry, which has enabled supplies to be transported greater distances.

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Natural gas trade will continue to expand during the 1980s, as several more large export projects come on stream and consumers seek to reduce further their dependence on oil. If all pending and proposed projects are completed, the volume of trade could double again by 1990. More likely, however, the rate of growth will be slowed some by a continued escalation in prices and a growing reluctance on the part of some importers to become overly dependent on external gas supplies.

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Completion of the proposed Western Europe-USSR gas pipeline would place the Soviet Union by the mid-1980s far ahead of the Netherlands as the world's largest gas exporter, with shipments of about 3.5 trillion cubic feet per year. Exports from Algeria and Indonesia, presently the two largest LNG exporters, will also grow considerably in the coming decade, as these two countries seek to offset declining oil exports. Nigeria, Malaysia, Australia, and possibly Cameroon and Qatar are also likely to begin exporting LNG in the next several years.

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Natural gas traditionally has been priced below crude oil. While the difference was relatively narrow in the 1960s, the runup of crude prices in 1973 widened the gap considerably in most countries. Different use patterns for gas, the timing of contract negotiations, and varying degrees of market leverage existing between individual producer and consumer have caused variations in gas prices even within the same country. Producers are attempting to tie gas prices directly to crude oil and oil-product prices, and we expect this linkage to become well established, although with variations reflecting differences in the market and in the volume of alternative sources.

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The highly segmented structure of the natural gas market, with relatively few exporters servicing selected customers, will hinder producer efforts to effect unified pricing policies in the short term. Instead, most producers will

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continue to rely on bilateral negotiations to establish secure long-term markets and, at the same time, gain the most favorable price. Some producers have already resorted to gas cutoffs and the use of oil leverage against individual customers in an attempt to extract price concessions. [Redacted]

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Declining availability of domestic gas supplies will make most West European countries increasingly dependent on imported gas. Several West European countries—faced with declining Dutch and domestic supplies—may be willing to pay premiums to encourage development of North Sea gas supplies to avoid becoming overly dependent on Soviet or Algerian gas. Japan will have to rely exclusively on imports to expand future gas supplies. The United States may also have to rely more heavily on imported gas later in the decade if efforts to boost or stabilize domestic production fail. [Redacted]

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Natural Gas: International Trade and Pricing Issues

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The Resource Base

Proved reserves of natural gas have been estimated at about 2.64 quadrillion cubic feet, the Btu equivalent of 455 billion barrels of crude oil, and reserve additions continue to outpace consumption. In comparison, proved world crude reserves total about 650 billion barrels, but are being depleted rapidly. []

More than one-third of world natural gas reserves are located in the Soviet Union; slightly more than one-fourth are in the Middle East. Huge reserve additions in the USSR and Middle East and sharp reductions in reserve additions in North America have shifted the distribution of reserves in recent years. Only one-tenth of world natural gas reserves are in North America, which accounts for more than 40 percent of world natural gas consumption. Western Europe, with 6 percent of world reserves, accounts for about 14 percent of natural gas consumption. []

Gross production of natural gas totaled an estimated 67 trillion cubic feet in 1980—the oil equivalent of nearly 32 million barrels per day. Large quantities of gas have to be vented or flared if an appropriate collection and distribution system is not available. An estimated 7 trillion cubic feet were vented or flared in 1978—the last year for which data are currently available—with OPEC producers alone flaring about 4.7 trillion cubic feet. About 30 percent of natural gas production occurs in association with oil production. []

Development of Natural Gas Industry and Trade

Since most of the initial production of gas occurred as a byproduct of oil production, the production cost of gas was virtually zero. Still, even local trade in natural gas was nonexistent for many years because of the large capital expenditures required to move gas from the wellhead to markets. Transport costs are two to five times as much for gas as for crude oil on a heat equivalent basis, with the relative disadvantage greater for small-scale movements. Thus associated gas was simply vented or flared, and nonassociated gas wells were shut in. []

The United States was the first country to develop a major internal market for gas. Lack of alternative uses for gas enabled pipeline companies to obtain gas from producers at relatively low prices. With relatively low pipeline construction costs, and the need to amortize pipeline investments, the pipeline companies were able to offer gas at attractive prices with the added security of long-term contracts. The low prices in turn encouraged gas consumption as a substitute for coal, manufactured gases, and residual fuel oil in the industrial and utility sectors. Gas also became a favorite substitute for heating oil in the residential and commercial sector as a result of lower prices, and the cleaner burning characteristic of the fuel. Rapid growth led to government regulation of pipeline companies as a public utility, also helping to keep prices down. []

