BIOGRAPHY

Neil Edmunds

Laricina Energy Ltd.

Neil Edmunds is currently Vice President, Enhanced Oil Recovery (EOR) for Laricina Energy Ltd. in Calgary. Mr. Edmunds brings a background of over 31 years in the oil and oil sands industry focused primarily on thermal recovery of bitumen. Prior to his current position with Laricina, Mr. Edmunds was Reservoir Engineering Specialist with EnCana Corp. from 2000 to 2005 where he provided reservoir and operations direction for the Foster Creek SAGD and Vapex pilots, researched new recovery technologies and provided expert testimony on gas over bitumen issues before regulatory hearings. Formerly, Mr. Edmunds was Manager, Enhanced Oil Recovery for CS Resources Limited, responsible for the Senlac thermal project and later Vice President, Recovery Technologies focused on enhanced recovery research. As Principal of Clearwater Engineering he provided consulting services in thermal recovery and developed reservoir simulation software. Prior to that, Mr. Edmunds was Process Development Coordinator at the Underground Test Facility (UTF) for Alberta Oil Sands Technology and Research Authority (AOSTRA), and was previously Senior Reservoir Engineer with Vikor Resources Ltd. and AOSTRA.

Mr. Edmunds holds a Bachelor of Science in Mechanical Engineering (Gold Medal) from the University of Alberta. He is a member of the Canadian Heavy Oil Association, Petroleum Society of the CIM and Association of Professional Engineers, Geologists and Geophysicists of Alberta. In 2008 he was appointed Adjunct Associate Professor with the Schulich School of Engineering, University of Calgary.

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ABSTRACT

Innovation and the Future Carbon Footprint of In Situ Oil Sands; A Very Positive Story

Neil Edmunds

Laricina Energy Ltd.

In situ oil sands is an emerging energy subsector where innovative recovery technology is providing an opportunity for both more cost effective resource recovery, and a reduced carbon foot print. Laricina Energy Ltd is a leading in situ recovery innovator, with an emphasis on solvent applications. Laricina has operated cold solvent tests in the emerging carbonate bitumen play, and is advancing a commercial demonstration project of its proprietary solvent-cyclic-SAGD application. Recent work on life-cycle carbon emissions shows that solvent can transform the carbon foot print of Canadian in situ oil sands, to match that of the average imported crude into the United States. In situ innovation in oil sands offers a good news story, meeting a balance in energy security, environment and the economy for Alberta, Canada and North America.

5th NCUT Upgrading and Refining Conference

LARICINA

ENERGY LTD.

Innovation and the Future Carbon Footprint of *In Situ* Oil Sands; a Very Positive Story

September 15, 2009

Forward-looking statements advisory

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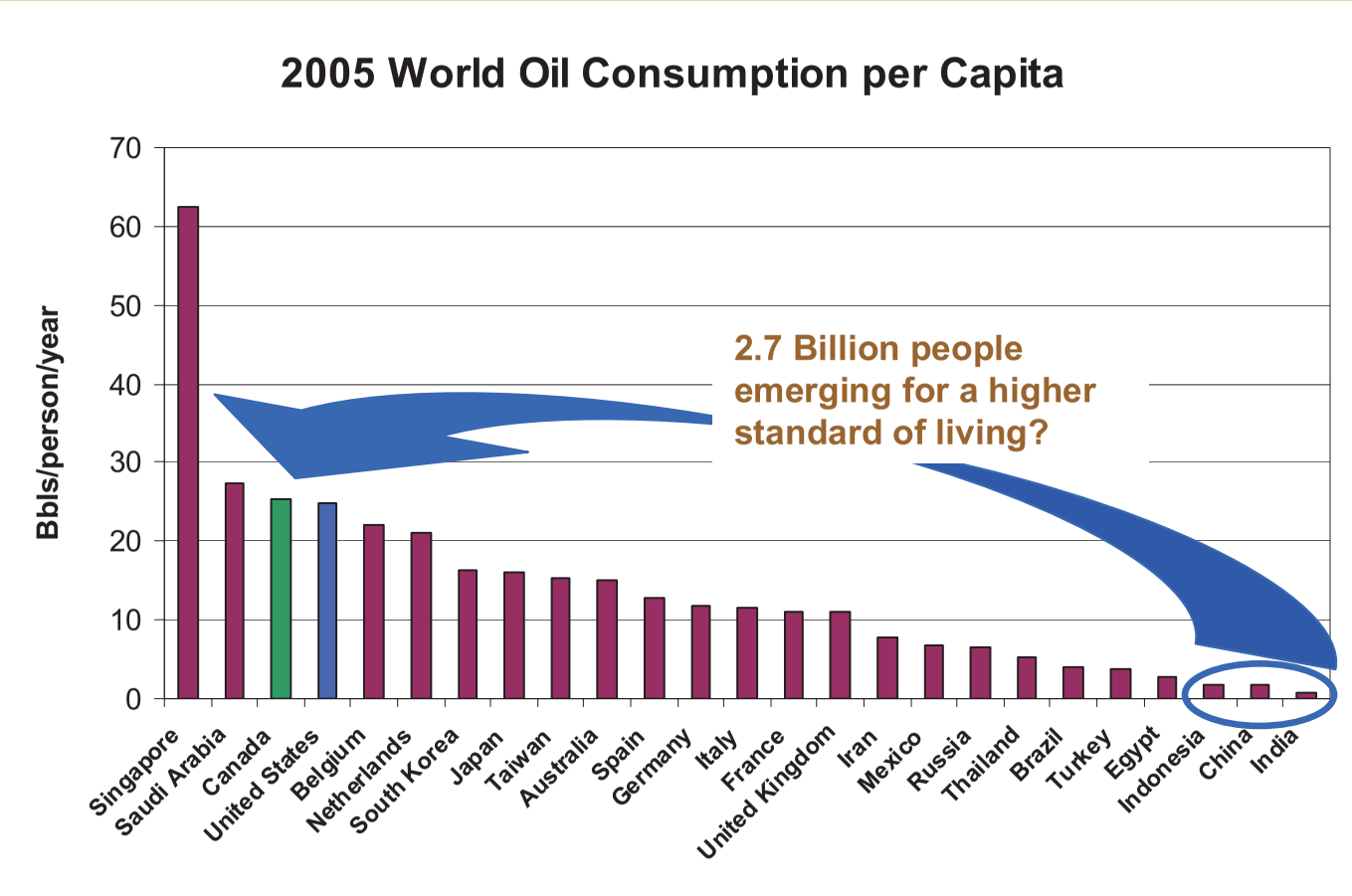
Outline

