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EVALUATING THE ALASKA HIGHWAY GAS PIPELINE PROJECT:

NATIONAL AND STATE BENEFITS, COMMERCIAL AND FINANCIAL VIABILITY, AND THE CONSEQUENCES OF DELAY

A PRELIMINARY REPORT TO THE ALASKA STATE LEGISLATURE

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FOREWORD TO THE DISCUSSION DRAFT

This discussion draft is intended to become a part of the authors' third and final report to the legislature, expected in April. The final report will contain, in addition to these chapters, detailed technical notes describing the methodology and assumptions used in the calculations, and references for other factual and analytical statements in the text.

Comments on this discussion draft may be forewarded to me at the address below, or directly to the authors.

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INTRODUCTION

The proposed Alaska Highway gas pipeline confronts Alaska and the United States with the same dilemma: the project seems to offer substantial net benefits to each, but a favorable benefit-cost ratio is not the same thing as a viable enterprise, and not every prospectively viable enterprise can be financed in private capital markets. As a result, the expected state and national benefits may be lost or postponed unless one or both governments accept financial burdens or take other actions that are not normally regarded as governmental responsibilities in the United States.

In 1978, the State of Alaska received an explicit request --- which has this year taken on the tone of an ultimatum --- that it participate directly in pipeline financing. While the project sponsors have not yet approached the federal government with a similar demand, it too must be prepared to respond.

Prudent decisions about state or federal financial participation must be grounded on a comfortable understanding of at least two basic questions:

(1) From either a state or federal standpoint, what are the benefits of this project; and

(2) How crucial is governmental support to the

project's success?

The following chapters provide an overview of the benefits the state and nation might expect to receive. Likewise, they review the commercial and financial prospects of the pipeline venture. The dimension of time is added, with a look at how delays might affect both the benefits and the project's viability. Two closely related issues are postponed for other chapters of the final report: (1) Is debt or equity investment in the pipeline a prudent risk for the state, and (2) How far might other parties (the sponsors, producers, and lenders) be willing to go in taking on financial risks.

CHAPTER I

NATIONAL AND STATE BENEFITS

It is a widespread belief that the "cost" of gas delivered through the Alaska Highway gas pipeline will be five or six dollars or more per thousand cubic feet (mcf). Such a statement makes the project look like an extravagant boondoggle in view of the fact that the U. S. Department of Energy last summer rejected as overpriced an opportunity to buy similar quantities of Mexican gas at $2.65. If comparative costs were really so disadvantageous to the Alaska project, its construction would clearly be against the national interest, and its commercial prospects would be nil. Further consideration of state support to the project would be a preposterous waste of time.

Five to six dollars is not an unrealistic estimate for the price of Alaska gas in Lower 48 markets, but it is important to understand what this estimate means, and what it does not mean. Firstly, the correct measure of the cost of Alaska gas to the United States is not its final price to consumers, but its "real resource cost" --- the value of the labor, capital and materials actually consumed in producing, conditioning and transporting the gas. The consumer price includes important charges that are not real resource costs

to the nation but only "transfers" from U. S. consumers to gas producers or governments.

Secondly, the $5 to $6 figure is in inflated dollars several years in the future. In 1983, 1984 or 1985, when the pipeline finally goes on stream, the prices of alternate fuels, including imported gas from Mexico, will be much higher than they are now (though how much higher is a critical issue for the pipeline's financial viability).

Finally, the initial price of Alaska gas delivered through the pipeline is not necessarily representative of the price that will prevail over the facility's entire economic life. Pipeline tariffs, like most utility rates, are calculated against a "rate base" that declines as the original investment is amortized, while larger gas shipments after the first years may reduce the amount of the fixed capital charge that each mcf of gas must bear. It is possible (though not inevitable), therefore, that the price of Alaska gas would go down over the years.

Thus, the price of Alaska gas in inflated dollars during the early years of pipeline operation is certainly a relevant consideration in judging the marketability of the gas and the project's commercial outlook. But it is not a meaningful measure against which to weigh the project's national benefits, nor an effective index of its long-term

viability.

There is no single, correct method for judging either net benefit to the nation or the business prospects of the pipeline venture. The following pages do, however, try to put the two concepts into perspective. The details of our assumptions and procedures may reasonably be debated, but we are confident of the major thrust of their results: the Alaska Highway gas pipeline almost certainly offers substantial net economic benefits to both the United States and the State of Alaska, but its soundness as a business venture is marginal at best without extraordinary kinds of government assistance.

