

Economic Impact of a North Slope Rail Extension on Northern Energy and Mineral Development

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Constraints on Northern Alaska Oil, Natural Gas, and Mineral Development

- Higher capital and operating costs relative to other regions of Alaska and much higher costs relative to the contiguous states.
- High transportation costs and long supply chains.
- Historic high total tax burdens relative to jurisdictions with lower total costs.

State of Alaska's Options for Enhancing the Competitive Economic Environment

- Reducing oil taxes has been an essential and necessary first step.
- Developing a railroad system to handle large volumes of bulk freight at competitive costs is an absolute necessity for non-conventional oil and gas production including large scale horizontal drilling and hydro-fracturing of shale oil and shale gas bearing formations.
- Rail transport to the North Slope can also provide backhaul capabilities for low cost transport of mineral commodities south to tidewater.

High Cost of Alaska North Slope Operations – An Independent Analysis Based on U.S. Department of Defense Historic Data

- North Slope Operational Cost Factors (DoD Area Cost Factors (ACF) - 2012)
- Historic area cost factors for North Slope DoD facilities similar to area cost factors for Aleutian Island facilities (Shemya, Adak, etc.).
- ACF is function of the average construction cost of all U.S. DoD facilities nationwide (ACF=1).
- Currently all North Slope DoD facilities are closed.
- Eareckson, AFB (Shemya Is.) is a proxy for North Slope costs with an $ACF = 4.37$.

North Slope ACF Relative to Major Shale Oil Producing Areas in Continental U.S.

- Shale Oil Field Cost Factors for Texas (Eagle Ford Formation)
 - East Texas Gulf ACF=0.72
 - State of Texas Average ACF=0.81
- North Slope costs relative to East Texas = $4.37/0.72 = 6.55$ times
- North Slope cost relative to State of Texas = $4.37/0.81 = 5.39$ times

Proposed Shale Oil Development on the North Slope

- An example of proposed shale oil development (Petroleum News September 2012 Reported – Great Bear Petroleum proposed drilling 200 horizontal wells per year in various shale oil targets on the North Slope including the Shublik Formation).
- Based on other shale oil developments (Eagle Ford or Bakken):
 - Each well would be hydro-fractured.
 - Each well would require an estimated 5,000-6,000 tons of frac sand and equal aggregate tonnages of drilling steel, drilling fluids, cement, diesel fuel and equipment.
- Total annual logistic requirements =
 $200 \text{ wells} \times 12,000 \text{ tons/well} = 2,400,000 \text{ tons.}$
- This requirement is:
 - Equivalent to approximately five 10,000 ton each freight trains per week, or
 - Equivalent of 168 eighteen wheelers (40 tons each) per day one way!

Rail vs. Truck Freight Costs for North Slope Shale Oil Logistics

- 12,000 tons per well
- 470 miles of road miles (Fairbanks to Prudhoe bay)
- Trucking cost = \$1.00/ton-mile.
- Trucking cost per well = $12,000 \times 470 \times \1.00
= \$5,640,000.
- 450 miles by rail from Dunbar (Nenana to Prudhoe Bay).
- Rail freight cost (estimated) = \$0.10/ton-mile.
- Rail cost per well = $12,000 \times 450 \times \0.10
=\$540,000.

Capital Cost of Rail Extension from Dunbar to Prudhoe Bay

- Distance – 450 miles
- Cost of embankment, track, ties, rail =
= 450 miles x \$6,000,000/mile
= \$2,700,000,000.
- Tunnel South of Yukon River (1.6 miles).
= 1.6 miles x \$285,000,000/mile.
= \$456,000,000.
- Tunnel at Atigun Pass (4.5 miles).
= 4.5 miles x \$285,000,000/mile.
= \$1,283,000,000.
- Yukon River Bridge = \$500,000,000
- Other Bridges = \$200,000,000
- North Slope Terminal = \$50,000,000
- Total Estimated Capital Cost = \$5,189,000,000.