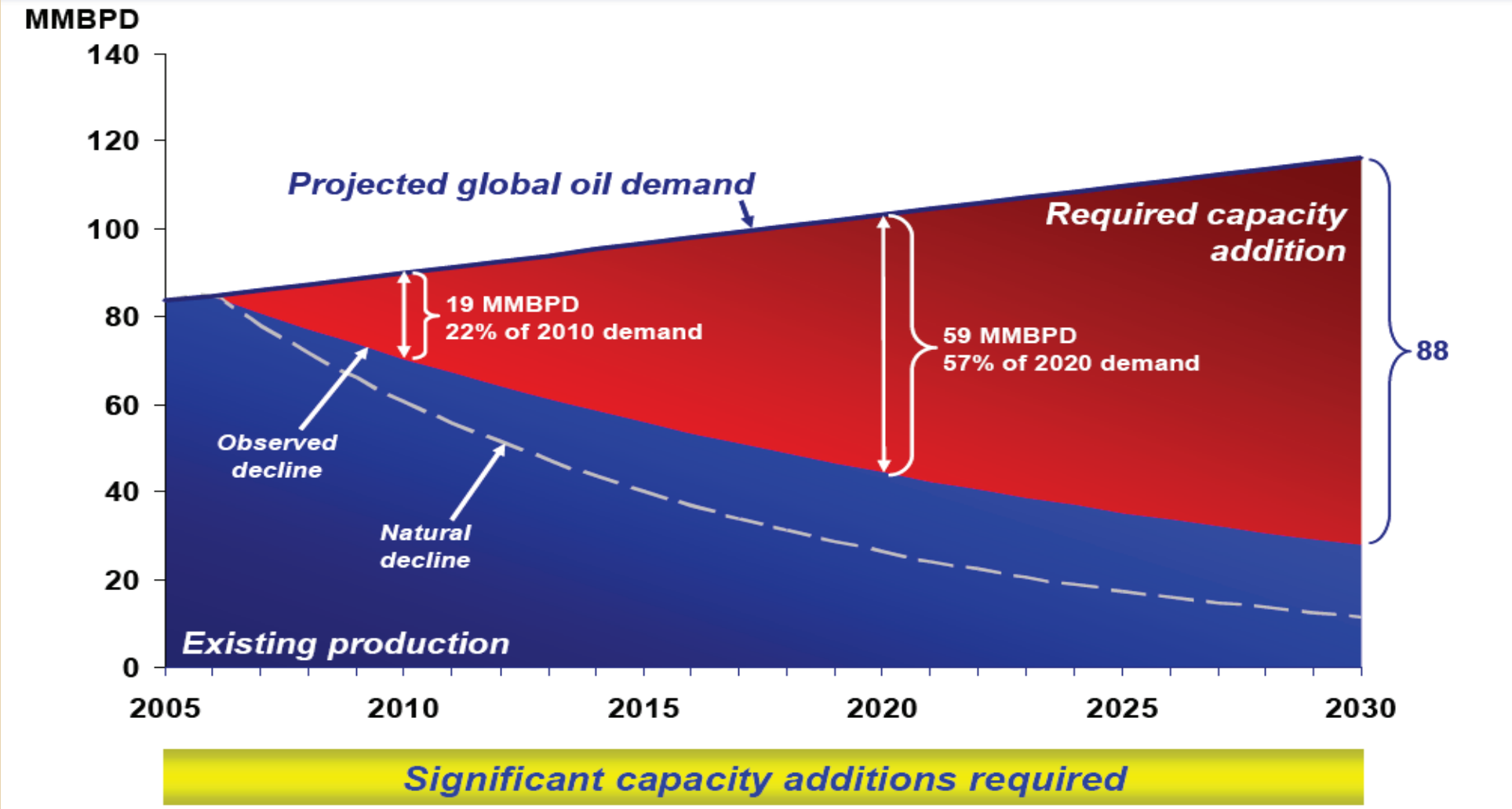
- Why the oil sands?
- *In Situ* oil sands in Alberta
- Environmental impacts: land, water & air
  - with respect to local sustainability
  - relative to international norms
  - compared to our existing options
- Lower impacts by better (still) technology
  - the coming solvent revolution
  - reductions in all impact intensities

The energy challenge



- At current levels of consumption, the present world oil reserves would be depleted in 40 years.
- At current levels of demand growth, the reserve life would be 27 years
- The potential for demand growth from developing nations is very large

Why are we in this business?