The first major international shipments were from Canada to the United States. In 1952, Canadian producers, taking advantage of the spreading US distribution network, began exporting to the northwestern United States. The volume of trade expanded rapidly during the 1960s. []

Several West European countries began to supplement their limited domestic output with imports of small amounts of Libyan and Algerian LNG in the 1960s, but development of the Groningen field in the Netherlands led to the first *major* international gas trade in Western Europe in the late 1960s. The Dutch pursued export sales in order to recoup some of the investment costs in developing the field. They offered long-term contracts at extremely low prices to encourage gas substitution and to head off expansion of nuclear power. At about the same time, the discovery of North Sea gas and construction of pipeline facilities enabled the United Kingdom to develop a large internal gas market. In the early 1970s, the USSR began piping gas into Western Europe at prices even below those for Dutch gas. []

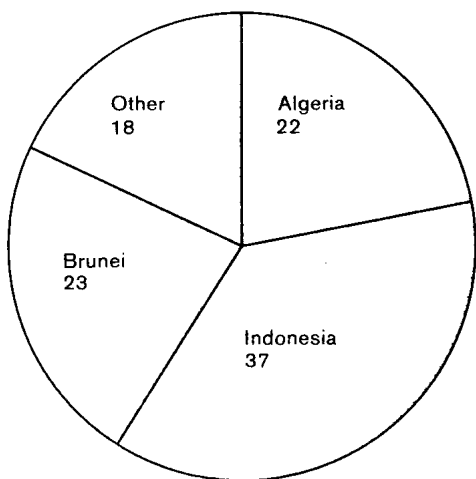
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Natural Gas Exports, by Country, 1980

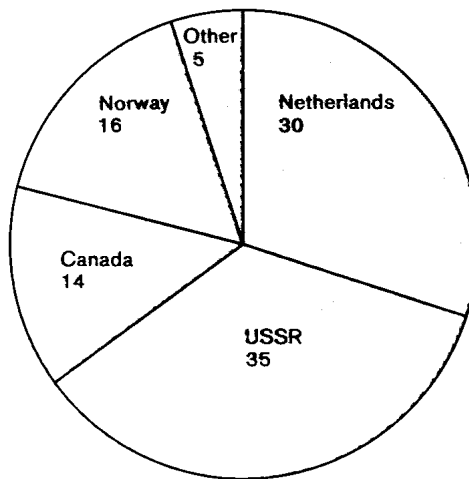
Percent

Liquefied Natural Gas Exports



1.2 trillion cubic feet

Pipeline Exports of Natural Gas



5.9 trillion cubic feet

[Redacted]

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Japan also began LNG imports in the early 1970s, with deliveries from Alaska and Brunei. By the latter part of the decade, Tokyo was also receiving shipments from Indonesia and Abu Dhabi. The Japanese have no significant natural gas resources. [Redacted]

Among LDCs, only Saudi Arabia, Mexico, Iran, Venezuela, Kuwait, and Pakistan—all of which produce for their own needs—are substantial consumers of gas. Programs to expand the use of gas domestically are also well under way in Saudi Arabia and Mexico. Other LDCs also possess gas reserves, but lack of financial resources or political will has limited development of gas resources for either internal use or export. Only Argentina has imported significant quantities of natural gas—from Bolivia and Chile. [Redacted]

International trade in natural gas has grown rapidly in recent years from about 3.4 trillion cubic feet in 1973 to about 7.1 trillion cubic feet in 1980. Nevertheless, only about 12 percent of marketable gas flows in international trade. [Redacted]

Market Structure

The bulk of internationally traded gas moves via pipeline. Pipeline gas exports totaled about 5.9 trillion cubic feet in 1980 or roughly 80 percent of total gas exports. The Netherlands, USSR, Norway, and Canada accounted for 95 percent of pipeline exports. [Redacted]

The growth of the liquefied natural gas industry in recent years has increased supply flexibility in the gas industry, but there are still only a small number of countries that have the facilities to receive and distribute the fuel. Many countries have been dissuaded from importing LNG by the high capital costs associated with constructing regasification facilities (up to \$370 million each), LNG tankers (\$150 million each), and internal gas distribution networks. At present there are only 16 LNG import terminals in operation—seven in Japan, six in Western Europe, and three in the United States; 70 LNG tankers are in service. LNG shipments totaled about 1.2 trillion cubic feet in 1980. [Redacted]

