

# NPRA



## Western Canadian Crude Oil Production

- an overview

Presentation to the National Petrochemical and Refiners Association
2007 Q&A and Technology Forum

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Crude Quality Inc.



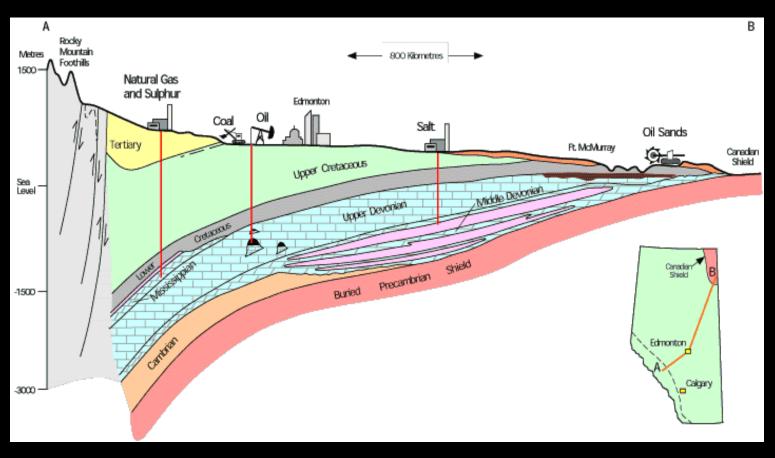
### Principal Geology

- Predominant Geology
  - PreCambrian Shield
  - Rockies, et al thrust zones
  - Western CanadianSedimentary Basin (WCSB)
- Four Provinces, Two Territories
  - All have hydrocarbon reserves





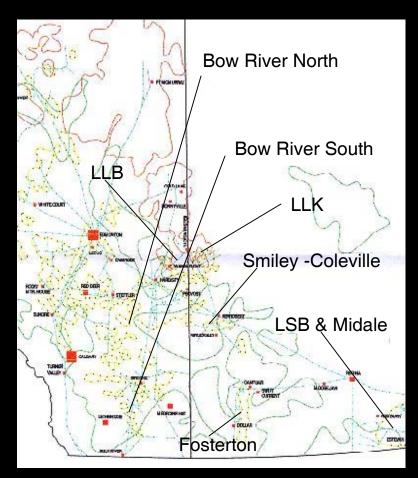
### Alberta – Subterranean Cross Section





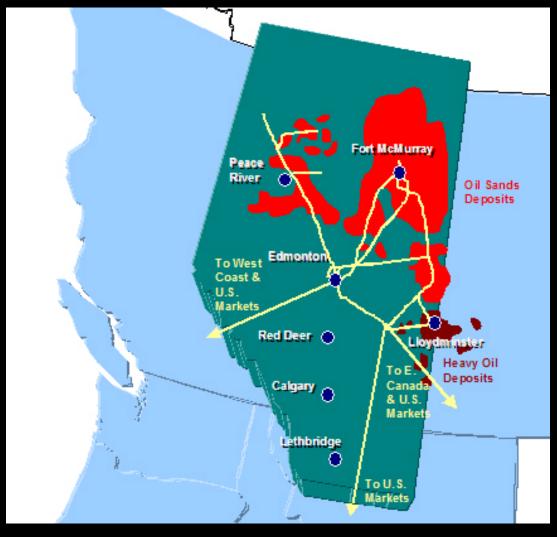
# Western Canadian Sedimentary Basin (WCSB)

- Heavy Conventional
- Medium Conventional
- Light Conventional
- Bitumen regions
  - Cold Lake
  - Athabasca
  - Wabasca
  - Peace River





# Heavy Oil and Oil Sands - Locations





## **Key Producers**

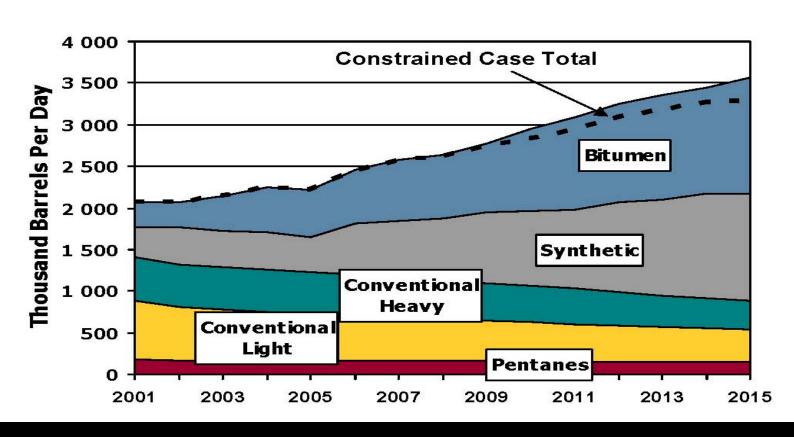
#### Western Canada Production (kbpd)

