

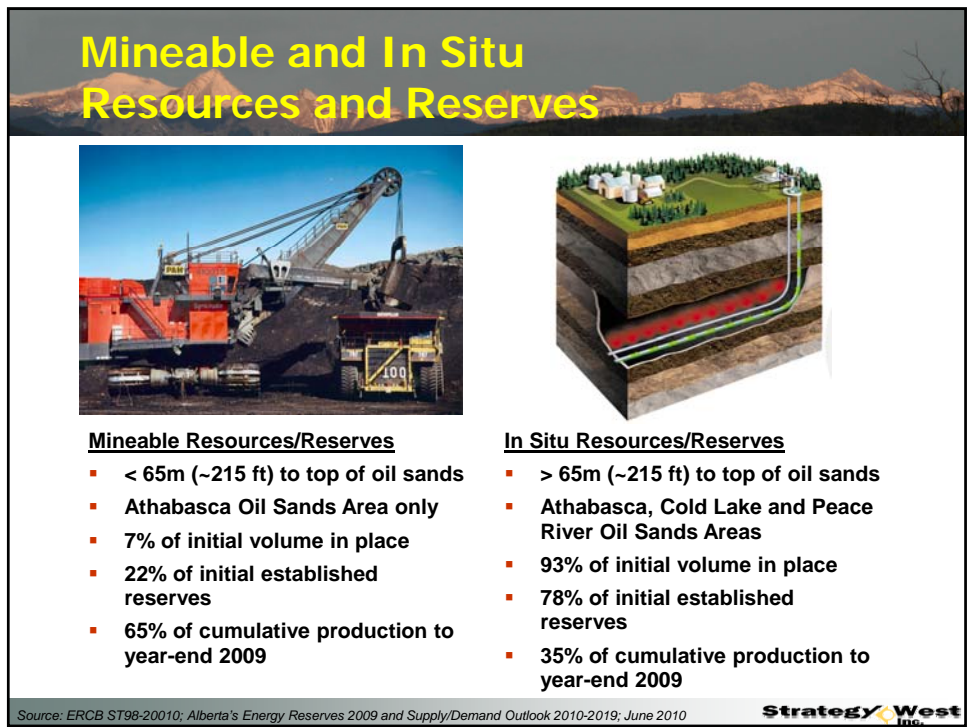
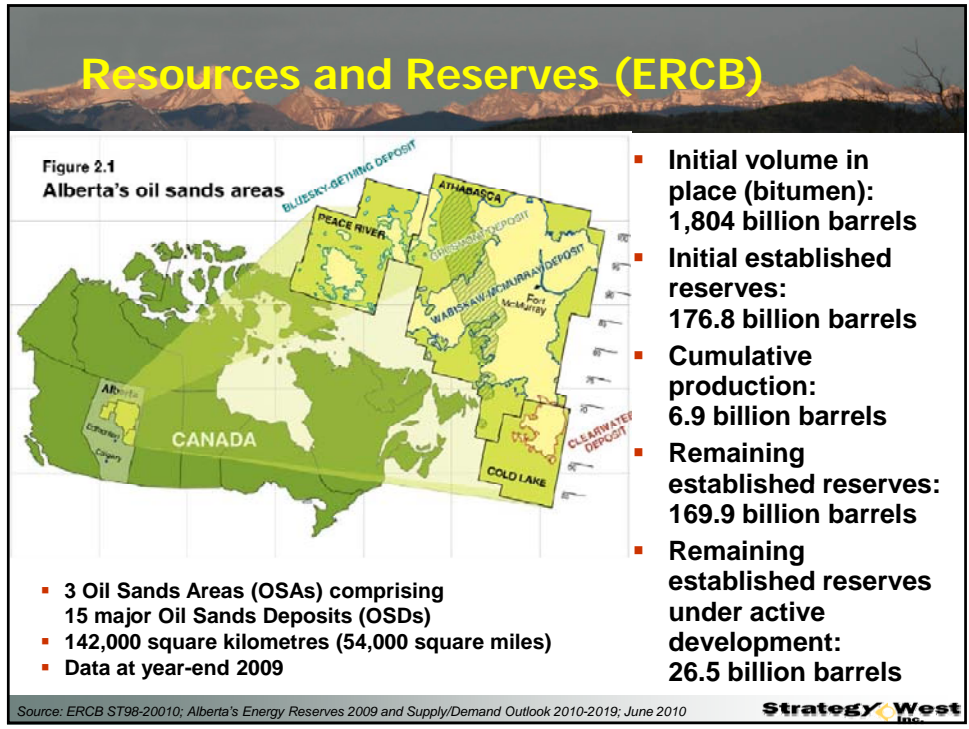


