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PETROLEUM DEVELOPMENT IN ALASKA: PROSPECTS AND CONFLICTS†

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Alaska has developed sporadically taking advantage of fur, gold, and a strategic defense location. Another rush is on. Petroleum development policy has been the major issue in Alaskan politics since the Prudhoe Bay discovery in February, 1968. Those who favor widespread economic development hope "black gold" will catalyze a chain reaction of industrial growth increasing the opportunity for employment and higher income. Conservationists, on the other hand, fear the very things developers hope for. If petroleum development were to bring industry and people to Alaska, soon there would be little reason to live in Anchorage rather than Los Angeles. The fears are real; controversies over potential resource-use conflicts due to petroleum development are raging. But the basis for controversy is often questionable. Within the limits of uncertainty imposed by the petroleum industry, the objective of this article is to investigate the effect of petroleum development on the Alaska economy and identify the important conflicts between petroleum extraction and other resource uses.

PROSPECTS

The course of petroleum development in Alaska will depend on the extent of Alaska's petroleum resources, world demand for petroleum, United States international trade policies and production prorationing policies, the world supply of oil, selection of transportation routes and means, and the interpretation of recent and possibly forthcoming environmental legislation. Because each of these factors may change with time, the only rigor that can be incorporated in an analysis of future developments is to state explicitly the assumptions on which the analysis is based. The sensitivity of Alaska's petroleum development to changes in these external conditions is also treated here.

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Supply, demand, and the institutional structure of markets together determine prices. The *real* price of petroleum in the United States has remained relatively constant during the past because domestic supply and demand have increased nearly proportionately and oil import quotas and market demand prorationing have been effectively imposed. Though some institutional changes will no doubt gradually occur, it is assumed that import quotas and prorationing will continue to stabilize real United States petroleum prices as they have in the past. A substantial portion of United States oil is produced, refined, and marketed by large international firms. These companies tend to shift their producing operations to lower cost areas. When a vertically integrated company sells its producing operations in one state and invests in wells in another, the supply of petroleum in the former does not immediately decrease, but demand for petroleum in that state by the company that moves does fall. Thus, there will be an incentive for more restrictive demand prorationing in the old producing area. Given this phenomenon, it is reasonable to assume that Alaska production will depend upon whether oil can be extracted and delivered to markets at a lower cost from Alaska than from other areas. Production levels in Alaska will be determined by the supply of deposits from which oil can be extracted at low cost and transport considerations.

PETROLEUM IN ALASKA

A. Cook Inlet

The Cook Inlet Basin is the only area where petroleum is presently commercially produced in Alaska. About 200 producing oil and gas wells have been drilled in the Swanson River field on the Kenai Peninsula and from 14 offshore platforms nearby in Cook Inlet. Crude oil production during 1969 totaled a little over 74 million barrels.¹ Cumulative production from the date of the first discovery well in 1957 through 1969 amounts to 233 million barrels. In 1969, 149 million cubic feet of natural gas were produced. Reserves in the presently developed upper Cook Inlet deposits are estimated at 1.7 billion barrels and 10 trillion cubic feet for crude oil and natural gas, respectively.² The value of petroleum produced in 1969 was about \$220 million. During 1969 a second refinery, a natural gas liquefac-

1. The textual statistics which follow are from Alaska Petroleum Industry Facts, 1970 (unpublished pamphlet on file with the Alaska Oil and Gas Association).

2. D. Blascoe, Feb. 1971 (unpublished Bureau of Mines report to the Fed. Field Comm. for Dev. Planning in Alaska).

Reserves include only petroleum discovered, developed, and producible with existing technology and using existing capital already in the field. Reserves are not an estimate of ultimate production from known deposits.

tion plant, and a combined ammonia-urea plant began operation near the city of Kenai. Developments in the lower Cook Inlet have been slowed by a state-federal jurisdictional dispute and by the recent industry shift of emphasis to the North Slope. Nevertheless, lower Cook Inlet might become as productive as upper Cook Inlet.

B. Arctic Slope

The discovery of a very large oil field at Prudhoe Bay in 1968 will probably shift the center of Alaska production to the North Slope for several decades. Current production plans are based on the construction of a 48-inch diameter, 780-mile long trans-Alaska pipeline from Prudhoe Bay to the ice-free port of Valdez on the Gulf of Alaska. The pipeline proposal has generated considerable controversy due to expected detrimental effects on the environment. For this reason, several alternative transport routes and means have been suggested. Further analysis will center around the proposed trans-Alaska pipeline. The effect on the Alaska economy and the environment of alternative transportation proposals are considered later in separate sections.

Initial production plans are to extract 700,000 barrels per day (255 million barrels per year) as soon as the trans-Alaska pipeline begins operation. The industry expects to use the full 2 million barrels per day capacity of the pipeline by 1980 (about 700 million barrels per year).³ The production level will be higher at a later date if more commercially profitable deposits are found and additional transportation investments are made. The official estimate of crude oil reserves in Prudhoe Bay, presently 10-15 billion barrels, will increase as developments on the North Slope proceed.⁴ Natural gas reserves in the main pool of the Prudhoe Bay field alone have been estimated at 26 trillion cubic feet.⁵ This means Prudhoe is also one of the largest reservoirs of gas in the world. George Gryc (Chief, Alaskan Geology Branch, U.S. Geological Survey) has estimated total potentially usable oil reserves on the entire Arctic Slope to be from 50 billion to 150 billion barrels.⁶ Similar estimates of the ultimate natural gas potential have not been made.

3. Current United States production is about 3.5 billion barrels per year. Bureau of Mines, Dep't of Interior, Minerals Yearbook (1970).

4. Oil and Gas Journal, Jan. 26, 1970. Atlantic Richfield Company (ARCO) uses the lower figures.

5. Am. Gas Ass'n, Reserves of Crude Oil, Natural Gas, and Natural Gas Liquids in the United States and Canada (1971).

6. G. Gryc, *Geologic Framework of the North Slope Petroleum Province*, Proceedings of the Twentieth Alaska Science Conference (Aug. 24-27, 1969).

C. Other Future Petroleum Provinces

In addition to Cook Inlet and the Prudhoe Bay area, petroleum exploration is presently underway on the far western part of the Arctic Slope near Icy Cape, in Bristol Bay and the Alaska Peninsula, in the Gulf of Alaska, and in the Nelchina Basin. These areas are very extensive, and the probability of finding one or more commercially profitable deposits in the next five years is fairly high. But fields as large as Prudhoe Bay are rare. The only other known field of similar magnitude in the United States is the East Texas field which was discovered in 1930 and from which about 4 billion barrels have been extracted to date. Less intensive exploration has been occurring in the Yukon Delta, in the upper Yukon near the Kandik basin, and in the vicinity of Nenana. At the end of 1969, a total of 11.4 million acres were under federal or state petroleum lease.

