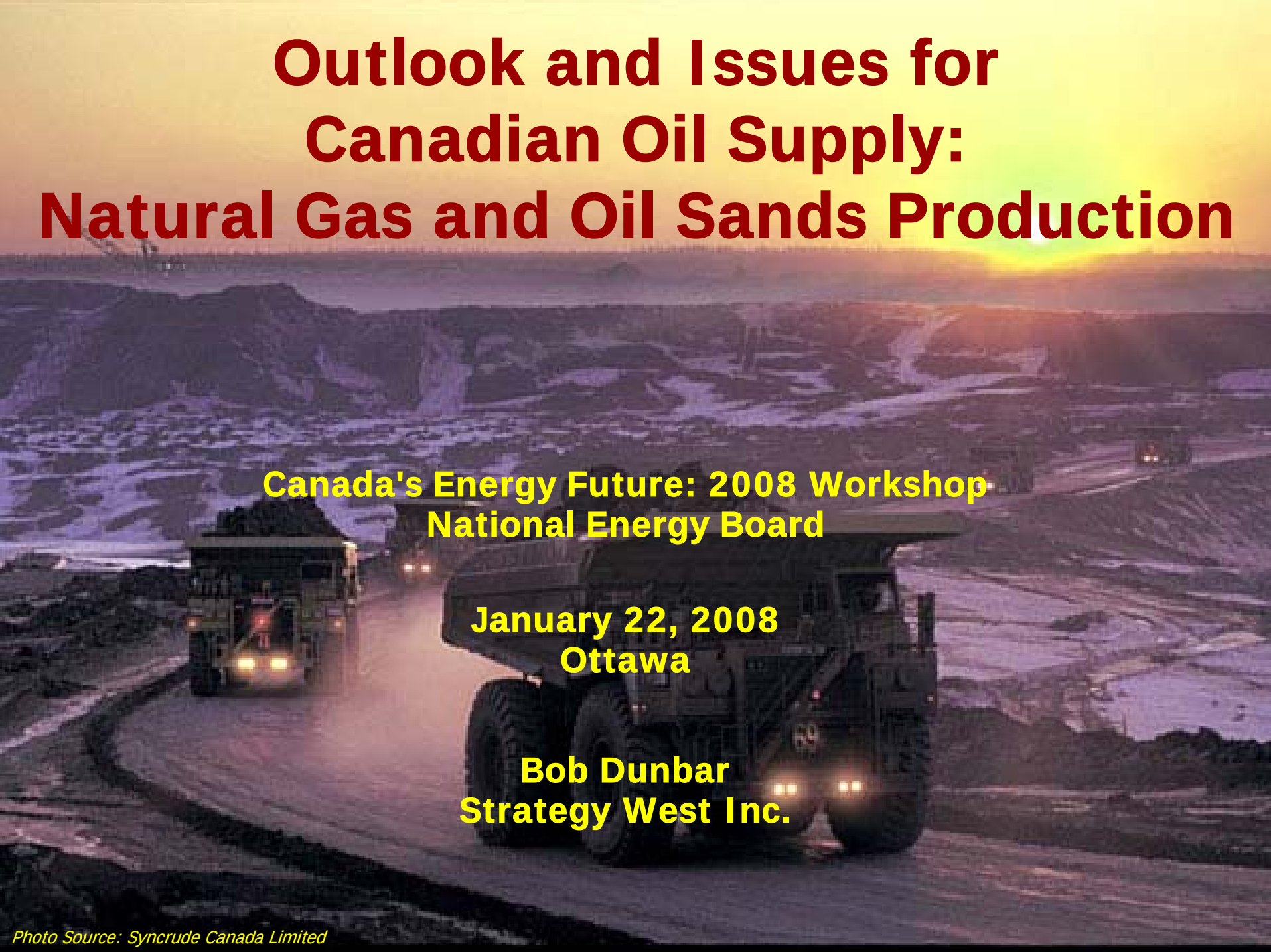
Outlook and Issues for Canadian Oil Supply: Natural Gas and Oil Sands Production



