The Oil Sands

October 2025

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Updates From Last Publication on Jul. 25, 2025

- **Slide 10**: Updated to reflect the latest oil sands capital spending estimates
- **Slide 16**: Updated to reflect the latest monthly bitumen production (Jul. 2025)
- **Slide 17**: Updated to reflect the latest monthly in-situ production (Jul. 2025)
- **Slide 20**: Updated to reflect the latest monthly upgraded & non-upgraded bitumen production (Jul. 2025)
- **Slide 21**: Updated to reflect the latest monthly U.S. crude oil import data (Jul. 2025)
- **Slide 22**: Updated to reflect the latest daily WTI-WCS pricing data (Oct. 2025)
- **Slide 25**: Updated to reflect the latest Alberta oil sands project status information (as of May 6, 2025)
- **Slide 26**: Updated to reflect the latest Government of Alberta fiscal data
- **Slide 27**: Updated to reflect the latest Government of Alberta fiscal data

Summary of the Oil Sands

Oil Sands Overview

- Roughly 159 billion barrels (+95%) of Canada's total proved oil reserves are in the oil sands(1), more than every country in the world's total proved oil reserves, except Venezuela, Saudi Arabia, and Iran.
- Oil sands are extracted via surface mining or in-situ with the use of steam (i.e., SAGD, CSS). Combined, these two extraction methods accounted for over 3.5 MMB/d of Canada's total oil production in 2024, close to 60%.

Fiscal Impact of the Oil Sands

- In the fiscal year 2024-25, oil sands royalties of $17 billion were the largest single source of revenue for the Government of Alberta and more than 4× larger than combined conventional oil and natural gas royalties of $3 billion and $1 billion, respectively.
- For context, in the fiscal year 2024-25, oil sands royalty revenue was greater than each of personal and corporate income tax of $16 billion and $8 billion, respectively, corresponding to over 20% of the Government of Alberta's total revenue. Oil sands royalty revenue was equivalent to 67% of the province's $26 billion healthcare operating expense budget in the fiscal year 2024-25.
- Alberta's bitumen royalty revenue is poised to increase in the years ahead as 38 projects transition from pre-payout to post-payout status, meaning they are subject to higher royalty rates. Higher royalty revenue allows for increased spending on public services such as healthcare, education, and social programs.

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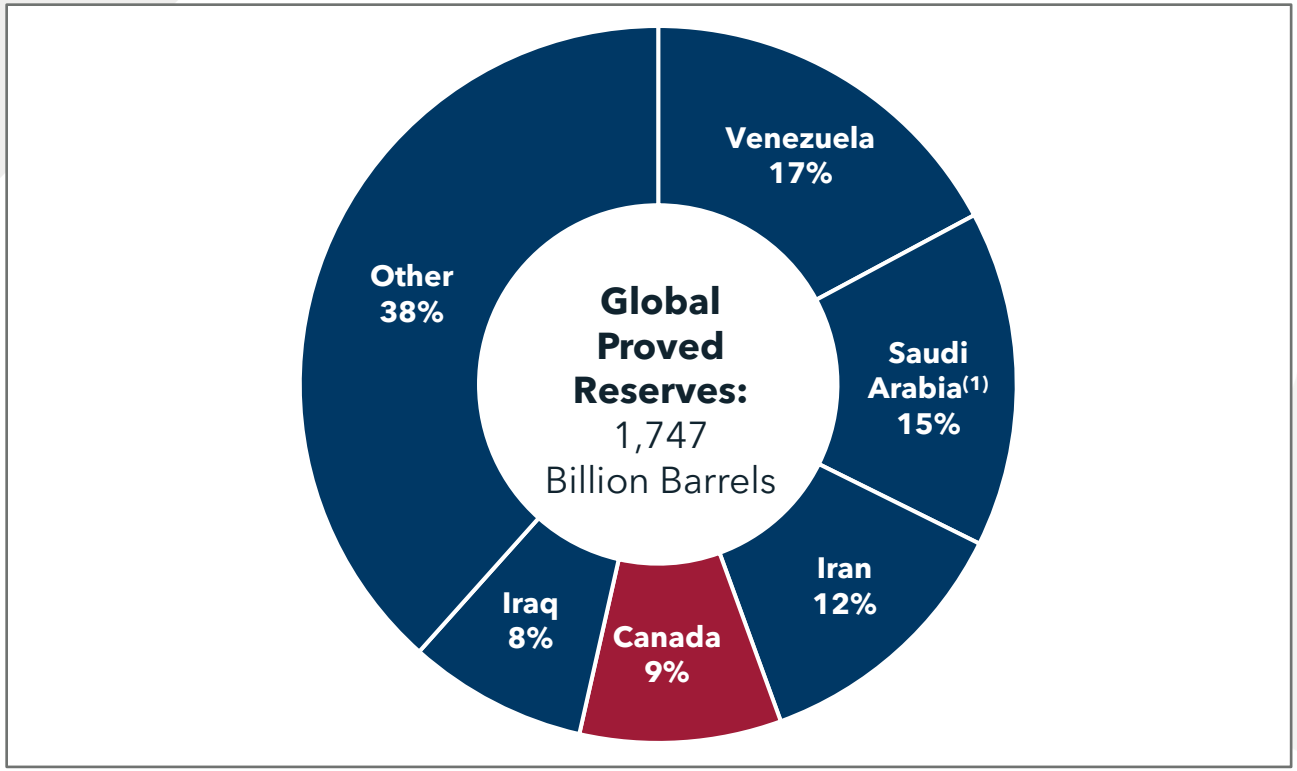
Source: Natural Resources Canada – Energy Fact Book 2024-2025, Alberta Energy Regulator, Canada Energy Regulator, Government of Alberta

(1) Oil sands facts and statistics

Oil Sands Overview

Global Proved Oil Reserves by Country



- Canada has the fourth largest proved oil reserves in the world at approximately 163 billion barrels.
- Roughly 159 billion barrels (+95%) of Canada's total proved oil reserves are in the oil sands.(2)
- Only ~19 billion barrels (or 12%) of Canada's proved oil sands reserves are under active development, which underscores their massive development potential, particularly through a global lens in which oil demand continues to grow and energy security and diversity in suppliers and resource scarcity is of the utmost importance for crude importers.

Source: Natural Resources Canada – Energy Fact Book 2024-2025

(1) Saudi Arabia and Kuwait reserves include the Saudi-Kuwaiti "neutral zone," with total proved reserves of 5 billion barrels.
(2) Oil sands facts and statistics

Timeline of Canadian Oil Sands Development

Indigenous Peoples have known about Alberta's large oil deposits since well before the arrival of Europeans, using the bitumen near the Athabasca River to caulk canoes and for other uses.

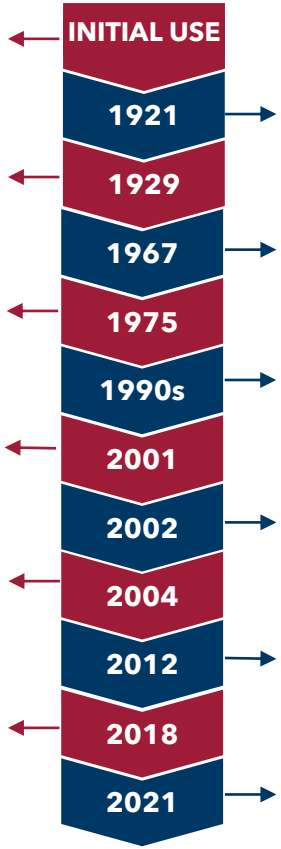
FIRST COMMERCIAL OIL SANDS MINE
The first privately financed oil sands operation at Bitumount, now part of the current Fort Hills lease. During the 1930s, this pioneering facility generated thousands of barrels of asphalt each year, primarily utilized for road surfacing and roofing applications.

PILOT AND COMMERCIALIZATION OF CYCLIC STEAM STIMULATION
Imperial Oil tests a cyclic steam stimulation (CSS) pilot, known as Leming, in the Cold Lake area. In 1985, Imperial would go on to commercialize Leming as the first oil sands in-situ production facility.

COMMERCIALIZATION OF STEAM-ASSISTED GRAVITY DRAINAGE
Foster Creek, currently owned and operated by Cenovus, was the first large-scale commercial SAGD facility, beginning operations in 2001 and marking the first development of its kind in the Athabasca Basin.

ALBERTA BITUMEN PRODUCTION EXCEEDS 1 MMB/D
Total Alberta bitumen production exceeds the 1 MMB/d mark following the expansion of oil sands mining operations and the growing adoption of in-situ extraction techniques like SAGD.

ALBERTA BITUMEN PRODUCTION EXCEEDS 3 MMB/D
Total Alberta bitumen production exceeds the 3 MMB/d mark following the expansion of oil sands mining operations, with the notable start-up of the Horizon, Jackpine, North Steepbank, Fort Hills, and Kearl surface mines.



OIL SANDS RESEARCH
The province of Alberta partnered with Dr. Karl Clark to explore methods for extracting bitumen at the University of Alberta. Clark discovered that by combining oil sands with hot water and caustic soda, bitumen could be effectively separated from the sand through gravity.

GREAT CANADIAN OIL SANDS
The first large-scale oil sands surface mine and upgrader began operation using bucket wheel excavators. The project was initially designed for 15,000 barrels per day but took five years to operate at capacity.

PILOTING OF STEAM-ASSISTED GRAVITY DRAINAGE
The Alberta government launches the Underground Test Facility, providing a dedicated site for advancing and refining steam-assisted gravity drainage (SAGD). Throughout the 1990s, several pilot projects were launched to further evaluate the technology, including operations at Primrose, Foster Creek, Surmont, and the Hangingstone Demonstration facility.

BITUMEN BECOMES THE LARGEST SOURCE OF OIL PRODUCTION
Total bitumen production from the oil sands officially surpasses conventional oil production in Alberta.

CANADA'S OIL SANDS INNOVATION ALLIANCE
Canada's Oil Sands Innovation Alliance (COSIA) is formed to advance technological innovations in environmental priority areas.

PATHWAYS ALLIANCE
Pathways Alliance representing six of Canada's largest oil sands producers is formed. Its members are Canadian Natural, Cenovus, ConocoPhillips Canada, Imperial, MEG Energy and Suncor. The Pathways Alliance is focused on advancing environmental innovation and projects, including carbon capture and storage.

Source: Oil Sands Magazine, Alberta Energy Regulator, Canada Energy Regulator, Pathways Alliance

Mining vs. In-Situ – What's the Difference?