THE COST OF ALASKA CRUDE OIL

The refinery gate price for medium gravity crude oil in Los Angeles is currently about \$3.25 per barrel. Production cost estimates have been made by Arlon Tussing for Cook Inlet and the North Slope of 40-50 cents and 24-44 cents per barrel, respectively.⁷ Tussing's estimates of North Slope production costs may be too high. Data supplied by Atlantic Richfield Company (ARCO) suggest production costs of 10-15 cents per barrel.⁸ Though transportation costs

7. A. Tussing, *The Impact of Oil Import Reforms Upon Alaska's Economy, 1970* (unpublished report on file with the Fed. Field Comm. for Dev. Planning in Alaska) [hereinafter cited as Tussing].

8. Conversation with Carter Barcus, July 1970. Information provided: (1) wells cost \$1 million, (2) wells will have an average initial capacity of 10,000 barrels per day, and (3) about 400 men will operate the entire field.

Given the above, the development cost per initial daily barrel of capacity is \$100. If we assume a 10 percent rate of return and an 8 percent rate of production decline, then, according to M. Adelman, *Oil Production Costs in Four Areas*, Proceedings of the Council of Economics of AIME, at 26 (1966), the present barrel equivalent is:

$$\Sigma \left(\frac{1 - .08}{1 + .10} \right)^t = 5.00$$

Development cost per barrel is, therefore:

$$\frac{\$100}{5.00 \times 365} = \$0.055$$

or 6-8 cents if we allow for dry-hole costs and a higher rate of return.

Operating costs can be estimated by assuming that 400 men cost \$200 each per day (wages, room, board, and transportation plus operating material expenses). Then,

$$\frac{\$200}{(\text{per day per man}) \times (\text{men per day})} = 4 \text{ cents per barrel or 4-7 cents to be safe.}$$

$$2 \times 10^6 \text{ barrels per day}$$

Thus, total production costs are 10-15 cents.

of about 40 cents from Cook Inlet and \$1.00 from Prudhoe Bay must be added to make the Alaska figures comparable to the United States, it is clear that the exceptional interest in Alaska crude oil rightfully stems from its low cost.

FUTURE PRODUCTION LEVELS

The discovery during the past decade of deposits which can be developed at a low cost has raised the hopes of finding more. Exploration effort has increased rapidly since the Prudhoe Bay discovery well. Though discovery and development in other areas are likely, most of the uncertainty about Alaska production levels during the next 10-20 years will probably be resolved as development in the area of Prudhoe Bay nears completion.⁹ The best indication of future production levels would probably be an optimistic projection of present industry plans. The initial capacity of the pipeline is to be 700,000 barrels per day. If construction is authorized in late 1971, production would probably begin in 1975. Initially, the 2 million barrels per day pipeline activity was expected to be utilized by 1984, but industry spokesmen have indicated that 1980 is now probably a more realistic estimate. Production of crude oil may occur at a rate greater than the pipeline's capacity after 1980 if tankers or other means of transport are introduced. If the pipeline alone were used at full capacity, it could transport the present estimated level of reserves in about 20 years. Since this reserve estimate is probably low and there may be other developments on the North Slope, it appears likely that additional means of transport may be profitable in the future.

Table 1 presents a rough estimate of upper and lower bounds on production levels through the year 2000. Since nearly all Alaskan crude oil will be produced by large vertically integrated firms, it has been assumed that these firms will find markets for their own production and that production prorationing in Alaska will not be necessary in the long run.

Natural gas will be jointly produced at a rate of 1.6 billion cubic feet per day when production of crude oil reaches the proposed pipeline capacity of 2 million barrels per day. State law requires that

9. It should be pointed out again that Prudhoe Bay is a very large field, and the probability of finding another field this size is small. Estimates of upper Cook Inlet reserves, for example, range between 5 percent and 10 percent of present estimates of Prudhoe Bay reserves, even though development in upper Cook Inlet is nearly complete while that in Prudhoe Bay has just begun. See note 2 and accompanying text *supra*. Numerous discoveries of the order of magnitude of Cook Inlet would have to be made before these new discoveries would be important relative to the still unknown dimensions of the Prudhoe Bay field.

TABLE 1
Alaska Crude Oil Production, 1972-2000

Year	Probable lower bound ^a			Plausible upper bound ^a			
	Prudhoe Bay	Cook Inlet	Total	Prudhoe Bay	Cook Inlet	Other (including North Slope)	Total
1972	0	0.2	0.2	0	0.2	0	0.2
1973	0	0.2	0.2	0	0.2	0	0.2
1974	0	0.2	0.2	0.3	0.2	0	0.5
1975	0	0.2	0.2	0.8	0.2	0	1.0
1976	0.6	0.2	0.8	1.2	0.2	0.1	1.5
1977	0.8	0.2	1.0	1.6	0.2	0.1	1.9
1978	1.0	0.2	1.2	2.0	0.2	0.2	2.4
1979	1.2	0.2	1.4	2.0	0.2	0.2	2.4
1980	1.4	0.2	1.6	2.0	0.2	0.3	2.5
1981	1.6	0.2	1.8	2.1	0.2	0.4	2.7
1982	1.8	0.1	1.9	2.2	0.2	0.5	2.9
1983	2.0	0.1	2.1	2.3	0.2	0.6	3.1
1984	2.0	0.1	2.1	2.4	0.2	0.7	3.3
1985	2.0	0.1	2.1	2.4	0.2	0.8	3.4
1986	2.0	0.1	2.1	2.4	0.2	0.9	3.5
1987-2000	2.0	0.1	2.1	2.4	0.2	1.0	3.6

^aThe lower bound was estimated by assuming that the pipeline would not start operation until 1976 and not reach full capacity until 1983. Cook Inlet production was assumed to be at its peak now and for the next few years and then decline. Other possible production areas were assumed not to exist. The upper bound assumes that the pipeline would start early in 1974 and reach peak capacity by 1980 and that pipeline transport would be supplemented by other means of transport after 1980. It was assumed that Cook Inlet would maintain its present productive capacity through 1985. In addition, production from other areas was assumed to begin by 1976 and would reach the equivalent total capacity of five Cook Inlets by 1987. As the text suggests, most of the variation between the two bounds is accounted for by the timing of developments at Prudhoe Bay rather than the effect of possible new producing areas.

this gas must either be marketed or reinjected into the reservoir. Some gas will undoubtedly be reinjected into the reservoir to aid subsequent recovery, regardless of marketing possibilities. The quantity marketed will depend on how present plans for a trans-Canada pipeline develop or whether other means of transport are constructed. It is possible that a gas line will be completed soon after the oil pipeline if oil pipeline construction is delayed beyond 1971 for further environmental evaluation or due to native land claim conflicts.

