Economic Risks Facing Athabasca SAGD Bitumen Production

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R.B. Dunbar, Senior Director, Research
Canadian Energy Research Institute

Outline

- CERI Overview
- Athabasca SAGD Supply Costs
  - Methodology
  - Assumptions
  - Results
- Natural Gas Supply and Costs
- Conclusions

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Canadian Energy Research Institute (CERI)

- Independent non-profit Calgary-based research institute founded in 1975
- Sponsors
  - Provincial government
  - Federal government
  - Industry
  - University of Calgary
  - International associate sponsors

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SAGD Supply Costs

- Previously Published in CERI Study No. 91: *Supply Costs and Economic Potential for the Steam Assisted Gravity Drainage Process; September 1999*
- This work updates some of the results reported in that study
  - Capital and operating costs
  - Natural gas prices
  - Athabasca Oil Sands Area only

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Supply Cost

- Supply cost is the constant dollar price that would recover all costs including:
  - Capital
  - Operating costs
  - Taxes
  - Royalties
  - Return on investment
- Supply cost is calculated using discounted cash flow techniques

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Energy Price and Economic Assumptions

- Energy
  - NYMEX Natural Gas: US$4.00/MMBtu
  - Plant Gate Natural Gas: C$4.63/GJ
  - Plant Gate Electricity: C$50/MWh
- Economic
  - Exchange Rate 0.72 US$/C$
  - Inflation Rate 2%/a
  - Return on Investment 10%/a (real)
  - All prices and costs are expressed in 2003 dollars

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Reservoir Assumptions - Athabasca Oil Sands Area

	High Quality Reservoir
Reservoir Quality	
Bitumen Gravity (^{0}API)	8
Continuous Pay Thickness (m)	35
Porosity (%)	35
Bitumen Saturation (%)	85
Effective Vertical Permeability (Darcies)	5
Bitumen viscosity (mPa.s)	1,000,000
Performance	
Recovery of original bitumen in place (%)	65
Cumulative steam/oil ratio	2.0
Design	
Depth to reservoir top (m)	200
Effective horizontal well length (m)	750
Inter-well spacing (m)	150
Peak production rate per well-pair (m^3/d)	245

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SAGD Project Description - Athabasca Oil Sands Area

	High Quality Reservoir
Nominal Capacity (b/d)	50,000
Initial CAPEX (C$ million)	356
Total CAPEX (C$ million)	633
Total CAPEX (C$/b/d)	12,600
Natural Gas (C$/b)	3.96
Other OPEX (C$/b)	1.91
Project Life (years)	30

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Bitumen Supply Costs at Plant Gate - Athabasca SAGD

	High Quality Reservoir (C$2003/b)
Capital	2.73
Natural Gas	3.94
Other Operating Costs	2.00
Taxes	0.83
Royalties	0.64
Return	Included
Total	10.15

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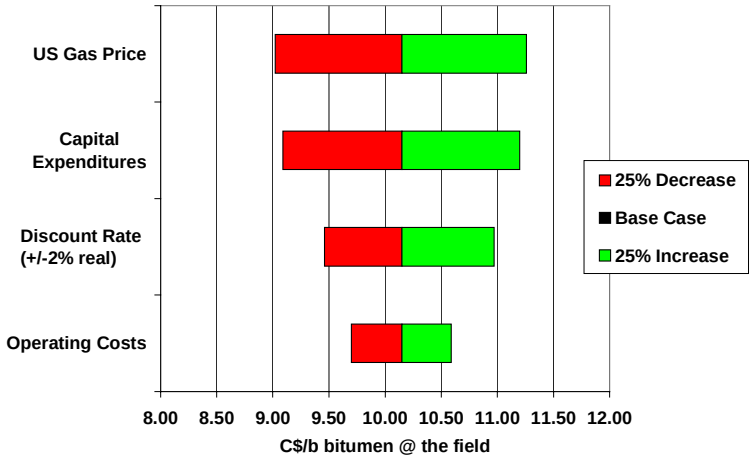
Supply Cost Sensitivities - Bitumen Field Prices



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Assumed Transportation Costs and Price Differentials

- **Diluted Bitumen**
  - Dilbit Composition 31.6% Condensate
  - Condensate Premium 7.0% over MSW
- **Transportation**
  - Dilbit to Hardistry C$1.15/b
- **Differentials**
  - MSW (Edmonton) - Dilbit (Hardisty) US$6.50/b
  - WTI (Cushing) - MSW (Edmonton) US$1.20/b