NATIONAL BENEFITS

The national case for the Alaska Highway pipeline is a strong one. It consists of the following generally valid arguments:

1. Measurable and predictable economic benefits. The measurable and predictable economic benefits of the project for the United States (and for Canada) are strongly positive. Even with large cost overruns and stable real prices for imported oil, the value of Alaska natural gas delivered in the Lower 48 states

would almost certainly exceed its real resource cost --- the value of labor, materials, and capital inputs. Even with a total capital cost of $17 billion 1979 dollars for field development, conditioning and pipeline facilities, and a gas volume of only 2.0 billion cubic feet per day (bcf/d), the average resource cost of Alaska natural gas delivered through the Alaska Highway system is not likely to exceed $2.40 per thousand cubic feet (mcf) in 1979 dollars over a 20 year economic life, while the average 1979 cost of an equivalent volume of imported low sulfur residual oil (No. 6 fuel oil) will probably be more than $2.80. These figures imply a minimum economic benefit to the nation of about $440 million per year in 1979 constant dollars.

2. Measurable but speculative economic benefits. The total benefits of the project would be even greater in the likely case that it carried more gas than the 2.0 bcf/d minimum projected from Prudhoe Bay over the first 20 years of operation. The existence or anticipation of a gas transportation system may in fact be a powerful stimulus to petroleum exploration in the Arctic, and thus on the amount of additional gas discovered. Increasing the flow to 3.0 bcf/d and the

economic life to 30 years would reduce the maximum cost of Alaska gas to about $2.25 per mcf in 1979 dollars, for a minimum national economic benefit of about $550 million per year.

3. National security and international payments. Natural gas produced in the United States (or in Canada) will displace imported oil that is less secure and has a high foreign exchange cost. To the extent that Arctic gas supplies reduce world oil demand, they will also help to restrain future OPEC price increases. Alaska gas promises to supply about three quarters to one tcf of gas each year to U. S. markets, which now receive about 20 tcf per year.

4. Environmental considerations. Environmental, safety, and social disruption problems from the Alaska Highway project are probably lower than from any other currently available source of similar amounts of energy. (Consider, for example, coal mining and conversion, nuclear power, and offshore drilling.)

5. Alternatives. Hypothetical alternatives exist to the proposed pipeline for moving or using Prudhoe Bay natural gas, including transportation as methanol or by LNG icebreakers, and local petrochemical manufacturing. None, however, appears to be tech-

nically and economically feasible in the near future, at least for the volumes of gas available at Prudhoe Bay.

ALASKA BENEFITS

There is also an impressive case for the pipeline from an Alaskan viewpoint; the state clearly stands to be the biggest single beneficiary from production of Prudhoe Bay gas. The main elements of the Alaska economic case are the following:

1. Measurable and predictable revenue benefits. For each mcf of gas produced, the State of Alaska could expect to receive about 35.5 cents in 1979 dollars in royalties and production taxes if Prudhoe Bay gas sold at its legal ceiling price ($1.45 in March 1977 dollars --- about $1.75 in 1979). The state also levies a 20 mill tax on oil and gas pipeline property, and a 9.4 percent corporate income tax. With marketed gas production of 2.0 bcf/d, the state's total revenues from these sources would be on the order of $340 million per year in 1979 dollars. Increases in the need for state services directly due to the pipeline or gas sales would be minor in comparison.

2. Measurable but speculative revenue benefits. Any additional gas carried by the pipeline beyond the 2.0 bcf/d minimum projected for the Prudhoe Bay field would increase net state revenues almost proportionally. 3.0 bcf/d would produce expected state revenues of about $460 million per year, with very little offsetting increase in the demand for state services. To the extent that the existence of a transportation system for Arctic gas would stimulate industry interest in exploration, state oil and gas leasing bonuses and rentals might increase significantly.

3. Direct employment effects. Field development and construction of the pipeline and conditioning plant would require 50-60,000 man years of direct labor in Alaska over a four-year period. There would be several hundred permanent jobs in administration, operation and maintenance of the field, plant and pipeline.

4. Multiplier and induced economic effects. The spending of construction payrolls and state revenues will reverberate throughout the Alaska economy, creating further jobs, additional state revenues, and further increases in gross state product and personal income. Increased income and employment opportunities will encourage net in-migration to Alaska, further swelling

the labor force and population. Values will rise for assets such as urban land and housing whose supply is fixed or relatively inelastic, thus increasing the real wealth of some present Alaska residents.

5. Energy for Alaska households and industry. A transportation system for moving Alaska gas to the Lower 48 may also make natural gas (and perhaps natural gas liquids) available for residential, commercial, industrial and electric utility use in Fairbanks and elsewhere in interior Alaska.

6. Environmental considerations. Expected and potential environmental, safety and social disruption problems from the project are probably lower than for any other foreseeable source of comparable state revenue or personal income. (Consider, for example, coal or metallic mining, timber, or even tourism.)

7. Alternatives. Exactly the same point can be made about other uses of Prudhoe Bay gas for the state as for the nation: plausible alternatives do exist, but none of them seems economically feasible in the foreseeable future.

Not all the foregoing effects on Alaska's economy are wholly predictable, nor are they necessarily unmixed blessings.