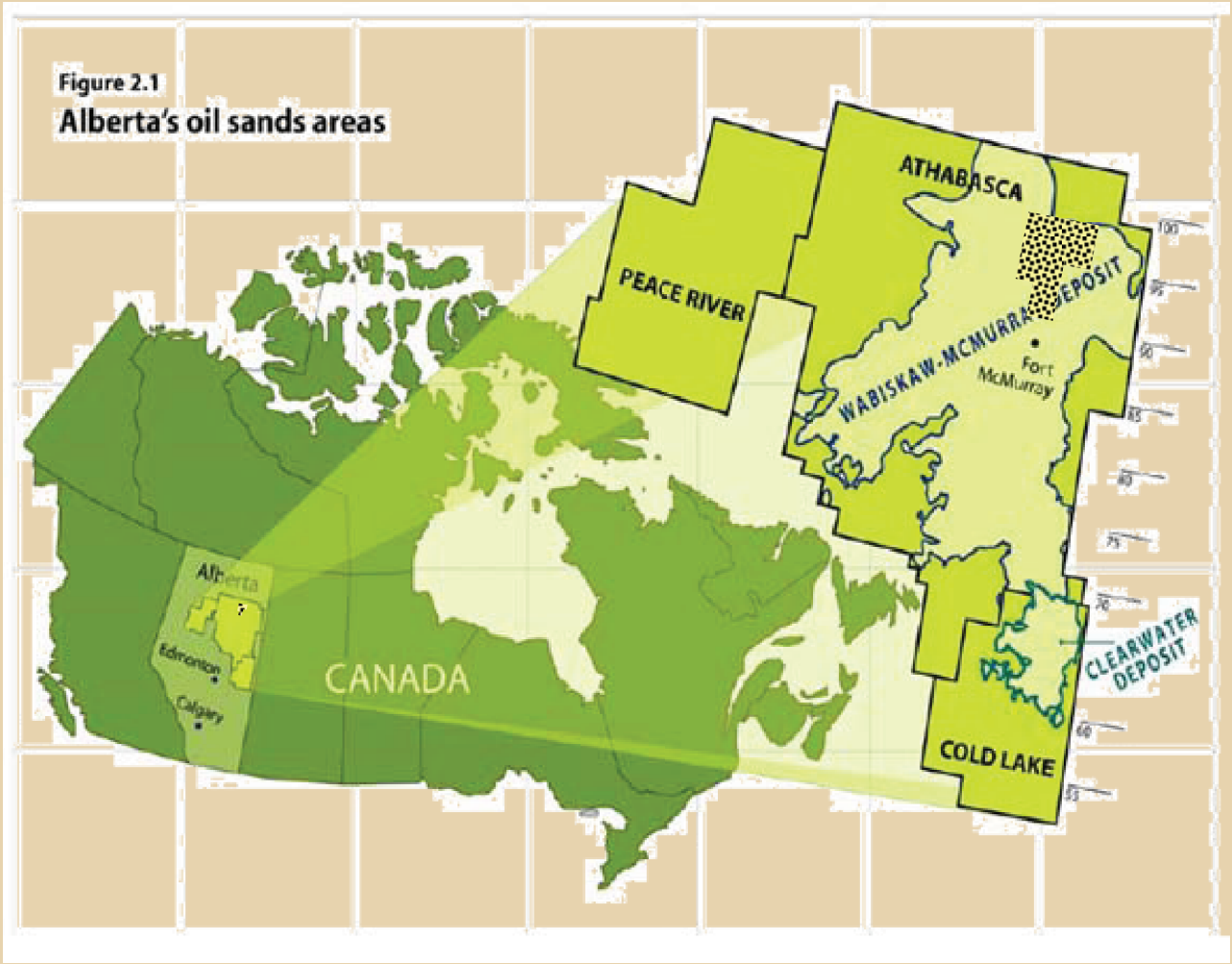
Source: Based on *IEA World Energy Outlook 2007/ConocoPhillips*