Oil sands consist of a naturally formed blend of sand, clay, various minerals, water, and **bitumen** - a dense, highly viscous form of crude oil. Bitumen is produced via two main techniques: surface mining and in-situ:

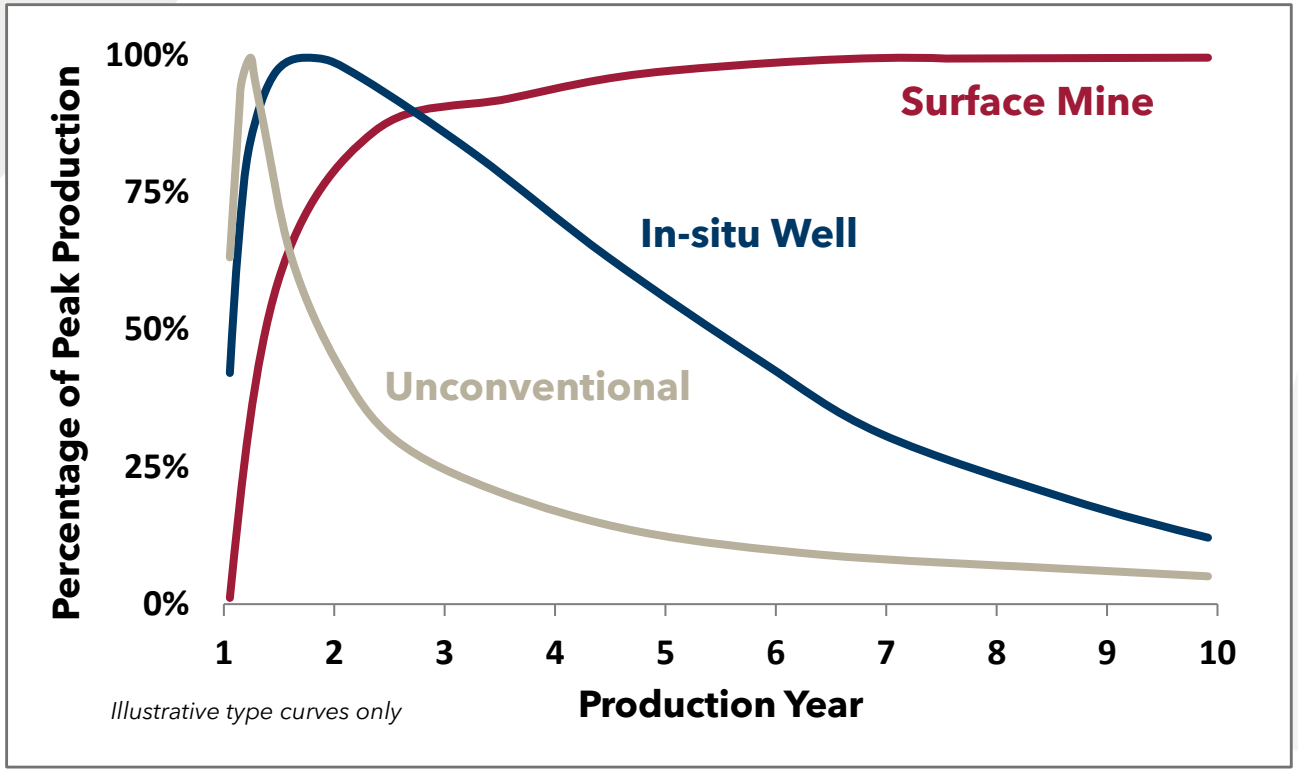
- **Surface Mining** – The bitumen, mixed with sand, clay, and water, is extracted from the surface using traditional mining techniques, and then the bitumen is physically separated from the sand in a processing plant. Mined bitumen is either upgraded into a lighter crude oil, called synthetic crude oil (SCO), or diluted with light liquids (often condensates), called dilbit, so that it can be thinned and transported by pipeline.
- **In-Situ** - For deeper bitumen deposits, typically in excess of 75 meters below the surface, clearing overburden via surface mining becomes too costly, and the bitumen is instead recovered from the subsurface by in-situ methods that rely on injected steam to recover bitumen from underground reservoirs. The most common commercialized method is steam-assisted gravity drainage (SAGD); the other is cyclic steam stimulation (CSS). Non-thermal methods also include 'primary' and 'enhanced' recovery methods. In-situ land disturbance is 10-15% of a similar-sized mining project(1) due to their smaller surface footprint that does not require large-scale excavation and tailings management.

1. **Steam-Assisted Gravity Drainage (SAGD) –** A bitumen extraction technique wherein two horizontal wells are drilled into the reservoir and stacked roughly five meters apart. Steam is injected through the top well to heat the bitumen, allowing it to mobilize from the sand and accumulate with the produced water in the lower well. The bitumen is then pumped from the lower well and brought to the surface, where it is separated from the water. The recovered water is treated and recycled back into the system. SAGD recovers a significant amount of the oil in place, over 80% in some cases.
2. **Cyclic Steam Stimulation (CSS) –** A single well alternates between phases of steam injection, soaking, and bitumen production. Steam is injected at pressures that will increase the sand porosity and enhance reservoir permeability. The reservoir dilates during the steaming cycle, then compacts during the production phase. Each subsequent cycle allows the steam to re-energize and transfer heat to the oil allowing it to drain back to the well. Over its lifespan, a CSS well typically completes 10 to 20 cycles, recovering up to approximately 50% of the oil in place. The steam-to-oil ratio (SOR) averages around 6.0x throughout the well's lifecycle.
3. **Primary Oil Recovery –** Involves pumping the oil out of the ground, similar to conventional oil recovery. No steam is required in this method.
4. **Enhanced Oil Recovery (EOR) –** Improves hydrocarbon recovery by injecting fluids into a reservoir to increase or maintain reservoir pressure, displace hydrocarbons to production wells, or alter reservoir fluids to improve hydrocarbon flow.

Source: Oil Sands Magazine, Alberta Energy Regulator

(1) Government of Canada – Oil Sands Land Use and Reclamation

Oil Sands Assets Are Long Life, Low Decline

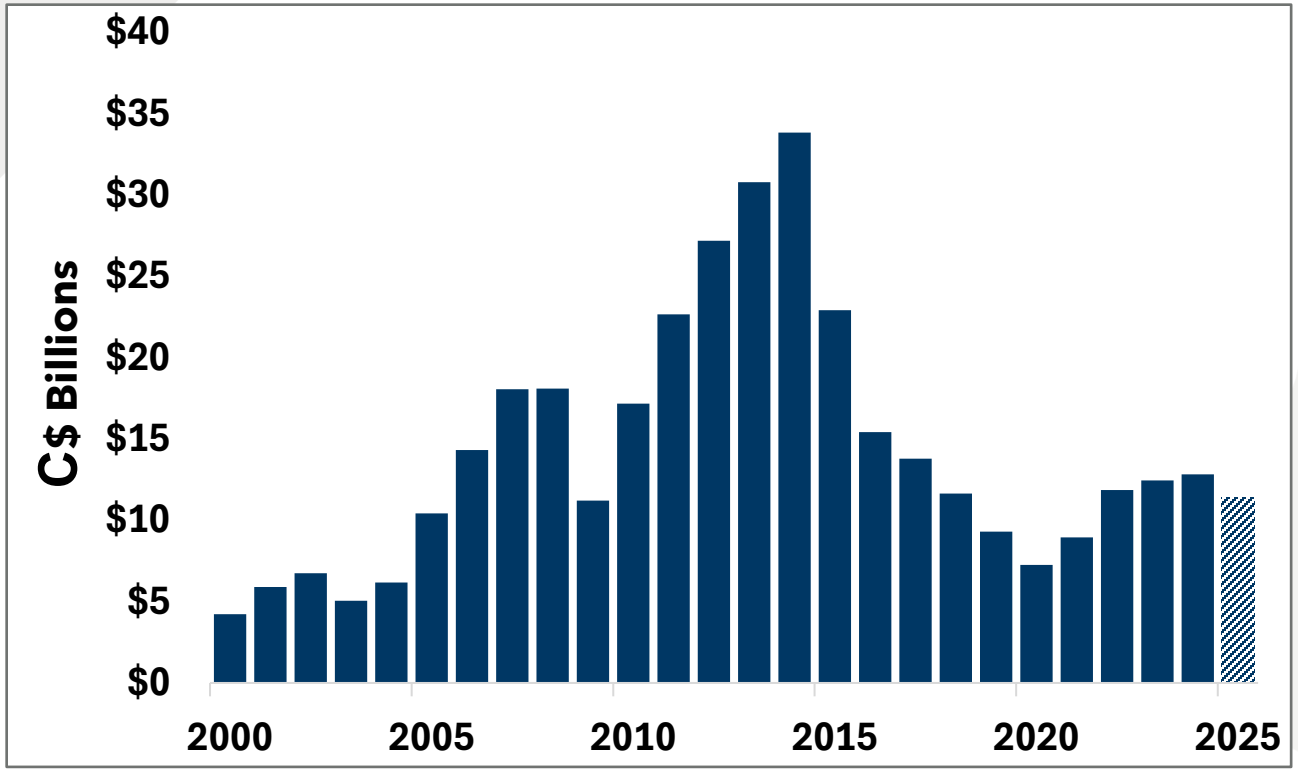


- Compared to other forms of oil extraction (i.e., unconventional), oil sands projects (i.e., in-situ, surface mining) require a larger upfront capital investment.
- A decline rate in oil and gas refers to how quickly production decreases, as a percentage, on a year-over-year basis. While oil sands projects generally have higher upfront capital costs, they are advantaged by having a significantly lower decline rate, meaning they require less ongoing drilling to sustain production.
- **The decline rate in Alberta's oil sands is about 4% annually.**[1] Notably, for mining operations, there is steady production (no decline) until the mine reaches end of life. By comparison, first-year decline rates for some unconventional oil plays in the United States are greater than 40%.[2]

(1) Oil Sands Magazine - Oil Sands Geology and the Properties of Bitumen
(2) Hart Energy – Why US Shale Production Declines Are Higher Than You Might Think

Oil Sands Capital Spending

Annual | 2000 to 2025E



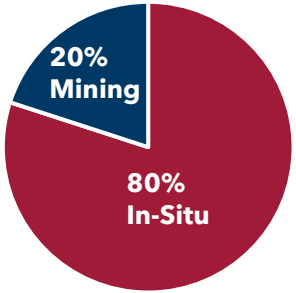
- Investment in the oil sands began to increase in 2004 following technological advancements in extraction methods and rising oil prices. Capital expenditures peaked at ~$34 billion in 2014 and bottomed out at ~$7 billion in 2020 following the COVID price shock.(1)
- The oil price collapse in 2014, inadequate pipeline takeaway capacity out of the Western Canada Sedimentary Basin, and policy uncertainty have all contributed to a decreased investment since the peak.
- Multiple proposed oil sands projects have been shelved in recent years, notably Teck Resource's $20.6 billion Frontier mine.(2)
- Instead of more costly greenfield development projects, oil sands operators have instead focused on brownfield development of existing assets, as well as optimization and debottlenecking opportunities.

