Energy Intelligence

Powerful Thinking for the Global Energy Industry

Update on Competitiveness of Non-Conventional Oil

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Outline of Issues

- *Types of non-conventional oils*
- *Reserves*
- *Location and transport logistics*
- *Costs*
- *Role of new technologies*
- *Timing of development*
- *Quality of output*

Types of Non-Conventional Oil

- **Heavy conventional oil**
  - Existing 10-25° API
  - New heavy, shallow fields/zones
- **Bitumen/Oilsands**
  - Mineable
  - Traditional In-situ
  - New In-situ methods
- **Oil Shales**
- **Liquids from coal**

Reserves

- **Inclusion of Canadian Oilsands a major breakthrough**
  - "economically producible with current technology at current prices"
- **Non-Conventional Hydrocarbons-in-Place swamp conventional**
- **Technology challenge is to raise the recover ratio (reserves/resources)**

Location

- Canada and Venezuela still in the forefront
- Australian shale still on the margin
- Very limited progress elsewhere
- South African Sasoil marking time
- Big Chinese coal-to-liquids initiative likely

Transport Logistics

- Need for heated pipelines in cold climates
- Need for diluents to thin liquids streams
- Long distances to refineries
  - choice of where to upgrade, field vs. refinery
- Access to “conformable” product markets

Costs

- **Cost pressures building**
  - price of fuel, esp. natural gas
  - price of labor
  - delays and growing bureaucratic burdens
- **Lumping up of projects could add to pressures**
- **Full weight of environmental costs still to be determined**

Role of New Technologies

- **For Canada, how to make material mobile with less heat from gas**
  - Improved efficiency in heat generation
  - creating heat with residuum rather than gas
  - use of other hydrocarbons like propane
- **Besides recovery technologies, improved upgrading, blending and refining are needed**
- **Economic carbon sequestration has double benefit; project economics + environment**

