

Significant Financial Risks Confront Teck's Frontier Oil Sands Mine Project

**Industry Trends and Project-Specific
Challenges Suggest Project Will Never
Be Financially Viable**



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Table of Contents

Executive Summary	2
I. Background	3
Project Description	3
Credentials of Report Author	4
II. Project Specific Factors Weigh Against its Economic Viability	5
Frontier Project is Not— and Will Not Be— Commercially Viable	5
New Market Pressures Will Drive Down WCS Prices and Compound the Project's Already Distressed Finances	6
High Cost Structure of the Project Renders it Uncompetitive in the Global Market	8
Teck is Ill-equipped to Move Forward with the Project	9
Teck Has Limited Bandwidth to Move Forward with the Project	10
Projected Economic Benefits of the Project Have Declined Significantly	11
III. Teck's Plan to Sell Oil Sands Product to Asian Markets is Unrealistic	12
IV. Macro Factors that Could Lead to Project Cancellation are Not Being Considered	13
Permian Basin Supply Expansion, IMO Rules Will Further Erode WCS Market Position	14
Popular Opposition Can Lead to a Project's Cancellation	15
Peak Oil Could Affect the Market for the Frontier Project	16
Appendix I: Estimated Annual Expenditures for Phase 1 of Frontier Oil Sands Mine Project...	18
Appendix II: Oil Change International Frontier Project	19
Appendix III: Credentials of Tom Sanzillo	22

Executive Summary

Teck's Frontier Oil Sands Mine Project, which is now before the Canadian Environmental Assessment Agency Joint Review Panel, offers a weak financial case with little chance of remaining a going concern for the 41 years promised in the application. Based upon current oil price and cost projections the project, which is expected to cost \$20.6 billion,¹ is not commercially viable. From now until 2026, the first year of commercial operation, neither oil price increases nor production cost declines for oil sands are likely to be sufficient to improve its financial prospects. The project can expect financial distress for its entire life cycle.

The Frontier project faces a series of severe financial headwinds that will likely block any upside potential. These headwinds include high costs to produce oil sands and pressure on revenues, as described below:

- **Costly oil sands extraction.** On the cost side of the equation, the Frontier project, like most oil sands extraction, is expensive. Despite aggressive company and industry efforts to lower costs to a competitive range, many large global suppliers of oil and gas remain far more competitive than Canada's oil sands producers.
- **Continued low price of Western Canada Select (WCS) oil.** WCS oil is currently discounted against market competitors, specifically West Texas Intermediate (WTI), because of its low quality and the distance it must be transported to market.
- **New sulfur rules for maritime fuel users.** Regulations that go into effect between 2020 and 2025 will further depress the price of WCS and widen the price differential between WCS and WTI.
- **Chronic shortfall of pipeline capacity.** Pipelines connecting Canada's oil sands with ports and markets continue to face legal, regulatory and political challenges that create bottlenecks, and are expected to widen price differentials between WCS and WTI.²
- **Competition from expected surge of new investments in cheaper, lighter and sweeter oil grades.** These new oil products, coming principally from the Permian Basin, will exert ongoing pressure and erode Canada's WCS imports to America for the foreseeable future.
- **Unrealistic plans to export oil sands to Asia.** Canadian oil producer plans to export oil sands to Asian and other major importers face stiff competition from oil producers with existing trade relationships and lower cost structures. These competitors will win out over Canadian oil sands producers in Asia and other markets.

Beyond these macro factors, Teck Resources Limited is ill-equipped and ill-prepared to take on such a mega-project due to its relative inexperience in oil sands, limited bandwidth for such a project and the sheer scale of the project itself relative to Teck's market capitalization and capex budget. Teck, 100% owner of the project, has a market capitalization of \$13 billion. The Frontier project represents an investment of \$20.6 billion, an amount far in excess of the total market capitalization of the company. (By comparison, Suncor and ExxonMobil have, respectively, market capitalizations of \$66 billion and US\$330 billion.) If the project

¹ All dollars (\$) are in Canadian dollars unless specifically noted.

² 2017 Teck Resources Limited Annual Report.

moves forward, it appears that substantial changes in the company's capital structure will take place. The company has not outlined what those changes might be.

As described in Teck's latest updates, the company may not be able to begin the project in 2019. The company is engaged in a series of capex projects in its other core areas through 2021, and has not outlined any alterations to its existing pipeline of projects to incorporate the Frontier project. Further, the company has made no formal commitment to the Frontier project beyond that which is stated in the project documents before the Panel.

Teck's recent filings also demonstrate a significant reduction in the economic benefits that will be generated by the project in Alberta. Most notably, the projected economic benefits to Alberta household incomes have declined by more than 60% from the initial filing of the project. Similarly, the company notes a reduction in estimated royalty revenues.

In addition to traditional market forces, the Frontier project faces mounting public opposition. The depth of popular opposition to fossil fuel projects has surprised corporate leaders in Canada. Projects once thought to be in compliance with regulatory standards and part of a political consensus are being cancelled or delayed as citizen opposition mounts. Another surprising outcome of citizen activism is that companies like Kinder Morgan, which has contracted to sell its unfinished Trans Mountain pipeline and related assets to the Canadian government, find that their credit rating improves when they rid their balance sheets of financially distressed new projects.

Background

Project Description

The Frontier Oil Sands Mine Project ("Frontier project" or "project") is a greenfield investment of Teck Resources Limited (TECK), a Canadian-based company located in Vancouver, British Columbia. The project, when fully operational in 2037, is expected to produce 260,000 barrels of oil per day (bpd), or 3.2 billion barrels³ over a 41-year life cycle.⁴ Teck estimates that the cost of the project will be \$20.6 billion, with most of the capital expended during Phase 1 of the project (2019 through 2026).

It is anticipated that the project will produce \$61 billion in royalties and taxes,⁵ of which an estimated 17% will accrue to the federal government, 77% to Alberta royalties and taxes and 6% to the local municipality.⁶ The project is expected to support 2,500 permanent employees. Teck Resources Limited is a diversified resource company with a market capitalization of \$13.09 billion in assets and annual revenues of \$12 billion in 2017.⁷ The company has a portfolio of copper, zinc, coal, oil sands and other mineral resources in Canada, United

³ Teck Resources Limited Responses to Joint Review Panel Information Request. Package 5– Socio-economics. Section 5.1, p. 5-10. May 2017.

⁴ *Ibid.* Section 5.1, p. 5-4.

⁵ Teck Resources Limited Responses to Joint Review Panel Information Request. Package 5– Socio-economics. Section 5.1 p. 5-1 contains a statement from the JRP that the royalty rates have dropped by 7% or \$4.9 billion from the original application.

⁶ *Ibid.*, p. 1-17.

⁷ Information in this paragraph is taken from Teck Resources 2017 Annual Report (unless otherwise noted).

States, Chile and Peru.⁸ The company is recovering from a period of decline and in 2017 had gross profits of \$4.6 billion and net profits of \$2.5 billion, driven in large measure by rebounding prices in the coal and copper sectors.⁹ In 2017, the company was able to pay its dividend and reduce its debt levels due to a significant increase in profits. In 2018, the company has allocated \$2.1 billion for capital expenditures covering at least eight ongoing projects.

The development of Canadian oil sands is a relatively new core asset for Teck. The Frontier project is only its second oil sands investment. Its first oil sands investment, the Fort Hills project, was a joint venture with Suncor, in which Teck has a 20% interest. Fort Hills has recently completed the construction phase and is in early stages of commercial operation. The Frontier project represents Teck's first oil sands project in which it holds a 100% interest, and is currently being reviewed by Canadian environmental officials for compliance with the nation's natural resource management requirements.