The net revenues from gas sales almost certainly will not be as great as the state now anticipates because the price for Alaska gas established by the Natural Gas Policy Act of 1978 is only a ceiling above which the outcome of private sales negotiations and regulatory interference may not penetrate.

Pipeline construction would repeat the inflation and social turmoil of the TAPS oil line boom, albeit on a somewhat smaller scale, while construction jobs will not necessarily mitigate Alaska unemployment in the long run, and may indeed worsen it. The permanent increase in labor force and population, moreover, would have a mixed (and controversial) effect on the Alaska environment, and the style and quality of life in the state. Not every Alaskan agrees that increased leasing, exploration and development in the Arctic is desirable at this time. Finally, some Alaskans do not regard industrial development based on natural gas or gas liquids as necessarily a good thing, while others would be willing to give up or postpone the predictable revenue benefits from the Alaska Highway project in the hope that an alternative system more favorable toward Alaska processing operations will eventually turn up.

Notwithstanding all these reservations, there is one outstanding feature that the indirect, speculative, or

debatable Alaska "benefits" of the pipeline project (other than the construction boom) have in common: state government can control or at least influence them powerfully through mineral leasing, taxation and environmental policy, or by controlling the amount and kind of government spending. The measurable and predictable revenue benefits may be spent currently, used deliberately and consciously to stimulate further economic growth (perhaps as subsidies to industries as diverse as bottomfishing and chemical manufacturing), or invested outside of Alaska to meet future budget needs. At least according to conventional ways of thinking, therefore, there is little question that the prospective leasing and tax revenues would be real benefits to Alaska's economy, which the state may spend currently or invest for future needs at its own discretion.

CHAPTER II

ECONOMIC VIABILITY AND FINANCIBILITY

MARKETABILITY AND ECONOMIC VIABILITY

The fact that the real economic (or resource) costs of Alaska natural gas over the life of the pipeline will almost certainly be less than the cost of substitute fuel (No. 6 oil) does not necessarily imply that the consumer cost of Alaska gas will be less than the consumer cost of the alternative. And because the viability of the project depends upon the willingness of consumers to pay for the gas, the existence of net economic benefits does not automatically mean that the pipeline is a sound business venture.

The economic cost of producing, conditioning and transporting Alaska gas to the Lower 48 is composed only of amortization and return on the labor and materials invested in field development, pipeline and conditioning plant construction, plus the relatively small cost of labor and materials required for administration, operation and maintenance. The consumer cost of gas includes very substantial additional charges, the most important of which are the excess of the field price over the real resource cost of gas production and conditioning, plus Alaska and Canadian taxes.

There are other minor additions and some offsets (like the investment tax credit) which combine to make delivered cost of Alaska gas to U. S. consumers substantially different from its resource or economic cost.

Up to this point, moreover, the costs and benefits of the pipeline project have been discussed in terms of "levelized" values in inflation-adjusted dollars. In the real world, however, the marketability of Alaska gas and thus the viability of the pipeline project will depend upon the structure and the time profile of transportation and distribution charges (which will not be levelized). It also rests upon the ability of Alaska gas to meet the prices for alternative fuels in current nominal dollars, a consideration profoundly affected by the rate of future inflation. The following pages consider the effects of field prices, taxes, utility rate design, and inflation on the soundness of the Alaska Highway project as a business venture in which consumer charges must meet all its costs.

1. Field or "wellhead" prices. The gas producers and the State of Alaska both expect, and are legally entitled to demand, $1.45 in March 1977 dollars (about $1.75 in 1979) for each mcf of Prudhoe Bay gas. While the producers may eventually agree to a field

price lower than this ceiling established in the Natural Gas Policy Act of 1978, they will nevertheless insist on some payment beyond the bare "incremental cost" of field development, on the ground that the gas ought to compensate them for its "fair" share of the joint costs of leasing, exploring and developing the field for both oil and gas, plus a reasonable profit.

Assuming that the producers and the State are able to negotiate contracts at the ceiling price, but that they have to absorb production and conditioning costs of about 73 cents per mcf, the field price would add about $1.02 per mcf to the average consumer cost of the gas, beyond that determined by the actual input of labor, capital and materials. Consumers would have to pay the field price plus the production tax on gas used as pipeline fuel, as well as on delivered gas. At a 94 percent net fuel efficiency for the pipeline, this charge would be about 12 cents per mcf.

2. State, local and Canadian taxes. Federal taxes on corporate income are legitimately regarded as part of the resource cost of producing and delivering the gas, because the capital used in the project has to earn a high enough pre-tax return to bid it away from other potential investments where its profits would also

be subject to the corporate income tax. But state production, sales, and corporate income taxes, Canadian taxes, and import tariffs are additions to the costs of labor, capital and materials. Thus, at a field price of $1.75, the state production tax adds 16 cents per mcf to consumer costs; with net gas deliveries of 2.0 bcf/d, Alaska and local property taxes would add about 8 cents, state income taxes 3 cents, and Canadian federal and provincial taxes about 18 cents.