Natural decline forecast at 8% rate

Observed decline forecast at 4.5% rate requires substantial investment

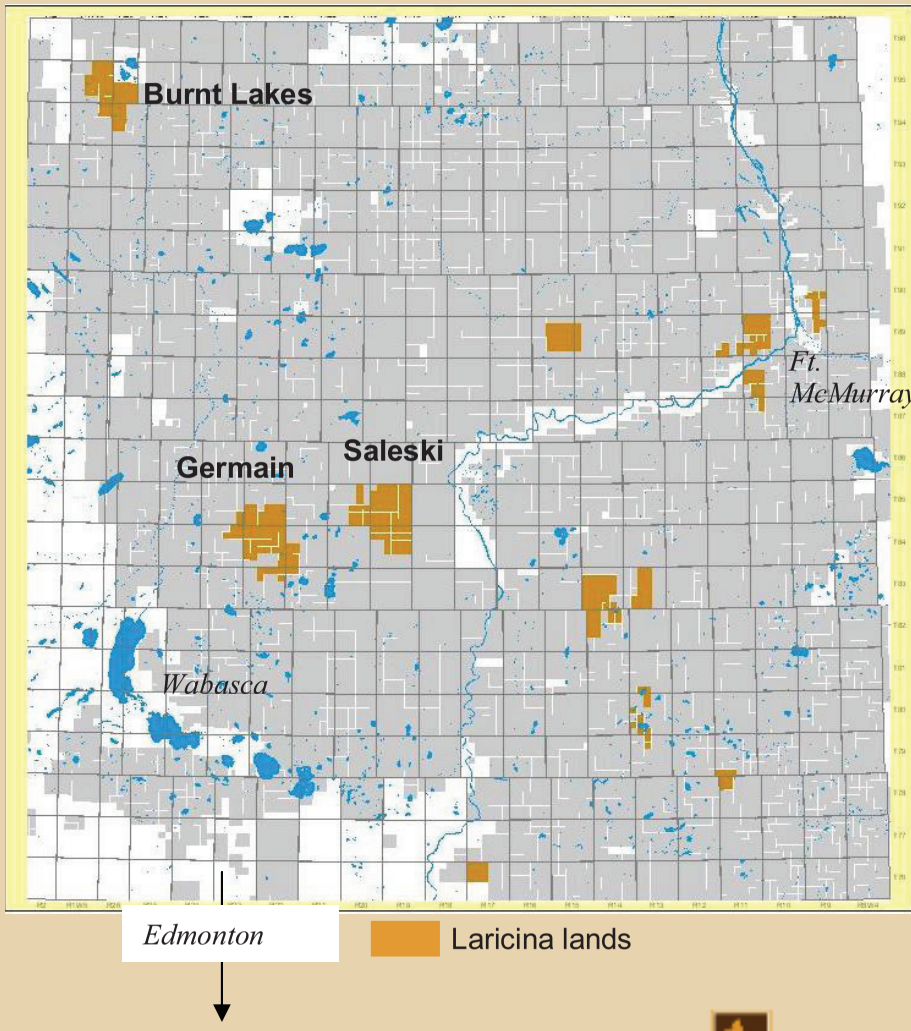
The future of oil sands is *in situ*

- Canada's bitumen resource of 1.7 trillion bbls retains enormous potential for reserve growth
- ***In situ*** oil sands supply potential is **85%** of 174 billion bbls of Alberta's oil sands reserves or **~ 150 billion bbls**
- Ultimate reserves are ~50% higher (315 billion bbls) via advanced *in situ* recovery technology



Laricina: Leader in the future of oil sands development

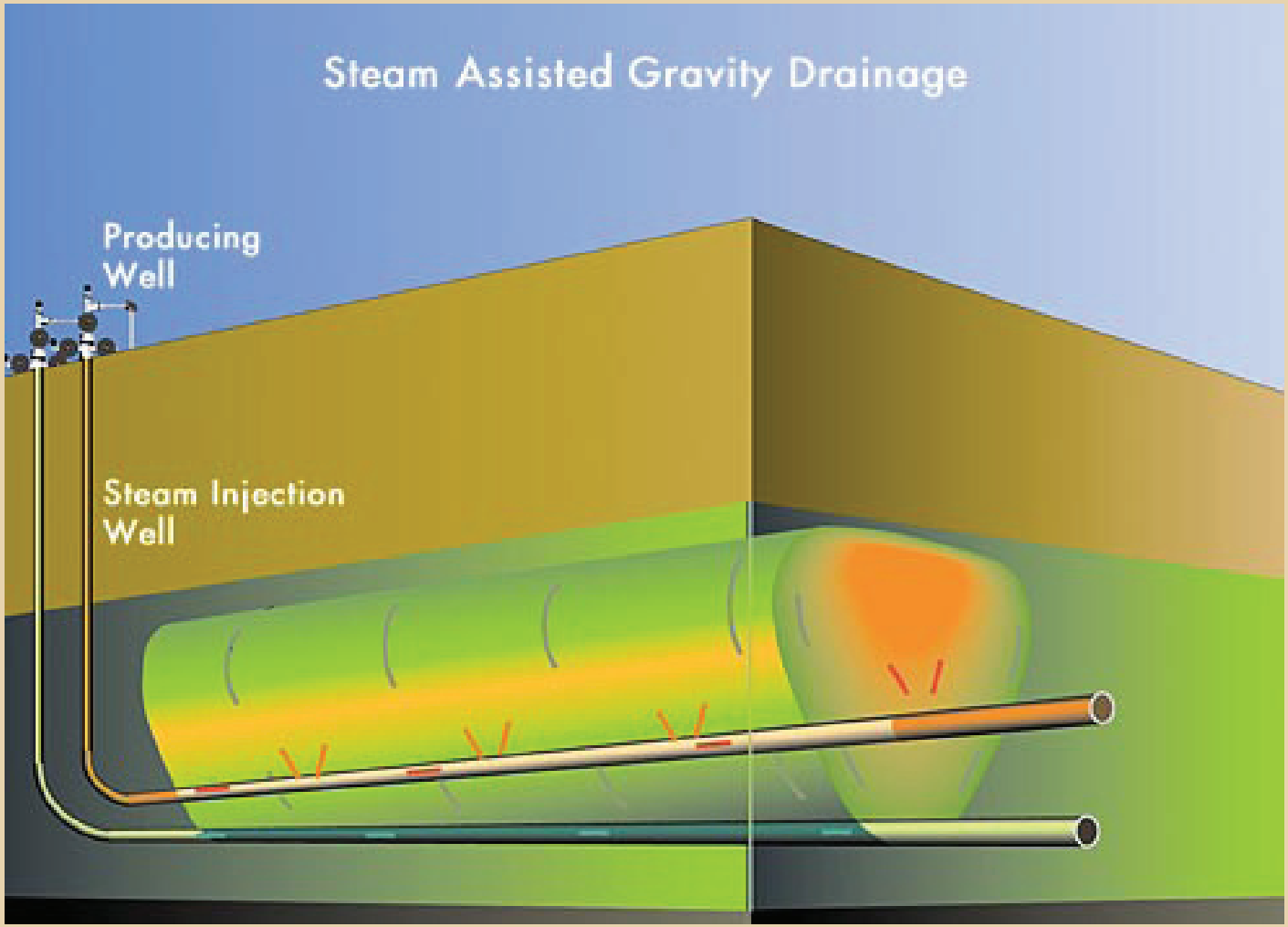
- **One of 3 emerging *in situ* oil sands companies with > 4 billion bbls of net recoverable bitumen**
- **High quality resource, with scale and proximity to infrastructure**
- **Clear path to 350,000+ net barrels per day production potential**
- **Well advanced, resource focused development of innovative SAGD processes, solvent recovery and carbon sequestration**
- **Leading the recovery of bitumen from carbonate reservoirs**



Alberta *in situ* bitumen technology

- New plants will primarily use Steam-Assisted Gravity Drainage (SAGD)
- **SAGD**:
  - descendant of steamflood technology developed in California in the ’50’s and 60’s
  - technology home grown in Alberta
  - applicable to “bitumen”, i.e. immobile oil
  - uses horizontal wells; minimal surface disturbance
  - ***significantly more efficient*** (lower impacts) than conventional steamflood/CSS processes

