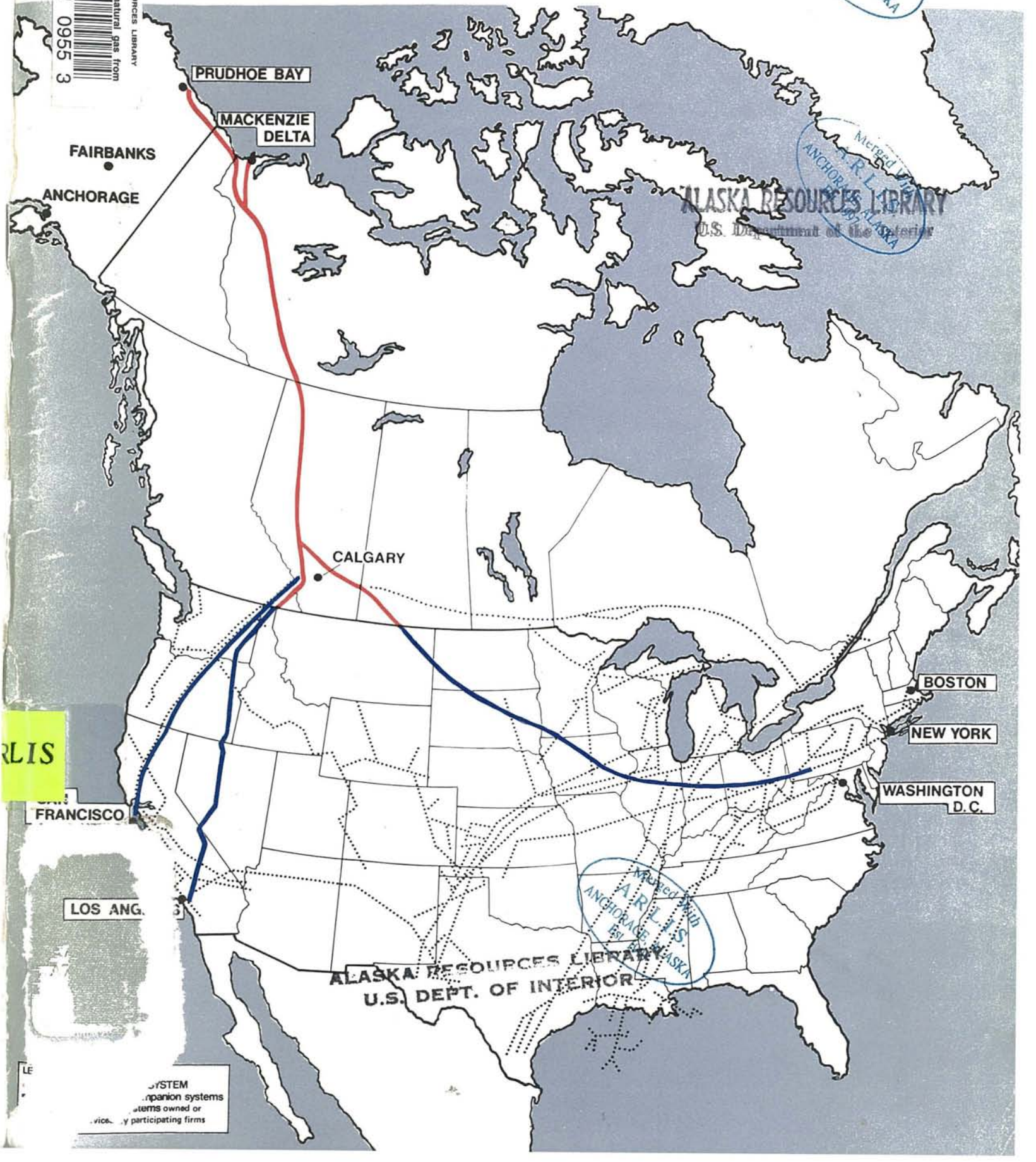
THE ARCTIC GAS PROJECT



THE ARCTIC GAS PROJECT

Natural Gas From Alaska

A DESCRIPTION OF THE PROJECT
AND ITS
PRINCIPAL ADVANTAGES FOR THE UNITED STATES

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I INTRODUCTION AND SUMMARY OF CONCLUSIONS

The Arctic Gas Project proposes to construct a natural gas pipeline from northern Alaska, south across Canada along the Mackenzie River, to energy-short markets throughout the United States. That pipeline will transport Prudhoe Bay gas, already equal to over 10% of the nation's gas reserves, and much greater amounts of additional gas which are being developed in the Arctic, to the markets which need it. The Project is important to the national interest of the United States. This paper, prepared by the Arctic Gas Project, describes the Project and demonstrates its importance to this nation, as well as to Canada.

The proposed Arctic Gas pipeline from Alaska through Canada will divide in southern Canada into two legs which will run to points on the Idaho and Montana borders with Canada. From there, companion pipelines will carry arctic gas directly to United States markets in the West, Midwest and East. The map on the cover of this paper shows the basic routing.

Prompt governmental approval of the Arctic Gas Project is required by the national interest. Applications for authorization to construct that Project have been filed with the appropriate agencies of the United States and Canadian governments, and voluminous direct evidence which has been submitted to such agencies demonstrates the economic and technical feasibility, and environmental acceptability, of the Arctic Gas Project. The applications and evidence are the culmination of years of work and study by engineers, leading experts in environmental and other disciplines, at a cost to date of more than 75 million dollars.

The Arctic Gas Project is a national project which will make substantial volumes of critically needed Arctic natural gas supplies directly available to high priority residential, com-

mercial and industrial markets in the lower 48 of the United States. The Project will make such gas supplies available expeditiously, efficiently, reliably and economically via the proven and environmentally sound method of a conventional buried natural gas pipeline.

The Arctic Gas Project also will permit the economic delivery of Canada's frontier reserves (Mackenzie River Delta and offshore Beaufort Sea) to expanding markets in southern Canada and is extremely important to the national interest of Canada. Providing Canada economic access to its frontier reserves will indirectly benefit the United States also, since it will permit the rapid development of large volumes of new gas supplies which will help to maintain existing authorized exports to the United States and, in the event a surplus of Canadian gas is found to exist, will permit additional exports.

The existence of an economic, readily expandable Arctic transportation system, coupled with markets in urgent and continuing need of gas supplies in the United States and Canada, will encourage exploration and development of additional gas supplies in the arctic regions of Alaska and Canada. The Arctic Gas Project, with gas supply legs stretching along the North Coast of Alaska and into the Mackenzie River Delta, provides an unrivaled capability to transport newly discovered gas supplies at minimum economic and environmental cost. In addition, proposed companion lines traverse areas in which coal is plentiful, and can provide a means of transporting gas manufactured from coal, when that source of energy is authorized.

As a competitive alternative to the Arctic Gas Project, El Paso Alaska Company proposes to construct and operate a complex transportation system by which natural gas from northern Alaska would be carried by a new pipeline to Gravina Point in southern Alaska. There the gas would be liquefied in a large plant to be constructed there, and loaded onto cryogenic

tankers for ocean transport to California, where the liquefied gas would be regasified in a new coastal plant, and then transported through new and existing pipeline systems either directly, or indirectly by displacement exchanges among systems, to markets in whatever areas such a system would serve. That system would cost well over $8 billion, at least, when all necessary elements are included, in contrast to a 1974 statement by El Paso that it would cost "in the range of $3.5 billion."

As detailed in the body of this paper, the Arctic Gas Project offers the following overwhelming benefits.

1. The Arctic Gas Project is the most environmentally sound transportation method for Arctic gas.
2. The Arctic Gas Project will provide a much lower transportation cost than an LNG tanker scheme, producing savings of hundreds of millions of dollars per year—over $845,000,000 per year, based on third year rates. These transportation cost savings will be realized for all market areas: western, as well as midwestern and eastern.
3. The LNG tanker project would consume over 78% more energy in transporting natural gas to markets than the Arctic Gas Project. The *additional* daily energy consumption amounts to almost four times the average daily consumption of Washington, D. C.: more than the residential consumption of each of 39 states. There is no reasonable basis for sanctioning such needless waste of this premium energy supply.
4. The Arctic Gas Project provides significantly greater reliability and security of service than the other methods can provide.
5. The Arctic Gas Project can be placed in operation sooner than alternative systems.

6. The Arctic Gas Project provides the only feasible access to Canadian arctic gas, which could come to the United States if declared surplus, and in any event will help support existing exports to the United States, as well as provide supply for Canada.

7. The Arctic Gas Project provides for direct delivery to the market areas served by shippers utilizing the project. In sharp contrast, the LNG tanker project would involve an extremely complex displacement scheme, posing substantial technical and rate problems and delays.

8. The Arctic Gas Project will provide employment and business activity to United States labor and industry, and will provide a modest balance of payment benefit.

In an attempt to obscure these many advantages, El Paso has simply attacked the reliability of the Canadian government. This attack is not only unfounded historically, and is inconsistent with past U.S. and Canadian reliance upon each others' good faith, such as in the St. Lawrence Seaway, but also ignores the eminently practical consideration that very large quantities of Canadian gas and oil, absolutely vital to Canadian energy balances, are transported from Canada through the United States and back in to Canada. It is to Canada's own self-interest to insure the integrity of Alaskan gas transported across Canada. In addition, a treaty guaranteeing nondiscriminatory security of throughput is in negotiation.

The Arctic Gas Project will employ conventional pipeline technology, emphasizing environmental safeguards. Millions of dollars have been spent by Arctic Gas to assure the construction and operation of an environmentally safe, and socially and economically desirable line. Although the pipeline is proposed to traverse the Arctic National Wildlife Range, Arctic Gas' unprecedented environmental and engineering research by a group of recognized experts, over a period of more than six

years, which is briefly described later in this paper, shows that it will have no adverse impact on the Range itself or on wildlife usage of the Range. Moreover, a pipeline is clearly within the present terms of permissible use of the Range.

The above affirmative conclusions are supported in the body of this paper under topic sections listed in the index. Those sections also analyze such arguments as have been raised against the Arctic Gas Project and demonstrate why the arguments are without merit.

As suggested above, this paper specifically compares the Arctic Gas Project with a liquefied natural gas tanker project, such as is proposed by El Paso Alaska Company, a subsidiary of El Paso Natural Gas Company.

These analyses and comparisons demonstrate that the national interest of the United States and Canada requires that the Arctic Gas Project rapidly be approved; that our national interest would be damaged by delay or disapproval.

The completion of the government approval process is, of course, a requisite to financing, construction and operation of the Project.

All sections of this paper are based upon extensive studies and materials produced by or for the Arctic Gas Project. Many of those materials are included in the Project's filings before the Federal Power Commission and the Department of the Interior.

Two documents have been of particular importance in preparing this paper. One is a study prepared by the distinguished economist, Dr. Ezra Solomon, Dean Witter Professor of Finance at the Graduate School of Business at Stanford University and formerly a member of the President's Council of Economic Advisors. Dr. Solomon analyzes the importance of the Arctic Gas Project to the economy of the United States and quantifies certain economic effects.

The other study was prepared by the engineering consulting firm of Purvin and Gertz, Inc. of Dallas, Texas. That document is a detailed analysis of a LNG tanker project, such as has been formally proposed to the United States government by El Paso. That study allows direct comparison of the all pipeline system of the Arctic Gas Project with the LNG pipeline-liquification-tanker-regasification-pipeline proposal.

II THE NEED FOR NATURAL GAS FROM THE ARCTIC

It is urgently necessary that the United States develop additional domestic sources of energy. Existing shortages of energy have so demonstrated this fact that no proof is required. Dr. Solomon's paper traces the growth and severity of the problem.

A. Domestic Energy Shortage

The character of natural gas as the cleanest fuel is well known. The fact that it is also the largest single source of domestically produced energy in the United States is seldom recognized. For example, in 1971, domestic natural gas provided 31.6% of total U.S. energy supply. In contrast, domestic crude oil provided 28.3%.

For the first time in peacetime, individual consumers have experienced actual shortages of gasoline, fuel oil and liquefied petroleum gases. The shortage of natural gas has grown. Reserves of both oil and gas have been shrinking, as usage has exceeded development of additional supplies.

Actual curtailments of deliveries of natural gas by interstate pipelines to their firm supply customers during the heating season, November, 1973 through March, 1974, were 443.6 billion cubic feet, or 7.32% of total firm requirements. For all of 1974, actual net curtailments of firm service totaled nearly

1.7 trillion cubic feet. That figure represents an increase of almost 55% from 1973 firm curtailments of 1.10 trillion cubic feet and is nearly triple the 1972 figure of about 650 billion cubic feet. For the full 1974-1975 heating season, the Federal Power Commission staff has estimated that firm curtailments will reach 12.87% of total requirements.

Natural gas curtailments to interruptible customers of the interstate lines, including many United States industries, have been even more severe. Indeed, some pipelines have been forced to curtail their interruptible customers totally. For the year September, 1973 through August, 1974, interruptible sales were curtailed 213.3 billion cubic feet, or 38.9% of requirements. The curtailments for the year September, 1974 through August, 1975 are expected to increase to 266.2 billion cubic feet, or 58.24% of requirements.

It is seldom recognized that the growing shortage of natural gas was a critical factor in setting the stage for our present total energy crisis.

B. Imported Energy—Cost

Greater hardship from want of energy than has been experienced has been avoided only by filling the gap with continuing large imports of foreign oil. In 1974, about 37% of the petroleum and petroleum products used by the nation was imported, with well over one half of that total being imported from the OPEC countries. Those countries have recognized the international political and economic power their supply position has created. Some of the OPEC nations have used that power, demonstrating that such sources are no longer stable or reliable.

The economic cost to the United States of relying on such large imports is clear. Prices have multiplied geometrically to the point that our payments for foreign oil have risen to about $25 billion in 1974. Accordingly, there is a clear market

for Alaskan natural gas, both from the point of view of cost and also security of energy supplies.

C. Growth In Demand

Even if we assume reduced growth in our population, and further assume that we in the United States develop and sustain a conservation ethic with respect to energy consumption, the demand for energy will grow. At best, we can hope only to moderate the rate of growth in that demand. Unless substantial new supplies of natural gas are brought to markets, the gas shortage, while serious now, will become much worse and will continue seriously to aggravate those economic imbalances which arise from increasing dependence upon foreign energy supplies.

D. Importance of Gas Reserves in the Arctic

Alaskan natural gas constitutes the largest new source of vitally needed natural gas which can be made available relatively soon. DeGolyer and MacNaughton, an internationally respected firm of oil and gas geologists and reservoir engineers, has estimated the proven salable reserves in the Prudhoe Bay field of Alaska to be approximately 24 trillon cubic feet (on a 1,000 btu basis), or over 10% of the nation's gas reserves. This proven reserve is the anchor of the Arctic Gas Project. But in addition, that firm reports that the exploration and development of north Alaska has only begun. They state that potential reserves estimates of 114 trillion cubic feet are "reasonable if not conservative". Recent new strikes have been announced.