Other possible differences between the economic or resource cost of Alaska gas and its delivered cost to consumers include the investment tax credit, which reduces fixed costs by about 12 cents per mcf; the "excess" profits, if any, allowed the pipeline owners above the minimum return required to attract equity; Lower 48 state and local taxes (on the Northern Border and Western leg systems); and charges for gas transportation and distribution beyond the "tailgate" of the Alaska Highway system.

Ignoring some of the smaller or more speculative items, we can arrive at an order of magnitude estimate of the price of 2.0 bcf/d of Alaska gas delivered to Lower 48 consumers, "levelized" in 1979 dollars. The major elements above total $3.82:

Consumer cost of Alaska gas in constant 1979 dollars

Field Price	$1.75
Production Tax	.16
Other Alaska Taxes	.11
Pipeline Fixed Cost	1.42
Pipeline Fuel	.12
Operation and Maintenance	.20
Canadian Taxes	.18
(Less) Investment Tax Credit	(.12)
TOTAL	$3.82 per mcf

It should be remembered that this list is not complete; in particular, it includes no transportation and distribution costs beyond the tailgate of the Alaska Highway system. It does assume that the producers receive the statutory ceiling price for gas in the field, but that they must absorb gas conditioning costs as a preliminary FERC ruling. This decision is being disputed; if gas purchasers had to pay all conditioning charges, the consumer cost of gas would rise about 40 cents more.

Thus, with the same relatively high capital cost assumptions used in the last section, and with net deliveries of 2.0 bcf per day, Alaska gas would not be a commercially sound venture today: consumers with a choice of fuels would not buy Alaska gas at its full cost. The viability of the pipeline project therefore depends upon (1) a firm conviction that both the nominal and real prices of

substitute fuels will increase very substantially, or (2) a firm conviction that consumer subsidies in the form of rolled-in and "value of service" pricing, and "front-end loaded" tariff profiles, could bridge any foreseeable gap that may occur between the delivered cost of Alaska gas and its market value.

These regulatory issues were elaborated in an earlier report in the present series, and will be treated again elsewhere in the final report. It is sufficient here to point out four important reasons why the two preconditions above may not be satisfied.

First, while it is a reasonable assumption that world oil prices will continue to rise, there are some very plausible circumstances in which they might remain stable or even fall in real terms for a number of years, at least after the end of the current Iranian crisis.

Second, the ability of rolled-in pricing to subsidize high-priced supplemental gas depends wholly on the "cushion" of low-price gas flowing under old contracts; this cushion will be largely depleted by the late 1980's.

Third, Congress and the President, through the Alaska Natural Gas Transportation Act and the decision selecting the Alaska Highway system, have explicitly rejected some of

the rate design mechanisms FERC might otherwise have employed and which may yet be essential to assure the marketability of Alaska gas.

Finally, it is not sufficient to deal with gas marketability in general, as we have done here. Specific gas transmission companies must want to acquire the gas, and be confident that they can track all of its costs through their distribution company customers to final consumers. Each system's willingness and ability to move the gas must be judged on the basis of its own customer mix; the size, term, and cost of its existing gas supply; and the policies of state regulatory commissions in its market area. As far as the authors can ascertain, neither FERC nor the pipeline sponsor has conducted this kind of demand analysis --- without it, even the most optimistic assumptions about gas marketability in general do not assure the commercial viability of the proposed project.

IS COMMERCIAL VIABILITY ENOUGH?

The previous pages have shown that a project that can be justified on the basis of predictable national economic benefits may not be a sound commercial venture. The same assumptions that generated an <u>average cost to the nation</u> of

about $2.40 per mcf for Alaska natural gas, suggested that its average cost to consumers would be about $3.82, both in terms of constant 1979 dollars. The one is considerably less, and the other considerably more, than the 1979 cost of substitute fuel. The Alaska Highway pipeline project seems, therefore, to be a worthwhile project from a national standpoint, but a questionable one from the standpoint of consumers or private investors.

Just as the promise of national economic benefits does not guarantee commercial viability, so the promise of a profitable venture does not necessarily mean the project can be financed (unassisted) in private capital markets. A venture whose success rests on large future price increases, however likely they may now seem, and on future actions by regulatory bodies, no matter how reasonable they appear today, bears a heavy load of "ordinary" commercial risk. The Alaska Highway project is also subject to some "extraordinary" engineering, political and regulatory risks, which will be considered further in another part of the final report.

Thus, two interacting characteristics of the proposed project make its financial viability doubtful. One is the range and severity of risks, and the other is the tremendous scale of the project. Either characteristic alone might not be terribly troublesome. For example, if the risks remained

unchanged but the capital commitment required of each lender or sponsor were not nearly so huge, cash might be forthcoming: Each party could afford to make a bad judgment without jeopardizing its overall well-being. Recognizing this, the gas pipeline's sponsors intend to seek debt contributions from as many different sources as possible, and the Department of Energy hopes that virtually all of the major gas transmission companies will take an equity position.