SAGD well configuration

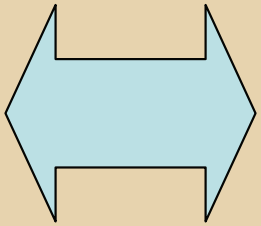


- SAGD uses pairs of horizontal wells, drilled from surface
- Steam is injected in the top well and oil produced from the bottom
- A typical pair of SAGD well-heads drains an area of 8 ha (20 acres) in 5-10 years

Source: EnCana Corporation

Environmental impacts of *in situ* recovery

- **Land**
  - intensity of disturbance
  - reclamation cycle
- **Water**
  - source volumes
  - recycling
  - disposal
- **Air**
  - CO_2
  - S_{ox}, N_{ox}



What are the impacts in terms of:

- Local environmental sustainability
- "International norms"
  - the oil industry
  - other industry
- The Alberta regulatory environment

Land (Habitat) impacts

- About 10% of the greater oil sands regional area has economically viable reserves
- SAGD well sites, facilities, and roads disturb about 15% of the area under active development
  - ultimate impact ~1.5% over the region
  - not all at once!

SAGD land use intensity

- A SAGD well pair produces 500-2000 bopd from a 1-hectare (2.5 acre) clearing
- Land areas required to produce the same amount of energy as 500 bopd:
  - from California-style thermal recovery:
    - ***20*** hectares (50 acres)
  - from wind turbines:
    - ***50*** x 1.5 MW turbines, plus power lines
  - from Iowa corn to ethanol:
    - ***750*** hectares (1900 acres)

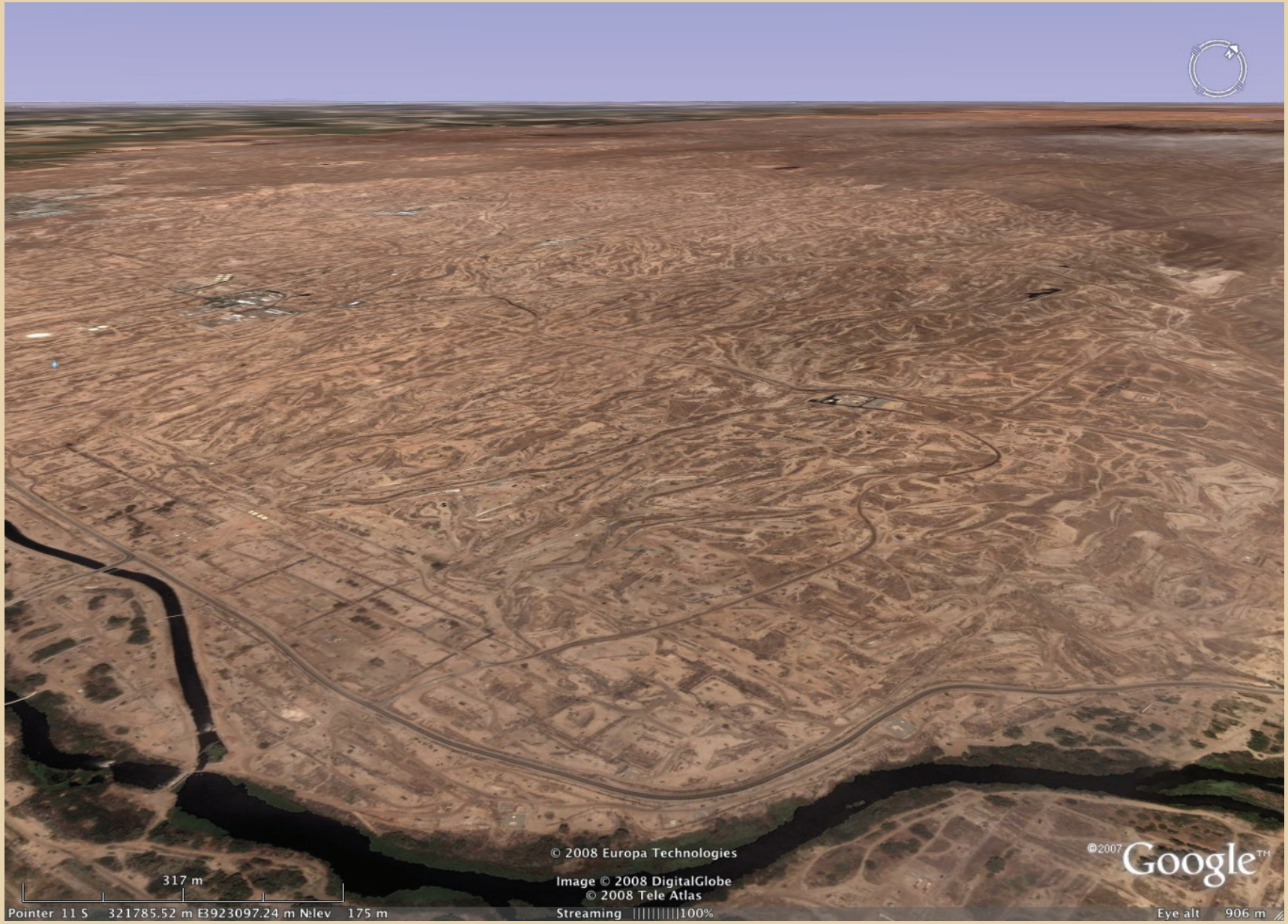
Land use intensity

- The total designated oil sands areas in Alberta contain 140,800 km^2 [$(375\ km)^2$]
- Potentially 5 million bpd of *in situ* recovery:
  - would require a total of about 10,000 ha in use, equivalent to 100 km^2 (10x10 km)
  - less than 0.1% of the area would be under active development at any one time

Foster Creek, Alberta (SAGD)

Duri, Indonesia (conventional steam)

Kern River, California



Belridge, California

Land impact mitigations

- A typical clearing-to-reclamation cycle is likely to be ~20 years
- Local residents are consulted with regard to special places; *in situ* siting is flexible
- Extensive flora & fauna studies are mandatory
- Timely reclamation is mandatory
- No soil contamination is permitted
  - *In situ* piping systems have to contain steam and are constructed to very high standards
- Shared land use (e.g. roads/ROW's) with conventional oil & gas, forestry, power transmission

