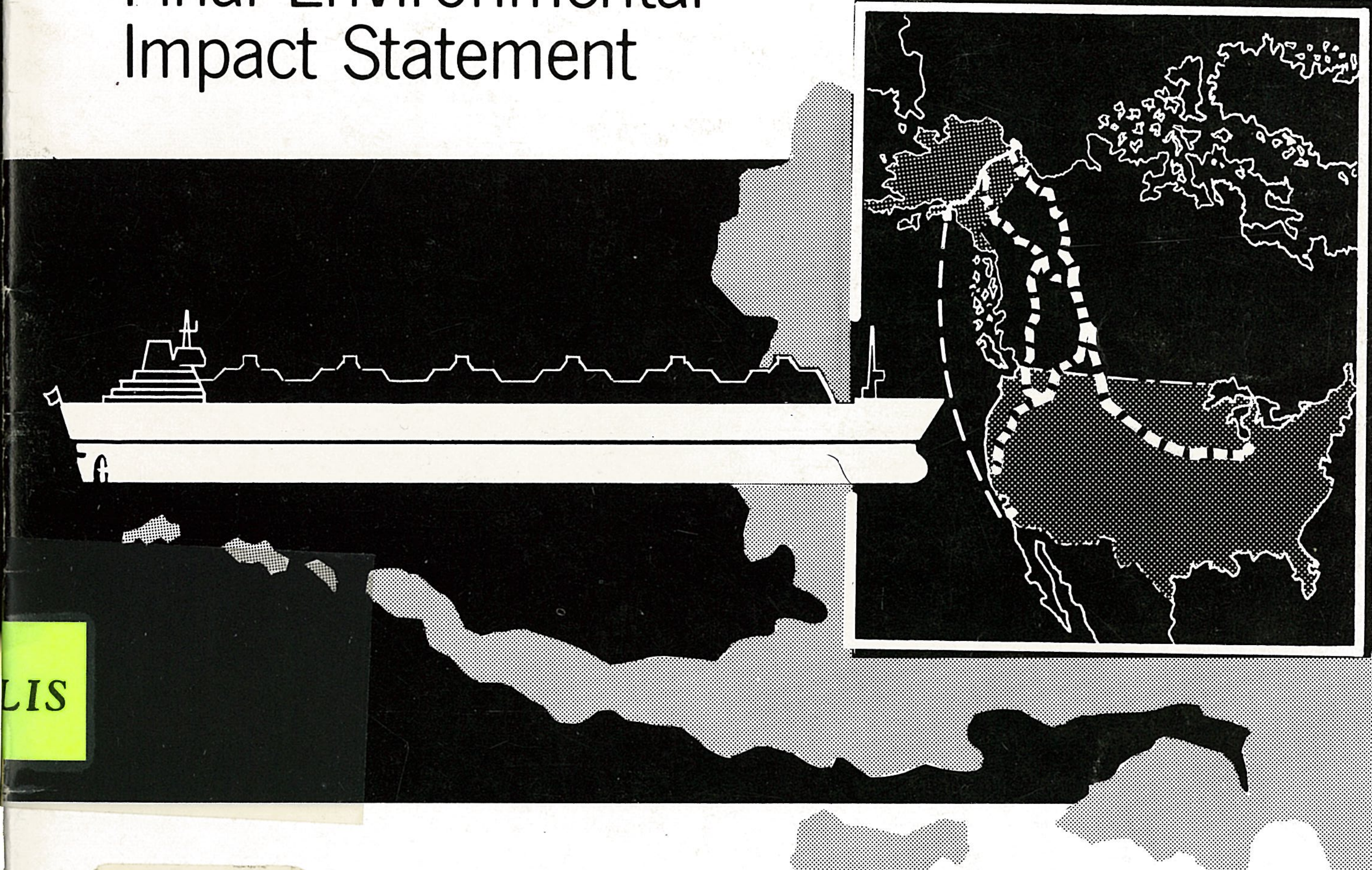
ALASKA NATURAL GAS TRANSPORTATION SYSTEMS