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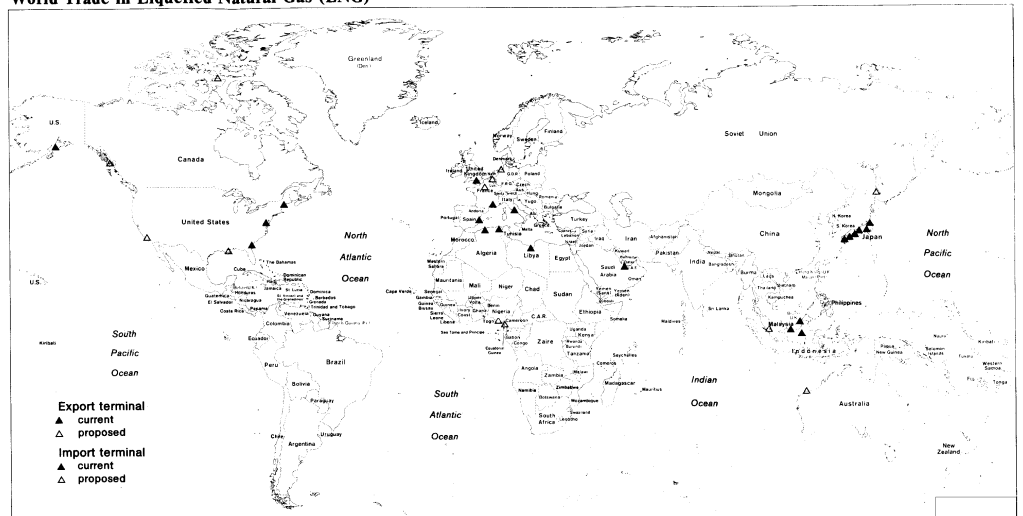
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World Trade in Liquefied Natural Gas (LNG)