In addition, the Arctic Gas Project is the only near term means of providing access to additional reserves of gas in the Canadian Arctic. Currently, proven, probable and possible reserves in only the Mackenzie Delta area of the Canadian

Arctic were estimated at 6.4 trillion cubic feet, with exploration continuing. This figure does not include recent and significant strikes in the Delta area. The potential of the area is well in excess of 50 trillion cubic feet. These reserves are important to Canada (1) in meeting its own needs, and (2) in meeting existing Canadian commitments to supply gas to United States markets, which needs and commitments are even now in excess of presently available supply. In addition, these reserves are a potential source of additional gas for export to the U.S.

III DESCRIPTION OF THE ARCTIC GAS PROJECT

A. Design And Operation

The basic concept of the Arctic Gas Project is construction of a buried overland natural gas pipeline over a relatively direct route from northern Alaska and northwestern Canada to market areas across both nations. It will be built with large capacity, in order to achieve the economies of scale made possible by transporting natural gas from both the United States and Canadian Arctic to market areas in both nations, which badly need the gas. It will be refrigerated in the north, where construction will also be in the winter: both measures are among the many steps which help protect the environment.

The enterprise is structured to operate as follows:

1. The Project will transport gas for anyone owning gas which can economically be hauled by the Project pipeline, and not solely for those who own interests in the pipeline. The Project does not plan to own, buy or sell natural gas.

2. The policy of the Project will be to expand the pipeline whenever needed to transport any gas available on an economic basis. Thus, whenever additional quantities of Alaskan or Canadian gas become available, the appropriate parts of the

system—in Canada and the United States—will continue to carry existing volumes and also will expand to carry the new gas.

3. Ownership of an interest in the pipeline is not a requisite to buying gas in the arctic. Acquisition of gas from the arctic will be the result of free bargaining between the owners of that gas and prospective buyers. Those who buy gas will then be free to contract with the Arctic Gas Project to have the gas transported. This policy would, of course, apply also to El Paso Natural Gas Company. Indeed, gas that El Paso might acquire in the arctic, if any, could most economically be transported by the Arctic Gas Project.

4. Ownership interest in the pipeline is not confined to the participating, sponsoring companies. Such interests are available to any investors.

B. Route and Organizational Structure

The cover page of this document contains a map of the entire Arctic Gas system. In this paper, the term Arctic Gas Project most often refers to that entire system, including its Alaskan and Canadian components and those companion connecting pipelines in the contiguous forty-eight states.

Nineteen U.S. and Canadian members presently make up the "Gas Arctic-Northwest Project Study Group," and sponsor and participate in the ownership of both Alaskan Arctic Gas Pipeline Company (an Alaska corporation, with offices in Anchorage and Washington, D.C.) and Canadian Arctic Gas Pipeline Limited (a Canadian corporation with offices in Toronto, Calgary, Yellowknife and Ottawa). The member companies are:

a. United States Pipeline and Distribution Companies: *

Columbia Gas Transmission Corporation
Michigan-Wisconsin Pipe Line Company (American Natural Gas Company)
Natural Gas Pipeline Company of America (Peoples Gas Company)
Northern Natural Gas Company
Pacific Gas & Electric Company **
Pacific Lighting Gas Development Company
Panhandle Eastern Pipe Line Company
Texas Eastern Transmission Corporation

b. United States and Canadian producing companies: ***

Atlantic Richfield
Gulf Oil Canada Limited
Imperial Oil Limited
Shell Canada Limited
Superior Oil Limited

c. Other Canadian member companies:

Alberta Natural Gas Company Limited
Canada Development Corporation
Canadian Utilities Limited
Northern and Central Gas Corporation Limited
The Consumers' Gas Company

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* Northwest Pipeline Corporation also co-sponsors the companion ITAA project in the United States, with Pacific Lighting.

** Participating through an affiliate and with its companion U.S. system.

*** The other major Prudhoe Bay producers (EXXON and SOHIO) are former participating companies, and continue to cooperate in studies, as do Canadian producers, Numac Oil and Gas Limited and Sun Oil Company.

TransCanada Pipelines Limited
Union Gas Limited

These companies and others have developed and financed the program of research, study and design of the Arctic Gas Project. The scope and extent of that program is unprecedented for any project prior to receiving governmental approval. The expenses of Arctic Gas alone, from 1968 through 1974, not including the three "lower 48" companion projects and their member companies, totaled over $70 million. The budget for 1975 alone is approximately $30 million more.

The United States companies are in the business of transporting or selling gas to most areas of the United States. It is of first significance that these companies regard the Arctic Gas Project as the most sensible and economic system for moving gas from the Arctic to the contiguous forty-eight states. That view is proved by their willingness to finance this program, despite no assurance of government approval. It must also be understood that such costs are an enormous burden for the companies to bear. This is another reason why prompt governmental approval is necessary.

1. *Alaskan Arctic Gas Pipeline Company*

Alaskan Arctic Gas will own and operate a pipeline from Prudhoe Bay on the Beaufort Sea coast of northern Alaska to the Alaska-Yukon border, approximately 195 miles to the East. There, the ownership of the pipeline will shift to Canadian Arctic Gas Pipeline Limited. In the Prudhoe Bay area, the large quantities of natural gas, as well as oil, which have been proven lie in the middle of an area of very large additional potential reserves of both oil and gas.

2. *Canadian Arctic Gas Pipeline Ltd.*

From the Alaska-Yukon border, the pipeline passes into the ownership of Canadian Arctic Gas and runs east and south

across the narrow Yukon neck to a point near Travaillant Lake, in the Northwest Territories, where it will connect with the pipeline lateral from the Canadian arctic producing areas in the Mackenzie Delta, which will be transporting Canadian source gas.

From Travaillant Lake, the pipeline carrying both Canadian and U.S. source gas will run in a generally southern direction up the Mackenzie River into the province of Alberta to a point near Caroline.

At Caroline the line will divide, with the western leg running to Kingsgate on the border between Idaho and British Columbia. The eastern leg will run to Monchy, Saskatchewan on the Montana border. The existing and proposed gas pipelines which will connect with Arctic Gas at the Monchy and Kingsgate points on the U.S.-Canadian border are essential parts of the Project.

The Canadian gas destined for Canadian pipelines and markets will leave the eastern leg of the Arctic Gas system at Empress, Alberta, where the line connects with that of Trans Canada Pipeline, a member company which is the major supplier to Manitoba, Ontario and Quebec. Other points of connection for supply of Canadian gas to other parts of Canada will also be provided.

3. ***Companion Connecting Systems In Contiguous 48 States***

a. To serve areas east of the Rocky Mountains: Northern Border Pipeline Company.

To carry Arctic gas to the U.S. Midwest and East, and to the regions south of there which they serve, six U.S. pipeline companies have created Northern Border Pipeline Company. Those six companies and the areas they serve are:

Columbia Gas Transmission Corporation
serves the District of Columbia, Kentucky, Maryland,

New York, Ohio, Pennsylvania, Virginia and West Virginia

Michigan-Wisconsin Pipe Line Company
serves Illinois, Indiana, Iowa, Kansas, Michigan, Missouri, Ohio, Tennessee and Wisconsin

Natural Gas Pipeline Company of America
serves Illinois, Indiana, Iowa, Kansas, Missouri, Nebraska, Oklahoma, Texas and Wisconsin

Northern Natural Gas Company
serves Colorado, Illinois, Iowa, Kansas, Michigan, Minnesota, Nebraska, and South Dakota

Panhandle Eastern Pipe Line Company
serves Illinois, Indiana, Kansas, Michigan, Missouri and Ohio

Texas Eastern Transmission Corporation
serves Alabama, Arkansas, Illinois, Indiana, Kentucky, Louisiana, Mississippi, Missouri, New Jersey, New York, Ohio, Pennsylvania, Tennessee and Texas

Northern Border will be a carrier of gas and will construct a pipeline from the Montana border point, past the coal fields of Montana and the Dakotas, through Minnesota, Iowa, Illinois, Indiana, Ohio and on to its terminus in western Pennsylvania. Along the way it will have connection points at which gas can be delivered to most of the companies which serve the area east of the Rocky Mountains, including the companies named above.

b. To serve areas of the United States West of the Rocky Mountains: two pipeline projects are proposed to carry gas from the western leg of Arctic Gas.

(1) Pacific Gas and Electric and affiliates.

Pacific Gas and Electric Company of San Francisco and its affiliates propose to expand existing facilities. One such affiliate, Alberta Natural Gas Company Limited, would take the gas from Canadian

Arctic at the Alberta-British Columbia border and deliver it at the British Columbia border to another affiliate, Pacific Gas Transmission Company, which runs through and delivers gas to Idaho, Washington and Oregon. At the California border, P.G.T. delivers gas to Pacific Gas and Electric, for service to northern California. P.G.T. also has connections in Oregon with Northwest Pipeline Corporation, which serves the Pacific northwest and intermountain western states of Washington, Oregon, Idaho, Utah, Wyoming, Colorado and northern Nevada.

(2) Interstate Transmission Associates (Arctic)

Interstate Transmissions Associates (Arctic) proposes to take gas from the Canadian Arctic system at the Idaho-British Columbia border and transport it in a new pipeline to interconnections with its sponsors. Those sponsors are: Pacific Interstate Transmission Company, whose affiliate serves southern California, and Northwest Alaska Company, whose affiliate is Northwest Pipeline Company, serving the areas in (1), above. Interstate Transmission Associates (Arctic) will be a carrier and does not plan to buy or sell gas.

C. Pipeline Capacity

The forty-eight inch main line of the Arctic Gas Project will carry approximately 4.5 billion cubic feet of gas per day when full compression horsepower is installed. The line can, of course, be expanded by looping and adding compression in order to carry additional volumes of gas as they become available.

Present planning calls for startup capacity and throughput of 3.25 billion cubic feet per day, with expansion to 4.5 billion in about three years, but these levels can be modified to carry the available gas.

D. Gas Supply and Distribution

As of the date of this paper, the largest portion of the proven Prudhoe Bay gas in Alaska has been optioned or tentatively committed.

Standard Oil Company of Ohio (SOHIO) and British Petroleum Corporation, under a complex arrangement, have granted options on their portion of the Prudhoe Bay gas to the Columbia Gas Transmission Company and to Northern Natural Gas Company.

EXXON, U.S.A. has entered into an arrangement giving the exclusive right to negotiate the purchase of their interest in the Prudhoe Bay gas to four companies: the rights of Northern Natural Gas Company and Michigan-Wisconsin Pipeline Company each extend to 25% of the gas, the rights of Pacific Gas and Electric Company extend to 30% of the gas and the rights of Natural Gas Pipeline Company of America to 20% of the gas.

The Atlantic Richfield Company (ARCO), has entered into an arrangement giving similar rights to 60% of their interest to Pacific Lighting Gas Development Company, with 40% of ARCO's interest remaining uncommitted.

E. Present Status Of The Project

On the date of publication of this paper, the Arctic Gas Project has made application for right of way permits to the United States Department of Interior, which is preparing its Environmental Impact Statement, and Canada's Department of Indian and Northern Affairs, which has appointed a Commissioner, who is holding hearings to recommend terms and conditions for a land use permit. Application has been made to the Federal Power Commission and Canada's National Energy Board, for certificates of public convenience and necessity to

construct the pipelines, and hearings are anticipated shortly. Although eminent domain will be available upon receipt of federal approvals, Arctic Gas has also indicated to the States and Provinces involved, its willingness to negotiate rights of way over their lands.

The estimated construction cost, resultant transportation costs and schedule for operations are described in later sections of this paper.

Arctic Gas desires government approvals by the end of 1975, so it can have a chance to begin delivering gas from Alaska to United States markets in 1980.

IV THE PRINCIPAL ADVANTAGES OF THE ARCTIC GAS PROJECT

Clearly, the best method for transporting natural gas is by a pipeline, running directly from the source of gas to the market. That is what the Arctic Gas Project basically is. There are other, more circuitous methods for carrying natural gas which involve changing the form of the gas. One method is to convert the gas into liquid (LNG) form and transport it by ocean going tanker. Generally, it is only when a pipeline cannot be used, as when oceans separate the gas source from the markets, that a LNG tanker system is utilized, because such a system uses more gas and costs more money.

If all of the land which connects the Arctic gas producing areas to the contiguous 48 States belonged to the United States, no one would ever question whether a buried refrigerated pipeline is the best way to transport natural gas to the United States. In later sections of this paper, it will be shown why the existence of Canadian lands does nothing to alter this obvious choice of transportation method. We will show that the Arctic Gas Project is superior to the proposed El Paso LNG plan, and other systems, because:

- Arctic Gas will deliver gas directly to the markets which need and have purchased it, and not by a circuitous sea route.
- Arctic Gas will use far less energy than any other system, thus avoiding waste of gas and other fuel.
- Arctic Gas will provide much lower transportation costs to the United States, including the West Coast, West, Middle West and East, than any other system. This provides the potential for lower costs to consumers, or higher revenues to producers to stimulate vitally needed gas exploration and production, or both.
- Arctic Gas provides the most environmentally sound method of gas transportation.
- Arctic Gas provides the most secure method of gas transportation.
- Arctic Gas will provide a transportation method which could be used to transport any surplus Canadian gas to United States markets, and support existing U.S. imports.
- Arctic Gas can be in operation faster than competing systems.
- Arctic Gas will not hurt the United States balance of payments status; it will provide a small surplus and other economic benefits to the United States.

A. Direct Delivery To All Markets

As the map on the cover shows, the Arctic Gas Project will move gas straight to the West, Midwest and East, deviating from basically direct routes only to skirt the Rocky Mountains and the Canadian rock shield, and to cross areas which environmental considerations indicate should be utilized by the pipeline areas.

Alternative systems which would use water transportation, including LNG tankers from south Alaska as proposed by El Paso, cannot make direct deliveries. The tankers must either land the gas on the West Coast, as proposed, or bring it through

the Panama Canal or around South America. From the West Coast the gas must then be regasified and transported by pipeline to market areas across the country. Such an indirect transportation route creates several problems. First, the circuitous haul uses more fuel, as explained in the next subsection. Second, it creates extra cost, as described below in subsection C. Moreover, a sea route is not as secure (subsection E, below) and does not provide transportation facilities for other gas sources, as does Arctic Gas, which we demonstrate below in subsection F.