This paper, prepared at the request of Stand.Earth,¹⁰ is designed to examine the economic and financial assumptions of the "Frontier Oil Sands Mine Project— Project Update— EPEA Application No. 001-247548 Water Act File No. 303079, CEAA Reference No. 65504 ERCB Application No. 1708793" and the questions and responses to the Joint Review Panel. This report expands upon a 2015 IEEFA study on Teck Resources that covered the company's finances and its focus on oil sands development. This report relies primarily upon material from the application and supplements information with company and industry data from a variety of sources, including Teck Resources corporate filings.

Credentials of Report Author

Tom Sanzillo, director of finance for the Institute for Energy Economics and Financial Analysis,¹¹ is the author of several studies over the last decade on coal and oil and gas industry project finance, credit, equity and fiscal analyses and public and private financial structures. His most recent work on oil and gas has focused on the financial condition of ExxonMobil, oil and gas pipeline expansions in the United States and Canada and the role of fossil fuels in institutional investment portfolios (including Norway's Government Pension Fund Global and the New York City and state pension funds). He has testified as an expert witness in the United States, taught energy-industry finance training sessions and is quoted frequently by the media. Sanzillo has 17 years of experience with the city and the state of New York in various senior financial and policy management positions. He is a former first deputy comptroller for the state of New York, where he oversaw the finances of 1,300 units of local government, the annual management of 44,000 government contracts, and where he had oversight of more than \$200 billion in state and local municipal bond programs and a \$156 billion pension fund.

The Institute for Energy Economics and Financial Analysis (IEEFA) conducts research and analyses on financial and economic issues related to energy and the environment. The Institute's mission is to accelerate the transition to a diverse, sustainable and profitable

⁸ Ibid., p. 41.

⁹ Teck Resources Limited Press Release. [Teck Reports Unaudited Second Quarter Results for 2018](#). July 25, 2018.

¹⁰ <https://www.stand.earth/>

¹¹ See Appendix III.

energy economy. IEEFA is based in the United States and has offices and professional relations in Australia, India, Indonesia, Hong Kong, the United Kingdom, South Africa, Canada, Philippines, Japan, Kosovo, and Bangladesh.

Project Specific Factors Weigh Against its Economic Viability

Frontier Project is Not— and Will Not Be— Commercially Viable

Based upon current oil price and cost projections, the Frontier Oil Sands Mine Project is not commercially viable. Neither company actions to reduce costs or an increase in the market price of oil are likely to be enough to make the project viable by 2026, the first year of commercial operation. The project is likely to experience financial distress for its entire life cycle.

IEEFA has recently reviewed company, industry, government and independent data on the project. The data support the conclusion that the project will enter the market when the market price of oil from the project will be less than the breakeven price needed to make the project commercially viable. Additional modeling of estimated project costs and oil prices also support a conclusion that financial deficits will occur throughout the life of the project.

According to independent data projections,¹² WTI prices in real dollars will range from US\$71.00/barrel (bbl) in 2019 and then decline to US\$67.30/bbl over the life of the project. The breakeven price for the project is US\$84/bbl for Phase 1 and US\$86/bbl for Phase 2. The project is not commercially viable in either phase of the project.

In a 2015 analysis, Oil Change International (OCI)¹³ concluded that the Frontier project was not commercially viable even at relatively high oil prices, due to factors affecting each phase of the project. The first phase of the project would require WTI oil prices to be at least US\$140/bbl due to built-in infrastructure costs. Phase 2 would require a lower price of US\$118/bbl because the infrastructure will largely have been completed. The project would not break-even during its entire lifecycle.

In its most recent filing with Canadian authorities, the company has identified cost savings on the project from enhanced technological improvements related to the project's participation in Canada's Oil Sands Innovation Alliance.¹⁴ Using Energy Information Administration (EIA) and International Energy Agency (IEA) production and oil price estimates, Teck Resources projects a more robust reference price for

¹² Rystad Energy AS (August 2018).

¹³ Oil Change International. [Teck Frontier: poster child of tar sands folly](#). See Appendix II. April 20, 2015.

¹⁴ [Teck Resources Limited Responses to Joint Review Panel Information Request. Package 5– Socio-economics](#). Section 5, p.5-5. See discussion on Canada's Oil Sands Innovation Alliance (COSIA). May 2017.

oil of WTI US\$95/bbl (nominal) over the life of the project.¹⁵ The Teck presentation does not disclose the full, actual, all-in break-even cost of the project, including its capital return assumptions or whether the project would declare a profit. This would be necessary to more fully evaluate the many financial data points used in the application. As discussed below it is anticipated that the actual price paid for the WCS oil produced at the project will be substantially lower due to the normal market discount between the two crudes and new market forces pushing the WCS price down further relative to WTI.

New Market Pressures¹⁶ Will Drive Down WCS Prices and Compound the Project's Already Distressed Finances

Recent regulatory changes by the International Maritime Organization (IMO) call for reductions in the sulfur content of maritime fuel supplies and will be implemented between 2020 and 2025. These changes are expected to significantly drive down the price of WCS and widen the traditional discount between WTI and WCS.¹⁷ This price reduction will decrease revenues for all oil sands producers, including owners of the Frontier Project. These cash losses will further weaken the finances for the Frontier Project, which will enter the market as prices are declining for WCS due to the new sulfur rules.

Canadian oil sands prices are based on WCS, which is priced at a discount to WTI because the West Texas crude is a lighter substance that flows easily, requires less refining and is a sweeter substance with less sulfur. WCS must also travel long distances to refiners and end consumers, further increasing the price differential between the two crudes. The differential between the two oils has historically ranged between \$6/bbl and \$37/bbl,¹⁸ and is expected to widen as the new sulfur regulation takes effect.

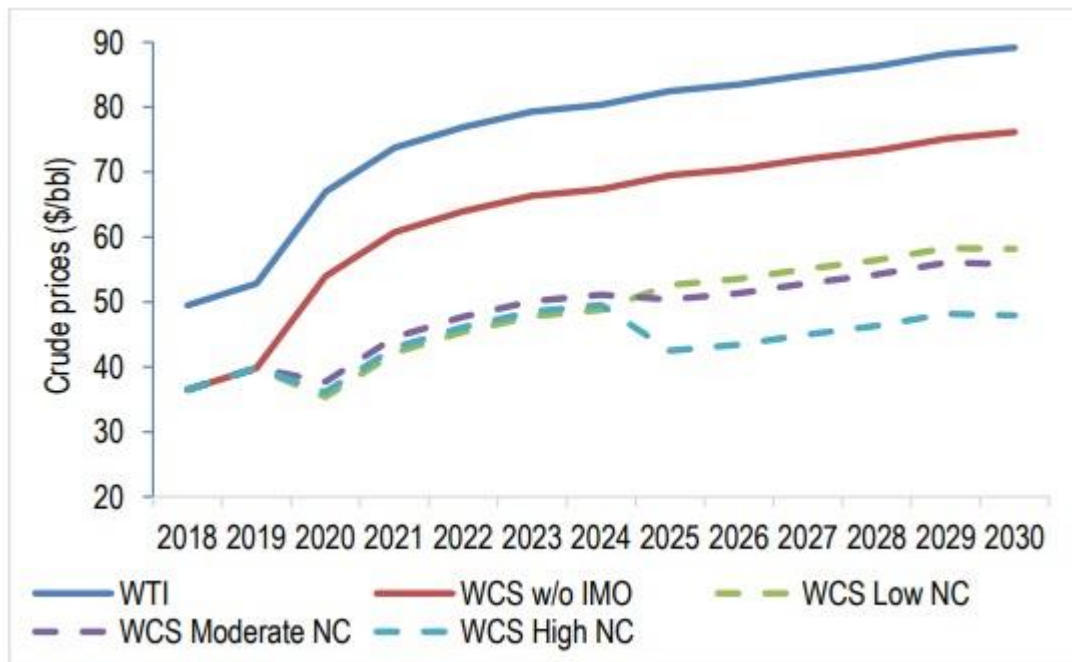
¹⁵ Teck Resources Limited Responses to Joint Review Panel Information Request, Package 10. Section 10, p. 10-93. February 2018.

