Alberta's Oil Sands Resources, Production Growth,Products and Markets

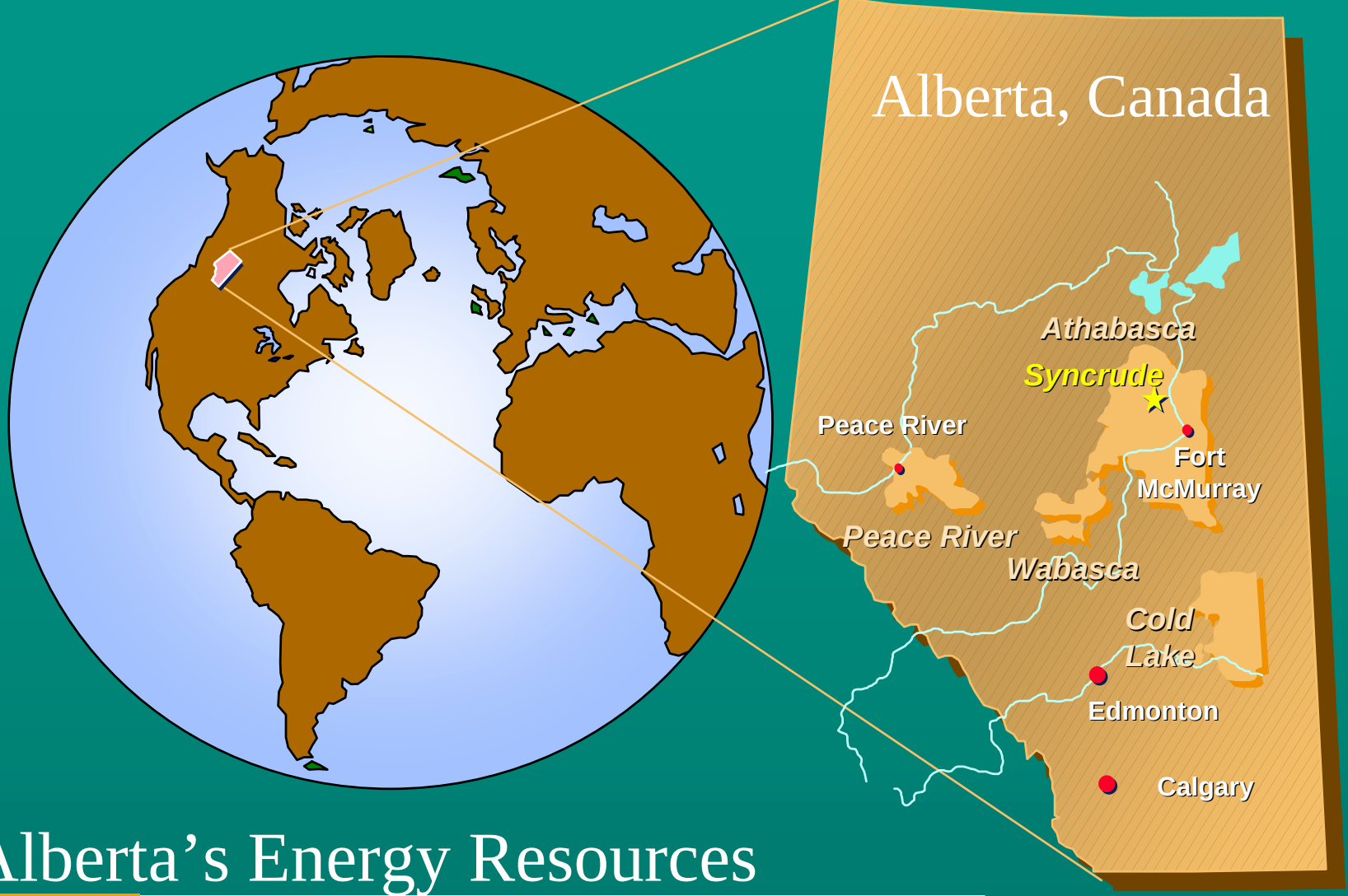
Duke du Plessis. Senior Advisor
Alberta Economic Development
and
Alberta Energy Research Institute
Calgary, Alberta , Canada

October 18, 2004

Snapshot of Alberta's Energy Industry

- Alberta has abundant energy resources and a vibrant energy industry
- World's 3rd largest natural gas producer
- 9th largest crude oil producer
- Large investments in expanding oil sands production
- Maintaining global competitiveness with new technologies
- Secure and efficient access to markets
- Planned pipeline expansions will provide increased access to Asia
- Attractive investment opportunities


Alaska Gas
Mackenzie Delta Gas
(developing)
Western Sedimentary Basin
Gas
Athabasca Oil Sands
Prince Rupert
Kitimat
Pacific Ocean
Edmonton
Vancouver
Coal/ Methane
Calgary
Seattle
Portland
Regina
Winnipeg
Denver
Minneapolis
Montreal
Ottawa
San Francisco
Chicago
Toronto
Buffalo
Philadelphia
Los Angeles
Dallas
Houston
Alberta - A major Energy hub in North America



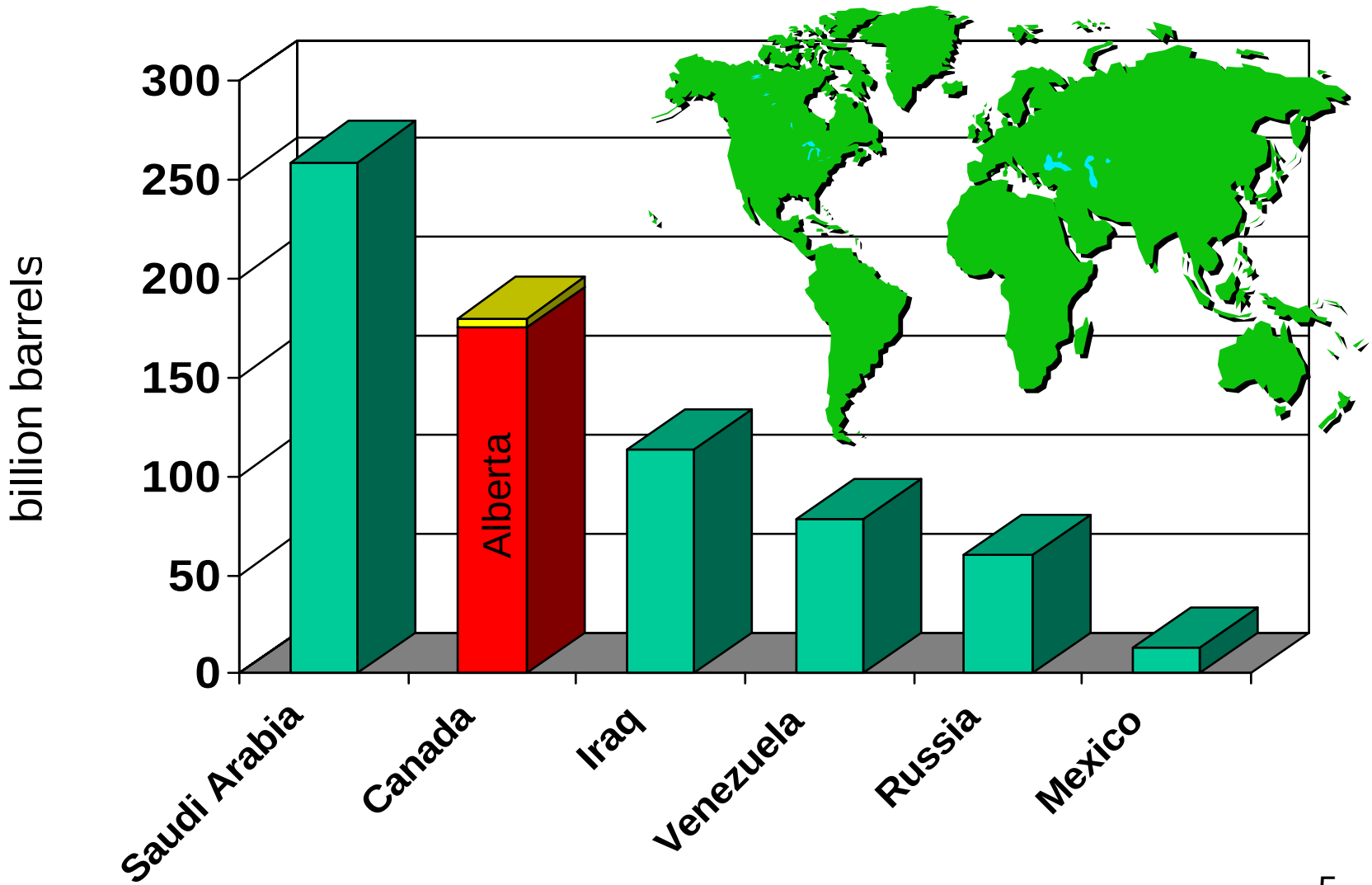
Alberta's Energy Resources

Resources	Oil	Gas	Bitumen	Coal
	Million m3	Million m3	Million m3	Mill tonnes
Remaining Reserve	291	1211	27,810	34,000
Annual Production	43.5	140.7	100.23*	34
Remaining Life	7	9	580	1000

Coal Bed Methane

>3,600 Million m^3

Proven World Reserves



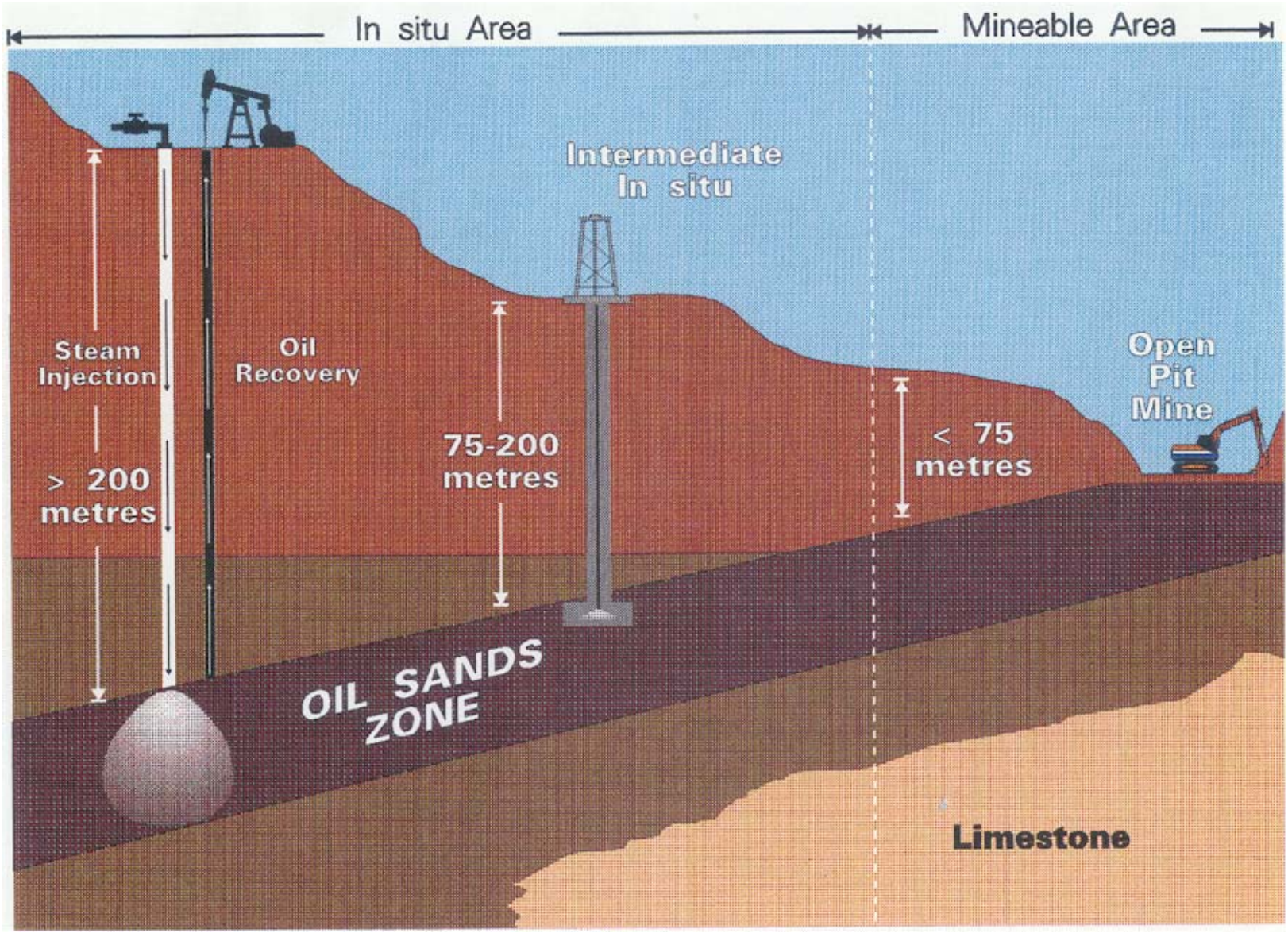
Sources: Oil and Gas Journal – Dec 2002, AEUB

The Oil Sands Resource

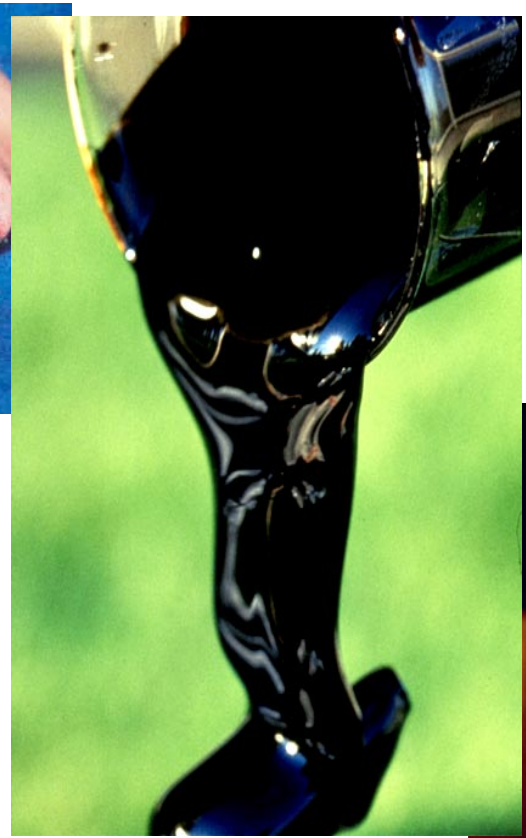
- 174 billion barrels of proven reserves
- 500 years of supply available at current production rates (app.. 1 million bbls/day)
- Production based on current *mining* and *In-situ* techniques
- Marketed to Canadian and US refineries (primarily Midwest US)
- $24 billion in investment – 1996 to 2003

