Chapter 6

Other Gas Sources—Summary

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Natural gas imports in 1981 totaled 904 billion cubic feet (BCF)[1] and composed 4.6 percent of the total U.S. dry gas consumption. As recently as 1979, however, imports constituted as much as **6.1** percent of the total U.S. dry gas consumption. The current import status and future import projections are summarized in table 28.

In evaluating "other" potential supplies of natural gas, the most obvious sources are the border countries, Canada and Mexico. Canada has been and probably will remain our most important source of supplemental natural gas. In January **1983,** the National Energy Board recommended an additional **9.25** trillion cubic feet (TCF) of reserves for export. Although this decision nearly doubles the exportable quantity available to the United States, actual imports are expected to remain low in the near-term, owing to decreased U.S. demand and noncompetitive pricing. In the long run, the increase in allowable exports will probably help encourage frontier development.

Exports from Mexico will probably remain at 300 million cubic feet (MMCF/day) in the near-term, consistent with what they have been since the present contract was negotiated in 1979. Although Mexican natural gas supplies are bountiful, the Mexican Government's current export philosophy seems to preclude significant increases in exports to the United States. Mexican consumption is expected to increase as the distribution infrastructure develops.

Alaska represents another large potential supply; the Prudhoe Bay Field alone constitutes over 10 percent of the total U.S. proved reserves. At present, there is no natural gas production reaching the Lower 48 States, owing to the lack of a means of transportation. Financing for a transportation project is difficult to obtain because of cur-

*This chapter summarizes a detailed discussion to be published in the background report to this technical memorandum

[1]U.S. [Department of Energy, Energy Information Administration, "U.S. Imports and Exports of Natural Gas 1981, ' June 1982

Table 28.—Natural Gas **Imports Summary Table**

Source	Natural gas supplied to Lower 48 States in 1981	Allowable imports under 1982 licenses/contracts	Proved reserve estimates	Range of future export estimates' -- 1990	2000
Mexico	0.1 TCF (EIA)	0.1 TCF	75 TCT (PEMEX)	0.1-1.0 TCF (AGA LA Mexico)	0-2,0 TCF
Canada	0,8 (EIA)	1.8 TCF	88 TCF (CPA)	1.0-2.5 TCF (AGA LA Canada)	1,0-3.0 TCF
Alaska	0	—	32 TCF (USGS PGC)	ANGTS[b] 0712 TCF	1 224 TCF
				Pacific-Alaskan LNG 0.1 TCF (AGA)	0,2-0,4 TCF
LNG	0,04 (AGA/GER)	0.9 TCF[c]	N.A.	Variable—depends on future U.S. policy and pricing,	
Total	0.9 TCT (EIA)				

[a]This range represents the highest and lowest estimates of the references cited
[b]Alaskan Natural Gas Transportation System
[c]This value represents the total contract volumes for completed terminals

REFERENCES

AGA -- American Gas Association *The Gas Energy Supply Outlook* 19802000 January 1982
AGA/GER—American Gas Association, Gas *Energy Review*. June 1982
CPA —Canadian Petroleum Association *Statistical Handbook* 1980
EIA— Energy Information Administration *U S Imports and Exports of Natural Gas 1981* J une 1982
LA –Canada– Lewin & Associates–Canad(ari *Natural Gas A Future North American Energy Source?* January 1980
LA—Mexico—Lewin & Associates–future *Mexican Oil and Gas Product(on* July 1979
PEMEX– in American Gas Association Gas *Energy Review* December 1982
PGC— Potential Gas Committee *Potential Supply of Natural Gas in the U S* May 1981
USGS– United States Geological Survey Circular 860

SOURCE Office of Technology Assessment

rent surplus supply and market prices below levels necessary for financial success. Despite a waiver package to eliminate roadblocks to private financing, the Alaska Natural Gas Transportation System project still has not achieved adequate financing arrangements. The rival, recently proposed TransAlaska Gas System would enable North Slope gas to be marketed outside of the domestic market. A methanol conversion alternative would allow the gas to be marketed either domestically or internationally. Neither of these alternatives appear to have good prospects for the immediate future.