¹⁶ Canadian Energy Research Institute (CERI). *An Economic Assessment of the International Maritime Organization Sulphur Regulations on Markets for Canadian Crude Oil*. July 2018.

¹⁷ *Ibid.*, 68.

¹⁸ CERI. *Canadian Oil Sands Supply Costs and Development Projects (2018-2038)*. p. 14. May 2018.

Figure 1: WTI and WCS Price Differential (2017 US\$) Due to the International Maritime Organization (IMO) Regulation¹⁹



Source: CERI. Note: “NC” means non-compliance, referring to the level of compliance expected (or not) with the IMO regulations on sulfur.

Figure 1 traces the trajectory of the WTI and WCS prices from 2018 through 2030 and shows the impact of the IMO standards as compared to the traditional differential between WTI and WCS prices. The market price of WCS (ranging between US\$35/bbl and US\$70/bbl) is compared to WTI (ranging from US\$50/bbl to \$90/bbl²⁰). With full implementation of the IMO standards it is anticipated that the discount of WCS to WTI will increase to more than US\$30/bbl.²¹ Such a discount will render certain oil sands projects uneconomic, particularly those that carry a heavy debt load.²² In the case of the Frontier project, either Teck's shareholders will absorb the exposure, the company will need to go into the capital markets to raise the forecasted \$20.6 billion project cost, or find a partner to share the costs. The company has not disclosed how it intends to fund the project or what changes it expects to its capital structure.

¹⁹ CERI. *An Economic Assessment of the International Maritime Organization Sulphur Regulations on Markets for Canadian Crude Oil*. p. 69. July 2018.

²⁰ The CERI oil forecast going forward suffers from many of the same issues that we see in the EIA and IEA forecasts. See discussion of Peak Oil below.

²¹ CERI. *An Economic Assessment of the International Maritime Organization Sulphur Regulations on Markets for Canadian Crude Oil*. p. 85. July 2018.

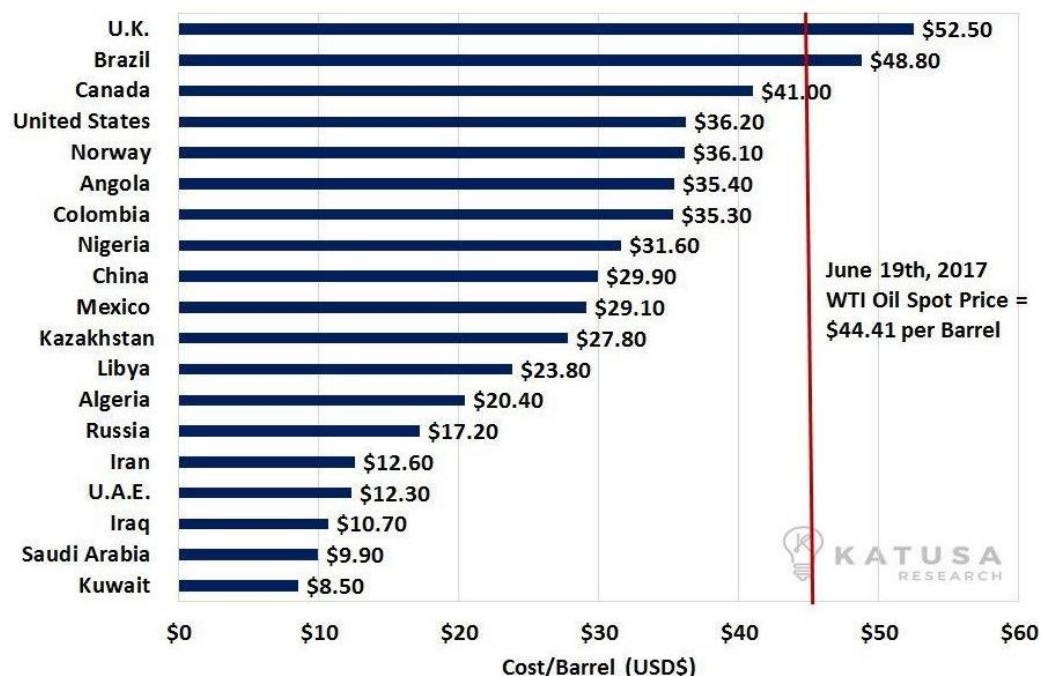
²² The discussion of price structure and cost of production throughout the application and much of the literature identified in this paper presents a misleading picture of actual, all-in costs to break even. Most of the analysis, with the exception of the Rystad data identified above excludes the impact of capital costs on project viability. Teck will need to absorb a \$20.6 billion capital outlay in addition to covering costs. It is the combined factors broadly understood as cost of production and capital cost that determine a breakeven price.

High Cost Structure²³ of the Project Renders it Uncompetitive in the Global Market

Figure 2 below ranks Canada as the third highest-cost oil producer in the world. In the wake of the 2014 oil price collapse and loss of major oil producers in Canada, the remaining oil sands producers have cut back on greenfield projects and also taken aggressive steps to reduce costs.²⁴ Those cost-control measures are showing progress.²⁵

For example, in its project update, Teck Resources offers evidence of industry costs dropping from \$39.05/barrel in 2011 to \$22.05/barrel in Q1 2017.²⁶ Teck also is reporting cost guidance on Fort Hills between \$28.50 and \$32.50.²⁷ Suncor, Teck's partner on the Fort Hills project, reported operating costs of \$23.80/barrel for 2017.²⁸ Teck has identified still further cost reductions that are likely to be achieved with the Frontier project.²⁹

Figure 2: Oil Production Cost by Country³⁰



Source: IEA, Rystad Energy.

²³ <https://www.quora.com/What-is-the-break-even-for-top-oil-producers-by-country>

²⁴ Financial Post. Breakeven costs of US\$40 — and falling — means it's too soon to count out the oilsands. September 6, 2017.

²⁵ Markham's May 14, 2018 blog puts the new cost of operations for greenfield and brownfield into perspective.

²⁶ Teck Resources Limited Responses to Joint Review Panel Information Request. Package 5— Socio-economics. Section 5, p. 5-5. May 2017.

²⁷ Thomson Reuters StreetEvents Transcript. TCK.B.TO- Q2 2018 Teck Resources Ltd Earnings Call. July 26, 2018.

²⁸ Suncor Annual Disclosure. p. 20.

²⁹ Teck Resources Limited Responses to Joint Review Panel Information Request. Package 5— Socio-economics. Section 5, p. 5-5. See discussion on Canada's Oil Sands Innovation Alliance (COSIA). May 2017.

³⁰ <https://www.quora.com/What-is-the-break-even-for-top-oil-producers-by-country>. IEEFA does not endorse any of the values assigned to cost of production in this chart. It does believe that the chart accurately captures the relative ranking of oil production costs across a broad range of operating environments.

However, Canada's competitors are also reducing their operational costs and benefit from having a lower cost basis for their products.³¹ The chart above illustrates the problems Canadian producers face. A reduction from \$40/bbl to \$25/bbl is an important improvement for Fort Hills, Frontier, or any other oil sands project. However, when the savings are compared to, for example, Saudi Arabia, which has a cost of \$9.90/bbl, Canadian oil remains uncompetitive against a large segment of the industry.

The reason for much of the differential is that oil sands production is one of the most expensive forms of oil extraction in the world. Oil sands, unlike other forms of oil extraction, are mined; this requires complicated and costly processes first to remove the oil sands bitumen from the ground, then to prepare it to improve flow, and finally to provide heavy refining to render it useful for consumption. And high shipping costs, due to the remote location of the mines in northeastern Alberta— far from any ports, consumers, or refineries— increase operating costs further.