Source: Studio.Energy

(1) Alberta Energy Outlook (ST98) – Capital Expenditures
(2) Teck withdraws application for $20B Frontier oilsands mine

Alberta Oil Sands Area

Oil Sands Reserves by Extraction Method:

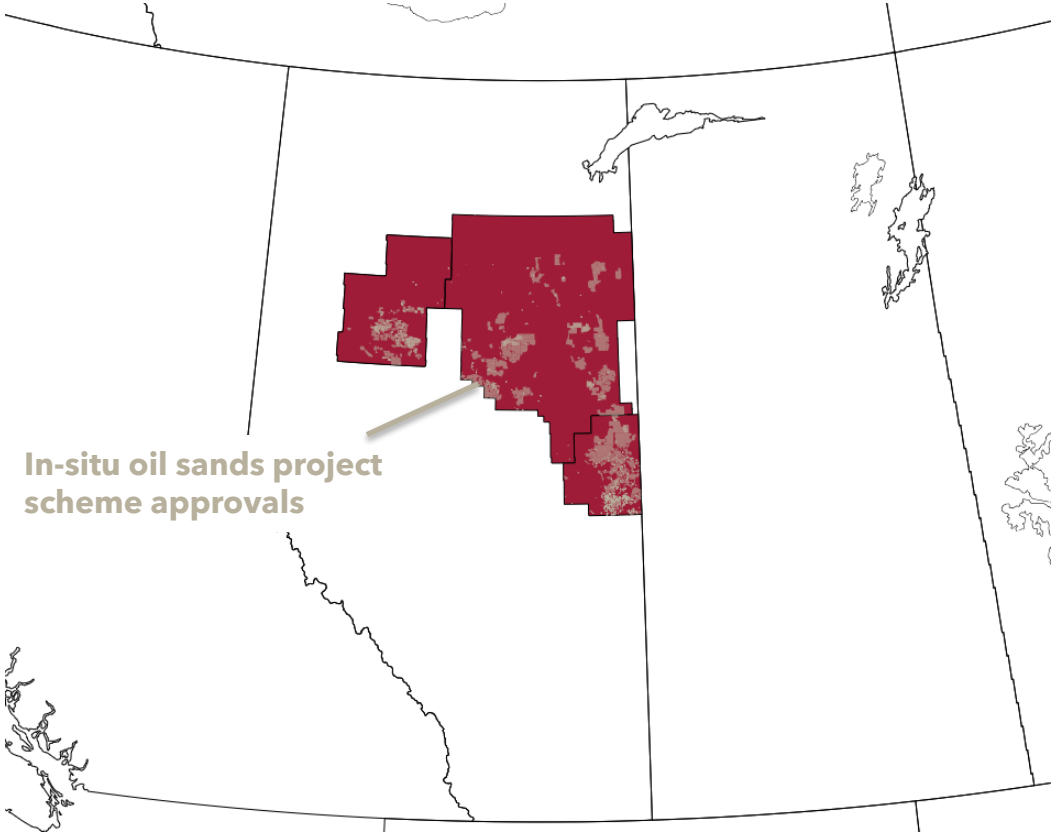


- Alberta's oil sands are comprised of three main deposits: Peace River, Cold Lake, and Athabasca.
- The collective surface area of these three deposits is 142,000 km^2, roughly equivalent in size to the state of New York.(1) The largest area, Athabasca, covers roughly 93,000 km^2, while the Peace River and Cold Lake areas cover nearly 29,000 km^2 and 18,000 km^2, respectively.
- Oil sands are extracted via surface mining or in-situ with the use of steam (i.e., SAGD, CSS, primary recovery, enhanced recovery). Roughly 20% of Alberta's recoverable bitumen reserves are extractable via surface mining, with the remaining 80% requiring in-situ techniques.

Source: Alberta Energy Regulator – Oil Sands Area Assessment, Government of Canada, geoSCOUT

(1) WorldAtlas – New York

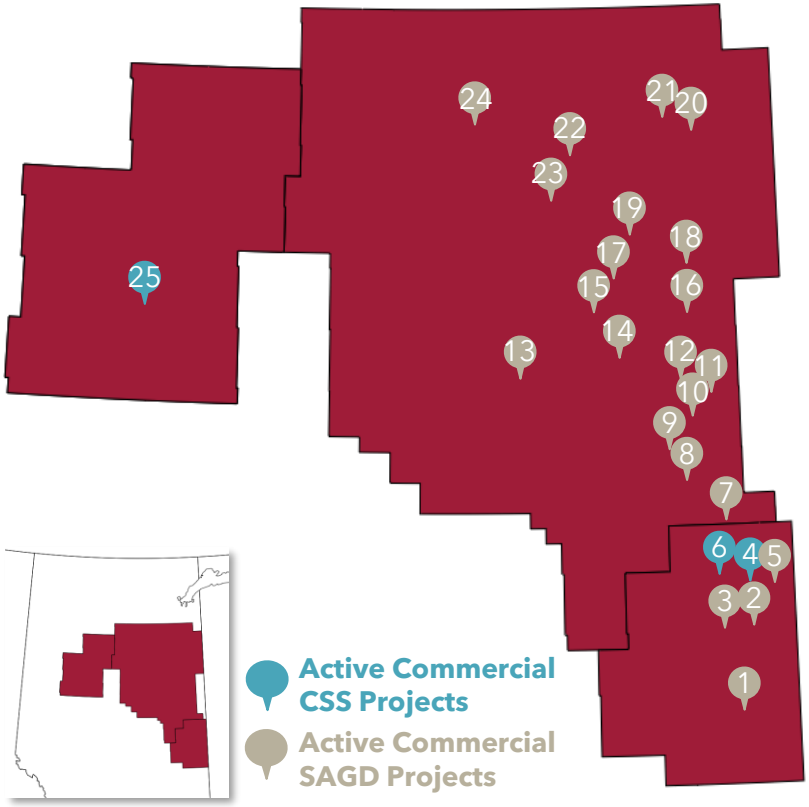
Alberta In-Situ Approved Projects



- For deeper bitumen deposits, typically in excess of 75 meters below the surface, clearing overburden via surface mining becomes too costly, and the bitumen is instead recovered from the subsurface by in-situ methods.
- According to the latest data from the Alberta Energy Regulator, there are currently 22 actively producing commercial SAGD projects and three actively producing commercial CSS projects. There are also several in-situ operations using primary and enhanced oil recovery methods.

Source: Alberta Energy Regulator, Government of Canada, geoSCOUT

Active Commercial SAGD and CSS Projects

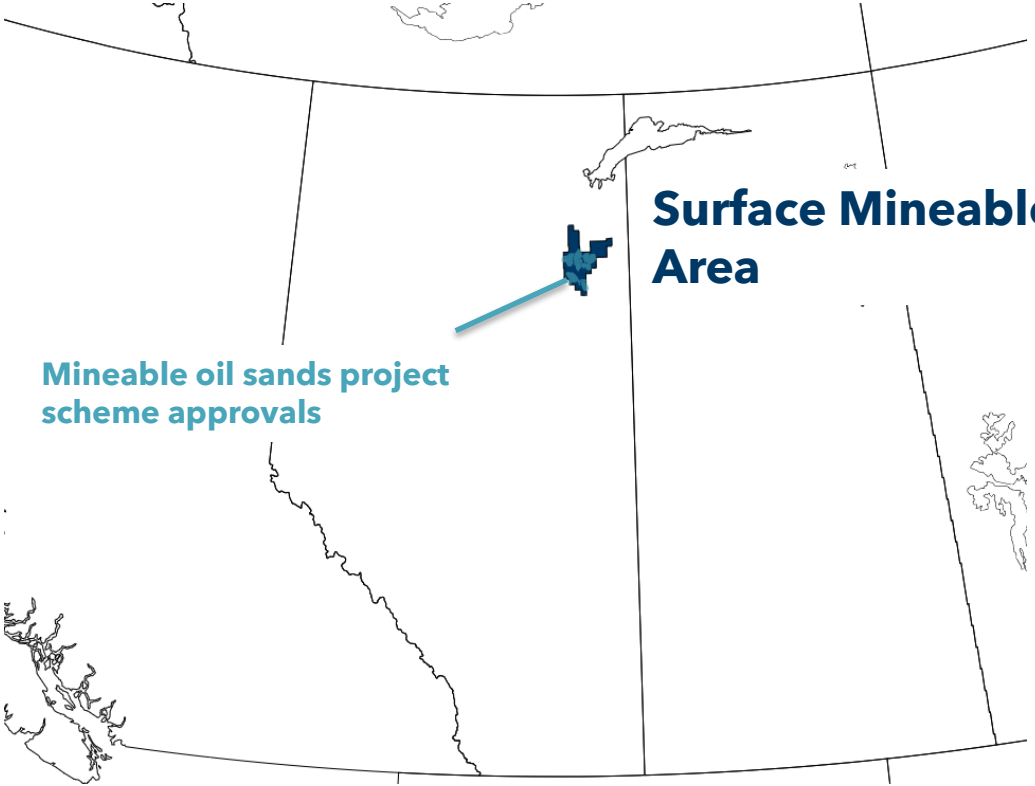


	Operator Name	Scheme Name	Recovery Method	Nameplate Capacity[1] (B/d)
1	Strathcona Resources	Lingbergh	SAGD	18,000
2	Strathcona Resources	Orion	SAGD	18,000
3	Strathcona Resources	Tucker	SAGD	30,000
4	Imperial Oil	Cold Lake	CSS	190,000
5	Imperial Oil	Grand Rapids	SA-SAGD[2]	15,000
6	Canadian Natural Resources	Primrose and Wolf Lake	CSS	140,000
7	Cenovus	Foster Creek	SAGD	180,000
8	Canadian Natural Resources	Kirby	SAGD	80,000
9	Canadian Natural Resources	Jackfish	SAGD	120,000
10	Cenovus	Christina Lake	SAGD	260,000
11	MEG	Christina Lake	SAGD	113,000
12	Harvest Operations	BlackGold	SAGD	10,000
13	International Petroleum Corp	Blackrod [3]	SAGD	31,000
14	Athabasca	Leismer	SAGD	20,000
15	Connacher	Great Divide	SAGD	20,000
16	ConocoPhillips	Surmont	SAGD	136,000
17	Greenfire Resources	Hangingstone	SAGD	28,000
18	CNOOC	Long Lake	SAGD	70,000
19	Athabasca	Hangingstone	SAGD	12,000
20	Suncor	Firebag	SAGD	215,000
21	Cenovus	Sunrise	SAGD	69,000
22	Suncor	MacKay River	SAGD	38,000
23	PetroChina	MacKay River	SAGD	35,000
24	Sunshine Oilsands	West Ells	SAGD	5,000
25	Canadian Natural Resources	Peace River	CSS	12,500

Source: Alberta Energy Regulator, Government of Canada, Oil Sands Magazine, geoSCOUT

(1) Barrels of bitumen per calendar day
(2) SA-SAGD = Solvent-Assisted, Steam-Assisted Gravity Drainage
(3) Under construction

Only ~1% of the Total Oil Sands Area is Being Mined

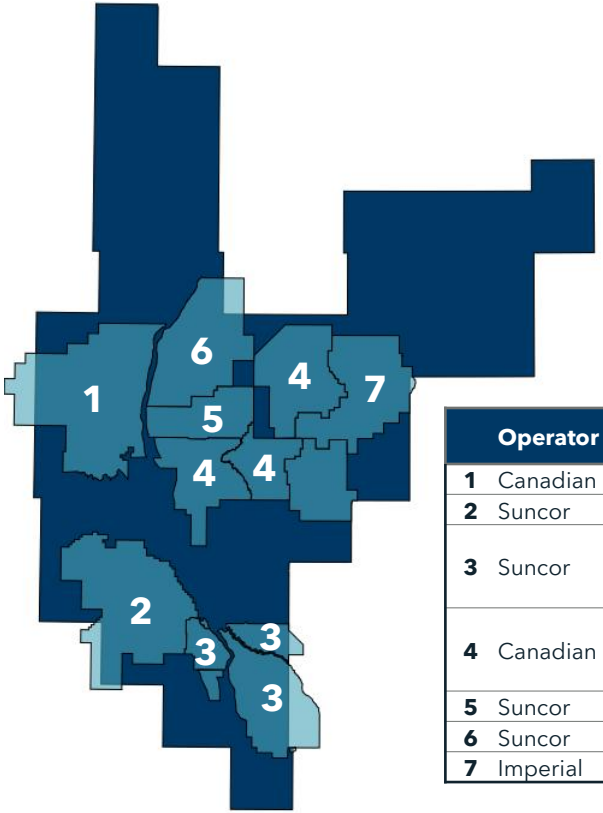


- When oil sands are located at depths of 75 meters or less from the surface, they are typically excavated using surface mining techniques.
- Approximately 1,100 km^2 of the 142,000 km^2 oil sands deposits in Northern Alberta are currently undergoing surface mining activity(1), which equates to roughly 0.8% of the total oil sands surface area.
- **There are currently nine active oil sands mining projects in Alberta**.(2) Collectively, bitumen production from these mines averaged 1.7 MMB/d in 2024, equivalent to roughly 30% of Canada's total crude oil production.(3)