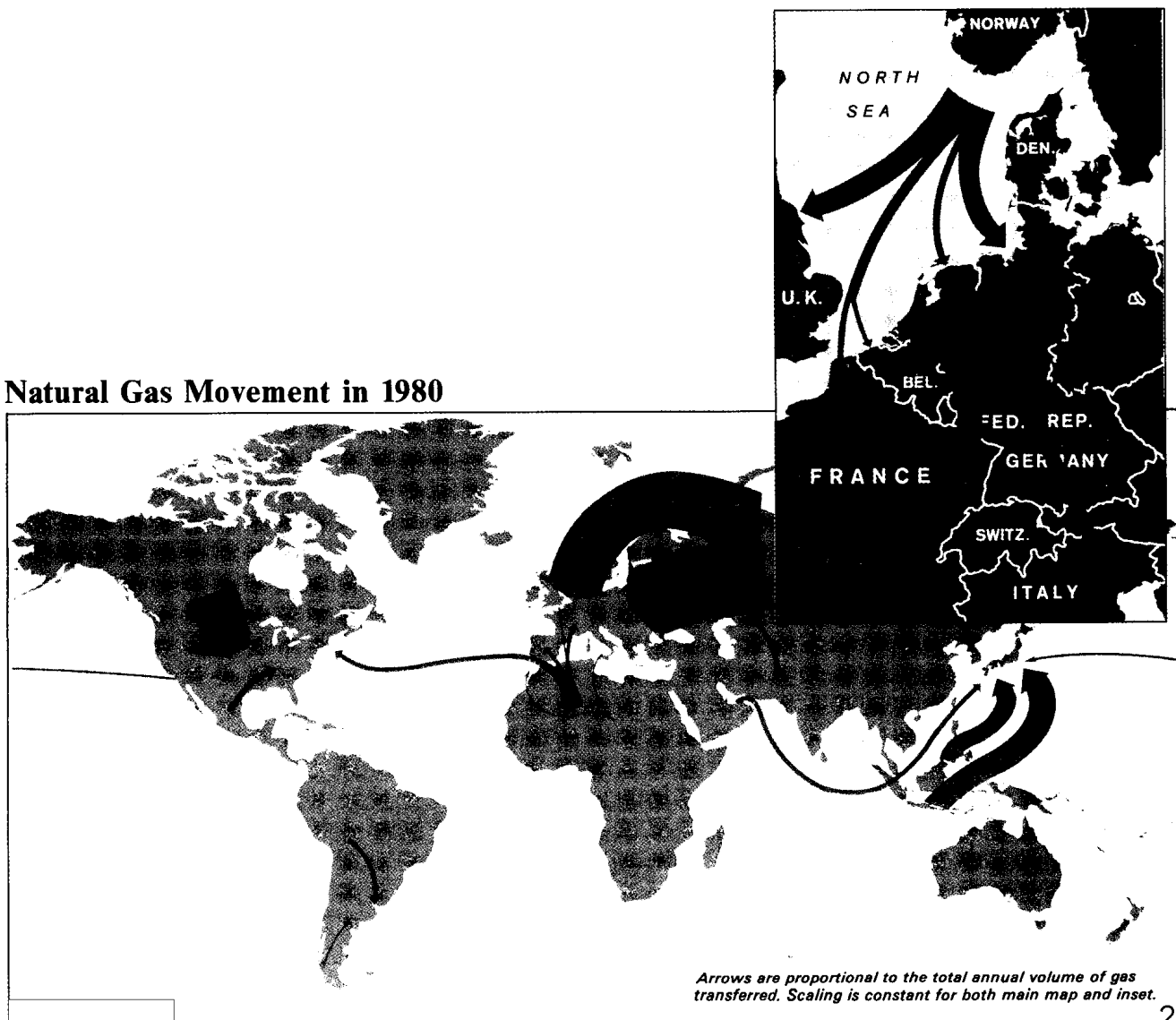


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Natural Gas Movement in 1980



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The inflexibility and high cost of gas transport has resulted in the development of three geographically segmented markets—United States (pipeline and LNG), Europe (pipeline and LNG), and Japan (LNG only)—each serviced by a small number of suppliers:

- Gas is supplied to the *US* import market via pipeline from Canada and Mexico and by LNG tankers from Algeria. US gas imports totaled about 1 trillion cubic feet in 1980, the bulk from Canada. LNG shipments amounted to only 86 billion cubic feet—down from 252 billion cubic feet in 1979—because of a pricing dispute with Algeria. Both Canada and Mexico have no alternative export outlets at present.
- The *European* market—West and East—is the largest gas trading market. The Netherlands, the USSR, and Norway are the major suppliers by pipeline. The Netherlands exported about 1.8 trillion cubic feet to West European countries in 1980; the USSR shipped about 2.1 trillion cubic feet, divided between Eastern Europe (57 percent) and Western Europe (41 percent). LNG imports into Western Europe from Libya and Algeria totaled about 260 billion cubic feet in 1980.

Table 1

Billion Cubic Feet

Estimated Natural Gas Trade in 1980

	Exporter														Total Imports
	Canada	Mexico	United States	Bolivia	Chile	Netherlands	Norway	USSR	Algeria	Libya	Afghanistan	Brunei	Indonesia	UAE	
Importer															
Western Hemisphere															
Argentina	0	0	0	70	15	0	0	0	0	0	0	0	0	0	85
United States	806	102	0	0	0	0	0	0	86	0	0	0	0	0	994
Europe															
Austria	0	0	0	0	0	0	0	85	0	0	0	0	0	0	85
Belgium, Luxembourg	0	0	0	0	0	350	70	0	0	0	0	0	0	0	420
Finland	0	0	0	0	0	0	0	36	0	0	0	0	0	0	36
France	0	0	0	0	0	390	90	170	78	0	0	0	0	0	728
Italy	0	0	0	0	0	240	0	240	0	50	0	0	0	0	530
Netherlands	0	0	0	0	0	0	110	0	0	0	0	0	0	0	110
Spain	0	0	0	0	0	0	0	0	70	30	0	0	0	0	100
United Kingdom	0	0	0	0	0	0	350	0	32	0	0	0	0	0	382
West Germany	0	0	0	0	0	800	330	380	0	0	0	0	0	0	1,510
Eastern Europe	0	0	0	0	0	0	0	1,200	0	0	0	0	0	0	1,200
USSR	0	0	0	0	0	0	0	0	0	0	85	0	0	0	85
Asia															
Japan	0	0	50	0	0	0	0	0	0	0	0	270	440	85	845
Total Exports	806	102	50	70	15	1,780	950	2,111	266	80	85	270	440	85	7,110