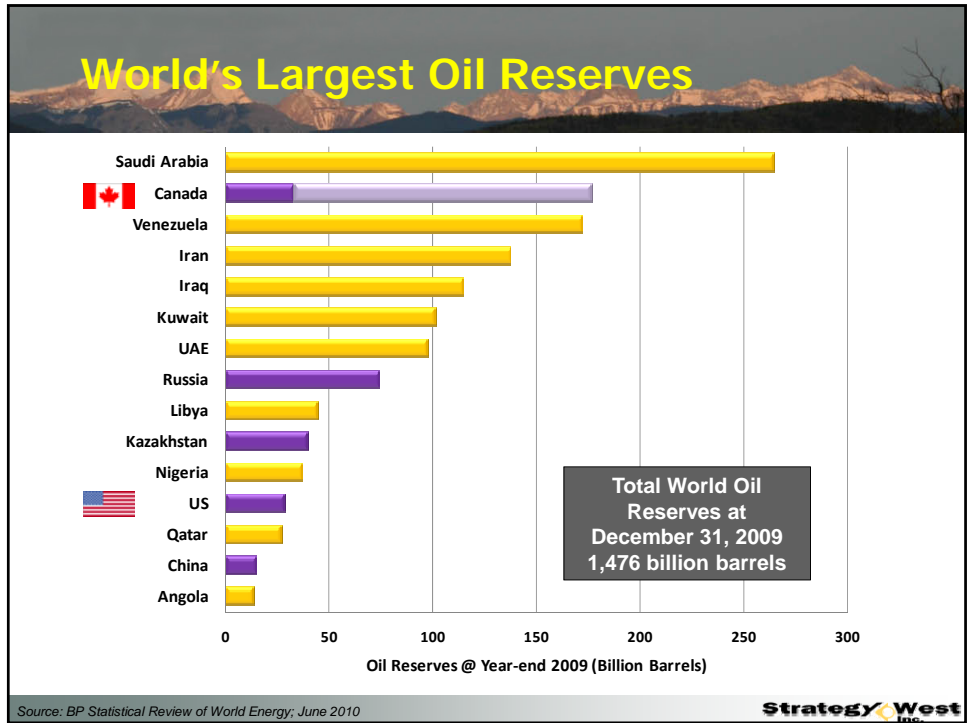
**Presentation Outline**

- Oil Sands Overview
- Markets
  - North America
  - Offshore
- Industry Challenges
  - ENGO Attacks/Image
  - GHG Emissions
  - Tailings
- Outlook
- Conclusions


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## Oil Sands to Synthetic Crude Oil



**Oil Sands:**  
Deposits of sand, sandstone or other sedimentary rocks containing crude bitumen



**Crude Bitumen:**  
A highly viscous mixture, mainly of hydrocarbons heavier than pentanes



**Synthetic Crude Oil:**  
A mixture of hydrocarbons, similar to light crude oil, that is derived by upgrading crude bitumen or heavy oil

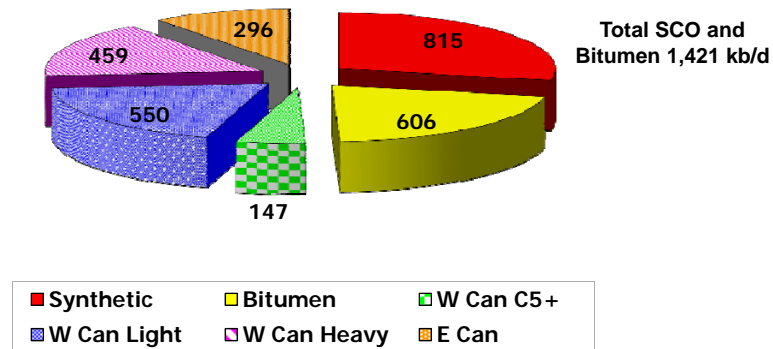
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Illustrations: Syncrude Canada Ltd.

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## Canadian Oil Production

Alberta's Oil Sands provided 49% of Canada's "crude oil" production in 2009 (Canada's total: 2,873 kb/d)



(all figures thousand b/d)

Source: National Energy Board, July 27, 2010

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## In Situ Recovery

- Primary Recovery
- Secondary Recovery
- Tertiary Recovery
  - Steam Injection
    - Cyclic Steam Stimulation (CSS)
    - Steam Assisted Gravity Drainage (SAGD)
  - In Situ Combustion
    - Toe-to-Heel Air Injection (THAI)
  - Solvent Injection
    - VAPEX
    - N-Solv
  - Hybrid (Steam/Solvent & Steam/Gas) Processes
  - Electric Heating



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## Thermal In Situ Recovery

### Cyclic Steam Stimulation (CSS)

Steam is injected into the reservoir.  
Steam and condensed water heat the viscous oil.  
Heated oil and water are pumped to the surface.  
Steam and condensed water heat the viscous oil.

Courtesy of the Petroleum Communication Foundation (PCF)

### Steam Assisted Gravity Drainage (SAGD)

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## Surface Mining & Bitumen Extraction

### Surface Mining

Mining shovels dig into sand and load it into huge trucks.

### Oil Sands Transport

Trucks take oil sand to crushers, where it is prepared for extraction.

### Bitumen Extraction

Hot water is added to the oil sand and then fed via hydrotransport to the extraction plant.  
Bitumen is extracted from the oil sands in the separation vessels.  
The tailings are pumped to the settling basin, where the water is recycled.

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## Upgrading Overview

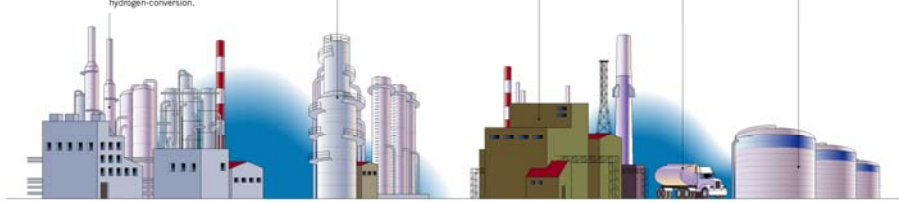
If the upgrading process includes coking, the coke is removed from the bitumen and used for industrial applications. Another upgrading process will add hydrogen to the bitumen and break up the large hydrocarbon molecules – a process called hydrogen-addition or hydrogen-conversion.