Final Environmental Impact Statement



FEDERAL POWER COMMISSION STAFF

SUPPLEMENT

PART 2 ECONOMIC ANALYSIS
ALCAN PIPELINE PROJECT

September 1976

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FINAL ENVIRONMENTAL IMPACT STATEMENT FOR THE ALASKA NATURAL GAS TRANSPORTATION SYSTEMS

SUPPLEMENT
PART 2 - ECONOMIC ANALYSIS

EL PASO ALASKA COMPANY
Docket No. CP 75 - 96, et al.

September 1976

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A. Summary and Conclusions

In this volume the results of a revised economic analysis, including the Northwest proposal, are presented. This work is based upon an improved model for estimating gross benefits that eliminates some of the deficiencies of the FEIS model.

The results of this analysis can be summarized as follows.

1) Net national benefits are generally lower.

2) El Paso is less disadvantaged than in the earlier analysis but is not the best alternative in any case.

3) Fairbanks-Alcan remains the economically superior alternative in all cases. However, its margin of superiority is reduced.

4) Northwest's flow rate is smaller than those for the other alternatives which makes comparison difficult. However, it appears that Northwest's economic benefits are significantly lower than that of the other candidates.

B. Analytical Methods

1. The Revised Model

For this study an improved model for calculating gross benefits has been developed. In this version states, rather than Census regions, are the basic demographic units. Each state possesses a gas demand function for each year -- in the FEIS version these demand functions were aggregated to Census regions -- and an assumed maximum gas production for each year. Calculations have been carried out for gas demand functions predicated upon \$12 per barrel oil and \$8 per barrel oil. The high and low aggregate gas supplies for the lower 48 states used in the FEIS study have been assigned to the states in proportion to their share in the 1970 aggregate supply. The model also contains a representation of actual pipeline routes along which supplies are transported in the lower 48 states. The objective of the model, which is of the nonlinear programming variety, is maximization of the annual gross benefits from gas consumption -- as described in the FEIS -- less the associated transportation operating costs of 2¢/Mcf/100 miles. Maximization is achieved by finding the appropriate allocation of supplies to states. The gross benefits of the Alaskan gas, less transport costs, are found as the difference between the maximum value with the Alaskan plus the lower 48 supplies and the maximum value with the lower 48 supplies alone.

The revised model remedies several deficiencies in the earlier model. First, the savings in lower 48 transportation costs that can be realized through displacement are taken into account. The earlier model did not have that capability, essentially because it was not complex enough to incorporate multiple sources for the lower 48 supplies. Second, transportation costs for the lower 48 supplies, as well as Alaskan supplies, are incorporated. This feature is important as transportation costs may rise more than proportionately with volumes when the Alaskan supply is added, because the nearby and more valuable demands have been supplied by the lower 48 gas. Third, multiple entry points for the Alaskan gas can be incorporated which allows evaluation of, e.g., the Arctic system with both Illinois and California deliveries.

The model was developed with capacity constraints on existing pipelines and the capability for adding capacity required for displacements at optimal points. The latter feature requires that the maximization be done simultaneously over the 20 year period rather than year-by-year. These features proved to require prohibitive amounts of computational time and were not incorporated in the model as utilized. However, results of the analysis which was conducted can be used to determine the amount of new capacity required for the displacement that takes place.

