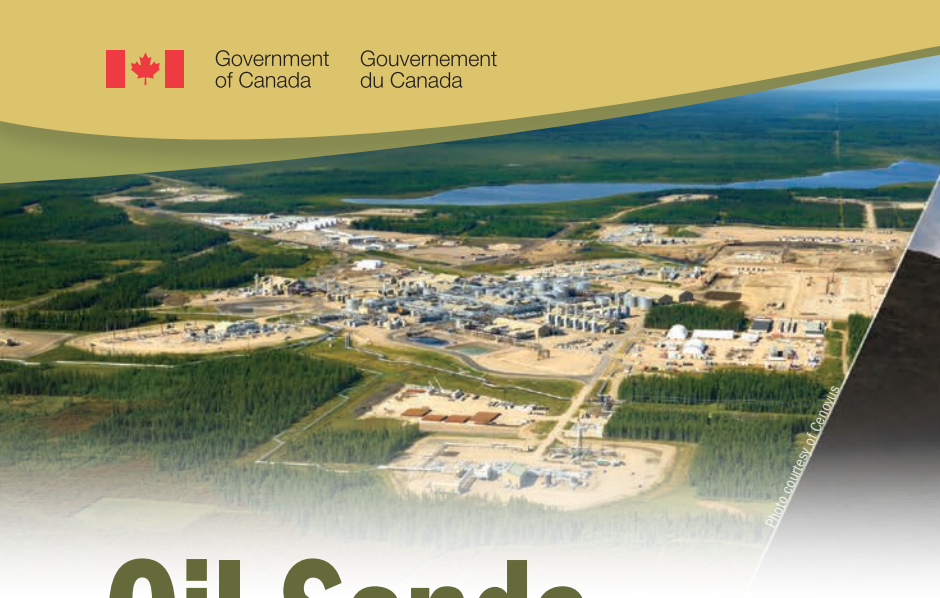


Photo courtesy of Cenovus

Oil Sands

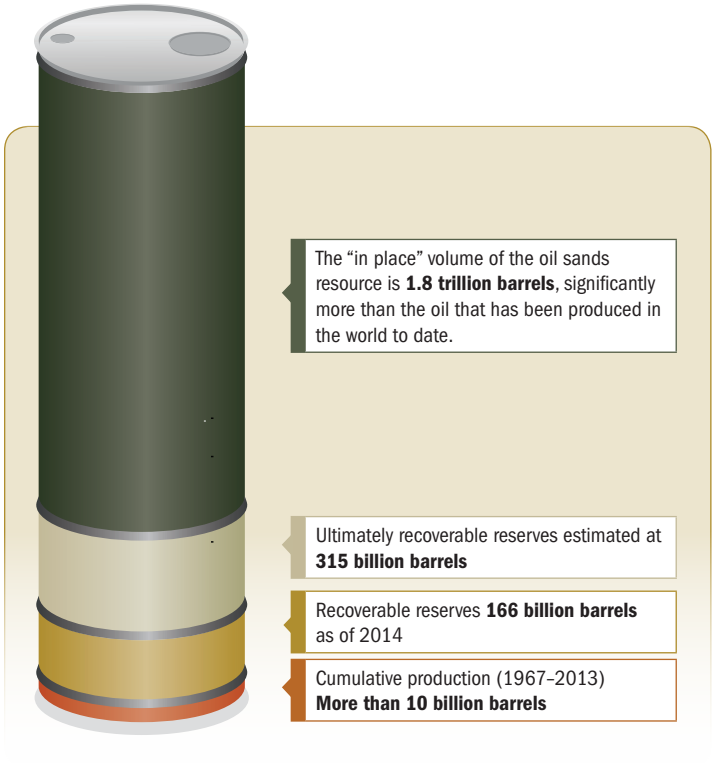
Economic contributions

The oil sands are a strategic resource that contributes to economic opportunity and energy security for Canada, North America and the global market. The oil sands comprise 167.2 billion barrels of crude oil – 97 percent of Canada's 172.5 billion barrels of proven oil reserves – and are a vital part of the Canadian economy. The industry is one of Canada's largest employers, with more than 400,000 people deriving direct, indirect and induced employment from the oil sands and supporting sectors.