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- *Japan* imported about 850 billion cubic feet of LNG in 1980 from Indonesia, Brunei, the United States (Alaska), and the United Arab Emirates. Japan has no external pipeline sources of natural gas. []

Pricing Trends and Policies

Low initial prices for natural gas reflected low production costs, pipeline company desires to penetrate and establish long-term markets, the lack of alternative uses of gas, and the relatively low price of alternative fuels that natural gas replaced. The long-term contract prices, in turn, set an effective ceiling on prices for new supplies. In the US market, for example, domestic gas prices initially put an upper limit on the prices the Canadians could demand. Similarly, Dutch pricing policy held down gas prices in Europe well into the 1970s. The price of Soviet gas in Western Europe in 1974, for example, ranged from \$0.30 to \$0.50 per million Btu delivered and reflected almost a zero wellhead price. Heavy fuel oil, a major competing fuel, was selling for \$1.86 per million Btu in Western Europe at the same time. Gas prices from different producers have varied widely even within the same country in Europe, reflecting different degrees of leverage between buyer and seller and different periods of contract negotiations. In 1980, for example, Italy was paying three different prices for delivered gas from the USSR, Libya, and the Netherlands. []

On the other hand, because the Japanese market had no competing sources of gas via pipeline and only limited domestic production, delivered LNG prices soon became closely tied to crude oil prices as an alternative fuel supply. LNG prices charged by various sources in Japan have remained fairly closely linked to crude prices and to each other. []

The delivered price of natural gas was roughly half that of crude oil on an energy-equivalent basis during the 1960s. The gap widened sharply following the oil price runup in 1973, with prices realized by some gas producers equating to only 10 to 20 percent of the price obtained for oil in the same market. []

In response to these disparities, the Dutch enacted the Natural Gas Act of 1974 giving the government authority to raise prices unilaterally for exported gas, regardless of the provisions of existing contracts. Until then, even those contracts that called for automatic

price increases based on increases in fuel oil prices allowed only for a percentage of the oil price increase and lagged by several months the change in oil prices. Other producers such as the USSR soon followed the Dutch precedent in raising prices. [] 25X1

Several other factors have also influenced the upward trend in gas prices:

- Natural gas use has grown. Besides its use as a fuel, it is a raw material for petrochemical production and can be reinjected into many oil reservoirs to enhance oil recovery.
- The inability to substantially boost supplies of low-priced traditional sources of gas in the United States and the Netherlands has eliminated the effective ceiling that these gases placed on imported prices.
- New gas sources, particularly LNG projects and offshore gasfields now being developed, are costlier. [] 25X1

Several gas exporters have sought and, in some cases, received substantial increases in prices during the past year:

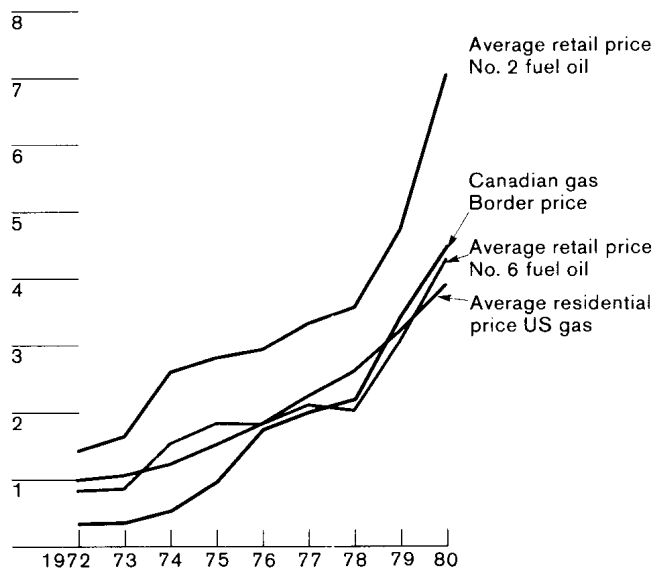
- *Canada* and *Mexico* received increases of 30 and 25 percent, respectively, in their export prices to the United States in 1980. The Canadian price increase, however, resulted in a sharp cut in US demand. 25X1
- The *Netherlands* renegotiated prices with its West European clients last year, linking the price of gas to the price of low sulfur fuel oil. Under the new formula, gas prices at the Dutch border would now equate to about \$4.40 per million Btu but are being phased in at a lower level. Dutch gas prices for domestic users have traditionally been considerably higher than export prices. 25X1
- *Norway* concluded a deal with a West German firm that has the delivered gas price linked to a basket of crude oils at essentially heat-equivalent prices. Oslo is expected to receive close to thermal parity on all future sales of its North Sea gas. 25X1
- *Abu Dhabi* and *Brunei* boosted prices for their LNG exports to Japan by having them indexed to crude oil prices on a delivered basis. 25X1