2. Remarks on Two Methodological Questions

a. Treatment of U.S. Income Taxes

The DOI and the FPC Staff have not included as a cost, imposed on the U.S. as a whole, U.S. income taxes that would be incurred by constructing and operating the proposed projects. Arctic, on the other hand, has argued in Exhibit AA-127 for the inclusion of such taxes as a cost. Qualitatively, the Staff reasoning runs that U.S. income taxes, like other Federal receipts, represent a transfer of income among U.S. citizens and a provision for public services. The payment of taxes does not result in fewer U.S. resources being available for other uses and is not an opportunity cost imposed construction and operation of a project. The grounds, in quantitative terms, for the contention that U.S. income taxes have this character are the following. First, much of the total of Federal expenditures is simply a transfer of funds and is not a payment for any resources. For example, 65% of Federal expenditures in 1975 were for transfer payments to individuals, grants to state and local governments, and interest payments on the national debt, while 35% were for the purchase of goods and services. 1/ On page 171 of the referenced report it is found that 67% of the purchases of goods and services were for national defense. Surely, no increase in national defense expenditures will be occasioned by the construction of any of the proposed transportation systems. Thus, only about 12% (= 33% x 35%) of Federal

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1/ Economic Report of the President for 1976, page 250.

expenditures are for non-defense purchases of goods and services. It seems apparent that the costs to the Federal government resulting from the construction of an Alaskan gas transportation system that were not offset by decreased costs elsewhere due to this construction are a very small part of the above 12%. Furthermore, only 15% of Federal receipts flow from corporate income taxes. 2/ Assuming costs are borne in proportion to the contribution to receipts, the result would be that only a small part of 1.8% (15% x 12%) of the U.S. income taxes paid by the applicants could correspond to costs that the project imposed on society.

Two other issues related to U.S. income tax treatment have been raised by Alaskan Arctic Gas Pipeline Company in Exhibit AA-127. First, that income taxes represent payment for the cost of externalities. In this connection it should be noted that Congress imposes the same tax structure on all corporations, independently of whether they impose external costs on society or not, and has not expressed any notion similar to that advanced by Arctic. Furthermore, Congress has enacted the Environmental Protection Act for the purpose of doing what cannot be done through income taxes; namely, closing the gap between private and social costs when and where it actually appears.

2/ Economic Report of the President for 1976, page 250.

Second, that the income taxes paid will, when expended by the government, change the distribution of income which will alter the allocation of resources in an inefficient and costly way. This strange proposition requires at least the following premises: (1) That no comparable revenue producing investments will be displaced if the gas transportation system is built. This proposition is necessary to ensure that the applicant's U.S. income taxes are an increment to Federal government receipts that would not have otherwise occurred. (2) That government expenditures are so closely tied to tax revenues that an increment to corporate taxes will result in an increment to Federal outlays. So closely tied, indeed, that the approximately .04% of Federal expenditures represented by El Paso's U.S. taxes will occasion an equal increase in Federal expenditures. (3) That any alteration in resource allocation resulting from the impact on income distribution of an increment in government expenditures is inefficient, and that efficiency is a cost to be attributed to the alleged revenue source. It is meaningless to speak of the efficiency effects of a change in income distribution and presumptuous to suppose that Arctic's dislike of a particular type of change in income distribution converts that dislike to a cost to the nation. In addition, no foundation is known to us for the novel view that payment of taxes necessarily causes governmental inefficiency.

b. <u>Multiplier Effects of Project Investment</u>

It can happen that expenditures on a project of the kind analyzed here will generate additional jobs and additional real income elsewhere in the economy. Clearly, however, that can happen only if the expenditures are increments to total outlays in the economy rather than displacements of other expenditures. Predicting whether future expenditures of this kind will be increments to total outlays or not is a hazardous undertaking. Indeed, it is extraordinarily difficult to discover even retrospectively whether expenditures have been of this character. It is also clearly necessary that the appropriate resources be underemployed when the expenditure takes place; otherwise, inflation is the only result. Thus, the future course of the economy must also be predicted in considerable detail. These two predictions are chancy enough that, on average, the results will be less favorable than assuming the full effect of the multiplier is on real income and more favorable than assuming the full effect is felt through inflation.