Likewise, if the project size remained unchanged but its risks were substantially reduced, financing would also be less of a problem. This principle has motivated the sponsors of the Alaska Highway group to design a system whose technological, engineering and political risks were considerably less than those of their former rivals, El Paso, Alaska and Arctic Gas.

A previous report in this series elaborated on the reasons that risk-reduction is still insufficient to attract sufficient private debt and equity to this project. Elsewhere in the final report, we shall set out in detail the preconditions for allocating ordinary and extraordinary risks in such a way that the pipeline might be financed.

CHAPTER III

THE CONSEQUENCES OF DELAY

INTRODUCTION

Whatever state or national perceptions may be of the costs and benefits of this proposed pipeline, or of its commercial or financing outlook, the likely consequences of project abandonment or serious delay are crucial considerations in deciding how much of the financial burdens and risks either government could responsibly assume. If the project is not put together now, what does the state or nation lose (or gain) in the meantime? What are the chances that it (or something functionally similar) might be put together later --- and under more or less favorable conditions?

If one believes that failure to finance and build the pipeline immediately would be a disaster to the state or to the nation, prudence demands that government be prepared to step out front on financing matters. On the other hand, if the consequences of delay are not judged so ominous, then a more restrained approach may be in order.

The consequences of delay should be looked at in two ways. First, what is the effect of a simple postponement of benefits? Second, how might a delay alter the actual

character or scale of the expected benefits, or the project's viability?

THE EFFECT OF DELAY AS A POSTPONEMENT OF CERTAIN BENEFITS

Preceding any speculation of how conditions might change in the event the pipeline is delayed (and whether such changes constitute net benefits or net costs), one must examine the effect of a delay all else being equal. That is, if the costs and benefits were to remain the same whether the pipeline is built now or later, what difference would a delay in and of itself mean to the State or nation?

Notwithstanding Department of Energy statements extolling the long-term benefits of Alaska gas to U. S. consumers, the unique national benefit of Alaska gas is usually perceived as its contribution to increased domestic energy security and as an offset to the increasing flow of U. S. dollars to foreign (particularly OPEC) nations. One might argue against building the pipeline now on the theory that world energy supplies will keep getting tighter. The indicated U. S. policy, therefore, would be to "drain Arabia first," keeping Alaska oil and gas in the ground until it is desperately "needed." In truth, no one knows whether energy security and international payments problems will be more

pressing in the mid-1980's, when the pipeline is scheduled to go on stream, or some twenty years later, when the Prudhoe Bay field would have been largely depleted under the present production schedule.

The current Iranian crisis demonstrates, however, that the security and price of imported oil are real problems today, and they will almost certainly still be problems five years from now. Further, it is very likely that the Alaska gas transportation system will in fact carry significantly more gas than has yet been proved up in Arctic Alaska, and for considerably longer than 20 years. Viewing the pipeline as opening up a potential energy frontier that could supply the nation with secure domestic energy for thirty, fifty or more years, there is little point in "saving" Alaska gas for a more acute future crisis that may never materialize. All other things being equal, the national strategic benefits of the Alaska Highway system argue for building it sooner rather than later.

The primary benefits to the State from the proposed project are usually cited as jobs and money. The question of jobs now versus jobs later, like the question of how soon the nation increases its security of domestic energy supplies, does not lend itself to rigorous mathematical analysis. One observation is in order, however: Whenever it may take

place, pipeline construction is too far away in time to be a meaningful cure for Alaska's present post-TAPS slump. Before any pipeline jobs come along, most of the currently unemployed will have had to find other jobs, leave Alaska or starve.

On the other hand, much technical debate has already taken place in Alaska about the "time value" of money to the State. All else being equal, what difference does it make whether the State earns a billion (inflation-adjusted) dollars in royalties over a twenty year period beginning in 1984 or beginning in 1990?

Simply stated the "time value" of money reflects the fact that a dollar today is worth more than a dollar tomorrow because (1) we can invest today's dollar in such a way that we will have more than a dollar tomorrow, and (2) we would have to repay more than one of tomorrow's dollars in return for borrowing a dollar today. This concept sounds rather simple on the surface --- so we will leave it at that. When employed to determine the consequences of a delay in the receipt of revenues, however, it is actually quite complex, and, like most tools of economic analysis, is only as good as the assumptions with which it is combined. The most difficult (and important) assumption turns on the question of what is the proper "discount rate" for dollars

accruing to a particular entity --- in this case, the State.

Moreover, whatever one concludes with respect to the "time value" of money for the State and the consequent "costs" of a delay in gas royalties and taxes, one ought to remember that several qualitative factors may be as important as the "discounted present value" of state revenues. If state officials attach some special value to early receipt of cash -- say a need to meet ongoing government operations, cover debt service obligations, or fund capital improvements for which borrowing is not an acceptable alternative because of constitutional restrictions, political pragmatism, or plain business sense -- then a strict profit-maximizing calculation of the time value of gas revenues is not the appropriate basis upon which to make decisions. Likewise, those who believe that having spare cash on hand to reinvest within Alaska carries some intangible benefits will probably attribute a higher value to early generation of cash than might be accorded by a traditional "time value" formula.

