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REFINING BITUMEN: COSTS, BENEFITS AND ANALYSIS

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Executive Summary

The unlocking of unconventional resources for both oil and natural gas has resulted in discounted North American crude oil and natural gas prices in relation to the rest of world. As a result, many North American refineries benefit from having access to lower priced feedstock making the finished products more competitive. Canada is in a unique position because Canada produces far more oil and gas than can be consumed domestically. With bitumen production slated to increase over time and the US taking advantage of overseas markets, there have been questions about why Canada has not developed a more integrated value-added chain within the country.

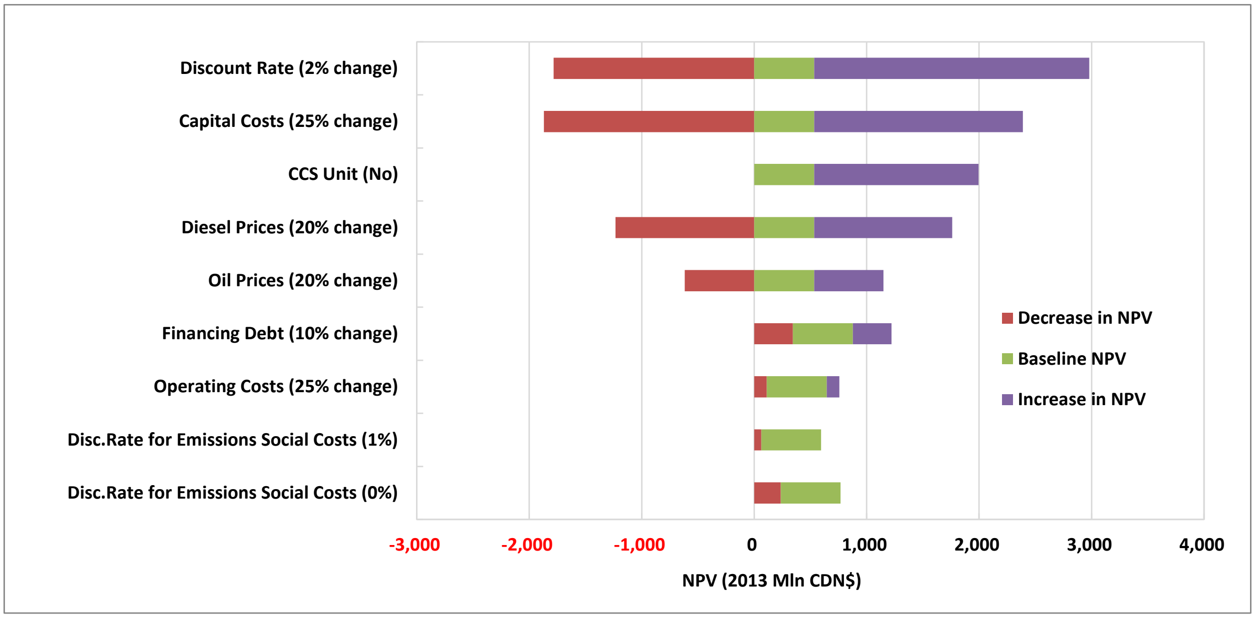
In this study, CERI conducted a cost-benefit analysis (CBA) for a greenfield refinery using up-to-date information[1] to estimate the costs and benefits of the project. The CBA results suggest that a greenfield commercial refinery project is net socially beneficial across a typical discount rate range (13-15 percent) for the refinery business. The net present value (NPV) of a greenfield refinery in Alberta with a carbon capture unit installed is a net benefit of almost $533 million.[2] However, if the average West Texas Intermediate (WTI) price drops below $85 over the life of the project[3] – the project would be a net cost to society. There is the potential for the project to be a net cost given that the analysis excluded a number of environmental costs such as potential greenhouse gas (GHG) damage costs from final consumption emissions, water pollution, opportunity cost of water consumption, and potential human health impacts.

A sensitivity analysis was conducted together with the CBA to examine how alternative values for particularly uncertain parameters affect NPV. The economics of a refinery are complex and depend on many factors. Profits or losses result primarily from the difference between the cost of inputs and the price of outputs. In the oil refining business, the cost of inputs (crude oil) and the price of outputs (refined products) are both highly volatile, influenced by global, regional, and local supply and demand changes. Refineries must optimize production against a backdrop of changing environmental regulation, changing demand patterns and increased global competition among refiners in order to be profitable. Eight different parameters were analyzed that would influence the NPV of a project: discount rate, capital costs, carbon capture unit, the price of diesel, the price of crude oil, financing costs, operating costs, and discount rate for social costs.

