McCullough Research

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To: David Bookbinder

From: Robert McCullough

Subject: Supplement to July 3, 2019 report entitled "Natural Gas Supplies for the Proposed Jordan Cove LNG Terminal"

On March 19, 2020, FERC issued an order giving the Jordan Cove Energy Project ("JCEP") permission to proceed on a project unlikely ever to be operated and, currently, is unfinanceable.

The basic issue is economics. JCEP, at current prices, could not afford to buy, transport, process, and ship natural gas to Japan for anywhere near its costs. An updated version of our 2019 analysis indicates that JCEP's costs are U.S.$6.43 per mmbtu.[1] At that cost, the

	Jordan Cove	LNG Canada	Cheniere
Output (MTPA)	7.8	14	31.5
Pipeline ($ billions)	$ 2.46	$ 4.77	
Project ($ billions)	$ 7.30	$ 10.77	$ 30.00
Required Margin for FID ($ billions)	$ 0.98	$ 1.55	$ 3.00
Total ($ billions)	$ 10.74	$ 17.09	$ 33.00
Total Per MTPA ($ billions)	$ 1.38	$ 1.22	$ 1.05
Annualized/MTPA ($ billions)	$ 0.15	$ 0.13	$ 0.11
Annualized/MMBTU ($)	$ 2.96	$ 2.63	$ 2.26
O&M $ billions)	$ 0.04	$ 0.04	$ 0.02
O&M/MMBTU ($)	$ 0.84	$ 0.74	$ 0.32
Break Even ($/mmbtu)	$ 3.80	$ 3.37	$ 2.58
Transportation ($/mmbtu)	$ 0.87	$ 0.87	$ 1.50
Required Margin ($/mmbtu)	$ 4.67	$ 4.24	$ 4.08
AECO ($/mmbtu)	$ 1.75	$ 1.75	$ 1.75
Delivered Cost ($/mmbtu)	$ 6.43	$ 6.00	$ 5.83

[1]. "Break Even" represents the cost required to provide "tolling" a third party's natural gas into LNG. "Required Margin" is the margin above the cost of Alberta natural gas delivered to Japan. "Delivered Cost" is the total cost of LNG landed in Japan.
https://www.mresearch.com/the-questionable-economics-of-jordan-cove-lng-terminal-revised/

project could not turn a profit through to 2023 – the last date JKM prices are quoted on the appropriate Chicago Mercantile Exchange market.[2]