On the other hand, if one views the goal of "saving" the State's nonrenewable resource wealth for future generations as worthwhile yet difficult to achieve, then again the conclusions drawn from time value analyses would be viewed with skepticism. In this case, even if conventional financial analyses showed convincingly that the State would be better

served by cashing out its resource wealth earlier rather than later, and investing it in assets that yielded a higher rate of return than gas in the ground, one may nevertheless wish to postpone the metamorphosis of hydrocarbons into cash. Such an approach may be the only certain way to avoid swelling the bureaucracy, underwriting risky developmental ventures, or otherwise spending what should really be saved.

THE EFFECT OF DELAY ON THE CHARACTER AND SCALE OF EXPECTED BENEFITS AND THE PROJECT'S VIABILITY

Up to this point, our discussion of the consequences of postponing pipeline construction has assumed that its benefits remain essentially the same in kind and magnitude regardless of their timing. If this premise is accepted, economic and strategic benefits to the nation seem to argue strongly for early construction and gas sales. Alaska's fiscal interests may tilt the argument in the same direction, with the important reservation that the State might not have the ability to carry out a financial strategy that maximizes the present worth of all its future revenues --- even if it wanted to do so.

In the real world, postponement of benefits from

producing Prudhoe Bay gas will involve important changes in the scale and character of those benefits and the project's viability. It will surely have some impact, for example, upon:

(1) the volume of gas available for sale;

(2) the costs of producing, processing, and transporting the gas;

(3) the demand for the resource and its consequent "market value."

The following pages will explore what these changes might be, and how such changes might affect the project's viability and the benefits to Alaska and the nation.

THE EFFECT OF DELAY ON THE VOLUME OF GAS AND OIL AVAILABLE FOR SALE

An understanding of what is likely to happen physically to hydrocarbon resources at Prudhoe Bay if pipeline construction is postponed is probably one of the most important considerations from either a State or national viewpoint. The authors' non-expert understanding, both from the published literature and from conversations with experts, is that prolonged gas reinjection would create no foreseeable danger to oil recovery, that the physical loss of gas would be minor (at least in comparison to the financial cost of

postponing gas sales), and that the capital outlay for necessary reinjection facilities would be essentially the same whether or not the proposed gasline is built according to present schedules.

Our impression of a consensus among the experts is not shared, however, by responsible officials of all the affected companies. The various parties with whom the authors have discussed this question seemed reasonably certain that they knew what the consequences of prolonged gas reinjection would be, but surprisingly, their opinions were far from unanimous. For example, a spokesman for one of the Prudhoe Bay gas producers maintained that loss of gas volumes resulting from prolonged reinjection would be minimal --- and he, in fact, stressed the value of prolonged reinjection for increasing ultimate recovery of the associated oil resource. Spokesmen for another producer, however, painted a gloomy picture, warning of substantial gas loss in the event gas pipeline construction is seriously postponed; while a major institutional lender felt certain that gas offtake and sale by 1981-82 were absolutely essential for proper field management of oil as well as gas.

A related question involving more visible public controversy is the effect of early gas production on the ultimate recovery of oil from the Prudhoe Bay field. Most engineers seem to agree that gas production will entail some

sacrifice in oil recovery, or at the very least, will require greater investment in water injection to avoid the potential loss of oil. A few engineers have argued that prudent operation of the reservoir requires reinjecting all of the gas produced in association with crude oil, postponing gas sales until after the oil has all (or nearly all) been produced. Making a rational decision on this issue, however, requires a judgment on the relative value of oil and gas at different times in the future, and on the appropriate discount rate for weighing earlier against later revenues, as well as a knowledge of reservoir engineering.

The State has contracted for a detailed study of the likely costs and physical effects -- translated into economic consequences -- of various gas production profiles for the Prudhoe Bay field, including prolonged gas reinjection. There is some chance that this and other subsequent studies would indicate that prudent reservoir management (with due consideration of financial factors) would dictate postponing gas shipments beyond 1983-84, or limiting them to volumes less than the economic threshold of pipeline viability --- but we would not rate these chances as very high.

In addition to a technical evaluation of the effects of prolonged gas reinjection on the functioning of the Prudhoe Bay reservoir, one should consider several other issues

which likewise affect the volume of gas available for sale and, thereby, the project's viability.

First, regardless of the actual effect of delay on the volume of oil and gas ultimately recoverable, delay will certainly increase the confidence in the predictions voiced by reservoir engineers, corresponding to an accumulation of field production history upon which predictions are based. To date, a lack of production history and the attendant uncertainty about reservoir performance has been one element impairing gasline financing, which depends upon a reliable flow of gas at projected volumes.