In addition, however, those market areas which are remote from the port area have expressed apprehension that they will be unable to secure an equitable share of Alaskan gas, if only because the gas would be so much cheaper on the West Coast than in other areas, which makes for attractive marketing. Such reactions are in part reflected in the fact that pipeline and distribution companies in the East and Midwest, as well as the West, uniformly favor the Arctic Gas Project.

B. A LNG Tanker System Will Use Over 78% More Energy Than The Arctic Gas Project

It is a basic characteristic of a gas transportation system which requires liquefaction of the gas (LNG) that a relatively large amount of the gas is consumed in the process. Thus, the proposed LNG system will use about 270 billion Btu per day of gas *more* than the Arctic Gas Project. This is a huge amount of energy. It is greater than the residential usage of 39 of our states. It is about four times the *total* daily gas usage of Washington, D.C. and in excess of the total usage of 15 states. Clearly, this great waste of energy is an unreasonable price for our nation to pay.

The LNG system uses gas in its liquefaction phase, and also in its tanker, pipeline and regasification phases. It further will consume substantial quantities of oil and electricity.

The Purvin and Gertz report computes the total energy usage of that system to be the equivalent of about 618 billion btu per day (Btu/d), or about 16.6% of the input from Prudhoe Bay, assuming an input of 3.28 Bcf/d (3311 billion Btu/d).

By contrast, Table 1 of the Appendix of this paper shows that the Arctic Gas Project will use only about 347 billion Btu/d, or about 9.3% of the same input from Prudhoe Bay. (In fact, this usage is likely to be overstated by about one half of one percent, since midpoint Btu's have been used, rather than a weighted average.)

In an effort to offset the fact of the waste of gas, El Paso asserts that it will reclaim some of this energy loss at the regasification terminal by using the "cold" created. However, an analysis of current liquefaction technology indicates that of the total energy input to liquefaction, approximately 50 percent is *irretrievably lost* to the atmosphere in the form of heat, because of inefficiencies in energy conversion. Therefore, the maximum possible energy recovery from the LNG, *even theoretically*, is approximately 50 percent of the energy required for liquefaction, or less than 25% of the system usage. But that figure is also speculative. For example, if the cold energy could be used for refrigeration (the most efficient and commercially feasible method of utilization), it might be theoretically possible to recover up to 80 percent of the available energy, which is equal to about 3 percent of the Prudhoe Bay input. But from experience in the actual application of cold energy, it is determinable that it is actually feasible to recover only a small portion of the energy; probably not more than 0.1 percent of the Prudhoe Bay input.

Further, the quantity of cold energy that an LNG project would produce in the course of the gasification phase is so large that no more than a small portion of it could conceivably be utilized. For example, such a project would produce over

four times the 1973 liquid air production in the entire United States, or roughly equivalent to the annual amount used by the entire U.S. cold storage industry in recent years. Accordingly, centralizing enough demand to utilize an appreciable amount of the cold energy is not feasible.

It is clear from scientific literature that refrigeration is the only economically attractive use of LNG cold energy today, because development of usable energy from the regasification of LNG either involves unattractive economics or undeveloped technology. Moreover, balancing regasification plant output of cold potential with industrial demand, transportation timing, and requirements for the safe handling of LNG further complicates even the use of cold energy.

There is a possibility that the cold energy potential of LNG at the West Coast terminal could be utilized as a "heat sink" for certain processes, notably electric power generation. This suggestion is interesting, but involves theoretical technologies which to date have not been tried or proven. The ultimate decision whether to use the cold potential in this manner will involve considerably more study, the identification of super fluids, specialized metals, and pilot plant verification before it can be employed in actual practice. Further, the use of LNG cold for such processes would tightly "interlock" the LNG vaporization and the power plant operations, meaning alternate back-up systems would probably have to be provided at an additional cost to all the "interlocked" or interdependent processes.

It should be pointed out that El Paso's assertions regarding energy recovery are obviously not accepted by the sponsors of Western LNG Terminal Company, one of whose regasification plants El Paso proposes to use. That company is the one which would make use of the cold, if it were practical. But Western's application to the Federal Power Commission, for

permission to construct three LNG regasification terminals in Southern California states (contrary to El Paso's assertions) that Western will use conventional sea water LNG vaporizers, which do not allow "cold reclamation", rather than any unproven technology. (See also the discussion of this topic in the Purvin and Gertz report.)

In short, the LNG tanker-pipeline proposal would waste very large amounts of fuel, as compared to the Arctic Gas Project, and the theoretical methods proposed are not feasible and would, in any event, recover only a fraction of the wastage.

C. The Substantial Cost Advantage Of The Arctic Gas Project

The Arctic Gas Project will deliver gas to market areas at much less transportation cost than any other method. In the Project's filing with the Federal Power Commission and the Department of the Interior, on March 21, 1974, the proposed pipeline was compared to nine alternative ways to transport that gas: liquefaction and transmission from the North Slope by tanker or submarine, by railroad or monorail, or by airplane or heliofloat; conversion to densephase or methanol and transportation by pipeline; and generation of electricity with the gas and transmission of the electricity to market areas. All were shown to be far more expensive, in terms of money and energy loss, than the Arctic Gas Project, as described fully in the exhibits filed.

Since that time, the Arctic Gas Project has updated its costs, and the Purvin & Gertz report shows the costs of the Alaskan LNG system, computed on a comparable basis, using a south Alaska port. The result is a finding of a cost saving from use of the Arctic Gas Project of several *hundreds* of *millions* of dollars *per year*. For example, the table below shows that the Arctic Gas Project would produce a savings in transportation costs in excess of $845,000,000 per year, comparing

costs for the third year of operations for each project. The table also shows a saving of about $686,000,000 per year, on a 10 year average rate basis, which basis assumes no expansion of capacity, and thus declining rates, and therefore tends to understate the savings. These savings would be distributed among illustrative market areas as follows, based on the assumptions detailed in Table 4 of the appendix.

Market Area	Transportation Cost Savings: Cents per million Btu — 3rd Year Costs	Cents per million Btu — 10-year avg. Costs	$ per day — 3rd Year Costs	$ per day — 10-year avg. Costs
Los Angeles	$ .39	$ .28	$ 408,200	$ 293,100
San Francisco	$ .50	$ .40	298,900	239,200
Chicago	.98	.83	989,600	838,100
Pittsburgh	1.25	1.03	618,900	509,900
TOTAL DAILY SAVINGS			$2,315,600	$1,880,300
ANNUAL SAVINGS			$845,200,000	$686,300,000

Such levels of *annual* savings are obviously of very large dimensions. They are of such size that they put the full burden of proof on anyone who supports the alternative: why should the citizens of the United States be subjected to such an economic penalty, as well as to the great loss of energy which is explained in the preceding section of this paper?

Tables 4 through 21 of the Appendix to this paper give the basic information which supports the transportation cost savings illustrated above, and allow any combination of savings calculations to be made. Those tables were prepared for the same four illustrative delivery points used in the Purvin & Gertz Report, on both a cost per Btu basis (Table 4-13) and a cost per Mcf basis (Tables 14-21). Each table was calculated on the basis of 1974 costs per segment divided by volumes

delivered at the end of each segment or the total system. Comparison of the figures on those tables with the Tables in the Purvin & Gertz report will allow complete comparison of the Tariffs of the Arctic Gas and LNG tanker systems. Addition of the difference between fuel costs on Table 6 and the comparable table of the Purvin and Gertz Report (page 26), will yield a differential which, when added to such Tariff differentials, gives total transportation cost savings from use of the Arctic Gas Project.

An example of such comparisons, which underlie part of the savings table set forth above, shows the relative ten year average transportation costs per million Btu for each delivery system to the four delivery areas used (Los Angeles, San Francisco, Chicago, and Pittsburgh), and resultant per unit savings used in the table above, all as follows:

Delivery Point	Transportation Cost in Cents per million BTU *		Saving
	Arctic Gas Project**	LNG System***	
Chicago	$1.08	$1.91	$ .83
Pittsburgh	1.21	2.24	1.03
Los Angeles	1.24	1.52	.28
San Francisco	1.07	1.47	.40

* Including fuel at 50 cents per Mcf for illustrative purposes. At higher fuel price levels, the Arctic Gas cost advange is increased.

** Table 6 of the appendix of this paper.

*** From page 25 of Purvin and Gertz report, plus energy cost on page 26 (50¢ column), using "Case III Displacement" example for Chicago and Pittsburgh.

The costs for the LNG system were derived by Purvin and Gertz by computing the total cost, in 1974 dollars, of a trans-Alaska LNG system, using the El Paso application as a base. This allowed the costs of the Arctic Gas Project and a trans-Alaska LNG system to be compared, using the same basic cost-

ing standards for both systems, the same Alaskan gas volumes delivered through each system, and the same delivery points. The Purvin and Gertz report explains how the "displacement" proposal of El Paso, including a new line by that company from the Permian to Anadarko Basin, was utilized and corrected to produce such project costs. The Arctic Gas Project costs are developed on the basis of its system carrying 3.28 Bcf/d of Alaskan gas, which is the Alaskan gas volume claimed and used by El Paso. The Canadian volumes are, in these calculations, carried by Canadian Arctic and are at a level which has been demonstrated to be reasonable for the first year of operations.

It is clear that the Arctic Gas Project has a very large cost advantage, even for deliveries to California cities, which are relatively near the LNG port area. When the comparison is made for deliveries to midwestern and eastern points the advantage multiplies, because the Arctic Gas Project will be able to deliver gas to the Middle West for about the same transportation cost as to California cities, as shown in the above table. In contrast, an LNG tanker system would require large extra costs to move gas from the West Coast to midwestern and eastern points.

The very large cost savings from the Arctic Gas Project reflect the basic fact that the capital cost of the tanker LNG system, including facilities needed to be added to existing pipeline systems in the contiguous 48 states, is considerably larger than that of the Arctic Gas Project relative to the volumes which each can transport. It is far costlier per unit of capacity than the Arctic Gas Project, which has a larger design capacity of 4.5 Bcf/d, without looping, as compared to 3.28 Bcf/d. That larger capacity provides for the Arctic Gas Project to carry Canadian as well as Alaskan gas.

We must here point out the significance of the benefits derived from the cost savings produced by the Arctic Gas Project. Since the Arctic Gas Project proposes to operate on the basis of a cost of service tariff, lower costs automatically mean lower transportation rates. Obviously, lower transportation rates benefit the consumer, either by reflecting all or part of the lower costs in lower gas prices, or by reflecting all or part of those lower costs in producer prices to encourage more exploration and development to produce additional supplies of energy for the consumers.

Finally, it must be noted that the above comparisons actually are more favorable to the tanker LNG system than is justified in fact. The Purvin and Gertz figures are based upon the assumption that it is feasible to "exchange" Permian Basin (Southeast New Mexico, Southwest Texas) gas for a substantial portion of the Alaskan gas which is to be tankered to California. The Permian gas, so goes the assumption, could then be transported north and east to markets. Thus, the cost calculations for the tanker LNG system are true only so long as such relatively large amounts of Permian gas are physically producible and contractually available to the California market. El Paso's current regulatory applications, however, show volumes of gas being transported from California to points east of there, indicating insufficiency of Permian Basin supply now.

As the deficiency of such amounts of gas in the Southwest grows larger, then even more steps, with related costs, must be taken to move larger quantities of Alaskan gas all the way from California to the Midwest and East. Such steps then could include additional reverse flow in pipelines which now carry gas from the Permian Basin to California—assuming such lines are not then needed for east to west flow—with the resultant new capital expenditures and operating costs which that reversal would require. This will be particularly expensive,

since El Paso would need to retain the capacity to flow gas either way, since it cannot know where a supply deficiency will occur. This means the expense of some duplicate facilities will be incurred. It also produces technical complexities, with resultant loss of efficiency and capacity, which also increases cost of transportation.

El Paso's own 1973 "System Deliverability Summary" filing to the FPC shows the deficiency in Permian gas, reflecting the fact that the reserves of El Paso in the Permian Basin are dwindling at a rapid rate. It indicates that El Paso's 1974 reserves are some 15 percent less than its projected annual requirement, approximately 26 percent less in 1975, and over 35 percent less in 1976. The supply deficiency increases steadily through the succeeding years until 1993 (20th year), when the reported deficiency would be nearly 85 percent. Consequently, it becomes obvious that El Paso would experience extreme difficulty in furnishing a continuous and dependable gas supply to midwestern and eastern market areas from its west Texas gas fields.

Thus, either the consumers in those midwestern and eastern markets would be forced to contend with the growing gas deficiency, or the El Paso Pipeline System would be forced to reverse flow further and send more and more Alaska gas eastward out of California to meet the contractual commitments to them. Knowledgeable representatives of those markets have expressed concern that this would not, in fact, be done, since California has been projected to have, by 1983, a daily gas supply deficiency below *current* supply levels on the order of 1.1 billion cubic feet per day. Further, deficiencies below potential gas requirements are estimated to be 1.9 Bcf/d for 1974, rising to 4.8 Bcf/d in 1983—even though the 1983 projection assumes California will receive 50 percent of the Prudhoe Bay gas volumes. Thus, the truth concerning El Paso's supply picture

is that it has little chance to maintain a status quo situation with its West Coast customers, much less seriously guarantee a continuous supply of exchange gas to midwestern and eastern markets.

Neither eastern, midwestern, nor western markets, accordingly, can justify acceptance of the El Paso proposal when the Arctic Gas Project is available. The problems inherent in the LNG tanker proposal would become increasingly severe as new arctic reserves are discovered, requiring increased transportation capacity. The vast potential of the arctic gas reserves demands a direct transportation link between the reserves and the markets they will supply, all across the United States, as well as Canada.

It must also be recognized that the claims of El Paso that the shipping portion of the LNG process will be unregulated means the actual costs could be well in excess of the levels shown, depending upon sponsor desires and success in establishing its position. The Arctic Gas Project is structured as a totally regulated pipeline.

The Purvin and Gertz capital costs estimates, like those of El Paso, are based upon the pipeline (from Prudhoe Bay to the LNG port on the south coast of Alaska) being built, in major part, along the right of way proposed by El Paso. However, as is explained more fully in Subsection D, below, review of the route indicates that a gas pipeline through the Brooks Range may require a route even more separate from the Alyeska oil pipeline alignment than is shown in the El Paso application, because of extremely steep mountainous terrain and very narrow valleys, with resultant increased costs.

It should also be noted that in many instances, the El Paso costs have been accepted on the most favorable assumptions: in practice, it is likely that unforseen matters, such as marine

conditions near the Alaska port and other yet to be fully studied factors, will produce higher costs.