Hydrocarbons are stabilized by adding hydrogen in the presence of catalysts. After stabilization, they are separated into naphtha, kerosene and gas oil.

The utilities plant provides steam, water and electric power to the rest of the plant.

Sulphur can be recovered to be used in fertilizer and other products.

A range of products including light sweet and sour crude oils and diesel products are blended and shipped to markets.



Courtesy of the Petroleum Communication Foundation (PCF)

▪ **Purpose:**

- Produce higher value liquid hydrocarbon products
- Produce valuable byproducts

▪ **Mechanisms:**


- Remove or breakdown bitumen residues
- Remove contaminants

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## Bitumen Based Feedstocks to Refined Products

**Canadian & US Refineries**



Mines & In Situ Projects

↓ Blended Bitumen

Upgraders

→ Synthetic Crude Oil

Blended Bitumen →

→ Refined Petroleum Products

Gasoline

Diesel

Jet Fuel

Fuel Oils

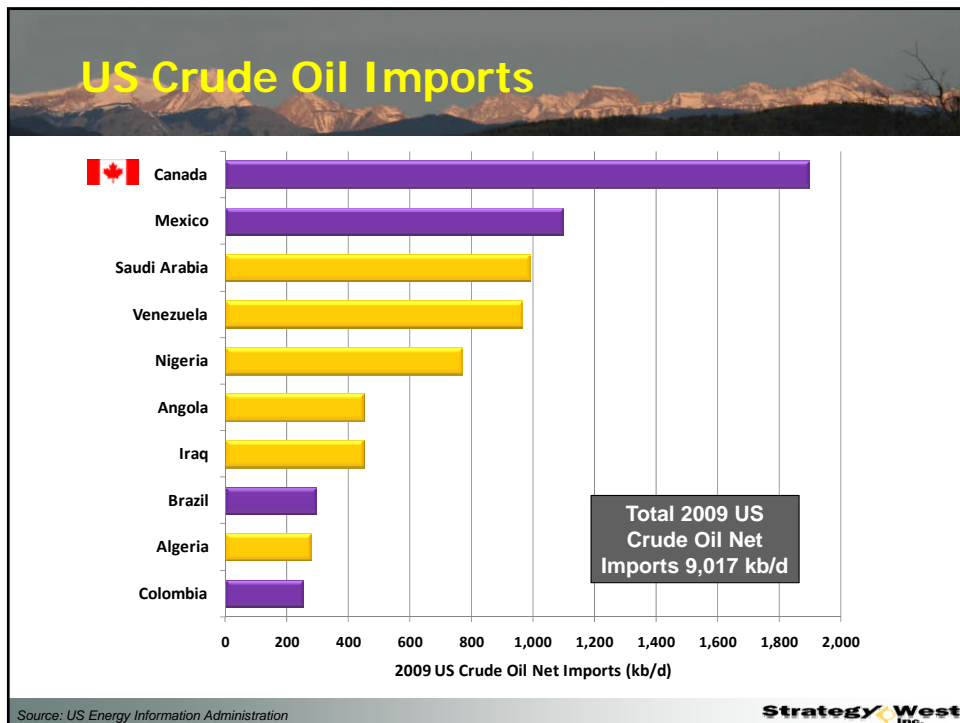
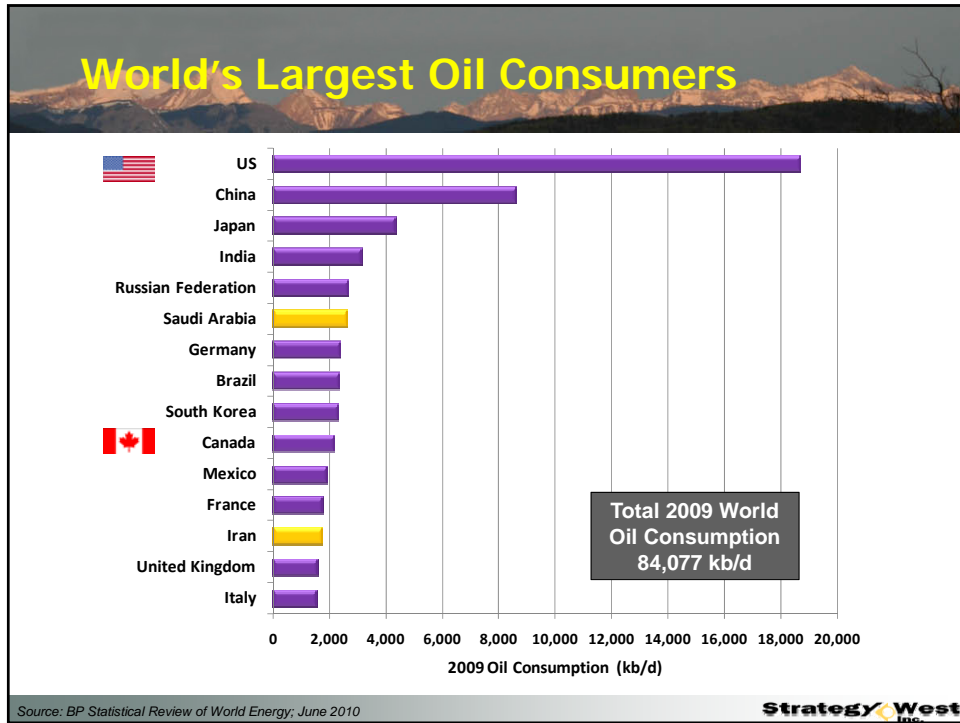
Lubricants