	ВС	AB SK	MB	NWT	Total
1996 1997 1998 1999 2000 2001 2002	46 53 57 50 55 55 53	1 557 361 1 620 404 1 632 399 1 536 374 1 537 417 1 550 427 1 550 422	11 11 10 11 11	30 29 28 28 26 26 25	2 004 2 117 2 128 1 999 2 047 2 070 2 061
2003 2004 2005 est YTD 2006 est YTD	49 47 <i>4</i> 2 <i>4</i> 6	1 643 420 1 741 423 1 712 421 2 030 477	11 11 <i>12</i> 13	24 23 20 23	<ul><li>2 147</li><li>2 245</li><li>2 208</li><li>2 589</li></ul>



#### WCSB Production Estimates

Chart 5: Western Canadian Crude Oil Production Moderate Case vs. Constrained Case





#### **Production Techniques**

- Conventional
  - Natural gas, light, medium, heavy crudes
  - Traditional drill a hole, mount a pump (if needed), connect a pipeline to a battery
- Non-conventional
  - Cyclic Steam Stimulation (CSS)
  - Steam Assisted Gravity Drainage (SAGD)
  - Vapour Extraction (VapEx)
  - Mining
  - Upgrading (full and partial)
  - Coal Bed Methane (CBM)



#### **Conventional Production Methods**

- Natural gas, light, medium, heavy crudes
- Production Methods
  - Largely dependent on formation pressure, porosity, permeability, viscosity of the fluids and age of well
- "Pull" techniques
  - Reciprocating pumps (pump jacks)
  - Rotary pumps (vane submersibles, positive displacement)
- "Push" techniques
  - Water flood, gas/solvent flood, steam flood



# API and Sulfur Trends -Conventional Production



Kindersley

**Drayton Valley** 

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#### **Conventional Production**





#### Non-Conventional Production

- Coal Bed Methane (CBM)
- Mining
- Cyclic Steam Stimulation (CSS)
- Steam Assisted Gravity Drainage (SAGD)
- Vapour Extraction (VapEx)
- THAI (Toe to Heel Air Injection)
- Upgrading (full and partial)

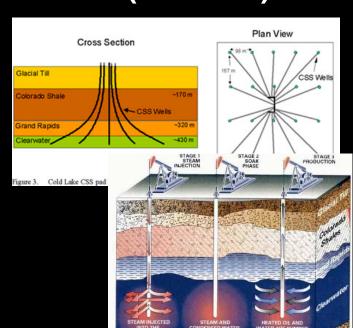
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### Non-Conventional Production



# Cyclic Steam Stimulation (CSS)

- Cold Lake bitumen production
- Production zones are deeper than in SAGD and mining operations
- Inject steam into zone, then allow heat to diffuse into formation
- Move in pump jacks and start production

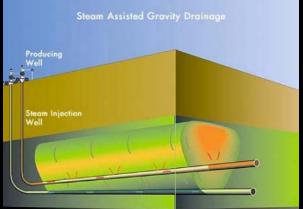


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SAGD (Steam Assisted

Gravity Drainage)

- Series of horizontal wells (upper and lower)
- Steam is applied to upper well, formation is heated
- Bitumen and condensed steam produced from lower well
- Unlike CSS, heating and production are simultaneous



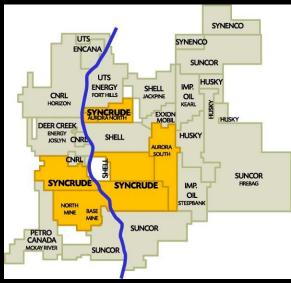


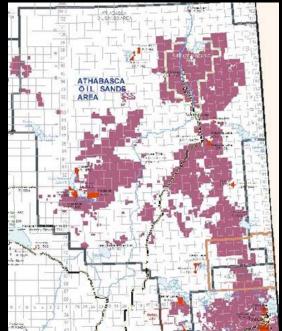




### Mining

- Driven by standard strip ratio, recovery economics
- All operations are now truck and shovel
- Bitumen production is fully or partially upgraded
- Current mining economics do have geographical limits







### Upgrading

- Conventional process is to extract bitumen from sand, then coke, and hydrotreat coker products
- Hydrocracking extracted bitumen recently more prominent
- HGO conversion will improve marketability
- Market upgraders





### Upgrading Mined Oil Sands

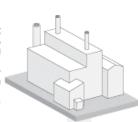
#### **Getting the oil** out of oil sands

A multistep process is required to extract the bitumen (a thick tarlike substance) from the sand, clay and water in oil sands and turn it into something equivalent to crude oil.