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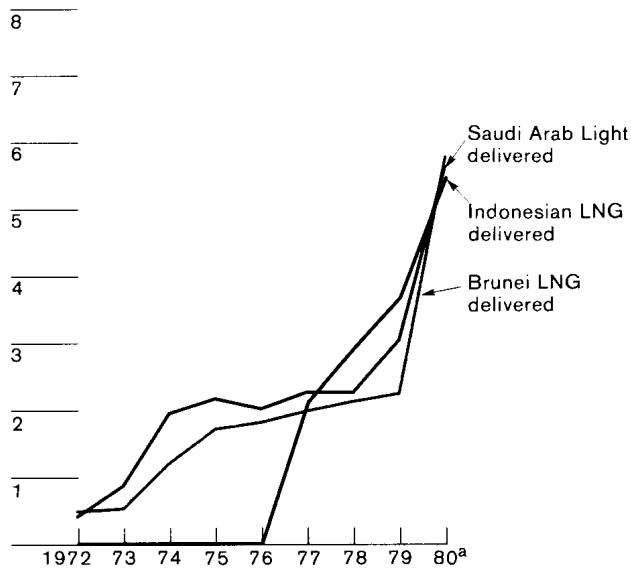
Average Prices for Oil and Natural Gas

US \$ per million BTU

United States

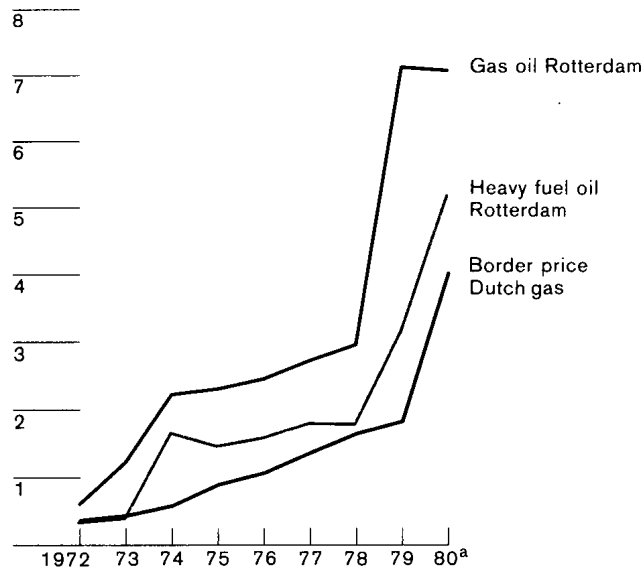


Japan



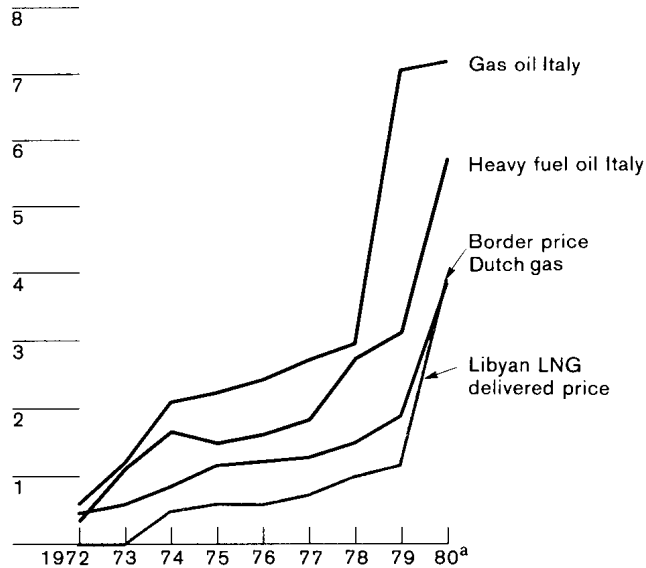
^aFourth quarter 1980 prices.

West Germany



^aAverage price 4th quarter 1980.

