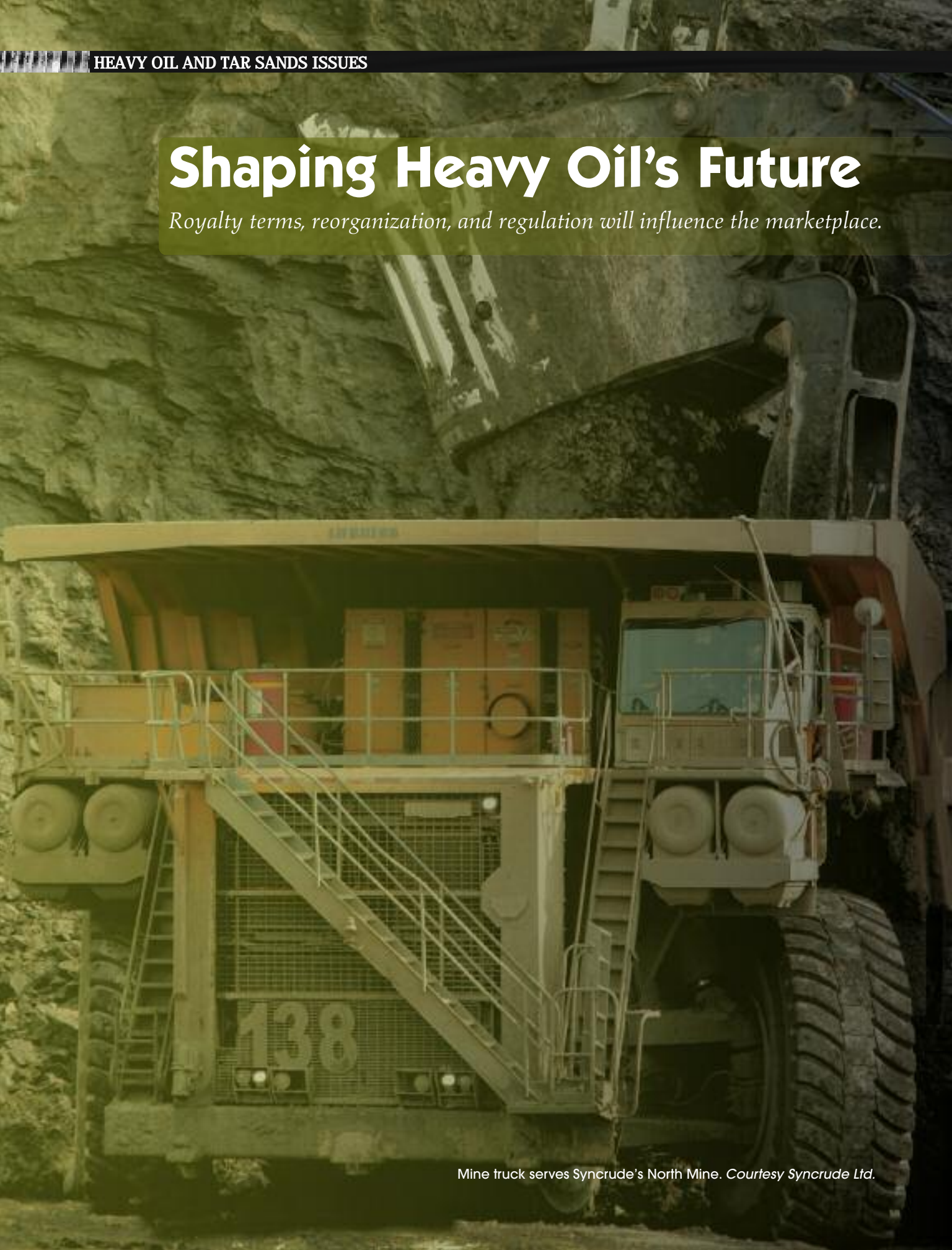


Shaping Heavy Oil's Future

Royalty terms, reorganization, and regulation will influence the marketplace.



The two countries with the largest heavy oil resources – Venezuela and Canada – are in the process of adapting to new economic realities.