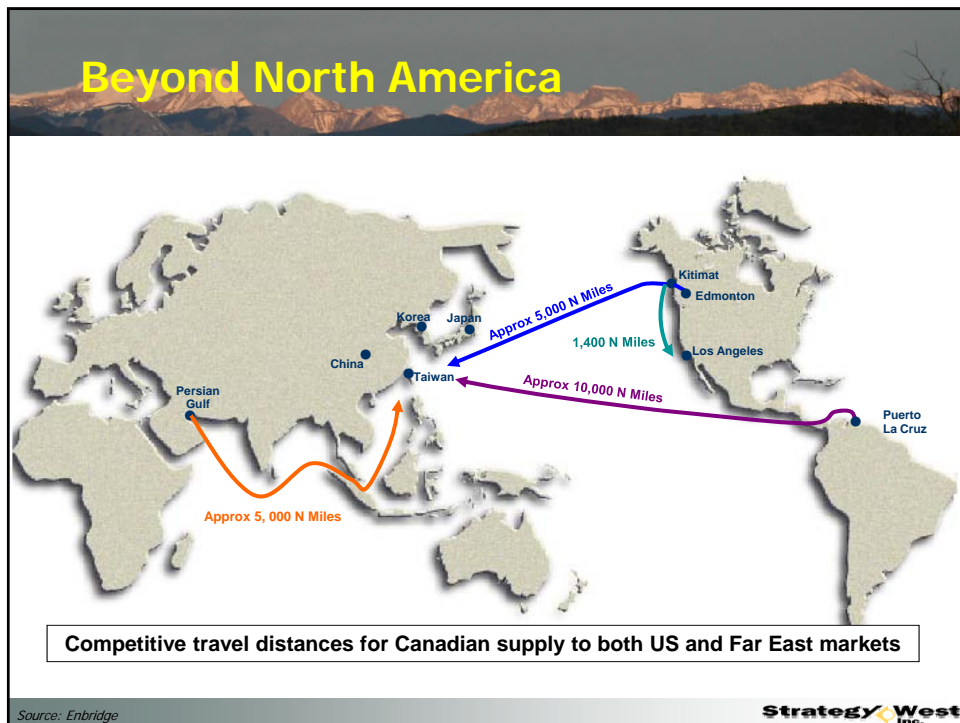
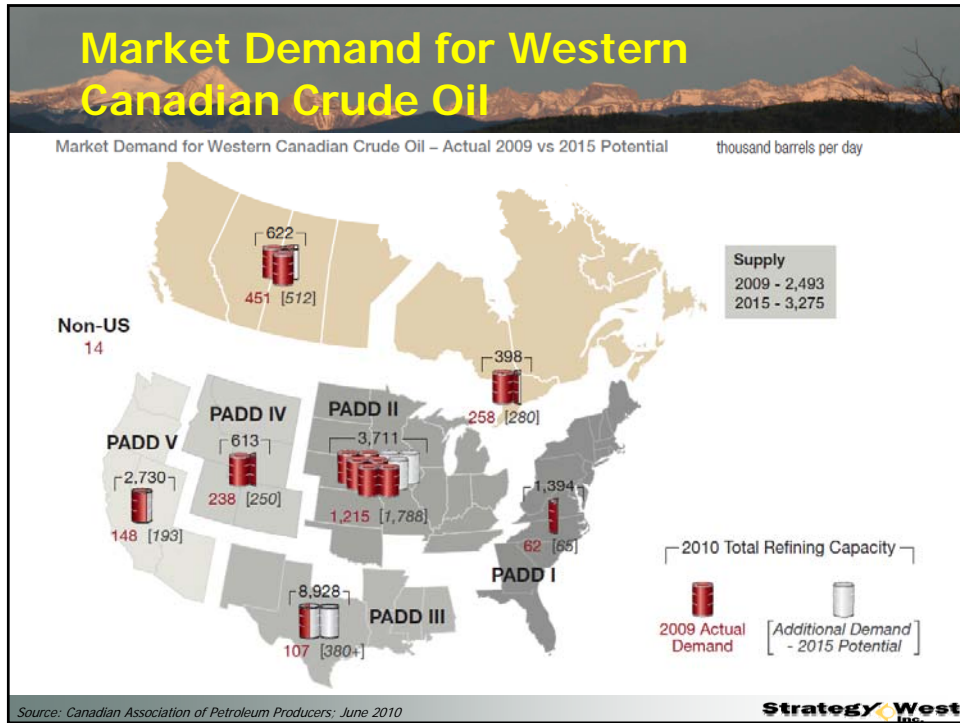
Asphalt

Others

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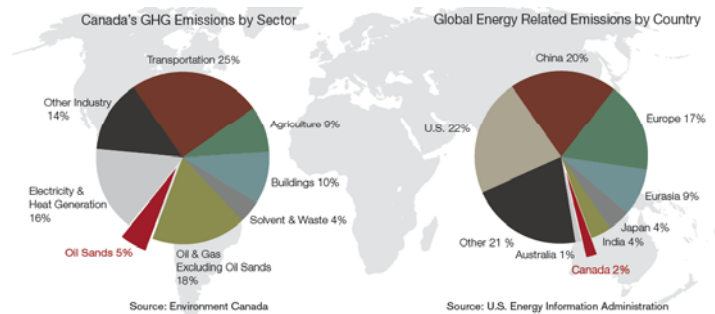
## ENGO Attacks/Industry Image