The Nature of the Oil Sands Resource

- Different technologies required for Mining and in Situ Areas -



Continuous Innovation Since the 1930's



From Oil Sands → **To Bitumen** → **To Synthetic crude oil**

Nature of Alberta Bitumen

Bitumen Characterized by

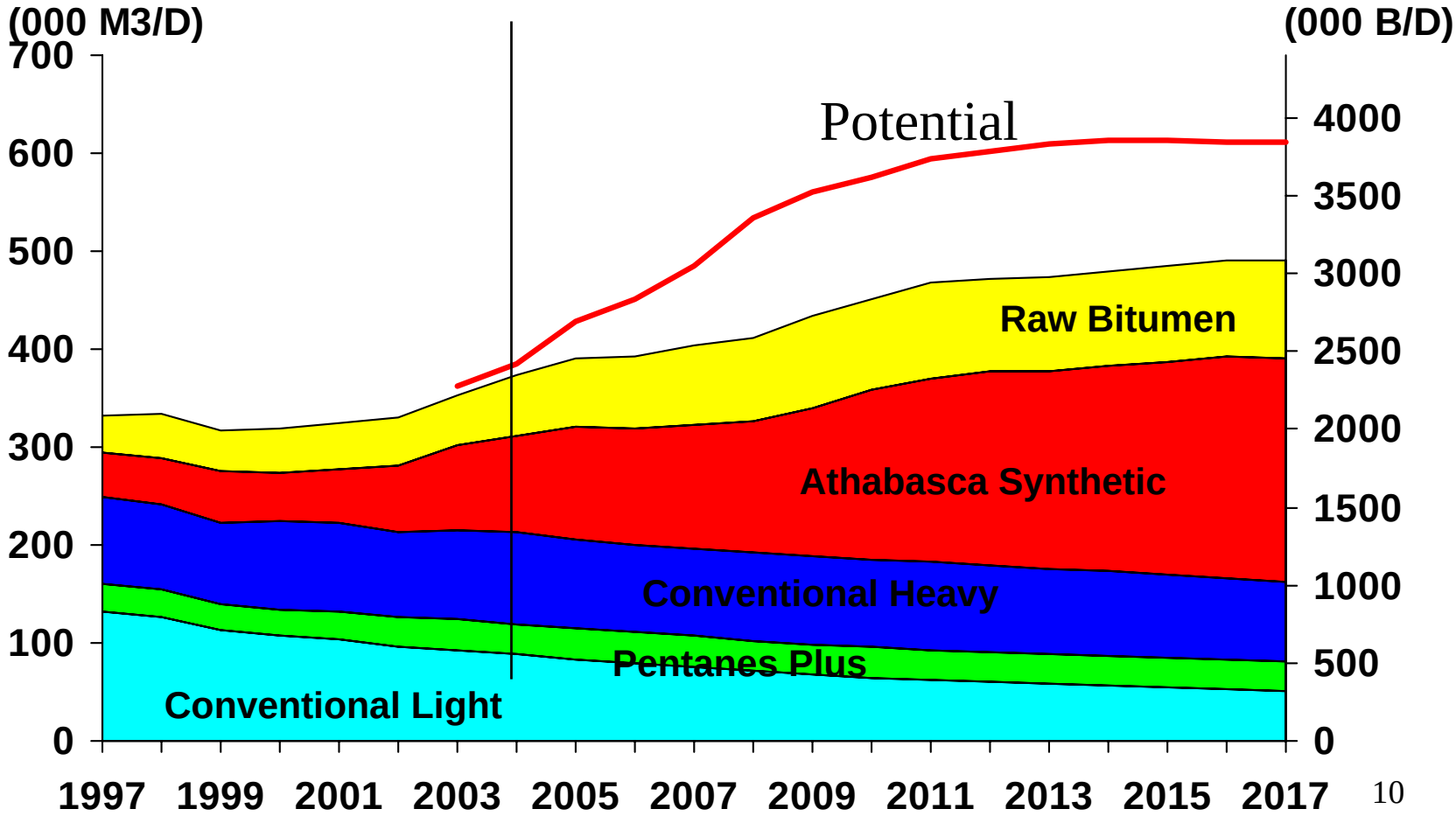
- High Density
- Substantial Residue Yield
- High Viscosity
- High Sulphur
- for some, High TAN

Bitumen Must Be Blended or Upgraded to Access the Market

- Synthetic Crude Oil
- Heavy Crude Oil Blend
  - Diluent-Bitumen (Dilbit)
  - SCO-Bitumen (Syn-bit)

Western Canada Sedimentary Basin Crude Oil Production Potential

- $24 bill (Cdn) under construction or approved
- $60 bill additional announced
- > 66% of Canada's production by 2020



Source: CAPP

Who's Playing the Game

- *Mining* Projects -

1980	2000	2006+
Suncor	Suncor	Suncor
Syncrude	Syncrude	Syncrude
		Imperial
		Albian/Shell
		Synenco
		CNRL
		Fort Hills

Not an all inclusive list

Source DOE

Who's Playing the Game

- *Insitu* Projects -

1980	2000	2006+	
Imperial	Imperial	Imperial	Jacos
	AEC	Encana	Deer Creek
Numerous	CNRL	CNRL	OPTI/Nexen
Experimental	Shell	Shell	BlackRock
Projects	PanCdn	Suncor	ConocoPhillips
	Numac	PetroCanada	Husky
	Northstar	Petrovera	Total
	Murphy	Devon	

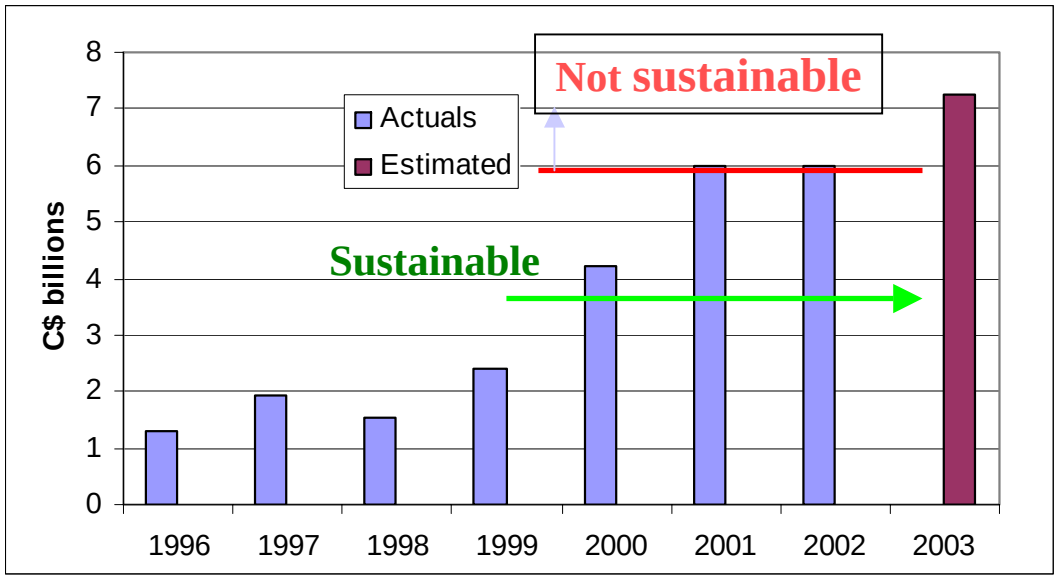
Not an all inclusive list

Source DOE

Capital Expenditures

1996-2003:Total Investment > $24 billion ($3.5 bill/year-Sustainable)

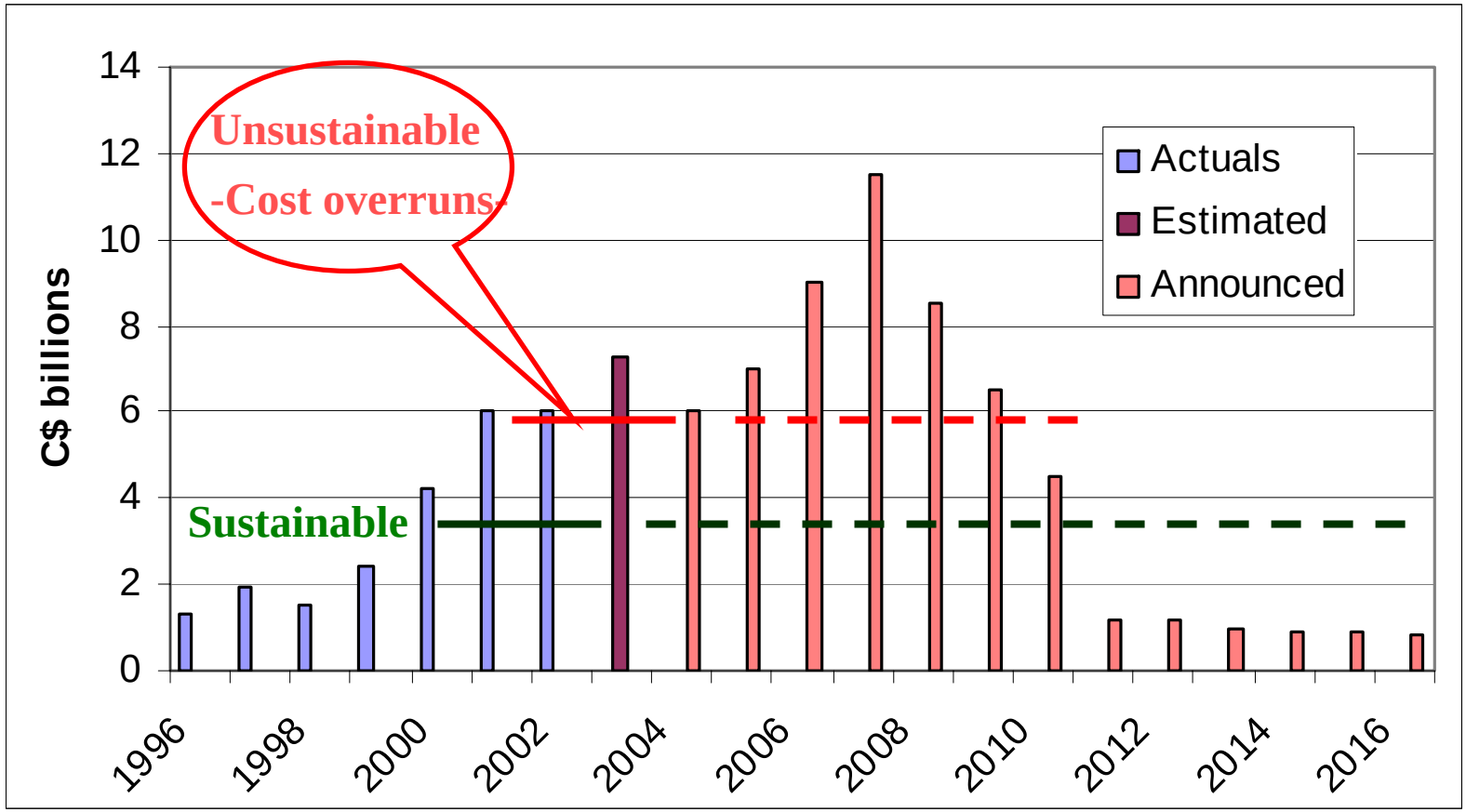
Average: 2000-2003 = $5.9 bill/year (not sustainable- Cost overruns)



- **Since 2000 high capital investment ($5.9 bill/year) has exceeded Alberta's engineering and construction capacity resulting in cost overruns**
- **Planned investments for 2004 – 2020 is $60 billion ($3.3 billion/year)**
- **Sustainable if properly phased**

Planned investments for 2003-2020 > $60 billion ($3.5 bill/year)

Oil Sands Capital Investment



1996-2003:Total Investment > $24 billion

Average for 2000-2003 = $5.9 bill/year

2003- 2020:Total Investment > $60 billion

Sustainable if phased over 17 years ($3.5 bill/year)

Technology Trends

- **Surface Mining**
  - **Truck and shovel**
  - **Hydro-transport**
- **In Situ**
  - **Cyclic Steam Stimulation (CSS)**
  - **Cold Heavy Oil Production with Sand (CHOPS-Primary)**
  - **Steam Assisted Gravity Drainage (SAGD)**
  - **Vapor Extraction (VAPEX)**
- **Upgrading & Value-Added Products**
  - **Integration/Synergies with existing facilities**

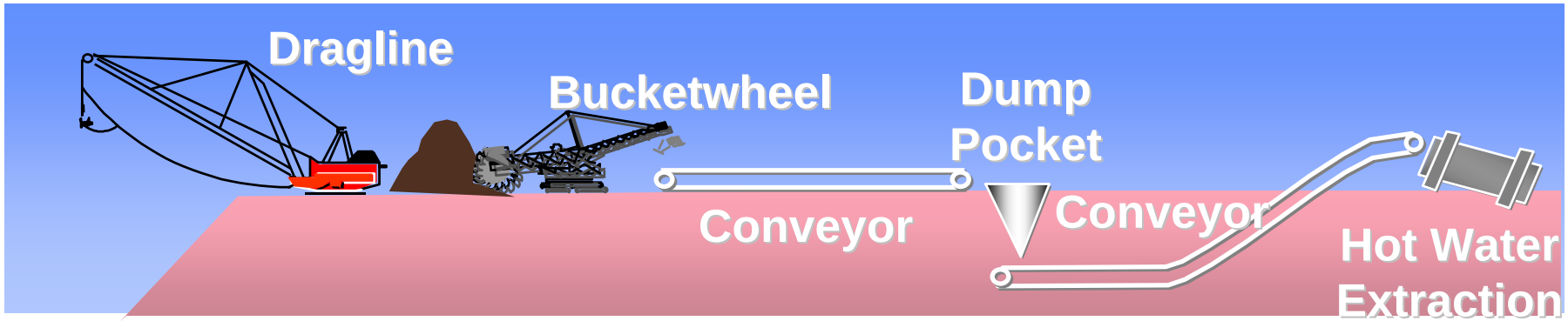
Innovation in Mining Technology

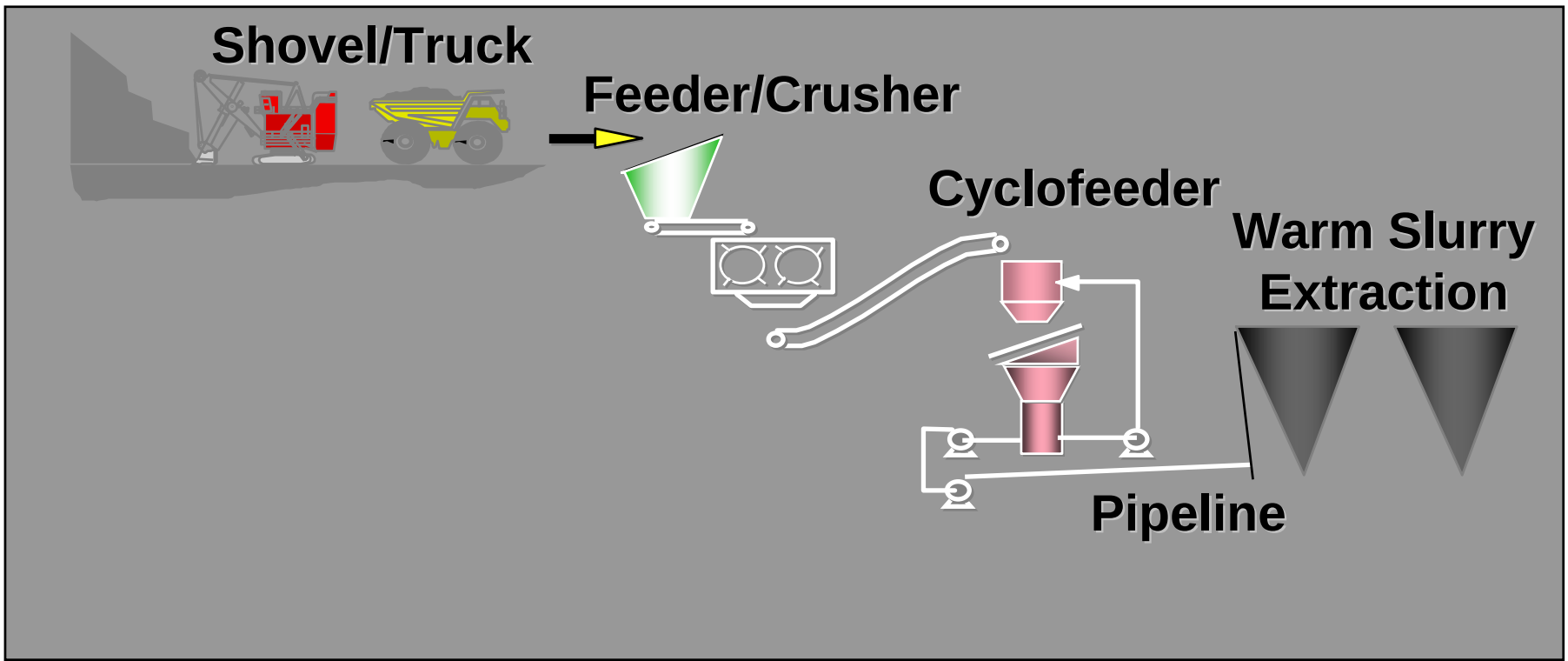
From Draglines to Shovel & Truck Operations