Canada's Energy Future: 2008 Workshop
National Energy Board

January 22, 2008
Ottawa

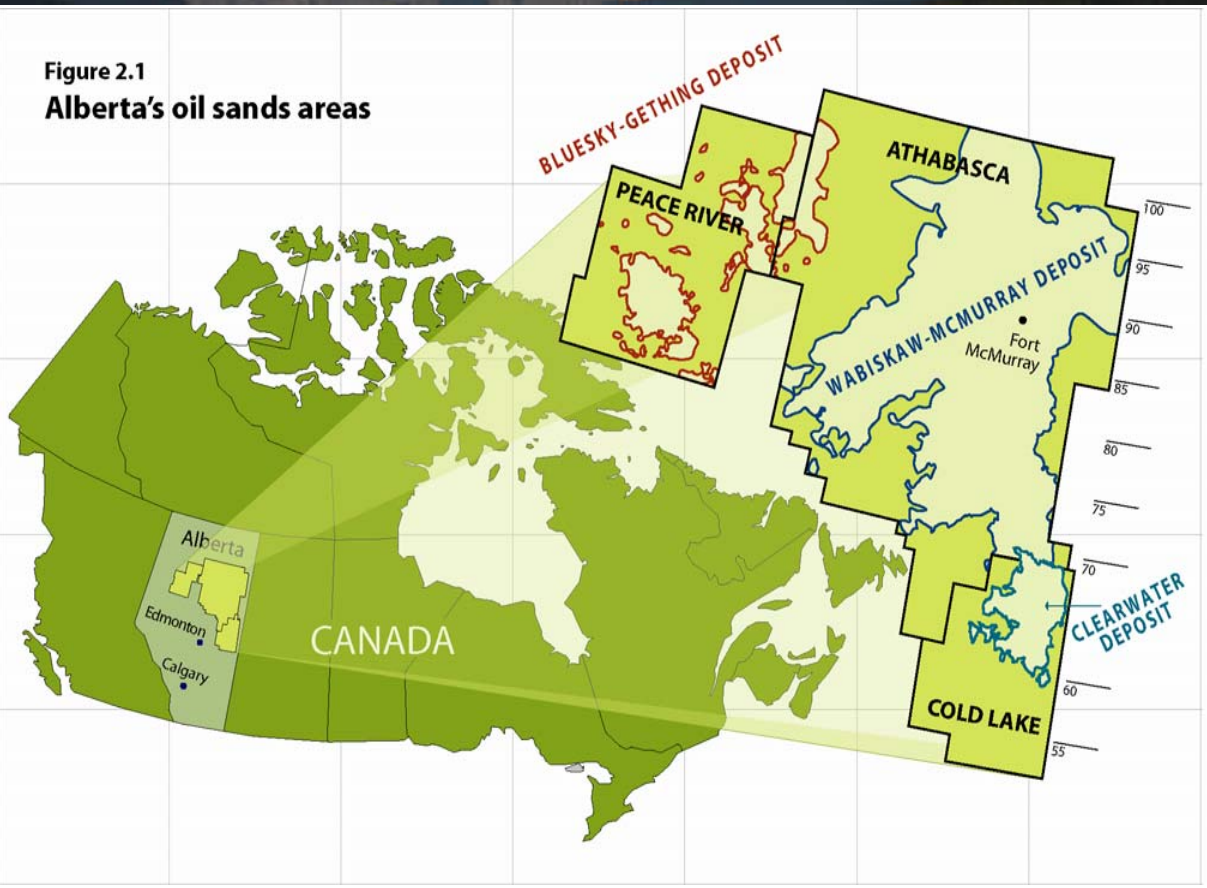
Bob Dunbar
Strategy West Inc.

Photo Source: Syncrude Canada Limited

Presentation Outline

- Oil Sands Industry Overview
- Unadjusted Oil Sands Production Outlook
- Oil Sands Industry Challenges and Sustainability
- Oil Sands Energy and Hydrogen Requirements
  - Current Sources
  - Industry Options to Reduce Purchased Gas Requirements
- Conclusions

Resources and Reserves

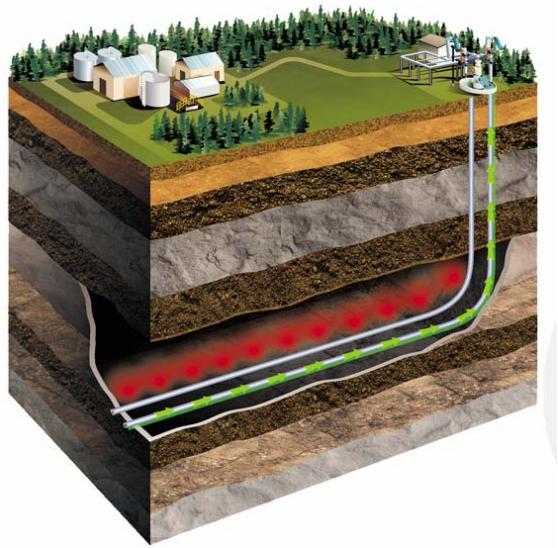


- 3 Oil Sands Areas (OSAs) comprising 15 Oil Sands Deposits (OSDs)
- 140,000 square kilometres (54,000 square miles)
- Data at year-end 2006

- **Initial volume in place (bitumen): 1,701 billion barrels**
- **Initial established reserves: 178.7 billion barrels**
- **Cumulative production: 5.4 billion barrels**
- **Remaining established reserves: 173.2 billion barrels**
- **Remaining established reserves under active development: 21.0 billion barrels**

Source: EUB ST98-2007; Alberta's Energy Reserves 2006 and Supply/Demand Outlook 2007-2016; June 2007

Mineable and In Situ Resources and Reserves



Mineable Resources/Reserves

- < 75m (250 ft) to top of oil sands
- Athabasca Oil Sands Area only
- 6% of initial volume in place
- 20% of initial established reserves
- 67% of cumulative production to year-end 2006