In 2014, production from the oil sands was about 2.3 million barrels per day (mb/d). While more than 10 billion barrels of oil sands crude oil have been produced to date, this represents only a small portion of the overall resource. Continued demand for oil is expected to contribute to ongoing growth in oil sands production for years to come. However, the economic importance of the oil sands reaches beyond its role as a crucial source of global supply. Eighty percent of the world's oil reserves are controlled by national governments or state-owned oil companies. Of the 20 percent that remains open to investment, about 50 percent is found in Canada's oil sands.

Oil plays a dominant role in meeting the world's energy needs and will for decades to come. Even with the investments that Canada and other countries are making in renewable energy, energy efficiency and other measures to support a low-carbon economy, the International Energy Agency's 2015 *World Energy Outlook* expects world oil demand to increase from 90.1 mb/d in 2013 to 103.5 mb/d in 2040 and the global economy to continue to rely more on oil than any other fuel.

As more easily accessible and lighter crude oils are depleted around the world, countries are turning increasingly to heavier and less accessible oil resources, which require more processing. As this shift in global production toward heavier crude continues, the carbon intensity of global oil supply will increase.



Source: Alberta Energy Regulator

Canada

Through strict regulatory regimes and new technological developments, Canada is committed to the sustainable development of our resources, including reducing the carbon intensity of oil sands production and processing, and will become an increasingly important supplier of energy to world markets.

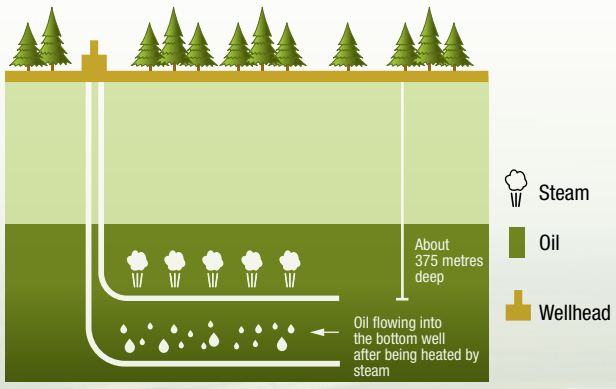
What are the oil sands?

The oil sands are the third-largest proven or established deposit of crude oil in the world, underlying a land mass of 142,000 square kilometres (km²) (54,827 square miles [sq. mi.]). The oil sands are found in western Canada, beneath sections of boreal forest, prairie and muskeg. They consist of crude bitumen suspended in an ore that is a mixture of sand, clay and water.

Bitumen can be extracted using two methods, depending on how deep the deposits are below the surface. About 20 percent of the oil sands resource is within 75 metres (250 feet) of the surface and can be accessed through conventional mining. The ore is dug up and mixed with hot water to separate and recover the bitumen from the sand. The remaining 80 percent of the oil sands resource is too deep to mine, and some form of drilling technology is required to extract the bitumen. Generally, drilled (in-situ) oil sands production involves pumping steam underground to separate the bitumen from the sand and then recovering the bitumen through wells.

Raw bitumen, like other heavy oils, cannot be shipped because it is too thick for pipeline transportation. Bitumen is either diluted with lighter hydrocarbons to allow it to flow through pipelines or upgraded. Upgraders are similar to refineries and specialize in transforming bitumen into lighter crude oil.

In-situ production



Source: Cenovus, adapted by Natural Resources Canada, 2010

Production and investment

Canada's oil sands are developed by the private sector, with major investments from companies based in Canada, the United States, Europe and Asia. As a result, the economic benefits of their development reach across Canada and around the globe. An estimated C$217 billion of capital expenditures have been invested in the oil sands industry to date, including $33 billion in 2013.