How sensitive are the above estimates to changes in the assumptions? What would happen to Alaska petroleum production if the United States price fell to \$2.25 per barrel because the present restrictions on foreign crude oil were dropped or if demand rationing in the lower 48 ports were terminated? These questions have been asked before.¹⁰ It is apparent from the cost data already presented that development and production in Alaska's two known petroleum basins will continue even if the price of crude oil falls to the present world price. Exploration in Alaska would probably decrease, however, and the likelihood that new areas would be brought into production would be reduced. Compared with production on the North Slope, on the other hand, production from these additional areas would probably be small for some time to come. Thus, production would not fall below the lower bound estimate if the United States price of crude oil fell to the world market level.

The Jones Act requires that cargo transported between United States ports must be carried in United States-built ships. United States shipbuilding costs are high. The cost of transporting crude oil between Alaska and the lower 48 ports, now about 50 cents per barrel, is perhaps twice what it would be if the Jones Act were repealed and less-expensive, foreign-built ships were employed. This shipping cost reduction, at most in the order of 20 cents, would have a small impact on production levels. Exploration would be stimulated moderately, and existing wells would produce longer since elimination of the Jones Act would raise the wellhead price of petroleum and make it profitable to produce a little longer from marginal old wells. These effects, however, would be small and do not provide sufficient reason to increase the estimate of the production level upper bound.

BENEFITS FROM PETROLEUM DEVELOPMENT

Alaskans are well aware that petroleum development will change

10. Fed. Field Comm., *supra* note 7.

their economy. There is considerable confusion, however, about how these changes will benefit present residents of Alaska. The objective of this section is to identify the possible extent of economic change and the beneficiaries of development.

The major benefit to the State of Alaska will be the rent collected through the lease bonuses, royalties, and severance taxes paid by the petroleum industry. The industry pays a 12.5 percent royalty on wellhead value. The severance tax was recently modified by the State Legislature from a flat 4.5 percent to a sliding scale ranging from 3 to 8 percent, depending on output per well. Since Alaska wells tend to have a high output, the average severance tax will probably be about 7 percent. Assuming that the average wellhead price of crude oil will be about \$2.40,¹¹ then the state will collect 48 cents per barrel in royalties and severance taxes or nearly \$1 million a day when the pipeline is operating at full capacity.¹² The present values in 1972 of royalties and severance taxes through the year 2000, using an interest rate of 8 percent, are approximately \$2.5 and \$4.2 billion for the lower and upper bound total Alaska production estimates, respectively. If the wellhead price of crude oil fell to \$1.50 per barrel (this would put the Alaska tidewater price at about the *competitive*

11. This wellhead price is based on an *average* Alaska tidewater price of \$2.90 less an average transport cost to tidewater of 50 cents per barrel. The transport cost estimate has been calculated by M. A. Adelman, *Significance of Shifts in World Oil Supplies*, Proceedings of the Twentieth Alaska Science Conference (1969), and by Tussing, *supra* note 7. Adelman estimated the cost at 45 cents per barrel; Tussing, at 60 cents. Adelman's estimate is lower because he assumes that the pipeline will start at half capacity rather than quarter and reach peak capacity after three years of operation. Since the date of Adelman's estimate, one must also add in the cost of delay and the possibility of higher construction costs due to environmental factors that have been given more serious considerations. The analysis and assumptions presented below indicate that the pipeline capital cost per barrel would be 33 cents or 31 cents based on the lower or upper bound throughput schedules presented in Table 1.

$$K = \sum_{t=1}^n \frac{Q_t C}{(1+r)^t} \quad \text{or} \quad C = \sum_{t=1}^n \frac{(1+r)^t K}{Q_t}$$

where:

C = amortization of pipeline cost per barrel

K = cost of pipeline, including interest to date of initial operation (estimated at \$2 billion)

Q_t = flow in year t

r = real rate of return (8 percent was used)

and

n = 25 years.

In addition to C, operating and maintenance costs will probably be 10-20 cents per barrel due to special problems of operating in Alaska. Adelman indicates that 15 cents was on the high side.

12. The state collects the severance tax from all wells and receives 90 percent of the royalties from federally leased land, so this assumption is not particularly critical.

world level), these values would be reduced proportionately to about \$1.6 and \$2.7 billion.

If the assumptions used to estimate the lower bound for future production levels are realistic, then additional large lease bonus payments are unlikely. The present value of future lease bonuses, given the assumptions used to estimate the upper bound, is probably of the order of magnitude of \$100 million. Royalties and taxes collected from future gas production are quite difficult to estimate because of the uncertainty over when transportation facilities will begin operation. But their present value is also small relative to that of oil. The present value of all rents collected by the state between 1972 and the year 2000 will probably fall between \$2.0 and \$3.5 billion where the lower bound estimate assumed a \$1.50 per barrel wellhead price. If the \$900 million from the September, 1969, lease sale is included, it is obvious that the present value of petroleum rents likely to accrue to the state between 1969 (September) and the year 2000 are sizable. They amount to about \$10,000-\$15,000 per 1970 Alaska resident.

The rents collected by the state will be large, but many people look forward to other substantial benefits from petroleum development. Petroleum development means more jobs and a larger gross state income. People will be employed to extract, to transport, to search for more petroleum, and possibly to refine or further process the product. In addition, people will be employed to provide these new workers with housing, food, and services. Many Alaskans expect these indirect effects to provide jobs or better jobs, income or more income. Development has been promoted as a blessing for all. But on the average, these expectations will not be realized.

All the anticipated benefits of petroleum development will not be realized because both the number of permanent jobs and the probability that an Alaska resident will be hired for any individual job are small. Exploration, development drilling, and pipeline construction will employ many but for only a relatively short time. Peak petroleum-related employment in Alaska began in 1969 with extensive exploratory drilling prior to the September lease sale and may end in a few years with the completion of the proposed pipeline. Table 2 presents employment data from 1965 to 1970.

ARCO and British Petroleum Alaska, Inc., expect to operate the Prudhoe Bay field with a total work force of about 400 in the field.¹³ This number is low because highly automated equipment is

13. Conversation with Geoffrey Larminie, Area Manager, British Petroleum Alaska, Inc., July 1970. Workers would work two weeks on the North Slope and then return to Anchorage or Fairbanks for one week; thus, 600 persons will, in fact, be operating in the field.