#### **Utilities** plant

Fueled by coke from the upgrading process or natural gas, the plant provides:

- Steam, water and heat for mining, extraction, upgrading and in-ground processing.
- Electricity for mining and inground processing pumps.



#### In-ground processing

Oil sands more than 250 feet underground are too thick to be easily pumped out and too deep to mine from the surface.

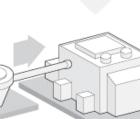
- High-pressure steam is injected into a well. ■ Bitumen is heated to make it flow more easily.
- Bitumen and water are pumped to the surface. ■ Water and sand particles are removed. Water is recycled.
  - Bitumen is diluted and piped to upgrading.

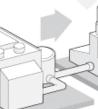


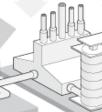


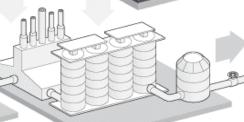












#### Site preparation Trees and brush are cleared. Top soil and decaying plant

material are saved for reclamation. Clay, silt and gravel are used to build tailings ponds.

#### Mining

Oil sands are removed with huge mining shovels and trucks.

Ore is crushed. Hot water is added so mixture can be piped to extraction plant.

#### 3 Primary extraction Hot water is mixed with oil sands in large

vessels to separate bitumen from sand.

A froth of bitumen and air bubbles is skimmed off the top.

Water collects in the middle.

Sand sinks to the bottom.

Tailings, a mixture of water, clay, sand and small amounts of bitumen, are pumped to holding ponds after extraction.

- Bitumen traces are digested by bacteria.
- Sand and clav slowly settle over a decade or more and are used to fill the mine site.

■ Water is reused for extraction.

#### Secondary extraction

Bitumen froth is mixed with a solvent called naphtha and soun in centrifuges to remove water and fine clay particles.

5 Upgrading Naphtha is removed and recycled for extraction.

Bitumen is heated to separate hydrocarbon vapors from solid residue called coke.

Sulphur can be removed and sold for use in fertilizers and other products.

Vapors are separated into:

- Naphtha.
- Gas oil, a type of fuel oil.

These products can be mixed into a crude oil equivalent or used separately.

Coke, similar to coal, can be used as a fuel in the utilities plant, stockpiled or sold.

The Denver Post

Transportation Products are

shipped by pipelines to

refineries throughout

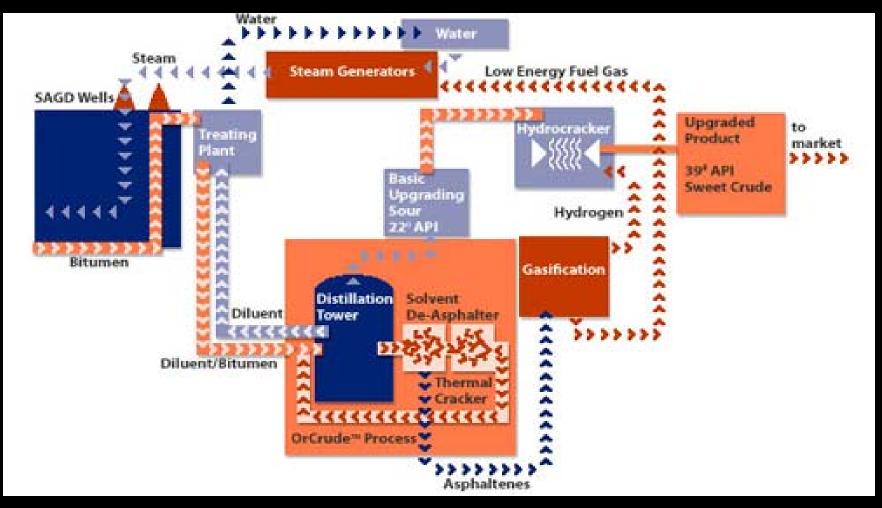
North America.



Sources: Suncor Energy Inc., Petroleum Communication Foundation



# Upgrading – New Version(s)





### WCSB Product Quality

- Products
  - Conventional light, medium, heavy
  - Non-conventional dilbit, synbit, synthetic
  - Custom blended products
- Conventional streams should remain consistent into future though volumes are predicted to decrease
- Non-conventional streams will attempt to develop market differentiation (SSB→SSP, OSn)
- Light/ heavy spread will determine upgrading versus direct-to-dilbit decisions



#### Q & A

# National Petrochemical and Refiners Association Austin, TX October 9-12, 2007



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