Since 1967, when commercial oil sands development began, production has grown as the technology to extract and process the resource has advanced and allowed commercial operations to become more cost-effective. Today, the oil sands and supporting sectors generate economic benefits across the country. Various projections forecast oil sands crude production will rise to over 3 mb/d by 2020.

Governance

The Government of Canada's policy toward the development of the oil sands and other natural resources has its basis in an open market where companies make business decisions within a regulatory framework designed to protect current and future Canadian interests. In Canada, the provinces of Alberta and Saskatchewan have jurisdiction over the development of oil sands within their provincial boundaries. The Government of Canada shares responsibility with the provinces for environmental protection and is committed to ensuring the economic and energy security benefits of the oil sands are balanced by sound environmental stewardship.

Oil sands development is subject to strict environmental standards. Major oil sands projects require substantive environmental assessments before they are approved. Governments also require extensive environmental monitoring and reporting throughout the life of each project.

Addressing the environmental impacts

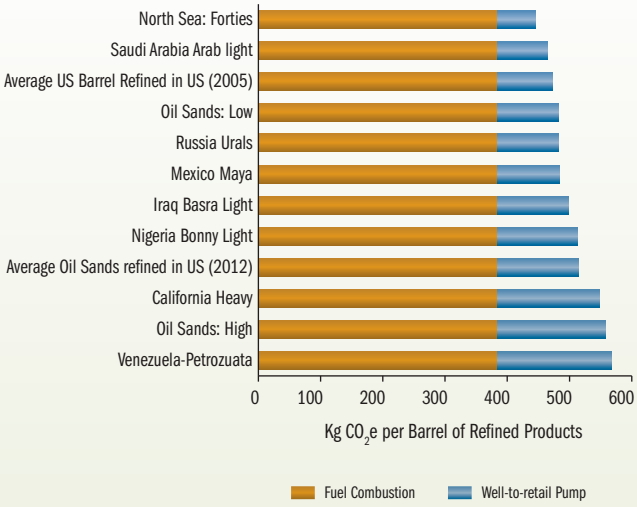
Similar to other existing and emerging energy sources, the development of the oil sands has impacts on air, water and land.

Greenhouse gas (GHG) emissions: The Government of Canada is committed to working with provinces to address Canada's climate change challenge and to reduce GHGs. Oil sands facilities currently account for about 9.3 percent of Canada's GHG emissions or approximately 0.1 percent of global emissions. The oil sands industry has made significant progress in reducing its emissions per barrel of oil produced. GHG emissions per barrel of

oil sands in 2014 were 31 percent below 1990 levels.[1] Oil sands facilities must continue to reduce their GHG emissions as part of Canada's commitment to emissions reductions.

GHG emissions from oil production should be considered in their full effect, taking into account the emissions that are produced when the oil is consumed. Life cycle assessment tracks GHG emissions from the extraction of crude through to production and use of the end product. All sources of oil have relatively similar life cycle GHG intensities due mainly to the fact that transportation fuel derived from any crude oil source has the same emissions at the end-use or combustion stage, which accounts for 70 to 80 percent of total life cycle emissions.

Life cycle GHG emissions for various sources of crude oil

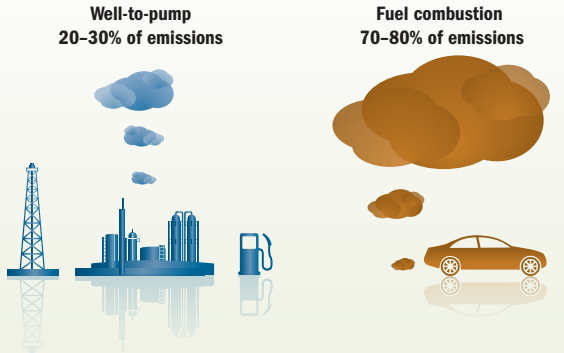


Source: IHS ENERGY, *Comparing GHG Intensity of the Oil Sands and the Average US Crude Oil*, May 2014

Water use and tailings ponds: Water use in oil sands production varies depending on the technology used for extraction. For instance, oil sands mining operations use three to four barrels of new water per barrel of bitumen produced, while oil sands in-situ operations requires an average of 0.4 barrels of fresh water per barrel of bitumen. In-situ projects rely largely on groundwater for their water needs, with an increasing amount being saline or brackish water.