Source: Alberta Energy Regulator, Government of Alberta, geoSCOUT

(1) Government of Alberta – Oil Sands Mine Reclamation and Disturbance Tracking by Year
(2) Base Plant and the Athabasca Oil Sands Project each consist of two mines
(3) Includes condensate and NGLs

Active Oil Sands Mining Projects



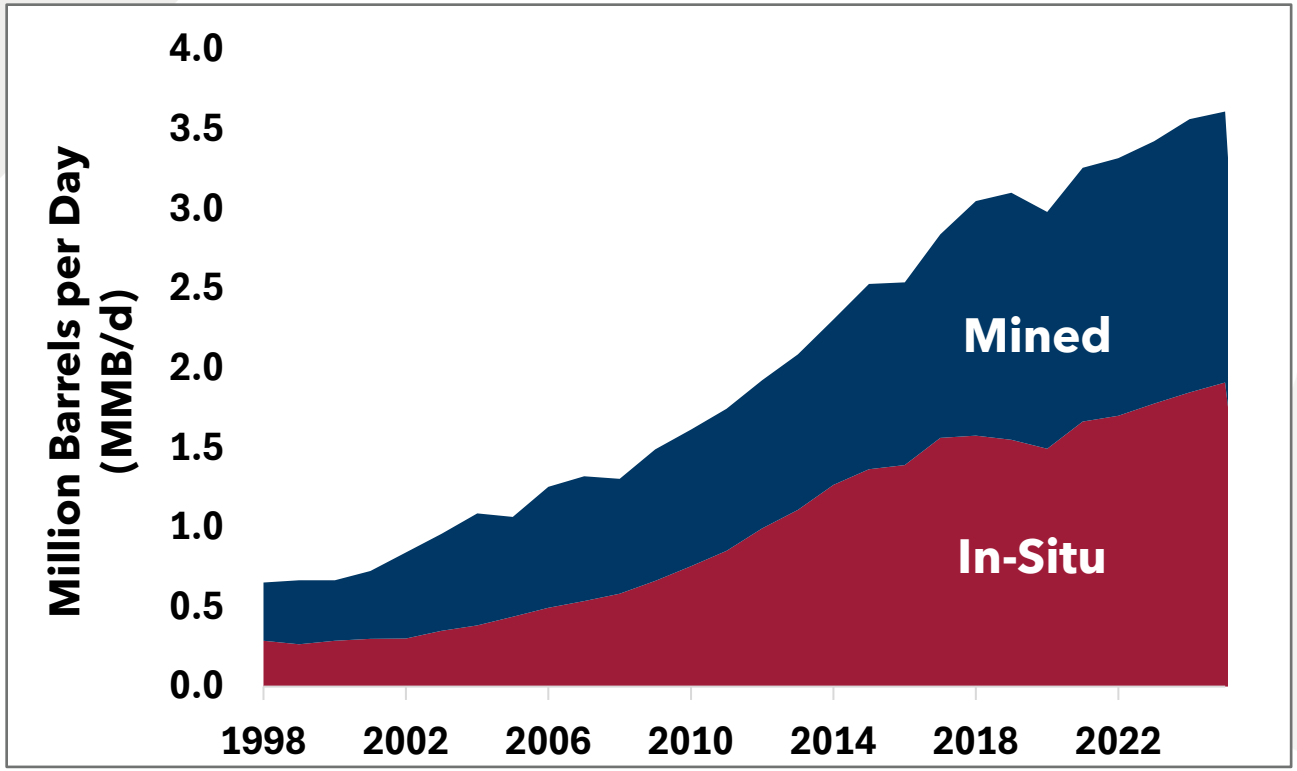
	Operator Name	Mine Name	Nameplate Capacity[1] (B/d)
1	Canadian Natural Resources	Horizon	264,000
2	Suncor	Syncrude-Mildred Lake	180,000
3	Suncor	Base Plant • Millenium • North Steepbank	300,000
4	Canadian Natural Resources	Athabasca Oil Sands Project • Muskeg River • Jackpine	328,000
5	Suncor	Syncrude-Aurora North	225,000
6	Suncor	Fort Hills	194,000
7	Imperial	Kearl	280,000

Source: Alberta Energy Regulator, Government of Canada, Oil Sands Magazine, geoSCOUT

(1) Barrels of bitumen per calendar day (before upgrading)

Bitumen Production

Annual | 1998 to 2025(1)



- Bitumen has been the primary source of oil production growth in Canada since 2008.
- In 2024, in-situ bitumen production averaged ~1.9 MMB/d, up 5.4x from 1998 levels. Meanwhile, mined bitumen production averaged ~1.7 MMB/d in 2024, up 3.7× from 1998 levels.
- **Combined, these two sources accounted for close to 60% of Canada's total oil production(2) in 2024.**
- According to the latest Alberta Energy Outlook (ST98) in 2023, by 2033, total raw bitumen production is forecast to increase to ~4.0 MMB/d, with the majority of the growth coming from in-situ sources.(3)

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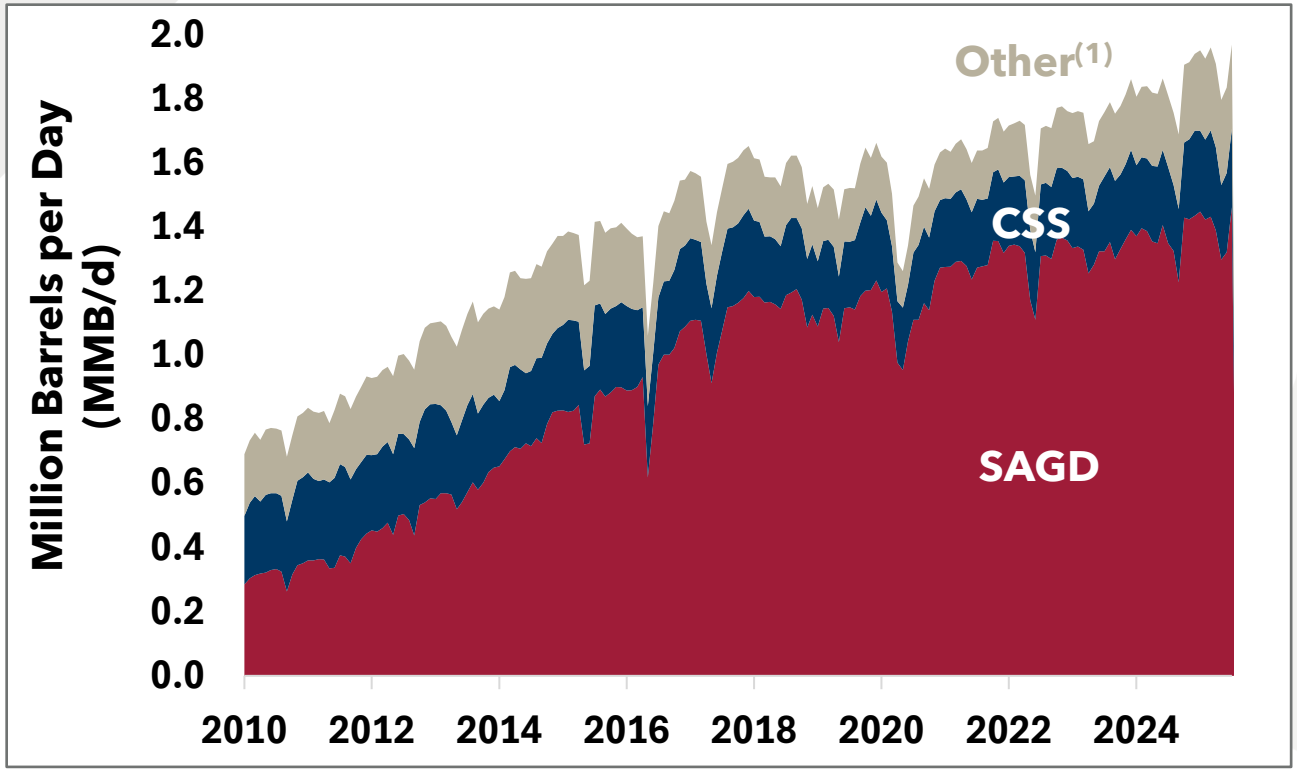
Source: Alberta Energy Regulator, Canada Energy Regulator

(1) 2025 YTD average from Jan. – Jul.
(2) Includes condensate and NGLs
(3) Alberta Energy Outlook (ST98) – Crude Bitumen Production

In-Situ Production

Monthly | Jan. 2010 to Jul. 2025



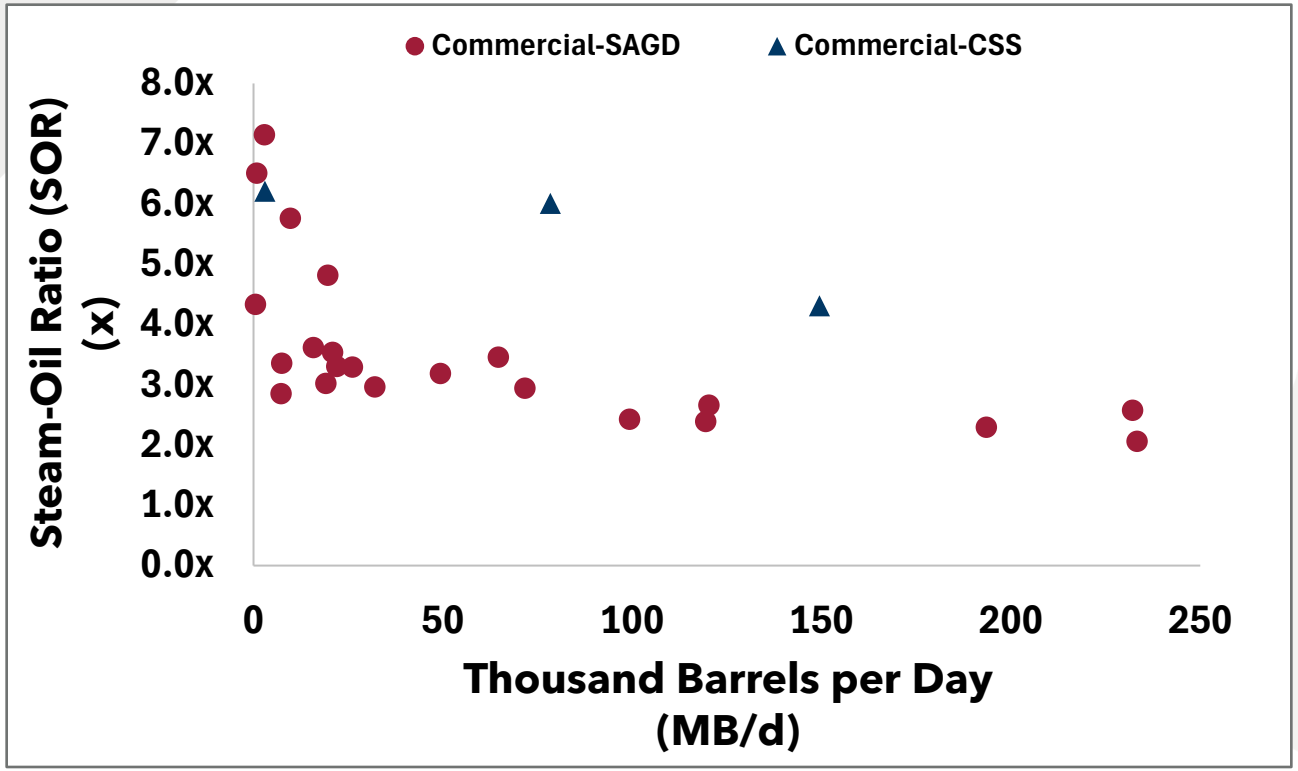
- Steam-Assisted Gravity Drainage (SAGD) and Cyclic Steam Stimulation (CSS) are the primary forms of in-situ extraction.
- According to the latest available data from the Alberta Energy Regulator, SAGD is the main form of in-situ production, totaling ~1.3 MMB/d as of May 2025.
- CSS and Other(1) represent a much smaller share of total in-situ production, averaging 234 MB/d and 259 MB/d in May 2025, respectively. The development of SAGD has driven the majority of the growth in in-situ production over the past 15+ years.