In Venezuela, reorganization of the government's relationship with private operators in the Orinoco heavy oil region, along with new recovery objectives, will alter the direction of development. In Canada, a new royalty regime in Alberta will affect oil sands project economics in the shorter term.

Canada is also accelerating the development of technology and policy to confront the growing concern that carbon dioxide (CO₂) poses a significant climate risk. Carbon capture and storage (CCS) is likely to become an integral part of many heavy oil development projects.

HIGHER ROYALTY IN CANADA

The cost of doing business in Alberta's oil sands will go up next year as the province's New Royalty Framework takes effect. A report by the government late last year estimates royalties will increase by US \$1.4 billion (C \$1.4 billion) in 2010, an increase of 20% over revenues forecast under the current regime.

Most changes are scheduled to take effect in January 2009, though some operators have reached agreements with the government that would modify the provisions of the new regime during the transition to the new rates.

The proposed royalty scheme is a significant change and will result in higher costs, said Pius Rolheiser, spokesman for Imperial Oil Ltd. As an owner of the Syncrude Canada project, Imperial was involved in discussions with the Alberta government in early 2008 to create a transition agreement for the project. In 1997, Syncrude owners entered a royalty agreement that was due to run until the end of 2015.

"Syncrude's goal is to come to an agreement that will meet the needs of all parties and still preserve the intent of the existing agreement," Rolheiser said.

Here are highlights of the new framework, according to Alberta government information:

- Conventional oil royalties will be simplified, eliminating specialty programs and old and new tiers. Royalties will be set by a single sliding-rate formula containing separate elements that account for oil price and well production. New rates will range up to 50%, compared with the current maximums of 30% and 35% for old and new tiers, and rate caps will be raised to US \$120/bbl (C \$120/bbl).
- Natural gas royalties will also be set by a single sliding rate formula sensitive to price and production volume. Rates, currently 5% to 35%, will range from 5% to 50%

with caps at US \$16.59 (C \$16.59) per gigajoule.

- Currently, the base, or start-up, royalty rate for oil sands is 1%. Under the new system, the base rate will start at 1% and increase for each dollar that oil is priced above \$55/bbl, to a maximum of 9% when oil is priced at \$120/bbl or higher. The net royalty of 25%, applied post-payout, will start at 25% and increase for every dollar that oil is priced above \$55/bbl to 40% when oil is priced at \$120 or higher.
- The government will not grandfather existing oil sands projects.

In early April, the Energy Department announced two additional five-year deep resource programs intended to increase development and generate energy royalty revenues to be implemented with the New Royalty Framework on Jan. 1, 2009.

For individual companies, implementation of the new framework will take slightly different routes. In January, Suncor Energy Inc. entered a Royalty Amending Agreement with the provincial government that modifies the rates that would otherwise apply under the proposed framework.

"How the royalty change affects individual companies will be determined by their own circumstances," said Alan Boras, spokesman for EnCana Corp. "The new royalty regime did curtail some of our future investment in our longer-term projects."

For example, more evaluation drilling had been planned for EnCana's Borealis development. "Some of that has been curtailed," Boras said. Borealis is more remote and less well established, and it faces larger upfront capital costs because it is a new project.

"We'll see how the final royalty details work out, but for the most part, we are carrying on with our short-term and medium-term plans, which are concentrated at Foster Creek and Christina Lake," he said. "We'll see how the new royalty regime affects our longer-term plans at Borealis."

NEW RULES, NEW GOAL

In Venezuela, the government has reorganized its petroleum industry and dictated new terms to international operators. New laws created in 2002 were accepted by most foreign oil companies, but some resisted.

During the past year, some key changes have been finalized. In November, Venezuela created PetroCedeño and in January 2008 transferred Sincor's extra-heavy oil development operations in the Orinoco Belt to the new company.

In February, Total S.A., state-owned Petroleos de Venezuela (PDVSA) and the Venezuelan Ministry of Energy and Mines finalized a June 2007 memorandum of understanding that

set forth the transfer of Sincor to PetroCedeño, according to a report by Total.