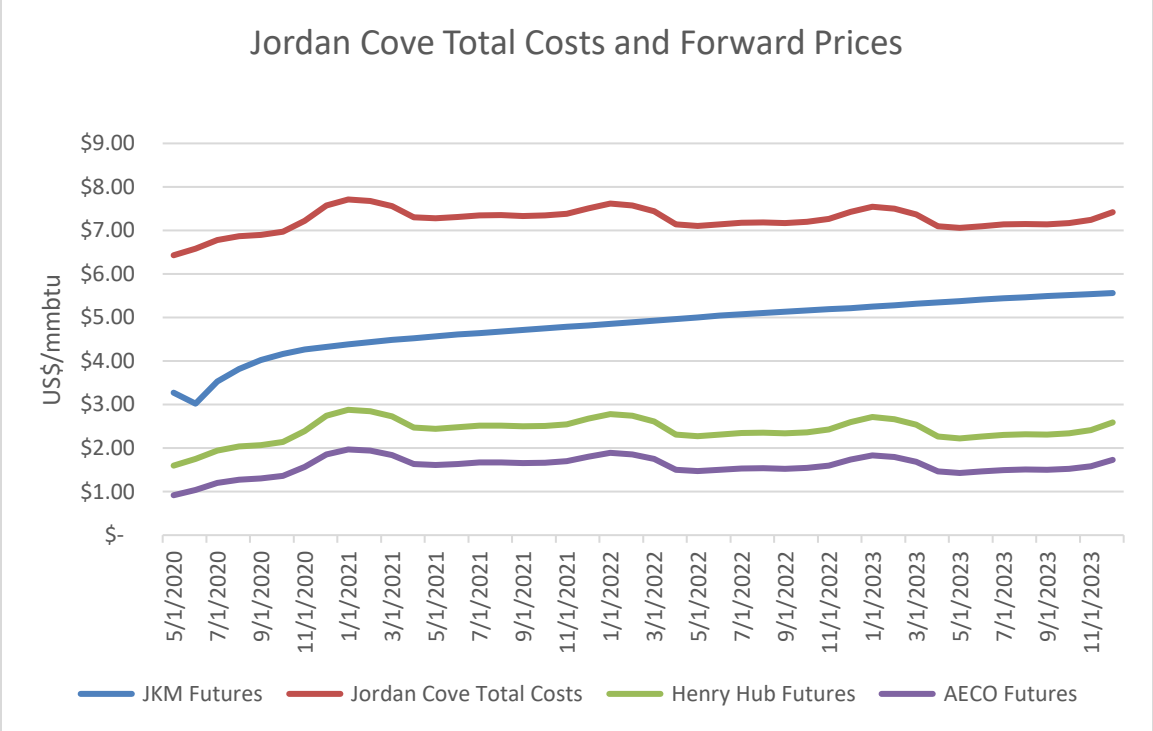

Figure 1 Jordan Cove Costs and Forward Prices

Any due diligence on the project would first review whether the project could afford to purchase natural gas and sell the LNG in Japan or Korea at a profit. For out as far as prices are quoted for the Japanese Korea Marker (JKM), this is not the case. The red line is the cost of Jordan Cove LNG delivered to Japan.

The approval of this project constitutes an unpaid option conferred on a foreign investor, while also imposing real costs on U.S. citizens. This enables Pembina to sell the project to a third party, while does not require them to actually build the pipeline, transport natural gas, or process the natural gas into LNG.

In its approval of the JCEP, FERC stated that:

[2] https://www.cmegroup.com/trading/energy/natural-gas/lng-japan-korea-marker-platts-swap_quotes_settlements_futures.html/

> Here are no proposed LNG export terminal proposals in the same geographic area and temporal scope as the Jordan Cove LNG Terminal, so that preparing a programmatic EIS would not assist in our decision making. Thus, we find a programmatic EIS is neither required nor useful under the circumstances here.[3]

This is a very odd comment. As the FERC commissioners should know, Jordan Cove is just one of more than twenty LNG projects that have been proposed for Oregon and British Columbia. Two of these projects, Jordan Cove and Oregon LNG, were subject to FERC's regulatory review. Another thirty projects have been given export permits by Canada's National Energy Board, although some of the projects have secured more than one permit.[4] At this point, none of the projects appear viable, although two of the Canadian projects have commenced construction.[5]

A central feature of the FERC order was the assumption that there are credible and committed customers for the proposed Pacific Connector pipeline from Malin, Oregon to Coos Bay, Oregon. Unfortunately, the only customers for the pipeline are affiliates of the owner of the project. No other purchasers are likely since contracting for space on the pipeline is required to carry natural gas that the project cannot afford and to process the natural gas in a project that the proponent cannot build. This would be a substantial gamble for a third party. Inter-affiliate transactions are not a gamble for the proponent, since the transaction can simply be cancelled at a later date.

Although the project could not currently pass any form of lender due diligence, I have updated the Monte Carlo study from our June 5 2019 report, cited in our July J, 2019 report.

The Monte Carlo method was invented by Stanislaw Ulam during the Second World War at Los Alamos National Laboratory where models were used to help design the first thermonuclear weapons. One of the challenges Dr. Ulam and his colleagues faced in developing atomic fission was the sheer complexity of the possible reactions. Calculating over all possible interactions was impossible given the limited computers of his era (who generally were staff doing computations on mechanical calculators). The Monte Carlo method relies on large volumes of random samples. Each pick of variables is called a "game" and the results, when averaged, closely approximate what a very extensive analysis might develop. Today, Monte Carlo models are frequently used in economics, finance, engineering, and science.

