



Imperial innovation

Our commitment to the
responsible development of
Canada's energy resources





We've been an energy innovator for generations of Canadians. Looking forward, we plan to build on this legacy by continuing to invest in industry-leading research and development.

Our charge is two-fold: to dependably deliver energy that supports human progress, and to do so in a way that positively supports the communities and environments in which we operate. We believe that smart innovation and new technology will help us meet this dual challenge.

Taking an innovative approach is part of who we are. More than 100 years ago, we established Canada's first oil and gas research department. Today, we're one of the country's only energy producers with dedicated research laboratories, and a leading research spender across all industries. Through these efforts, we aim to continually identify new ways to recover oil that are safer and more efficient, while contributing to local economies and minimizing impact on local environments.

In the past 20 years, **we've spent more than \$2.1 billion in research and technology development (R&D)** – one of Canada's largest R&D investments in any industry. That's in addition to ExxonMobil's global R&D spending of \$1 billion per year, which grants us access to industry-leading insights and experts at all times.

As we develop Canada's resources, we aim to minimize impact on air, land, water and wildlife. We plan to do this through:

- A commitment to operations integrity
- Adherence to government regulations
- Investments in new technology

135 years+ of innovation

Canada, as a country, was only 13 years old when the Imperial Oil Company was formed in 1880. Since then, Imperial innovations have helped shape Canada and formed the foundation of the country's energy industry.

Here are some of our historical highlights, which show just how far we have come due to innovation and technological advancements:

1880

Sixteen refiners form The Imperial Oil Company in London, ON.

1907

We open **Canada's first service station** in Vancouver, BC.

1924

We create **Canada's first petroleum industry research department**.

1930

We develop the process to **manufacture lubricants**.

1936

We sponsor **Hockey Night in Canada** radio broadcasts for the first time.

1947

We **discover oil at Leduc**, beginning Western Canadian oil development.

1964

We begin an **experimental program to extract bitumen** from the oil sands in Cold Lake, AB.

1966

We invent **Cyclic Steam Stimulation** technology.

1979

We invent **Steam Assisted Gravity Drainage** technology.

2001

We invent **Liquid Addition to Steam for Enhanced Recovery** technology.

2005

We establish the **Institute for Oil Sands Innovation** at the University of Alberta.

2005

We pilot **Paraffinic Froth Treatment** technology.

2008

We pilot **Continuous Infill Steam Flooding**.

2009

We invent **Non-Aqueous Extraction** technology.

2012

We become a charter member of **Canada's Oil Sands Innovation Alliance**.

2014

We initiate Cyclic Solvent Process technology at Cold Lake.

2016

We open a new state-of-the-art oil sands laboratory in Calgary, AB.

Air

How we are tackling oil sands emissions head on

“ We are currently conducting field tests on cutting-edge steam-reduction technologies that could reduce GHG emissions at our Cold Lake operation by about 90%. ”

- Cheryl Trudell, PhD
Vice President, Research

First, through innovation

We are an active member of Canada's Oil Sands Innovation Alliance (COSIA), where we collaborate and share new ways to **reduce energy use and associated greenhouse gas (GHG)**, with the aim of improving environmental performance for all oil sands operations.

We will reduce more than 25% of GHG emissions per barrel by using our LASER (Liquid Addition to Steam for Enhanced Recovery) technology at our Cold Lake operations, efficiently producing more oil per unit of steam.

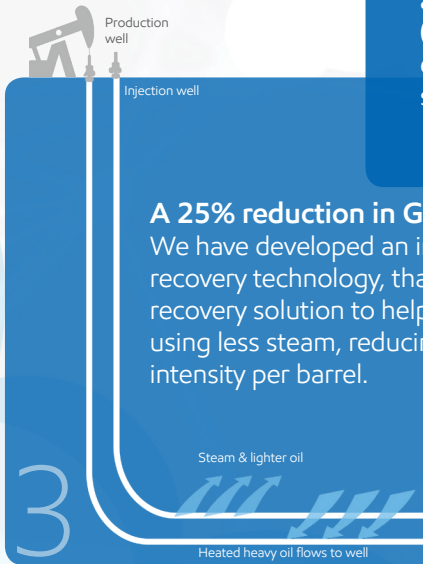
A 25% reduction in GHG intensity

We have developed an improved recovery technology, that adds a recovery solution to help the oil flow using less steam, reducing GHG intensity per barrel.

