

# **Hybrid Life Cycle Assessment of Alberta's Oil Sands Industry**

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The continuous development of life cycle models that handle technological changes and emerging markets in the economy are necessary for effective decision-making. Analysing the environmental impacts associated with current and new technologies call for hybrid LCA methods in order to capture all economy-wide effects. Hybrid LCA models combine process-based LCA techniques with Economic Input-Output Life Cycle Assessment (EIO-LCA) and thus solve the problem of limited boundary definitions.

A Canadian EIO-LCA model developed at the University of Toronto is applied in a hybrid structure to quantify and analyse the resource use and environmental discharges of low sulphur gasoline and diesel production from Albertan oil sands. The process-based life cycle inventory (LCI) captures the details of oil sands processes while the EIO-LCA completes the analysis by including intersectoral resource flows not captured in the process-based model. The full life cycle of current oil sands projects is examined in terms of energy efficiency and GHG emissions.

Results from the hybrid models are validated against two existing process-based LCI models of oil sands pathways: the GHGenius model developed by Natural Resources Canada and the GREET model developed by Argonne National Laboratory.