1970

2000

Surface Mining and Extraction





400 tonne Ore Trucks

Cyclofeeder

Slurry Hydrotransport

Primary Separation Vessel

Technology advances over 20+ years have reduced mined oil sands production costs from > US$30 to < $10/barrel

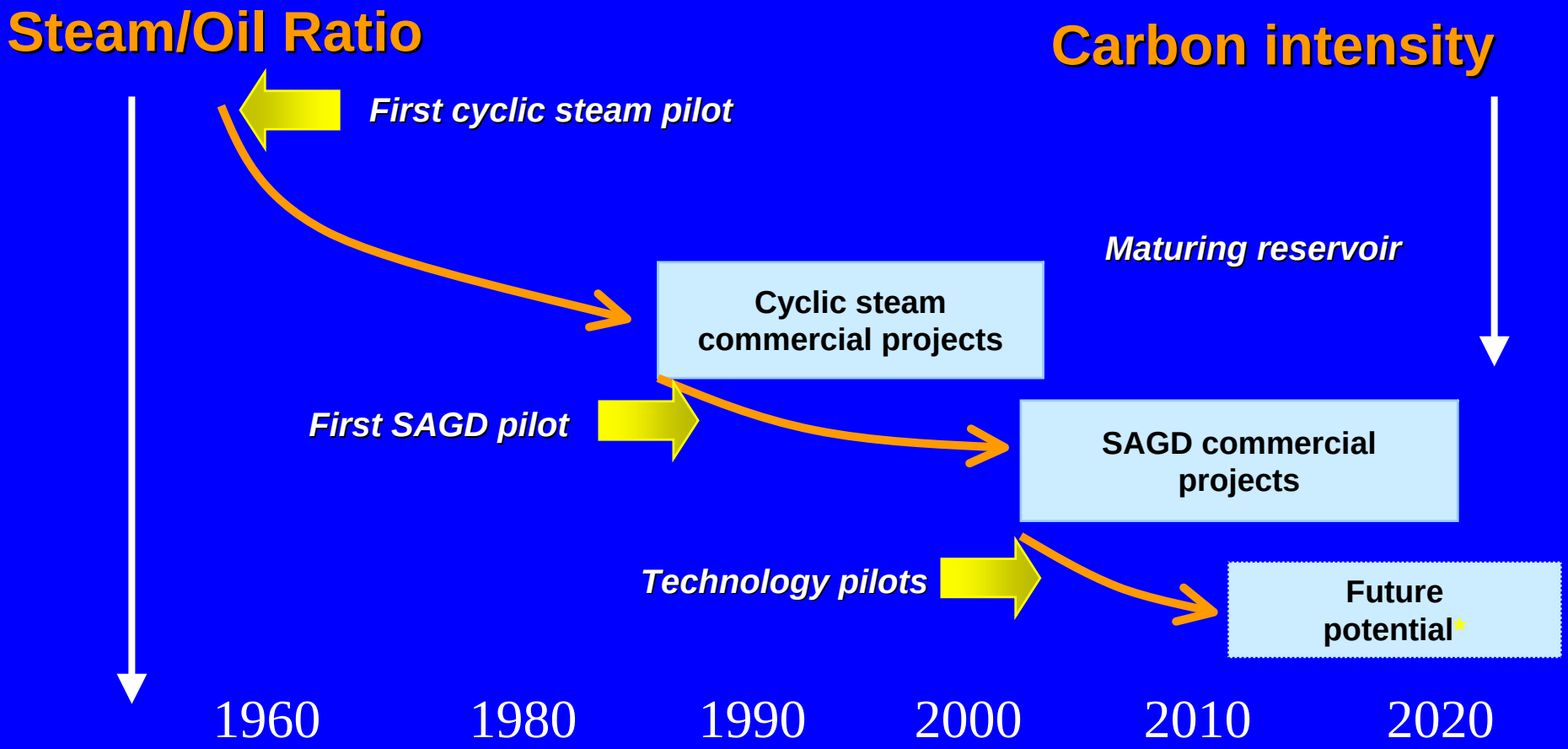
Source: Syncrude Ltd.

Mining/Extraction/Upgrading Opportunities to Further Reduce Costs

- **Replace coking with critical solvent deasphalting**
- **Replace natural gas with coke or asphaltene gasification**
- **Reduce water use: recycling tailings consolidation**
- **Continuous mining & extraction equipment**
- **Improved froth treatment to produce a cleaner bitumen for upgrading**
- **Improved catalysts**

Continuous Development of In situ Technologies

Thermal Oil Sands Efficiency Improvement

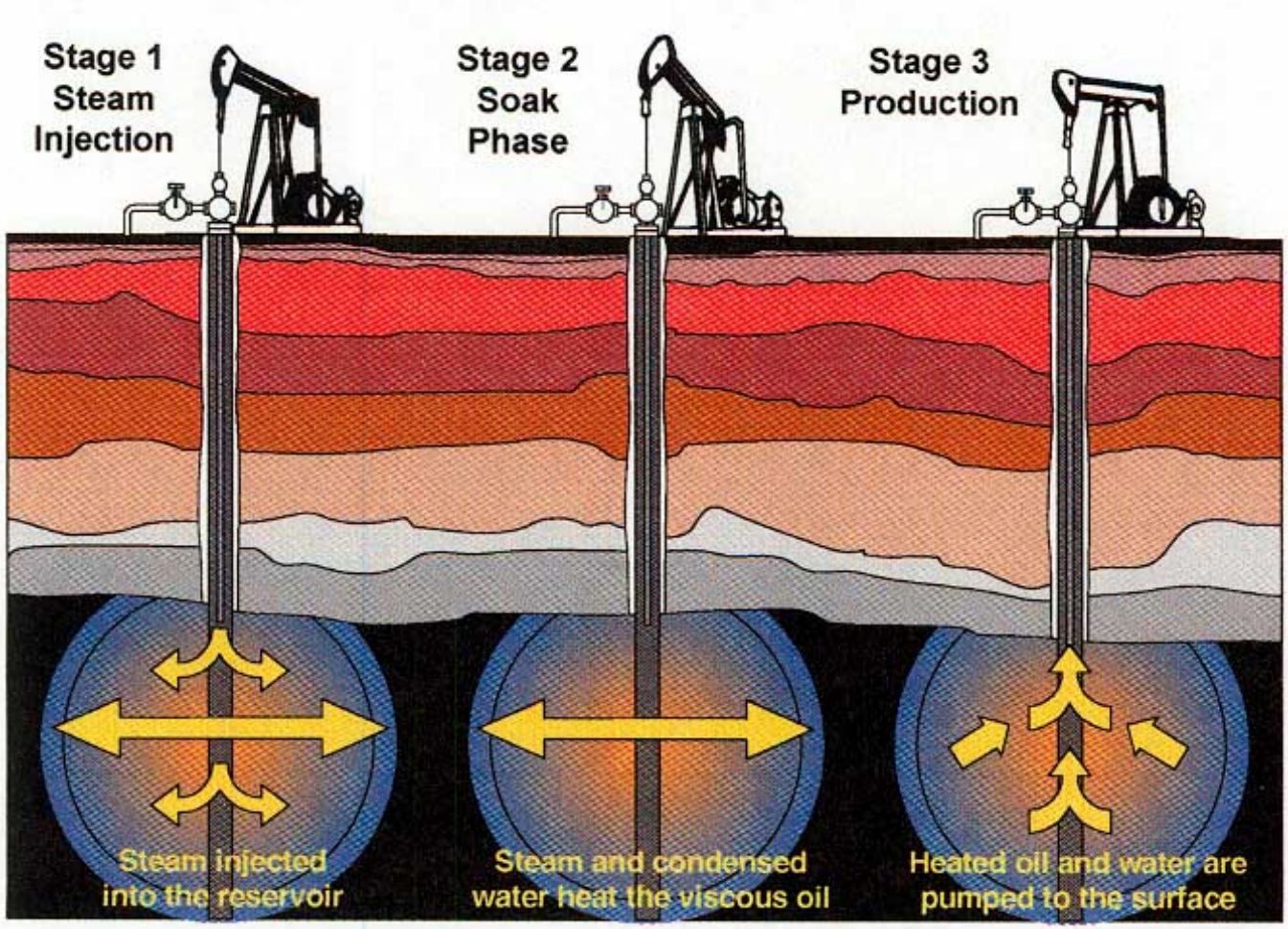


*Future potential could include VAPEX, thermal solvent, etc.

In Situ Recovery Technologies

- Primary Recovery- Cold Heavy Oil Poduction with Sand (CHOPS)
- Thermal Recovery
  - Cyclic Steam Stimulation (CSS)
  - Steam Assisted Gravity Drainage (SAGD)
- Solvent-based recovery processes
  - Vapour Recovery Extraction (VAPEX)
- Hybrid thermal/solvent processes
  - Steam Assisted Gas Push (SAGP)
  - Expanding Solvent SAGD (ES-SAGD)Steam
  - Low Pressure Solvent SAGD
  - Tapered Steam Solvent SAGD(TSS-SAGD)

Cyclic Steam Stimulation Process



Cyclic Steam Stimulation (CSS)

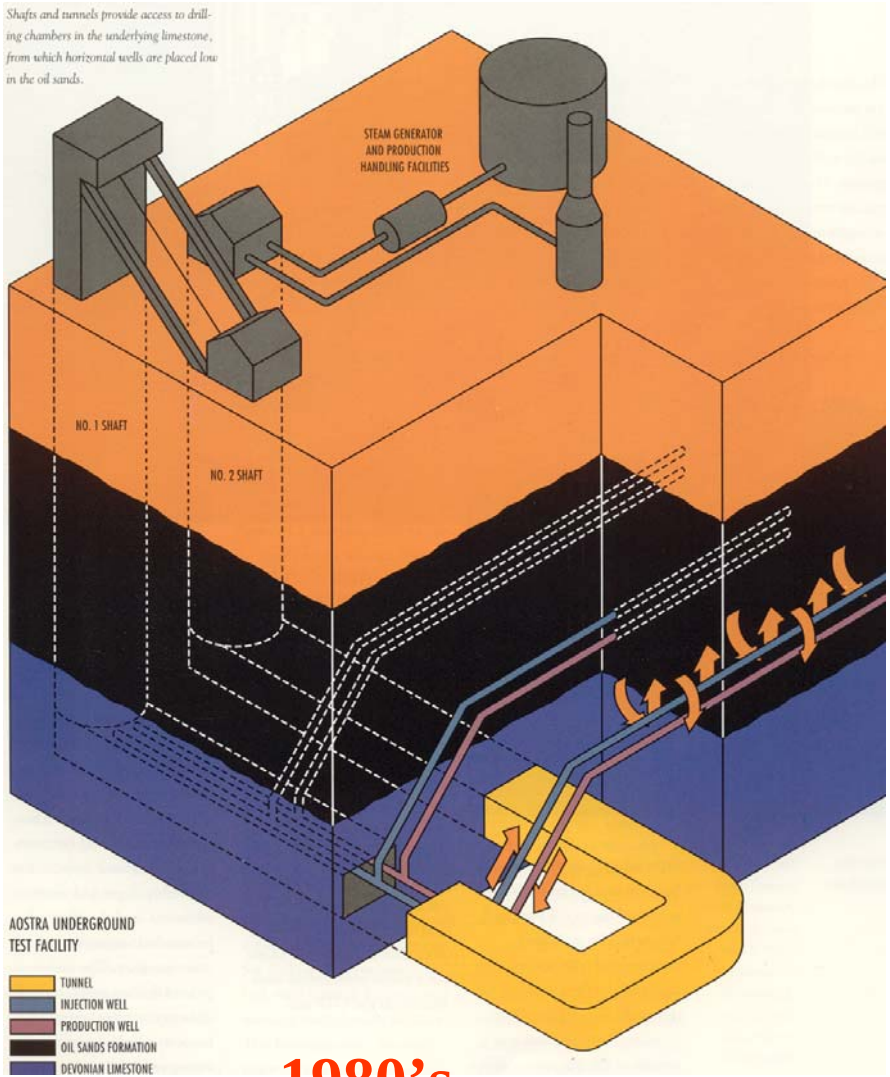
Current Technology

- Developed by Imperial Oil in late 1950's
- Steam Cycle:
  - Steam injection (4-6 weeks)
  - Soak (4-8 weeks)
  - Production (3-6 months
- Recoveries 20-25% of original bitumen in place
- Current production > 120,000 b/d
- Successful at Cold Lake

Innovation

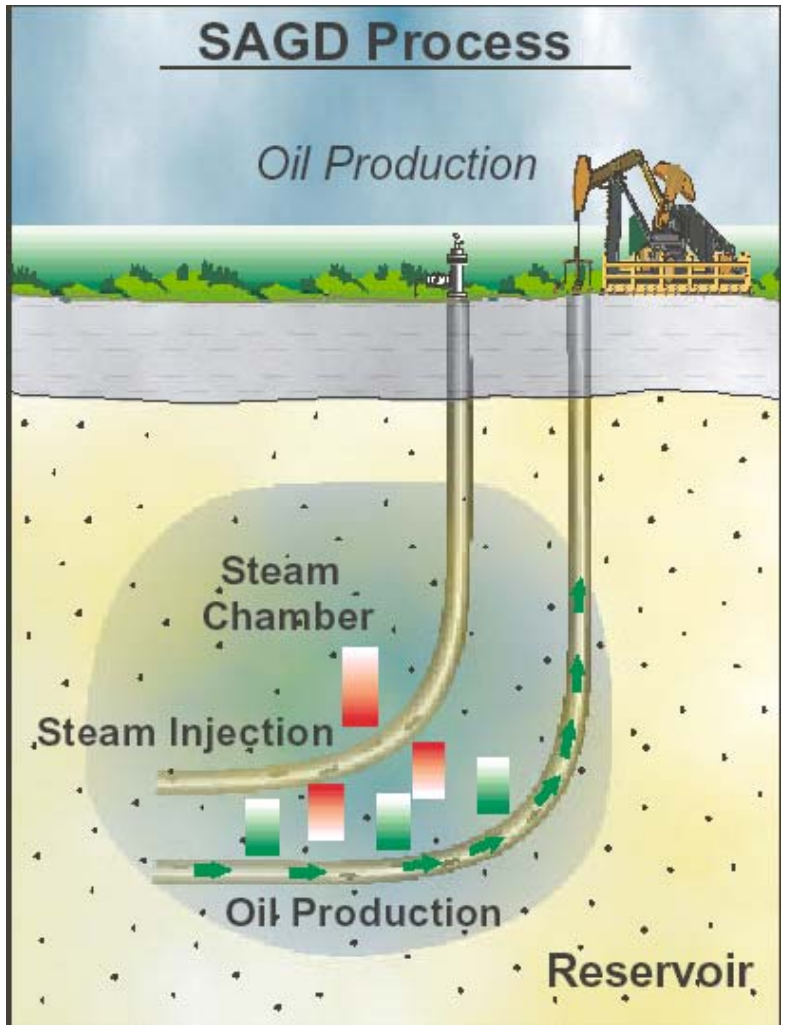
- CSS less successful for Peace River
- Not economical in Athabasca deposits
- CNRL Innovation: Increase steam injection pressure to fracture pressure
- Steam plus solvent process being tested in a field pilot