Staff believes, therefore, that it is prudent to concentrate upon prediction and analysis of the primary effects, whose character and direction are known, rather than to embark upon studies of secondary multiplier effects whose direction cannot even be known. This belief is further reinforced by the fact that the agencies responsible for fiscal and monetary policy can take actions in the future to offset, independently of the FPC action, any predicted secondary effects. We would, therefore, have to predict future monetary and fiscal policy as well. It seems better to concentrate upon what is directly affected through project selection; namely, the primary costs and benefits.

3. Important Assumptions

In this section we discuss the more important assumptions contributing to the results obtained.

Perhaps the most important are those incorporated in the gas demand functions and the lower 48 supply projections. For this reason a sensitivity analysis has been carried out using demand functions based on $8 and $12 oil and on the high and low supply projections given in the FEIS. Naturally, the combination of $8 oil and high supplies for the lower 48 states yields the lowest level of net national benefits. Indeed, an increase in the discount rate to 15% in this case results in negative net national benefits. However, more modest changes in the comparative net national benefits occur over the range of the sensitivity analysis. Based upon the experience of our previous work where $15 oil and an intermediate supply level were investigated, and found to yield no additional insights, these cases were omitted from the current analysis owing to the much greater computational requirements of the revised model.

Of course, the results depend on the levels of the Prudhoe Bay and Mackenzie Delta supplies as well. Generally, Fairbanks-Alcan net national benefits are improved relative to the other competitors and Arctic relative to El Paso when Prudhoe supplies increase. An increase in Mackenzie Delta supplies provides additional advantages to Arctic.

Based upon Dr. Goldstein's testimony it appears that cost overruns due to higher installation costs -- up to 200% increases -- above the Arctic Circle, while more disadvantageous to Arctic than Fairbanks-Alcan and El Paso, do not change the relative comparisons.

Schedule slippage -- without cost overruns -- reduce the net national benefits by a bit less than 10% per year of slippage. It can be seen from Table II-3 that a year's slippage by either Fairbanks-Alcan or Arctic alone can alter the ranking, particularly in the high supply case for the lower 48.

Generally, expansion owing to new discoveries in a location near one route will be advantageous to that route. For example, new discoveries in the Beaufort Sea will improve Arctic's net benefits relative to the others, while new finds in the interior of Alaska will improve Fairbanks-Alcan, El Paso and Northwest relative to Arctic. Other things equal, a given expansion will result in larger unit cost reductions for the all-pipeline routes than for El Paso.

No effect has been given to the arguments advanced by Arctic in AA-127 regarding cost and shrinkage matters as these issues have not yet been resolved.

C. Economic Comparison of Alternative Systems

In this section economic comparisons of the competing systems, similar to those made in Section I-C1c of the FEIS, are made. Two systems have been added. One is the proposed Northwest system with costs as shown in Appendix A. In the absence of any alternative the costs used are those developed by the applicant. The other is the Alaska-Canada system with a western leg to California. In the Appendix costs, from the Department of the Interior's 75%-25% case without the segment from Chicago to Pittsburgh -- see reference 13, page I-C35 of the FEIS, are given.

In Table II-1 the system costs are presented. These are, for the systems evaluated in the FEIS, identical with the corrected costs presented there. Gross benefits less lower 48 transportation costs are shown in Table II-2. Comparing these with the figures in Table I-C of the FEIS it is seen that the improved model reduced these benefits by about $1.4 billion, and $1.0 billion, for high lower 48 supplies together with $12, and $8, per barrel oil, respectively. In the low lower 48 supplies case, El Paso's benefits are reduced about $1.0 billion and $.6 billion for $12 and $8 per barrel oil prices; while the other two alternatives are reduced by about $1.8 billion and $1.3 billion for the two oil price cases. These surprising results can be explained in the following way. First, El Paso is reduced less in the low lower 48 supply cases because of the correct accounting for displacement costs. In fact, an examination of the flows reveals that the Texas gas that is displaced from California is essentially all consumed in Texas. It may be, therefore, that the El Paso displacement cost is too high in this case. Second, in the FEIS results there was little disadvantage to El Paso, in the high lower 48 supply case, from the fact that displacement was treated incorrectly -- see page I-C12. Finally, taking account of transportation costs for the lower 48 supplies, both when Alaskan gas is present and when it is not, increases total transportation costs disproportionately when Alaskan gas is introduced; because the markets near sources of supply have been more fully satisfied so that gas has to be shipped further.