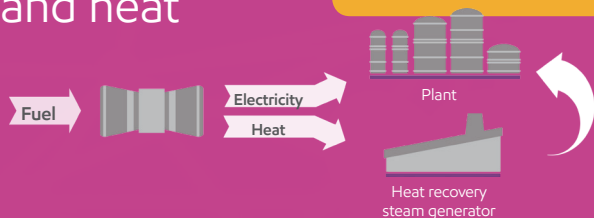
We can potentially cut up to 90% of GHG emissions at our future operations by eventually eliminating the use of steam through methods we are now developing in research and field pilots.

We will save steps and energy

By eliminating an extra processing step, our Kearl oil sands operation delivers heavy oil directly to markets, further reducing GHG emissions for the life of the mine.



Generating our and heat



Energy-saving cogeneration, producing steam and electricity from the same fuel, reduces the energy draw from the Alberta electricity grid and lowers GHG emissions.

- a. Cogeneration at Kearl and Cold Lake has produced more than 350 MW of combined power per year – the equivalent of supplying over 400,000 homes.
- b. Cogeneration systems installed at our two newest plants **reduce GHG emissions** associated with electricity production and steam generation by **30-40%** in comparison to electricity import and stand-alone steam generation.

Monitoring

We closely monitor GHG emissions to improve understanding of the sources and emission patterns so we can work on reducing them.

7



Our Cold Lake operation is partnered with the Lakeland Industry and Community Association, which operates a continuous air quality monitoring network. Four monitoring stations provide up-to-the-minute measurements of ambient concentrations of several man-made and natural emissions. Additional monitoring stations provide data about regional patterns in air quality and for long-term trend analysis.

9

Working with a global emissions monitoring company, we are using new satellite technologies to gain more accurate and frequent understanding of methane emissions and their impact on the total oil sands emissions.



8

Working together

We continually team with our partners, to work on solutions to monitor and reduce emissions.



WOOD BUFFALO
ENVIRONMENTAL ASSOCIATION



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AT THE UNIVERSITY OF ALBERTA

10

A better way to recover oil

An important part of our oil supply is “heavy oil,” also called bitumen. It has a thick texture, like peanut butter, and is found mixed into sand and clay underground, which means it can be challenging to get out.

In the past, we exclusively used steam to heat and mobilize the oil so we could recover it and bring it to the surface. But in recent years, we’ve developed advanced oil recovery technologies that are more efficient and environmentally friendly.

Mobilizing with lighter oils

Light oils like propane and butane flow more easily and are a natural part of heavy oil. Injecting these oils underground, along with some steam, mobilizes the heavy oil so it can be brought to the surface.

This approach recovers more heavy oil using less steam, significantly reducing greenhouse gas (GHG) emissions and water use.

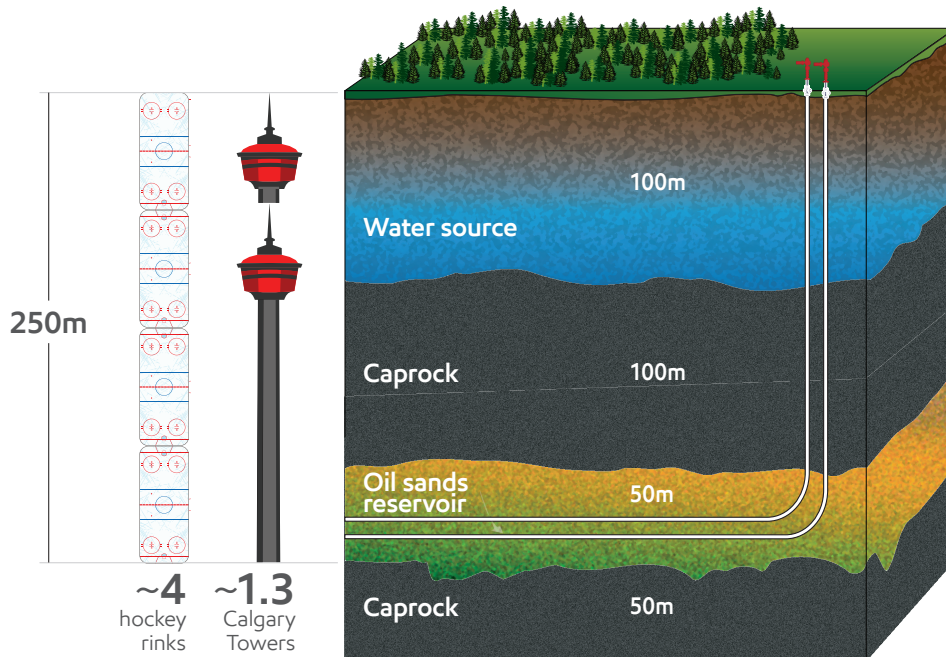


Illustration based on the Aspen project location

Technologies

LASER

(Liquid Addition to Steam for Enhanced Recovery)