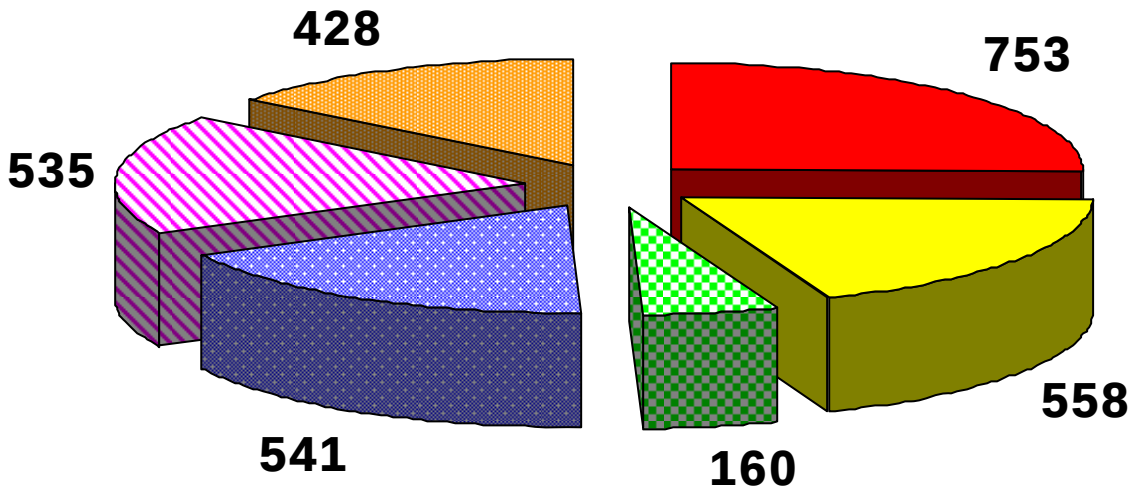
In Situ Resources/Reserves

- > 75m (250 ft) to top of oil sands
- Athabasca, Cold Lake and Peace River Oil Sands Areas
- 94% of initial volume in place
- 80% of initial established reserves
- 33% of cumulative production to year-end 2006

Source: EUB ST98-2007; Alberta's Energy Reserves 2006 and Supply/Demand Outlook 2007-2016; June 2007

Canadian Oil Production

Alberta's Oil Sands provided 44% of Canada's "crude oil" production in 2007 (Canada's total: 2,975 kb/d)

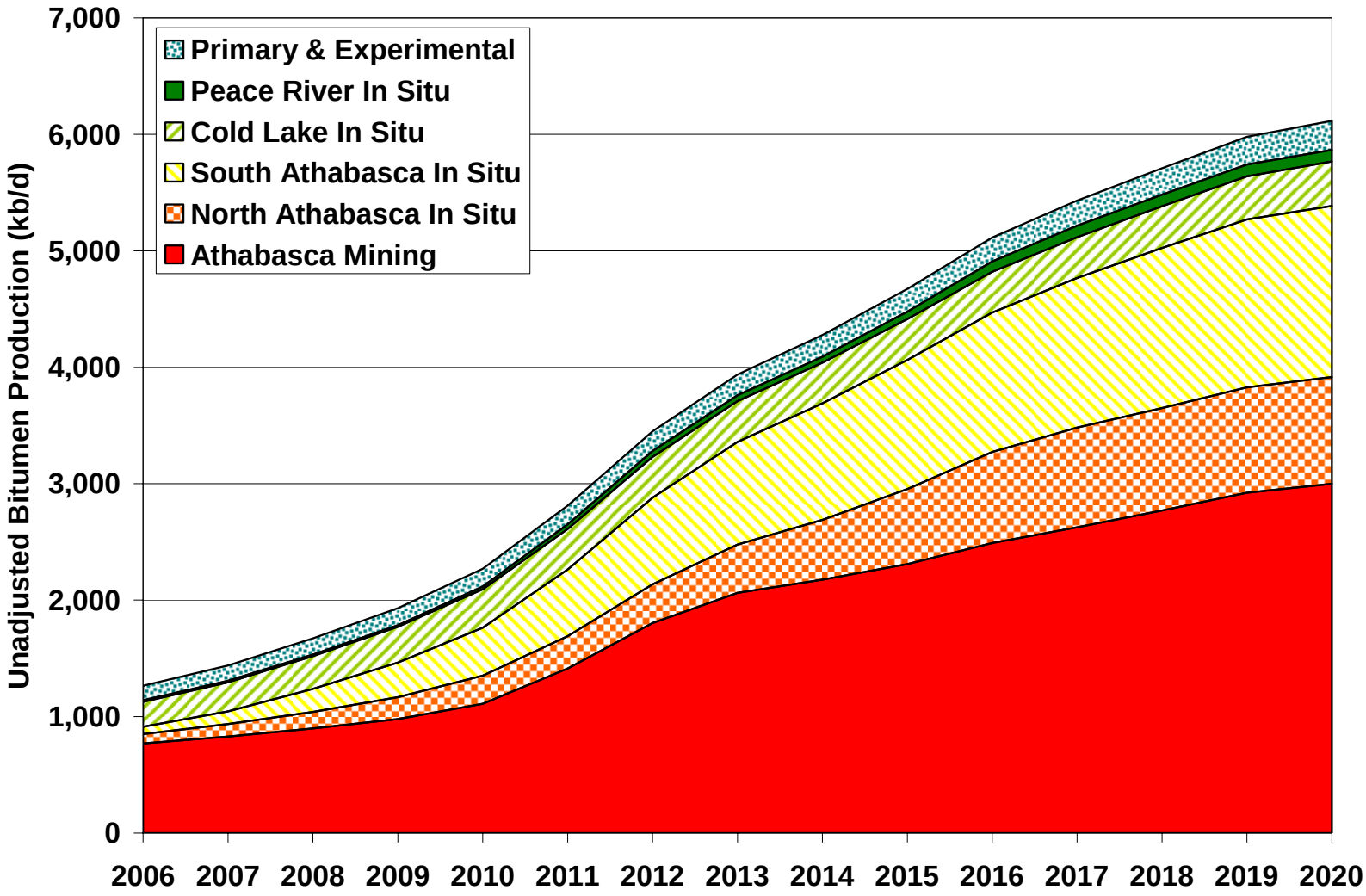


Total SCO and Bitumen 1,311 kb/d

(all figures thousand b/d)