TABLE 2
Summary of Alaska Petroleum Industry Employment by
Standard Industrial Classification (SIC)

	Calendar year (12 month averages)					
	1965	1966	1967	1968	1969	1970
SIC 131						
Oil and gas producers	233	260	382	525	706	926
SIC 1381						
Well drilling	190	374	783	998	1,641	1,121
SIC 1382						
Field exploration	199	236	227	344	515	298
SIC 1389						
Other field services	39	74	211	286	358	304
SIC 281						
Industrial chemicals	33	33	46	87	172	181
SIC 29						
Petroleum refining and related industry	25	28	28	25	32	52
SIC 461 ^a						
Petroleum pipeline	9	9	9	12	10	10
SIC 492						
Gas companies and systems	80	93	128	144	155	185
SIC 5084 ^a						
Wholesaling oil field tools and equipment					154	203
Total	808	1,105	1,814	2,421	3,743	3,280

^aEstimated

Sources:

For SIC 461: A. Tussing, G. Rogers, V. Fischer, G. Erickson, Alaska Pipeline Report (U.S. Dep't of Interior, 1971).

For SIC 5084: B. Tuck, A Preliminary Discussion of the Impact of the Petroleum Industry on the Alaska Economy (Atlantic Richfield Co., Mar. 1971). Processed.

Alaska Dep't of Labor, Statistical Quarterly, 1960-1970.

both cheaper and more reliable in the northern environment. Exploration and development work will, of course, continue but on a reduced scale; and there will undoubtedly be a few smaller North Slope producing operations. Operation of the proposed pipeline and tank farm at Valdez will require only about 200 workers.¹⁴ The proposed combination refinery and electricity generation plant at Fairbanks will be sufficient to supply the interior region for many years to come. About 100 persons will be employed at this plant.¹⁵ No other city along the proposed pipeline route is large enough to justify another refinery. Table 3 provides estimates of future employment related to Prudhoe Bay.

TABLE 3
Projected Employment of Prudhoe Bay Development and Production; Construction and Operation of the Proposed Pipeline; and Construction and Operation of the Proposed Refinery-Power Plant

	Employment				
	1970-71	1972-73	1974-75	1976-77	1978-2000
	1,000				
Exploration, development, and construction	2.4	10.0	5.3	0.7	0.1
Operation	0	0.2	0.6	0.9	0.9
Administration	0.3	0.3	0.3	0.3	0.3
Total	2.7	10.5	6.2	1.9	1.3

Source: A. Tussing, G. Rogers, V. Fischer, R. Norgaard, G. Erickson, Alaska Pipeline Report, Table 26 (U.S. Dep't of Interior, 1971).

Since the vast majority of oil and gas that is now or could be produced in Cook Inlet is still available for primary processing, there is little reason to expect an influx of refineries and chemical industries with the start of production on the North Slope. In addition, processing industries are not likely to be labor intensive; the liquefied natural gas plant, prilled urea plant, and refinery on the Kenai Peninsula together currently employ only about 200 persons. Further and substantial development of a petrochemical industry in Alaska is possible but unlikely because there is little demand for chemicals in Alaska and because crude oil is generally cheaper to transport than chemicals.

Since Alaska imports a large portion of its goods and services from the "lower 48," the number of jobs associated with serving the

14. Conversations with A. Morel, Trans-Alaska Pipeline System (now Alyeska Pipeline Service Company), Aug. 1970.

15. The payroll has been generously estimated at \$2 million by the plant promoters, Alaska Energy Company, a subsidiary of Earth Resources Company. Fairbanks Daily News Miner, Feb. 19, 1970. The number employed was estimated from this figure.

households of industry workers or supplying the industry directly with materials is also small. The population of Kenai and Soldotna increased from less than 1,000 in 1960 to about 5,000 in 1970—mostly because of the Cook Inlet petroleum development. In 1971 there are indications of population loss in the area. The increase of 4,000 persons in 10 years suggests that about 1,500 jobs were created for all reasons. But employment growth due to Prudhoe Bay production will not be proportionate to that in Cook Inlet because of the high output of Prudhoe Bay wells and the automated equipment that will be used. It is not very likely that total Alaska petroleum industry employment will be more than 5,000 after Prudhoe Bay development and means of transport are completed. Employment will probably decline moderately after production begins and then rise slowly as production increases over time and a few new processing industries begin to operate. When production begins, jobs will tend to be more permanent and year-round.

To the extent that presently unemployed Alaskans receive the permanent jobs associated with production and transportation of North Slope crude oil, Alaska's economy as a whole will benefit. But Alaska is a small part of the larger United States economy. Alaska has a labor force of about 100,000 persons, but "\$100 away" in the Seattle area there exists a labor force of 1 million persons, many of whom are unemployed or looking for a better job. People in the even larger California labor force can fly to Alaska for a little more than \$150. Anyone in the entire 80 million United States labor force can fly to Alaska for \$300 or less. In some sense, the entire 80 million labor force will be competing for the 1,300 new permanent jobs resulting from Prudhoe Bay extraction, pipeline transportation, and the Fairbanks refinery. Alaskans are a very small part of the total United States labor force; they have a competitive edge in that they do not have to pay the monetary and psychic cost of moving. But the number of unemployed Alaskans who acquire jobs or employed Alaskans who find better jobs due to petroleum development will be much smaller than 1,300. Since 70 percent of the present Alaska labor force was born outside Alaska, competition from new residents should not be surprising to the present residents.¹⁶

Petroleum extraction employment in the lower 48 has declined substantially since its peak in the mid-1950's. Many workers in the Gulf Coast states have experience in the petroleum industry that

16. Less than 30 percent of resident males, including natives, between 20 and 69 in 1960 were born in Alaska. U.S. Bureau of the Census, U.S. Census of Population, 1 Characteristics of the Population, pt. 3 (Alaska) § D (Detailed Characteristics) (1963).

they are unable to put to work. Employment in Alaska petroleum fields can mean a rise in income, and these workers will be willing to pay their transport costs. On the other hand, very few Alaskans have acquired comparable experience. Workers will come into Alaska as a result of oil development, population will increase, but per capita income exclusive of rent received by the state will not necessarily rise nor will the unemployment rate decrease due to higher levels of petroleum extraction.¹⁷

Because Alaskans must compete with millions of non-Alaskans for employment in Alaska, it is clear that any action by the state to encourage industrialization—for example, with a primary processing law—will have an insignificant impact on the employment of present Alaska residents. It may not be so obvious, however, that any primary processing requirement for the petroleum industry that must be enforced by the state would significantly reduce future lease bonus, royalty, and/or severance tax payments. If processors do not now choose to locate in Alaska, it is because construction, operation, and transport costs are higher. If the petroleum industry were forced to process its product in Alaska, these higher costs would have to be paid. The wellhead price of crude oil is the finished product price determined in markets outside Alaska, less transport and processing costs. If these costs increase because of a primary processing requirement, the wellhead price will fall. With a lower wellhead price, future lease bonus payments will be smaller. And since extraction costs rise over time on any given deposit, a lower wellhead price means extraction will become uneconomic and will be terminated at an earlier date. The state then loses the royalties and severance tax on the petroleum not produced. The benefits of forcing Alaska processing on the petroleum industry would be small; the costs paid by the state could be quite large.