Environmental benefit¹:

Up to 25% ↓ GHG intensity

Up to 25% ↓ steam

Status:

- Currently in use in about 240 wells at Imperial's Cold Lake operation.
- Expansion of program underway.

SA SAGD

(Solvent-Assisted, Steam Assisted Gravity Drainage)

Environmental benefit²:

Up to 25% ↓ GHG intensity per barrel

Up to 25% ↓ steam

Status:

- Successfully piloted for more than seven years at our Cold Lake operation.
- Proposed technology at Aspen project.

CSP

(Cyclic Solvent Process)

Environmental benefit¹:

Up to 90% ↓ GHG emissions by eliminating the use of steam

Up to 100% ↓ water

Status:

- Initiated \$100 million pilot facility at Cold Lake in 2014.
- Successfully piloted the technology at our Cold Lake operation for more than four years.

EBRT

(Enhanced Bitumen Recovery Technology)

Environmental benefit²:

Up to 60% ↓ GHG emissions

Up to 90% ↓ steam

Status:

Advancing a field trial to demonstrate the process and validate it for commercial use.

¹Compared to cyclic steam stimulation (CSS) production methods.

²Compared to steam-assisted, gravity drainage (SAGD) production methods.

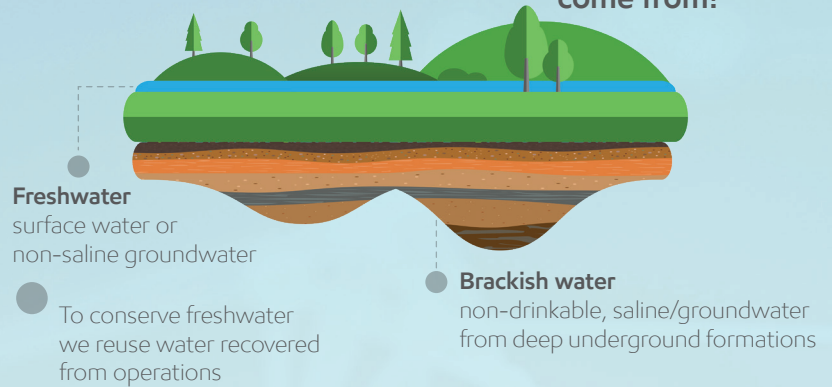


In May 2018, Imperial was awarded \$10 million by Emissions Reduction Alberta towards development of our Enhanced Bitumen Recovery Technology.

Water

We continually aim to minimize our use of water and protect this resource

Where does the water come from?



How we use water



To recover the oil

We inject steam into underground reservoirs to heat the thick, heavy oil, so it is able to flow to a producing well.



Mining

We use water to separate heavy oil from sand and clay.



Tailing ponds

We form ponds to hold the water, clay, sand and residual oil we use in the separation process. Over time, these solids settle and allow us to reclaim the ponds and reuse the water. This, in turn, helps us reduce reliance on freshwater sources, such as rivers and lakes.

Real gains



80 to 95% of water recovered

from our oil sands production is treated, recycled and re-used as steam, significantly reducing freshwater use.



90% less

freshwater is needed for each barrel produced at Cold Lake since the 1970s.



Fish habitats

We build viable lakes to compensate for fish habitat removed as a result of our oil sands mining operation.



“ Since the 1970s, we’ve reduced the amount of fresh water we use at our Cold Lake operation by 90%. Today, we’re working on technologies that could make even more positive impact, by completely replacing steam with a recovery solution in the process. ”

- Cheryl Trudell, PhD
Vice President, Research

Virtually eliminate water use

Our researchers are developing a technology for a commercial trial that may eliminate the use of water.

We initiated a **\$100 million field pilot** in 2014 to test this promising technology.