SAGD water consumption

- Water for new steam projects in Alberta is sourced from deep, brackish (non-potable) aquifers
- Produced water is 80-95% recycled
- **e.g.:**
  - **SOR=3 & 80% recycle:**
    - **0.6 bbl of (brackish) makeup / bbl of oil**
  - **SOR=2 & 90% recycle:**
    - **0.2 bbl of (brackish) makeup / bbl of oil**

Volume of water used to produce things

Product	Average virtual water content (m^3/ton)
Beef	15,500
Rice	2291
Wheat	1334
Corn	909
SAGD Bitumen	0.6

http://www.waterfootprint.org/Reports/ResearchData/Appendix%20XV.xls

SAGD **water** consumption

- Compared to local rainfall:
  - e.g. rainfall of 40 cm/year over 1 Twp. (93 km^2) project area
  - averages to 640,000 bbls of water per day (bwpd)
- Expected typical/maximum SAGD project demand over the same area would be ~50,000 bwpd (100,000 bopd/township)
  - *no surface or potable water is used for steam*

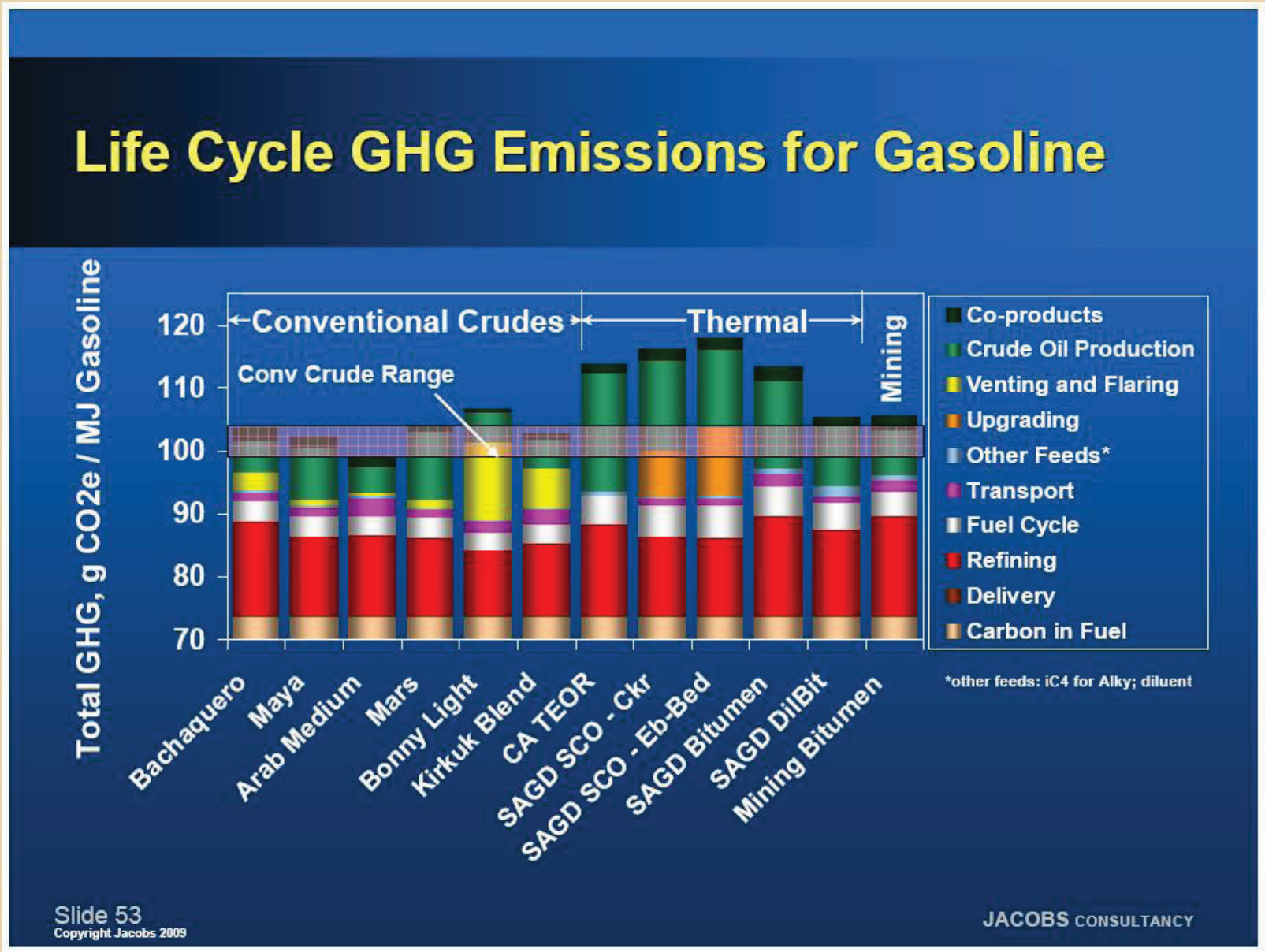
Waste water disposal

- All non-recycled waste water is injected into deep formations (below the oil sands)
- Generally the injected water is of higher quality than the receiving formation
- **'Zero' water is discharged at the surface**