In Situ Extraction of Deeper Bitumen Resources
Development of Steam Assisted Gravity Drainage (SAGD)



1980's

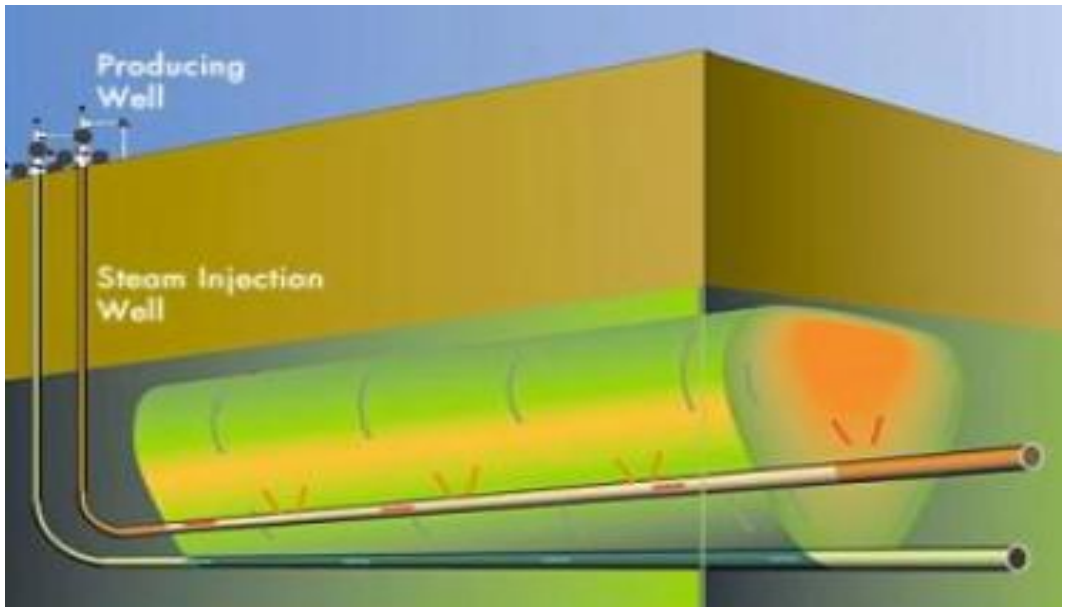
Underground Test Facility



2000

Horizontal wells drilled from surface

Steam Assisted Gravity Drainage (SAGD) – Commercial after 20 years and some 30 pilot projects

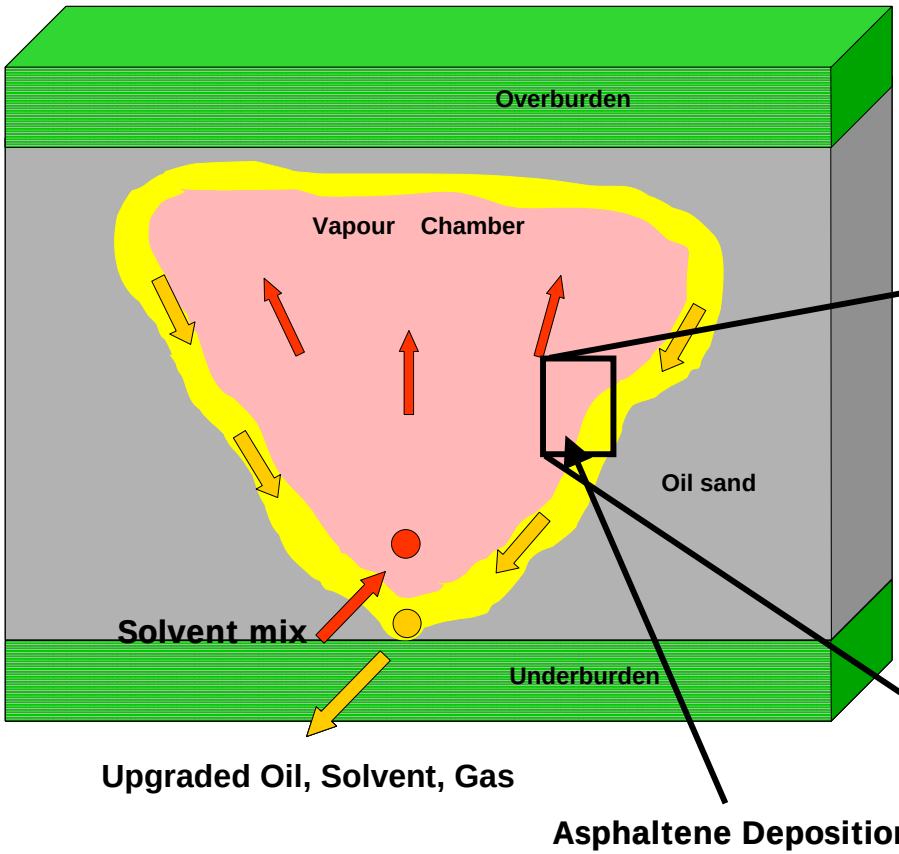


- Only viable technology for 90% of bitumen resources in Athabasca
- Significantly reduced land disturbance
- Higher recovery than CSS (up to 50%)
- Lower steam-oil ratios than CSS

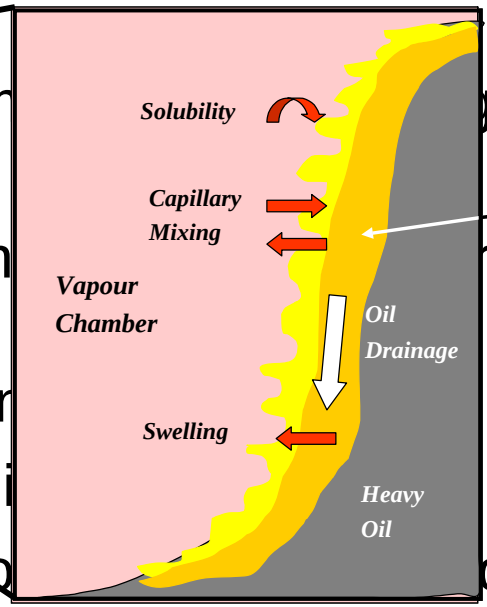
Technology Issues

- Requires good vertical permeability
- Sub-optimal steam-oil ratios
- Natural gas for steam requirements
- Water
- Energy intensity – GHG emissions

Continuing Innovation-VAPEX Process

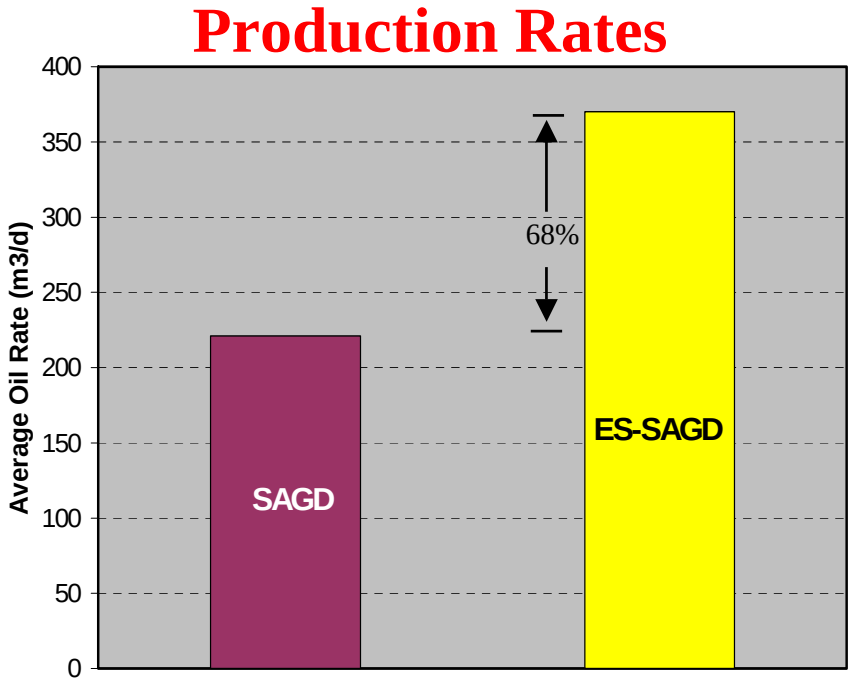


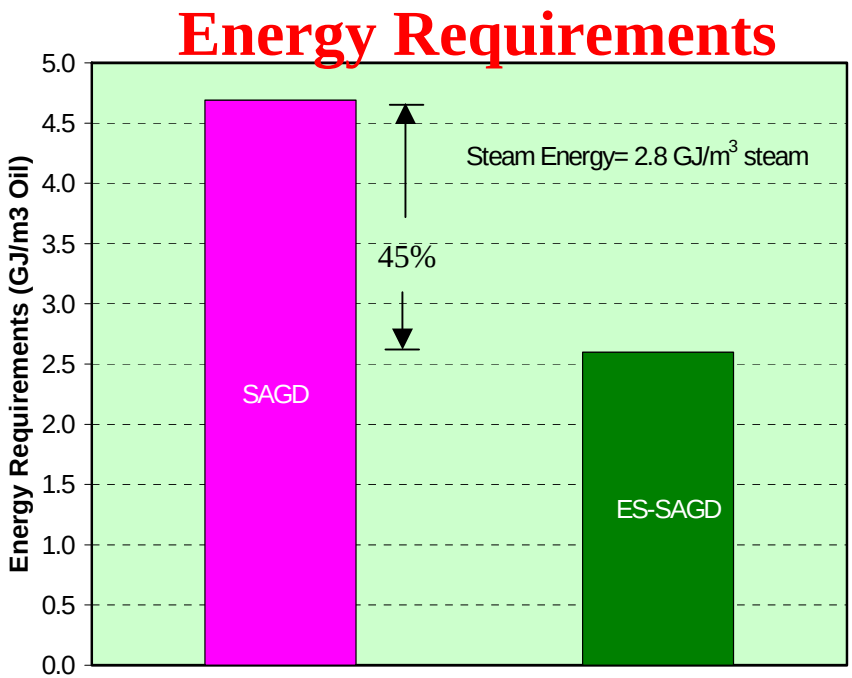
- Low energy consumption
- Reduce greenhouse gas emissions
- Minim /disposal
- Poten rading
- Advar
  - thi
  - bo oirs



Continuing Innovation-VAPEX Process

- **Non-thermal:Uses hydrocarbon solvents instead of steam**
- **Vaporized solvent injected into reservoir**
- **Reduces water use, energy and CO2 emissions**
- **Solvent is recycled and recovered at the surface**
- **Potential to recover up to 90% of solvent**
- **Produced bitumen has higher quality**
- **Potential to reduce costs significantly**
- **Challenges: Solvent recovery**
- **Field trials by DOVAP Industry Consortium since 2002**
  - –Devon
  - –Chevron
  - –Imperial
  - –Gibson
  - –PetroCanada
  - –Total
  - –Suncor
  - –CNRL
  - –Nexen
  - –JACOS
- **At least 5 years from commercial application**

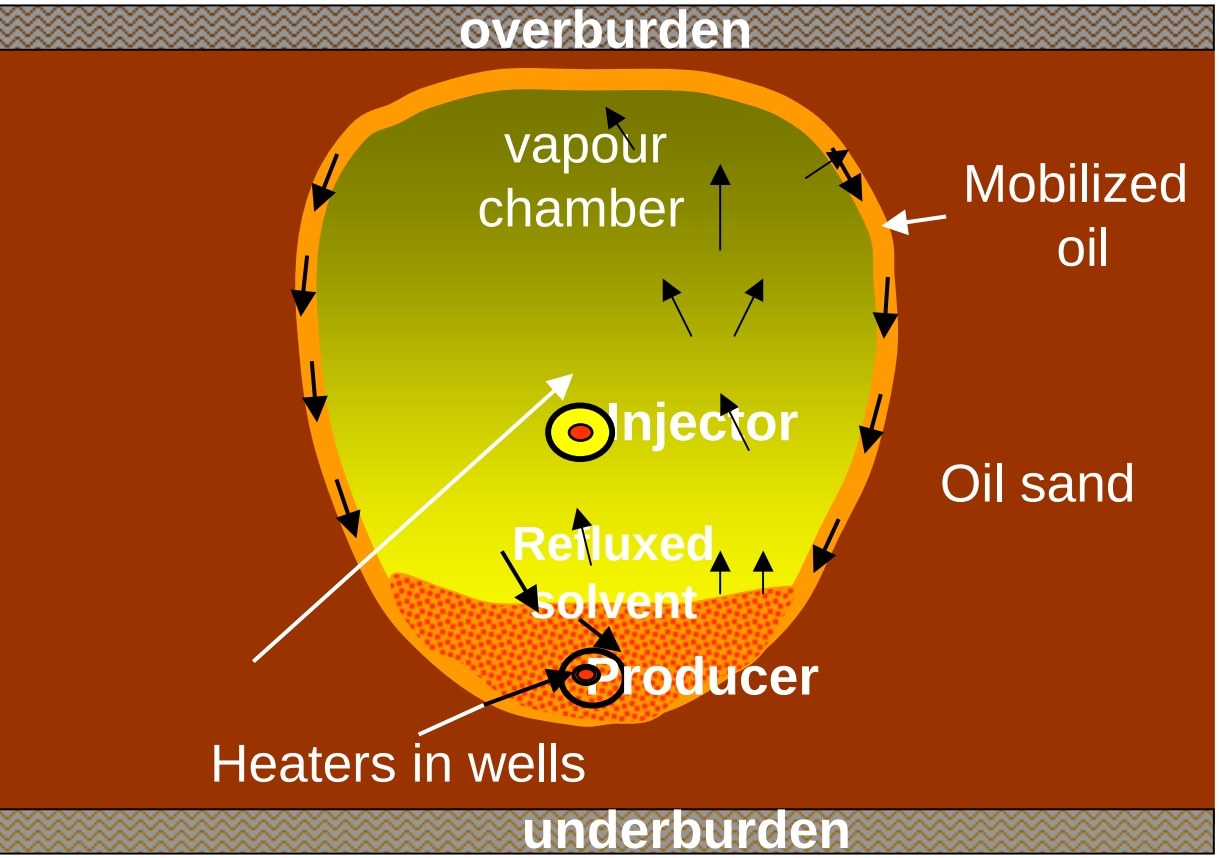




Continuing Innovation Hybrid Thermal-Solvent Process ES-SAGD Process

- Patented steam-solvent hybrid process
- Ongoing research at the Alberta Research Council
- Oil rates ↑ 68%
- Energy & water use ↓ 45%
- Reduced GHG emissions
- Field tests being conducted by Suncor, CNRL, EnCana, ConocoPhillips, PetroCanada