The Purvin and Gertz analysis of the possible methods of "displacing" Alaskan gas from the West Coast to Midwestern and Eastern areas, does not attempt to predict the results of the complicated and lengthy regulatory cost allocation proceedings which such displacement proposals would bring. Purvin and Gertz point out that their report assigns only the costs of new facilities to the west to east movement of the Alaskan gas. In fact, however, since use of some existing facilities would be involved, and/or termination or reduction of use of other existing facilities, the owners of such facilities, and their customers, will demand compensation for such results. The consequence will be time consuming cost allocation hearings, litigated by multiple parties. Not only do such proceedings require companies to participate in the regulatory proceedings of others, to protect the interests of their market areas on a continuing basis, but the results are also unpredictable. One can never be sure, therefore, what level of costs of existing facilities will be assigned against a given activity, either initially or in subsequent proceedings.

As noted, the Arctic Gas Project costs used in this paper have been developed by totaling the per unit costs of the various companies which will transport the gas. The Alaskan Arctic costs are for its filed 48 inch system, powered to carry the volumes used by El Paso. Canadian Arctic figures are for transport of the same volumes, plus Canadian gas. (It should be noted that the Canadian Arctic costs shown on a Btu basis are somewhat overstated—as is the system's fuel consumption —because of use of an average assumed heating value.) For the illustrations of transport to Los Angeles and San Francisco, the cost of the intra-state systems in California which will be involved are included, since the ITAA and PGT facilities do

not enter California. The volumes utilized for developing the costs for the transportation systems in the "lower 48" states are those which are optimum for each system, as originally proposed. Actual volumes, when the systems begin to operate, may be lower. However, those systems have since filed alternative pipe size and length, and compression, combinations, which they would utilize if the volumes such systems have available are less than optimum for the original proposals. Accordingly, those pipelines will be appropriately sized, to match volumes, so that such volumes will be optimal for those systems. This process cannot be completed until all Prudhoe Bay gas is sold. Thereafter, additional quantities of Alaskan gas which are developed and any Canadian gas which is declared surplus, if added to the Prudhoe Bay gas, will increase the throughput of the United States lines and aid their economies.

In connection with these possible reduction of system sizes, the facilities originally filed by the Arctic Gas Project were estimated to cost about $9.5 billion, including non-cash items. Those facilities, however, would have substantial initial excess capacity, and alternative filings have been made which would reduce the systems to conform to smaller volumes. Adoption of such changes would reduce the cost to, or below, the cost of the LNG tanker systems, which would still have substantially less capacity, and thus much higher per unit transportation costs.

In summary, analysis shows that:

(1). Even using the optimistic premises of the El Paso Application, the Arctic Gas Project will save the United States hundreds of millions of dollars per year, with very large savings to western States, and even larger savings to the Midwest and East. Complicated multiple rate hearings, with resulting uncertainty and waste of time and expense, will also be avoided.

(2). Substitution of other more realistic premises for those advanced by El Paso would indicate cost savings of even greater proportion for the Arctic Gas Project, and would also increase the energy savings produced by that Project.

In short, even portraying the LNG tanker project in its most favorable light, it is decidedly less attractive than the Arctic Gas Project as a method for transporting natural gas from the Arctic. It would be worth considering only if an overland pipeline were unavailable. But it is not unavailable. It can be secured by a timely governmental choice.

D. The All Land Pipeline Route Of The Arctic Gas Project Provides The Most Environmentally Sound Transportation For Alaskan Gas

The environmental research undertaken by the Arctic Gas Project is the most extensive in construction history. Over thirteen million dollars have been spent for direct biological research, several million dollars more for socio-economic research, and at least ten million dollars for geo-technical and other engineering research relating directly to the environment. These and other expenditures have been made and continue to be made before any assurance of government approvals. As a result, the limits of human knowledge have been expanded, and the application of that knowledge has produced a planned and engineered pipeline which will have minimal environmental effect.

The independent environmental experts retained by the Arctic Gas Project have conducted not only surveys of existing biological and physical conditions, but also experiments involving potentially disturbing activities.

In the geotechnical field, the Project created four test sites and carried on controlled experiments with refrigerated and unrefrigerated gas being pumped through above and below ground pipes, while developing the technique of transporting

chilled gas. This allows a buried pipeline to be used in permafrost soil, without degradation. This, in turn, allows the pipeline to avoid being an obstacle to animals, and obtrusive visually, and aids security. The test sites also involved extensive research in such subjects as frost heave, degree of external and internal stress, and the development of pioneer methods of revegetation, again with combined ecological and engineering benefits.

Snow and ice roads over the tundra have been created and vehicles run over them repeatedly in tests to prove that the pipeline can be built without permanent roads and without damage to the permafrost. These techniques will be used in conjunction with a winter construction schedule in the north, which has both geotechnical and biological advantages. New ditching machinery and techniques have also been developed and tested, again to prevent unnecessary damage and also improve productivity.

In the biological areas, skilled work crews in the mammal, fish and bird fields, supervised by acknowledged experts in their fields, began by conducting the most extensive baseline studies ever performed in the arctic. Fish spawning and overwintering areas were located, so that the pipeline could avoid river crossings which would destroy or injure those key areas. Winter construction was also found to be useful in this regard. Studies were also made in such areas as levels of siltation, life cycles and tolerance levels relative to foreign substances such as methanol.

Mammals and birds of all kinds were surveyed, and important locations established. These include breeding, nesting and hibernating areas, so that they can be avoided by the pipeline. The routes and schedules of migratory species have been surveyed over several years, so that construction schedules could be developed to avoid the places used at the time of use. Tests

were conducted to determine the sensitivity of the animals to various kinds of disturbance. These included tests involving human presence only; overflights by fixed wing aircraft and helicopters (to establish acceptable flight routes, schedules and heights); and use of other mechanical equipment, including the simulation of the sound of compressor stations and other mechanical equipment, by recording and loudspeaker equipment. That equipment was turned on and off in repeated tests to determine effect and degree of response. Again, this was used in determining acceptable routes and sites, and in predicting results.

As a result of the extensive work done, the management of the Arctic Gas Project is convinced that the Project can be constructed and operated without significant adverse environmental impact, and has determined that the necessary steps to accomplish that result will be taken.

Operating under that policy, therefore, techniques have been developed, by consultation of environmentalists, engineers and management, which will avoid damaging activities. Those techniques have involved such steps as changes of route in many locations; carrying on activities only at less sensitive times of the year, even if it is inconvenient and more expensive; use of special equipment which avoids damage; development of new, unconventional techniques, such as refrigeration of the gas; and development of programs to train workers in environmental protection, including use of environmental inspectors with each pipeline construction spread. Operation and maintenance procedures have been developed which regulate aircraft times and routes, utilize low ground pressure vehicles, keep equipment at locations which involves less damaging movement, operate by remote control, and build in greater reliability. In short, the Arctic Gas Project has been engineered, developed and planned to be the most sound and unobtrusive means of transporting

energy which exists; it will cause the least possible environmental impact.

The route of the pipeline, as chosen, avoids biologically and geotechnically sensitive areas, and avoids disruption to human activity. This has involved detailed route selection to avoid smaller specific sensitive locations, within a general "corridor", and also selection of the most desirable corridor, which is discussed under "Alternative Routes", below. The technique of chilling the gas, to keep it and the pipeline below freezing in the northern permafrost soil allows the pipeline to be buried, out of sight, without obstruction and without damage to the ice-rich soil. Further, winter construction has been chosen for the North to avoid damage to the permafrost soils and to avoid human presence to the maximum extent possible around animals. (Work crews will move to the southern areas of the pipeline for summer work.) In addition to winter work, special techniques and scheduling have been developed to minimize erosion, avoid disturbance to breeding, denning and spawning areas, and to avoid disturbance at biologically sensitive times. The snow road techniques which have been developed avoid substantial permanent road construction.

As a result of the research done and planning carried on, the Arctic Gas Project has been developed on a basis which will cause minimal environmental effect, and maximum benefits to human beings, both in Alaska and in the contiguous 48 States. These benefits include economic benefits and the air pollution avoidance nature of natural gas. (The line will also be environmentally sound in Canada. In addition, adoption of an "all Alaskan" route by the United States would not avoid a line in Canada: it would simply delay it until a "Canadian only" line could become feasible—even though less desirable economically.)

Before its project was fully planned, Arctic Gas compared a number of non-pipeline systems and possible pipeline routes.

That examination demonstrated the superiority of the proposed Arctic Gas pipeline and its route, as will now be described.

1. *Alternate Systems*

The transportation systems alternative to a pipeline considered by Arctic Gas included LNG transport by tanker or submarine, railroad or monorail, airplane or heliofloat, and conversion of gas to densephase, to methanol or to electricity, for transmission. All but the pipelines had significant environmental, as well as economic, disadvantages relative to the Arctic Gas Project, as is fully described in the Arctic Gas environmental report. Of these various modes, only LNG tankers have been seriously advanced as a feasible alternative to a pipeline. The proponents of the LNG tanker project have suggested that such a project would be environmentally preferable, because the pipeline portion of it could parallel the already "disturbed" route of the oil line. There are several answers to this claim.

First, an LNG tanker system obviously would have several components in addition to its pipeline across Alaska. There would be a very large liquefaction plant on the south coast of Alaska (in the El Paso proposal, it would be in the virgin area of Gravina Point), together with a large port and docking areas. There would be a constant shuttle of the largest cryogenic tankers ever made, carrying liquefied gas between that point and Point Conception, California, where regasification facilities would be constructed. From there, pipeline facilities throughout the United States would be constructed or expanded. These facts are noted, not because LNG facilities are unacceptable from an environmental point of view, but only to point out that it is misleading to compare the full scope of the Arctic Gas pipeline with the Alaska pipeline portion of the LNG tanker project alone.

Secondly, looking at Alaska only, the Arctic Gas Project will consist of about 195 miles of pipeline in the extreme northeastern section of the State. An LNG tanker system would require about 900 miles of pipeline through the middle of the state. The greater extent of human activity would result in more socio-economic pressures for Alaska, straining and inflating costs of services and facilities, a factor with which the Alaska State Government has been concerned. The Arctic Gas project will, because of its size and location, avoid that strain, but at the same time will produce very substantial tax and royalty revenue for the State.

El Paso and others claim that the environmental effects of its project will be minimal, because it proposes to use the same "corridor" as the Alyeska oil pipeline. A natural gas pipeline, if constructed with the arctic safeguards developed by the Arctic Gas Project, is not environmentally damaging. However, it is misleading to picture the Arctic Gas Project as invading "undisturbed" territory and the El Paso proposal as traversing an area already "disturbed". In fact, the proposed line of the LNG system would be over three miles away from the oil pipeline for over 11% of its length. It would be over a quarter of a mile away for over 55% of its route. This includes the fact that the cross-Alaska pipeline is proposed to deviate from the oil pipeline at its southern end, to cross "undisturbed territory". In addition, the deviation would increase markedly if, in fact, a gas pipeline could not use the same passes through the Brooks Mountain Range as the oil pipeline is using, requiring that such line cross even more miles of previously "undisturbed" land.

Finally, it is *not* established that a concentration of uses, in close proximity, is more ecologically desirable than two separated uses. This is a concept which has been advanced by laymen, and qualified ecologists differ on the subject, since two

separated, smaller uses can be less significant than closely aligned uses.

2. *Alternate Pipeline Routes*

In addition to considering a variety of alternative transportation modes, the Arctic Gas Project studied many different pipeline routes before determining that the present route is the most desirable. Costs, environmental effect and possible technical problems were considered in reaching the conclusion. Five pipeline routes were examined in most detail, were presented in our Environmental Report and will be discussed here. They are:

a. The presently proposed route ("Prime Route") which runs parallel to the shore along the Arctic Coastal Plain from Prudhoe Bay to the Yukon Border at a distance ranging from three to thirty miles from the coast. It will traverse 194.8 miles in Alaska.

b. The "interior route", which the Arctic Gas Project has shown as its main alternative to the Prime Route. This route follows the Department of Interior "utility corridor" through the Brooks Mountain Range, running west and south of the Arctic Wildlife Range into Canada, where it joins the Prime Route. This route is approximately 40 miles longer than the Prime Route overall, but about a hundred miles longer in Alaska.

c. The "offshore route", which would run underwater along the Arctic Coastal Plain, roughly paralleling the coastline. The route shown in the filings runs underwater offshore from a point near Flaxman Island, returning to shore just east of the Alaska-Yukon border.

d. The "Fort Yukon route", which would follow the Alyeska route to Oksrukuyik. It would then run southeast past Fort Yukon, across the border at Eagle, Alaska toward Dawson. At Dawson it would connect with a line running south and west from the Mackenzie River Valley and from there it would

run south and east into Alberta and on to the border points. It is over 400 miles longer than the Prime Route.

e. The "Fairbanks corridor route", which would run south from Prudhoe Bay through the Brooks Mountain Range, curving slightly to the east to pass close to the city of Fairbanks. From there the Corridor generally follows the Alaska Highway into Canada past Whitehorse in the Yukon, across northeast British Columbia and on to a junction with the Prime Route in central Alberta. It is over 900 miles longer than the Prime Route.

Costs

As noted above, all of the four routes alternative to the Prime Route are longer and more expensive to construct and to operate. Such additional costs, if incurred, would be an additional burden for the United States.

In the Arctic Gas Project's initial application to the Federal Power Commission, the costs of the five alternate routes described above are shown on a consistent basis. It is shown that the offshore route would be a minimum of about $300 million more costly than the Prime Route, for a less reliable system; the Interior route about $525 million more; the Fort Yukon route about $1 billion more; and the Fairbanks route about $2.4 billion more, on the pricing basis used. The additional operating costs involved range from about $5 million to over $50 million per year. The result, of course, would be many millions of dollars per year of extra transportation costs.

Since that time, the costs of the Prime Route have been updated, using 1974 unescalated dollars. The new costs were approximately 10% greater than the comparable unescalated cost previously computed. The costs of the alternate routes have not been fully updated, but from work done, it is clear that the differences between them and the Prime Route have become

even larger. This is particularly true of the Offshore route, where considerably more technical research would need to be done before the route could be selected (assuming favorable results.)

Environment and Technology

The Arctic Gas Project concluded that the Prime Route is not only the least costly, but also the most environmentally desirable of the routes that are technically feasible at this time.

Arctic Gas is well aware of the concern expressed by certain organization and individuals arising from the fact that the Prime Route, running along the Arctic Coastal Plain, traverses the Arctic National Wildlife Range. However, a buried, refrigerated natural gas pipeline constructed in the winter months —when very little wildlife is present in that area—is entirely compatible with the purposes for which the Range was designated.

The Wildlife Range is not a Wilderness Area. It is not closed to human activity, and no one should be misled about its actual nature and use.