Under the agreement, Total, which had held a 47% interest in Sincor, will have an approximately 30.3% interest in PetroCedeño, PDVSA will have 60% and Statoil will have approximately 9.7%. Total will be compensated with oil for the transfer of the 16.7% interest to PDVSA, according to Total information.

Sincor includes development of the Zuata extra-heavy oil field in the Orinoco Belt and upgrading of the oil in a dedicated facility at José. Production capacity is around 200,000 b/d of extra-heavy crude, which makes 180,000 b/d of synthetic crude.

A new recovery goal is part of the transformation of Venezuela's petroleum industry. Though recovery to date is only about 8%, the government has set a recovery target of 20% of the estimated 1,300 billion bbl of oil in place.

CARBON CAPTURE AND SEQUESTRATION

The relationship between climate change and atmospheric CO₂ is still not fully understood. But because of their relatively high carbon content and significant process fuel requirements, heavy oil and tar sands development gets special scrutiny by governments, companies, and consumers.

Even if heavy oil maintains today's approximately 2% share of world oil supply, production will increase; if its role grows, production will rise even faster. And so will CO₂ production. Refining crude oil to transportation fuel means removing the carbon, and heavy oil has a higher carbon-to-hydrogen ratio than lighter oil.

"As overall oil demand grows and the share of heavy oil in the world market increases, more carbon dioxide will be produced and enter the atmosphere for every gallon of transportation fuel produced," said Jacob Thomas, director of strategic technology, Halliburton.

This will result in having to deal with regulation governing release of greenhouse gases, including CO₂. In the United States, even as several bills are moving through Congress to address the CO₂ issue, states are already acting and passing laws, according to Thomas. In some cases, the actions have resulted in a need for alternative methods to minimize environmental impact.

"Carbon mitigation will have to go hand-in-hand with increases in heavy oil development. Carbon capture and sequestration is an option that industry, academia, federal, and state agencies are investigating collaboratively," Thomas said.

CCS initiatives in Canada's heavy oil region have been driven by major producers. As Rick George, president and chief executive officer, Suncor, described the challenge at the World

Heavy Oil Congress on March 10, 2008, in Edmonton. "Given the level of public concern about this issue, it's clear our industry's long-term licence to operate depends on a comprehensive effort to better manage greenhouse gases," he said.

Not all of the Canada's heavy oil carbon issue relates to extraction. California could be a strong market for oil sands crude. But George cites a recent executive order requiring that fuels sent into the state contribute to a targeted 10% reduction in the carbon content of all passenger vehicle fuels by 2020.

"California's objective is laudable," he said. "But the reality is that the light sweet crude they are pinning this initiative on is in decline. They'll figure that out at some point...when they do, heavy oil and oil sands producers need to have our own carbon house in order."

The US federal government took a similar position to California's in the Energy Independence and Security Act of 2007. One section states:

No Federal agency shall enter into a contract for procurement of an alternative or synthetic fuel, including a fuel produced from non-conventional petroleum sources, for any mobility-related use, other than for research or testing, unless the contract specifies that the life-cycle greenhouse gas emissions associated with the production and combustion of the fuel supplied under the contract must, on an ongoing basis, be less than or equal to such emissions from the equivalent conventional fuel produced from conventional petroleum sources.

INDUSTRY COOPERATION

Recently organized to address the carbon issue, the Integrated CO₂ Network (ICO2N) includes 15 of Canada's largest industrial companies, representing 95% of oil sands production; and 60% of Alberta's electricity-generation capacity. Together, the companies emit about 100 million tonnes of CO₂ annually. Oil sands facilities in the Fort McMurray area and oil upgrading and refining facilities in the Fort Saskatchewan area are among the significant sources of CO₂ in Alberta.

ICO2N is a proposed system for capture, transport, distribution, and storage of CO₂.

In a report issued late last year, "Carbon Capture & Storage: A Canadian Environmental Superpower Opportunity," the group cited studies that indicate a phased buildup of the CCS system could cut CO₂ emissions by more than 20 million tonne/year over the next decade.

"With the right long-term approach, reductions could grow to more than 100 million tonne/year, roughly 13% of Canada's current emissions," according to the ICO2N report.