Our model compares all the possible combinations of feed gas and Asian landed gas prices observed over the past decade, to generate a total of 92,416 games. Even with the unusually high

[3] Order Granting Authorizations Under Sections 3 And 7 Of The Natural Gas Act, March 19, 2020, page 70.
[4] https://www.cer-rec.gc.ca/pplctnflng/mjrpp/lngxprtlcnc/index-eng.html
[5] Woodbine has contractor and financing challenges. LNG Canada's owners have recently reduced their work force by 50%.

post-earthquake prices of 2011-16 included in the study period, this analysis indicates that the probability of Jordan Cove successfully reaching FID is no more than 34%, as shown in Figure 2 below.

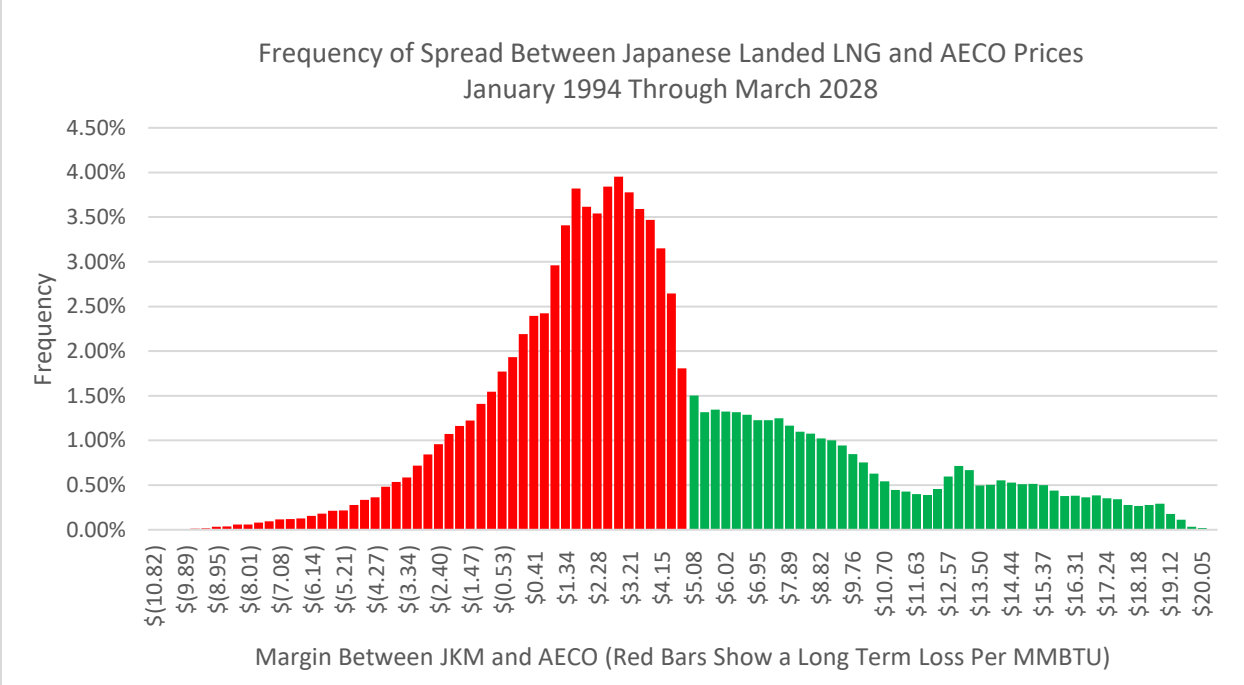

Figure 2: Monte Carlo Results

The Monte Carlo study complements the conclusions raised in Figure 1. Even assuming that the prices for landed LNG in Japan and Korea are incorrect, any prudent investor would investigate how often such a project could be profitable over market conditions since 1994. The answer is daunting – the project would only meet or exceed its costs 30% of the time.

The modeling suggests strongly that more often than not, the spread between these prices is substantially less than what would be required to cover the costs of JCEP, let alone earn any profits.

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