In proposing the coastal route, Arctic Gas is not ignoring ecological factors. Instead, Arctic Gas has considered environmental factors carefully, relative to both the United States and Canada, and chosen the route which is best on that basis too. Both governments must concur on a route. Arctic Gas also favors maximum feasible energy conservation, but recognizes that even with such conservation, rapid development of available energy supplies is essential to our citizens. Just as Arctic Gas has taken all practical steps to insure that it has designed the most economical energy transmission system possible, in order to avoid economic burden to our citizens—including the economically disadvantaged—so also has the Project designed the most environmentally desirable system possible.

Specifically, alternate routes are either somewhat less desirable from an environmental standpoint, or pose such technological problems as to be infeasible at present, or both. This conclusion is based upon the very extensive environmental research done by and for Arctic Gas, which shows that the route across the Wildlife Range is environmentally preferable. This is established by the Environmental Report filed by Arctic Gas, the Biological Report Series of publications by Arctic Gas which support it, and testimony filed before the Federal Power Commission. In part, this reflects the characteristics of the Arctic Ocean coastal plain, as compared to the foothills and mountains which must be crossed by other routes. In part, it reflects the fact that the Wildlife Range is a very large area, with differing ecological characteristics between its regions; the Arctic Gas Project proposes to cross the least sensitive portion, in the most environmentally protective manner. In part, it reflects the fact that the coastal plain route allows winter construction, while some summer construction is required for mountainous routes. In part, it reflects the fact that there will be less contact with wildlife on the Prime Route.

The coastal route chosen by Arctic Gas is also shortest in Alaska, and overall, which has favorable ecological features. The Coastal route also lies closest of any land pipeline route to more of the most likely areas of future gas production. Future lines to connect those areas with the main trunk pipeline will therefore be the shortest.

The Offshore Route presents a variety of special technical problems which have yet to be solved. Even the marine work done to date has not established that such an offshore line in the arctic can be successfully constructed, or the techniques necessary to do it. Even more importantly, however, construction of such a line would not solve the problems of possible ice

damage of the operating line, or of repair of any service interruption during periods of freeze up and breakup. These problems also raise the question of whether such a line could, in fact, be built at the presently estimated cost levels. Double lines could be required, in view of the concern over the security of such a line. The resultant large cost increase could prejudice the financing of the total system. Further, compressor stations, which are the only above ground facilities proposed in the Range would, in any event, be required to be built on land in the Range, even if the offshore route were chosen.

Arctic Gas is aware that the Arctic National Wildlife Range has been referred to as unique, with allusions to the unbroken sweep from mountain to sea. Such opinions represent one end of the value judgment scale, against which must be weighed the actual ecological impact—the actual environmental balance of judgment—and the factors of energy supply, and technical and economic features of the alternative routes. Arctic Gas has presented detailed studies in support of its choice of the coastal plain route, which provides material from which such an overall judgment can be made. Arctic gas is confident that its choice of what it has chosen as its "Prime Route" is supported by the relevant facts and the actual environmental balance of judgment, as well as economic factors.

E. The All Land Pipeline Route Of The Arctic Gas Project Provides More Secure Transportation For Alaskan Gas Than Any Alternate Method

It is clear that on all physical grounds, a natural gas pipeline across an all land route is the most secure method of transporting natural gas. It is the method least subject to interruption. The nature of the Arctic Gas pipeline, and the experience of the industry, is such as to make 24-hour transmission the rule. As the Purvin and Gertz report states,

> "There is considerable commercial experience in the operation of large-diameter, long-distance pipelines. In

general, gas transmission lines have an excellent operating history with very little downtime due to system failure."

The technology of an LNG tanker system, by comparison, is less reliable than a pipeline operation. This is particularly true when, to quote from the Purvin and Gertz report, the proposed "specific project would involve an extrapolation of present technology to a size range that has not been proven commercially." That report also points out the seismic and shipping risks and vulnerability to labor disputes of the LNG tanker, pipeline project.

Finally, it is also obvious that a tanker sailing from Alaska to the contiguous United States cannot possibly be under United States control at all times: international or Canadian waters, or both, intervene. Despite this, El Paso has raised, as its most frequent ground of attack against the Arctic Gas Project, the fact that the gas will be transported through Canada.

But in fact, the route across Canada is a major strength of the project. That routing is what allows use of the all pipeline method and the increased transportation economies of scale through joint haul of both Alaskan and Canadian gas, with the additional possibility of coal gas from our northern plains states being carried too. Further, Canadian capital, materials and workers, hopefully to a very large extent, will be available to assist in the construction and maintenance of the system, which aids both nations. Separate systems in each country to carry gas would together cost well in excess of the joint Arctic Gas Project.

Hoping to offset these benefits, El Paso has alleged that transit of Alaskan gas through Canada is replete with danger. But the facts are otherwise. As the Canadian Minister of Energy, Mr. Macdonald stated when apprised of El Paso's claims:

"It is clearly in Boyd's corporate interests to develop bad relations between Canada and the U.S." (Mr. Boyd is chief executive of El Paso.)

1. *Canadian Federal Matters*

One of the principal allegations made by El Paso in opposing the Arctic Gas Project relates to the political security of Alaskan gas passing through Canada. Specifically, it has been alleged that United States gas, moving in bond across Canada, will not be safe from interference or discriminatory treatment. These allegations are contrary to, and go right to the heart of, long-standing and sound relationships between the United States and Canada.

In this connection, it is useful to note a few aspects of Canadian-American trade, which illustrate the interdependence of the two nations. Canada's world trade comprises twenty-five percent (25%) of its gross national product. Seventy percent (70%) of that trade is with the United States!

United States imports from Canada are increasing at a relatively steady rate of about 15 percent per year, while U.S. exports to Canada have grown at a rate of around 11 percent per year between 1960 and 1973. It is interesting to note that fuels provide only 2.6 percent of U.S. exports to Canada and 10.9 percent of imports from Canada, while corresponding automotive figures are about 31.0 percent and 35 percent, respectively, or about 476,000 and 862,000 units. This trade, under the Bilateral Automotive Agreement of 1965, is vital to Canada; the exports amount to 70 percent of Canadian auto production. Finally, the United States' direct investment in Canada has been estimated at approximately $40 billion. Thus, the two nations are highly interdependent.

To discuss more specifically the allegations of El Paso, it is necessary to separate (a) the flow across Canada of

United States gas from Alaska, and (b) the sale of Canadian gas to United States purchasers.

a. *Transit of Alaskan Gas*

The Arctic Gas Project, as it relates to the United States, is a means of transportation of Alaskan gas to the contiguous forty-eight states. Before the project can be constructed, it must receive approval not only from several government agencies in the United States, but also from the government of Canada. Such approval by the government of Canada is based upon recommendation of the National Energy Board and the Department of Indian and Northern Affairs, other Departments and inter-departmental groups. Such approvals and reviews will be on the basis of applications for the throughput of Alaskan—as well as Canadian—gas. Such approvals must explicitly authorize the throughput of Alaskan gas, and any conditions put upon such approvals will be known before the sponsors of Arctic Gas or prospective shippers take implementing action. The line would not be built if there were unacceptable conditions.

The Canadian government, moreover, has officially stated its willingness to guarantee the transportation of American hydrocarbons through Canada. At the highest levels of that government, they have proposed that questions of security of, and discrimination relative to, the transit of petroleum products through our respective countries, taxation of such products, and related questions, be made the subject of an international agreement. On December 6, 1973, Prime Minister Trudeau stated in the House of Commons:

> ". . . I can see no reason why Canada could not give suitable undertakings as to the movement, without any discriminatory impediment, of Alaskan gas through the pipeline across Canada to U.S. markets, provided all public interest and regulatory conditions

> are met in the building and operation of the pipeline. An undertaking of this sort would, of course, be reciprocal, with the same assurance being given Canada regarding our oil and gas shipments through the United States."

This offer has been reiterated by several Ministers of the Canadian government. Since that time, discussions have been conducted between representatives of the United States and Canadian governments, looking toward an agreement with regard to the treatment of hydrocarbons of one country passing through the other, and progress appears to be expeditious.

The Act of Congress which authorized the issuance of a construction permit for the Trans-Alaska oil pipeline contained a specific provision directing the President of the United States to initiate discussions with the government of Canada regarding the construction of oil and gas pipelines from Alaska across Canada to the Midwest. Thus, an international agreement would not only be a useful step, but would be consistent with the past and expected future course of dealings between the two countries.

But, the claimants of "political insecurity" allege, the Canadian government will then violate its own approvals of the pipeline project and even violate a treaty. It is claimed that this might be done by intercepting and taking some United States gas for Canada. Or, they assert, Canada will discriminate against United States gas or the pipeline carrying it.

There is no justification in history, law, or current evidence for such allegations and suspicions. First, one nation's interception of another nation's gas, in transit, after approval of uninterrupted throughput, would be unconscionable. The allegation that Canada would engage in such activity, just as a matter of Canadian principles of fair dealing, is entirely with-

out justification. (But in addition, see also the self-interest points discussed below.)

As to discrimination, it must be recalled that in the Arctic Gas Project, Canadian gas will be carried in the same pipeline with Alaskan gas. Therefore, if that pipeline were taxed more heavily, for example, than other Canadian pipelines, not only would Canadian law be violated, but Canadian gas would also be burdened. Again, there is no support for such allegation.

The present trade relations between the two nations attest to a history of fair dealing. In the case of existing oil and gas pipelines, there is a history of uninterrupted transit and fairness without any international agreement having been necessary. The existence of such trade means that Canada also has a vital interest in maintaining the integrity of arrangements covering the transportation of Canadian oil and gas "in bond" through the United States. Indeed, the following are examples of facilities *located in the United States* which are used to transport Canadian-owned oil and gas into Canada:

(1.) The pipeline system of Lakehead Pipeline Company which transports approximately 500,000 Bbls of Canadian oil daily from the Manitoba-Minnesota international boundary through the United States into Canada at a point near Sarnia, Ontario.

(2.) The pipeline system of Great Lakes Transmission Company which transports approximately 300 Bcf of Canadian gas annually from the Manitoba-Minnesota international boundary through the United States and into Canada at a point near Sarnia, Ontario. This represents some 40 percent of populous eastern Canada's present natural gas requirements!

(3.) The pipeline system of Portland Pipe Line Corporation which transports from Portland, Maine to Quebec, oil purchased abroad by Canada.

Thus, though neither nation looks at these present examples of mutual benefit in such a way, it is nevertheless true that existing pipelines provide a deterrent, if any were needed, to the impropriety by Canada which critics of the Arctic Gas Project allege would occur.

It is also vital to recognize that the El Paso claim that the United States should deny itself the benefits of the Arctic Gas Project, in terms of cost and direct access to the market areas, because the transportation channel would run through Canada, flies directly in the face of established United States policy. Gas produced in Montana now flows through Canada and back into the United States, without interference or discrimination. This is also true of the approximately 50,000 barrels of oil which daily is carried from Chicago to Buffalo through Canada in the Interprovincial Pipeline. But another more obvious example is the St. Lawrence Seaway, which is a vital part of the United States transportation system. Thousands of ships each year pass up the St. Lawrence to Great Lakes cities in the United States, carrying millions of tons of needed products. The land transportation system of a large part of the United States has been adjusted to be compatible with, and is dependent upon, the St. Lawrence Seaway.

The United States has done this despite the fact that the first several hundred miles of the Seaway requires the ships to pass solely through Canadian controlled territory. Even after the Great Lakes are entered, passage is frequently through Canadian waters, Canadian canals and Canadian locks. This confidence has not been misplaced. Canada and the United States have both kept their agreements. The two nations have cooperated to the mutual benefit of their citizens. U.S. transit has never been interrupted.

The Arctic Gas Project is proposed as another example of mutually beneficial cooperation. There is no merit in argu-

ments that both nations should be penalized, so that need for international cooperation can be avoided.

b. *Sale Of Gas From The Canadian Arctic To The United States*

The claimants of "political insecurity" of gas transported across Canada do not distinguish the transportation of United States gas, which is discussed above, from the matter of United States purchase of Canadian gas. But the two subjects are entirely different.

There are two major points to be made. First, provincial governments in Canada have authority over gas produced in their Provinces; British Columbia, for example, has been active in limiting export of gas produced in its province. But that is irrelevant to the Arctic Gas Project, which will be carrying gas produced in Canadian federal territory—not in any province. Provincial authority over gas produced outside the Province, or over "interprovincial commerce", is quite limited, generally similar to state authority relative to interstate commerce in the United States.

Second, whereas all Alaskan gas carried by the Arctic Gas Project across Canada will be delivered for United States consumption, only that Canadian gas which is found to be surplus to Canadian needs will be available for export to the United States. This is pursuant to the long standing duty of the National Energy Board and Canadian government to assure conservation of gas to meet Canadian demand. The Arctic Gas pipeline will also carry gas from the Canadian Arctic to Canadian markets. That gas, plus Alaskan gas, *plus any export gas*, will make up the throughput of the line.

But if, as might be the case, the Arctic Gas Project is never able to carry any Canadian gas for export to the United States, because all gas from the Canadian Arctic is needed in Canada, the joint pipeline is still the best choice for the

United States, because it is the most economical way to transport Alaskan gas to the contiguous United States, and has the other benefits described in this paper. Therefore, the question of whether there will be Canadian exports of Arctic gas, how much, and for how long—all of which will not be known until purchasers of Arctic gas from Canada have applied for export licenses and those applications have been acted upon by the National Energy Board and the Canadian government—are not essential to the Arctic Gas Project. But if authorized, the Arctic Gas Project would be capable of transporting that gas too.

2. *Canadian Provincial Matters*

El Paso, in addition to its claims that the Canadian federal government is unreliable, has alleged that the Arctic Gas Project could be disrupted by one or more provincial governments. In making that claim, they not only cite the irrelevant provincial control of provincial gas, described above, but also make the assertion that the provinces of Canada would not be bound by an international agreement, unless signatories to it, and would therefore not be barred from activities prohibited by such agreement.

These allegations then go on incorrectly to assert that this means disruption by a provincial government could take place. As pointed out above, in so arguing, El Paso mistakenly disregards the provisions of Canadian law which limit provincial action with regard to transactions affecting more than one province.

There is no credible evidence to suggest that Canadian provinces even would attempt to interfere with or unfairly tax an "inter-provincial" pipeline. However, in light of assertions made, we specifically treat those two allegations below.

a. *Taxation And Regulation*

The Canadian constitution confers only limited taxation powers upon the provinces. A province may impose direct taxation within its borders to raise revenue for provincial purposes. Provinces also have power to license, for fees, certain activities in the province.