Throughout the early to mid-1970's, liquefied natural gas (LNG) contracts were viewed as a favorable means of achieving long-term natural gas supplies. Since that time, the supply scenario has changed significantly, and LNG purchasers are now confronted with high-priced gas during a time of gas surplus. In the near term, there is little incentive to increase LNG imports; however, the availability of the long-term contracts and the opportunity to diversify U.S. supply may prove to be attractive in the future.

MEXICO

Mexico had reported 75.4 TCF of proved reserves as of December 1981. Within the last 4 years, large reserve additions have caused Mexico's reserve-to-production ratio to double from 30 to 60.

Most of Mexico's gas production is from wells associated with oil; nonassociated wells are typically not put into production. This practice reflects Mexico's policy of exporting oil and using natural gas primarily to meet domestic energy demands. Mexico exports only the surplus gas remaining after domestic demand is met, which is the primary limiting factor to export levels. Mexico's current export level of 110 BCF/yr was established in 1979 by a contract with Border Gas, a U.S. pipeline company.[2] This quantity is recognized as a compromise between Mexican policymakers, who believe energy exports are necessary to bolster Mexico's ailing economy, and those who believe the resource should be saved for future domestic use.

Mexico has been successful in encouraging conversions to natural gas, and, as a result, domestic gas demand has been growing at a rate of 13 percent per year. [3] Because Mexico's financial condition has precluded investment in distribution equipment, the primary constraint to increased domestic consumption is a lack of transmission and distribution capability. As the distribution system develops and the process of converting end users to gas progresses, domestic consumption will increase, which could further constrain the exportable surplus.

Substantial increases in the export level are not expected in the near term. Early in 1982, the Mexicans talked of increasing exports to 500 MMCF/day and later to 1,000 MMCF/day; however, these plans were not carried out, owing to problems with gas-gathering systems and budget cutbacks.[4]

There is a considerable range of estimates for the future quantity of Mexican gas available for export to the United States. In their "high success" case, Lewin and Associates estimate that annual exports will rise to 766 BCF in 1990 and then decrease to 255 BCF by 1995 and O by 2000.[5] The American Gas Association (AGA) is considerably more optimistic in its long-run projections and estimates that between 100 and 1,000 BCF/yr will be available in the 1990's and between 100 and 2,000 BCF/yr will be available by 2000.[6]

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[2]Border Gas is owned and controlled by six interstate pipeline companies: Tennessee Gas Transmission Co., Texas Eastern Transmission Corp., El Paso Natural Gas Co., Transcontinental Gas Pipeline Corp., Southern Natural Gas Co., and Florida Gas Transmission Co,

[3]*Petroleum Intelligence Weekly,* Special Supplement, "Mexico's Expanding Role in World Oil Markets, " June 28, 1982.

[4]Ibid.

[5]Lewin and Associates, *Future Mexican Oil and Gas Production,* July 1979.

[6]American Gas Association, *The Gas Energy Supply Outlook: 1980-2000,* January 1982.

CANADA

Canada also has large natural gas reserves, estimated at 88.4 TCF by the Canadian Petroleum Association. Its ultimately recoverable resource base estimate of 420 TCF[7] could be increased considerably by developing unconventional gas in Western Canada. At present, the technology to produce most of these low permeability reservoirs has not been demonstrated.

Marketability problems have created a large surplus export capability. In January 1983, in an attempt to alleviate the situation, the National Energy Board nearly doubled the exportable quantity of gas available to the United States. Also, in April 1983, the price was reduced from $4.94 per thousand cubic feet (MCF) to $4.40 per MCF to compete more readily in the U.S. market. However, despite these efforts, the price differential, decreased U.S. demand, and improved short-term domestic supply prospects are still expected to keep U.S. imports of Canadian gas low in the near term.

The 1980 National Energy Plan (NEP) is expected to have far-reaching effects on the Canadian petroleum industry. The NEP established guidelines aimed at enabling Canada to achieve energy self-sufficiency by 1990. Several NEP objectives include:

- encourage substitution of gas for oil by favorable pricing;
- increase Canadian ownership of the domestic petroleum industry to 50 percent by 1990;
- stimulate frontier exploration off the East Coast and in the Arctic;
- allow a 25 percent back-in interest for the Canadian Government on federal leases; and
- increase the Canadian Government's share of petroleum revenues relative to those received by industry and the producing provinces.