Net national benefits are shown in Table II-3. El Paso is disadvantaged less than in the FEIS results but is still never the best alternative. The higher gross benefits of the western leg for Alaska-Canada are more than offset by the higher costs which confirms that Alaska-Canada is a better system without that leg. In all cases, Fairbanks-Alcan, with its superior environmental features, remains the best economic choice although Alaska-Canada is a close second when the full Mackenzie Delta flows are available. Lastly, Northwest is not comparable since the only available costs are for lower flows than for the other systems. However it can be seen that, e.g. to overtake Fairbanks Alcan in the $12, low lower 48 supplies case, Northwest would have to obtain additional gross benefits of $3.94 billion while experiencing a cost increase of $.673 billion, or $5.85 of additional benefit for each additional dollar of cost. For a system with a benefit to cost ratio at its current value of 1.55, it seems quite unlikely that it would be competitive with Fairbanks-Alcan at the higher volume nor with a scaled-down Fairbanks Alcan.

Table II-1

System Costs

(Billions of Dollars)

Discount Rate 10%

	Gas Transportation	Canadian Taxes	Displacement	Gas Production		Total	
Alaska Canada 1/							
with Western Leg							
Delta .5 to .9 BCFD	4.881	.511	0	2.372 3/	2.148 4/	7.764 3/	7.540 4/
Delta 0 BCFD	5.526	.623	0	2.372 3/	2.148 4/	8.591 3/	8.367 4/
w/o Western Leg							
Delta .5 to .9 BCFD	4.509	.462	.008	2.372 3/	2.148 4/	7.351 3/	7.127 4/
Delta 0 BCFD	5.212	.563	.008	2.372 3/	2.148 4/	8.155 3/	7.931 4/
Improved El Paso 1/	5.117	0	.327	2.372 3/	2.148 4/	7.816 3/	7.592 4/
Fairbanks-Alcan 1/	4.695	.353	.008	2.372 3/	2.148 4/	7.428 3/	7.204 4/
Northwest 2/							
with Western Leg	4.159	.585	0	2.011 3/	1.787 4/	6.755 3/	6.531 3/

1/ Prudhoe Flow 2.5 BCFD to 3.5 BCFD.

2/ Prudhoe Flow 2.4 BCFD.

3/ Lower 48 oil price at $12/bbl, foregone Prudhoe Bay oil valued at $9/bbl.

4/ Lower 48 oil price at $8/bbl, foregone Prudhoe Bay oil valued at $5/bbl.

Table II-2

Gross National Benefits
Less Lower '48 Transportation Costs
(Billions of Dollars)

Discount Rate - 10% to January 1, 1977

Lower 48 Transportation Costs - 2¢/Mcf/100 miles

	$12 per barrel oil		$8 per barrel oil	
Non-Alaskan Supply	High	Low	High	Low
Alaska-Canada 1/				
with Western Leg	11.698	14.378	8.124	10.807
w/o Western Leg	11.589	14.255	8.019	10.684
Improved El Paso 1/	11.857	14.015	8.294	10.452
Fairbanks-Alcan 1/	11.703	14.397	8.096	10.791
Northwest 2/				
with Western Leg	8.495	10.457	5.904	7.866

1/ Based upon an Alaskan Supply of 2.5 BCFD from mid-1982 through 1985, 3.5 BCFD from 1986 through 2001.

2/ Based upon an Alaskan supply of 2.4 BCFD for 20 years.