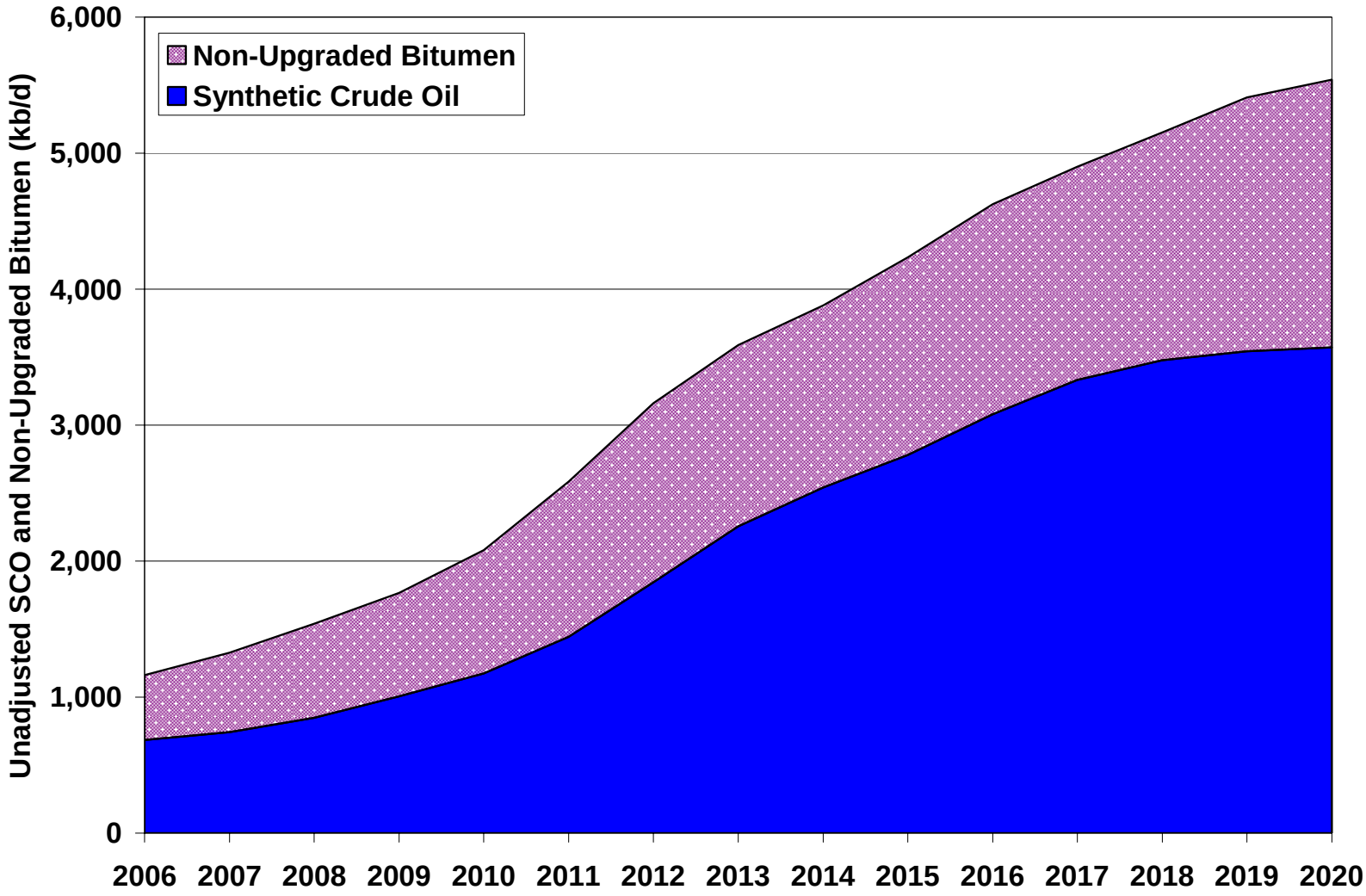
Source: National Energy Board; Preliminary Data; November 6, 2007

Bitumen Production Outlook - Unadjusted Case



Source: Strategy West Inc.

SCO and Non-Upgraded Bitumen Supply Outlook - Unadjusted Case



Source: Strategy West Inc.