Like reasoning applies to methods of transporting oil and gas. Movement to port by rail or motor truck is technically feasible and would create more employment per barrel or per million cubic feet than would pipelines. Even in the doubtful instance that the price of oil or liquefied gas would support highway or rail tariffs, however, the employment gain to Alaska would be outweighed by the direct loss of revenues attending a lower wellhead value. The cost advantage between an “all Alaska” oil pipeline, plus marine tankers to the West Coast ports, compared with an all-pipeline route through Canada, is

17. Conceivably, state per capita income might rise slightly due to an influx of skilled petroleum workers, which could increase the mean skill level in Alaska. But the incomes of previous Alaskans would, on the average, still remain about the same.

not clear. But if the latter route resulted in even a few cents' advantage at the wellhead, this difference would be more important to Alaska's economy than the relative loss of employment.

In summary, if the state's goal is to increase the *welfare* rather than the *number* of Alaskans, the rent from the petroleum deposits collected in the form of lease bonus, royalty, and severance tax payments is the central benefit to Alaska from petroleum development.

The comparable benefits to the United States as a whole will consist of the rent collected by the State of Alaska, plus the profits earned by those companies or individuals who hold leases on the North Slope before the 1968 discovery, less the rents lost by owners of petroleum deposits in the lower 48 where production would be relatively lower. It would appear that the developments in Alaska will put the experience of lower 48 oil extraction personnel to better use; but, in fact, Alaska oil will replace some production from other states, and total employment will decline somewhat in the United States industry due to the higher productivity of Alaska wells.

CONFLICTS

A. *Wilderness Preservation*

If the petroleum industry paid all of the costs of its operation in Alaska and captured all benefits through oil and gas revenues, the rents collected by the state would be a net gain to the state. However, some of the costs of petroleum development are paid by the wilderness enthusiast who loses a wild area, by the hunter who finds the stock of game has been reduced, and by the resident of Anchorage who thought the city used to be just the right size. On the other hand, there will be spillover gains to some residents who perceive improved opportunities for outdoor recreation because of access to new country or who value the increase in urban amenities attending population growth. Though they are difficult to quantify, these costs and benefits are real. The objective of this section is to define some of these resource-use conflicts and to evaluate existing institutions for minimizing them.

Probably the greatest and definitely the most irreconcilable resource-use conflict in Alaska exists between petroleum development and wilderness preservation. Wilderness is becoming increasingly scarce. At the same time, per capita income is rising, and more and more persons can afford to travel to undeveloped areas. In addition, people who live in developed areas are putting an ever higher value on knowing that some undisturbed areas still exist regardless of

whether they will ever see them. Coal, hydro and nuclear power are substitutes for petroleum. As technology advances, there will be more. But there are no substitutes for wilderness nor, by definition, will new technology ever produce any. The decision not to preserve a wild area is irreversible. The rising value of wilderness, the increasing availability of energy substitutes over time, and the flexibility of the preservation option should all be considered when the demand to develop a wild area arises.

The area that is being developed on the North Slope was wilderness before the petroleum industry came. The trans-Alaska pipeline will cross the Brooks Range and divide the largest United States wilderness in two and, via the pipeline access road, provide opportunity for development that could spread east and west. The cost of not invading the North Slope would have been the several billion dollars of rent foregone by the state less the rents that would be retained by producers of the lower 48 states.¹⁸ The cost of not invading the Brooks Range would have been the extra delay, extra transport cost, and possibly extra risk of transporting petroleum by tanker from Prudhoe. There is also another alternative to the trans-Alaska pipeline; those who value wilderness may prefer a pipeline along the North Slope, through the Arctic Wildlife Range, and across the wilderness of Canada rather than over the Brooks Range.

When and how was this conflict resolved in favor of development on the North Slope and in favor of the proposed transport routes? How will similar conflicts be resolved in the future? Geophysical and exploratory well drilling equipment was first moved onto the North Slope in 1944 when the U.S. Geological Survey began exploration on Naval Petroleum Reserve No. 4. This decision was made by the Department of Defense at a time when concern for wilderness was at an ebb and for more than the immediate future was uncommon. The alternatives were not considered.

Between 1958 and 1966 the Bureau of Land Management made available for noncompetitive lease sale a total of 20 million acres between the Naval Petroleum Reserve and Arctic Wildlife Range and

18. Conservationists argue that there are other benefits from not developing North Slope oil—that is, we are using too much oil now, our supplies are being depleted too rapidly, and we are emitting too many pollutants from hydrocarbon combustion into the air. The first point assumes that technology will not continue to advance and find energy substitutes (and it may not). The second assumes that North Slope production will have a significant effect on total consumption of petroleum in the United States. It was pointed out earlier, however, that the major effect will be a shift in the location of production from inferior to superior deposits. Air pollution is serious; and new, stronger, and pervasive policies will have to be instituted to solve the problem. These policies, if they were in effect, might affect the decision to develop North Slope oil; but not developing North Slope oil will have little effect on our air pollution problem.

an additional 4 million acres west of the petroleum reserve. The areas selected and timing of these sales were largely determined by industry interest in the North Slope. The decision to lease or not lease an area depends on the timing and availability of other public land throughout the United States and political factors. The final decision is made in Washington and published by the Secretary of the Interior in the Federal Register. The Environmental Policy Act now requires the Bureau of Land Management to make an evaluation of the broad environmental impact of decisions, such as opening new acreage to oil and gas leasing.¹⁹ The effect this requirement will have on the decision to develop or not develop would probably be marginal if it were not for the fact that it provides those who favor preservation with the opportunity to challenge the evaluation, and thereby the decision, in the courts.

Alaska was granted upon statehood the right to select 104 million acres from the unreserved public domain. Due to interest in petroleum development on the North Slope, the state selected nearly 4.5 million acres north of the Brooks Range. About 1.3 million acres were leased competitively by the state between 1964 and 1969, including 146,147 acres which are offshore. Since the area of wilderness compared to the number of citizens is large in Alaska, the state has never selected land from the public domain in order to assure that it will be preserved in a wild state. This is probably rational behavior for the state in spite of the growing interest in wilderness preservation among Alaskans, but it can clearly present serious conflicts with the national interest.²⁰ State selection implies use in the near future, and the state will probably select all land with petroleum development potential that the federal government has not already set aside as a national park, wildlife refuge, military reserve, or other reserved use. It is clear that, given the present institutions and attitudes, wilderness will always succumb to petroleum development whenever industry shows an interest and the state can select the land.