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Bitumen Supply Costs Relative to Market Values

	C$2003/b	US$2003/b
Bitumen at Plant Gate	10.15	7.31
Dilbit at Hardisty	16.96	12.21
MSW Equivalent at Edmonton	25.99	18.71
Equivalent WTI at Cushing	27.65	19.91

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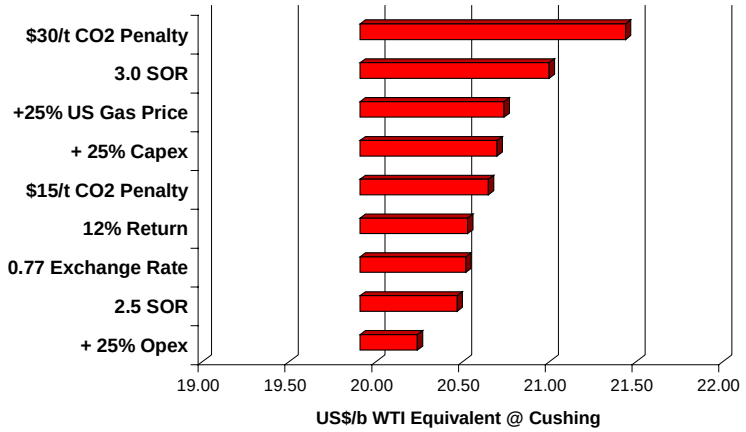
Supply Cost Sensitivities - WTI Equivalent Prices



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Reservoir Assumptions - Athabasca Oil Sands Area

	High Quality Reservoir	Low Quality Reservoir
Reservoir Quality		
Bitumen Gravity (^{0}API)	8	8
Continuous Pay Thickness (m)	35	15
Porosity (%)	35	31
Bitumen Saturation (%)	85	71
Effective Vertical Permeability (Darcies)	5	2.5
Bitumen viscosity (mPa.s)	1,000,000	3,000,000
Performance		
Recovery of original bitumen in place (%)	65	50
Cumulative steam/oil ratio	2.0	2.8
Design		
Depth to reservoir top (m)	200	200
Effective horizontal well length (m)	750	750
Inter-well spacing (m)	150	100
Peak production rate per well-pair (m^3/d)	245	95

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SAGD Project Description - Athabasca Oil Sands Area

	High Quality Reservoir	Low Quality Reservoir
Nominal Capacity (b/d)	50,000	25,000
Initial CAPEX (C$ million)	356	334
Total CAPEX (C$ million)	633	1,256
Total CAPEX (C$/b/d)	12,600	49,900
Natural Gas (C$/b)	3.96	5.82
Other OPEX (C$/b)	1.91	3.97
Project Life (years)	30	30

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Bitumen Supply Costs at Plant Gate - Athabasca SAGD

	High Quality (C$2003/b)	Low Quality (C$2003/b)
Capital	2.73	7.82
Natural Gas	3.94	5.98
Other Operating Costs	2.00	4.12
Taxes	0.83	1.71
Royalties	0.64	1.47
Return	Included	Included
Total	10.15	21.11

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Bitumen Supply Costs - WTI Equivalents

	High Quality (C$2003/b)	Low Quality (C$2003/b)
Bitumen (Plant Gate)	10.15	21.10
Dilbit (Hardisty)	16.96	28.36
MSW Equivalent (Edmonton)	25.99	37.39
	(US$2003/b)	(US$2003/b)
WTI Equivalent (Cushing)	19.91	28.12

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The Gas Supply Issue - Gas Use in 2002

	Bitumen (Mb/d)	Gas (MMcf/d)	Factor (Mcf/b)
Thermal In Situ	185	222*	1.20*
Other In Situ	115	-	-
Syncrude/Suncor	530	213	0.40
Total	830	435	0.52

* estimate based on assumed average SOR of 2.5

Source: Various EUB Reports

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The Gas Supply Issue - Estimated Gas Use in 2012

	Bitumen (Mb/d)	Factor (Mcf/b)	Gas Use (MMcf/d)
Thermal In Situ	660	1.20	790
Other In Situ	115	-	-
Mining	1,560	0.30	470
	SCO		
Upgrading	1,480	0.10	150
Total Gas Use			1,400