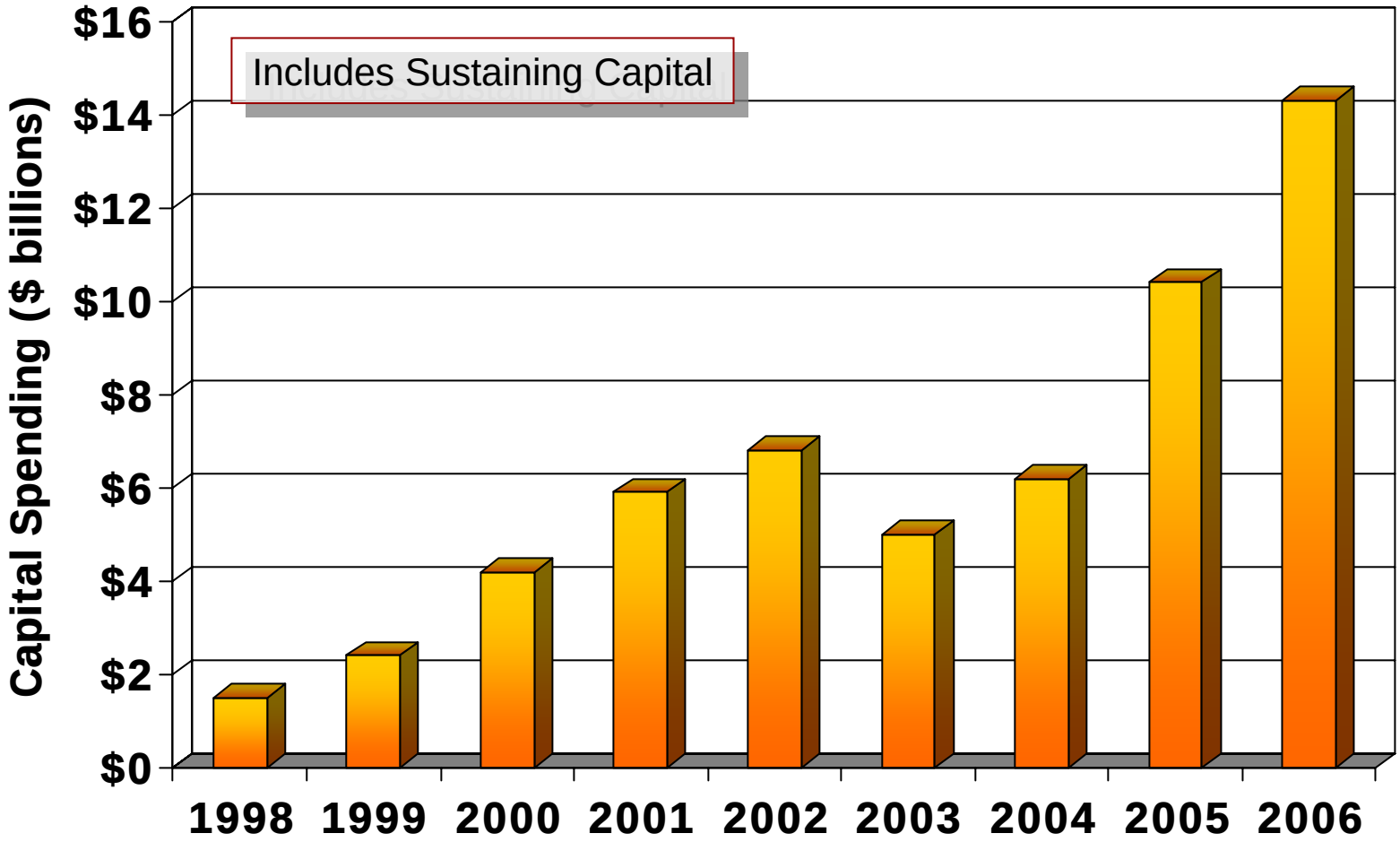
CAPEX – Unadjusted Case

	Production Increase 2008-2020 (million b/d)	Initial CAPEX (2007 C$ per b/d)	Average Annual Initial CAPEX 2008-2020 (2007 C$ billions)
Mining & Extraction	2.2	$40,000 (Bitumen)	$6.7
In Situ	2.5	$10,000-$35,000 (Bitumen)	$5.7
Incremental Production	4.7		$12.4
Upgrading	2.8	$50,000 (SCO)	$10.9
Total CAPEX			$23.3

Note: does not include sustaining capital

Source: Strategy West Inc.