Chronic shortfalls of pipeline capacity will further widen the price differentials between WCS and WTI, a risk factor the company acknowledged in its 2017 annual report.³² Pipelines connecting Canada's oil sands regions with ports and markets continue to face legal, regulatory and political challenges that create bottlenecks. Completion of the Trans Mountain pipeline has been delayed, for example, because Kinder Morgan backed away from the project. While the Canadian government contracted to buy and complete the unfinished pipeline, the purchase included related assets, among them are pipelines that span the Canadian and U.S. borders, and thus require special permits from the U.S. government, which has caused further delays.³³

Teck is Ill-Equipped to Move Forward with the Project

At the enterprise level Teck Resources has a market capitalization of \$13 billion. (By comparison, Suncor and Total, which are partners in the Fort Hill project, have, respectively, market capitalizations of \$66 billion and US\$171 billion.) The Frontier project represents an investment of \$20.6 billion, an amount far in excess of the company's total market capitalization. Given this, if the project moves forward substantial changes in the company's capital structure almost certainly will be needed, but Teck has to date refused to comment on this issue.

Frontier is the first oil sands project the company is pursuing as sole owner. Given the highly speculative nature of oil sands investments in the current market, its relative inexperience with oil sands mining and the company's pipeline of other, more conventional projects (described below), it is highly unlikely that Teck will be ready to proceed in 2019, if ever. The risk here is that even a modest decline in metallurgical coal, copper, or zinc prices will cause the company to confront negative free cash flow. The copper, zinc and metallurgical coal sectors are all very familiar to company management— as are the revenue and profit

³¹ Oilprice.com. [Clean Oil That Only Costs \\$20](#). February 13, 2018.

³² [2017 Teck Resources Limited Annual Report](#).

³³ Tom Sanzillo and Kathy Hipple (IEEFA). [IEEFA update: U.S.-Canada trade tensions could scuttle Kinder Morgan sale of Trans Mountain Pipeline](#). August 3, 2018.

volatility that come with it.³⁴ The company's revenues have experienced significant declines, such as the annual declines in 2012, 2013, 2014 and 2015. Teck's revenue drivers are cyclical and volatile commodity prices, which are beyond its control. In 2017, for example, Teck's largest revenue source, steelmaking coal, experienced "significant volatility in... prices,"³⁵ ranging from US\$140 to US\$300 per metric ton largely because of cyclone-induced price spikes.³⁶ As recently as 2016, spot price assessments and quarterly pricing for steelmaking coal were closer to \$US60-70, by comparison. The 2017 price spike was also tied to increased demand from China, which may slow as that economy appears to be slowing.

Furthermore, Teck's energy business unit recorded gross losses in 2015 (\$2 billion) and 2016 (\$3 billion) and just broke even in 2017. Despite progress made on its joint venture on the Fort Hills project, oil sands are not considered a proven core asset by the company. Company officials believe that decision, concerning to the role of oil sands in the company's future, will not be made until at least 2020.³⁷

Teck Has Limited Bandwidth to Move Forward with the Project

In addition to the Frontier project, Teck has an ambitious pipeline of projects to fund over the next three years. Those projects likely will prevent the company from move forward with the Frontier project in 2019. If Frontier is included, the annual price tag for capital expenditure suggests a significant future increase in annual outlays beyond the current \$2.1 billion annual level. The company has not outlined potential changes to its capex budget to account for potential increases needed for the Frontier project.

According to Teck's latest project update, construction³⁸ and outlays³⁹ for the Frontier project will start in 2019. However, these outlays are not included in the company's annual report either as projects in the pipeline⁴⁰ or as planned expenditures through 2021.⁴¹

In some years of Phase 1, Frontier project outlay will exceed the corporation's entire current annual capex budget. Teck's updated disclosures reaffirm that the project will cost \$20.6 billion. IEEFA estimates that over the course of Phase I (2019-2026), Teck will spend an estimated \$14.6 billion, with approximately \$300 million spent annually for the first two years, rising to \$3.8 billion in 2026.⁴² During an extended exchange with stock analysts in its most recent earnings call the company discussed how it would deploy almost \$7 billion in liquidity between now and 2021. Copper was identified as the company's priority with no mention of

³⁴ For a discussion of the relative strengths and challenges (including the risk of negative free cash flow and commodity volatility) to the company see:

https://www.moody.com/researchdocumentcontentpage.aspx?docid=PBC_1122128 and
https://www.moody.com/research/Moodys-upgrades-Tecks-rating-to-Ba1-outlook-stable--PR_382551

³⁵ 2017 Teck Resources Limited Annual Report, p. 15.

³⁶ 2017 Teck Resources Limited Annual Report.

³⁷ Thomson Reuters StreetEvents Transcript, TCK.B.TO- Q2 2018 Teck Resources Ltd Earnings Call, p. 11, July 26, 2018.

³⁸ Teck Resources Limited, Frontier Oil Sands Mine Project: Responses to Oil Sands Environmental Coalition (OSEC) Statement of Concern Regarding the Project Update, Figure 2-1, a, p. 15, April 2016.

³⁹ See Appendix I.

⁴⁰ 2017 Teck Resources Limited Annual Report, p. 41.

⁴¹ *Ibid.*, p. 43.

⁴² See Appendix I.

oil sands investments.⁴³ Teck's pipeline of projects threatens to crowd out its commitment to Frontier. The company has identified at least eight projects covering copper, zinc, molybdenum, lead, refined silver and metallurgical coal extractions that are moving forward through 2021.⁴⁴ Most notably, the Quebrada Blanca 2 copper project is at the top of the priority list.⁴⁵

Projected Economic Benefits of the Project Have Declined Significantly

Teck's update of the economic benefits of the project substantially reduces the project's GDP benefit and household income contribution.⁴⁶ The newest revisions also reduce the royalty payments to Alberta by 7%.

Since the original integrated application was filed by Teck Resources in 2011,⁴⁷ the potential economic benefits of the project for Alberta have been revised substantially, and reveal significantly reduced benefits to Alberta residents and royalties to the provincial government. For example, the household income benefit for Alberta residents has been revised downward by 64%. The estimated royalty revenues that will be used to fund government services have declined by 7%.

The health of the Alberta economy and the Frontier project are tied closely to the price of oil.⁴⁸ Just as Teck Resources will need to carefully monitor market changes related to WCS to determine if the company should ultimately make a final investment decision,⁴⁹ so too must Alberta and Canadian officials monitor the economic and fiscal benefits of the project to determine if the potential benefits are worth the costs.

In response to a question by the Joint Review Panel (JRP), Teck acknowledged that the economic benefits of the project have decreased since the last analysis.

The economic benefits are organized around the construction investments and the operations of the project. The presentation of benefits is done to show the macro benefit to Alberta over the life of the project.

- In the Integrated Application, the **construction investment** creates \$18.3 billion of GDP benefit. In the Update, the GDP benefit is \$12.3 billion, a 33% decrease.
- In the Integrated Application, the **construction investment** creates \$13.2 billion of household income. In the Update, household benefit is \$7.5 billion, a 43% decrease.

⁴³ Thomson Reuters StreetEvents Transcript. [TCK.B.TO- Q2 2018 Teck Resources Ltd Earnings Call](#). p. 17-19. July 26, 2018.

⁴⁴ Thomson Reuters StreetEvents Transcript. [TCK.B.TO- Q2 2018 Teck Resources Ltd Earnings Call](#). July 26, 2018.

⁴⁵ *Ibid.*

⁴⁶ [Teck Resources Limited Responses to Joint Review Panel Information Request, Package 10](#). p. 10-88. February 2018.

⁴⁷ [Frontier Oil Sands Mine Project Integrated Application- Supplemental Information Request, Round 3: AER Responses](#). October 2014.