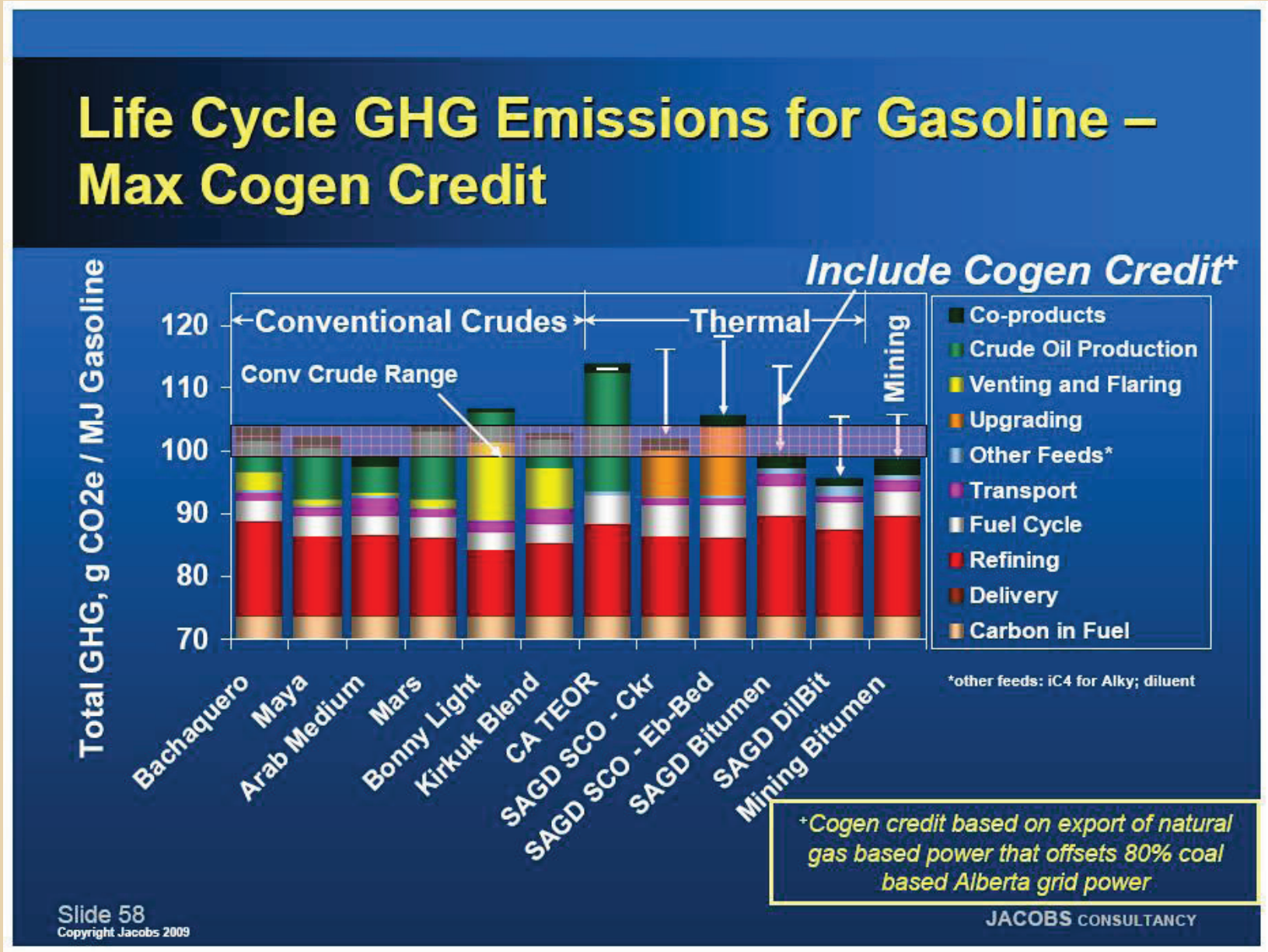
Suncor, camp operator fined $400,000 for dumping waste into Athabasca River

- Calgary Herald, April 2, 2009

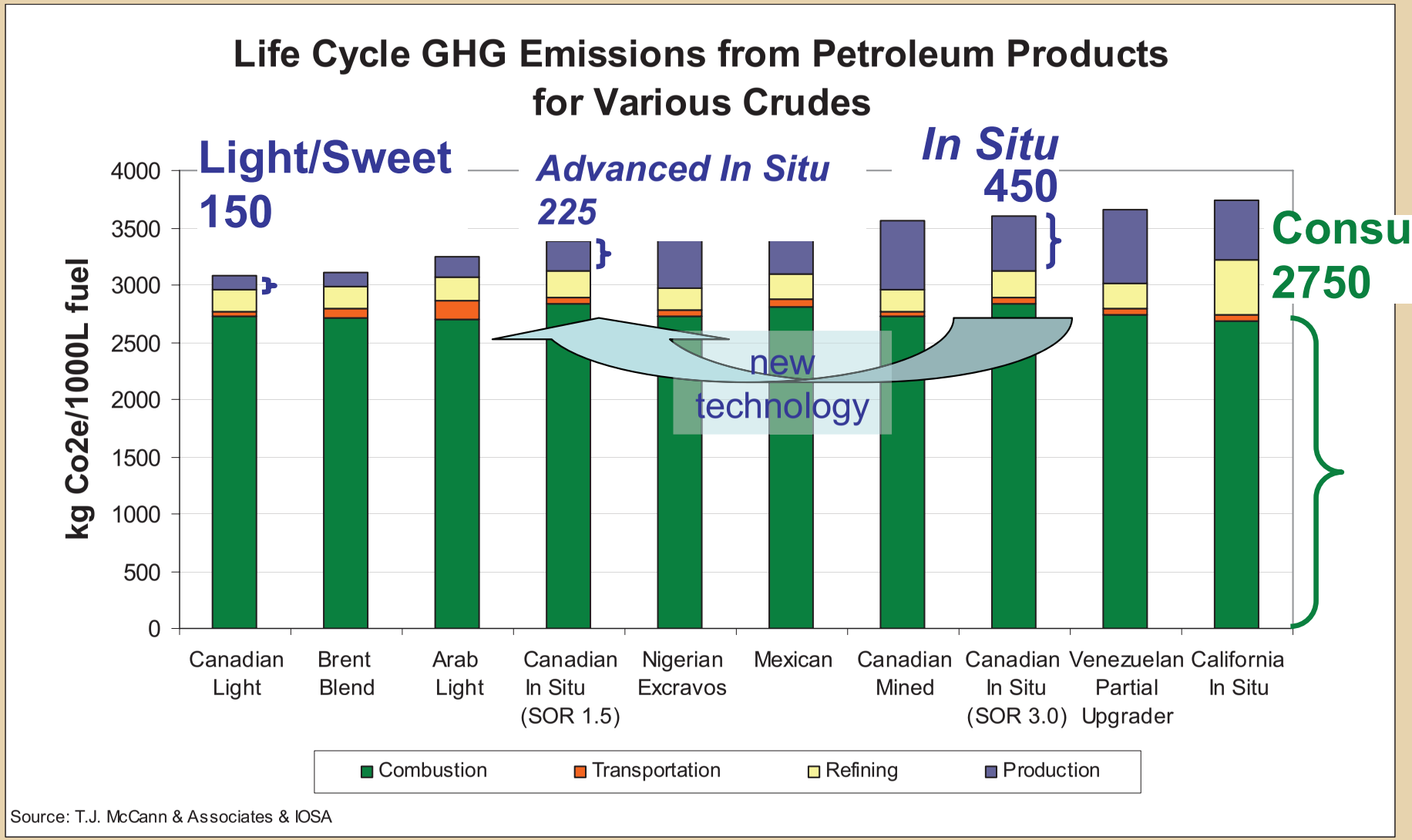
AERI LCA study (2009)