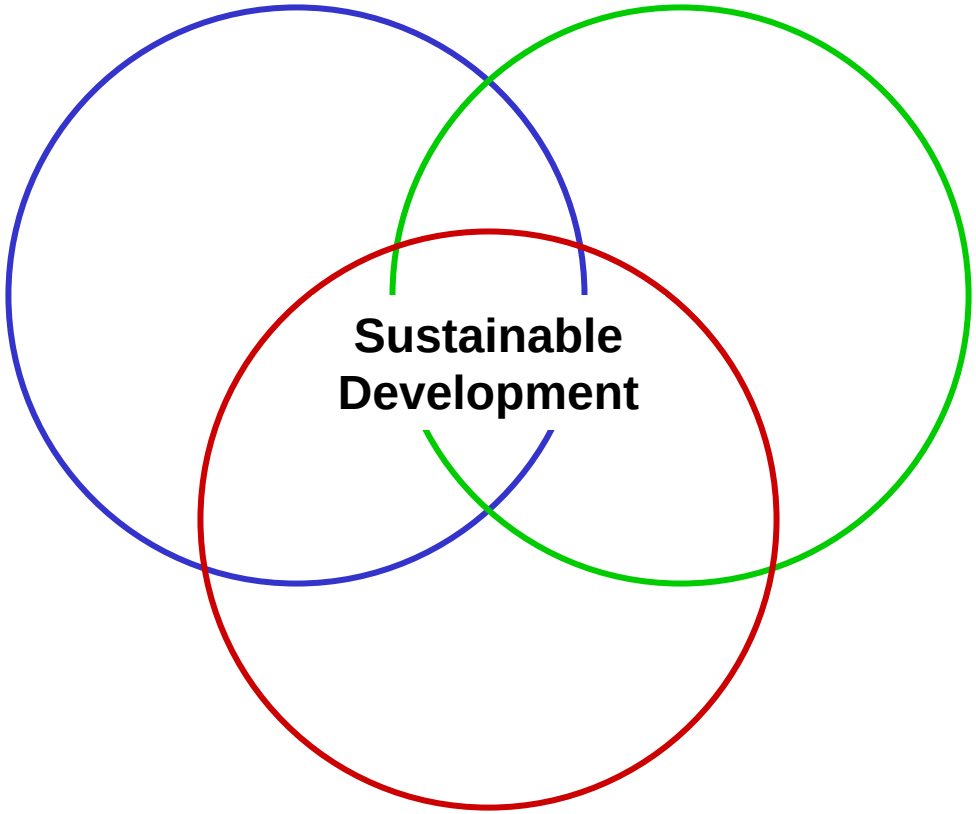
Oil Sands Historical CAPEX



Source: Canadian Association of Petroleum Producers

Oil Sands Industry Challenges and Sustainability

The "Triple Bottom Line"



Oil Sands Energy and Hydrogen Requirements

Energy

- In situ steam and process heat
- Mining/extraction process heat
- Upgrading process heat
- Electricity

Hydrogen

- Hydro-conversion processes (upgrading)

Current Sources of Thermal Energy, Hydrogen and Electricity

Thermal Energy

- Purchased natural gas
- Produced gases (in situ projects)
- Process gases (upgraders)
- Liquid hydrocarbon fuels
- Crude bitumen
- Coke and other bitumen residues (upgraders)

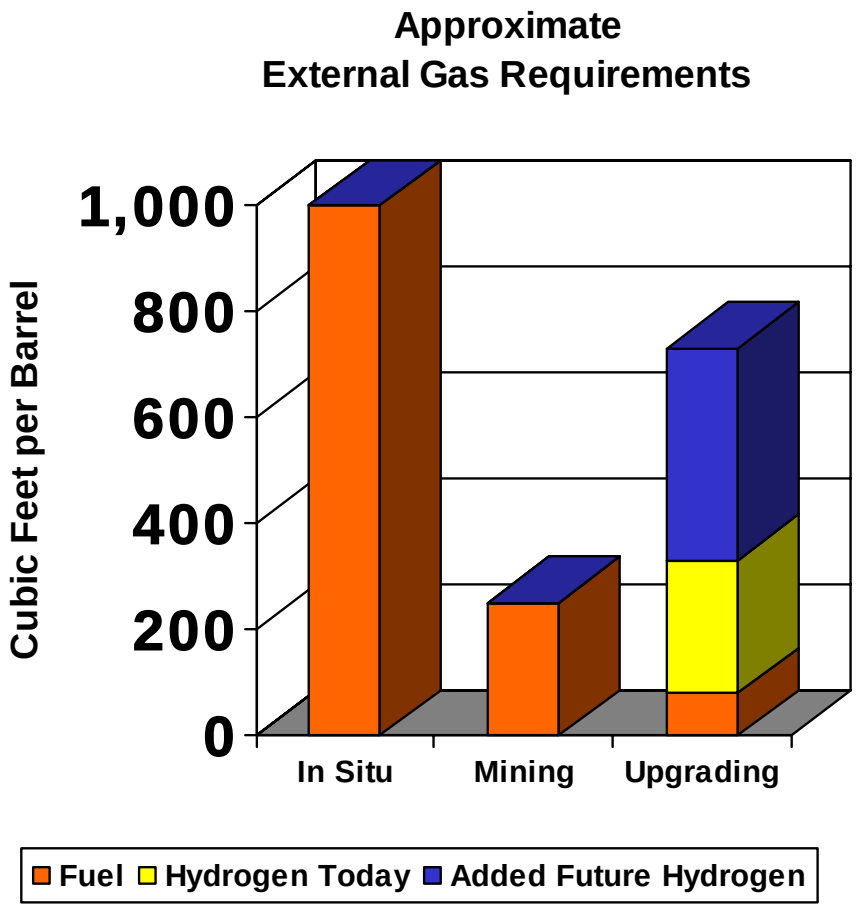
Hydrogen

- Steam Methane Reforming (natural gas)

Electricity

- On-site generation
- Purchased electricity

Oil Sands Purchased Natural Gas Requirements



- Thermal in situ projects are very large energy consumers – gas use depends on recovery performance
- Gas use for upgrading is higher for production of higher quality synthetic crude oil

Source: Oil Sands Technology Roadmap

Industry Options to Reduce Purchased Gas Requirements

- Conservation/Energy Efficiency Improvements
- New (Less Energy Intensive) Bitumen Recovery Technologies
  - In Situ
  - Mining and Extraction
- Alternative Sources of Thermal Energy, Electricity and Hydrogen
  - Gasification of Bitumen Residues
  - Combustion of Bitumen/Bitumen Residues
  - Nuclear

New In Situ Bitumen Recovery Technologies

- In Situ Combustion
  - Toe-to-Heel-Air-Injection (THAI)
- Solvent Injection
  - VAPEX
  - Thermal Solvent
- Hybrid (Steam-Solvent) and Co-injection Processes
- Polymer Flooding
- Electric Heating