The increased regulation of the NEP has had a noticeable negative impact on risk investment. Canadian operators and support companies have left Canada for more lucrative prospects in the United States. Many petroleum companies have cut expenditures and long-term projects and suffered severe losses. These effects could lessen the quantity of gas produced in the remainder of the century, thereby limiting the availability of surplus for export to the United States.

Another factor affecting gas export is the level of Canadian gas consumption. In an attempt to reduce the need for expensive foreign oil imports, the Canadian Government is encouraging increased use of natural gas and has provided several incentives for doing so, such as favorable gas prices, grants, and loans. The NEB forecasts natural gas demand to increase at 4 percent per year during the 1980's and 3 percent per year throughout the 1990's.[8] Although the conversion process is progressing slowly, the quantity of gas available to the United States could be constrained if Canadian consumption increases substantially in the future.

Under current Canadian export agreements, natural gas exports will increase to about 1.6 TCF/yr by 1990 and then decline to about 0.15 TCF/yr by 2000.[9] AGA estimates that between 1.0 and 1.7 TCF/yr will be exported by 1990 and 1.0 to 2.0 TCF/yr by 2000. Lewin and Associates believe that technological advances in the frontier areas and the development of unconventional gas could allow exports of 2.5 and 3.0 TCF/yr in 1990 and 2000, respectively.[11]

[7] R.M Procter P. J. Lee, and D. N. Skibo, "Canada's Conventional Oil and Gas Resources" Geological Survey of Canada, Open File 767, March 1981, p. 27.

[8] National Energy Board, "Omnibus '82 Backgrounder," Jan 27, 1983.

[9] Ibid,

[10] American Gas Association, The *Gas Energy Supply Outlook: 1980-2000,* January 1982,

[11] Lewin and Associates, *Canadian Natural Gas: A Future North American Energy* Source, January 1980.

ALASKA

The massive hydrocarbon potential of Alaska was realized with the discovery of the Prudhoe Bay Field in 1968, which added 26 TCF to estimated U.S. proved gas reserves. Reserve estimates for Alaska average 32 TCF, and resource base estimates are as high as 145 TCF.[12]

Despite the substantial quantity of reserves in Alaska, lack of a transportation system has precluded marketing of Alaskan gas to the Lower 48 States. The Alaskan Natural Gas Transportation Act of 1976 directs the President, subject to congressional approval, to establish a means to transport Alaskan natural gas to the Lower 48 States. To ensure domestic use of the resources, the Export Administration Act of 1979 forbids the export of North Slope hydrocarbons to non-U, S. customers. Several transportation methods have been proposed; not all of these have designated the Lower 48 States as the final market.

In September 1977, the Alaskan Natural Gas Transportation System (ANGTS) was chosen over several alternatives. The **4,800-mile** pipeline was to be routed from Prudhoe Bay across Alaska and Canada to Alberta, and split into a western leg to California and an eastern leg to Illinois. Despite a waiver submitted by President Reagan and approved by Congress in mid-December 1981, to remove any legislative deterrents to private financing, the pipeline has not yet been financed. Investment capital has been difficult to attract because the marketability of the gas is questionable. ANGTS is estimated to cost between $38.7 billion and $47.6 billion[13] and deliver gas at prices estimated between $4.85 per MCF[14] and $20 per MCF.[15] ANGTS is the only transportation scheme designed to market North Slope natural gas in the Lower 48 States. AGA estimates that between 0.7 TCF and 1.2 TCF could be available by 1990 and 1.2 TCF to 2.4 TCF by 2000, depending on when the pipeline is completed.[16]

Converting North Slope gas to methanol could provide an alternative market for the gas. The principal advantage of the methanol option is that the existing oil pipeline system could be used to transport the methanol from the North Slope to Valdez, assuming capacity were available. The major problems with the methanol alternative are the high energy loss associated with conversion and the potential that future demand for methanol might be insufficient to absorb Alaskan production. Also, costs would be very high; estimated first year costs for conversion and transportation range between **$14.24** and $17.24 per million Btu.[17]