Source: Alberta Energy Regulator (ST53)

(1) 'Other' includes Primary & Enhanced recovery

In-Situ Production and SOR

2024 Average



- The size of Alberta's commercial SAGD and CSS projects varies significantly, with the largest operations exceeding 200 MB/d and the smallest operations less than 5 MB/d.
- **Steam-oil ratio (SOR)** measures the volume of steam required to produce one unit volume of bitumen. It is a key metric for gauging the thermal in-situ operations efficiency. Typically, geology and reservoir quality have the largest influence on a project's SOR.
- The most efficient SAGD projects have an SOR less than 3.0x, while CSS projects require higher steam pressure due to lower reservoir permeability.

Source: Alberta Energy Regulator (ST53)

Upgraded vs. Non-upgraded – What's the Difference?

Upgraders are processing facilities that convert bitumen from oil sands into a lighter product known as synthetic crude oil (SCO). This is achieved through chemical processes that remove sulfur, and heavy metals, and add hydrogen (through a process called "hydrotreating"). Upgrading enhances the quality of crude bitumen, resulting in a transportable, lighter, sweeter product that commands a higher market value and can be processed in more simple refineries (that process lighter crude oils). **There are eight active upgraders in Alberta and Saskatchewan with a combined upgrading capacity of ~1.5 MMB/d.**(1)

If they are not upgraded, raw bitumen and other heavier crude oils do not naturally flow through pipelines due to their high viscosity. To facilitate transport, non-upgraded bitumen is blended with a diluent. The primary diluents used are condensate and SCO, which reduce the viscosity for pipeline transport. Additionally, naphtha, light crude oil, and butanes can also be blended to ensure the bitumen blend meets pipeline specifications.

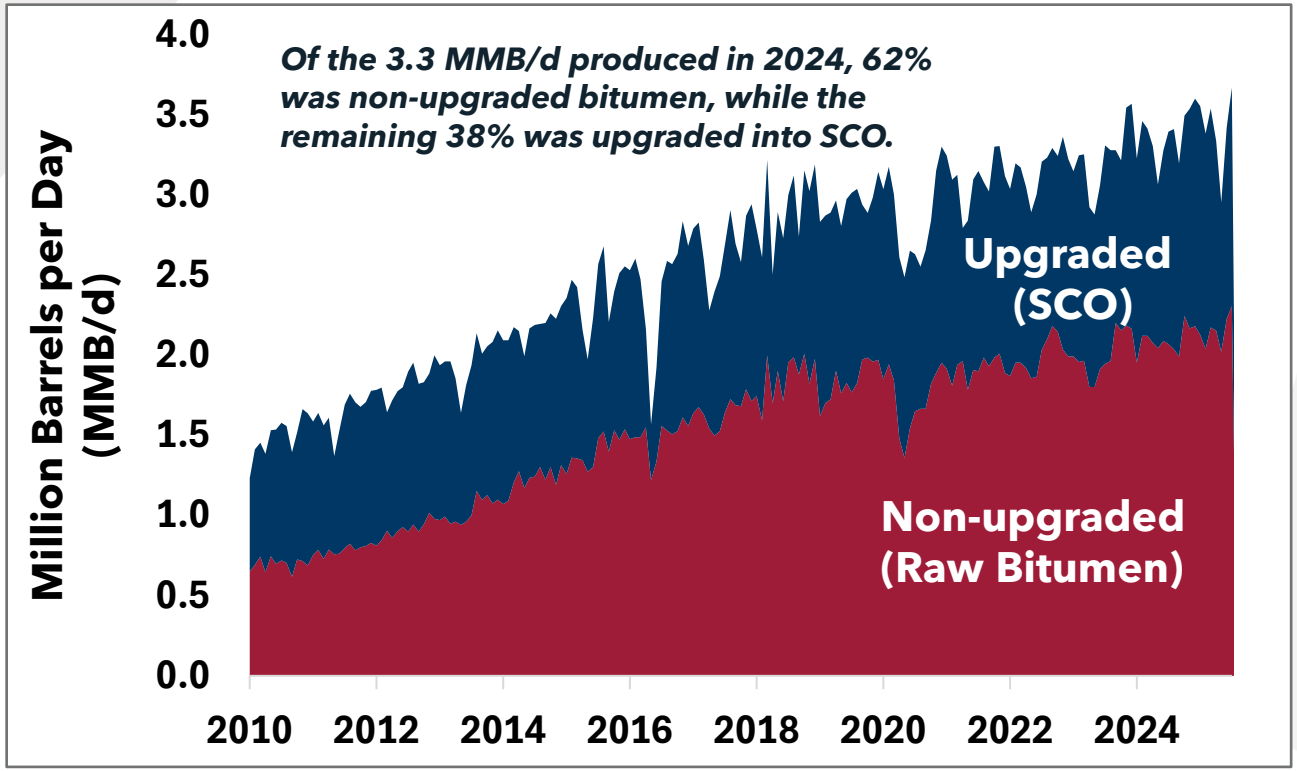
- **Synthetic Crude Oil (SCO) –** Also referred to as 'upgraded bitumen'. It is light, low-sulfur crude oil derived from bitumen through a process called upgrading (akin to refining). SCO can be transported by pipeline oil that is suitable for conventional (simple) refineries.
- **Diluted Bitumen (Dilbit) –** Produced by blending non-upgraded bitumen with condensate or diluent, typically 20-40% by volume. Dilbit is too heavy/sour for simple refineries and, therefore, can only be processed through high-conversion refineries.
- **Synbit –** A mixture of synthetic crude oil and bitumen, typically a 50/50 blend. Synbit volumes have diminished in recent years in favour of the more cost-effective Dilbit production.

Source: Alberta Energy Regulator, Oil Sands Magazine

(1) Oil Sands Magazine – Bitumen Upgraders

Upgraded vs. Non-upgraded Production

Monthly | Jan. 2010 to Jul. 2025

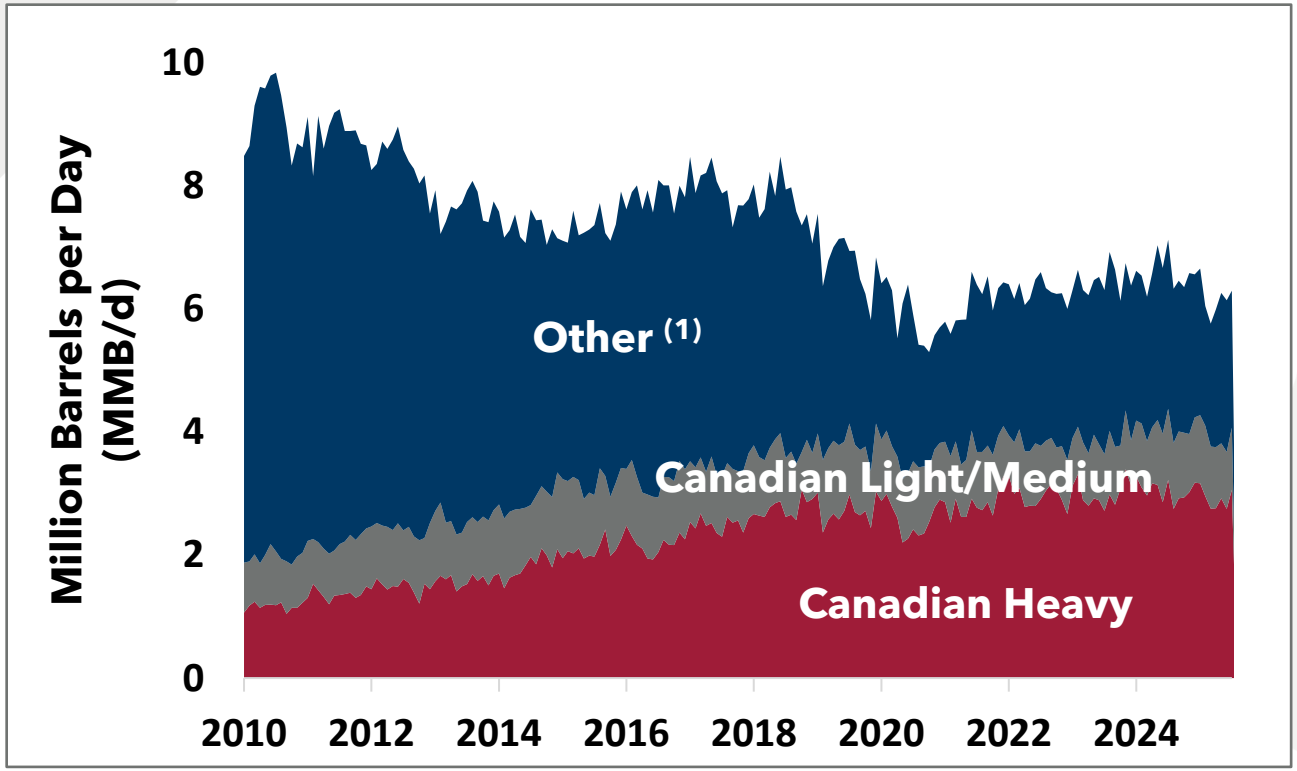


- Since the early 2010s, no new upgraders have been built in Alberta. This is due in part to lack of demand from refiners, and also due to investment uncertainty.
- Upgraders involve high capital and operating costs, making them a less appealing option for producers, who often find it more economical to export diluted bitumen (dilbit) to US refineries in the Midwest and Gulf Coast designed to process Canadian bitumen. Furthermore, technological advancements like Paraffinic Froth Treatment (PFT) have reduced the need for upgrading.
- As a result, Alberta's oil sands industry has shifted toward a "produce and export" approach, prioritizing raw bitumen sales (i.e., non-upgraded bitumen blends) over local upgrading.