Alternatives to steam

are key to increasing energy efficiency and reducing water use from our operations:

Promising pilot programs

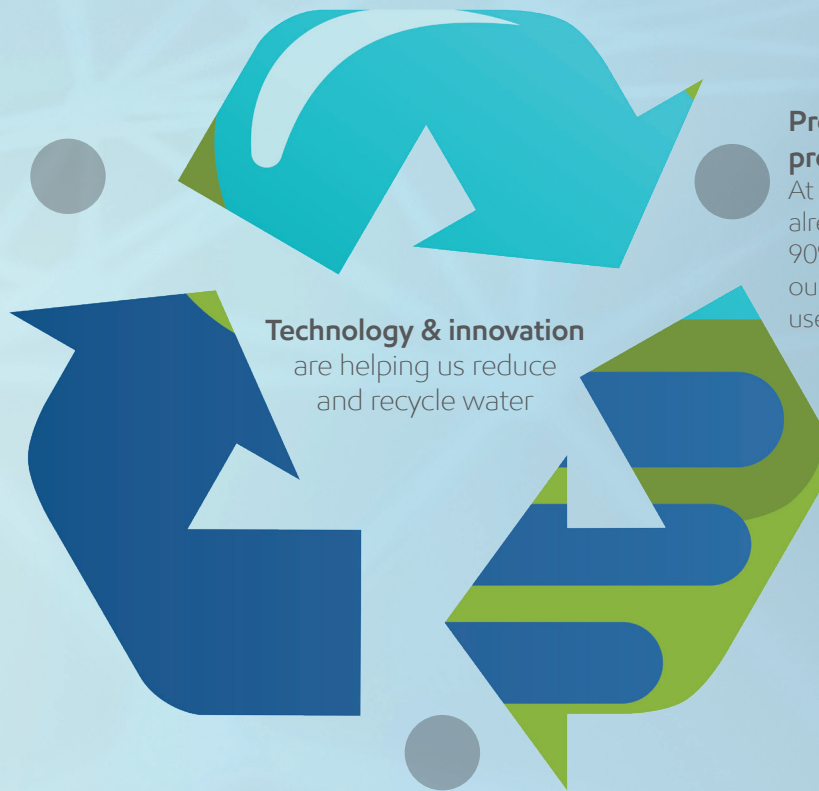
At Cold Lake, we’ve already surpassed the 90% reduction mark on our way to 100% water use reduction.

Technology & innovation

are helping us reduce and recycle water

More than 90% reduction

in water use through a new process that creates dry, stackable tailings in the oil sands mining process. This also allows for earlier reclamation.



Reclaiming the land

Through the life cycle of our oil sands mining operation



We carefully consider land use, biodiversity and ecosystems in project planning, operations and reclamation.

Reclamation goal for our Kearl oil sands mine

We've set out to achieve a maintenance-free, self-sustaining boreal forest that supports wildlife and fisheries habitat, recreation and traditional use by Indigenous people.

Starting at the beginning

Reclamation of the land at the Kearl oil sands mine is a continuous process. From the outset right through closure and beyond, we will continuously refine mine, tailings and closure plans.





Oil sands are located in the Boreal Forest Natural Region of Alberta. This landscape is known for short summers, long winters and is made up of deciduous, mixed-wood and coniferous forests amid extensive peatlands.

“Our Indigenous Reclamation Planning group has taught me successful reclamation is not just about the plants, but also about how animals can be attracted and encouraged to remain on the reclaimed land.”

- Lori Neufeld, P. Biol.
Imperial land use and biodiversity lead



Reclamation certification achieved

Monitor reclaimed areas including wildlife use

Place soil and plant vegetation characteristic of the local boreal forest

Reclamation planning starts before the first shovel is placed in the ground.

We reclaim as we go.