A pipeline was selected by some oil companies as the most feasible means of transporting petroleum from Prudhoe Bay. The companies selected Valdez as a terminus because it was a good ice-free port and considerably easier to reach than Seward or a suitable alternative in Cook Inlet. The industry then went to the Bureau of Land Management and asked permission to build the pipeline on the route they had selected. The formal opportunity for public agencies to become involved in the question of transporting oil from the Slope did not

19. Environmental Policy Act of 1969, 91 Stat. 190 (1969).

20. In 1969 the state selected acreage in the Wood River-Tikchik Lake area which the National Park Service had proposed for national park status.

arise except in the form of having the choice of approving or denying this specific request. The many issues with respect to transport means and routing versus wilderness values, wildlife, recreation, and marine resources were not discussed at an early stage. With time it has become increasingly apparent that there are other alternatives: A pipeline through Canada, which is likely anyway; tankers, which will probably be used to a small extent also; and submarine tankers, which are still in the development stage. Given this range of alternatives, it is unfortunate that the question of when and whether North Slope oil is produced still rests legally on the engineering and environmental problems of only one narrowly defined transport option. In the course of hearings in February and March, 1971, on the Interior Department's environmental impact statement, Department spokesmen promised an examination of the full range of alternatives to the specific pipeline proposal.

The preservation-development conflict, on the other hand, is not as great as wilderness enthusiasts have imagined. Conservationists have accepted developers' beliefs that many more deposits of Prudhoe Bay size will be discovered, thousands of miles of roads will be built, refining and chemical industries will become established and others will follow in their wake, thousands of jobs will attract a larger population, and everyone will be richer and able to afford to invade the remaining wild areas. These beliefs were considered earlier and were found to be unrealistic. Given the quality of petroleum deposits in Alaska, petroleum extraction generates far greater rents per unit of area developed than any other resource extraction activity.

B. Marine Oil Spills

Those who view a clean ocean as the basis for a sport and commercial fishery, a habitat for waterfowl, a necessary adjunct to a beach, or as an important and life-giving natural area see the petroleum industry as the great despoiler. Tankers and offshore wells have spilled phenomenal quantities of oil on the world's oceans during recent years. The industry has made its impression. Large portions of the public are understandably outraged. This is the second major area of resource-use conflict with respect to the petroleum industry in Alaska.

Tankers presently haul most of the production from Cook Inlet to the lower 48 states. Small oil slicks are spotted frequently in Cook Inlet but are short lived due to the strong tidal action in the Inlet. It has been estimated that approximately 17,000 barrels per year are

spilled in the Inlet without obvious and important short-term effects.²¹ The long-term effect of this level of pollution has not been determined. Slop oil and dirty ballast water dumped from one or more tankers off Kodiak Island in late January, 1970, were apparently the source of Alaska's largest oil spill. A summary report by the Federal Water Quality Administration notes that at least 10,000, and possibly as many as 100,000, birds were killed; crab and shrimp fishermen found that their floats and lines were coated with oil; and the slick encroached upon 1,000 miles of shoreline along the eastern side of the Kodiak Islands, Alaska peninsula, and Montague Island in Prince William Sound.²² Though this is the largest oil spill in Alaska to date, it is comparatively small. With offshore production occurring in Cook Inlet and likely to occur in the Beaufort Sea, Bristol Bay, and the Gulf of Alaska and with 2 million barrels of oil per day being transferred from the pipeline to tankers at Valdez and then shipped south along the coast, it is a statistical certainty that numerous small and several large spills will occur in the future. The offshore and ocean transport operations of the petroleum industry will impose damages on other users of the ocean and society at large.

Good legislation can force the industry to reduce this conflict. Present state water quality standards for Valdez harbor require that there be no visible pollution. But this regulation will only be enforced by the Commissioner of Health and Welfare if the administration finds that enforcement is expedient at the time. The Federal Water Quality Improvement Act of 1970 forces the petroleum industry to pay the cost of oil spill cleanup up to \$14 million or the entire amount if willful misconduct can be shown.²³ In addition, federal agencies are now preparing to initiate emergency clean-up action whenever an oil spill occurs. The new legislation, however, does not provide for an assessment for damage which cannot be restored.

C. Wildlife

To date, petroleum development has only had a small effect on the ability of wildlife agencies to manage the traditionally managed species—that is, big game. The Swanson River field, which is a part of

21. P. Kinney *et al.*, Quantitative Assessment of Oil Pollution Problems in Alaska's Cook Inlet 7 (Inst. of Marine Sciences, Jan. 1970).

22. Fed. Water Quality Ad., U.S. Dep't of Interior, Kodiak Oil Pollution Incident, February-March 1970 (1970).

For an extensive description of the effects of earlier oil spills, see Evans, *Environmental Effects of Petroleum Development in the Cook Inlet Area*, Proceedings of the Twentieth Alaska Science Conference, (Aug. 24-27, 1969).

23. Water Quality Improvement Act of 1970, 91 Stat. 224 (1970).

the Cook Inlet basin and located in the Kenai National Moose Range, has been producing for a decade. The moose seem to be quite indifferent to the petroleum industry. Exploration lease contracts on the refuge (written and enforced by the Bureau of Sports Fisheries and Wildlife) have contained several environmental stipulations with respect to debris removal, erosion control, pollution, and access to areas where damage to wildlife may be great. In this way the conflict between petroleum development and wildlife management has been at least partially eliminated. It has cost the Bureau of Sports Fisheries and Wildlife one or two supervisory personnel. The cost of the industry has clearly been larger but, relative to their total operation, the extra cost of the environmental stipulations has been insignificant.

The Kenai Range has traditionally been managed for the benefit of moose hunters as well as for moose or wildlife in general. Apparently both the hunters and their prey have enjoyed the improved access provided by the broad trails constructed by seismic crews. The industry likes to argue that these trails are the reason for the now larger moose population, but there are several other more plausible explanations, such as recent fires which have probably increased the carrying capacity of the range.

On the other hand, those who prefer wildlife refuges to be natural areas that are left alone will find that the industry has had a substantial impact. An extensive and fine grid of seismic trails crisscross the refuge. They total more than 2,500 miles.²⁴ Broad paths cut through nearly every stand of trees. Actual production occurs in a much smaller area which now contains numerous roads, an airstrip, a topping plant, and several buildings. But this is really the development-preservation conflict and is somewhat independent of a narrow interpretation of wildlife management problems.