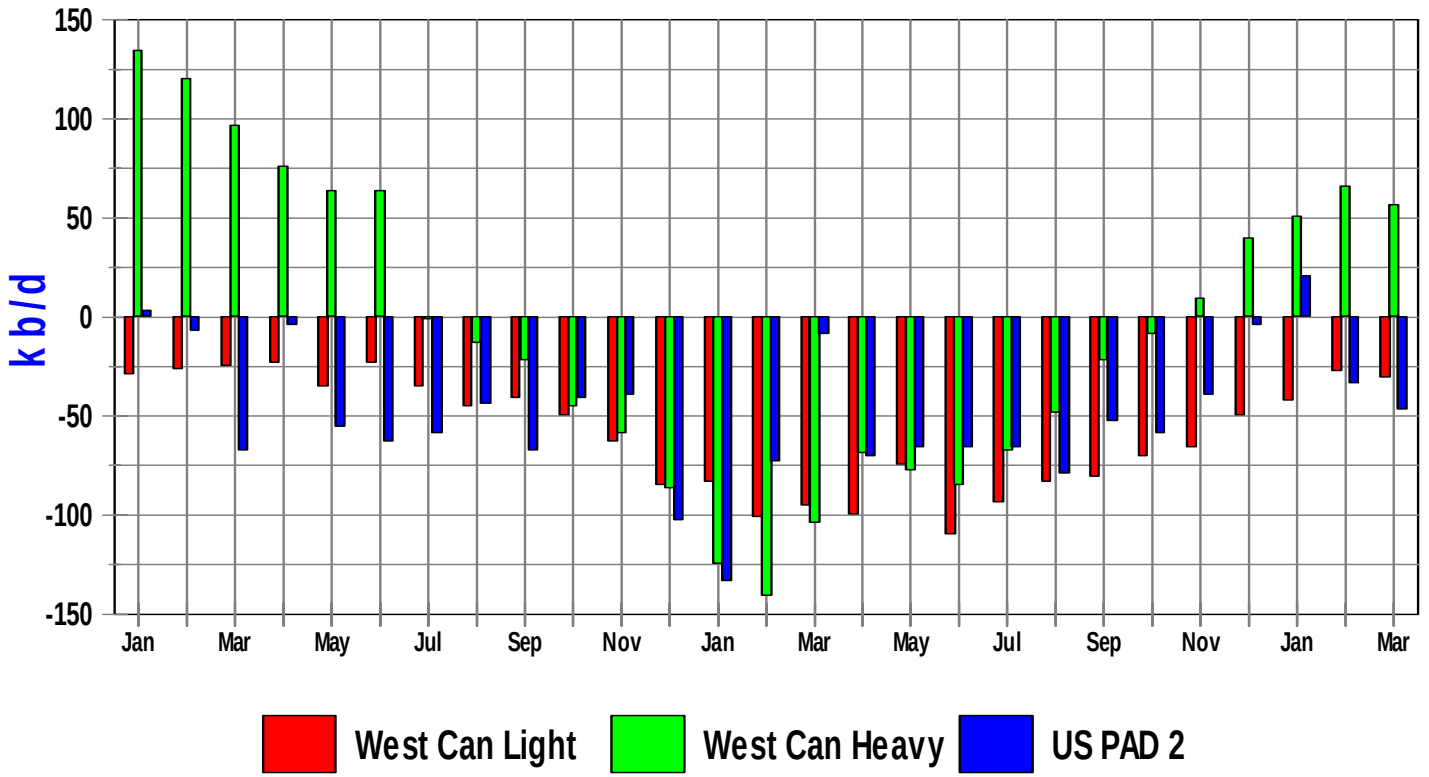
Economic Margin of the Market

- Heavy fields consistently 1st shut-in by Opec
- Heavy oil-bitumen (with US stripper wells) bore the brunt of 1998 production shut-ins
  - highest production cost
  - higher processing costs
  - more impurities
  - bigger environmental impact, risks
- Even with higher oil price levels, cost increases could push heavy oil to the margin

The Economic Margin for Oil Supply

North American Crude Oil Production

(Year-on-Year Changes 1998 -2000)



Profitability

- **Profitability always depends on:**
  - unit price
  - minus government take
  - minus op. costs (inc. cap. recovery)
- **Non-conventional competitiveness**
  - cost risk becoming as important as price risk
  - government takes/subsidies in play
  - risk of differential environmental costs

Key Financial Issues

- **Canada**
  - Kyoto cost uncertainties
  - Natural gas. diluent availability & price
  - Water, air, and land pollution
- **Venezuela**
  - Production limitation
  - Government participation & royalties
- **Australia**
  - Subsidies vs. “green” attack

Environment & Competitiveness

- **Will heavy oils be part of the solution (H_2 source) or part of the problem?**
- **Need hydrogen/heat to split out useful oils**
- **Huge amounts of carbon involved**
- **Problems with air and water pollution**
- **Recent big cost overruns in Canada troublesome; not just labor costs?**

Alberta Tar Sands & Bitumens

- Synthetics from oil sands nearing 500,000 b/d
- Could hit 750,000 b/d by 2005
- Bitumens also around 500,000 b/d
- Steady markets in US Midwest
- Need to expend deeper into US, overseas

Canadian Oil Sands

Field/Mine	Operator	2004	2005	2006	2007	2008	2009	2010	2011	2012
Oil Sands										
Suncor	Suncor	144	205	205	205	255	305	305	305	355
Steepbank Mine		90	80	80	80	80	80	80	80	80
Millenium		125	125	125	125	125	125	125	125	125
Voyageur						50	100	100	100	150
Syncrude	Syncrude	316	371	371	371	335	400	466	466	466
Mildred Lake		152	152	152	152	100	100	100	100	100
Aurora 1		109	109	109	109	117	117	117	117	117
Aurora 2		55	109	109	109	117	117	117	117	117
Aurora 3 +							65	131	131	131
Muskeg River	Shell et al	155	155	155	155	225	225	325	425	425
Horizon	CNR			30	110	128	180	180	270	270
Total Synthetics		616	731	761	841	943	1,110	1,276	1,466	1,516

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Current Canadian Bitumen Outlook