The courts have construed the provincial taxation powers in such a way as to make clear that provincial taxes could not unduly interfere with the Canadian Arctic Gas corporation. Specifically, a province could not impose a tax on the throughput of gas, for this would be an indirect tax. Further, it could not interfere with interprovincial trade by imposing taxes on the import of gas into or the export of gas out of the province. A province can impose an income tax on the pipeline corporation, and a tax on its real or personal property within the province, which are allowed for in our cost estimates, but these taxes could not be imposed on a discriminatory basis: they can only be imposed by general direct tax legislation which applies to all taxpayers in similar circumstances. Finally, a province could require the pipeline company to obtain a license, but the license could not be refused nor the license fee be discriminatory. Nor can regulations be discriminatory.

In summary, the taxation and regulatory powers of a province relating to the Arctic Gas Project, an *interprovincial* pipeline, are limited. They are quite similar to those of a State of the United States relating to an *interstate* pipeline, and would not interfere with the Arctic Gas Project.

b. *Service Interruption*

Obviously, the Canadian portion of the Arctic Gas System will be subject to Canadian federal jurisdiction and, therefore, no province will have the power to interfere with the

volume of gas which passes through the province. This is quite different from the situation in which gas is *produced* in a province. In a producing situation, as noted above, some Canadian provinces have asserted jurisdiction and limited removals of gas from the province. Whether such assertion of power will withstand legal challenge under Canadian law—which is denied by many Canadian legal authorities—is irrelevant to the Arctic Gas Project. The gas which will be transported by the Arctic Gas Project is not produced in any province. No province has the authority, nor has any even claimed to have the authority, to interfere with the throughput of Alaskan and Northwest Territories gas in a federally authorized pipeline.

Summary

The El Paso allegation that "you can't trust the Canadians" is inaccurate and self-serving. There is no basis for claiming that the mature relationship between the United States and Canada is in danger. The welfare of both countries is advanced by continuing sound economic and political relations. There is no reason for the United States to give up the economic benefits of pipeline transmission for Alaskan gas, and the allied advantages of a line across Canada, simply because a Canadian route is involved. El Paso's allegations that the Canadian government will not honor its pledges and obligations are a slur without foundation or factual support.

F. The Arctic Gas Project Provides Transportation For Canadian Gas

An LNG tanker project would transport only gas from Alaska. The Arctic Gas Project, however, will carry not only Alaska gas, but also Canadian gas, and also will provide the potential to carry gas made from United States coal.

The latter point is clear: At least two members of the Study Group have made application for, or are considering, the construction of extensive coal gasification plants, to supplement their gas supplies. The Northern Border Pipeline portion of the Arctic Gas Project is planned to pass relatively near those plants, and would thus be available to carry the gasified coal, along with Alaskan gas, for those member companies and any other companies which secure gas, from coal or otherwise, within economic reach of that U.S. pipeline.

The fact that the Arctic Gas Project will carry Canadian gas will also be beneficial to the United States, as well as Canada, in several basic ways. One is, as discussed above, that the large volume transportation of U.S. and Canadian gas jointly produces economies of scale in transportation costs, with benefits to each nation, including production stimulation. But there are other gas supply benefits too.

First, like any nation, Canada will export its products if it has enough to meet its own demand and can carry on the export in an economic fashion. Canada too is running short of energy. However, Canada has discovered huge volumes of gas, not only in the Mackenzie Delta, but also in the Arctic Islands, and there is prospect of much more. Accordingly, while prospects of a Canadian surplus of gas immediately are not good, Canada vitally needs access to its arctic gas soon. The Arctic Gas Project is the most feasible way to secure that gas, since there is not yet enough gas to make a "Canada-only" line, such as that proposed by Foothills Pipeline Ltd., feasible, and it would provide more expensive transportation in any event. When the Arctic Gas Project is accomplished, and the gas in the arctic areas of Canada continues to be developed, the prospects of creation of an exportable surplus of gas to be sold to the United States brighten, with obvious potential benefit to the U.S.

More immediately, however, the United States is now importing substantial quantities of gas (about three billion cubic feet a day) from Canada. Canada, without early access to Delta reserves, will have difficulty in meeting its own needs and the existing export commitments. In fact, shortages may occur prior to connection to Delta supplies, which could result in a sharing of such shortages between the export and domestic Canadian markets. Access by Canada to its arctic gas will greatly reduce, and hopefully eliminate, the chances of such occurence, so again the U.S. has a direct stake. But, as explained above, the Arctic Gas Project is Canada's only way to get access to its Arctic gas in a timely and economical fashion.

G. Transportation Of Canadian Mackenzie Delta Gas By The Alaskan LNG Tanker System Is Not Feasible

As indicated earlier, the Arctic Gas Project will transport Alaskan gas, and also gas from the Mackenzie Delta area, which also will aid the United States, as well as Canada, by economies of scale in transportation of the higher joint volumes, and by delivery to the U.S. of any Canadian gas found to be surplus to Canadian needs.

El Paso has suggested that its system could achieve advantages by carrying Canadian gas. The assertions do not make clear whether this refers to Canadian gas sold to United States purchasers, or sold to Canadian purchasers, or both. In any of those cases, El Paso apparently is suggesting that Canadian gas from the Mackenzie Delta could be transported several hundred miles westward from the Delta to Prudhoe Bay, be there combined with Alaska Prudhoe Bay volumes, and then moved 900 miles to southern Alaska. There the gas would be liquefied, shipped 2,100 miles to Los Angeles via LNG tanker, regasified and delivered to the West Coast market area.

Just that description starts to show the problems of such a proposal. But there is more. That system only gets the gas to our West Coast. From there, any gas which has been purchased by midwestern and eastern companies is proposed to be "displaced" to those areas, by exchanging the Canadian arctic gas for El Paso's dwindling West Texas gas reserves, which in turn would be transported from the Permian Basin to midwestern and eastern U.S. market areas or back into Canada through existing gas transmission systems.

That proposal has major defects: (a) the circuitous transportation is expensive generally, and even more so for the Canadian gas, and (b) El Paso's West Texas reserves are not large enough to support a "trade" for Canadian arctic gas. Both of these subjects have been discussed in preceding sections of this paper.

It is also totally impractical to move Canadian gas from the Delta to Prudhoe Bay, through the El Paso project to Los Angeles, and displace it back to Canada, when the cost of doing so would far exceed the cost of bringing Canadian gas directly to Canadian markets.

Therefore, the El Paso proposal is expensive and inefficient for Alaskan gas, and also completely impractical for Canadian gas. This subject provides a graphic example of the reasons why overland pipelines are used for the transmission of natural gas when, as here, they can be utilized.

H. The Arctic Gas Project Can Be Put Into Operation Faster Than Other Systems

El Paso has proposed that its LNG tanker system will be constructed on a schedule which indicates the first gas delivery could occur five years and ten months after a significant financial commitment has been made to undertake detailed

design engineering and construction planning. That project would require an expenditure of about $50 million in the first project year. But El Paso has recently declined to spend a previously proposed $30 million for engineering and environmental work and has refused to file an application for a right-of-way with the Department of the Interior (which might expose it to fees).

It is obvious from these actions that El Paso would not start that first project year, with its attendant financial commitments, until governmental approvals are secured. Thus, if such approvals came at year end 1975, 1976 would be the first project year and El Paso's schedule would call for first gas deliveries in November 1981. (The Purvin and Gertz report points out the above facts and shows that delays of that schedule could occur: in shipbuilding, for example.)

The Arctic Gas Project planning, on the other hand, calls for gas to be flowing from Prudhoe Bay and the Mackenzie Delta by mid-1980, or over 19 months before the LNG Pipeline Tanker System, if governmental approvals are secured by the end of 1975. Even extending the filed schedule by a full year would have Mackenzie Delta gas flowing by 1980, with delivery of Prudhoe Bay gas a year later. Thus, Arctic Gas deliveries would clearly precede the November, 1981 date posited by El Paso.

It is the complex liquefaction plant, and possibly the LNG tankers, which extend the El Paso schedule. A case in point is the liquefaction plant presently under construction at Arzew, Algeria, to handle gas which El Paso has contracted to purchase from Algeria. It will have only about one third the capacity of El Paso's proposed Alaskan installation. With governmental approvals secured, all of the engineering essentially completed and all of the required major equipment on order,

the contractor for the Arzew plant was released to commence construction on April 1, 1973. At that time, the completion date was set as April, 1976—three years later. Now, at the halfway point of the construction period, the "in-service" date has slipped. No LNG is expected from this plant before 1977.

El Paso apparently has assumed a shorter construction period for their proposed Alaskan liquefaction plant than that for the Arzew installation one third its size. In the face of lengthening delivery times for the necessary process equipment, complicated by harsh Alaskan conditions, this timetable lacks credibility.

Apparently in an effort to avoid the force of these facts, El Paso has claimed that Arctic Gas cannot meet its proposed schedule.

One claim seems to center on the availability of pipe, particularly of the 48-inch diameter category. However, Arctic Gas studies have shown that world pipe-making capacity is, and will be, well in excess of the requirements of the Arctic Gas Project. (El Paso's requirement for special steel, including high nickel content, provides a different problem.) The major question for Arctic Gas will be whether all or almost all of the pipe can be secured from United States and Canadian suppliers, or whether more extensive resort to overseas suppliers will be necessary. This question depends, in part, upon the willingness of North American pipe makers to develop the capacity to roll 48-inch pipe. One Canadian company already can roll over 500 miles of 48-inch pipe per year, and a major U.S. company can develop a large capacity rather quickly. German, Japanese and Italian companies now can roll more 48-inch pipe than North American companies, while pipe of smaller size is widely available from many sources here and abroad. In short,

the basic problem will not be to locate enough pipe, but rather will be to determine the best source for the needed pipe.

El Paso recognizes that it must go through basically the same governmental approval process in the United States as Arctic Gas, and thus has no time advantage here. In fact, by its refusal to file for a right-of-way permit from the Department of the Interior, El Paso has embarked on a course of action which will ensure a slower time schedule for receipt of the usual required government permits. It would need to go back to the Department if and after it received an FPC certificate, instead of having the necessary right-of-way permits before or at the time of FPC decision. Moreover, unlike the Arctic Gas Project, El Paso's plan would additionally require coastal port and maritime approvals. Finally, the Arctic Gas Project already has a number of companies which have combined to make the Project feasible: El Paso would need to put a group together before it could proceed.

Accordingly, El Paso has focused upon the Canadian approvals required to implement the Arctic Gas Project. But Canadian processes already have begun and, in actuality, allow faster action than in the United States. Canadian procedures limit court appeals and employ less time consuming decisional processes. This is achieved by action of the Canadian government itself, in the process, which has the additional advantage of giving stability to decisions reached.

El Paso has further alleged that Canadian approvals cannot be timely secured because the land claims of organizations of "natives" (Indian, Inuit and Meti) in the Yukon and Northwest Territories of Canada will delay Canadian governmental approvals of the Arctic Gas Project. In fact, there is reason to believe such permits will not be delayed, for prompt approval would be in the best interests of native peoples: the

pipeline would provide unprecedented economic opportunities to the peoples of the North.

With further reference to the question of native rights, although it is overwhelmingly likely that the matter will be resolved by settlement, it is relevant to note that the legal conclusion is not as clear in Canada as in the United States that aboriginal interests in land exist apart from specific grants made to native peoples. Recent court decisions leave the matter in doubt. Further, part of the pipeline route lies in lands which were transferred by treaty to the government of Canada by the native peoples. If those treaties are valid, any aboriginal rights to those areas have been extinguished. Additionally, any aboriginal land interests which once existed may well have been extinguished by any of a multitude of past governmental actions which may be construed as inconsistent with the survival of the native rights.

Most importantly, however, negotiations have begun between the government and native groups, looking to the settlement of claims. These efforts are expected to conclude the matter by agreement.

Finally, it is also clear that all aboriginal interests in land which still persist, if any, can at any time be suspended or terminated by an Act of the Canadian Parliament which provides for payment of appropriate compensation. The settlement of the compensation need not defer the termination: the use of the land can be granted to the pipeline, and the compensation can be set later or can be paid by the pipeline, pending resolution of how and to whom compensation is to be paid. This is a just and equitable way to protect the rights of all concerned, without denying the benefits of the pipeline to the citizens of Canada. Arctic Gas believes that the Government of Canada will find that the pipeline is required in the public interest of Canada and will use such a procedure to avoid

frustration of the public interest, while protecting the rights of all through equitable exercise of the Government's sovereign power.

In summary, the physical and organizational facts of the LNG tanker system and the Arctic Gas pipeline indicate that the pipeline system can proceed more promptly, and allow gas to flow to market earlier. Government approval time is obviously difficult to predict and could have differing effects on the two schedules. However, the Arctic Gas Project can be expected to be approved somewhat earlier, because United States approvals now appear to be more time consuming than Canadian, and El Paso has positioned itself so that it cannot get U.S. approvals as soon as Arctic Gas can.

However, if the government of the United States decides that the Arctic Gas Project, if achievable in a timely manner, is the Alaskan gas project which is most in the national interest, but is worried that Canadian governmental approvals will delay the Project beyond the time that an LNG tanker system could be achieved, then the rational course of action is to put the Arctic Gas Project into position to be approved. Then, in the unlikely event it turns out to be necessary, the U.S. can pause a length of time acceptable to the U.S. to see if Canadian approvals are forthcoming. In view of the substantial cost and earlier completion advantages to Canada, as well as the United States, from its Project, Arctic Gas believes that such a pause, to wait for Canada, will not be required, and urges that the United States government move ahead promptly to the approval stage.

I. The Arctic Gas Project Gives Balance Of Payment And Other Economic Benefits To The United States

The subject of the United States trade balance has been of increasing concern over recent years—particularly as the

price of foreign oil has multiplied with incredible speed. The Arctic Gas Project will help the United States balance of trade in two ways, as discussed more fully by Dr. Solomon.

First, the United States energy needs and supply status make it clear that the "balancing" source of energy which fills the gap left by deficiencies in domestic supply, is OPEC oil. Thus, a project to give the United States access to Alaskan gas will not only reduce our dependence upon a potentially unstable source, but will also cut the outflow of funds for foreign purchases.

To illustrate the magnitude of this effect, note that 3 billion cubic feet of gas per day from Alaska would be equivalent to about 500,000 barrels of oil per day. At $12 per barrel, this would amount to a reduction in imports of over $2 billion a year, with obvious beneficial results to our balance of trade and energy independence.

This advantage is shared by the Arctic Gas Project with other means of transporting Alaskan gas to American markets, including an LNG tanker system. But the benefit from the Arctic Gas Project will be significantly higher, since it wastes less of the gas, and thus puts more energy on the market with which to displace OPEC oil.

There is another balance of payment benefit from the Arctic Gas Project which is not shared by other proposals. It is modest, compared to the first benefit discussed above. Arctic Gas is moved to discuss it, and asked Dr. Solomon to demonstrate it, because it has incorrectly been claimed that the Arctic Gas Project would injure the United States in this regard.