Table II-3

Net National Benefits
(Billions of Dollars)

Discount Rate - 10% to January 1, 1977
Lower 48 Transport Costs - 2¢/Mcf/100 miles

	$12 per barrel oil		$8 per barrel oil	
Non-Alaskan Supply	High	Low	High	Low
Alaska-Canada 1/, 2/				
with Western Leg	3.934	6.614	.584	3.267
	3.107	5.787	-.243	2.44
w/o Western Leg	4.238	6.904	.892	3.557
	3.434	6.100	.088	2.753
Improved El Paso 1/	4.041	6.199	.702	2.860
Fairbanks-Alcan 1/	4.275	6.969	.892	3.587
Northwest 3/				
with Western Leg	1.740	3.702	-.627	1.335

1/ Based upon an Alaskan Supply of 2.5 BCFD from mid-1982 through 1985, 3.5 BCFD from 1986 through 2001.

2/ Higher figure based upon a Mackenzie Delta flow of .5 BCFD from mid-1982 through 1985, .9 BCFD from 1986 through 2001. Lower figure based upon system constructed for above Mackenzie Delta flow which does not materialize.

3/ Based upon an Alaskan supply of 2.4 BCFD for 20 years.

Table II-4

Northwest Costs

as reported by applicant

2.4 BCFD
(Billions of Dollars)

	Capital	Operating and maintenance	Canadian taxes
1978	.821	.0	0
1979	1.305	.0	0
1980	1.816	.0	0
1981	.758	.0	.040
1982	.455	.043	.040
1983	.018	.060	.053
1984	0.0	.060	.071
1985	0.0	.060	.172
1986	0.0	.060	.112
1987	0.0	.060	.117
1988	0.0	.060	.118
1989	0.0	.060	.120
1990	0.0	.060	.121
1991	0.0	.060	.123
1992	0.0	.060	.124
1993	0.0	.060	.126
1994	0.0	.060	.127
1995	0.0	.060	.128
1996	0.0	.060	.130
1997	0.0	.060	.131
1998	0.0	.060	.142
1999	0.0	.060	.134
2000	0.0	.060	.136
2001	0.0	.060	.138

Table II-5

Alaska Canada Costs

2.5-3.5 Prudhoe Flow; 75% to Illinois, 25% to California

.5 to .9 Delta Flow

U.S. Share of Canadian Costs .82
(Millions of Dollars)

	Capital	O&M	Canadian Taxes	Total	U.S. Share of Total
1977	142	0	0	142	119
1978	399	0	0	399	334
1979	1395	0	0	1395	1167
1980	2083	0	0	2083	1803
1981	2279	0	- 9	2269	2038
1982	809	18	-24	803	723
1983	0	36	-34	2	3
1984	0	36	-34	2	3
1985	628	36	31	697	632
1986	0	79	232	312	260
1987	0	79	236	316	263
1988	0	79	214	294	245
1989	0	79	202	282	235
1990	0	79	189	268	224
1991	0	79	175	255	213
1992	0	79	163	243	203
1993	0	79	150	229	192
1994	0	79	137	217	182
1995	0	79	128	207	174
1996	0	79	118	197	166
1997	0	79	109	189	159
1998	0	79	100	179	151
1999	0	79	91	171	144
2000	0	79	84	163	138
2001	0	79	76	156	132
				6218	5391

Table II-6

Delivered Flows of Alaskan Gas
(BCFD)

	Prudhoe Flow (BCFD)	Delivered Flow @ Illinois	Delivered Flow @ California
aska-Canada			
with Western Leg	2.5 (3.5)	1.755 (2.352)	.585 (.784)
w/o Western Leg	2.5 (3.5)	2.34 (3.136)	0 (0)
proved El Paso	2.5 (3.5)	0 (0)	2.284 (3.153)
irbanks-Alcan	2.5 (3.5)	2.365 (3.167)	0 (0)
rthwest			
with Western Leg	2.4	1.223	.858
w/o Western Leg	2.4	2.047	0