Bitumen and SCO forecasts taken from EUB ST 2003-96

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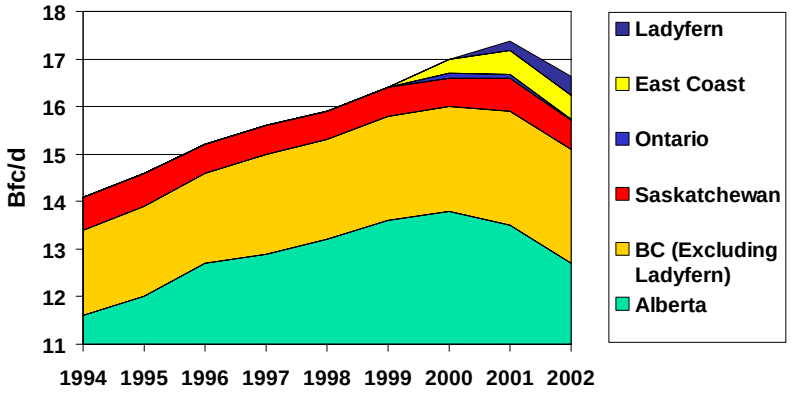
Historical Canadian Natural Gas Production



Source: CERI Study No. 107

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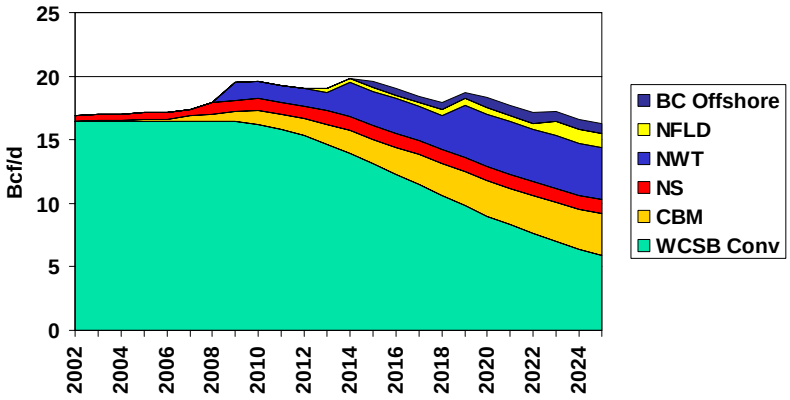
Projected Canadian Natural Gas Production



Source: CERI Study No. 107

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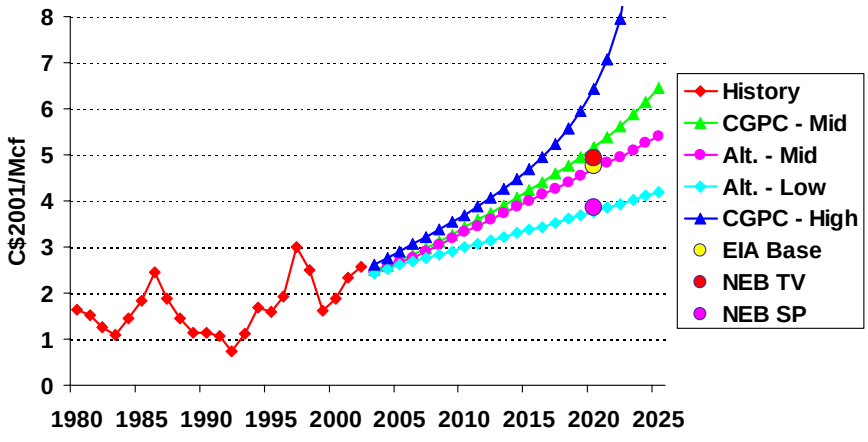
Average Marginal Supply Costs at AECO



Source: CERI Study No. 107

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Conclusions

- Production of crude bitumen from the Athabasca Oil Sands Area is economic under today's crude oil and natural gas price environment
- Economics are influenced most by the following key variables
  - Reservoir quality/project performance
  - Natural gas price
  - Project capital cost
  - Kyoto compliance cost
- Dwindling natural gas reserves and higher natural gas supply costs makes it clear that the industry must either
  - Move towards energy and hydrogen self-sufficiency, or
  - Find alternative external sources to satisfy its energy and hydrogen needs

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