⁴⁸ [Teck Resources Limited Responses to Joint Review Panel Information Request. Package 5- Socio-economics](#). p. 5-4. May 2017.

⁴⁹ Teck Resources Limited. [2017 Annual Information Form](#). p. 48. February 26, 2018. The company's expenditure commitment thus far is limited to supporting the environmental review process.

- In the Integrated Application, **operational expenditures** create \$2.1 billion of GDP benefit. In the Update, the GDP benefit is \$1.52 billion, a 38% decrease.
- In the Integrated Application, **operational expenditures** create \$2.2 billion of household income. In the Update, the GDP benefit is \$790 million, a 64% decrease.

Teck explains that the revisions are a result of changed assumptions about the location of businesses where money will be spent, a change in the “ripple effect of the money through Alberta’s economy and technical changes to econometric multipliers.”⁵⁰

Teck was responding to a question from the review panel, which requested an explanation of the reduction in the royalty estimate. The question also pointed out that the earlier oil price estimate of \$100/bbl had been changed to \$95/bbl, which would reduce the amount of royalty payments.

Teck’s response tracked long-term oil price estimates provided by IEA and EIA for 2016 and 2017.⁵¹

Teck’s Plan to Sell Oil Sands Product to Asian Markets is Unrealistic

Teck anticipates selling a considerable amount of Frontier’s reserves into the Asian market.⁵² Canadian oil producers and government officials emphasize potential in Asia based on the need for most of the countries in that region to diversify their sources of oil to drive down prices and to hedge against geopolitical disruptions, particularly disruptions related to Middle East and Latin America suppliers.

The potential for Canadian producers to meaningfully enter the Asian market comes against a backdrop of strong competition and established relations between other existing suppliers. Building capacity for Asian sales is not happening only in Canada. Other supplier countries are doing the same. The distinctive Canadian advantage in the global market that would provide it with an appreciable market share remains to be seen. It is more likely that Canadian producers will, over the long run, become swing producers for Asian oil consumers during periods of temporary disruptions or political conflagrations.⁵³ Swing suppliers cannot expect a permanently stable source of demand that can sustain a \$20.6 billion investment.

In 2017, Canada exported oil valued at \$54 billion, making it the world’s fourth largest oil exporter. But virtually all those exports,⁵⁴ some \$53.3 billion went south to the United States.⁵⁵ Canada is effectively starting its foray into Asia from scratch.

⁵⁰ Teck Resources Limited Responses to Joint Review Panel Information Request, Package 10. p. 10-88. February 2018.

⁵¹ Teck Resources Limited Responses to Joint Review Panel Information Request. Package 5– Socio-economics. p. 5-4. May 2017.

⁵² Frontier Oil Sands Mine Project Update. p. 1-14. June 2015.

⁵³ Financial Post. [Canada to be stuck on sidelines in 'extraordinary times' for global energy](#). November 13, 2017.

⁵⁴ S&P Global Platts. [Interview: Canadian crude oil exports to Asia could rise](#). September 8, 2017.

⁵⁵ World’s Top Exports. [Crude Oil Imports by Country](#). August 11, 2018.

The Frontier project and Trans Mountain pipeline are both targeted to increase sales of Canadian oil sands product to Asia. But the competition will be steep. Twenty countries, including Russia, Saudi Arabia, Iran, Iraq, Kuwait, the United Arab Emirates, the United States, the United Kingdom and Indonesia already export nearly \$300 billion in oil to China, Japan and India.⁵⁶ In addition, several smaller suppliers, such as Vietnam, Ecuador and Malaysia, provide important swing functions to the market. It is unclear what market advantage Canadian oil possesses that will move market share in its direction.

Canadian oil sands producers must also overcome several major hurdles related to the low quality of Canada's oil product, transportation costs and bottlenecks, public opposition, refinery capacity and stiff competition from the United States' shale gas and oil producers. This is true wherever Canadian oil sands producers sell their product. However, in the global market, Teck faces these same headwinds— but without the benefit of trading with an ally.

Macro Factors that Could Lead to Project Cancellation Are Not Being Considered

Over the last decade, the cumulative risks facing small and large-scale oil sands projects in Canada have grown and have resulted in the cancellation⁵⁷ of numerous high-profile projects, a pull-out of investment by the world's oil majors, massive write-offs and substantial reductions in the outlook for the industry.⁵⁸ Fundamentally, Canadian oil sands extraction is expensive. Globally, the industry is producing more oil and gas at declining production costs. Oil sands extraction, however, still requires a high oil price environment to be profitable. Oil sands production processes cannot compete with technological cost-reduction strategies such as fracking. Canadian oil sands, which produce heavy sulfur oil, must compete with other heavy crude products as well as cheaper-to-refine light, sweet crude products. And, adding to its competitive disadvantage, Canadian oil must travel long distances to reach the markets, particularly when compared to supplies from the Permian Basin in Texas which are close to refineries and ports. For these reasons and other geopolitical factors, Canadian oil sands producers face strong international competition as they try to increase sales and boost revenues through export strategies.

Some of these risk factors are partially addressed in Teck's application and supplementary updates. The discussion of costs, for example, is one area that receives the company's attention. However, the application and underlying data provided offer no convincing rationale that cost savings will be of substantial size and duration to offset the countervailing competitive market pressures facing the company and the Frontier project.

The application also suffers from a dearth of analysis of certain macroeconomic factors that individually or collectively may force project cancellation.

⁵⁶ *Ibid.*

⁵⁷ EnergyNow Media. [Canada's Long History Of Cancelled Oil and Gas Megaprojects– David Yager– Yager Management](#). August 9, 2017.

⁵⁸ The Canadian Press. [Canadian oil production expected to rise: industry association predicts](#). June 12, 2018.

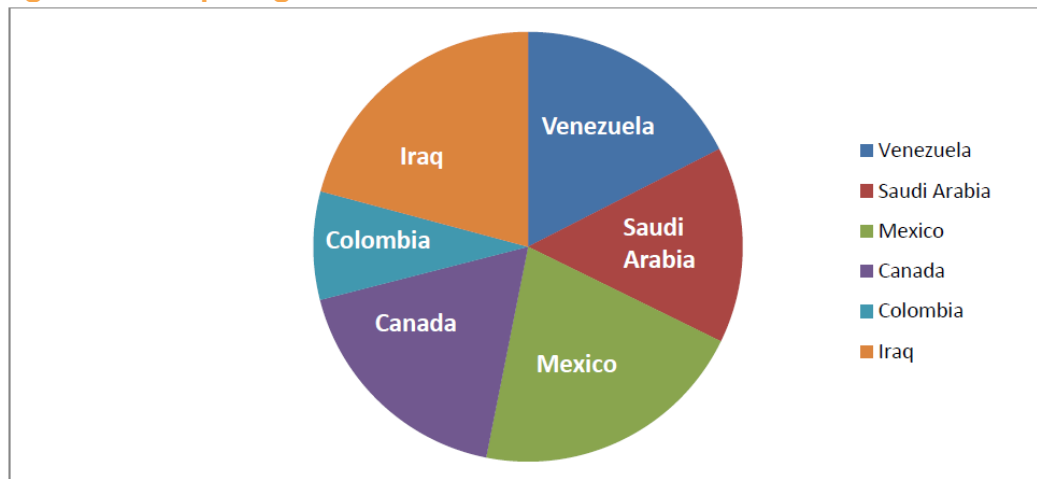
Permian Basin Supply Expansion, IMO Rules Will Further Erode WCS Market Position

Just as the price decline driven by the International Maritime Organization (IMO) sulfur regulations hits the market, U.S. oil producers will be expanding their production of light, sweet oil out of the Permian Basin. This surplus of new oil will drive down prices for WCS further.

