Might Canadian Oil Sands Promote Hydrogen Production for Transportation? Greenhouse Gas Emission Implications of Oil Sands Recovery and Upgrading

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In ***World Resource Review***, Volume 17, No.2: 220-242 (2005)

Abstract

As world oil demand increases and OECD production has stagnated, oil price has moved above U.S. $50 a barrel. While worldwide conventional oil reserves continue to deplete, there are large amounts of "unconventional" oil reserves worldwide for recovery and upgrading. Among unconventional oil types, Canadian oil sands, primarily in Western Canadian Alberta province, have experienced large increases in production in recent years. This trend is predicted to continue to reach about 5 million barrels a day oil production by 2030. Recovery and upgrading of oil sands requires a large amount of steam and hydrogen, whose production demands a large amount of energy and generates a large amount of greenhouse gas emissions. In fact, the majority of natural gas available in Western Canada would be consumed by oil sands operations, if natural gas will continue to be the fuel for the operations and if the scale of oil sands operations will increase as predicted. Also, the amount of greenhouse gas emissions generated from the operations could challenge Canada's fulfillment of its Kyoto commitment of reducing Canada's total greenhouse gas emissions.

In this paper, we analyzed energy use and greenhouse emissions of Canadian oil sands recovery and upgrading with the current practice (where steam and hydrogen are produced with natural gas) and with alternative practices of providing steam and hydrogen. Although we found that the current practices requires a large amount of natural gas and generates a large amount of greenhouse gases, alternatives such as using nuclear power to provide steam and hydrogen can help reduce natural gas requirements and reduce greenhouse gas emissions. In contrast, if coal is used to generate steam and hydrogen, greenhouse gas emissions could be increased further from the current practice. We realize that nuclear-based options are long-term options. However, there is also an anticipated long-term demand for hydrogen for fuel-cell vehicle applications. While fuel-cell vehicles are still in the research and development stage, the immediate demand for hydrogen by oil sands operations could help jump start low-carbon hydrogen production technologies such as nuclear-based options. Low-emissions hydrogen production operations for oil sands operations could thereby offer a test bed for low-emission hydrogen production options for fuel-cell vehicle applications.