Two LNG projects have been proposed to market Alaskan gas. The Alaska Governor's Economic Committee recommended the TransAlaska Gas System (TAGS). The TAGS requires an 820-mile pipeline from the North Slope to the Kenai Peninsula, where the gas would be liquefied and shipped to foreign markets, principally Japan. If this proposal is adopted and an executive order or legislation declaring gas exports to be in the national interest is obtained, the Lower 48 States may never receive supplemental gas from the North Slope. Another LNG proposal, the Pacific Alaska LNG Project, calls for the shipment of south Alaskan LNG to receiving facilities on the California coast; however, the potential supply contribution from this project is small. AGA estimates 0.1 TCF could be supplied by 1990 and between 0.2 and 0.4 TCF by 2000, depending on the construction schedule.[18]

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[12] Potential Gas Committee, *Potential Supply of Natural Gas in the U. S.*, May 1981,

[13] 'American Gas Association, *Gas Energy Review*, vol. 10, No 1, January 1982.

[14] *International Gas Technology Highlights*, "Alaskan Pipeline Costs Could Be Lower Because of Delay: Northwest Heat, " Aug. 30, 1982.

[15] *Oil and Gas Journal*, "Angts Seen Top Option for Alaskan Gas, " Aug. 9, 1982, p. 61.

[16] *American Gas Association, *The Gas Energy Supply Outlook: 1980-2000*, January 1982

[17] Congressional "Research Service, *Major issues Associated With the Alaska Natural Gas Transportation Waivers, Dec. 18,* 1981.

[18] American Gas Association, *The* Gas ***Energy Supply*** *Outlook*: 1980-2000, January 1982,

LIQUEFIED NATURAL GAS

During the early to mid-1970's, when the United States was confronted with natural gas shortages, LNG imports appeared to be a favorable supplemental supply alternative. Several long-term contracts were established with Algeria. Since then, the supply situation has changed drastically, and in the midst of a natural gas surplus, LNG purchasers are confronted with very high-cost gas supplies.

Although existing agreements enable imports of up to **800** BCF per year, the U. S. imported only **61** BCF of LNG in 1982 at two of four- existing receiving facilities. The Distrigas facility in Everett, Massachusetts, received **34.0** BCF and the Lake Charles, Louisiana, facility received **27.0** BCF since its first shipment in September 1982. Small amounts of LNG were also trucked from Canada to New England. Also in 1982, the United States exported 55.9 BCF from Cook Inlet, Alaska, to Japan, and in 1981 was a net exporter of LNG.[19]

For purposes of evaluating future LNG availability, the LNG resource base includes any large reserves which, owing to remote location or lack of a transportation method, are not committed to existing markets. In **1978** OTA estimated that of the **2,257** TCF of proved reserves in the world, about 812 TCF were surplus (635 TCF of the surplus are located in the U. S. S. R., Iran, and Algeria[20]). Although reserves are plentiful, high costs preclude a large percentage of natural gas reserves from being made available as LNG. The total capital required for a world-scale LNG facility (1 BCF/day) is around **$5** billion (in **1978** dollars). Generally, **40** percent is required for production and liquefaction, **40** percent for transporttion, and **20** percent for receiving and vaporization facilities.[21]

The future of LNG depends principally on pricing and policy. If the producing country is willing to accept a price that achieves parity with the price of oil at the burner tip, the future of LNG is considerably brighter than if the oil parity price is demanded at the wellhead. The additional costs for liquefaction and transportation are reflected in the burner-tip price, which, if too high, is not competitive with oil and is not economically justifiable. Currently, the price of LNG is higher than market-clearing levels, and lower cost gas is used as a cushion to moderate the price. This average pricing concept is often criticized for substituting high-cost imports for lower priced alternatives, creating a potential misallocation of resources. Also, from a policy standpoint, importing foreign supplies of natural gas, particularly from a member of OPEC, is not consistent with U.S. goals of reducing energy dependence.

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[19]U S. Department of Energy, Energy Information Administration U s Imports and Exports of Natural Gas 1Q81 , June 1 982

[20]Office of Technology Assessment, *Alternative Energy Futures, Part. 1, The Future of LNG,* March 1980.

[21]Ibid.