Source: Alberta Energy Regulator (ST3)

U.S. Crude Oil Imports

Monthly | Jan. 2010 to Jul. 2025



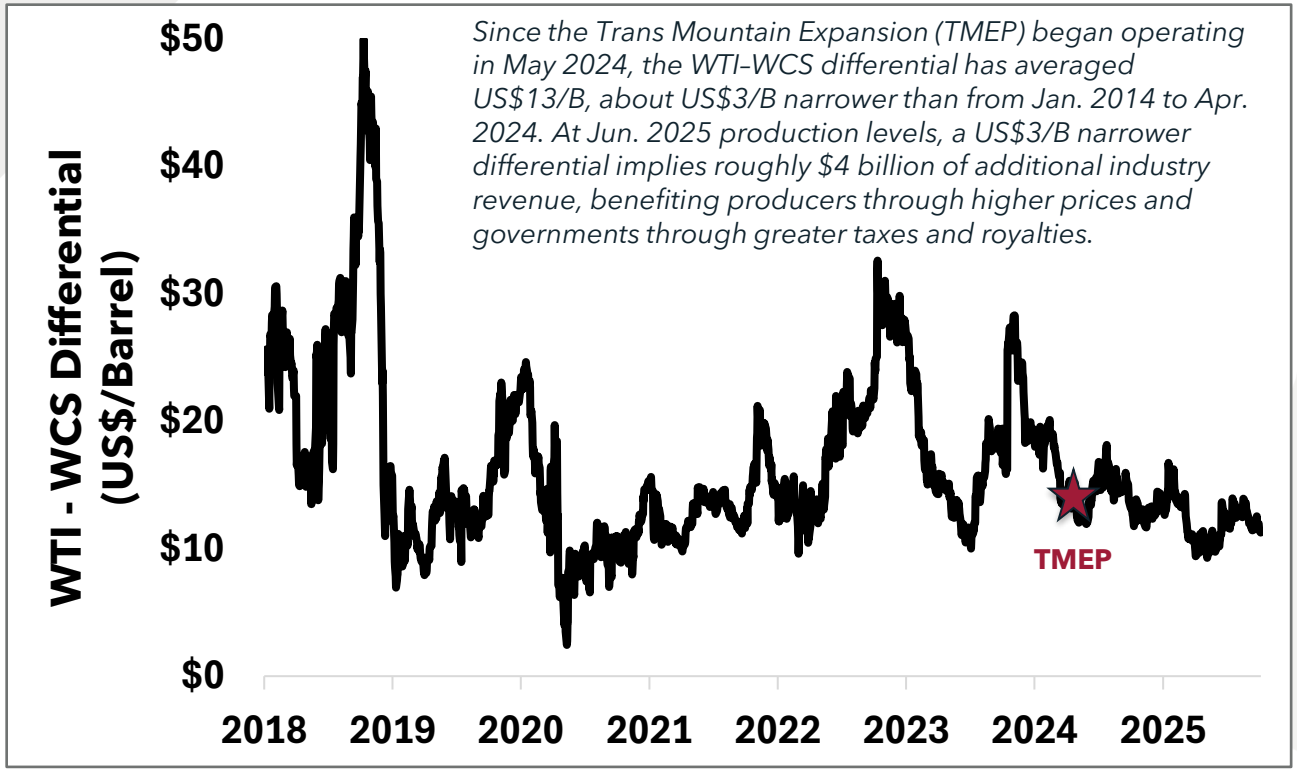
- Canada's refineries are primarily designed to process lighter crude blends. As such, Canada is reliant on the United States for refining its heavy oil/bitumen.
- The United States is home to one of the world's largest and most complex refinery systems, which processes significant volumes of heavy crude oil.
- The U.S. complex refineries (primarily in the Gulf Coast and the Midwest) are built for processing heavy oils.
- Canadian heavy oil (primarily bitumen blends) now accounts for ~45% (~3 MMB/d) of all US crude oil imports.
- The Midwest and Gulf Coast regions are the largest consumers of Canadian heavy oil (primarily bitumen). Canada's supply to these regions has increased over 150% since 2010.

Source: U.S. Energy Information Administration

(1) Other is comprised of approximately 28 countries based on 2024 data

WTI-WCS Price Differential

Daily | Jan. 2018 to Oct. 2025



- **Western Canadian Select (WCS)** is the most significant heavy oil benchmark in North America produced exclusively in Western Canada. It is a representative benchmark for a crude oil stream comprising of primarily bitumen from the oil sands blended with diluents.
- WCS trades at a discount to West Texas Intermediate (WTI) due to quality differences (WCS has a higher sulfur content and lower API gravity) and transportation costs to ship it from Western Canada to the United States.
- A wider WTI-WCS discount leads to lower revenues for oil sands producers, and in turn, lower royalty and tax revenue for governments.

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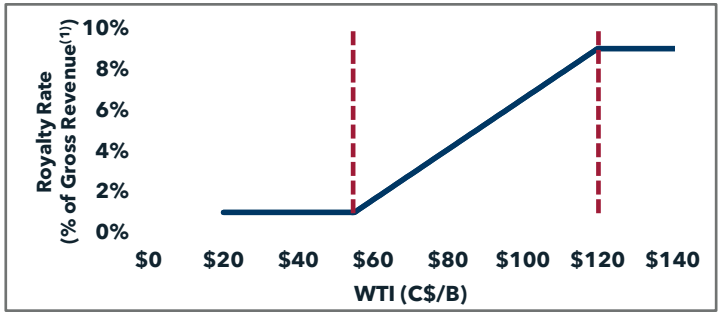
Source: Bloomberg

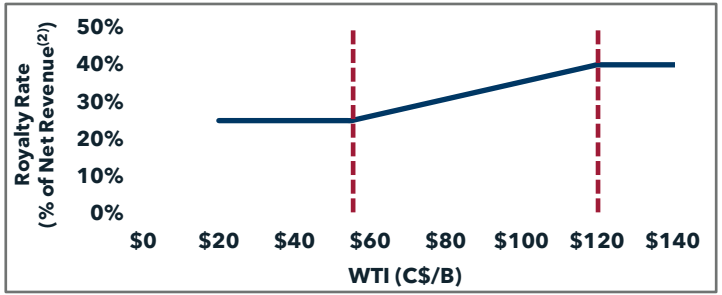
The Fiscal Impact of the Oil Sands

Oil Sands Royalty Framework

Most oil sands developments in Alberta are classified as "Royalty Projects," a designation granted by the Government of Alberta upon meeting predefined criteria. These projects are subject to a **pre-payout** and **post-payout** royalty framework.

A project's royalty rates will depend on whether it is in the pre-payout phase or the post-payout phase. Royalty rates are lower when a project is in the pre-payout phase to maintain a competitive investment climate due to the high initial costs for oil sands projects. A project transitions from pre-payout to post-payout once its total cumulative revenues equal or exceed its total cumulative costs for building the project.





Pre-Payout Phase

- The pre-payout phase is the period before an oil sands project has reached payout.
- Royalty rates in this phase are lower (ranging from 1-9% of gross revenue(1), depending on the price of WTI).

Post-Payout Phase

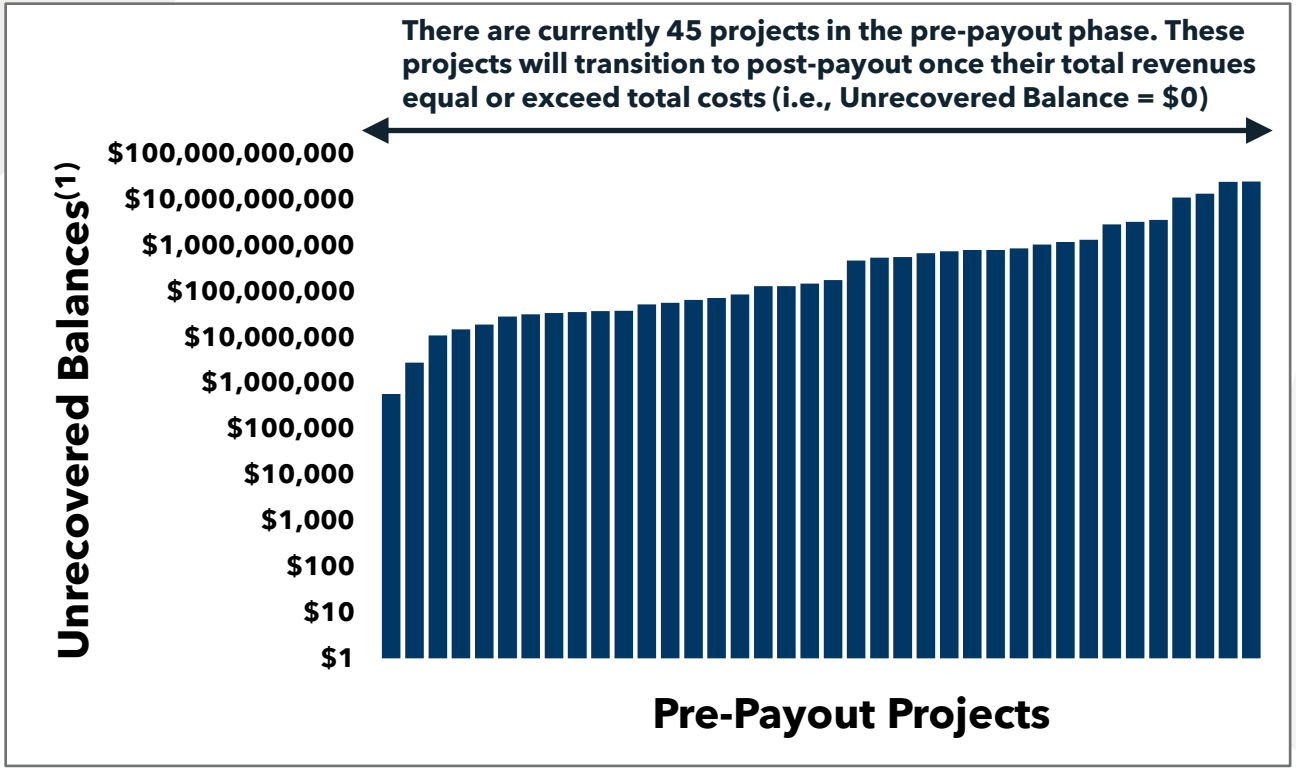
- The post-payout phase is the period after an oil sands project has reached payout.
- Royalty rates in this phase are higher (ranging from 25-40% of net revenue(2), depending on the price of WTI).
- Once a project reaches post-payout, it remains in this phase. When a post-payout project undergoes brownfield development, these are considered 'Allowable Costs', which are deducted from net revenue to calculate the royalty rate.