New Thermal Solvent Reflux Process Concept
(being developed at the Alberta Research Council)



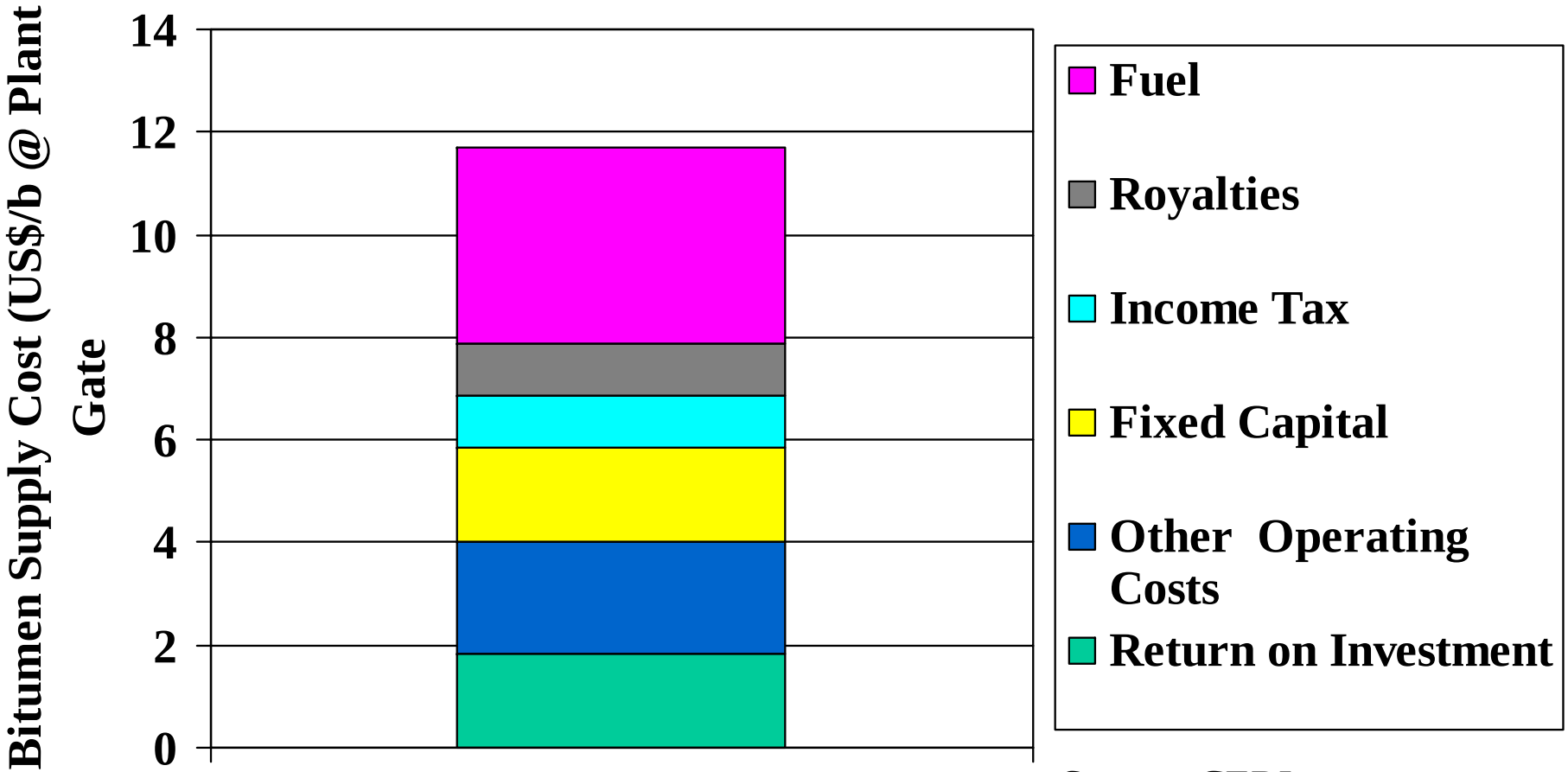
- Heaters in injector and producer wells vaporize solvent in reservoir
- Solvent reflux mobilizes oil
- No external recycling & recovery of solvent
- Faster start-up
- Lower costs
- Industry sponsored R&D

Current Production Costs

Production Method	Crude Type	Cost per barrel ($ CDN, 2003)	
		Operating	Supply
Mining/Upgrading	Synthetic	12 to 18	22 to 28
Mining/Extraction	Bitumen	6 to 10	12 to 16
SAGD	Bitumen	8 to 14	11 to 17
CSS	Bitumen	8 to 14	13 to 19
CHOPS	Bitumen	6 to 9	12 to 16
Cold	Bitumen	4 to 7	10 to 14

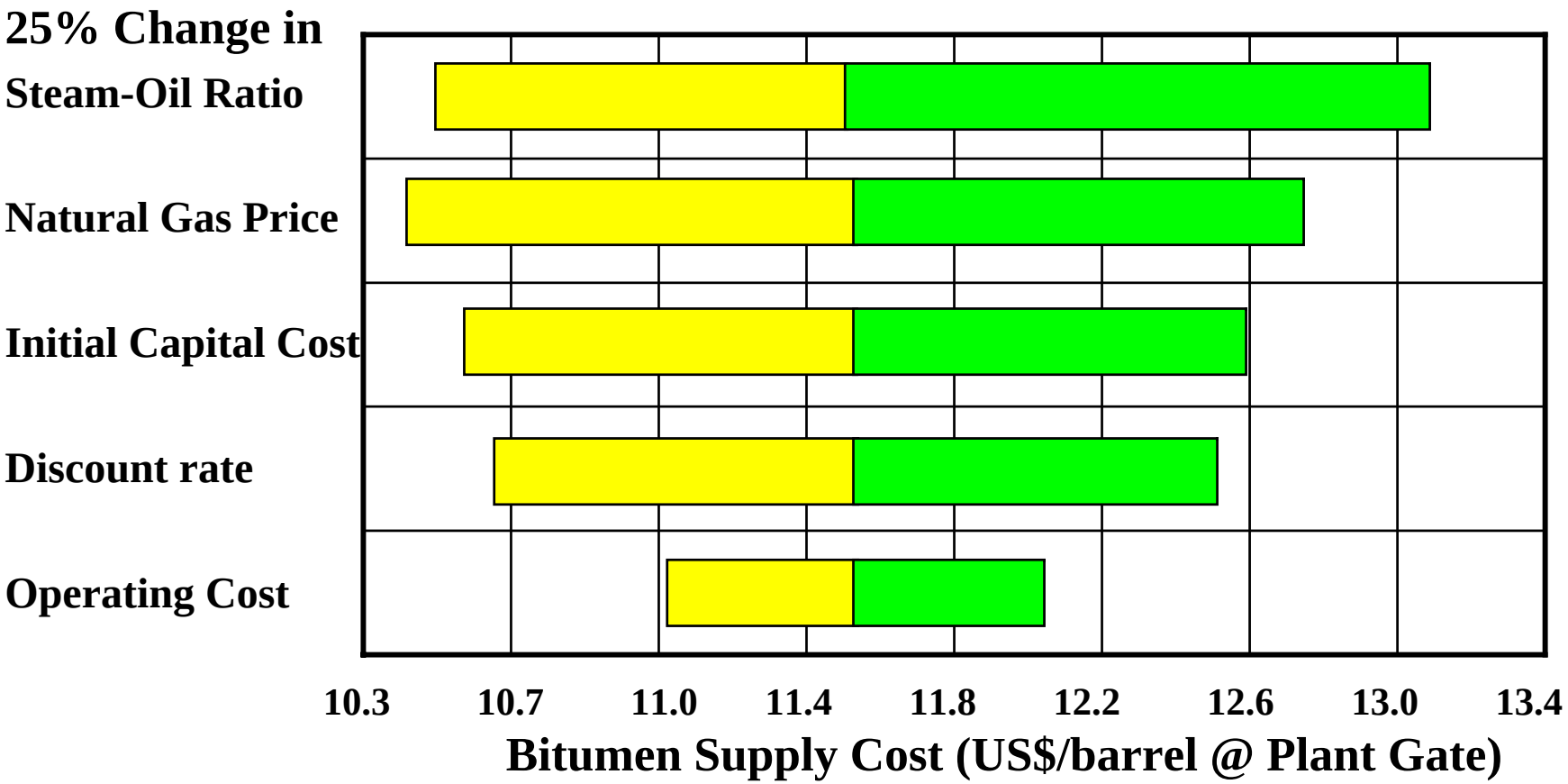
Source: NEB

Bitumen Supply Cost
Typical Athabasca SAGD Project



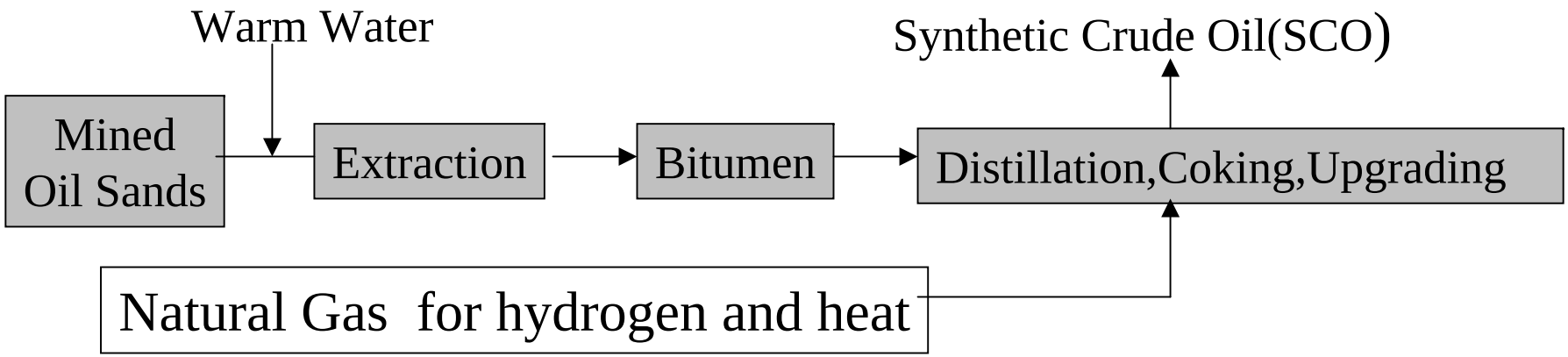
Source: CERI

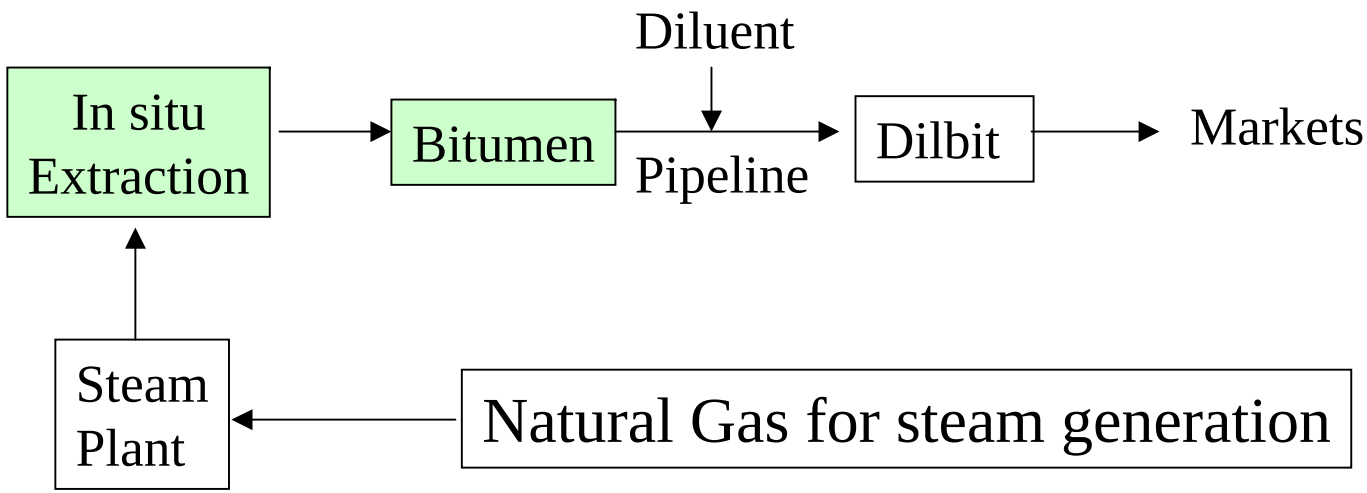
Bitumen Supply Cost Sensitivities
Typical Athabasca SAGD Project