We are committed to:

- Indigenous and community engagement
- Ongoing research to reclaim sustainable landscapes
- Air, water and wildlife monitoring

Baseline environmental assessment to understand the environmental setting prior to operations

Seed collection of plants native to the area

Timber salvage

Salvage original layer of topsoil, subsoil and root debris for future reclamation use

Remove overburden materials to access oil sands resource

Mining begins

Ongoing efforts to limit soil erosion and sedimentation within our operating area

Treat and responsibly place mine waste

Construct landscapes

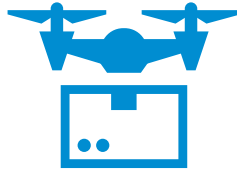
Place soil and plant vegetation characteristic of the local boreal forest

Monitor reclaimed areas including wildlife use

Reclamation certification achieved

Productivity

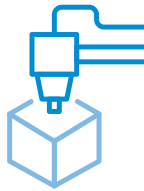
Using the latest technology to improve how we work



Drones for mine planning at Kearl



Virtual and augmented reality for incident management and safety training



3D printing to produce replacement parts



Autonomous haul truck pilot at Kearl



RFID chips for turnaround productivity



Enhanced mobility bringing information to our people

Advanced products

Imperial is committed to delivering solutions that enable our customers to reduce their emissions and improve their energy efficiency.



Advanced plastics: creating stronger plastics that last longer, reducing waste.

Synergy™ gasoline: 7 key ingredients help provide better fuel economy, lower emissions and improve engine responsiveness.*

Esso diesel efficient: designed to improve fuel economy in both Class 8 heavy-duty and light-duty trucks.

Testing **biofuels** to meet Canadian climate extremes.

Speedpass+ app: the first mobile payment option at the pump in Canada, that combines customer convenience and loyalty rewards.

Increasing recycled content in asphalt. Higher rates of recycled asphalt pavement benefit the environment and reduce road maintenance costs.

Did you know?

Imperial is one of the largest suppliers of paving asphalts in Canada. In fact, one in every three kilometres of Canadian highway is surfaced with asphalts produced at our Strathcona and Nanticoke refineries.

*Improvements, such as fuel economy, are based on Synergy-branded gasoline, where and when available, compared to gasoline meeting minimum Canadian government detergency standards. Actual benefits will vary depending on factors such as vehicle type, driving style and gasoline previously used.

Leveraging ExxonMobil research

Through our relationship with ExxonMobil*, we have access to global R&D spending of ~\$1 billion per year and access to industry-leading insights and experts at all times.

Imperial is **leveraging ExxonMobil's research on advanced biofuels, as well as carbon capture and storage (CCS)**. ExxonMobil is at the forefront of developing these exciting technologies, many of which can play big roles in a lower-carbon future.



Algae and other advanced biofuels

ExxonMobil has invested **\$250 million** on biofuels research in the past decade.

ExxonMobil is actively researching biofuels made from algae. Algae naturally produce lipids that can be turned into a renewable, lower-emission fuel for transportation. Because the manufacturing processes for algae biofuels and today's transportation fuels are similar, algae biofuels could be processed in existing refineries to supplement supplies of conventional gasoline, diesel and other fuels.

Carbon capture and storage

ExxonMobil captured **6.3 million** metric tonnes of CO₂ for storage in 2016.

Carbon capture and storage (CCS) is the process by which CO₂ that otherwise would be emitted into the atmosphere is captured, compressed and injected underground for permanent storage. The Intergovernmental Panel on Climate Change has recognized **CCS as essential to meeting global emissions-reduction goals**.

*Exxon Mobil Corporation (ExxonMobil) owns approximately 69.6 percent of the outstanding shares of Imperial Oil Limited.

Working together

In addition to our in-house research, we partner with academic institutions, industry peers and third-party companies to accelerate the pace of environmental performance improvement in Canada.



Imperial is a charter member of Canada's Oil Sands Innovation Alliance (COSIA). COSIA is an alliance of oil sands producers focused on accelerating the pace of environmental performance improvement in oil sands development and production. To date, **COSIA member companies have shared 981 distinct technologies and innovations that cost more than \$1.4 billion to develop.**

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Imperial is the founding sponsor of the Institute for Oil Sands Innovation (IOSI) at the University of Alberta. Through the institute, university experts are conducting groundbreaking research to address a variety of environmental challenges associated with oil sands development, including climate change. To date, we have contributed \$24M in funding to IOSI.



Imperial is working with GHGSat, a global emissions monitoring company, to utilize new satellite technologies to gain more accurate and frequent understanding of methane emissions and their impact on the total oil sands emissions.

RICC | Regional Industry
Caribou Collaboration

In 2015, Imperial became a member of the Regional Industry Caribou Collaboration (RICC), a group of nine companies working together to contribute to conservation of boreal caribou and restoration of habitat through collaborative, range-based efforts.

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