Currently, the Permian Basin in the United States is a target of intense investment activity.⁵⁹ If the basin stood alone as an oil production country it would be the fourth largest oil producing country in OPEC.⁶⁰ Kinder Morgan, after recently cancelling its interest in the Trans Mountain pipeline,⁶¹ has redoubled its efforts to build its business in the Permian Basin.⁶² Marathon Oil, a significant oil sands player, sold its Canadian assets to participate in the Permian Basin.⁶³ ExxonMobil de-booked 4 billion barrels of oil sands reserves in Canada, and then announced a threefold increase in its investment activity in the Permian.⁶⁴ By 2023 the Permian Basin is expected to produce more oil than every other OPEC nation except Saudi Arabia.⁶⁵

A recent Canadian Energy Research Institute (CERI) report makes clear that the IMO's regulatory preference for lower sulfur product will drive down the price for WCS and heavy crudes. CERI expects that the lower priced, heavy crude products will allow other heavy crude producers already doing business in the region (and with lower cost structures than Canada's) to increase their presence with additional refinery investment. This will further intensify competition with WCS and jeopardize market share.

Figure 3: Competing International Crudes in the Gulf Coast



Source: EIA, Argus.

⁵⁹ Fortune. *Lone Star Rising*. May 25, 2018.

⁶⁰ Bloomberg. *Permian Basin Is Growing Into the Largest Oil Patch in the World*. April 24, 2018.

⁶¹ Moody's: https://www.moody.com/research/Moodys-changes-Kinder-Morgans-outlook-to-positive--PR_387908

⁶² Nasdaq. *Kinder Morgan Inc. Wants to Take Another Ride on the Permian Basin Growth Highway*. June 26, 2018.

⁶³ Nasdaq. *Marathon Oil Sells Canadian Properties, Buys Permian Assets*. March 10, 2017.

⁶⁴ Rigzone. *ExxonMobil to Triple Production in the Permian*. January 30, 2018.

⁶⁵ Oil & Gas Journal. *IHS Markit forecasts Permian basin oil production will double from 2018-23*. June 13, 2018.

The Gulf Coast region also will be flooded with domestic, light sweet crude and liquefied natural gas (LNG) from the current round of intense investment activity. Investment will be directed toward higher value, cheaper and cleaner products. The likelihood, even with strong export demand from the United States, is that WTI and Brent prices will remain relatively modest. The cumulative impact of this competitive crossfire increases the risk that Canada could lose sales and market share in the United States.⁶⁶

For the Frontier project to succeed and for Canada's WCS to increase U.S. market share, there would need to be a rapid and permanent increase in the price of WTI and Brent oil *and* a substantial failure of companies that are increasing investments in the Permian Basin. The likelihood of these factors converging at scale and for a prolonged period is low.

Popular Opposition Can Lead to a Project's Cancellation

Public opposition to pipeline and oil sands projects has become intense in Canada as citizen activists, tribal nations and local and provincial governments question the environmental and climate impacts of new fossil fuel infrastructure and extraction projects. The CEOs of both TransCanada in the Keystone XL pipeline⁶⁷ controversy and Kinder Morgan in the Trans Mountain⁶⁸ dispute have each expressed surprise at the depth of public sentiment. For example, during the week of August 18, protestors opposing the Trans Mountain pipeline were arrested at the Burnaby RCMP encampment.⁶⁹

Public opposition to fossil fuel projects is posing qualitatively different challenges to the traditional regulatory and political risk calculations of investment analysis.⁷⁰ Whereas the traditional use of political risk by credit agencies⁷¹ has focused on political action that disrupts economic activity and impairs economic development, recent actions by climate activists have had either a mixed impact on economic activity or have resulted in generally positive outcomes.

For example, Moody's Investors Services, a U.S.-based company that analyzes risk and provides credit ratings, recently upgraded Kinder Morgan's credit after the company agreed to sell its unfinished Trans Mountain pipeline and related assets to the Canadian government. Kinder Morgan has limited its liability by selling off a financially distressed project and will also receive a substantial profit as part of its exit strategy.⁷² Both factors led to the credit rating improvement. Moody's has opined that in the face of the Kinder Morgan pull-out there could be negative consequences for the province of Alberta.⁷³ To date, no credit agency has

⁶⁶ CERI. [An Economic Assessment of the International Maritime Organization Sulphur Regulations on Markets for Canadian Crude Oil](#). See Chapters 6 and 7 in particular.

⁶⁷ Financial Post. [TransCanada in eye of the storm](#). September 8, 2011

⁶⁸ Tom Sanzillo and Kathy Hipple (IEEFA). [Canada's Folly](#). June 2018.

⁶⁹ CBC News. [5 arrested as Burnaby pipeline protest camp dismantled](#). August 16, 2018.

⁷⁰ Oil Change International and IEEFA. [Material Risks: How Public Accountability is Slowing Tar Sands Development](#). October 2014.

⁷¹ Moody's; https://www.moody's.com/researchdocumentcontentpage.aspx?docid=PBC_1084917

⁷² Moody's; https://www.moody's.com/research/Moodys-Kinder-Morgans-sale-of-the-Trans-Mountain-Pipeline-system--PR_384454

⁷³ Calgary Herald. [Varcoe: Moody's warns of economic consequences of Trans Mountain failure](#). May 24, 2018.

indicated what impact, if any, the Trans Mountain pipeline transaction will have on the government of Canada or the province of British Columbia.

For many years, citizen activists in the United States objected to coal-fired power generation due to its environmental and climate risks. A nationwide plan to build 150 coal plants was rebuffed and an estimated \$273 billion in planned capital expenditures was cancelled.⁷⁴ The public opposition led to positive financial impacts for the utility sector. In the area of coal-fired generation, Moody's now considers it credit-negative for a utility to be overly dependent on this fuel source.⁷⁵ Moody's also upgrades power generation companies that remove uneconomic coal liabilities from their balance sheets.⁷⁶ Further, 150 coal plants would have placed significant upward pressure on electricity rates during a time when lower cost alternatives from wind, solar and natural gas had become available. Economic transitions require regulatory and political risk assessments to be cognizant of often-contradictory pressures involved in fossil fuel transactions. Project cancellations or delays may immediately curtail investment because public institutions perceive unacceptable risks— especially for projects with marginal financial returns. Those actions that defeat one form of investment may also spur market forces that foster positive, financially viable investment in new and growing sectors of the economy.

Peak Oil Could Affect the Market for the Frontier Project

The Frontier project application, like the more generalized industry estimates offered by the Canadian Association of Petroleum Producers,⁷⁷ assumes a steady, modest increase in demand for Canadian oil sands. These assumptions are driven in part by other optimistic oil production and demand forecasts offered by the EIA and the IEA. These optimistic assessments have raised concerns about governmental and industry associations that appear to be acting more as cheerleaders than as objective observers.⁷⁸

Peak oil demand is more a function of the confluence of geological, economic, technological and political factors than of absolute abundance. Supply and demand factors move market prices, which adjust economically recoverable reserve levels up and down, as reserve calculations are based, in part, on market conditions to determine whether reserves are “economically producible.” As prices and reserves shift, so do perceptions of abundance or scarcity. The Frontier project— as well as other greenfield fossil-fuel projects— must pay careful attention to supply/demand trends. These trends affect peaks and troughs of price and product cycles and influence longer-term structural shifts. The recent CERI

⁷⁴ Oil Change International and IEEFA. [Material Risks: How Public Accountability is Slowing Tar Sands Development](#). October 2014.

⁷⁵ Moody's: https://www.moodys.com/research/documentcontentpage.aspx?docid=PBC_1096768, p. 12.

⁷⁶ Moody's: https://www.moodys.com/research/Moodys-affirms-Dynegy-Incs-B2-CFR-revises-outlook-to-stable--PR_344656

⁷⁷ The Canadian Association of Petroleum Producers (CAPP). [2018 Crude Oil Forecast, Markets and Transportation](#). p. 3.