- It is not possible to deal with all of these issues in the time available
- Two major oil sands industry challenges are discussed in more detail:
  - GHG Emissions
  - Tailings Disposal

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## Oil Sands GHG Emissions

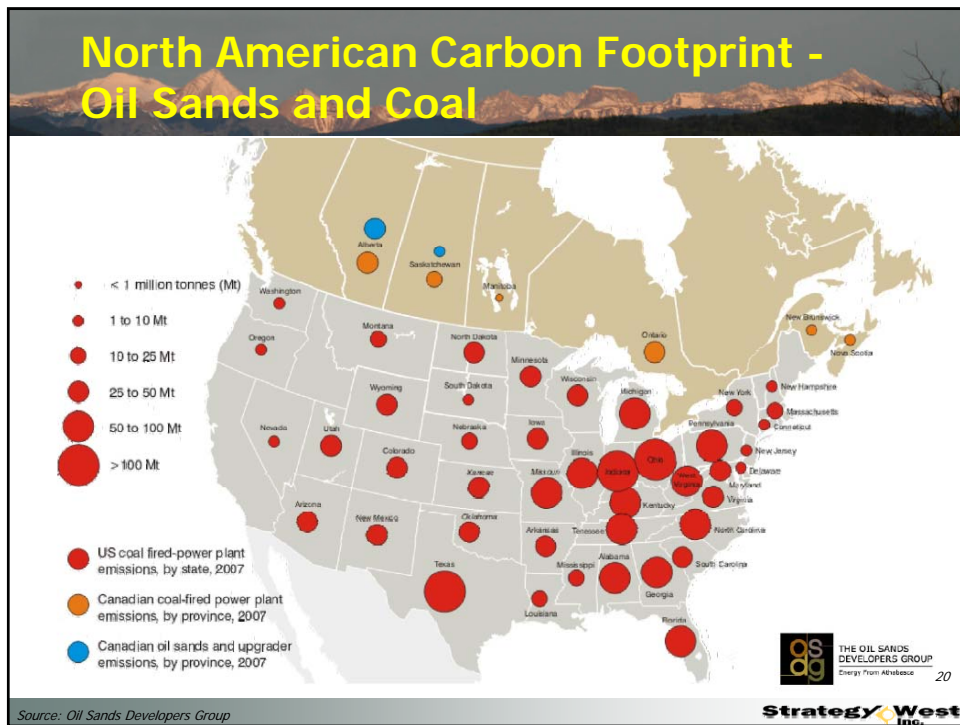
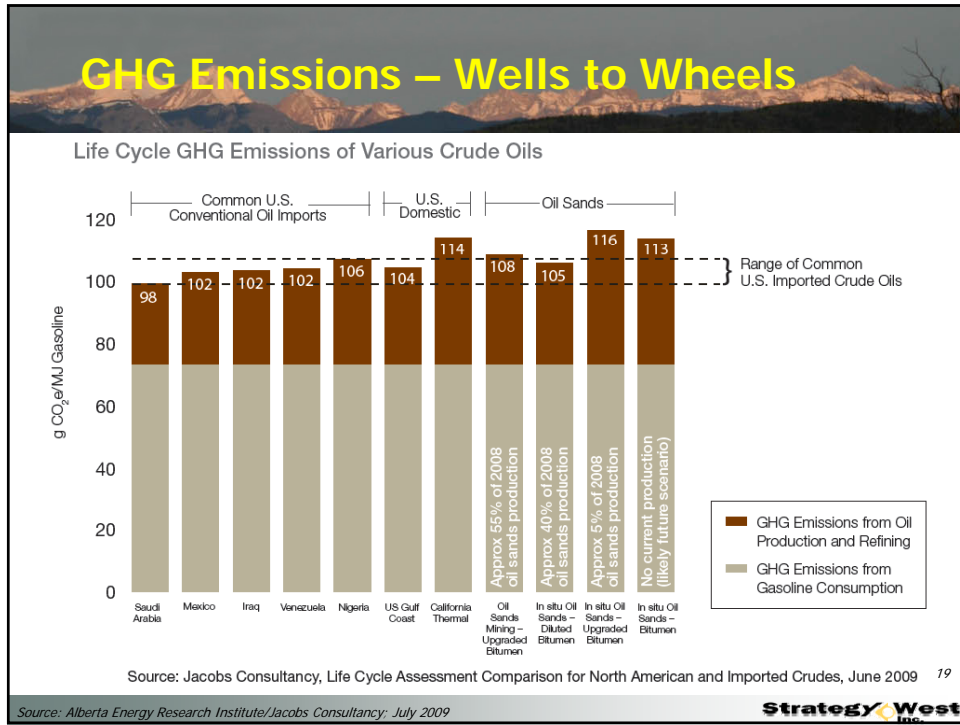
- In 2007, Canada's oil sands industry emitted 38 Mt of GHGs accounting for:
  - Less than 5% of Canadian GHG emissions
  - Less than 0.1% of global GHG emissions



Source: Canadian Association of Petroleum Producers

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## Industry Options to Reduce GHGs

- Improve Existing Processes
  - Reduce energy use
  - Capture fugitive emissions
- Employ New Technologies
  - Gas-fired cogeneration
  - Hybrid steam-solvent in situ processes (i.e., SAP, LASER)
  - In situ combustion processes (i.e., THAI)
  - In situ electric heating (i.e., ET-DSP)
  - VAPEX, N-Solv
- Carbon Capture and Sequestration (CCS)

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## Oil Sands Cogeneration

	Thermal Energy (kWh/b)	Electricity (kWh/b)	Ratio
Thermal In Situ	~300	~10	~30
Mining/Extraction	~70	~13	~5
Upgrading	~30	~12	~2

Cogeneration may be attractive at thermal in situ and mining/extraction projects due to their relatively high thermal energy needs and their relatively low electricity needs.