Estimated Benefits to State of Alaska

- Assume rail freight revenue neutral (freight revenue = operating costs + interest on debt).
- Assume only revenue to State of Alaska is 1/8th Royalty Oil from shale development.
- Assume IP for shale oil wells is 2000 barrels per day (Lower 48 wells range from 2000-3000+ barrels per day).
- 200 wells per year thus 400,000 barrels/day per year minimum.
- Assume \$85/barrel price of oil
- Annual Royalty Oil Revenue =
 - = 200 wells x 2000 bpd/well x 365 days/yr x \$85/barrel x 1/8
 - = \$1,550,000,000/yr.

Benefit/Cost and Rate of Return on Investment Analyses

- Capital cost = \$5,189,000,000
- Annual revenue = \$1,550,000,000 (shale oil royalty oil revenue only)
- Assume 10% minimum return on Investment.
- $n = 30$ years
- Benefit/Cost Ratio with 10% minimum Rate of Return on Investment
Present Worth Factor (PWF) = $[P/A @ i = 10\%, n = 30 \text{ years}] = 9.427$
Benefit/Cost at 10% ROI = $\$1,550,000,000 [9.427] / \$5,189,000,000 = 2.5$
or
- Rate of Return to State of Alaska (interest rate where $B/C = 1.0$) =
 $\$1,550,000,000 [PWF] / \$5,189,000,000 = 1.0$
- $PWF = 3.35$
- Present Worth Factor = $[P/A @ i = 30\%, n = 30 \text{ years}] = 3.332$
- Thus, the expected Rate of Return to the State on the railroad investment from shale oil royalty revenues only would be approximately 30% !!!

Project Funded by Alaska Railroad Corporation Bonds

- Non-recourse tax exempt revenue bonds.
- Interest on debt (bond interest) paid out of rail freight revenues.
- Bond retirement from a sinking fund established from a percentage of annual royalty oil payments to the State of Alaska.

Other Benefits – Northern Mineral Development

- Example - Mineral Freight from the Arctic Deposit in the Ambler Mining District.
- Assume one 5000 tpd mining operation (Arctic Deposit).
- 1500 tpd mineral concentrates from the processing plant (chalcopyrite ore).
- Assume pure chalcopyrite concentrate (34% Cu)
- Assume price of copper = \$3.20/lb.
- Value of copper concentrate at mine site =
 = .34 x 2000 lbs. x \$3.20/lb.
 = \$2176.00/ton
- Trucking distance from Arctic Deposit to Port MacKenzie is 779 miles.
- Cost of trucking concentrates to tidewater
 = 779 miles x \$1.00/ton-mile
 = \$779.00
- Trucking cost as a percent of concentrate value at mine = 36%

Other Benefits – Northern Mineral Development, continued

- Cost of rail transport to Port MacKenzie (truck from Arctic to Pipeline Corridor 200 miles and rail from Jim River to Port MacKenzie 579 miles)
- $= 200 \text{ miles} \times \$1.00/\text{ton-mile} + 579 \text{ miles} \times \$0.10/\text{ton-mile} = \$200 + \57.90
- $= \$257.90$
- Rail cost as a percent of concentrate value at mine = 12%
- The existing operating metal mines in Alaska have total transportation costs that average 14% of total operating costs whereas on a worldwide basis, mines on the average have transportation costs that are 5-6% of total operating costs.

Other Benefits Continued

- Combined North Slope and Ambler District logistics provides backhaul for railroad thus further reducing logistic costs.
- Rail access to other mineral occurrences in the North Slope Transportation Corridor (at least 685 within 50 miles of the centerline) from Fairbanks to Prudhoe Bay.
- Reduced logistic costs to conventional North Slope oil field operations.
- Without rail NO SHALE OIL DEVELOPMENT due to high cost of logistics and small margins on horizontal/frac wells!