THAI Process

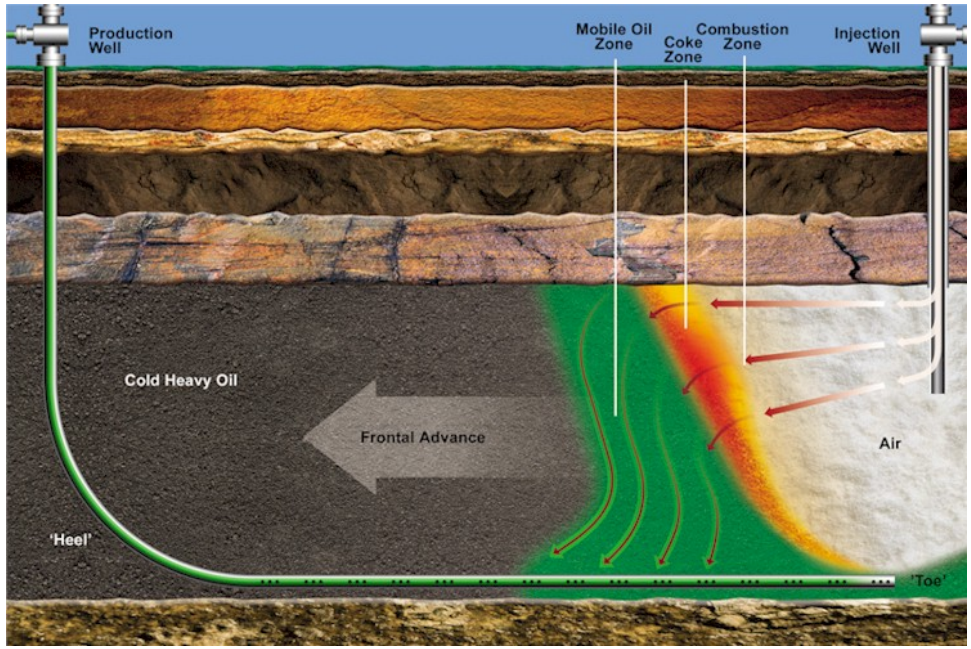


Image Source: Petrobank Energy and Resources

New Mining/Extraction Bitumen Recovery Technologies

- Mining
  - Mine-face Ore Preparation
- Extraction
  - Low-Energy Extraction
  - High-temperature Froth Treatment
  - Asphaltenes Recovery and Use
  - Bitmin Process
- Mine-face Extraction

Suncor's Mobile Crusher

Image Source: Suncor Energy Inc.

Oil Sands Gasification Projects

Project	Gasification Status
OPTI/Nexen Long Lake Phases 1-4	Construction (Phase 1)
North West Upgrading Phases 1-3	Approved
Northern Lights Phases 1 & 2	Application
Shell Scotford Upgrader 2 Phases 1-4	Application
Suncor Voyageur Phase 2	Being Evaluated
Fort Hills Sturgeon Phases 2 & 3	Being Evaluated
CNRL Horizon Phases 4 & 5	Being Evaluated
CNRL Primrose Phases 1 & 2	Being Evaluated
NAOSC Upgrader Phase 2	Being Evaluated

Source: Project Applications and Company Announcements

Combustion of Bitumen / Bitumen Residues

- Coke Burning
  - Suncor power plant
  - Syncrude Fluid Cokers
- **M**ultiphase **S**uperfine **A**tomized **R**esidue (MSAR)
- Asphaltenes
  - Mining project cogeneration facilities
- Issues
  - SO_2 and particulate emissions require flue-gas scrubbing
  - CO_2 emissions exceed those from combustion of natural gas
- Opportunities
  - O_2 firing
  - CO_2 capture

The Nuclear Option

Potential Benefits

- Reduced Greenhouse Gas Emissions
- Competitive Thermal Energy and Electricity Cost
- Long-Term Price Stability