This benefit relates to the direct and indirect balance of payments effects of expenditures for the construction and operation of the Arctic Gas Project itself (as opposed to the

replacement of foreign energy discussed above). The key point is the inclusion of the indirect, as well as direct effects. Chapter III of Dr. Solomon's report should be consulted on both aspects.

In summary, it is true that because the Arctic Gas Project includes a Canadian pipeline, a portion of the transportation cost paid by United States shippers, and thus consumers, will be paid to the Canadian company. This causes a balance of payments outflow. But to stop there, as have the El Paso assertions, is to be misleading in the extreme. As Dr. Solomon clearly demonstrates, the Canadian line will use U.S. goods, services and capital, which produce both positive and negative direct flows. And because Canada is such a large importer from the United States generally, the increase in overall Canadian economic activity which this project will cause will increase Canadian imports from the United States, with resultant positive balance of payment flows for the United States.

Dr. Solomon explains this indirect effect at pages 17 to 19 of his report. Next, at pages 19 to 20, and in Table II on page 22, he shows that the overall positive balance of payments effect of the Arctic Gas Project is estimated to be over three billion dollars over ten years. Although relatively small, in comparison to the huge United States economy, it is helpful, and completely refutes the claims that the Arctic Gas Project will hurt the U.S. balance of payments picture.

Finally, as Dr. Solomon points out at pages 20-21 of his report, not only will the greater gas deliveries by the Arctic Gas Project give the U.S. an additional balance of payments advantage over an LNG tanker project, but the effect of the Arctic Gas Project in producing and allowing more Canadian gas for the United States is also likely to be beneficial relative to balance of payments too.

Dr. Solomon also discusses, in Chapter IV of his report, the favorable overall economic impact on employment and

output in the U.S. economy. He points out that the four U.S. components of the Arctic Gas Project, plus the U.S. portion of the Canadian segment, are estimated at several billion dollars. To this is added the induced results from the effect on the Canadian economy. Clearly then, the Project will produce a substantial stimulus to the U.S. economy through increased business activity and employment in Alaska and in the contiguous 48 States.

On balance, it is clear that the Arctic Gas Project will provide greater net benefits to the U.S. economy than any alternative system.

CONCLUSION

The preceding sections of this paper have established that the Arctic Gas Project will save very large amounts of money and energy for the United States, while carrying gas directly to the markets which require and have purchased the gas. In addition, it can begin to carry gas sooner, is the most secure means of transportation, will help assure Canadian gas supply for Canada and the United States, and will provide balance of payments and other benefits to the United States.

In light of these facts, El Paso is driven to the argument which reduces itself, upon analysis, to a claim that assisting a foreign nation, by carrying on an activity which also aids your own nation, is undesirable. Specifically, El Paso argues that the Arctic Gas Project is undesirable because it means American consumers will pay taxes to Canadian governments. The fact that American consumers will pay rates for gas from the Arctic which will include the transportation charges of Canadian Arctic Gas Pipeline Company is, of course, true. And it is equally true that such rates are designed to cover costs which include Canadian taxes. But to argue from these facts that this is bad for the United States, is to attack the basic

premises of foreign trade, because the same facts occur in every foreign trade transaction. But those transactions are carried on in rather significant volumes (in the face of the El Paso thesis it would seem), when the importing nation either cannot produce the good or service itself or cannot do so as economically.

That is exactly the situation with which we are now faced in the Arctic Gas Project. The use of the joint international pipeline concept which underlies the Arctic Gas Project requires use of a Canadian link in the pipeline chain, and that chain is what produces, for the United States, the very large savings, in both money and energy, which are described earlier.

In short, without the indirect payment of Canadian taxes, the American consumer does not get the great savings of gas transportation costs, and suffers the large waste of energy of an LNG tanker system. It would be a bad trade. Faced with such a choice, foreign consumers buy U.S. products and services and U.S. consumers buy foreign products and services, as each nation strives to do what it does best, in the interest of overall—and thus, individual—efficiency and gain. In this case, a Canadian pipeline—in cooperation with, and partially owned by, U.S. pipelines—is needed to best transport Alaskan gas to the markets in the contiguous lower 48 states. Almost all United States companies involved, from coast to coast, have recognized these facts.

El Paso speaks of the larger amount of taxes it will pay in Alaska, but ignores the Arctic Gas facilities—and resulting taxes—in the "lower 48" states, as well as Alaska, and also ignores the cost savings to those states.

The energy needs of the United States require access to Arctic gas in Alaska as soon as is physically possible. The best available method of transportation of natural gas has long

been established: a gas pipeline, buried along an overland route. Accordingly, to carry Alaskan gas to the lower 48 states, that means an international project, with resultant benefits in terms of economies of scale, achievement of threshold volumes jointly, joint financing, and the possibility of helping support existing or expanded levels of exports of Canadian gas by aiding Canada to have access to its arctic reserves.

Arctic Gas urges that the governments of both the United States and Canada, in the interests of their own peoples, proceed as fast as humanly possible to approve the Arctic Gas Project, which will allow financing, procurement and construction to begin forthwith.

APPENDIX

TABLES OF FUEL USAGE AND EFFICIENCY AND TABLES OF COSTS OF SERVICE PER MCF AND BTU, AND OF COST SAVINGS

INDEX TO TABLES

INDEX OF TABLES—Continued

TABLE 1

Arctic Gas System
Fuel And Losses

	Fuel & Loss	Delivered Amount	Shrinkage
	(Million BTU/D)	(Million BTU/D)	%
Inlet Volume		3710.6*	
Los Angeles Delivery	106.4	1086.2	8.9%
San Francisco Delivery	49.9	612.8	7.5
Chicago Delivery	122.1	1114.8	9.9
Pittsburgh Delivery	68.5	549.9	11.1
Total	346.9	3363.7	9.3%

Details of Fuel and Loss and Delivered Amounts, per system, are shown on Table 2.

* Equivalent to 3.28 bcf/d.

LNG Tanker System *
Fuel and Losses

	(Million BTU/D)	%
Inlet Volume	3710.6	
Los Angeles Delivery (Including Southwest)		13.8%
San Francisco Delivery		11.3
Chicago Deliveries		19.9
Pittsburgh Delivery		21.5
Total Shrinkage	617.8	16.6%
Total Deliveries	3092.8	

* Source: Purvin and Gertz, Table X.

TABLE 2

Arctic Gas System
Fuel And Loss

	Market Area			
	Los Angeles	San Francisco	Chicago	Pittsburgh
Assumed Inlet Energy (MMMBTU/D)	1192.6	662.7	1236.9	618.4
Percent of Total Inlet Energy	32.14	17.86	33.00	17.00
(Million BTU/D)	Fuel and Loss			
AAGPL	4.77	2.7	4.9	2.5
CAGPL	75.0	39.5	79.6	39.8
Alberta Natural Gas		3.1		
PGT/LGE		4.6		
ITA/SoCal	26.7			
Northern Border			37.6	2.6
Total Energy Consumption	106.4	49.9	122.1	68.5
Deliveries	1086.2	612.8	1114.8	549.9

Table 1

TABLE 3

Alaskan LNG Project vs Arctic Gas System
Illustration Of Savings Resulting From Arctic Gas Proposal

Market Area	Transportation Differential [1] $/Million BTU (Fuel cost included @ $.50/mcf) 3rd Project Year	10 Yr. Average	Assumed Deliveries [2] Million BTU/D	Savings of Arctic Gas System $ Per Day 3rd Project Year	10 Yr. Average
Los Angeles	.39	.28 .30	1,046.8	408,200	293,100
San Francisco	.50	.40 .40	597.9	298,900	239,200
Chicago	.99	.83 .80	1,009.8	989,600	838,100
Pittsburgh	1.25	1.03 1.00	495.1	618,900	509,900
Total Daily Savings				$ 2,315,600	$ 1,880,300
Total Savings Per Year				$845,200,000	$686,300,000

Note: 1. Calculated on basis of transportation cost indicated for Alaskan LNG Project less Arctic Gas Transportation cost for comparable delivery.

2. Delivery amounts are those shown in the Purvin & Gertz Report.

The above illustrative savings include Tariff cost differentials, as set forth in Table 4, below, plus the difference in the cost of energy consumed by the two projects (at the assumed equivalent of 50¢ per Mcf, for illustrative purposes). Such energy differentials are based upon comparison of the Table 5 fuel costs with those from the Table on page 26 of the Purvin and Gertz report.

Or Table 6 For Arctic Gas costs
p25 P&G Rpt for El Paso costs

TABLE 4

Alaskan LNG Project vs Arctic Gas System
Illustration Of Savings Resulting From Arctic Gas Proposal
Excluding Fuel Cost Differentials

Market Area	Tariff Differential [1] $/Million BTU (exclusive of fuel costs) 3rd Project Yr.	10 Yr. Average	Assumed Deliveries [2] Million BTU/D	Savings of Arctic Gas System $ Per Day 3rd Project Yr.	10 Yr. Average
Los Angeles	.38	.27	1,046.8	397,800	282,600
San Francisco	.49	.39	597.9	293,000	233,200
Chicago	.93	.77	1,009.8	939,100	777,500
Pittsburgh	1.19	.98	495.1	589,200	485,200
Total Daily Savings				$ 2,219,100	$ 1,778,500
Total Savings Per Year (Millions of Dollars)				$810,000,000	$649,200,000

Note: 1. Calculated on basis of tariff indicated for Alaskan LNG Project as shown in the Tables of the Purvin and Gertz Report, less Arctic Gas tariff for comparable delivery, as shown in Table 6 of the appendix of this paper.

2. Delivery amounts are those shown in the Purvin & Gertz Report.

TABLE 5

Arctic Gas System
Cost Of Fuel

Illustrative Field Price:	Heating Value Basis [1] (Cents Per Million BTU) $0.50/MCF	$1.00/MCF	$1.50/MCF	Volume Basis [2] (Cents Per MCF) $0.50/MCF	$1.00/MCF	$1.50/MCF
Delivery Area						
San Francisco	3.68¢	7.36¢	11.04¢	4.07¢	8.14¢	12.21¢
Los Angeles	4.42	8.85	13.27	4.89	9.79	14.68
Chicago	4.95	9.90	14.85	5.48	10.95	16.43
Pittsburgh	5.63	11.26	16.89	6.23	12.46	18.69

Note: 1. Reflects fuel usage and other costs at full operating capacity, not on a per different year basis.

2. Assumes 1.1064 million BTU's per MCF.

TABLE 6

Arctic Gas System
Cost Of Service Tariffs
(Cents Per Million BTU)

Year	Excluding Fuel Costs				Including Cost of Fuel Valued @ 50¢/MCF			
	Los Angeles	San Francisco	Chicago	Pittsburgh	Los Angeles	San Francisco	Chicago	Pittsburgh
1980	214.1¢	132.9¢	130.1¢	142.6¢	218.5¢	136.6¢	135.1¢	148.2¢
1981	139.7	122.4	120.4	133.6	144.1	126.1	125.4	139.2
1982	128.7	113.1	113.0	125.9	133.1	116.8	118.0	131.5
1983	119.9	105.9	107.0	119.5	124.3	109.6	112.0	125.1
1984	113.2	101.9	103.5	115.7	117.6	105.6	108.5	121.3
1985	110.3	99.1	100.3	112.2	114.7	102.8	105.3	117.8
1986	107.6	96.4	97.4	108.8	112.0	100.1	102.4	114.4
1987	105.0	94.5	94.7	105.8	109.4	98.2	99.7	111.4
1988	102.1	92.3	91.8	102.4	106.5	96.0	96.8	108.0
1989	98.4	88.7	88.2	98.4	102.8	92.4	93.2	104.0
Average								
5 year	135.2	113.3	113.2	125.8	139.6	117.0	118.2	131.4
10 year	119.1	103.2	103.2	115.3	123.5	106.9	108.2	120.9
20 year	99.9	87.4	87.3	97.7	104.3	91.1	92.3	103.3

≈ 1.05
≈ 1.20

Note: The "Excluding Fuel Costs" columns of this table are drawn from Tables 7 through 13, following.

The "Including Cost of Fuel Valued @ 50¢/mcf" columns of this table are the "Excluding Fuel Costs" columns figures, plus per BTU fuel costs from Table 5.

In calculating the per BTU costs for facilities in the "lower 48 states", (this Table and Tables 7-13) volumes used were those which are optimum for each such facility, as filed with the Federal Power Commission. If volumes turn out to be different, those facilities will be changed to match the volumes, so that changes in per BTU costs would be minimized.

TABLE 7

Tariffs On Heating Value Basis

Arctic Gas System
Tariff To Los Angeles
Cost Of Service For Each Segment Divided By
Delivered Volume At Los Angeles

Year	Cents Per Million Btu			
	AAGPC	CAGPL (Kingsgate)	I.T.A. System	Total Tariff [1] to Los Angeles
1980	12.9	82.7	118.3	214.1
1981	12.6	76.6	50.6	139.7
1982	11.9	71.0	45.6	128.7
1983	11.6	66.4	42.1	119.9
1984	11.5	64.2	37.7	113.2
1985	11.0	62.6	36.9	110.3
1986	10.5	61.1	36.1	107.6
1987	9.9	59.9	35.3	105.0
1988	9.4	58.4	34.4	102.1
1989	8.8	56.1	33.5	98.4
Average				
5 year	12.0	71.0	52.2	135.2
10 year	10.9	65.0	43.2	119.1
20 year	8.6	55.3	36.1	99.9

Note: 1. Total tariff is derived and then rounded. Inconsistencies in the sum of the individual tariffs vs. the indicated total tariff is due to rounding.

TABLE 8

Tariffs On Heating Value Basis

Arctic Gas System
Tariff To Los Angeles
Cost Of Service To The End Of Each Segment Divided By
Delivered Volume At End Of Segment

Year	Cents Per Million Btu*		
	AAGPC	CAGPL (Kingsgate)	I.T.A. System
1980	11.8	95.2	214.1
1981	11.8	87.9	139.7
1982	10.8	81.6	128.7
1983	10.4	76.4	119.9
1984	10.3	73.6	113.2
1985	9.9	71.6	110.3
1986	9.4	69.7	107.6
1987	8.9	68.1	105.0
1988	8.4	65.9	102.1
1989	7.9	63.1	98.4
Average			
5 year	10.8	81.6	135.2
10 year	9.8	74.3	119.1
20 year	7.6	62.4	99.9

* Figures are cumulative.