Since caribou do not adapt to the encroachment of civilization as well as moose, their range on the North Slope will undoubtedly be reduced by petroleum development. The feeder lines from individual wells are likely to be the greatest nuisance. The impact of wells, roads, and feeder lines has been reduced by state-imposed, 640-acre well spacing²⁵ and the industry's decision to directional drill five wells from a single drilling pad. Thus, there is only one cluster of wells for every five square miles. Though the Department of the Interior pipeline Stipulation K7 requires that the main trans-Alaska pipeline must not obstruct the migration and movements of big game animals,²⁶ no one can say for sure how caribou will, in fact, respond

24. Evans, *supra* note 23.

25. Div. Oil and Gas, State of Alaska, Conservation Order 83-B (Feb. 1970).

26. U.S. Dep't of Interior, Stipulations from Trans-Alaska Pipeline (1971).

to the above-ground portions of the pipe. Enough is not known about their migratory patterns to determine quickly whether their habits will change once the pipeline is built. Presently, plans are to put the pipe underground except where complications associated with permafrost make placement above ground necessary.

Section K of the Department of the Interior's stipulations also provides for a minimum of 300 feet of undisturbed buffer strip along streams, the protection of spawning beds, the safe passage of migrating fish, and the protection during construction of areas where game concentrate, such as nesting areas. In addition, there is a stipulation that the use of underwater explosives requires a permit from the Alaska Department of Fish and Game. To the extent that these stipulations are enforced, the industry will initially bear the cost of protecting wildlife which the state has "reserved to the people for common use."²⁷

27. Alas. Const. art. VIII, § 3.

Alaskans will bear about one-fifth of any additional pipeline costs since they receive about this portion in royalties and taxes on the wellhead price of crude oil, which is determined in part by transport costs.

How expensive can the pipeline be due to extra environmental costs and still leave an 8 percent return to North Slope petroleum development? If we assume that the real tidewater price of crude oil per barrel will remain at \$2.90, that production costs are 15 cents per barrel (see n. 8), and pipeline operating costs are 15 cents per barrel (see n. 11), then \$2.75 per barrel can be allocated between royalties and severance taxes and amortization of the pipeline cost and lease bonus payments.

Let:

- K = maximum total pipeline cost
- c = amortization of maximum pipeline cost per barrel
- B = lease bonuses paid to state
- b = amortization of B per barrel
- s = severance taxes and royalties per barrel paid to state
- r = real rate of return, 8 percent
- Q_t = flow in year t
- n = number of years for pipeline life expectancy, 25 years

$$2.60 = c + b + s$$

$$c = \sum_{t=1}^n \frac{(1+r)^t K}{Q_t} \quad (\text{see footnote 11})$$

$$b = \sum_{t=1}^n \frac{(1+r)^t B}{Q_t}$$

$$s = 0.20 (2.90 - 0.15 - c)$$

$$2.60 = \sum_{t=1}^n \frac{(1+r)^t K}{Q_t} + \sum_{t=1}^n \frac{(1+r)^t B}{Q_t}$$

Another game management problem is associated with the introduction of people and, consequently, hunters into areas which previously did not need surveillance. The Alaska Department of Fish and Game does not feel that any of the big game populations along the pipeline route will be harmed by additional hunting pressure. They are concerned, however, that there may be unnecessary killing of black and grizzly bears, wolves, foxes, and smaller game if they become a nuisance after being attracted to poorly stored food supplies and improperly disposed garbage. This has been the only problem to date other than the common administrative problems, such as finding persons hunting without licenses. North Slope petroleum development has increased the administrative duties and research requirements of wildlife managers in Alaska. Reducing conflicts to the present level requires several additional men in the field and an airplane. The Alaska State Legislature appropriated \$125,000 to the Department of Fish and Game for North Slope surveillance and research during fiscal year 1970. This figure gives the order of magnitude of Department of Fish and Game expenditures due to developments on the North Slope.

Wildlife managers are also concerned with the possible extent of effects from a large pipeline oil spill resulting from dislocation of the pipe stemming from permafrost-related stresses or an earthquake. As long as the oil stays on land, the impact would be contained and limited. But a large spill along most portions of the route would

$$+ 0.20 (2.75) - \sum_{t=1}^n \frac{(1+r)^t K}{Q_t}$$

$$K = \frac{2.05}{0.8 \sum \frac{(1+r)^t}{Q_t}} - \frac{B}{0.8} = \frac{2.05 \times 5:66 \text{ billion}}{0.8}$$

- 1.25 billion.

If we let $r = 8$ percent, $n = 25$ years, Q_t = the lower-bound estimate of flow given in Table 1, and $B = \$1$ billion, allowing for all lease bonus payments and rentals and some North Slope exploration expenses, then, $K = \$13.25$ billion.

If K did go this high, the present value of royalties and severance taxes paid to the state would be reduced by 20 percent of the difference in pipeline costs or by 0.20 ($13.25 - 2.00$) = \$2.25 billion.

The same issue has been examined by Tussing, who treats also several institutional factors influencing the relation between pipeline costs and tariffs. His analysis was written before the state increased its production tax schedule, hence his estimate of a 16.5 percent loss to the state for increased pipeline cost. Tussing, *Who Will Bear the Incremental Costs of the Trans-Alaska Pipeline?* Anchorage: Federal Field Committee for Development Planning in Alaska, April, 1970.

inevitably find its way into a stream and, eventually, one of Alaska's major rivers—the Copper, the Yukon, the Sagavanirktok, or one of their large tributaries. Much of this oil would be carried to the highly productive wildlife habitats in the deltas and estuaries. The damage to fish and waterfowl could be extremely large. This aspect of the conflict has hopefully been reduced by the additional pipeline and permafrost research undertaken during the permit delay.

Alaska state law empowers the Commissioner of Health and Welfare to establish and enforce regulations pertaining to pollution control equipment.²⁸ With respect to oil pipelines, Regulation 510C1 requires that means for containing the maximum volume of oil that could be spilled from a pipe must be built. The Department of the Interior stipulated (Stipulation B16b)²⁹ that containment areas must be provided around storage tanks but not the pipeline itself. It would seem that some spill control devices would be in order in the vicinity of waterways and especially at crossings. According to Department of the Interior Stipulation B9, the trans-Alaska pipeline is required to comply with all state laws and regulations, but the Health and Welfare regulation will only be enforced if the Governor's Office directs the agencies to enforce this rule. Health and Welfare has not given any indication that this regulation must be followed.

The Department of the Interior has stipulated (B16c) that an oil spill contingency plan must be submitted 60 days prior to the commencement of pumping and that the pipeline company will be responsible for cleaning up or paying the Department of the Interior to clean up after any spill. Though damages will not be assessed, a fine may be levied. Areas will have to be restored to as near the original condition as possible. The effectiveness of these stipulations with respect to wildlife and habitat will depend on how strictly they are enforced.

The Alaska Department of Fish and Game submitted a report on the pipeline impact on wildlife to the Bureau of Land Management and the Trans-Alaska Pipeline System in 1969. The following is the summary statement:

If the U.S. Department of Interior, Trans-Alaska Pipeline stipulations are strictly enforced minimum hazards to wildlife population are anticipated during the construction period.

