THE OIL SANDS DEVELOPERS GROUP
Energy From Athabasca

Extracting Oil Sands – In-Situ and Mining Methods Fact Sheet

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There is more than one way to extract oil sands from the ground. Mining techniques are used where the oil sands are close to the surface and in-situ techniques are used for deeper deposits. In mining operations, oil sands ore is dug out of the ground and processed to separate the bitumen from the sand. When an area is mined out, the earth is put back and reclaimed to productive use. In-situ techniques are used underground to liquefy bitumen flow to a point where it can be pumped by a well to the surface, leaving the sand in place. In-situ is Latin for "in place." Both methods of extraction present benefits and challenges in terms of production rates, surface land disturbance, energy use, time and investment required for each type of project.

In-situ extraction

Fact: In-situ techniques are generally used to recover bitumen that is more than 200 feet deep and where surface mining is not viable.

- Currenly, 20 per cent of Alberta's total oil sands reserves are deemed to be mineable, the remaining 80 per cent can be accessed through in-situ techniques.
- In 2007, Alberta produced 243 million barrels of oil from the mineable oil sands and 196 million barrels from the in-situ areas. That means about 45 per cent of the oil from the oil sands came from in-situ operations.

Fact: In-situ technology is relatively new and has opened access to the majority of Alberta's oil sands reserves.

- The potential value of in-situ oil sands development was recognized in 1974 when the Alberta Oil Sands Technology and Research Authority (AOSTRA) was created to research in-situ technologies.
- In 1985 commercial in-situ production began at Imperial Oil's project in Cold Lake, Alberta.
- The per-barrel costs of in-situ production compares favourably with mining techniques.

Fact: The two in-situ techniques most commonly used in commercial projects today are cyclic steam stimulation (CSS) and steam assisted gravity drainage (SAGD).

- CSS injects steam into the oil reservoir to heat up the bitumen to make it flow more easily, allowing it to be brought to the surface. The steam condenses into water in the reservoir and the water is often recycled and then reused as steam.
- SAGD uses two horizontal pipes that are drilled into the oil sands formation. The top pipe injects steam into the formation to liquefy the bitumen allowing it to flow to a lower pipe that brings it to the surface.

Fact: There are several evolving in-situ methods of extraction that are aimed at improving environmental performance and increasing production.

- Vapour recovery extraction (VAPEX) is a method that uses solvents instead of heat and steam to make bitumen flow.
- Toe-to-heel air injection (THAI) is an in-situ process that relies on underground combustion rather than steam to warm the bitumen and make it flow. This method uses comparatively little water and emits fewer green house gases.
- Low pressure SAGD uses electric submersible pumps to reduce the amount of pressure that is needed from the steam to get the bitumen moving.

Fact: In-situ processes come with a specific set of challenges, which are being addressed.

- The main challenges facing in-situ producers are improving production rates and energy efficiency and reducing reliance on water.
- There have been dramatic improvements in water consumption over the last 20 years. In-situ facilities have progressed from using approximately 3.5 barrels of fresh water for every barrel of bitumen produced to using half a barrel of fresh water, a 600 per cent improvement. For the most part, water used to generate steam is drawn from underground aquifers, and operators use brackish/saline water which is unsuitable for human consumption. In-situ operators recycle up to 90 per cent of the water they use.
- It takes about 28 cubic metres (1,000 cubic feet) of natural gas to produce one barrel of bitumen from in-situ projects. Emerging technologies are aimed at reducing this level.

- Many in-situ producers install cogeneration units to produce steam and generate electricity. Many projects produce enough electricity to be self-sufficient and the potential exists to send excess energy to the power pool.

Mining extraction

Fact: Commercial open pit mining has been ongoing in the oil sands for over 40 years.

- Open pit mining of the oil sands first began in the 1920s. The first large-scale commercial operation was introduced by Great Canadian Oil Sands (now Suncor Energy) in 1967.

Fact: Oil sands mining technology has evolved significantly over the years.

- Suncor Energy used bucket wheels from the coal mining industry in its early operations. Bucket wheels were some of the largest vehicles ever built. A large rotating wheel was mounted on a boom, and on the outer edge of the wheel, buckets would remove earth and carry it around to the backside of the wheel where it would fall onto a conveyer that carried it up the excavator.
- Syncrude Canada Limited relied on enormous draglines that were connected to a plant by a network of conveyor belts when it opened in 1978.
- Today, massive trucks and shovels have replaced draglines and bucket wheels. The trucks can carry up to 400 tonnes of oil sands to separation plants in surface mining operations.
- Hydro-transport has in many cases replaced conveyor belts. Oil sands ore is mixed with water and transported as slurry through pipelines to the processing facility. Bitumen begins to separate out of the sand in the pipeline, making separation more efficient than in the past.

Fact: Oil sands mining requires a series of steps to turn oil sands ore into synthetic crude oil.

- First land is cleared of trees and the overburden is drained and stored to be later used for reclaiming the area.
- Oil sands ore consists of sand, fine clays, water and bitumen. Shovels excavate the oil sands ore and place it into large haul trucks. The trucks haul the ore to a central location and dump it into hoppers where it is ground up and mixed with

water. It is then piped via hydro-transport pipeline to the extraction plant where the bitumen is separated from the sand.
- The sand, fine clays and a small amount of unrecovered bitumen, mixed with water, is transferred to settling basins known as tailings ponds while the separated bitumen is sent for further upgrading.
- Bitumen is upgraded into a synthetic crude oil that can then be processed by refineries into end products such as gasoline, diesel or jet fuel.

Fact: Open pit mining projects are large-scale undertakings that require much planning, time and investment while adhering to strict government regulations.

- It takes about 8 to 10 years to bring mining projects into production. This includes the time required to complete engineering feasibility studies, to gain regulatory approval, to complete construction and to start up production facilities.
- Ongoing oil sands projects must receive renewed government operating approval at least every 10 years.
- Typical mining, extraction and upgrading projects require a multi-billion-dollar investment to produce 100,000 barrels per day of high quality synthetic crude oil.
- Oil sands developers must post financial security equivalent to the cost of reclamation before it begins any activity. This money is kept in the Environmental Protection Security Fund and is returned when reclamation certificates are issued. As of June 2008, the fund held more than $720 million.
- One hectare of a surface mine will produce about 10,000 barrels of bitumen.
- About two tonnes of oil sands must be dug up, moved and processed to produce one barrel of oil.

Fact: Mining operations are always employing new technology to improve their environmental and economic performance.

- Replacing draglines and bucket wheels with trucks and shovels has resulted in more efficient operation as it has allowed developers to be more selective in mining.
- Processes such as hydro-transport and low energy extraction have reduced energy use in mining and extraction by about 45 per cent per barrel since 1990. Low energy extraction typically operates at 35 to 40 degrees celsius versus the 80 degree celsius processes emplyed by the industry in the 1980s.
- New technology will reduce the time needed to reclaim tailings ponds and eventually could reduce the volume of tailings or eliminate them altogether.

- More than 80 per cent of the water used during surface mining operations is repeatedly recycled.

Sources for all facts available upon request