⁷⁸ For the most thorough review of issues see: Oil Change international and IEEFA. [How the International Energy Agency Guides Energy Decisions towards Fossil Fuel Dependence and Climate Change](#). April 5, 2018; and also National Observer. [Is industry exaggerating the need for new Canadian pipelines?](#) October 21, 2016.

report, for example, points to a peak of demand for automobile fuel⁷⁹ and the impact such a benchmark would have on WCS and the oil market in general. The demand for automobile fuel in the future will be driven in part by standard demographics, but also by the impact of electric vehicles, growth in autonomous driving, electrification of urban transport and continued efforts to improve vehicle fuel efficiency standards throughout the world, which will increasingly be driven not only by air quality issues but also by the increasing urgency to address climate change.

The application for the Frontier project, because it requires a \$20.6 billion investment spread over many years, requires attention to this type of long-term market analysis. The market analysis in the Teck application is only concerned with United States export sales and potential Asian markets; a wider scope would be significantly more useful.

⁷⁹ CERI. *An Economic Assessment of the International Maritime Organization Sulphur Regulations on Markets for Canadian Crude Oil*. July 2018.

Appendix I: Estimated Annual Expenditures for Phase 1 of Frontier Oil Sands Mine Project

Phase 1	Estimated Employment	Estimated Expenditure (in billions)
2019	500	\$0.30
2020	500	\$0.30
2021	900	\$0.55
2022	3,000	\$1.83
2023	5,300	\$3.23
2024	6,300	\$3.84
2025	5,300	\$3.23
2026	2,900	\$1.77
Total		\$15.05

Assumptions:

1. Phase 1 employment distribution 2019-2026 estimated from <https://www.ceaa-acee.gc.ca/050/documents/p65505/101951E.pdf>, p. 16-9, Figure 16.3-1 On-site construction Workforce.
2. Estimated Expenditure– Total expenditure derived from Expenditures in Alberta <https://www.ceaa-acee.gc.ca/050/documents/p65505/121936E.pdf>, p. 87. Phase 1 expenditures \$11.552 billion. Phase 2 expenditures \$4.254 billion. Using \$20.6 billion as total for phases 1 and 2, Phase 1 total expenditures (Alberta plus other) estimated at \$15.05 billion.

Appendix II: Oil Change International Frontier Project

Teck Frontier: Poster Child of Tar Sands

Folly⁸⁰

Lorne Stockman, April 20, 2015

Amidst the crumbling edifice of the tar sands sector – brought about by the combination of falling oil prices and strengthening opposition to pipelines that would open new markets to the world's dirtiest oil – is a proposed tar sands mine that defines a bad investment: the [Teck Frontier](#) project.

For many of us, [the wanton destruction](#) of open cast mining for oil that we can't afford to burn within a sane carbon budget is a bad idea to begin with. Not to mention that the area Canadian mining company Teck proposes to mine with its Frontier project lies north of the Firebag River, territory of the Athabasca Chipewyan First Nation, which they [have declared off limits](#) to tar sands development.

So, there are very clear environmental and social justice reasons to not go ahead with a project that would potentially extract billions of barrels of high carbon bitumen and could ultimately destroy 30,000 hectares of boreal forest and muskeg – land that First Nations have built their lives and livelihoods around for centuries.

But there's money to be made, right?

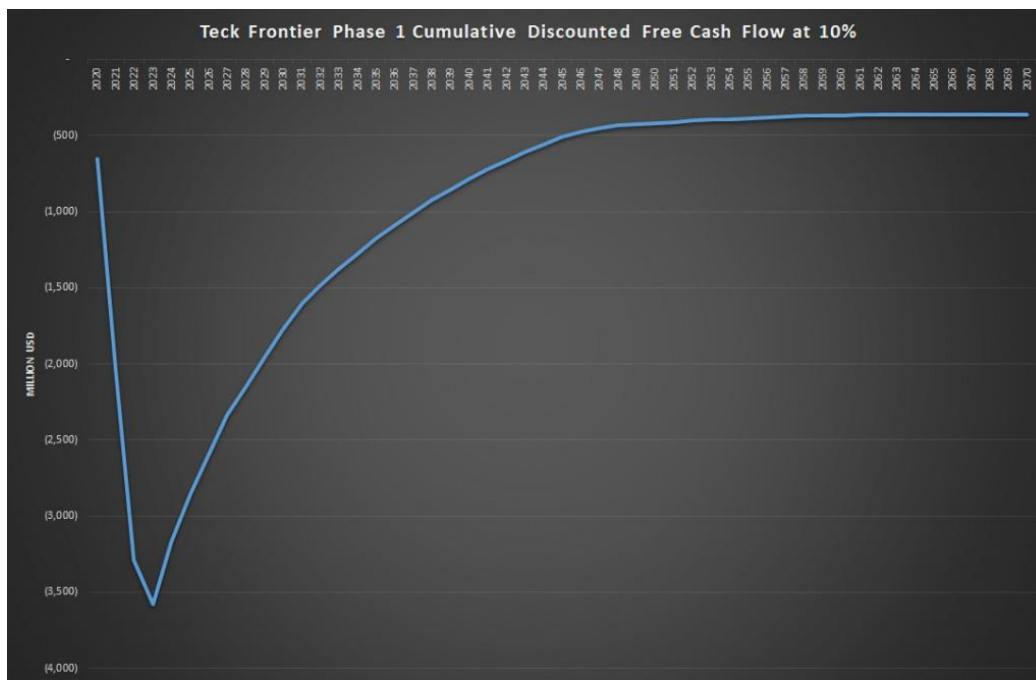
Actually, when it comes to the Teck Frontier mine, no.

There may be billions of dollars to be spent constructing and operating this giant boondoggle and for sure engineers, construction companies, steelmakers, cement pourers and all the various service companies, equipment providers and technical consultants would make some money. But will Teck make a profit on this huge investment of capital?

According to data from [Rystad Energy's UCube](#) database of global oil and gas projects, the Teck Frontier mine is a noncommercial project that would require oil prices to remain above \$140 per barrel in today's money.

We downloaded the data and modeled the project's initial first phase to illustrate the project's cash flow shown in the chart below. This illustrates how the project will destroy value to the tune of hundreds of millions of dollars a year at Rystad's current oil price forecast.

⁸⁰ <http://priceofoil.org/2015/04/20/teck-frontier-poster-child-tar-sands-folly/>



The project exemplifies a sector that is mired in [high costs](#) and poor returns due to a number of factors. Tar sands mines require a lot of capital to build infrastructure to extract and process the bitumen in a remote corner of Alberta. The market for everything from labor to cement is inflated due to the remote location. The high environmental impact of extracting energy from the tar sands has also placed an [additional burden](#) onto the sector in the form of increasing opposition to pipelines that would carry the product to market and thereby enable further extraction. Whether these proposed pipelines aim west or east through Canada, or south to the Gulf Coast via the seemingly doomed Keystone XL pipeline, this much needed new market access is being delayed or denied across the continent.

This is raising the risk of building new projects and leading to project delays and cancellations. On top of the decline in oil price outlook brought about rising tight oil production and a [strategy to retain market share over price](#), the outlook for capital intensive tar sands projects is getting grimmer by the day.

This can only be good news for the climate as the more carbon we can keep in the ground the better chance we have of [meeting the imperative climate goal](#) of containing average global warming to below 2 degrees Celsius.

The Teck Frontier project first filed for regulatory approval in late 2011 and the process is expected to move to a public hearing in the latter half of this year. Meanwhile, Teck has been drilling exploratory wells on the lease in order to assess the quality of the resource. Teck has given no indication that it is concerned about the poor economics of the project and appears to be persevering with the regulatory process.

There may be several reasons for this persistence. The regulatory process is a relatively minor cost and there is likely little to lose by staying the course with it, not least because the Albertan government is yet to deny a single tar sands project permit. A project with poor economics is just that little bit more viable with a permit in hand.