Italy



^aAverage price 4th quarter 1980. No Libyan LNG was delivered.

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- *Algeria* has sought to have f.o.b. prices for its LNG exports based on the thermal equivalent of high-quality Algerian crude—about \$6.90 per million Btu at present crude prices. The United States and France refused these demands and deliveries were cut off last April. An agreement with the El Paso Company and the United States Government has failed to materialize and deliveries remain suspended. French deliveries were resumed on an interim basis although the price issue remains unsettled.
- *Iran* demanded a severalfold increase in prices from the USSR. The Soviets did not agree, and gas deliveries have been cut off since early 1980.
- *Libya* cut deliveries of LNG to Spain and Italy in an effort to extract sharply higher prices. While shipments to Spain have been resumed after reaching a pricing agreement, deliveries to Italy remain suspended.
- *Indonesia* recently concluded an agreement with Japan on future LNG deliveries which effectively links f.o.b. gas prices to crude prices on a heat-equivalent basis. The agreement is the first of its kind in the industry. []

The relationship of current natural gas prices to the price of substitute fuels varies widely among countries depending upon the use of gas. In Japan, for example, delivered prices for LNG currently are close to the price of imported crude oil on a heat-equivalent basis and 5 to 15 percent more than the delivered price of residual fuel oil. Nevertheless, most natural gas is used as a substitute for residual fuel oil in electricity generation and industry because of its cleaner burning nature and the utilities' desire to cut oil use. Natural gas is also substituted, to a much smaller extent, for direct crude burning in electricity generation. It does not substitute for higher valued oil products such as heating oil in the Japanese residential sector. []

In France, about 45 percent of natural gas is used in the residential/commercial sector where it substitutes for heating oil, a product with a current f.o.b. price about 15 percent higher than average crude prices and

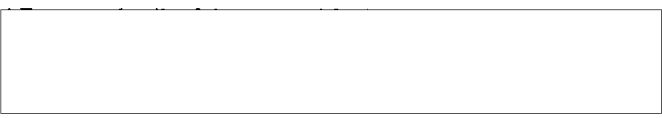
85 percent higher than natural gas prices. Similar use patterns and price differences occur in the United States, the Netherlands, and the United Kingdom. Indeed, the price of natural gas in these countries remains well below equivalent crude oil prices because of the availability of lower priced competing fuels, including domestic gas, in each of these markets. [] 25X1

Outlook

Although leadtimes are such that large-scale expansion will take several years, supplies and trade of natural gas are likely to grow over the longer term as real price growth encourages the development of new distribution systems. Moreover, as prices rise, transportation costs will become less of a constraint on gas trade and pricing issues. [] 25X1

The USSR is in the best position to expand its gas trade.¹ It is negotiating with several West European countries to build a large new gas pipeline from West Siberia to Western Europe which would more than double its current gas exports to that region. Under the proposed project, a European consortium would provide the engineering, equipment, and financing for the pipeline. In terms of capacity and length, it would push the state of the art to new levels. An agreement by the participants to go ahead with this multibillion-dollar 25X1 project would greatly improve the gas supply situation in Western Europe, but probably not before the late 1980s at the earliest. [] 25X1

Algeria, Nigeria, and Indonesia, all of which have abundant reserves, are likely to rely on gas export projects for a considerable portion of future revenue needs. These producers will not be as constrained by revenue surpluses and conservationist tendencies as the Persian Gulf oil producers and are likely to expand gas output noticeably over the next decade. [] 25X1



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Table 2

Gas Contract Pricing

Exporter	Importer	Price ^a (US \$ Per Million Btu)	Comments
Abu Dhabi	Japan	5.57	Delivered price at heat equivalency with Abu Dhabi crude oil (f.o.b.)
Afghanistan	USSR	1.98	At Soviet border
Alaska	Japan	5.93 ^b	Delivered price tied to average crude import prices in Japan
Algeria	Spain	4.50	Base price (\$3.50) indexed to 80 percent of crude price change
	United Kingdom	4.60	Escalates to \$4.80 on 1 July
	US (Distrigas)	4.40	
	US (El Paso)	1.95	Shipments suspended
	France	3.75	
	Belgium	4.80	Start 1982; escalation linked to crude prices
Brunei	Japan	5.40	Delivered price tied to average crude import prices in Japan
Canada	United States	4.94 ^b	Tied to basket of Canadian crude imports
Indonesia	Japan	5.42	90 percent crude oil equivalent 10-percent inflation index
Libya	Spain	4.50	Escalates at 83 percent of crude price change
	Italy	3.45	Shipments suspended August 1980 over price dispute
Mexico	United States	4.94 ^b	Tied to five key export crudes
Netherlands	France, Italy, Belgium, West Germany	3.90-4.10 ^c	95 percent of low-sulfur fuel oil price change with a five-month lag
Norway	United Kingdom	4.00 ^b	Landed cost at Emden, West Germany
	West Germany	4.60 ^b	
	France	4.60 ^b	
	Belgium	4.60 ^b	
	Netherlands	4.60 ^b	
USSR	Italy	3.81	Price at Czech border
	France	3.90	
	West Germany	4.00	