Mining operations take much of their water from the Athabasca River in Alberta. The government manages this water use by setting a limit on the water that can be withdrawn from the river.

Life cycle emissions



Source: IHS ENERGY, *Comparing GHG Intensity of the Oil Sands and the Average US Crude Oil*, May 2014

The Athabasca River Water Management Framework ensures that annual withdrawals by oil sands companies never exceed 3 percent of Athabasca River flow. In practice, annual withdrawals are often less than 1 percent. Regulations also control instantaneous flows, based on the given flow in the river, as river flow changes considerably from season to season. To protect the quality of the river water, no production water is returned to the river. Instead, it is stored in tailings ponds and then recycled to the production process. The Government of Alberta has established performance criteria for the reduction of tailings that result from the oil sands mining process. The in-situ method of accessing oil sands resources does not produce tailings.

Boreal forest: Companies are required by law to remediate and reclaim 100 percent of the land after the oil sands have been extracted, returning it to an equivalent self-sustaining ecosystem. Canada's boreal forest stretches more than 5,000 km (3,100 mi.) from coast to coast and covers about 30 percent of the country's land mass.[2] After almost 50 years of oil sands development, oil sands mining has impacted 895 km² (346 sq. mi.) of land. While oil sands operations are projected to expand, the vast majority of this growth is anticipated to arise from in-situ operations. The land impact of an in-situ project is 10 to 15 percent the size of a similar mining operation.

[1] Environment Canada, *National Inventory Report 1990-2014: Greenhouse Gas Sources and Sinks in Canada* and Natural Resources Canada

[2] The boreal forest, as described here, includes forest and other wooded land in Canada's boreal zone.

Using technology to achieve sustainability

Innovation has been, and will continue to be, critical to reducing the environmental footprint of oil sands development. Industry and governments are making substantial investments to support a range of new technologies. For example, the federal and provincial governments are committed to exploring carbon capture and storage (CCS) to reduce GHG emissions in key sectors of the Canadian economy, including thermal electricity generation and the oil sands. Working collaboratively, the governments of Canada, Alberta, Saskatchewan and British Columbia have committed more than C$1.8 billion to support CCS research, development and demonstration initiatives. With leveraged private sector investments, the total Canadian investment in CCS has the potential to rise to around C$4.5 billion. This includes funding for two oil sands-related, large-scale demonstration projects: the Quest Project and the Alberta Carbon Trunk Line, currently under construction in Alberta.

New technologies are also being developed by government, industry and universities to reduce land impacts, water use and GHG emissions from oil sands development. Technologies that reduce steam requirements for in-situ oil sands are being developed and piloted to reduce water use and improve energy efficiency. These technologies use solvents in conjunction with steam or employ radically new techniques such as heating the bitumen through electricity to move the bitumen toward the wells. Oil sands mining research includes processes to separate the bitumen from the sand more efficiently and to reduce energy and water requirements as well as processes that will reduce the need for, and speed the reclamation of, large tailings ponds.

Advances in upgrader technologies include innovative combustion techniques, such as gasification, which could reduce the industry's reliance on natural gas while enabling the use of other transformative technologies, such as CCS.

The Government of Canada works to ensure that the challenges associated with the development of the oil sands are being addressed through strong regulatory safeguards and through technological innovation.

Aussi disponible en français sous le titre : Sables bitumineux : Apport économique

May 2016