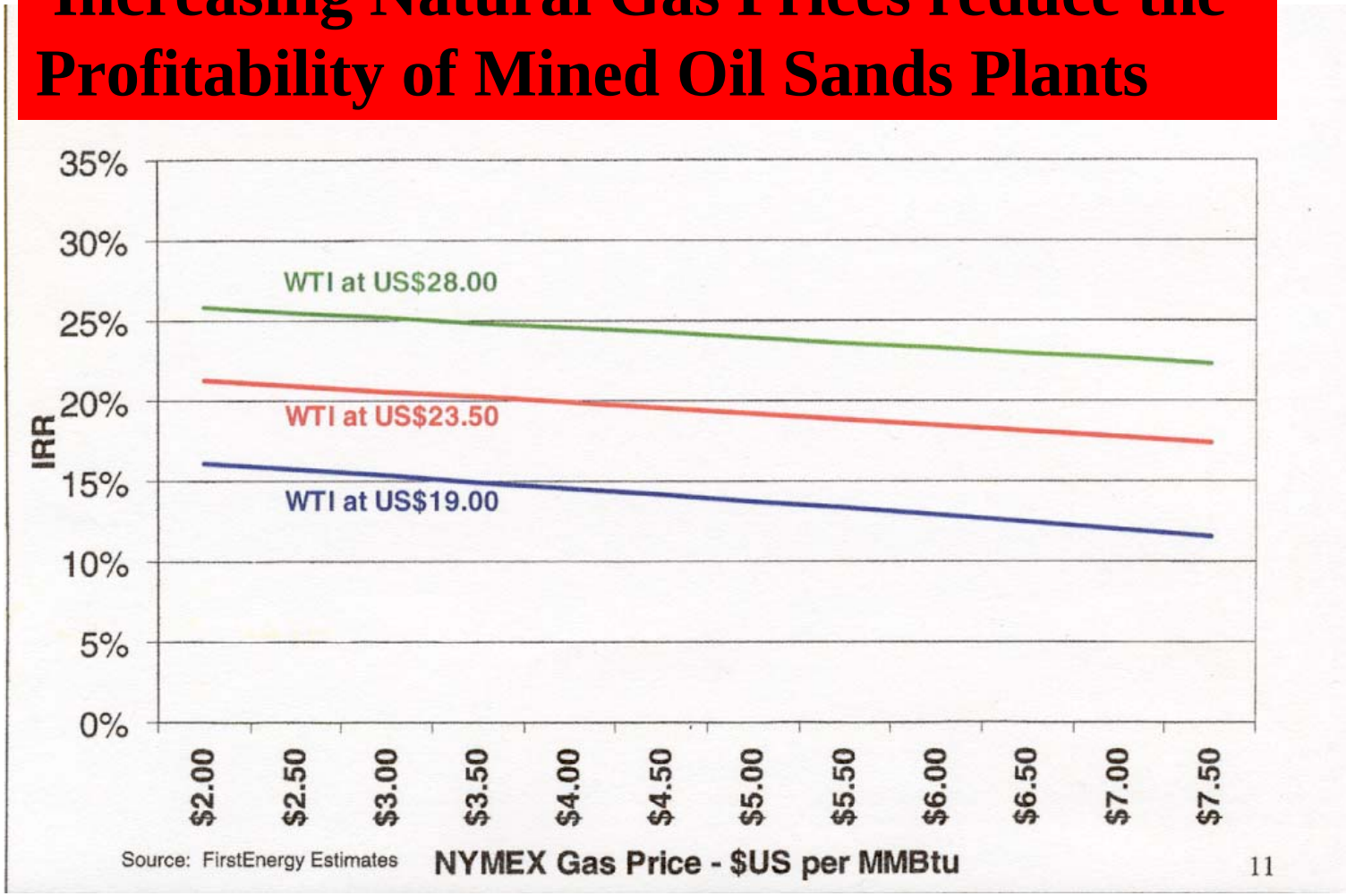
Source: CERI

Both Mining and In Situ Extraction Processes use large amounts of Natural Gas

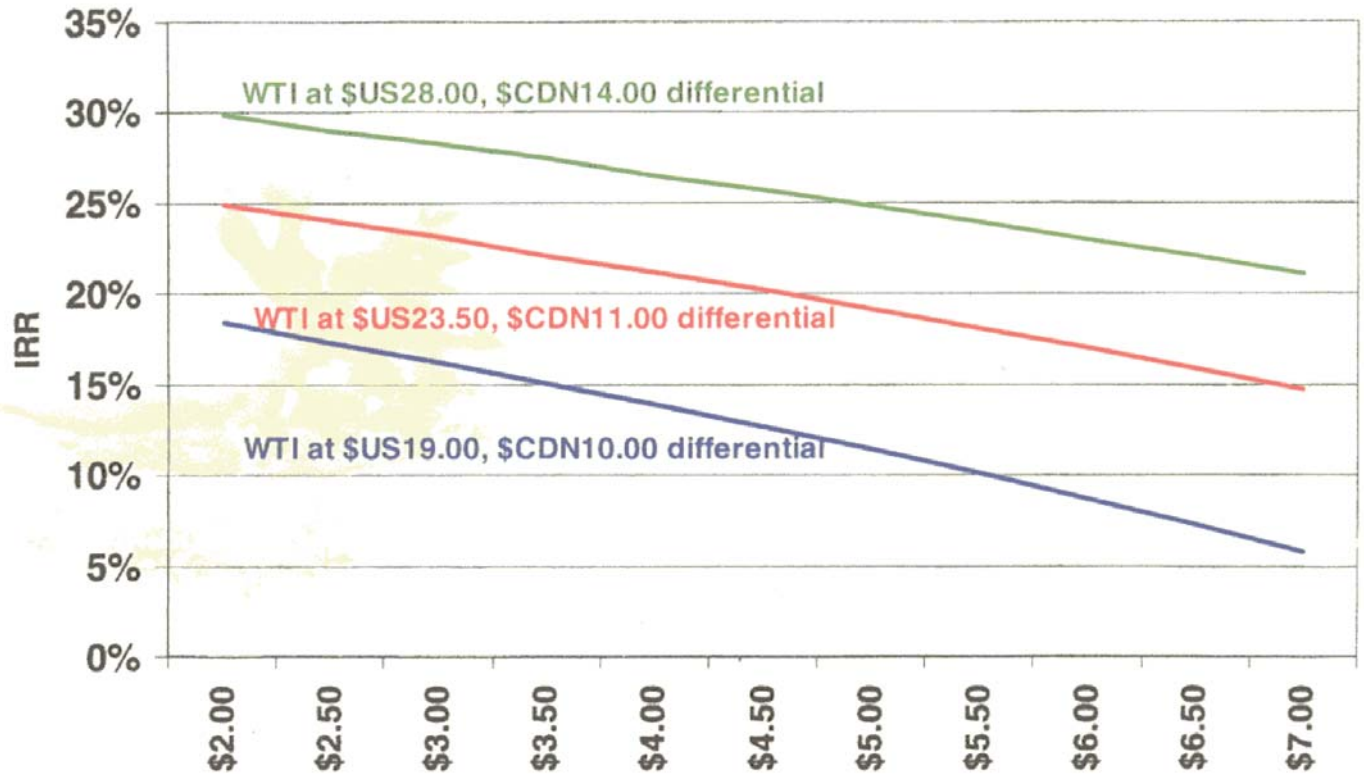




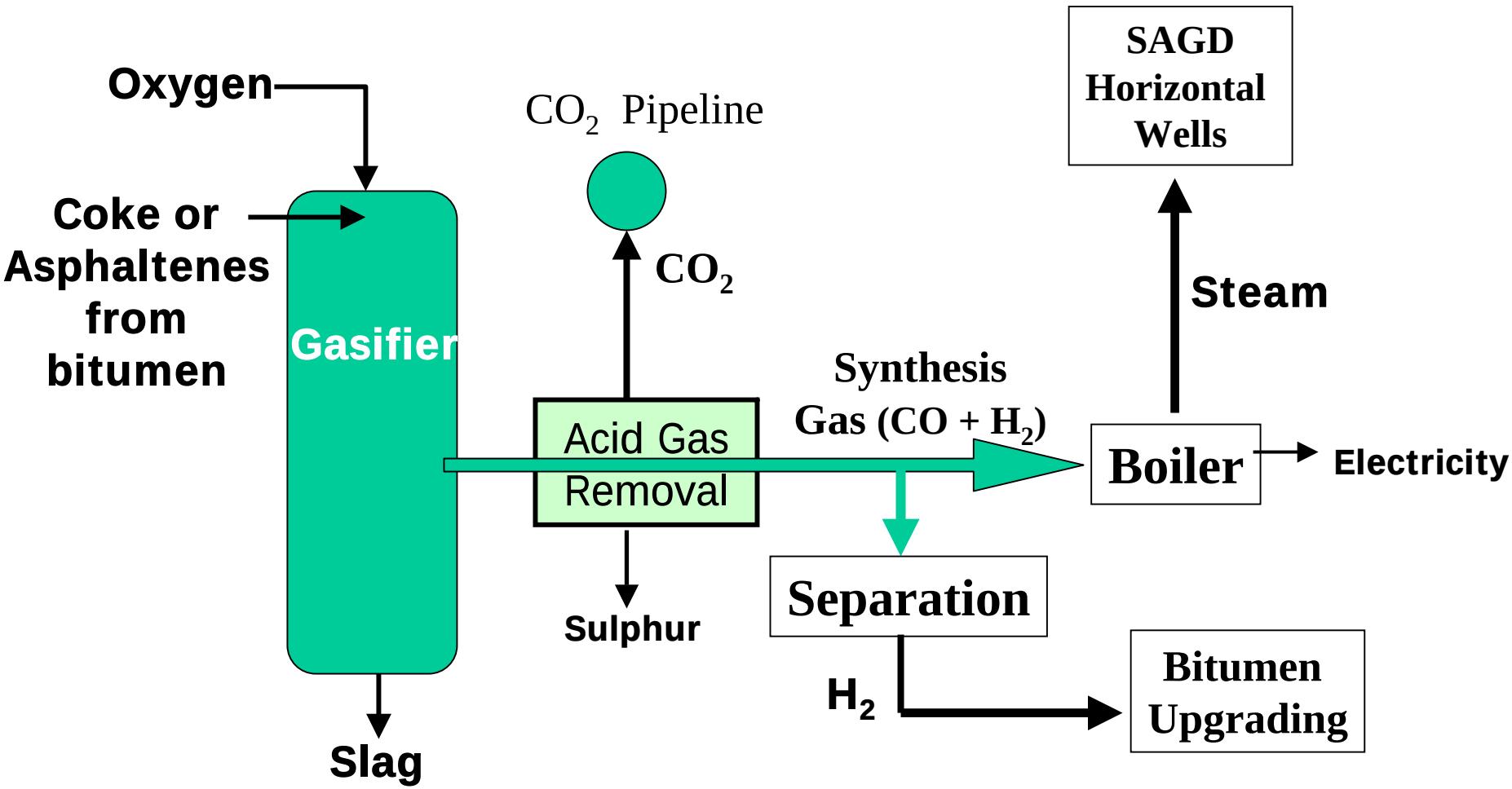
Increasing Natural Gas Prices reduce the Profitability of Mined Oil Sands Plants



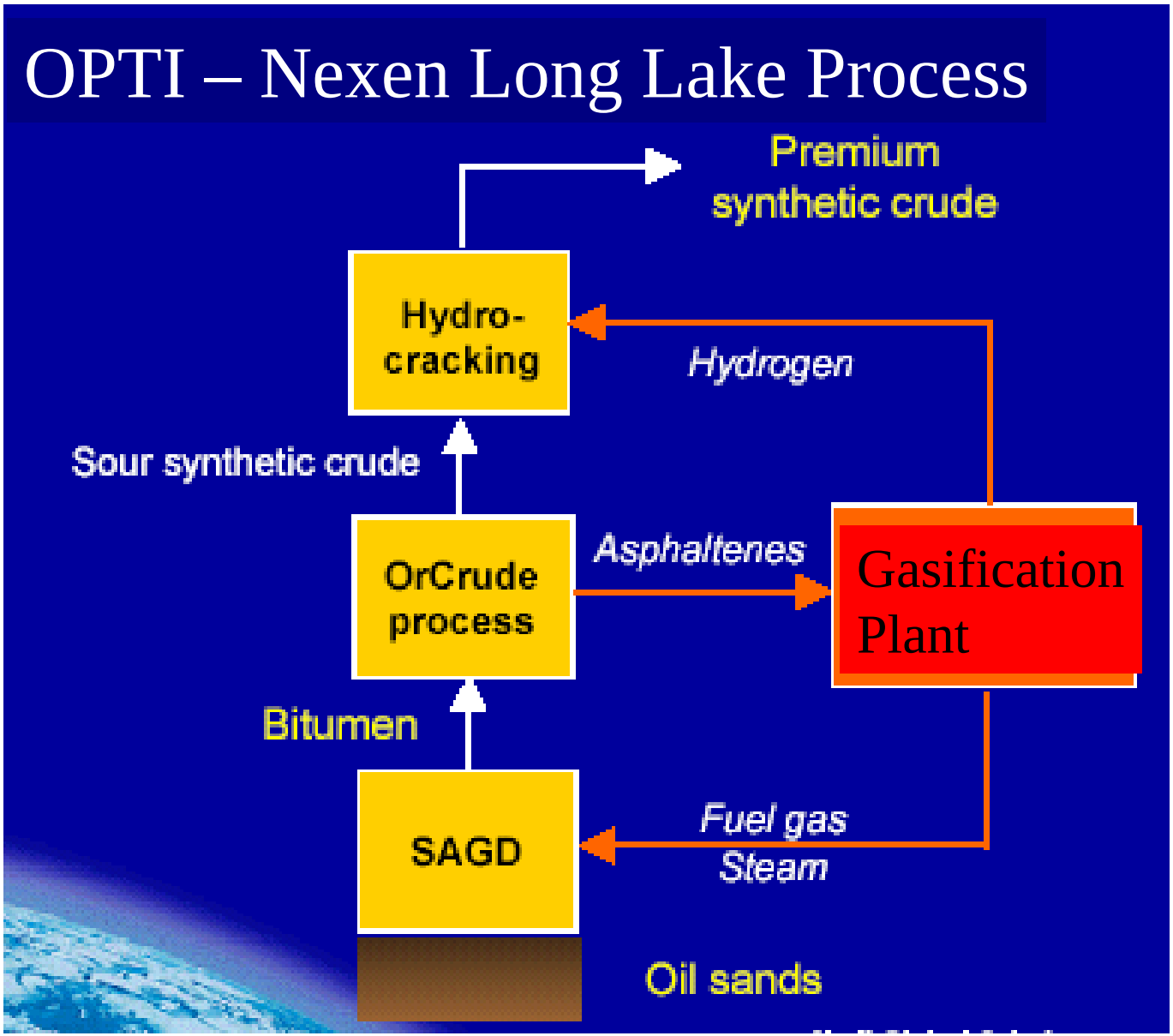
Increasing Natural Gas Prices decrease the profitability of SAGD Projects even more



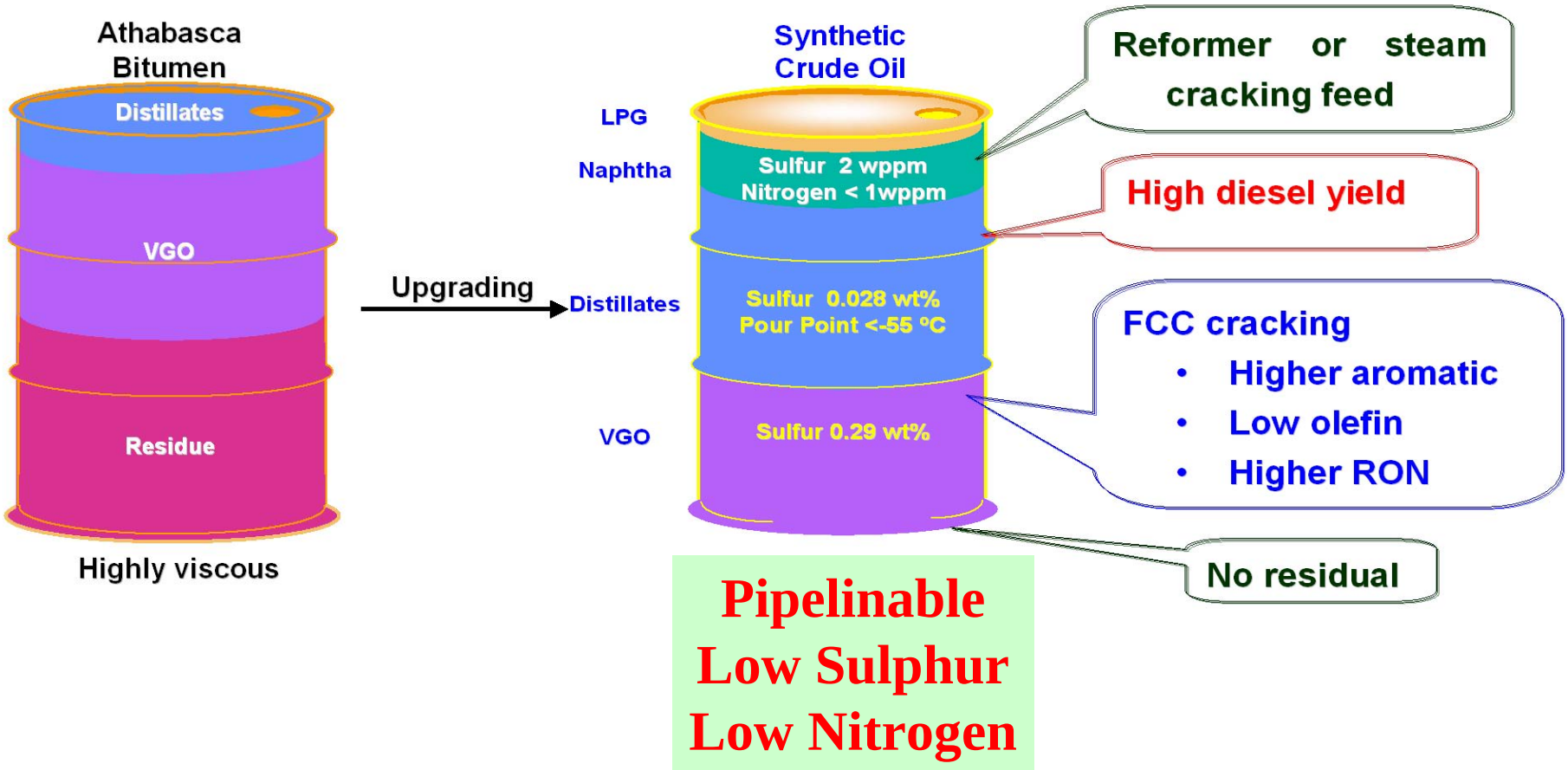
Gasification of Coke or Asphaltenes Replaces Natural Gas in Mining/Upgrading and in SAGD Processes and Reduces CO_2 emissions