Source: Government of Alberta

(1) Gross Revenue = the total revenue for the Royalty Project, minus the total diluent cost
(2) Net Revenue = Gross Revenue – Operating Costs – Capital Costs – Return Allowance – Other Costs + Other Net Proceeds

Oil Sands Pre-Payout Projects

Unrecovered Balances[1] | as of May 6, 2025[2]



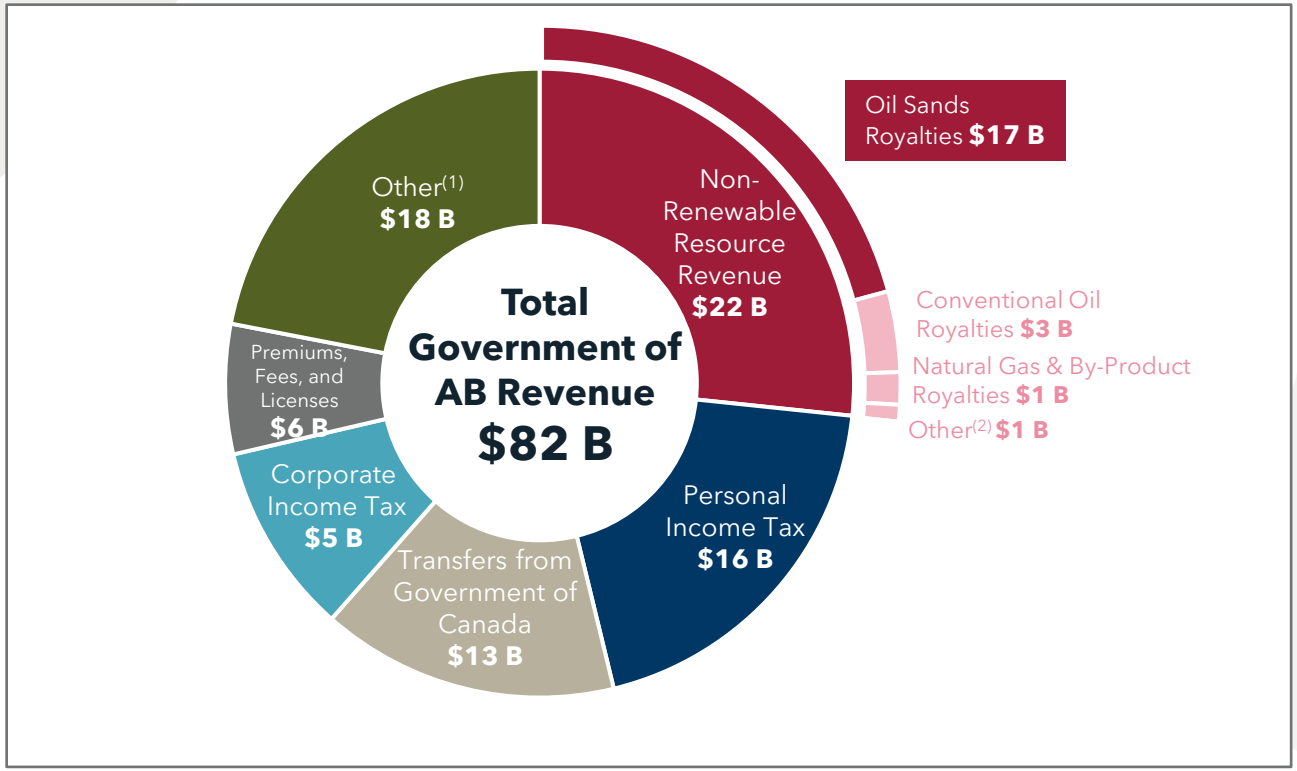
- In Alberta, there are currently 109 oil sands projects. According to the latest available Government of Alberta data, 71 of the 109 projects (65%) have reached post-payout status[2], where they have to pay higher royalty rates (25% to 40%). **The remaining 38 projects (35%) remain in the pre-payout phase** paying lower royalty rates (1-9%) until they transition to post-payout.
- Numerous factors, including oil prices, initial capital costs, production rates, and operating costs, amongst others, can influence the timeline for which a project transitions from pre-payout to post-payout status.
- Alberta's bitumen royalty revenue is poised to increase in the years ahead as these 45 projects transition from pre-payout to post-payout status. This will benefit the Alberta government's budget by increasing oil sands royalty revenue.

Source: Government of Alberta

(1) Unrecovered Balance = Cumulative Project Costs – Cumulative Project Revenue; Logarithmic scale for illustrative purposes
(2) Government of Alberta – 2024 Oil Sands Project Data as of May 6, 2025

Government of Alberta Revenue

Fiscal Year 2024-25



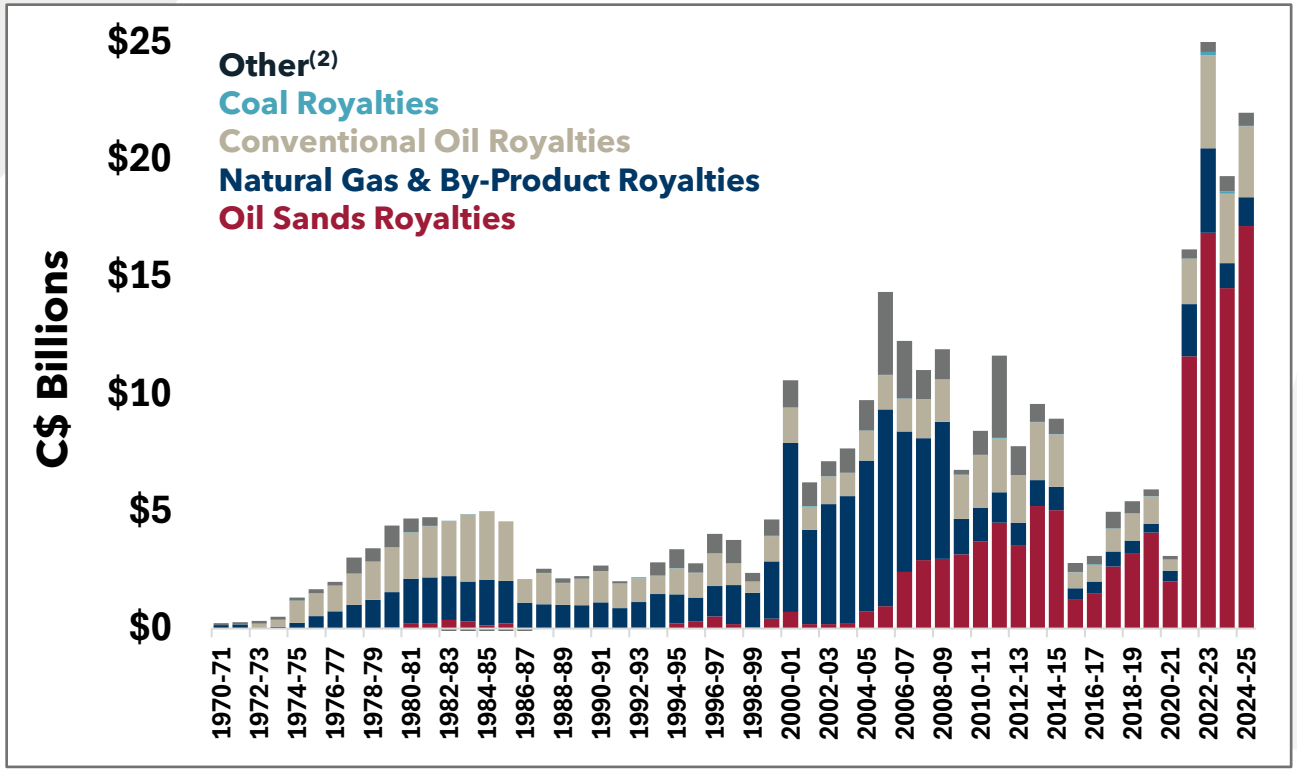
- In the fiscal year 2024-25, oil sands royalties of $17 billion were the largest single source of revenue for the Government of Alberta and more than 4× larger than conventional oil and natural gas royalties combined.
- Oil sands royalty revenue was greater than personal and corporate income tax of $16 billion and $8 billion, respectively, and equivalent to over 20% of the Government of Alberta's total revenue in the fiscal year 2024-25. In the years ahead, as more oil sands projects reach post-payout status, this revenue source should continue to increase.
- For context, oil sands royalty revenue was equivalent to 67% of the province's $26 billion healthcare operating expense budget in the fiscal year 2024-25.
- Higher royalty revenue allows for increased spending on public services such as healthcare, education, and social programs.

Source: Government of Alberta

(1) 'Other' includes Education property tax, other taxes, Heritage/endowment fund investment income, Other investment income, Net income/(loss) from government business enterprises, SUCH sector sales, rentals/fundraising, donations, and Other Revenue
(2) 'Other' includes Coal royalties, Bonus leases & sales of crown leases, Rentals & fees, Special royalty features, and ARTC

Alberta Non-Renewable Resource Revenue

Fiscal Year | 1970-71 to 2024-25



- Since the fiscal year 2009-10, oil sands royalty revenue has been the dominant source of non-renewable resource revenue for the Government of Alberta, largely driven by bitumen production growth and major projects reaching post-payout status.
- Some of Alberta's non-renewable resource revenue is directed to a Heritage Fund, which as of September 30, 2024, sits at $24.3 billion. The Government of Alberta recently announced plans to grow its Heritage Fund to at least $250 billion by 2050.(1)

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Source: Government of Alberta

(1) Government of Alberta - Heritage Savings Trust Fund
(2) 'Other' includes Bonuses & sales of crown leases, Rentals & fees, Special royalty features, and ARTC

Oil Sands Development

Emerging Emissions Reduction Initiatives and Technologies

- **Solvent-assisted steam assisted gravity drainage (SA-SAGD)** is an emerging bitumen extraction technology that supplements steam injection in the traditional SAGD process with light oil (solvents) such as butane and propane to reduce steam use. The solvents are then recovered and re-used, reducing steam requirements compared to traditional SAGD and allowing for lower steam-to-oil ratios (SOR). Current applications include:
  - **Imperial Oil** is the first operator to commercialize SA-SAGD at its 15 MB/d Grand Rapids Phase 1 project, which achieved first oil in 2024.
  - **Canadian Natural, Cenovus, ConocoPhillips**, and **Suncor** have piloted solvent-enhanced technologies across their thermal operations.
- **Direct contact steam generation (DCSG)** combusts fuel with oxygen and water at high pressure to create a stream of CO_2 and steam.(1) DCSG can be applied in processes such as SAGD and bitumen mining with wastewater containing solids and hydrocarbon to generate steam. This technology minimizes freshwater requirements and produces a pure CO_2 stream that can be permanently stored and not released into the atmosphere.
- **Cogeneration** uses waste heat to generate electricity, thereby reducing the need to burn additional fuel for power generation. Cogeneration is well suited for oil sands operations, which generate waste heat via steam generation for bitumen extraction. Excess electricity can then be sold to the grid.
  - Oil sands operators who use cogeneration include Imperial (Kearl, Cold Lake), Suncor (Syncrude, Fort Hills, Firebag, Mackay River), Canadian Natural (Horizon, Primrose, Muskeg River), Cenovus (Foster Creek, Christina Lake), CNOOC International (Long Lake), MEG (Christina Lake), Shell (Scotford), and Strathcona (Lindberg).