Most likely Teck, which has no first-hand experience of operating a tar sands mine, is gambling that in the five to ten years between now and the project potentially breaking ground some combination of higher oil prices and innovations to reduce construction and operating costs might occur.

No one can predict the future but from today's standpoint, there would have to be some really substantial changes for this project's economics to turn positive.

The poor prospects for Teck's tar sands endeavours is the subject of a [report published today](#) by the Institute for Energy Economics and Financial Analysis. It is published just ahead of the company's Annual General Meeting in Vancouver, BC tomorrow.

Teck's shareholders would do well to take heed of the report's findings and realize, as many of us already do, that another giant tar sands mine makes no sense.

Appendix III: Credentials of Tom Sanzillo

THOMAS SANZILLO

Curriculum Vitae

CAREER HIGHLIGHTS

- Co-founder of not-for-profit organization designed to provide economic and financial analysis in support of renewable energy and energy efficiency and to curtail the use of fossil fuels in energy sector. Organization has grown to a global operation with worldwide reporting and training capabilities on energy and finance.
- Established business platform with special consultancies for business, labor and nonprofits in energy, public finance and public policy arena. Within five years established 10 state client base and revenues in excess of \$2 million.
- Supervised investment team that increased state pension fund from \$97 billion to \$150 billion over four years.
- Architect of multi-pronged reform campaigns to improve integrity and efficiency in government.
- Managed financial oversight for State of New York assets of approximately \$650 billion annually. All external audits of assets under my watch disclosed no adverse material findings.
- Assumed responsibilities of the New York State Comptroller in late 2006 after the elected State Comptroller resigned. Reappointed First Deputy Comptroller in February 2007 by new Comptroller.

AREAS OF EXPERTISE

Public Budgets and Finance	Govt. Business Operations	Energy Finance Project Analysis
Pension Investment Strategy	Market Analysis – coal, energy, other	Corporate/Labor/Govt. Alliances
Corporate Governance	Fiscal Analysis of Energy Facilities	Professional Team Building

INSTITUTE FOR ENERGY ECONOMICS AND FINANCIAL ANALYSIS (IEEFA)

Director of Finance

May 2013-Present

- Design, research and write economic and financial studies for clients involved with alternatives to fossil fuels. Studies cover coal plant, oil and gas drilling/mining, construction and finance, institutional investment and fossil fuels, competitive energy markets, fossil fuel subsidization, employment and taxation, corporate and public finance of coal, oil and natural gas.
- Cofounder of non-profit, first year budget over \$2 million, extended service package overseas and established operations in ten countries.

TR ROSE ASSOCIATES

President

September 2007-Present

- Financial and Public Policy Consultations. Created business platform to provide highly specialized consultations on complex policy, fiduciary and fiscal topics for corporate, labor and not for profit clients.

- Developed special consultancies on energy, coal, energy efficiency and energy related financial services. Served as expert witness and financial advisor in ten states and at national level on coal and alternative energy campaigns.
- Member, Advisory Committee, Long Island Power Authority, Long Range Planning Committee (2007-10).

OFFICE OF THE NEW YORK STATE COMPTROLLER

State of New York's publicly elected chief financial officer & sole fiduciary of pension fund

Acting New York State Comptroller

December 2006-February 2007

First Deputy Comptroller

January 2003-September 2007

- Directed investment team. Increased state pension fund from \$97 billion to \$150 billion. Exceeded investment target every year. Cited by Standard and Poor's as one of the best managed funds in the nation. Comptroller's representative to labor/business and others. Passed law \$15 billion in new authority for global, higher yield, lower risk investments.
- Architect of multi-pronged reform effort to improve integrity and efficiency at public authorities, state agencies, local governments and school districts; streamline contracts process and improve public debt programs. Over 400 newspaper editorials in support. Approximately half of over 100 specific reforms enacted into law.
- Assembled acclaimed group of financial experts to operate the backbone of the State's finances:
 - \$150 billion pension investment fund – 300 global relations
 - \$100 billion receipts, \$130 billion expenditures – accounting system
 - \$6 billion in annual disbursements to 1-million-member retirement system
 - \$12 billion annual daily cash balance - 60 banking relationships
 - \$16 billion annual, biweekly payroll for 250,000 employees
 - 19 million annual expenditure transactions worth \$85 billion to vendors
 - 40,000 contracts reviewed worth \$85 billion annually
 - Oversight of \$150 billion in public debt
 - Oversight of 1600 units of local government/school districts with aggregate annual budgets \$100 billion
 - Monitoring and oversight of \$120 billion state budget
 - Fiduciary oversight of \$10 billion more in miscellaneous state funds
- Managed audit plans of the state of New York including 400 annual audits of state and local governments; an internal control program within OSC; the annual review of the state's retirement system and separate five-year audit of the \$150 billion investment program, as well as the annual audit of all state government and authorities.
- Supported and coordinated with OSC Executive Deputy on the management of 2400 employee operation with a \$400 million annual budget in 17 locations. Participated in all critical policies regarding human resources, OSC budget, information technology, agency real estate and management arrangements, agency revenue initiatives and management of miscellaneous funds. In each year agency expenditures were below budget.
- Assumed responsibilities of the State Comptroller in late 2006 after the elected State Comptroller resigned. Drove effort to ensure prospective candidates for State Comptroller, State Legislative leaders, the Governor and other stakeholders received fair and balanced information during an unprecedented and contentious

appointment process for the new Comptroller. Reappointed First Deputy Comptroller in February 2007 by new Comptroller.

Deputy Comptroller for Budget and Policy

September 2001-December 2002

Director of Policy

August 1995-August 2001

Assist. Director Expenditures/New York City

January 1994-August 1995

- Served under Comptroller H. Carl McCall in increasingly high-ranking positions, including the agency's five-member Executive Committee. Comptroller McCall was elected by voters in 1994 and in 1998 by an overwhelming margin.
- In 1996 joined the Office of Budget and Policy as part of management team. Created the only publicly available, independent monitoring of the state's \$80 billion annual budget with a small highly expert group of 12 professionals. As the Comptroller's "brain trust" the office established policy oversight that resulted in McCall's administration: increasing the state pension fund from \$56 billion to \$127 billion; \$750 million in state audit savings; \$400 million in new business investment programs in New York State, including a long-term effort to create a venture capital industry in upstate, and the design of a multiyear, \$400 million retooling of OSC's information technology systems.

SELECTED PUBLICATIONS, SPEECHES AND TRAINING SESSIONS

- Canada's Folly: Kinder Morgan Trans Mountain Pipeline, with Kathy Hipple, June 2018
- The Financial Case for Fossil Fuel Divestment, with Kathy Hipple and Sightline Institute, July 2018
- Privatization and Puerto Rico's Energy Crisis, with Cathy Kunkel, April 2018
- Red Flags at Exxon Mobil: A Note to Institutional Investors, October 2016
- Material Risks: How Public Accountability is Slowing Tar Sands Development, October 2014
- Making the Case for Norwegian Pension Fund investment in Renewable Energy, with Yulanda Chung and Tim Buckley, February 2017
- The New York State Comptroller, Tom Sanzillo, Oxford Handbook of New York State Government and Politics, editor: Gerald Benjamin, New York: Oxford University Press, 2012
- The Great Giveaway: Abuses in Federal Coal Leasing Program, IEEFA, June 201

PREVIOUS EXPERIENCE

Assistant Comptroller for Policy, NYC Comptroller; Housing Developer, NYS Department of Social Services; Non-profit executive management and tenant organizer, Mount Vernon Community Action Group and Suburban Action Institute; and Consumer Investigator, New York City Department of Consumer Affairs.

EDUCATION

Bachelor of Arts, Politics; University of California, Santa Cruz