TECHNOLOGIES, MARKETS AND CHALLENGES FOR DEVELOPMENT OF THE CANADIAN OIL SANDS INDUSTRY

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Overview

This paper provides an overview of the current status of development of the Canadian oil sands industry, and considers possible paths of further development. We outline the key technology alternatives, critical resource inputs and environmental challenges and strategic options both at the company and government level. We then develop a model to calculate the supply cost of bitumen and synthetic crude oil using the current key technologies.

In a first section, we describe the current state and the expected development of the industry. More specifically, we focus on the resources and the expected recoverable reserves, and outlines the main extraction technologies currently in use as well as prospective technologies under investigation by the industry. We also give an overview of the current development of the oil sands industry, and detail the major production operations as well as the specific transportation infrastructures and outlet markets of oil sands products.

In a second section, we analyse the near term challenges faced by the industry. We specifically identify access to labor and capital, access to outlet markets, and the current and forecasted natural gas consumption, water use and CO_2 emissions as issues that may bear on the future development of the oil sands resource.

Finally, using the model we evaluate the supply cost of the different oil sands products and the profitability of the currently available technologies, and we assess the sensitivity of the supply costs to the critical model inputs. A copy of the spreadsheet can be downloaded from the MIT CEEPR website where this paper is found (http://web.mit.edu/ceepr/www/workingpapers.htm).

Methods

We construct a discounted cash flow model to compute the supply cost of blended bitumen and SCO, i.e. the levelized price for end products that exactly covers all costs and earns a given return on capital. We model separately:

(i) in-situ production of bitumen using SAGD where the bitumen is blended 2:1 with condensate to yield DilBit,
(ii) an integrated mining and upgrading operation producing SCO,
(iii) a stand-alone upgrader, producing SCO from a DilBit feedstock.

The model can be used to calculate the rate of return earned on each technology given an assumed price for end products, or alternatively can calculate the levelized product price required in order to generate a minimum pre-required return. It is this levelized price that we call the supply cost. We calculate a levelized price for bitumen—actually a netback from the price of the DilBit—and for SCO. In both cases, for reference purposes, we translate this supply cost of bitumen or SCO to an equivalent WTI crude oil price in Cushing Oklahoma using assumed product quality and transportation spreads.

We first calculate the profitability of each technology given our base case assumptions about the crude oil price (WTI Cushing OK) and related product spreads. We then find the supply cost for each technology, using the crude oil price as the parameter to be varied and keeping fixed all of the related product spreads. Using the model we evaluate the sensitivity of the supply costs to the critical model inputs.

Results

SAGD in-situ DilBit production: The base case IRR is 20.2%, and varies between 3% and 40% as the exchange rate and the crude oil price are varied from 0.70 US$/C$ to 1.00 US$/C$ and from US$35 to US$70 per barrel, respectively. The DilBit supply cost is US$22.90 (measured at Hardisty, i.e., comparable to Lloydminster blend at Hardisty), which corresponds to a WTI Cushing price of US$34.50. The corresponding netback for raw bitumen is US$14.13 per barrel. Compared to the other technologies, SAGD production is clearly more sensitive to the price of natural gas, as this is a central cost of the production process.

Integrated mining-upgrading SCO production: The base case internal rate of return for the integrated mining and upgrading technology is 17.3%, and ranges from 7% to 30% as the exchange rate and the price of WTI at Cushing vary from 0.70 US$/$C to 1.00 US$/$C and from US$35 per barrel to US$70 per barrel, respectively. Under the base case assumptions, we find a SCO supply cost of US$27.82 per barrel (measured at Edmonton). This corresponds to a bitumen netback of US$11.29. Because of the capital intensive nature of this production process, the discount rate has a relatively more significant impact on the cost of this process.

Stand-alone upgrading SCO production: The base case internal rate of return for the stand-alone upgrader is 13.9%, and ranges from 7% to 24% when exchange rate and the price of WTI at Cushing vary from 0.7 to 1 and US$35 per barrel to US$70 per barrel. The stand-alone upgrader captures the required 6% rate of return with a spread between SCO and bitumen of $16.76. The supply cost for an integrated SAGD/SCO production, i.e., production of bitumen via SAGD and upgrading to SCO at the stand-alone unit, is estimated at US$30.90, which is higher but close from the integrated mining and upgrading supply cost.

Conclusions

A first set of conclusions stems from the oil sands production cost model. The main take-away is that supply costs of oil sands products are strikingly low compared with recent levels of the price of WTI and heavy hydrocarbon blends with wich SCO and DilBit respectively are competing, but higher than the prices usually reported in the literature, that rarely include full capital costs. Apart from price considerations, we show that access to labor and capital, access to outlet markets, and the current and forecasted natural gas consumption, water use and CO_2 emissions are major challenges to the future development of the industry. We conclude that the question of the viability and sensitivity to economic conditions of the current and forecast oil sands projects is not the most important driver of the further development of the oil sands industry in Canada, but only one aspect of a broader set of complex energy and environmental policy issues that are to be addressed to enable a sustainable path of development for oil sands.

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