TABLE 9

Tariffs On Heating Value Basis

Arctic Gas System
Tariff To San Francisco
Cost Of Service For Each Segment Divided By
Delivered Volume At San Francisco

Year	Cents Per Million Btu				
	AAGPC	CAGPL (Alta./ B.C. Border)	ANG (Kingsgate)	PGT/PGE (San Francisco)	Total Tariff To San Francisco [1]
1980	13.0	79.1	4.1	36.8	132.9
1981	12.6	72.4	3.3	34.1	122.4
1982	11.9	66.8	3.1	31.2	113.1
1983	11.5	62.2	2.9	29.4	105.9
1984	11.3	59.8	2.7	28.2	101.9
1985	10.9	58.1	2.6	27.5	99.1
1986	10.3	56.9	2.4	26.8	96.4
1987	9.9	55.6	2.7	26.3	94.5
1988	9.2	54.3	3.2	25.7	92.3
1989	8.7	52.2	3.2	24.6	88.7
Average					
5 year	12.0	66.8	3.2	31.3	113.3
10 year	10.8	60.9	3.0	28.6	103.2
20 year	8.3	51.0	3.1	25.0	87.4

Note: 1. Total tariff is derived and then rounded. Inconsistencies in the sum of the individual tariffs vs. the indicated total tariff is due to rounding.

TABLE 10

Tariffs On Heating Value Basis

Arctic Gas System
Tariff To San Francisco
Cost Of Service To The End Of Each Segment Divided By
Delivered Volume At End Of Segment

Year	Cents Per Million Btu*			
	AAGPC	CAGPL (Alta./B.C. Border)	ANG (Kingsgate)	PGT/PGE (San Francisco)
1980	11.8	90.3	95.2	132.9
1981	11.4	83.4	87.5	122.4
1982	10.8	77.4	81.2	113.1
1983	10.4	72.5	75.9	105.9
1984	10.3	70.0	73.0	101.9
1985	9.9	67.9	71.0	99.1
1986	9.4	66.6	69.0	96.4
1987	8.9	65.0	67.6	94.5
1988	8.4	63.0	66.0	92.3
1989	7.9	59.9	63.6	88.7
Average				
5 year	10.8	77.4	81.0	113.3
10 year	9.8	70.6	73.9	103.2
20 year	7.6	59.2	76.4	87.4

* Figures are cumulative.

TABLE 11

Tariffs On Heating Value Basis

Arctic Gas System
Tariff To Kankakee
Cost Of Service For Each Segment Divided By
Delivered Volume At Kankakee

Year	Cents Per Million Btu			
	AAGPC	CAGPL (Monchy)	Northern Border (Kankakee)	Total Tariff [1] To Kankakee
1980	13.4	88.0	28.9	130.1
1981	12.9	80.4	27.1	120.4
1982	12.2	74.4	26.5	113.0
1983	11.8	69.3	25.9	107.0
1984	11.6	66.7	25.3	103.5
1985	11.2	64.8	24.4	100.3
1986	10.6	63.6	23.3	97.4
1987	10.1	62.1	22.5	94.7
1988	9.5	60.6	21.8	91.8
1989	8.9	58.2	21.1	88.2
Average				
5 year	12.2	74.4	26.5	113.2
10 year	11.1	67.8	24.4	103.2
20 year	8.6	57.8	21.0	87.3

Note: 1. Total tariff is derived and then rounded. Inconsistencies in the sum of the individual tariffs vs. the indicated total tariff is due to rounding.

TABLE 12

Tariffs On Heating Value Basis

Arctic Gas System
Tariff To Delmont
Cost Of Service For Each Segment Divided By
Delivered Volume At Delmont

Year	Cents Per Million Btu			
	AAGPC	CAGPC (Monchy)	Northern Border (Delmont)	Total Tariff [1] To Delmont
1980	13.6	89.2	40.1	142.6
1981	13.1	81.5	39.1	133.6
1982	12.4	75.4	38.1	125.9
1983	12.0	70.2	37.2	119.5
1984	11.8	67.6	36.4	115.7
1985	11.4	65.7	35.2	112.2
1986	10.7	64.5	33.7	108.8
1987	10.2	62.9	32.5	105.8
1988	9.6	61.4	31.4	102.4
1989	9.0	60.0	30.3	98.4
Average				
5 year	12.4	75.4	37.9	125.8
10 year	11.3	68.7	35.1	115.3
20 year	8.7	58.6	30.3	97.7

Note: 1. Total tariff is derived and then rounded. Inconsistencies in the sum of the individual tariffs vs. the indicated total tariff is due to rounding.

TABLE 13

Tariffs On Heating Value Basis

Arctic Gas System
Tariff To Kankakee And Delmont
Cost Of Service To The End Of Each Segment Divided By
Delivered Volume At End Of Segment

Year	Cents Per Million Btu*			
	AAGPC	CAGPL (Monchy)	Kankakee	Delmont (Columbia Gas)
1980	11.8	97.7	130.1	142.6
1981	11.4	90.2	120.4	133.6
1982	10.8	83.7	113.0	125.9
1983	10.4	78.4	107.0	119.5
1984	10.3	75.6	103.5	115.7
1985	9.9	73.4	100.3	112.2
1986	9.4	71.6	97.4	108.8
1987	8.9	69.9	94.7	105.8
1988	8.4	67.7	91.8	102.4
1989	7.9	64.9	88.2	98.4
Average				
5 year	10.8	83.7	113.2	125.8
10 year	9.8	76.3	103.2	115.3
20 year	7.6	64.1	87.3	97.7

* Figures are cumulative.

TABLE 14

Tariffs On Volume Basis

Arctic Gas System
Cost Of Service Tariffs
(Cents Per MCF)

Year	Excluding Fuel Costs				Including Cost of Fuel Valued @ 50¢/MCF			
	Los Angeles	San Francisco	Chicago	Pittsburgh	Los Angeles	San Francisco	Chicago	Pittsburgh
1980	234.0¢	145.3¢	142.1¢	155.9¢	238.9¢	149.4¢	147.6¢	161.4¢
1981	154.5	135.4	133.2	147.8	159.4	139.5	138.7	153.3
1982	142.4	125.1	125.1	139.3	147.3	129.2	130.6	144.8
1983	132.7	117.2	118.3	132.2	137.6	121.3	123.8	137.7
1984	125.2	112.7	114.5	128.0	130.1	116.8	120.0	133.5
1985	122.0	109.6	111.0	124.1	126.9	113.7	116.5	129.6
1986	119.0	106.7	107.8	120.0	123.9	110.8	113.3	125.9
1987	116.2	104.6	104.8	117.0	121.1	108.7	110.3	122.5
1988	112.9	102.0	101.6	113.3	117.8	106.1	107.1	118.8
1989	108.9	98.1	97.5	108.8	113.8	102.2	103.0	114.3
Average								
5 year	149.3	125.1	125.0	138.9	154.2	129.2	130.5	144.4
10 year	131.7	114.1	114.1	127.5	136.6	118.2	119.6	133.0
20 year	110.5	96.7	96.6	108.0	115.4	100.8	102.1	113.5

Note: The "Excluding Fuel Costs" columns of this table are drawn from Tables 15 through 21, following.

The "Including Cost of Fuel Valued @ 50¢/mcf columns of this Table are the "Excluding Fuel Costs columns figures, plus per mcf fuel costs from Table 5.

In calculating the per MCF costs for facilities in the "lower 48" states (this Table and Tables 15-21) volumes used were those which are optimum for each such facility, as filed with the Federal Power Commission. If volumes turn out to be different, those facilities will be changed to match the volumes, so that changes in per BTU costs would be minimized.

TABLE 15

Tariffs On Volume Basis

Arctic Gas System
Tariff To Los Angeles
Cost Of Service For Each Segment Divided By
Delivered Volume At Los Angeles

Year	Cents Per MCF			
	AAGPC	CAGPL (Kingsgate)	I.T.A. System	Total [1] Tariff to (Los Angeles)
1980	14.1	90.4	129.3	234.0
1981	13.9	84.7	56.0	154.5
1982	13.2	78.5	50.4	142.4
1983	12.8	73.5	46.4	132.7
1984	12.7	71.1	41.7	125.2
1985	12.2	69.2	40.8	122.0
1986	11.6	67.6	39.9	119.0
1987	11.0	66.3	39.0	116.2
1988	10.4	64.6	38.1	112.9
1989	9.7	62.1	37.1	108.9
Average				
5 year	13.3	78.4	57.6	149.3
10 year	12.1	71.9	47.8	131.7
20 year	9.5	61.2	39.9	110.5

Note: 1. Total tariff is derived and then rounded. Inconsistencies in the sum of the individual tariffs vs. the indicated total tariff is due to rounding.

TABLE 16

Tariffs On Volume Basis

Arctic Gas System
Tariff To Los Angeles
Cost Of Service To End Of Each Segment Divided By Delivered Volume At End Of Segment

Year	Cents Per MCF*		
	AAGPC	CAGPL (Kingsgate)	I.T.A. System
1980	13.3	104.0	234.0
1981	12.9	97.2	154.5
1982	12.2	90.3	142.4
1983	11.8	84.5	132.7
1984	11.6	81.4	125.2
1985	11.2	79.2	122.0
1986	10.6	77.1	119.0
1987	10.1	75.3	116.2
1988	9.5	72.9	112.9
1989	8.9	69.8	108.9
Average			
5 year	12.2	90.1	149.3
10 year	11.1	82.1	131.7
20 year	8.6	69.0	110.5

* Figures are cumulative.

TABLE 17

Tariffs On Volume Basis

Arctic Gas System
Tariff To San Francisco
Cost Of Service For Each Segment Divided By
Delivered Volume At San Francisco

Year	Cents Per MCF				
	AAGPC	CAGPL (Alta./B.C. Border)	ANG (Kingsgate)	PGT/PGE (San Francisco)	Total Tariff [1] To San Francisco
1980	14.2	86.5	4.5	40.2	145.3
1981	13.9	80.1	3.7	37.7	135.4
1982	13.2	73.9	3.4	34.5	125.1
1983	12.7	68.8	3.2	32.5	117.2
1984	12.5	66.2	3.0	31.2	112.7
1985	12.0	64.3	2.9	30.4	109.6
1986	11.4	62.9	2.7	29.7	106.7
1987	10.9	61.6	3.0	29.1	104.6
1988	10.2	60.1	3.4	28.4	102.0
1989	9.6	57.8	3.5	27.2	98.1
Average					
5 year	13.2	73.8	3.5	34.6	125.1
10 year	12.0	67.3	3.3	31.6	114.1
20 year	9.2	56.4	3.4	27.6	96.7

Note: 1. Total tariff is derived and then rounded. Inconsistencies in the sum of the individual tariffs vs. the indicated total tariff is due to rounding.

TABLE 18

Tariffs On Volume Basis

Arctic Gas Ssytem
Tariff To San Francisco
Cost Of Service To End Of Each Segment Divided By
Delivered Volume At End Of Segment

Year	Cents Per MCF*			
	AAGPC	CAGPL (Alta./B.C. Border)	ANG (Kingsgate)	PGT/PGE (San Francisco)
1980	13.3	98.6	104.1	145.3
1981	12.9	92.3	96.8	135.4
1982	12.2	85.7	89.8	125.1
1983	11.8	80.3	84.0	117.2
1984	11.6	77.4	80.8	112.7
1985	11.2	75.2	78.5	109.6
1986	10.6	73.2	76.3	106.7
1987	10.1	71.5	74.8	104.6
1988	9.5	69.2	73.0	102.0
1989	8.9	66.3	70.4	98.1
Average				
5 year	12.2	85.5	89.6	125.1
10 year	11.1	78.0	81.7	114.1
20 year	8.6	65.5	69.1	96.7

* Figures are cumulative.

TABLE 19

Tariffs On Volume Basis

Arctic Gas System
Tariff To Kankakee
Cost Of Service For Each Segment Divided By
Delivered Volume At Kankakee

Year	Cents Per MCF			
	AAGPC	CAGPL (Monchy)	Northern Border (Kankakee)	Total Tariff [1] To Kankakee
1980	14.6	96.2	31.6¢	142.1¢
1981	14.3	88.9	30.0	133.2
1982	13.5	82.3	29.3	125.1
1983	13.0	76.7	28.6	118.3
1984	12.8	73.8	28.0	114.5
1985	12.4	71.7	27.0	111.0
1986	11.7	70.4	25.8	107.8
1987	11.2	68.7	24.9	104.8
1988	10.5	67.0	24.1	101.6
1989	9.8	64.4	23.3	97.5
Average				
5 year	13.5	82.2	29.3	125.0
10 year	12.3	74.9	27.0	114.1
20 year	9.5	63.9	23.3	96.6

Note: 1. Total tariff is derived and then rounded. Inconsistencies in the sum of the individual tariffs vs. the indicated total tariff is due to rounding.

TABLE 20

Tariffs On Volume Basis

Arctic Gas System
Tariff To Delmont
Cost Of Service For Each Segment Divided By
Delivered Volume At Delmont

Year	Cents Per MCF			
	AAGPC	CAGPC (Monchy)	Northern Border (Delmont)	Total Tariff [1] To Delmont
1980	14.8	97.5	43.8	155.9
1981	14.5	90.1	43.2	147.8
1982	13.7	83.4	42.1	139.3
1983	13.2	77.7	41.2	132.2
1984	13.0	74.8	40.3	128.0
1985	12.6	72.7	38.9	124.1
1986	11.9	71.4	37.3	120.4
1987	11.4	69.6	35.9	117.0
1988	10.6	67.9	34.7	113.3
1989	9.9	65.3	33.5	108.8
Average				
5 year	13.7	83.3	41.9	138.9
10 year	12.5	76.0	38.8	127.5
20 year	9.6	64.8	33.5	108.0

Note: 1. Total tariff is derived and then rounded. Inconsistencies in the sum of the individual tariffs vs. the indicated total tariff is due to rounding.

TABLE 21

Tariffs On Volume Basis

Arctic Gas System
Tariff To Kankakee And Delmont
Cost Of Service To End Of Each Segment Divided By
Delivered Volume At End Of Segment

Year	Cents Per MCF*			
	AAGPC	CAGPL (Monchy)	Kankakee	Delmont (Columbia Gas)
1980	13.3	106.8	142.1	155.9
1981	12.9	99.8	133.2	147.8
1982	12.2	92.6	125.1	139.3
1983	11.8	86.7	118.3	132.2
1984	11.6	83.6	114.5	128.0
1985	11.2	81.2	111.0	124.1
1986	10.6	79.2	107.8	120.4
1987	10.1	77.3	104.8	117.0
1988	9.5	74.9	101.6	113.3
1989	8.9	71.8	97.5	108.8
Average				
5 year	12.2	92.4	125.0	138.9
10 year	11.1	84.3	114.1	127.5
20 year	8.6	70.9	96.6	108.0

* Figures are cumulative.

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