Cogeneration can be used to provide a project's thermal energy requirements with surplus electricity sold into the Alberta Power Pool.

Cogeneration provides the opportunity to produce electricity at high energy efficiencies – i.e., low GHG emission intensities.

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## Government Investments in Carbon Capture and Storage

- In 2008, Alberta announced a \$2B fund for investment in Carbon Capture and Storage
- Four projects were selected for possible provincial and federal funding:
  - **Shell/Chevron/Marathon - Quest Project**
    - Integrated carbon capture and storage project at the Scotford Upgrader in the Alberta Industrial Heartland
  - **Capital Power/Enbridge – Project Pioneer**
    - Integrated gasification combined-cycle carbon capture power generation facility at the Keephills 3 power plant, west of Edmonton
  - **Enhance/Northwest - The Alberta Carbon Trunk Line**
    - Gasification, CO<sub>2</sub> capture, transportation, enhanced oil recovery and storage in the Alberta Industrial Heartland and central Alberta
    - CO<sub>2</sub> capture from the Agrium fertilizer plant and the Northwest upgrader
  - **Swan Hills Synfuels - in-situ coal gasification (ISCG)**
- **Proposed funding for each project has been announced – final agreements are required**

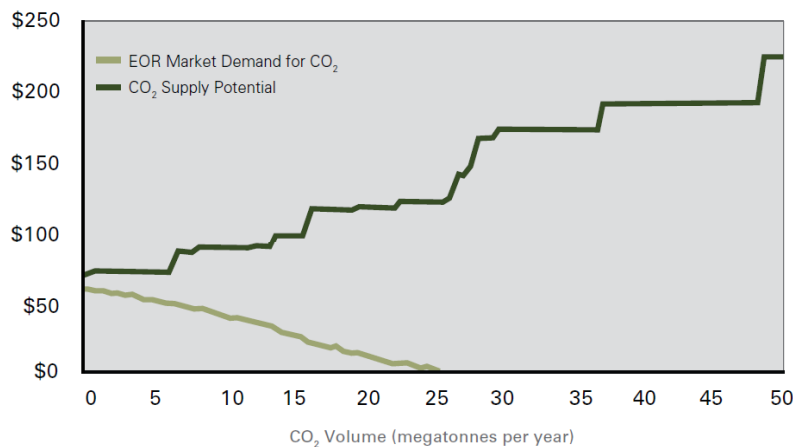
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Source: Alberta Energy

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## CO<sub>2</sub> Supply & EOR Demand Potential

CO<sub>2</sub> Supply & EOR Demand Potential circa 2020 / 2025 with \$75 Oil Price (WTI)  
(Supply cost includes capture and transport costs)



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Source: ICO2N, October 2009

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## CCS Summary

- CCS has potential to reduce the carbon footprint of the oil sands industry
- CCS is very costly
  - Gasification of bitumen residues provides the best opportunity for CO<sub>2</sub> capture in the oil sands
  - CO<sub>2</sub> capture from new and retrofitted SMRs may also be feasible
  - CO<sub>2</sub> capture from flue gases is very expensive
- EOR requires low-cost CO<sub>2</sub>
- The funding gap must be closed to achieve meaningful capture volumes
  - Government action would be necessary

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## Tailings Disposal at Oil Sands Mining & Extraction Operations

- Tailings are an aqueous waste product of the bitumen extraction process
- Tailings contain:
  - Unrecovered bitumen
  - Sand, silts and clays
  - Residual solvents and chemicals from bitumen extraction
- Fluid fine tailings are difficult to consolidate
- Alberta's inventory of fluid fine tailings that require long-term containment is now 840 10<sup>6</sup> m<sup>3</sup>
- Tailings ponds today are approximately 170 km<sup>2</sup>



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Source: Pembina Institute; Alberta Energy Resources Conservation Board

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## ERCB Directive 074

- *Directive 074: Tailings Performance Criteria and Requirements for Oil Sands Mining Schemes, was released February 3, 2009*
- Directive 074 requires operators to:
  - Prepare tailings plans and report on tailings ponds annually
  - Reduce the accumulation of tailings by capturing fine particles, that would otherwise remain suspended in tailings ponds, and placing them in a deposit that is “trafficable”
  - Specify dates for construction, use and closure of tailings ponds and file these dates with the ERCB by September 30, 2009.
- Operators’ compliance plans are available on the ERCB website. Supplemental Information Requests will also be available when they are completed.