Issues

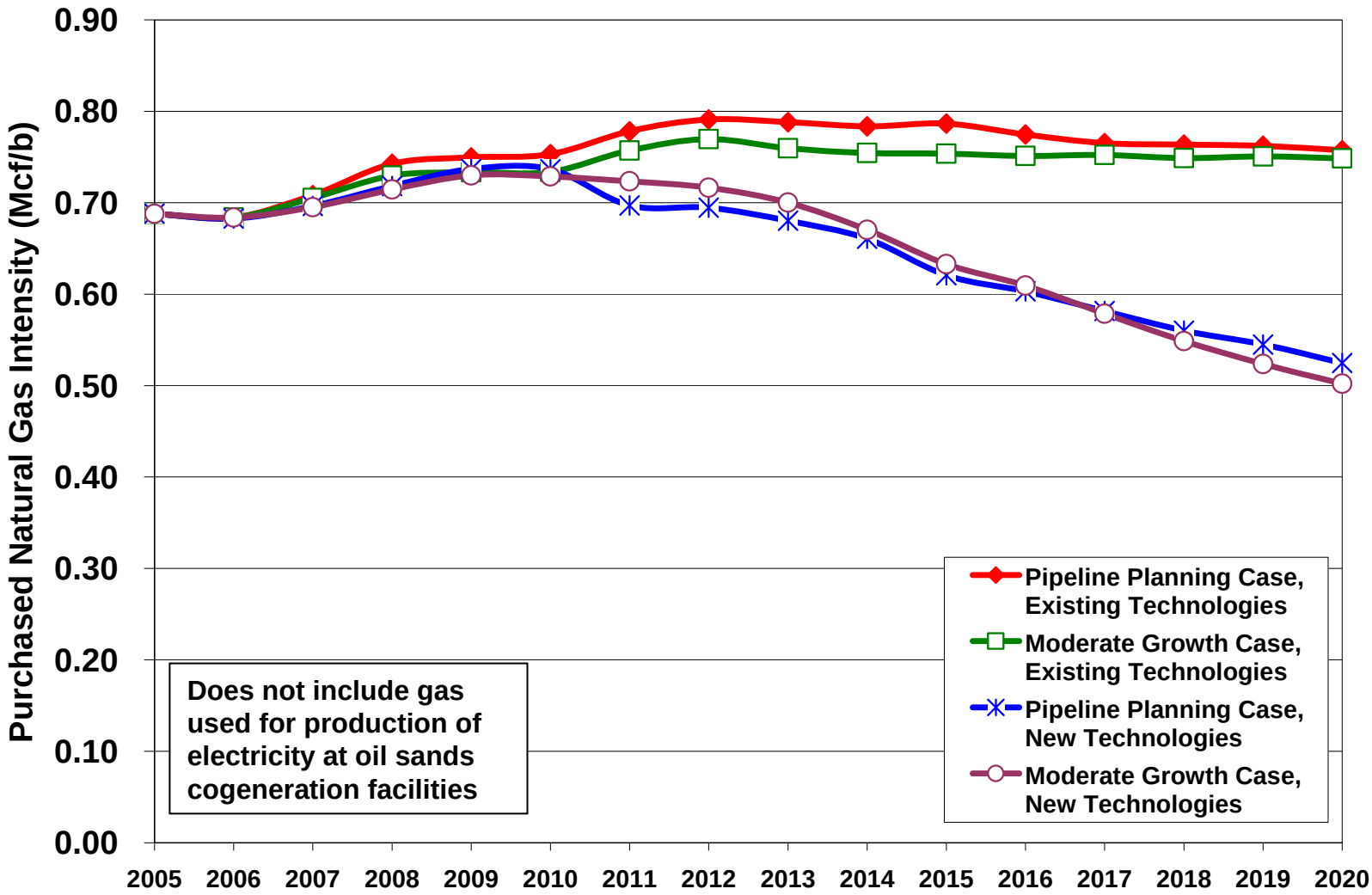
- Public Concerns
  - Safety
  - Terrorist threats
  - Nuclear waste disposal
- Capital Cost
- Reactor Size/ Technology
- Reliability/ Refurbishment
- Timing
  - Alberta nuclear by 2017?
  - All technologies must be certified by the CNSC

Strategy West/CAPP Study: Gas Use by the Canadian Oil Sands Industry

- Examination of the oil sands industry's present and future energy needs and energy sources over the 2006 to 2020 period to identify:
  - Industry gross thermal energy requirements consistent with CAPP's Canadian Crude Oil Production and Supply Forecast
  - Use of associated natural gas at bitumen production facilities
  - Use of process gases at upgrading facilities
  - Natural gas purchases after accounting for use of associated natural gas and process gases
- Strategy West's assessment was released in the report *Gas Use by the Canadian Oil Sands Industry* dated December 2007

Sources: Canadian Association of Petroleum Producers; Strategy West Inc.

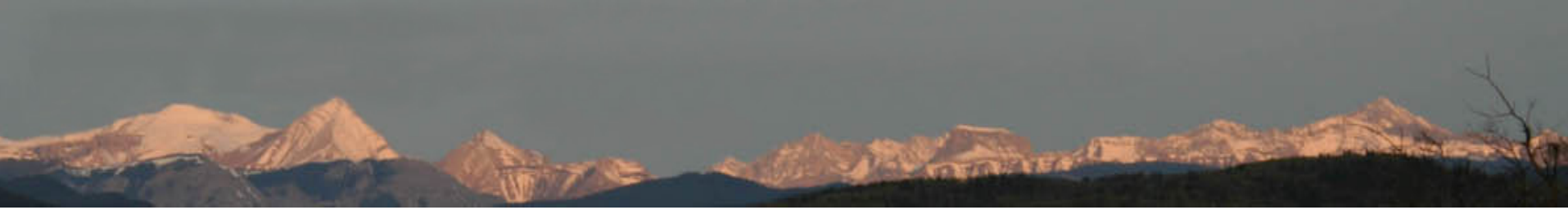
Projected Oil Sands Industry Purchased Natural Gas Intensities



Sources: Canadian Association of Petroleum Producers; Strategy West Inc.

Wrap-up and Conclusions

- Canada's oil sands deposits are among the world's largest hydrocarbon accumulations.
- The industry is well developed and making a substantial contribution to global oil supply.
- The oil sands industry is aggressively taking action to reduce its consumption of purchased natural gas.
- While the many challenges facing the industry will cause some project delays and cancellations, these challenges are being addressed and the industry will continue to grow.



Thank You

Questions?

Please visit www.strategywest.com for oil sands project lists and other detailed oil sands industry information