Second, delay may also provide a better understanding of how much gas might exist in other known reservoirs on the Arctic Slope (such as the Kuparuk and Cape Thomson) and how much gas might be discovered elsewhere in the region, for example, in the National Petroleum Reserve or the Beaufort Sea. Here too, added certainty of supplies -- and particularly any increases in proven reserves -- will improve the financing prospects for a transportation system, and will additionally assist in the design of its optimal capacity.

Third, the presently acknowledged delay in pipeline startup from 1982 to 1983-84 or later has already boosted the expected initial volumes of gas shipments, thereby reducing the proportion of fixed transportation costs each

unit of gas must carry. This conclusion is based on a virtually uncontroversial axiom of reservoir engineering --- that is, the notion that the daily volume of gas removal consistent with prudent reservoir management increases as oil is produced.

THE EFFECT OF DELAY ON THE COSTS OF PRODUCING, PROCESSING, AND TRANSPORTING PRUDHOE BAY GAS

One commonly cited economic effect of delaying the pipeline project is the belief that for each year construction is postponed, the system's capital cost will inflate by hundreds of millions of dollars. While this is not a particularly controversial statement, the extrapolation that such a consequence is necessarily "bad" has no justification. It is a valueless statement unless viewed in the context of assumptions about how the market value of gas likewise changes through time, and what the "discount rate" or "cost of capital" is held to be.

For example, if the real (i.e. inflation-adjusted) prices of construction and the market value of gas remain the same -- in other words, if construction costs and gas prices rise at the same annual rate as general inflation -- the real profitability of the pipeline (and the net national benefits from it as well) will be essentially the same

regardless of when it may be built. In this case, the "time value" principle probably argues for early construction. Complications arise, however, if construction costs and the value of gas are not expected to increase in tandem. The importance of those complications is magnified if the current prices of gas do not justify the project, but future price increases are expected to do so. In this instance, the timing of construction may make a big difference: Should the facility be built now, ahead of effective demand, in order to evade higher future construction costs, or should it be postponed until market conditions are more favorable despite rising capital costs?

The correct answer depends mainly upon the interplay of three factors: (a) the rate at which construction costs are expected to inflate, (b) the rate at which the value of the gas is expected to increase, and (c) the time value of money, as represented by the "cost" of capital (the rate of return the funds invested in the pipeline could earn in other uses.) It is a principle of natural resources financing that development ahead of demand is warranted only where (a) capital costs are expected to increase at a rate that is higher than the sum of (b) the rate at which sales prices (e.g. delivered prices for natural gas) are expected to increase and (c) the necessary return to capital.

Such a circumstance is certainly conceivable, but it does not seem very likely with respect to the present proposal. Consider some illustrative numbers: Suppose the value of gas is expected to increase at about 8 percent per year, while the rate of return on pipeline investment is 15 percent. Do we really expect construction costs to rise at a rate of 23 percent annually? Conceivably, but not very likely!

Thus, we can conclude that it probably makes more sense to build the pipeline earlier than later, but only if it is otherwise worth building at this time. Anticipated construction cost escalation is a legitimate consideration in timing the project, but it would not be a sufficient reason to build the pipeline before it could meet either a net national benefit or a marketability test.

In addition to the cost effects of delay posed by construction cost fluctuations and market value changes that do not move in tandem through time, one must consider the likelihood of technological or other breakthroughs which may sweeten project economics at some future date. Such a breakthrough might be of the sort which simply decreases the costs of constructing the project as now proposed. It might, instead, prompt a change in routing or design --- for instance to take advantage of economies of scale presented

by prospects for a gas transportation system that would serve the entire Canadian Arctic, as well as Northern Alaska. Or a substantial change in the project scope may take place: ice-breaking tankers, or in-state processing of gas into methanol, fertilizers or petrochemicals may prove more attractive. Underlying all speculation, of course, is the oft-cited "fallback" alternative of simply running the gas through an empty TAPS oil line 25 years from now.

Prudence, nevertheless, dictates that one not place unwarranted optimism in the prospects for speculative breakthroughs. The hope for any one of them must be weighed against the much greater likelihood of success for a conventional project already under way. Any alternative that involves delay, moreover, must be promising indeed to overcome the general presumption in favor of an early start that comes from the conventional discounting of future benefits.

THE EFFECT OF DELAY ON THE DEMAND FOR PRUDHOE BAY GAS

Spokesmen for the pipeline sponsors have argued that Prudhoe Bay gas must be sold quickly in order to tie up markets before potentially cheaper (at least in the short-term) supplies of Canadian and Mexican gas flood the U. S.

market. Interestingly enough, this scenario has very little to so with the real market demand for Alaska gas; it hinges more on institutional motivations and perceptions of the need for Alaska gas.