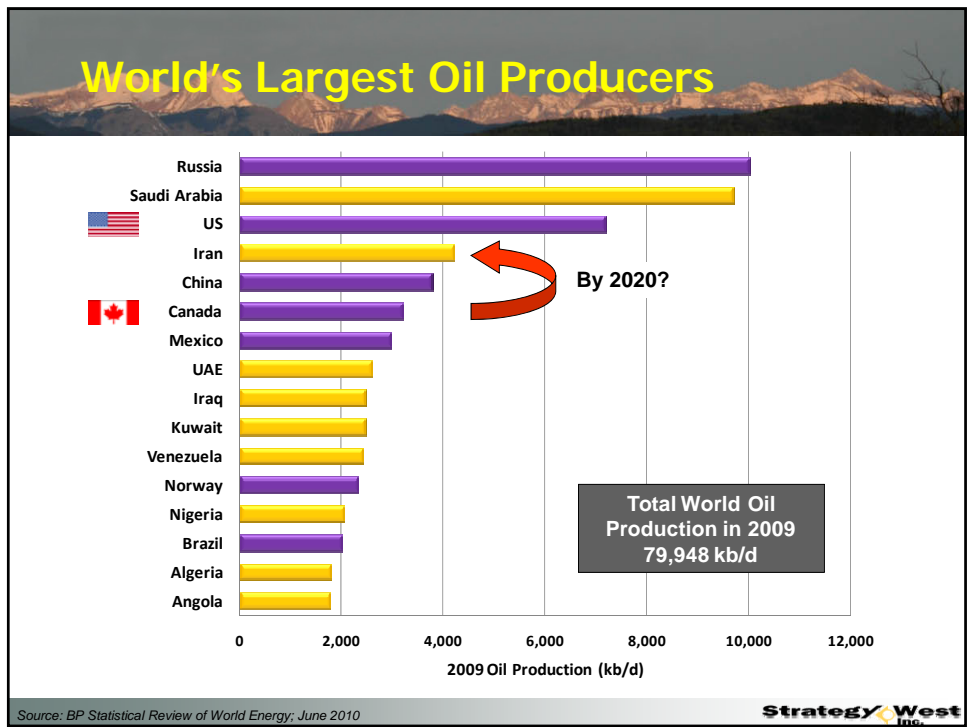
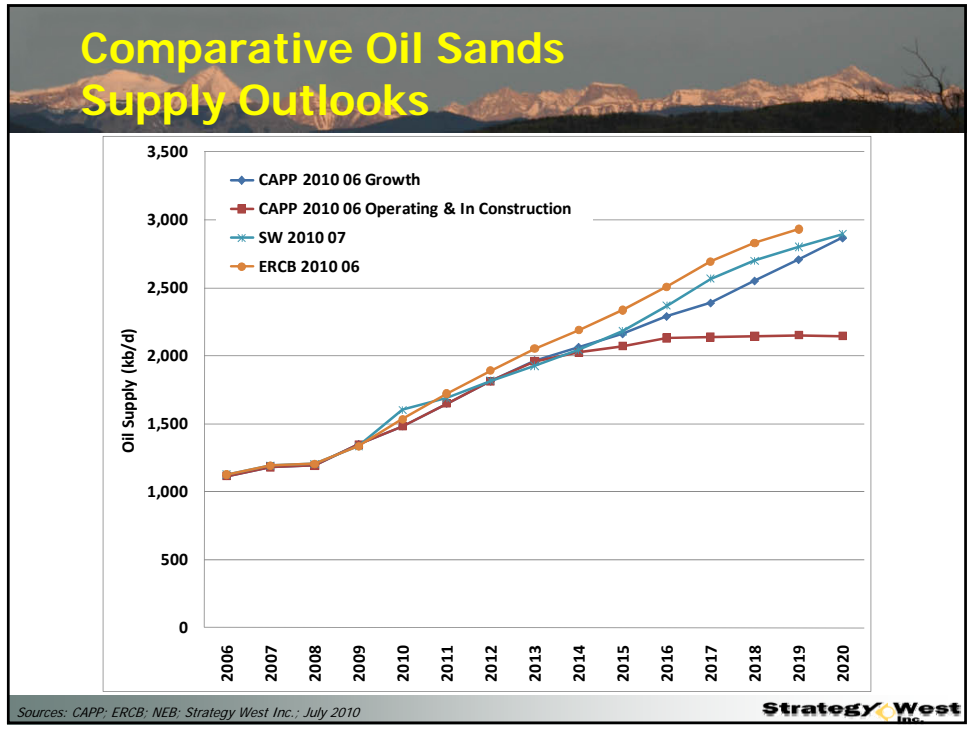
Source: Alberta Energy Resources Conservation Board

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## Compliance with Directive 074

- ERCB Conditional Approvals
  - Syncrude Mildred Lake and Aurora North (April 22, 2010)
    - MFT centrifugation
    - Commercial demonstration plant to be in operation by August 2011 with start up of a full-scale supplemental tailings plant by June 2015
    - Untreated MFT to end-pit lakes at end of mine life
  - Suncor Fort Hills (April 22, 2010)
    - Thin-lift drying of fluid fine tailings in Dedicated Disposal Areas (DDAs)
    - Pilot testing required
    - Zero inventory of Mature Fine Tailings (MFT) at end of mine life
  - Suncor Base, Steepbank and Millennium (June 17, 2010)
    - TRO (polymer flocculation and thin-lift drying)
    - Untreated MFT to end-pit lakes at end of mine life
  - Imperial Kearn Lake (August 11, 2010)
    - Commence TSRU tailings treatment and disposal in the in-pit DDA by March 31, 2018
    - Tailings pond to be decommissioned by 2038
  - Athabasca Oil Sands Project Muskeg River (September 20, 2010)
    - Atmospheric Fines Drying (AFD)
    - Commercial operations to commence by June 30, 2013
- Plans submitted by CNRL (Horizon) and AOSP (Jackpine) are still under review

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## Conclusions

- Canada's oil sands deposits are among the world's largest hydrocarbon accumulations.
- The oil sands industry is well established and making a significant contribution to global oil supply.
- The 2008/2009 financial and economic crisis caused project deferrals and cancellations.
- Industry growth has resumed; however, the growth rate will depend on oil prices and how industry and government address the many challenges the industry faces.