The results of the sensitivity analysis are presented in Figure E.1. The baseline NPV of the project (green bar) is positive $533 million. Changing the value of the variables affects the NPV of the project. For example, if a carbon capture unit is omitted, the capital cost will decrease, emissions will increase, and the NPV will increase to $2.0 billion.

[1] The cost estimates were taken from the recent cost evaluation of constructing the North West Upgrader.
[2] The NPV is $532.74 million with an assumed 15% discount rate and a 50-year project life.
[3] At the time of writing, the WTI price was just above US$77/bbl.

Figure E.1: NPV Sensitivity Analysis



Source: CERI

Not surprising, the choice of the discount rate will affect the economics of a refinery. In this case, increasing the discount rate to 17 percent drops the NPV of the refinery to -$1,251 million, whereas decreasing the discount rate to 13 percent will boost the NPV to $2,980 million.

After the discount rate, changes to capital costs have the greatest impact on NPV. Oil refining is a capital-intensive business. Planning, designing, permitting and building a new medium-sized refinery is a 5-7 year process with costs ranging from $7-10 billion, not including land acquisition. The cost varies depending on the location (which determines land and construction costs[4]), the type of crude to be processed and the range of outputs (both of the latter affect the configuration and complexity of the refinery), the size of the plant and local environmental regulations. Varying capital costs by 25 percent will change the NPV by almost the same magnitude, but in the opposite direction.

After the refinery is built, it is expensive to operate. Fixed costs include personnel, maintenance, insurance, administration and depreciation. Variable costs include crude feedstock, chemicals and additives, catalysts, maintenance, utilities and purchased energy (such as natural gas and electricity). To be economically viable, the refinery must keep operating costs such as energy, labour and maintenance to a minimum. Like most other commodity processors (such as food, lumber and metals), oil refiners are price takers: in setting their individual prices, they adapt to

[4] For example, building a comparable project on the US Gulf Coast costs less than half of what it does to erect a plant in Alberta according to IHS CERA's "Extracting Economic value from the Canadian Oil Sands: Upgrading and Refining in Alberta (Or Not)?"

market prices. In the sensitivity analysis the 25 percent increase in operating costs reduced the NPV by $112 million and vice versa.

Other factors that could affect project economics are the prices of crude oil and diesel, with diesel prices having a larger impact than crude prices. Dropping diesel and oil prices by 20 percent over the project life makes the project's NPV negative and vice versa.[5] For example, reducing diesel prices by 20 percent causes the NPV to be -$701 million. Since refineries have little or no influence over the price of their input or their output, they must rely on operational efficiency for their competitive edge.

The social costs of emissions varied depending on the chosen discount rate for these costs. Generally, the lower the discount rate, the more social cost incurred in the future is placed on society today. In other words, the cost of polluting has more "value" today than what's left for future generations. Hence, choosing a smaller discount rate reduces the NPV of the project. Table E.1 summarizes the NPVs for all the cases.

Table E.1: Sensitivity Cases

Variable	Base Line	Change to the Variable	Resulting NPV	Change from Baseline NPV
CCS Unit	CCS installed	No CCS unit	$1,994.1	$1,461.34
Discount Rate	15%	+2%	-$1,251.1	-$1,783.9
		-2%	$2,979.9	$2,447.1
Oil Prices[6]		+20%	$1,150.3	$617.5
		-20%	-$84.8	-$617.5
Diesel Prices[7]		+20%	$1,761.6	$1,228.8
		-20%	-$700.6	-$1,233.4
Capital Costs	$8.5 billion	+25%	-$1,336.5	-$1,869.2
		-25%	$2,389.2	$1,856.4
Operating Costs	$164 million/year	+25%	$420.5	-$112.2
		-25%	$645.0	$112.2
Disc. Rate for Emissions	3%	0%	$297.3	-$235.4
		1%	$469.7	-$63.1
Debt Financing	40%	+10%	$188.6	-$344.1
		-10%	$876.9	$344.1

Source: CERI

[5] The differential between diesel and oil prices is not constant. The differential narrows in the latter part of the time period as oil prices grow faster than diesel prices.
[6] See Chapter 2, Revenues section under Benefits, page 17.
[7] Ibid.