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Source: Alberta Energy Regulator, Company Reports

(1) Direct Contact Steam Generation (DCSG) technology

Oil Sands Mining Tailings Management and Reclamation

- Bitumen extraction from mined bitumen generates a by-product known as **tailings**, which are a mixture of sand, clay, water, silt, residual bitumen, and other hydrocarbons, salts, and trace metals.
- Collected tailings are deposited into aboveground structures known as tailings ponds, which act as a settling area to separate water from the tailings. Once separated, the water is recycled back into the mining operations for reuse.
- Tailings ponds are located in areas of low permeability or are lined with compacted sand and a layer of fine clay. The low permeability materials are used to mitigate seepage of tailings water from penetrating the groundwater below. Vertical monitoring wells are also installed on the perimeter of the tailings pond to monitor potential seepage.
- Tailings ponds are required to maintain an engineered design freeboard, which is the difference between the level of the water and the top of the dyke.

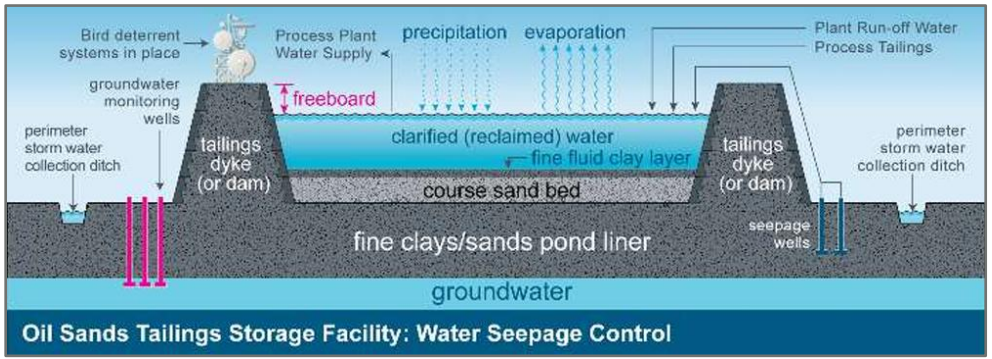
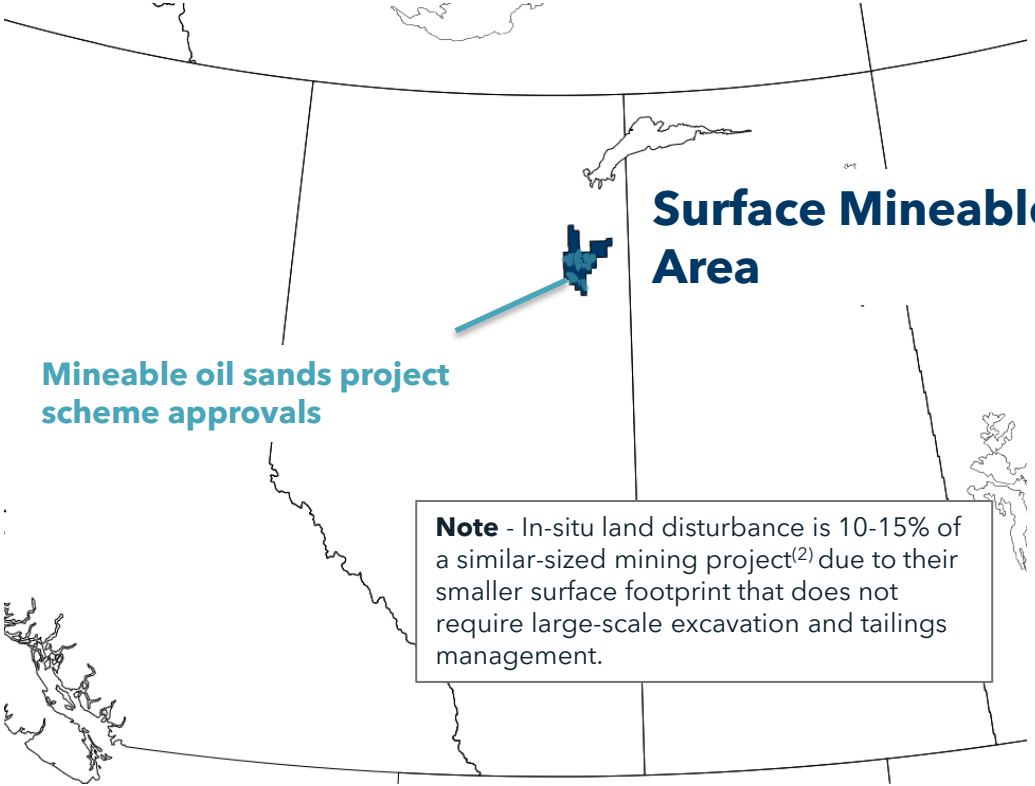


Image Source: Government of Alberta

- Tailings generated as part of the bitumen mining extraction process must be managed in accordance with the Alberta Energy Regulator's Directive 085.
- Directive 085 strives to minimize fluid tailings accumulation by ensuring that fluid tailings are treated and reclaimed progressively during the life of a project.
- Mine operators are required to report annually on the performance of their fluid tailings management plans, including fluid tailings inventories, environmental monitoring results, and continuous improvement.
- For each project, all the fluid tailings associated with the mine are required to be ready to reclaim ten years after the end of the mine life.

Source: Alberta Energy Regulator, Oil Sands Magazine

Oil Sands Mining Land Reclamation and Disturbance



Note - In-situ land disturbance is 10-15% of a similar-sized mining project(2) due to their smaller surface footprint that does not require large-scale excavation and tailings management.

- Approximately 1,100 km^2 of the 142,000 km^2 oil sands deposits in Northern Alberta are currently undergoing surface mining activity(1), which equates to roughly 0.8% of the total oil sands surface area.
- As of 2023, roughly 13% of active oil sands mining lands is considered reclaimed.(1) However, many of Alberta's oil sands mines have yet to reach their end of life.
- At the conclusion of a mining project, the mine owner is responsible for dismantling all infrastructure, decommissioning the site, and restoring the land to a condition comparable to its pre-development state. Operators are required to supply reclamation security bonds to ensure requirements are met.

Source: Alberta Energy Regulator, Government of Alberta, geoSCOUT

(1) Government of Alberta – Oil Sands Mine Reclamation and Disturbance Tracking by Year
(2) Government of Canada – Oil Sands Land Use and Reclamation

Appendix

Acronyms and Abbreviations

AER – Alberta Energy Regulator

BOE – Barrel of Oil Equivalent

CER – Canada Energy Regulator

CO_2 – Carbon Dioxide

CSS – Cyclic Steam Stimulation

EOR – Enhanced Oil Recovery

m^3 – Cubic Meters

PFT – Paraffinic Froth Treatment

SAGD – Steam-Assisted Gravity Drainage

SCO – Synthetic Crude Oil

SOR – Steam-Oil Ratio

WCS – Western Canadian Select

WCSB – Western Canada Sedimentary Basin

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Glossary (1/3)

Bitumen – A dense, highly viscous form of crude oil that will not flow unless it is heated or diluted with lighter hydrocarbons. Compared to conventional crude oil, bitumen generally has higher concentrations of sulfur, heavy hydrocarbons, and trace metals.

Conventional Oil – Conventional oil is extracted from the ground by drilling and pumping, which is what differentiates it from the oil extracted from oil sands. Compared to bitumen, conventional oil is less viscous and less dense.

Cyclic Steam Stimulation (CSS) – A bitumen recovery method, where a single well undergoes alternating phases of steaming, soaking, and production at pressures slightly above the reservoir fracture pressure. CSS utilizes relatively high steam pressure to enhance reservoir permeability. Over its lifespan, a CSS well typically completes 10 to 20 cycles, recovering approximately 50% of the oil in place. The steam-to-oil ratio (SOR) averages around 6.0x throughout the well's lifecycle.

Diluent – Lighter viscosity petroleum products that are used to dilute bitumen for transportation in pipelines.

Diluted Bitumen (Dilbit) – Produced by blending non-upgraded bitumen with condensate or diluent, typically 20-40% by volume. Dilbit is too heavy/sour for simple refineries and, therefore, can only be processed through high-conversion refineries.

Enhanced Oil Recovery (EOR) – Used in conventional and oil sands recovery. Improves hydrocarbon recovery by injecting fluids into a reservoir to increase or maintain reservoir pressure, displace hydrocarbons to production wells, or alter reservoir fluids to improve hydrocarbon flow.

In-Situ – Relies on high-pressure steam to recover bitumen from underground reservoirs. The most common commercialized method is steam-assisted gravity drainage (SAGD); the other is cyclic steam stimulation (CSS). Primary and Enhanced recovery methods are non-thermal in-situ recovery methods that are also used.

Nonsaline Water – Water having a total dissolved solids content of 4000 milligrams per liter or less. Sometimes referred to as fresh water.

Paraffinic Froth Treatment (PFT) – A bitumen treatment process that uses a paraffinic solvent as a diluent to eliminate the need for upgrading.

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Source: Alberta Energy Regulator, Canada Energy Regulator, Oil Sands Magazine

Glossary (2/3)

Primary Oil Recovery – Involves pumping the bitumen out of the ground, similar to conventional oil recovery. No steam is required in this method.

Proved Oil Reserves – Estimated volumes of oil that analysis of geologic and engineering data demonstrates with reasonable certainty are recoverable under existing economic and operating conditions.

Steam-Assisted Gravity Drainage (SAGD) – A bitumen extraction technique wherein two horizontal wells are drilled into the reservoir and stacked roughly 5 meters apart. Steam is injected through the top well to heat the bitumen, allowing it to be liberated from the sand and accumulate with the produced water in the lower well. The bitumen is then pumped from the lower well and brought to the surface, where it is separated from the water. The recovered water is treated and recycled back into the system. SAGD recoveries can be quite high, over 80% of the bitumen extracted in some cases. Lifecycle steam-to-oil ratios average about 3.5x in more permeable pay zones.

Solvent Assisted, Steam-Assisted Gravity Drainage (SA-SAGD) – An enhancement of the SAGD process wherein a hydrocarbon solvent is injected simultaneously with steam to reduce the steam-oil-ratio compared to typical SAGD operations.

Steam-Oil Ratio (SOR) – A measurement in thermal in-situ operations for the volume of steam required to produce one unit volume of bitumen. It is a key metric for gauging a thermal in-situ operations efficiency.

Surface Mine – The bitumen, mixed with sand, clay, and water, is extracted from the surface using traditional mining techniques, and then the bitumen is physically separated from the sand in a processing plant.

Synthetic Crude Oil (SCO) – Also referred to as 'upgraded bitumen'. It is light, low-sulfur crude oil derived from bitumen through a process called upgrading (akin to refining). SCO can be transported by pipeline oil that is suitable for conventional (simple) refineries.

Tailings – A by-product of bitumen mining extraction, comprised of sand, clay, water, silt, residual bitumen and other hydrocarbons, salts, and trace metals. Collected tailings are deposited into aboveground structures known as tailings ponds, which act as a settling area to separate water from the tailings.

Unconventional Oil – Often found in shale and tight reservoirs. The permeability and porosity are so low that the oil cannot be extracted economically through a vertical well bore and instead requires a horizontal well bore followed by multistage hydraulic fracturing to achieve economic production.

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Source: Alberta Energy Regulator, Canada Energy Regulator, Oil Sands Magazine

Glossary (3/3)

Upgrader – Processing facility that converts bitumen from oil sands into lighter hydrocarbons, also known as Synthetic Crude Oil (SCO).

Water Use Intensity – Measures the barrels of water needed to produce one barrel of oil equivalent (BOE).

Source: Alberta Energy Regulator