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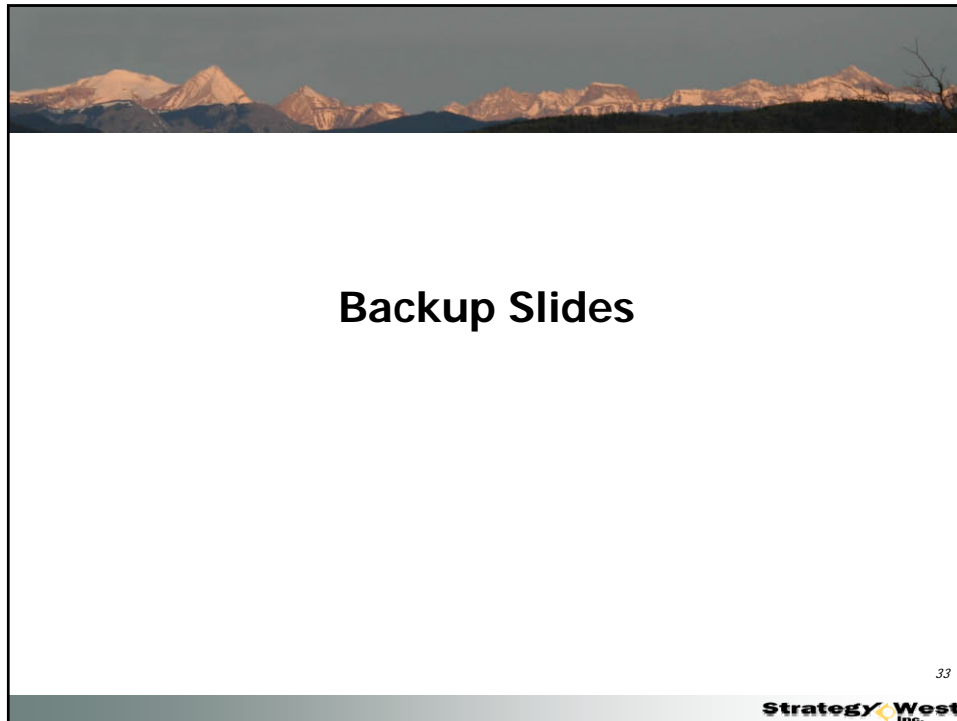
## Thank You

## Questions?

Please visit  
[www.strategywest.com](http://www.strategywest.com) for oil  
sands project lists and other  
detailed oil sands industry  
information

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## Canada's GHG Emission Reduction Commitments

- **1997 Kyoto Protocol**
  - Protocol to the United Nations Framework Convention on Climate Change (UNFCCC or FCCC), aimed at combating global warming
  - Initially adopted on December 11, 1997 in Kyoto, Japan and entered into force on February 16, 2005
  - As of November 2009, 187 states had ratified the Protocol
- **Canada's Kyoto Commitments**
  - Ratified by Canada on December 17, 2002 and committed to reduce GHG emissions to 6% below 1990 levels by 2008-2012
  - These commitments were not met
- **2009 Copenhagen Accord**
  - In January 2010, Canada submitted conditional targets to reduce GHG emissions to 17% below 2005 levels by 2020
  - Detailed plans have not been released

Source: Environment Canada

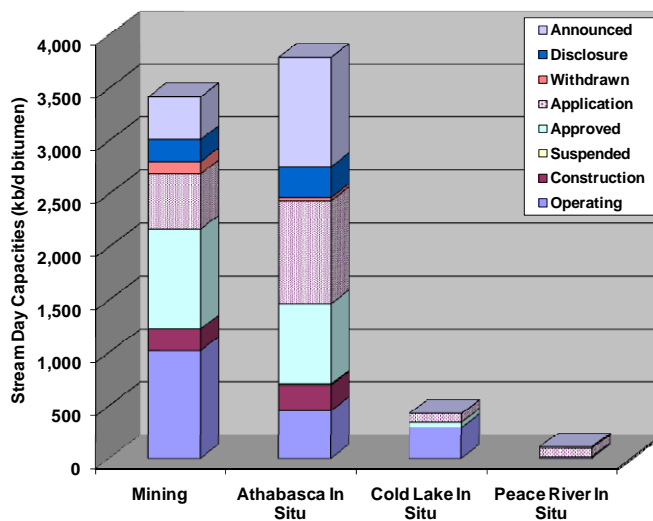
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## Strategy West's Oil Sands Industry Outlooks

- Comprehensive Project Database
- Industry Outlooks
  - Project-by-project timing adjustments
  - Project-by-project probabilities
  - Aggregation of results
- Project listing may be downloaded at [www.strategywest.com](http://www.strategywest.com)

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## Oil Sands Project Wish List



Sources: Operator Applications and Announcements; Strategy West Inc.; July 2010

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