Field/Mine	Operator	2004	2005	2006	2007	2008	2009	2010	2011	2012
Bitumen										
Cold Lake	Exxon	165	175	195	195	200	215	215	215	215
Phase 1-10		120	130	150	150	150	145	145	145	145
Phase 11-13		45	45	45	45	40	40	40	40	40
Phase 14-16						10	30	30	30	30
Primrose/Wolf Lake	CNR	65	85	95	110	120	135	135	135	135
Hnaging Stone	Japan Can. O.S.	10	10	15	15	35	35	60	60	60
Foster Creek	EnCana	25	67	70	110	110	110	110	110	110
MacKay	Petro-Canada	25	25	30	30	30	30	30	30	30
Christina Lake	EnCana	10	40	40	40	55	70	70	70	70
Firebag	Suncor	25	40	50	40	105	115	140	270	270
Long Lake	Nexen	10	20	20	70	70	70	70	70	70
Surmont	Conoco/Total			5	27	27	75	75	75	75
Orion	Black Rock	1	10	10	10	20	20	20	20	20
Meadow Creek	Petro-Canada				60	80	80	80	80	80
Kearl Lake	Husky				13	38	63	88	100	100
Horizon SAGD	CNR					20	20	40	70	70
Other		50	40	40	25	20	20	20	20	20
Total Bitumen		386	512	570	745	930	1,058	1,153	1,325	1,325

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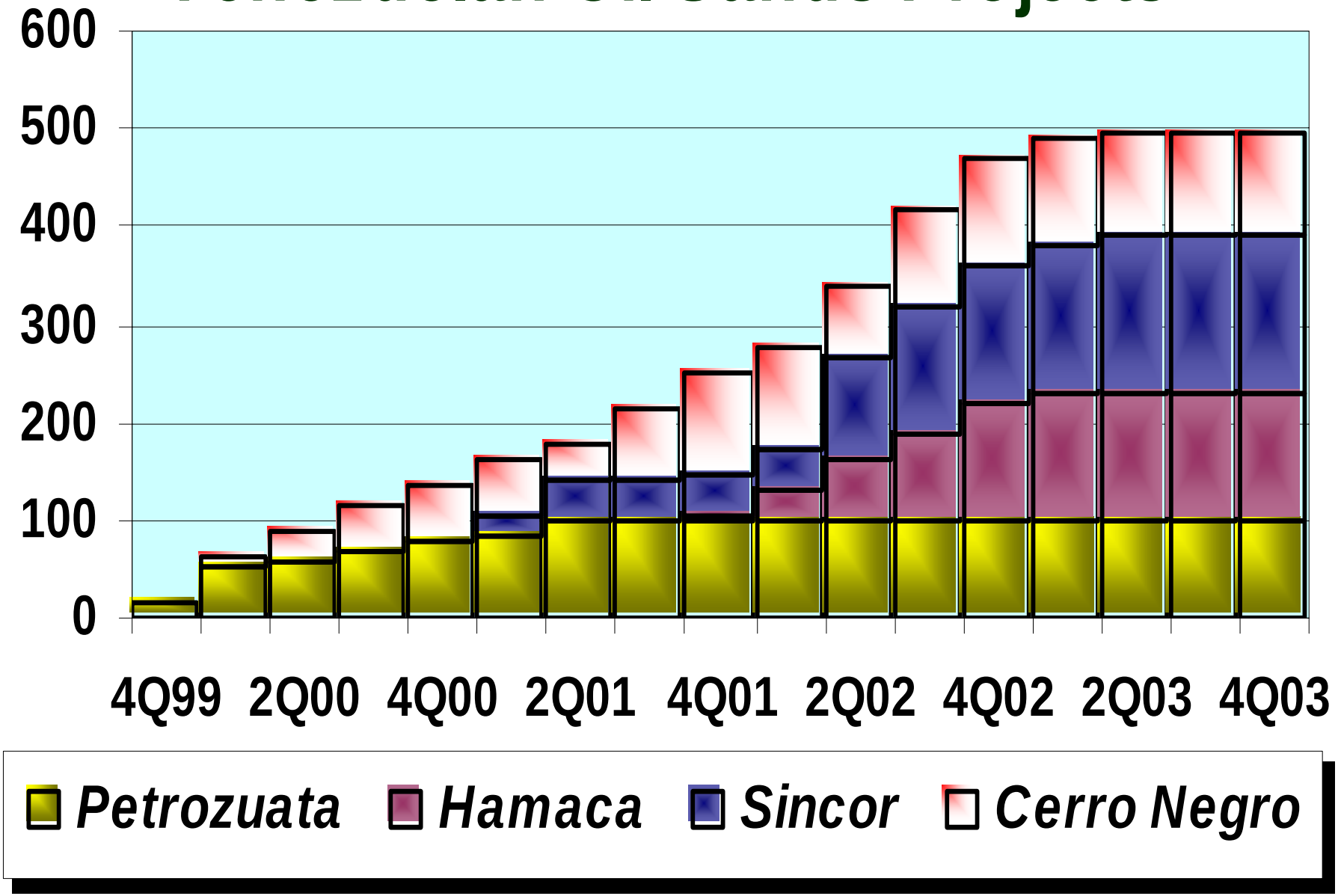
Venezuelan Oil Belt