Supplemental gas supplies -- be they Canadian, Mexican, Alaskan, Algerian, or whatever -- are not ultimately destined for use in so-called "premium" gas markets where residential and small commercial customers view electricity or distillate fuel oil (No. 2) as the alternative to gas. Existing Lower 48 reserves of conventional gas could satisfy these markets well into the next century. Instead, the main effect of supplemental supplies will be to allow the United States to continue burning gas in "low priority" markets, where residual fuel oil (No. 6) and coal are the alternate fuels. Given reasonable time for fuel users to adapt to the fact of more abundant gas supplies, this low priority market (encompassing the use of gas, oil or coal as industrial and electric utility boiler fuel) is virtually unlimited --- at least within the range of plausible gas volumes.

Hence, Canadian, Mexican and Alaskan gas are not competitive with one another, so long as they are all competitive in price with residual oil. The only way in which the entry of substantial volumes of Canadian and Mexican gas would adversely affect the marketing of Alaskan

gas is if the supplies are purchased at prices that remain significantly above that of No. 6 oil --- in which case, the "cushion" of cheap domestic gas under old contracts will be used to offset the higher-than-market price. If the marketability of Alaskan gas in the early years of pipeline operations explicitly depends on this cushioning effect, relatively high-cost Mexican or Canadian gas will compete with Alaska gas for the implicit subsidy provided by rolled-in pricing. This principle is not the same as the widespread and aberrant notion that "cheap" (i.e. at or below the residual oil price) Mexican or Canadian supplies will gobble up the markets for Alaskan gas. Indeed, the cheaper these supplies the less they should interfere with the marketing of Alaskan gas!

The sponsors of the gasline proposal, moreover, assert that additional sales of Canadian gas will actually boost the financing prospects of the entire proposed pipeline system by enabling "pre-building" of the eastern leg (800 bcf/day) and portions of the western leg (200 bcf/day).

Thus, the Department of Energy's stated position on the desirability of importing large volumes of natural gas from Canada and Mexico is correct at least in principle (though we do not necessarily endorse the way in which the Department has implemented that position). Gas imports are indeed

desirable, but at prices much higher than the cost of imported residual oil, they neither are a bargain for U. S. consumers, nor are they in the broader national interest. One of the reasons for the latter judgment is the adverse impact such imports would have on the marketability of Alaska gas.

In any case, institutional considerations may well have a greater effect on marketing perceptions and the "need" for Alaska gas than any theoretical arguments. If large quantities of Canadian and Mexican gas do become available and the outlook for continued shipments is reasonably secure, the "crisis" thinking behind the notion that Alaska gas is essential however much it may cost may well recede --- and with it, the willingness of transmission company sponsors to bear financial risks, the receptivity of federal and state regulatory bodies or Congress to sanction consumer risk-bearing, and ultimately the justification for federal involvement in the project's financing.

CONCLUSION

From a national viewpoint, it would be convenient if this kind of analysis led to definitive conclusions on the questions: "Will consumers end up paying more or less for Alaska gas if the project is delayed?" and "Might a crisis

develop in which the nation sorely regrets not having the gas (and potentially other Arctic supplies) available as soon as possible?"

From the standpoint of the state, a conclusion on whether royalty netbacks might benefit or suffer from delay would also be convenient. Likewise, both parties would be well served if some omniscient being could predict with certainty whether postponement of the pipeline construction and gas sales would change (1) how badly the project needs government assistance, and (2) the desires of other parties to bear financial risks.

This report, quite obviously, falls short of those goals. There is and can be no certain answer to these questions. Lack of certainty about what the future may bring (translated into "risks" by the financial community) has been one of the biggest stumbling blocks for this project all along, and it further promotes an atmosphere in which nobody wants to make commitments -- least of all government decisionmakers faced with the prospect of either consenting to certain extraordinary and potentially very unpleasant courses of action or being prepared to watch the project die, at least for the time being.

Nevertheless, the authors have attempted to stake out the bounds of the universe with respect to relevant questions,

and to attach some qualitative judgments on the prospects that various conditions will improve or deteriorate through time. Looking at how conditions may change with respect to volumes of gas available, project costs, and the marketing outlook, several broad conclusions are in order:

(1) The economic environment within which the pipeline must be justified and financed will probably not deteriorate with the passage of time. Likewise, prudent decision-making should not opt for delay based on the hope that future events will substantially sweeten the project's economics. While certainty about the project in some ways improve (for example, certainty about the volume of gas available), for the most part concern about events which may take place during the twenty-plus years of the project's operational life will not diminish whether the project is built tomorrow, ten, or twenty years from now. Uncertainty will always be with us.

(2) If the nation is truly concerned about domestic energy security, and if the state places an emphasis on the "present value" of its assets, it probably makes sense to encourage construction of the line now rather than later.

(3) While a further delay of one, two or more years will probably have measurable costs to the state and the nation, it is not likely to have catastrophic consequences for either of them, or for the eventual success of the project.