ICO2N's economic analysis concluded:

- Large volume reductions of CO₂ are feasible beginning in 2011-2012;
- The economic gap to produce significant capture volumes (the \$70/tonne threshold price on the CO₂ supply curve) must be addressed;
- Government and industry must work together to share risks and rewards of CCS; and
- Policy mechanisms are needed to manage the risks associated with CO₂ oversupply.

CCS will not be inexpensive. Using proprietary reports from members, ICO2N has built an economic model based on available technology options that suggest capture costs represent 70% to 80% of the total CCS cost. For member companies, the cost of capture would be in the billions of dollars.

The ICO2N reports that, during 2012 to 2015, CCS could be deployed at new and existing plants, "particularly steam methane reforming upgrading facilities."

Using CO₂ for enhanced oil recovery (EOR) can help kick start a CCS system, according to the report, but over time, CO₂ supply will far outstrip EOR demand. Even including other possible uses, large amounts of CO₂ "will need to be directed to secure, permanent underground storage," the report said.

ICO2N research indicated that because sources, destinations, and project volumes are usually known, the best approach is to plan a large integrated system, then build it in phases.

A related effort is the Alberta Saline Aquifers project comprised of 19 companies that will identify deep saline aquifers suitable for the permanent storage of CO₂.

WORK IS IN PROGRESS

Companies have not waited for government money or direction to press ahead with CO₂ mitigation measures.

Canada's Weyburn-Midale CO₂ project in Saskatchewan is one of the world's largest in-field carbon storage research projects. The two-phase US \$80 million (C \$80 million) study is evaluating long-term geological storage of CO₂ in mature oil reservoirs.

Sponsors of the project from Canada, the United States, Europe, Japan, and Saudi Arabia met late last year to kick off the project's final phase, expected to be completed in 2010.

EnCana Corp. is very involved in the Weyburn CO₂ EOR project. "Our work there has given us considerable experience," said Boras. "That's how we are pursuing the carbon sequestration issue."

EnCana also is participating in the Alberta Saline Aquifers group and "researching other opportunities," he said.

"Without EOR opportunities, carbon capture and sequestration could be expensive; carbon capture is the biggest part of the cost equation."

At Canadian Natural Resources Ltd.'s (CNRL) Horizon development, advanced technology will reduce greenhouse gas emissions. The company also has a plan to implement a process to sequester CO₂ into tailings, according to company information. At the completion of Phases 2 and 3 of Horizon, CNRL expects the process will eliminate approximately 180,000 tonne of CO₂ annually.

OTHER CANADIAN INITIATIVES

The Canadian government plans to achieve an absolute reduction of 20% in Canada's greenhouse gas emissions by 2020. The Canada-Alberta ecoENERGY Carbon Capture and Storage Task Force estimated that the country can store underground as much as 600 million tonne of CO₂ per year, roughly three-quarters of Canada's current annual emissions of greenhouse gases.

In early April, Canadian Minister of Natural Resources Gary Lunn announced several initiatives aimed at advancing clean energy technology. The Ministry's 2008 budget includes US \$5 million (C \$5 million) for the Institute for Sustainable Energy, Environment and Economy at the University of Calgary. Lunn also called for industry to submit proposals under two new programs:

- A US \$125 million (C \$125 million) fund to advance carbon capture and storage technologies that will reduce greenhouse gas emissions from the oil sands and coal-fired electricity plants; and
- A US \$15 million (C \$15 million) fund to advance the development of technologies that will reduce the environmental impacts of oil sands production, such as tailings ponds.

In late March, Prime Minister Stephen Harper announced that the Canadian government will partner with Saskatchewan to develop one of the world's first and largest commercial-scale carbon capture and storage demonstration projects at the SaskPower Boundary Dam Power Station.

According to the prime minister "...[the] project would reduce Canada's greenhouse gas emissions by 1 million tonne/year while generating up to 100 megawatts of clean power."

The Canadian government will contribute US \$240 million (C \$240 million) to the project; SaskPower will contribute US \$758 million (C \$758 million). •