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Supplying Synthetic Crude Oil from Canadian Oil Sands: A Comparative Study of the Costs and CO_2 Emissions of Mining and In-situ Recovery

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High crude oil prices and the eventual decline of conventional oil production raise the issue of alternative fuels such as non-conventional oil. The paper describes a simple probabilistic model of the costs of synthetic crude oil produced from Canadian oil sands. Synthetic crude oil is obtained by upgrading bitumen that is first produced through mining or in-situ recovery techniques.

This forward-looking analysis quantifies the effects of learning and production constraints on the costs of supplying synthetic crude oil from Canadian bitumen deposits. The learning, depletion, production, resources and carbon parameters of the model are not known precisely, and uncertainty is introduced by assigning a distribution to each parameter: these uncertainties propagate through the model, resulting in large uncertainties for the future supply costs of synthetic crude. Monte-Carlo simulations are performed to obtain the probability distribution over time of the costs of synthetic crude oil, with and without the social cost of carbon, which is the increase in future damage, discounted to the present day, that occurs if current emissions of CO_2 are increased by one ton.

In 2030, the most influential parameters appear to be the learning parameters in the case of in-situ produced bitumen and the depletion parameters in the case of mined bitumen. This is partly explained by the fact that the volume of bitumen resources recoverable through mining are much smaller than recoverable resources using in-situ techniques. Carbon costs have a large impact of the total costs of synthetic crude oil, in particular in the case of synthetic crude oil from in-situ bitumen, due to the carbon-intensity of

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the recovery techniques: taking into account the social cost of carbon adds more than half to the cost of producing synthetic crude oil from mined bitumen in 2050 (mean value), while the cost of producing synthetic crude oil from in-situ bitumen is multiplied by three.

The results show that the social cost of carbon has a significant impact on the marginal cost of synthetic crude oil from Canadian oil sands. This effect could have a large effect on the price of oil when synthetic crude oil becomes the marginal source of crude oil supply. The potential impact of additional liquid fuel production, including synthetic crude oil and first generation biofuels, on the world oil market and world oil prices will be assessed in future research.

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