- "Extra-heavy" rather the bitumen
  - Mobile under reservoir conditions
- 1.2 trillion barrels in place
- About one-fifth ultimately recoverable
- Only 2%-3% at current technology and prices
- Four projects underway, one (Hamaca) awaiting upgrader

Venezuelan Oil Sands Projects



Venezuelan Climate

- **Warmer environment lowers costs**
  - thinner resource
  - less heat needed to produce it
  - easier to move it
  - lower labor & equipment costs
- **“Hot” political environment adds to costs**
  - high political risk, restrains investment
  - threat that Opec quotas may return
  - threat from increased government take

Venezuela Unique

- **Only Opec member w/ major non-conventional**
  - quota treatment issues
  - interplay of State Oil Co. & IOC's
    - like some other Opec, but different
- **Prototype for global mix change**
  - declining light replaced by heavy/non-conv.
  - successful new "aperatura" model could influence other Opec producers

Future of Australian Oil Shale

- **Huge resource, small recovery**
  - 2.6 billion bbl at Stuart, 20 billion for 10 SPP sites
  - about 2/3 of Australian total
- **Provincial, Federal governments supportive**
  - special excise tax rebate, help on land acq., etc.
- **Greenpeace "line in the sands"?**
  - threatened refiners buying naphtha w/ boycott
  - strong public statements

Australian Stuart Oil Shale Project

- Phase-1 producing avg. 1,000-2,000 b/d; 4,500 b/d upside
- Phase-2 15,000-20,000 b/d
- Phase-3 65,000-80,000 b/d
- Local protests, odor problems overcome by hotter furnace temps
- Greenpeace blackmail of refiner naphtha purchases beaten by government subsidies
- Role of government tax breaks continues

Oil Sands Quality Issues

- SCO no tops, no bottoms, fat middle
- Nearby US markets want light ends for gasoline, heavy ends for asphalt
- US refining equipment set up for more complicated crudes, esp. Calif.
- Asian markets much better fit due to strong middles in product slate & simple refineries

Competitiveness Issues-2002

- Oil price <$15 would blunt non-conv. supply
- $15-$20 allow most tar sands, some shale
- Widened heavy-light differentials could limit bitumen, doesn't hurt upgraded syncrudes
- Still a quality horse race: heavier crudes coming on, but so are deepwater lights
- Access to Mideast Gulf upstream critical

Competitiveness Issues-2004

- Costs now probably more important than price outlook
- Availability of gas an issue in Canada
- Product quality and transportation
- Uncertain fiscal terms in Venezuela

Conclusions in 2002

- **Biggest competitive threat is low oil prices**
  - From: high conventional availability
  - weak Opec cohesion, ME Gulf openings
  - strong non-Opec conv. supply growth
- **Cost side threatened more by governments**
  - technological progress lowering op. costs
  - oil shale will lag heavy crudes, tar sands
  - Kyoto threat to competitiveness in Canada
- **Tar sands, oil shale will go global**
  - threats will spread as well

Conclusions in 2004

- **Growing threat from cost increases**
  - Cost overruns at Syncrude
  - Some projects cancelled or at risk
  - Escalating labor and materials cost
  - Costs could surge if projects pile-up
- **Price outlook substantially raised**
  - Mean reversion averaging up
  - Volatility, low stocks mean higher average prices
- **Non-conventional still about Canada, Venezuela**
  - Development elsewhere will depend on what happens there