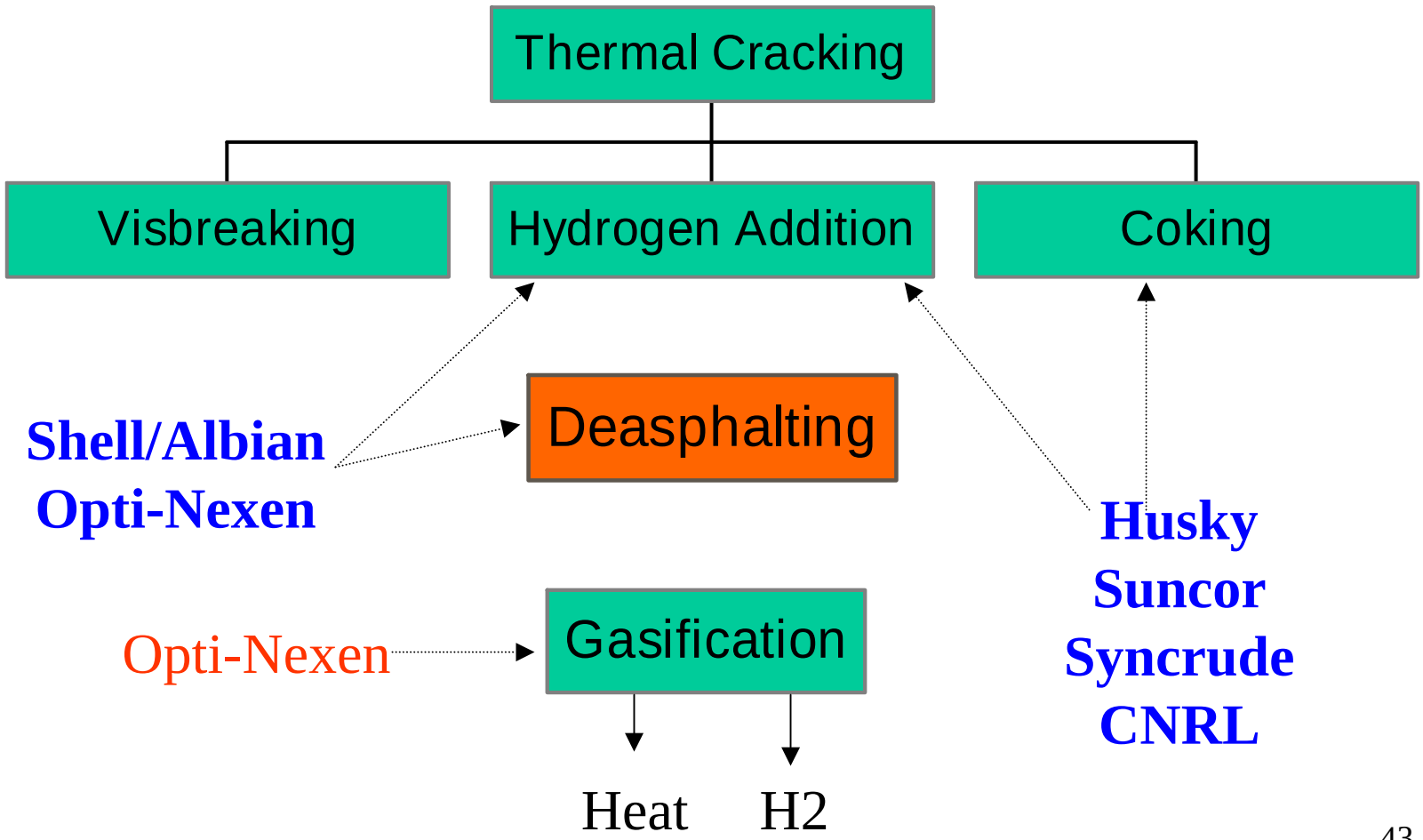
Gasification Replaces Natural Gas
for hydrogen and heat & produces a higher value synthetic crude



Desirable features of Alberta SCO



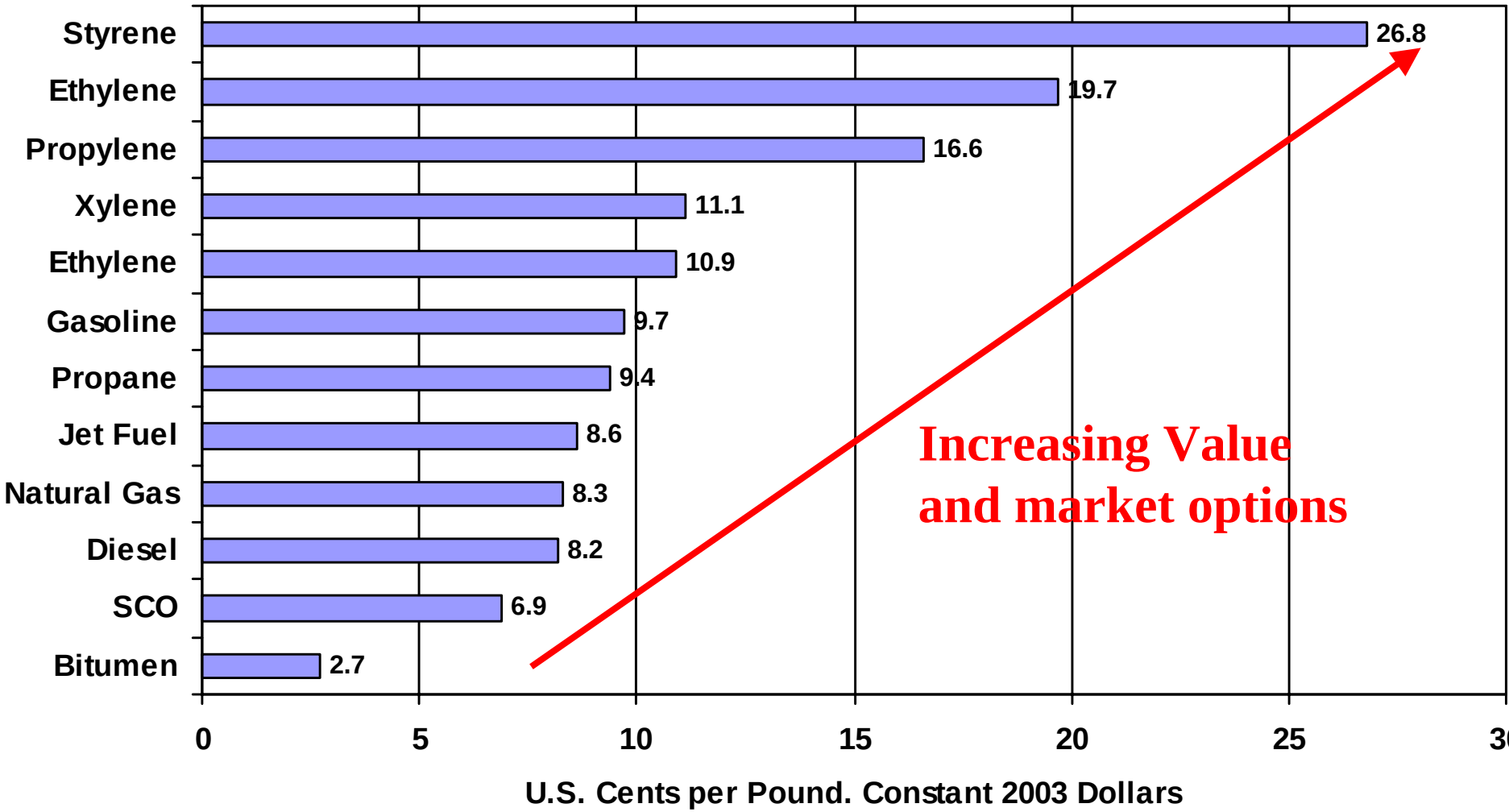
Upgrading Technology - 1940- Today



Innovation in Upgrading Technologies

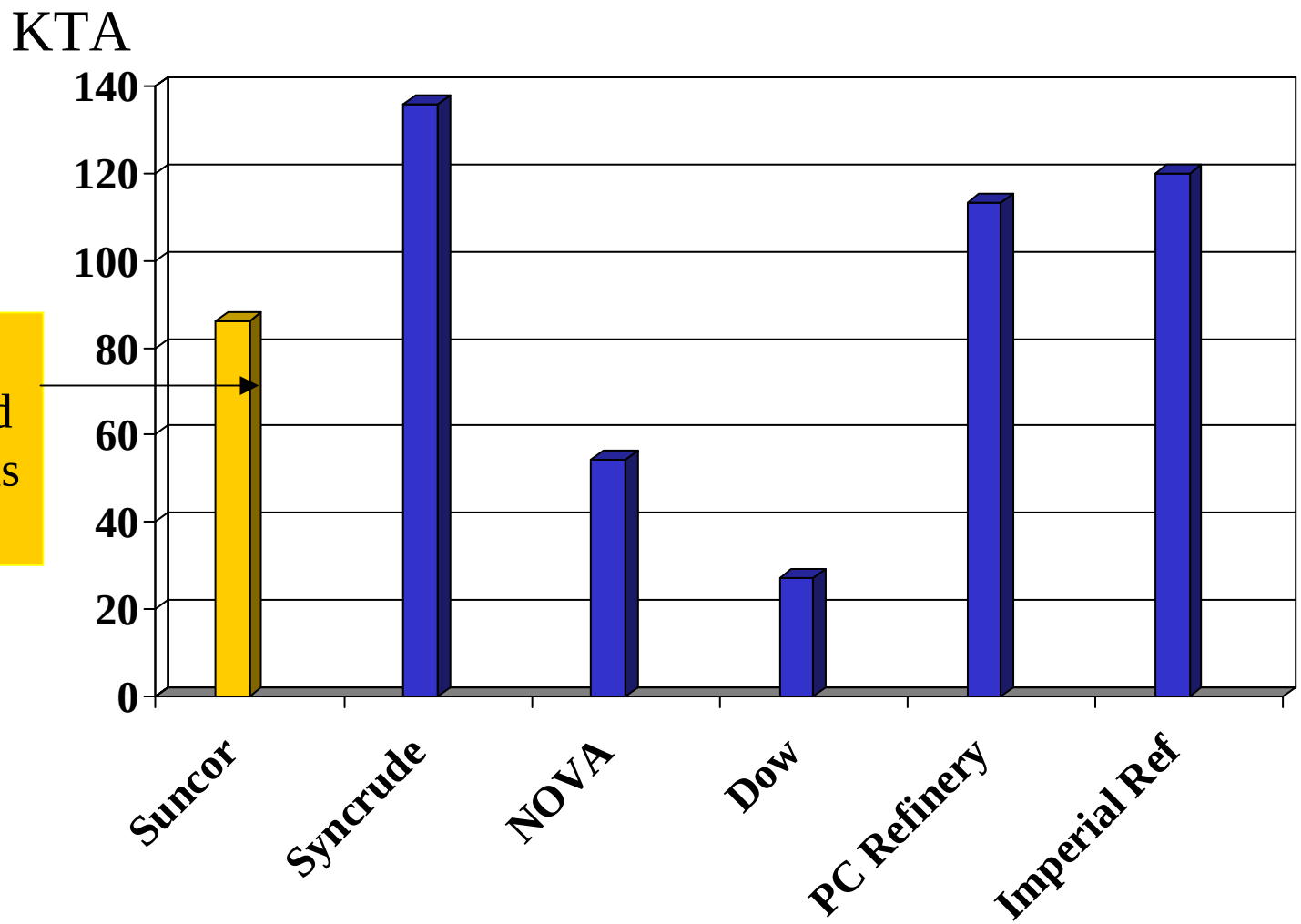
- **Solvent deasphalting**
  - **Used by Shell and Opti**
- **Supercritical Solvent Deasphalting to improve product quality**
- **Replace natural gas as a source of hydrogen and steam by gasifying coke or asphaltenes**
- **Extract valuable by-products: petrochemicals (and metals)**
- **Integrate Upgrading-Refining-Petrochemicals**
- **Membrane separation and Catalysts**

Refined Products and Petrochemicals Increase Value and Market Options for Rapidly Growing Oil Sands Production