^a Prices are f.o.b. the exporting country, unless otherwise noted.^b Prices are c.i.f.^c At the Netherlands border.

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West European nations that have been attempting to reduce their dependence on oil, largely by substituting gas, appear vulnerable to producer demands:

- The Algerians, disappointed with the resistance to their price demands, have halted plans for construction of both the Arzew (LNG-3) and Skikda II facilities that were to produce gas earmarked for West Germany, France, Sweden, Belgium, and the Netherlands; they are now considering expansion of pipeline transport. The Europeans in general, and West Germany in particular, have expressed concern that pipeline supplies are vulnerable to disruption by countries through which they transit.
- European gas companies have signed agreements to import one-half of Nigeria's output scheduled for 1985 and have indicated an interest in purchasing the remainder. Lagos has pressured the United States to take one-half of Nigerian gas production in the interest of diversifying its customers and maintaining leverage over US policy on southern Africa. Development of Nigeria's LNG system has been slowed pending approval of funding for the project.

[]

Western Europe probably will be forced to bank heavily on increased Soviet supplies and more rapid development of Norwegian North Sea reserves if gas supplies are to be increased during the 1980s. Recent contract signings have shown that some West European customers are willing to pay a premium for supply security although much remains to be resolved on pricing issues for future supplies of both Soviet and North Sea gas. []

Japan is depending on growth in Indonesian LNG supplies and development of LNG facilities in Malaysia and Australia to increase its natural gas supplies. While a joint US-USSR-Japan LNG project at Yakutsk is unlikely to materialize, Tokyo is hoping to begin imports of LNG from the Soviet island of Sakhalin by 1987. Qatar and Kuwait have expressed interest in LNG exports to Japan, but any project would probably require a considerable investment by the Japanese. []

The United States will become increasingly susceptible to producer price demands if, as many forecasters believe, domestic gas and oil supplies continue to

shrink. Future LNG imports from Algeria remain in doubt because of the pricing dispute. To date the United States has moved slowly on import projects involving Nigerian and Indonesian LNG. Some additional supplies of pipeline gas from Canada now appear likely by the mid-1980s following Canadian approval of the southern section of the Alaska-Canada pipeline. Still, considerable uncertainties remain regarding future availability of Canadian natural gas, despite Ottawa's sizable resource base. While Mexican exports to the United States are likely to show some growth, Mexican domestic consumption probably will limit the amount available to the US market later in the decade.

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Natural gas prices should rise faster than prices for crude oil, approaching parity with crude prices over the next few years as gas continues to replace higher priced oil in residential and commercial uses. Still, crude prices probably represent an approximate ceiling for gas prices in most markets in the near term because gas lacks the flexibility of oil as a fuel. []

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Over the longer term, gas prices may rise to the level of high-quality crudes if recent technological developments allow gas to be converted to high-value products that would substitute for gasoline or jet fuel. Mobil Oil, for example, has developed a process to produce synthetic gasoline from natural gas. []

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The highly segmented structure of gas trade and lack of supply flexibility provide little economic basis for the formation of a gas cartel. Because few producers are capable of competing in the same markets, there is little need to fix price or regulate output. Industrialized exporters such as Canada, Norway, and the Netherlands would have serious political reservations about joining a cartel-like pricing arrangement with OPEC gas exporters. Moreover, the incentive for cooperation on prices will diminish as natural gas prices are boosted by market forces. Consultations among gas exporters have been held and such discussions are likely to continue, but prospects are limited for unified pricing policies in the short term. Most producers will continue to rely on bilateral leverage to negotiate prices and will doubtless threaten to cut off oil or gas supplies to extract price concessions. []

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