Increased public access resulting from pipeline construction will improve recreational opportunity. Increasing input from resource

28. Dep't Health & Welfare Regs. Alas. Stat. § 18.05.040 (1949).

29. U.S. Dep't of Interior, Stipulations for Trans-Alaska Pipeline (1971).

agencies will be required to monitor growing resource utilization during the post construction period.

The potential hazards to wildlife will be great during and after the period of feeder line construction unless arctic engineering technology can be improved. Potential oil pollution from the Trans-Alaska Pipeline System remains as the greatest single hazard to wildlife.³⁰

The wildlife issue has received the most publicity. Within Alaska this may be due to the importance of big game as a means of subsistence or a source of supplementary meat. In the lower 48 states, Alaska is thought of as the last area where animals have not been affected by civilization. Perhaps it is merely easier to identify with caribou than tundra. But wildlife has historically been treated as special. There is an Alaska Department of Fish and Game which manages all wildlife except on certain federal lands. There is not an analogous statewide department to oversee and manage wilderness or natural areas per se.³¹ The basic reason the wildlife-petroleum development conflict has been well delineated is because there is an agency to speak for wildlife. The Alaska Department of Fish and Game has described the problem, provided information to the pipeline company and to the Department of the Interior, and put men in the field to reduce the conflict. But these actions do not imply that the conflict has been efficiently resolved. The Alaska Department of Fish and Game cannot impose the cost of damage from an oil spill on the petroleum industry so that the industry will minimize wildlife damage from this source the same as they minimize any other cost.

D. Recreation and Tourism

Alaska attracts tourists because of its wild beauty. Partly in jest and partly in earnest, conversation in the lower 48 states with respect to visiting Alaska centers around the "see it now before it's too late" argument. Few want to visit the most northern major oil-producing area, to travel a beautiful mountain highway conspicuously bordered by a pipeline, or view large erosion scars on the slopes above the road. Whether the tourist ever sees these things or not, Alaska's reputation has been tainted. The industry has become very sensitive to this problem. Both ARCO and British Petroleum have spent sev-

30. Game Div., Alas. Dep't of Fish and Game, Trans-Alaska Pipeline: Specific Ecological Considerations and Implications for Game Management (1969).

31. Wildlife managers by interest and education tend to be sympathetic toward preservation. As more and more interest has developed in protecting wild areas, wildlife managers have tried to fill the void resulting from the absence of a wilderness management agency.

eral hundred thousand dollars cleaning up debris left during North Slope exploration and experimenting with erosion control and tundra rehabilitation techniques.³² To a large extent, they are correcting mistakes that should not have occurred in the first place and for which they are not wholly to blame. Nevertheless, they are definitely putting on white hats and sincerely trying to play good-guy roles.

But regardless of the image of the industry and Alaska's new reputation, there will be some conflicts in the field between petroleum and outdoor recreation and tourism. The winter haul road, pipeline road, and pipeline will traverse the Brooks Range before the several proposals for Gates of the Arctic National Park have been considered and the best boundaries, means of access, and areas to be developed have been selected. Petroleum developments have limited some of the proposed national park options. Similarly, the pipe will pass through the proposed Keystone Canyon Scenic State Park near Valdez. It is not likely that the pipeline path will enhance the scenery.

It can also be argued that petroleum development and recreation development are joint products. The pipeline road will open up the Ray Mountains, the Brooks Range, and the North Slope to tourists, hunters, and mountain climbers much earlier than if oil had not been discovered on the North Slope. This argument is also valid, but the resulting unplanned recreation will be of lower quality.

No agency has studied the petroleum-tourism and recreation conflict. Though there are several agencies that should be concerned with the problem—such as the State Division of Parks and Recreation, the National Park Service, the Bureau of Land Management, or the Alaska Travel Division of the State Department of Economic Development—there is no agency which is broadly conceived, well financed, and staffed with a research team. Perhaps the new division status recently given to Parks and Recreation will help this group begin to meet the need. Given the lack of statewide, coordinated, and long-range recreation and tourism planning, it is not surprising that so little has been done about the conflicts between petroleum development and recreation and tourism.

ALTERNATIVE TRANSPORT ROUTES

This article concentrates on the economic and environmental aspects of the proposed trans-Alaska pipeline simply because this is the most likely transport route and means. Other researchers have investigated the alternatives. These include (1) a trans-Canada pipe-

32. Conversations with Tom Brennan, Public Relations, Atlantic Richfield Company, July 1970.

line to Chicago and on to New York, (2) tankers through the Northwest Passage to New York, and combinations of (3) railroad and pipeline or (4) airplane and pipeline. Cicchetti and Krutilla compared the trans-Alaska pipeline with alternatives (1) and (2) and found that the monetary gains of these alternatives were somewhat greater.³³ In addition, the environmental costs of the trans-Canada pipeline are likely to be less since the MacKenzie Valley route would probably have less permafrost problems, definitely little earthquake risk, and no tanker risk. Quirin and Wolff compared the trans-Alaska pipeline with alternatives (1), (3), and (4) and also found the trans-Canada pipeline to be the superior alternative.³⁴ Quirin and Wolff argue in addition that, given the low North Slope extraction costs and high market price, it may be economically feasible to fly the oil from Prudhoe Bay to Valdez or Edmonton. Both of these studies contain interesting and valuable insights and rough quantification of some of the environmental costs.

CONCLUSIONS

The State of Alaska will collect between \$1 billion and \$3 billion in the form of lease bonus, royalty, and severance tax payments during the next 15 years. Given that prorationing in the lower 48 states and import controls are maintained, the higher figure is much more likely. Petroleum development will have an impact on the Alaska economy. About 750 new permanent jobs will be created directly by petroleum extraction, transportation, and processing. On the other hand, the benefits to present Alaska residents will be minimal since most of these new jobs will be filled by migrants from the lower 48 states who already have the appropriate skills.

The major conflicts to date and for the foreseeable future seem to be those between the petroleum industry and (1) wilderness, (2) marine resources, (3) wildlife, and (4) recreation and tourism. There are other conflicts, such as air pollution from petroleum processing and gas flaring, but these conflicts are neither large nor particularly unique to the industry. Present institutions let the petroleum industry impose these costs on others except where specific corrections are made. It is interesting to note that the opposite is true in the case of the fishery or recreation industries which impose few costs and absorb many.

33. Cicchetti & Krutilla, *An Evaluation of the Environmental Impact Statement for the Proposed Trans-Alaska Pipeline*, testimony before the U.S. Bureau of Land Management (Wash. D.C., Feb. 1971).

34. Quirin & Wolff, *The Economics of Oil Transportation in the Arctic*, paper prepared for Conference on Canadian-U.S. Law of the Sea Problems, at University of Toronto (Toronto, Ontario, June 1971).