Adapted from Purvin & Gertz, March 30,2004

Propylene is a component of existing process streams



Extracted & produced by Williams Energy

Propylene Potential

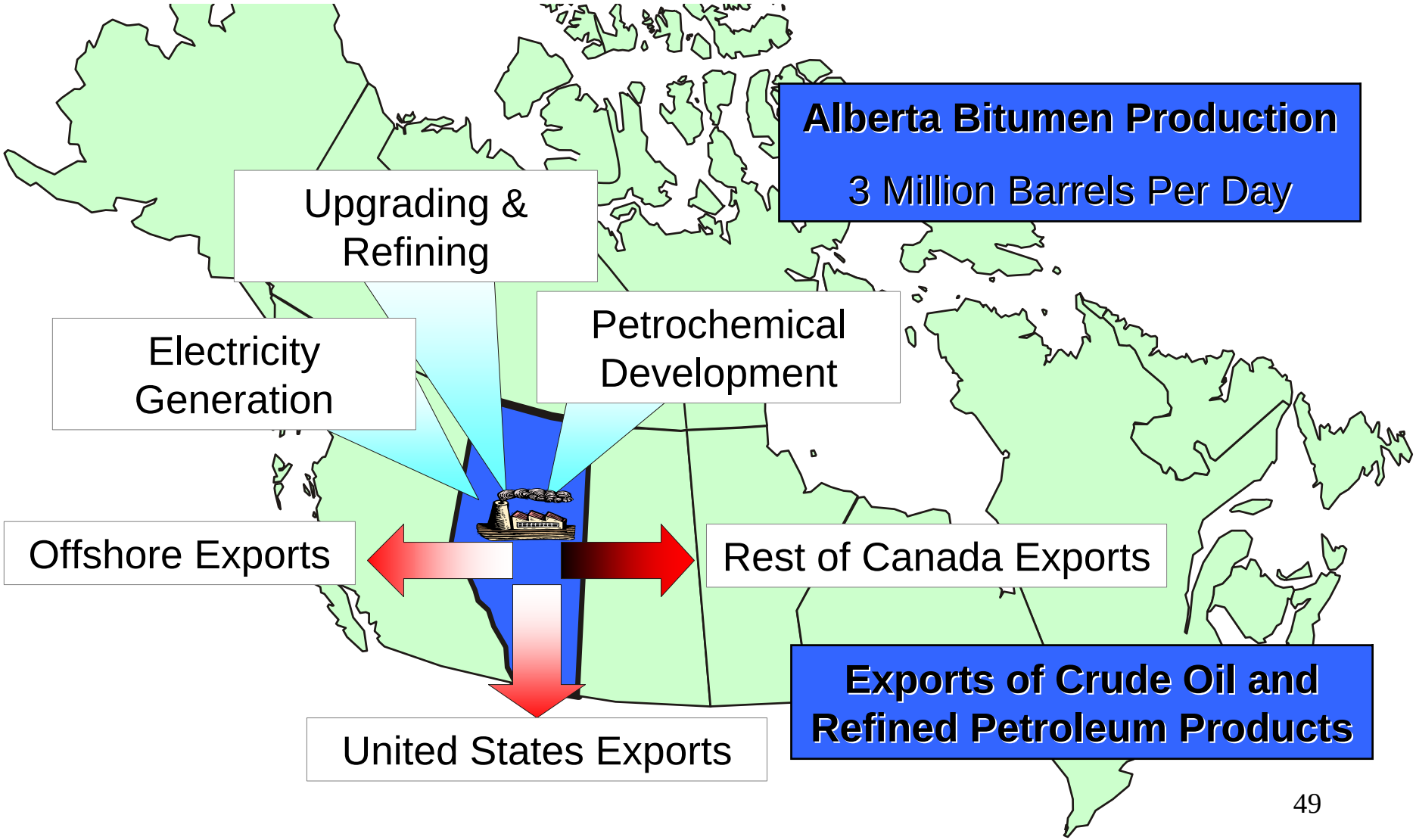
	Kilotonnes/year
• Refineries	320
• Existing Upgraders	230
• Petrochemical Plants	110
• Total	**660**

- Other sources
  - Existing upgrader expansions
  - BA Energy Upgrader
  - Opti

Summary

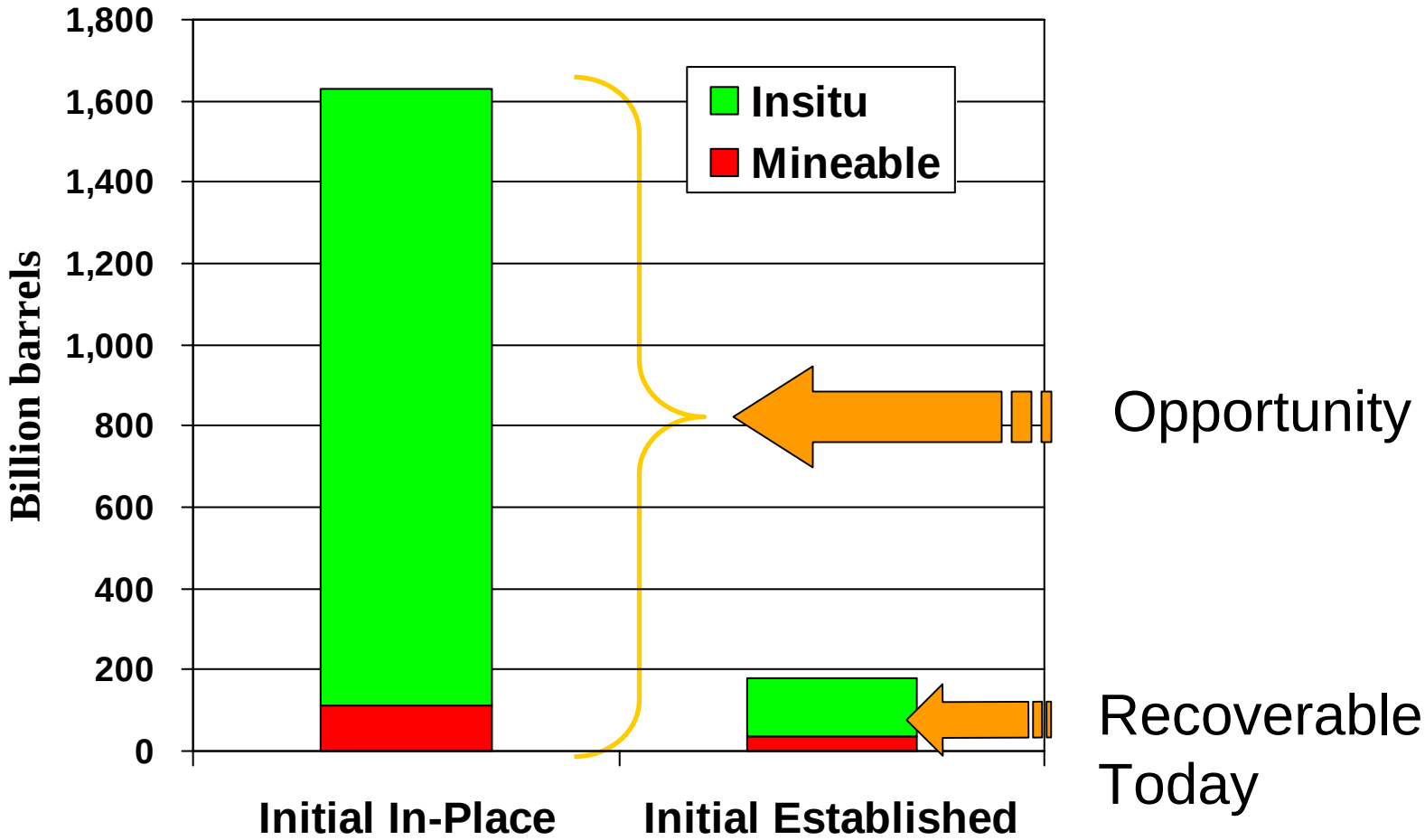
Alberta's Oil Sands in 2020

World Scale Hub for Energy and Refined Products



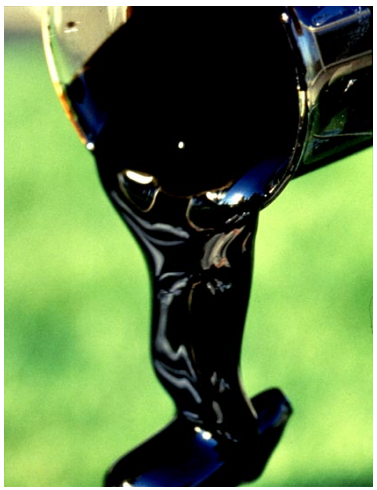
Oil Sands Reserves

Capturing the Opportunity



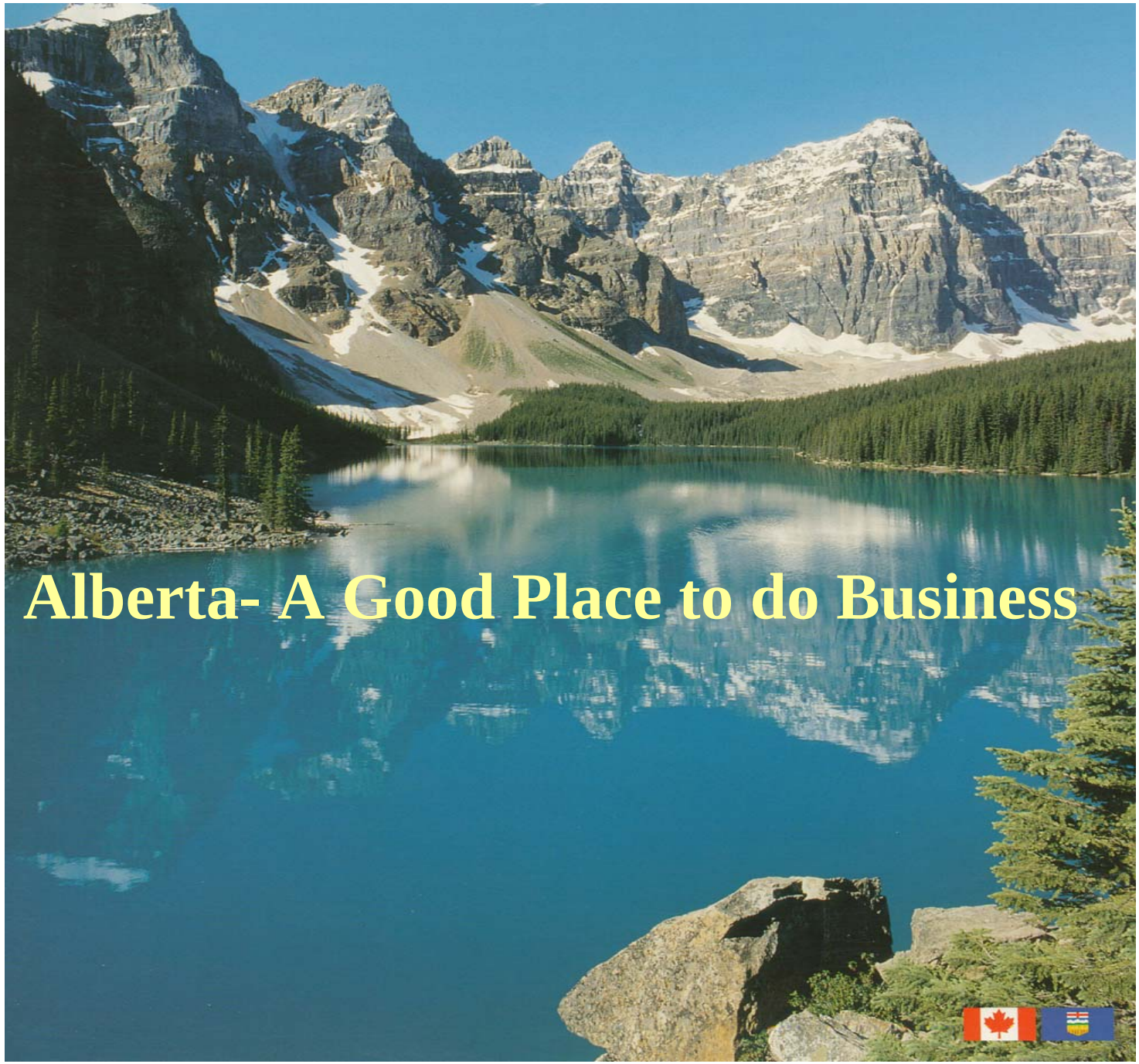
Source: EUB

Alberta Oil Sands Advantage

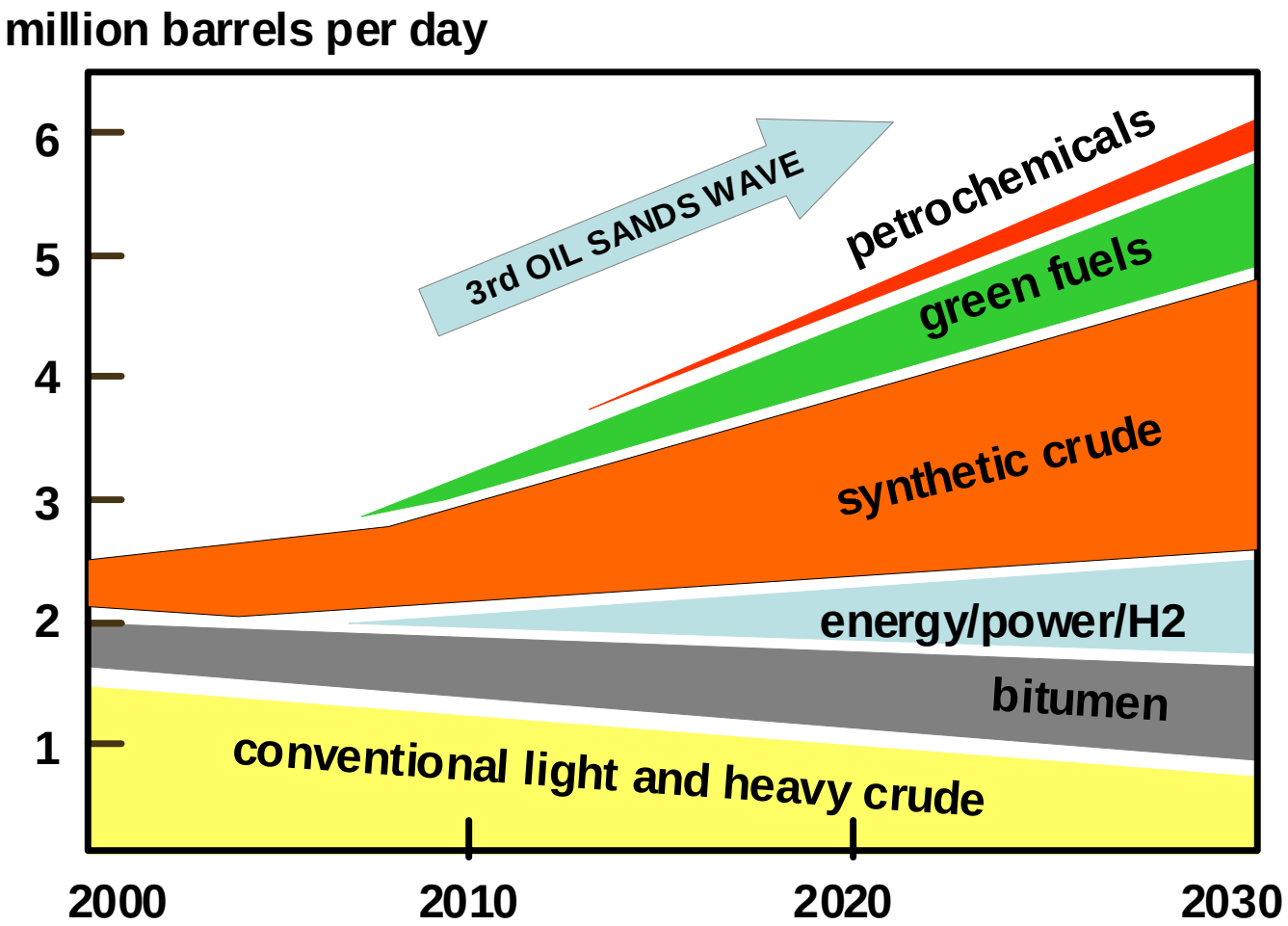


- **Abundant resource and world-class industry**
- **Regulatory stability and certainty**
- **Competitive fiscal regime**
- **Track record of innovation**
- **Open and competitive markets**

Oil sands pictures courtesy of Syncrude Canada.


Alberta- A Good Place to do Business

Vision for the Future



Oil sands: a sustainable competitive source of synthetic crude oil, refined products, petrochemicals and clean energy

Adapted from Oil Sands Technology Roadmap, Alberta Chamber of Resources, Jan 30, 2004