AERI LCA study (2009)



CO_2: "3 times" what, exactly?

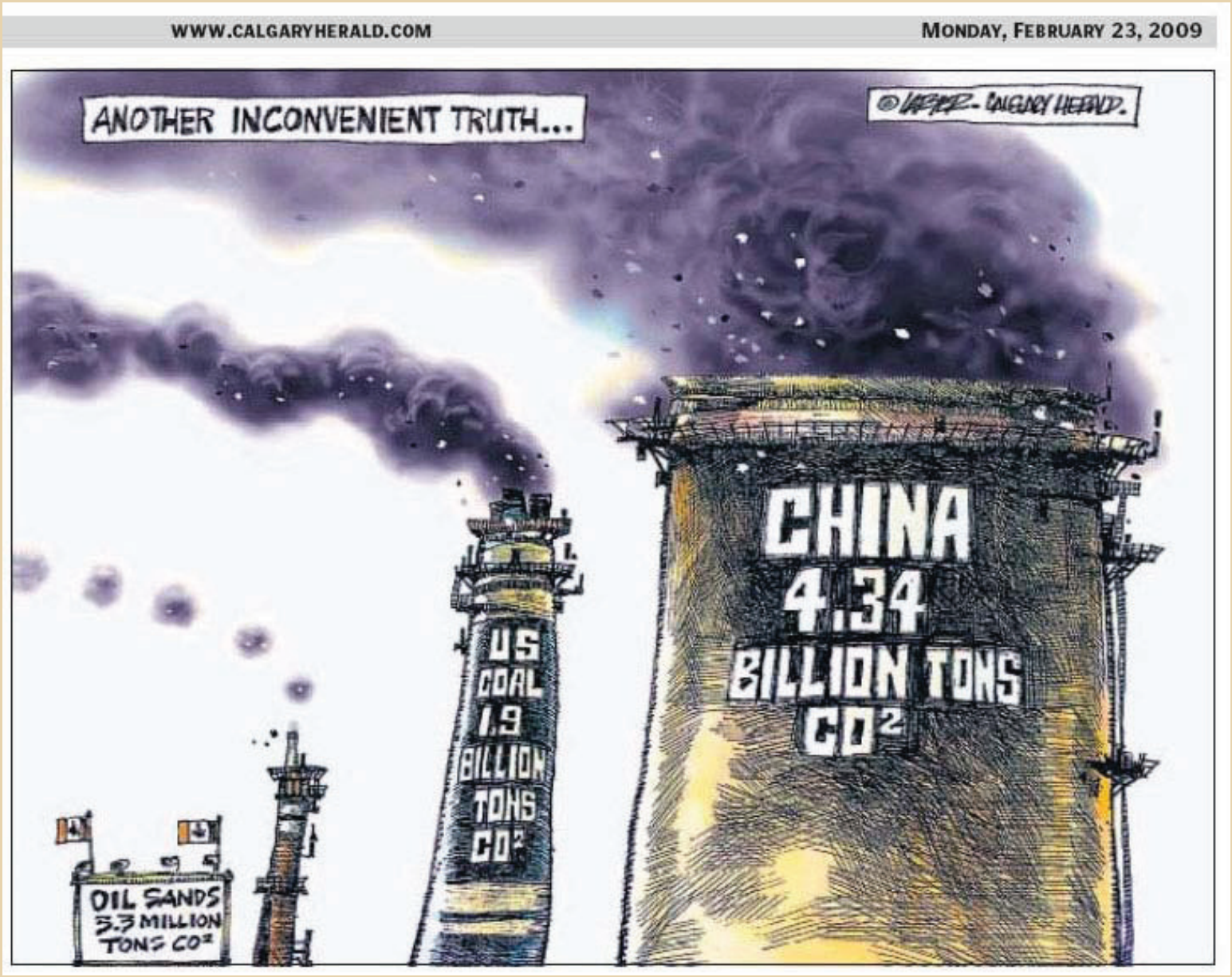


Source: T.J. McCann & Associates & IOSA

AERI LCA - Conclusions

- A wide range of GHG emissions for crude oils in North American refineries
- Imported and U.S. domestic heavy oil crudes have similar emissions to the oil sands pathways
- With some overlap, oil sands pathways generally have 10% higher emissions than conventional crudes
- GHG emissions from oil sands crudes are comparable to conventional crudes when potential cogeneration credits are considered

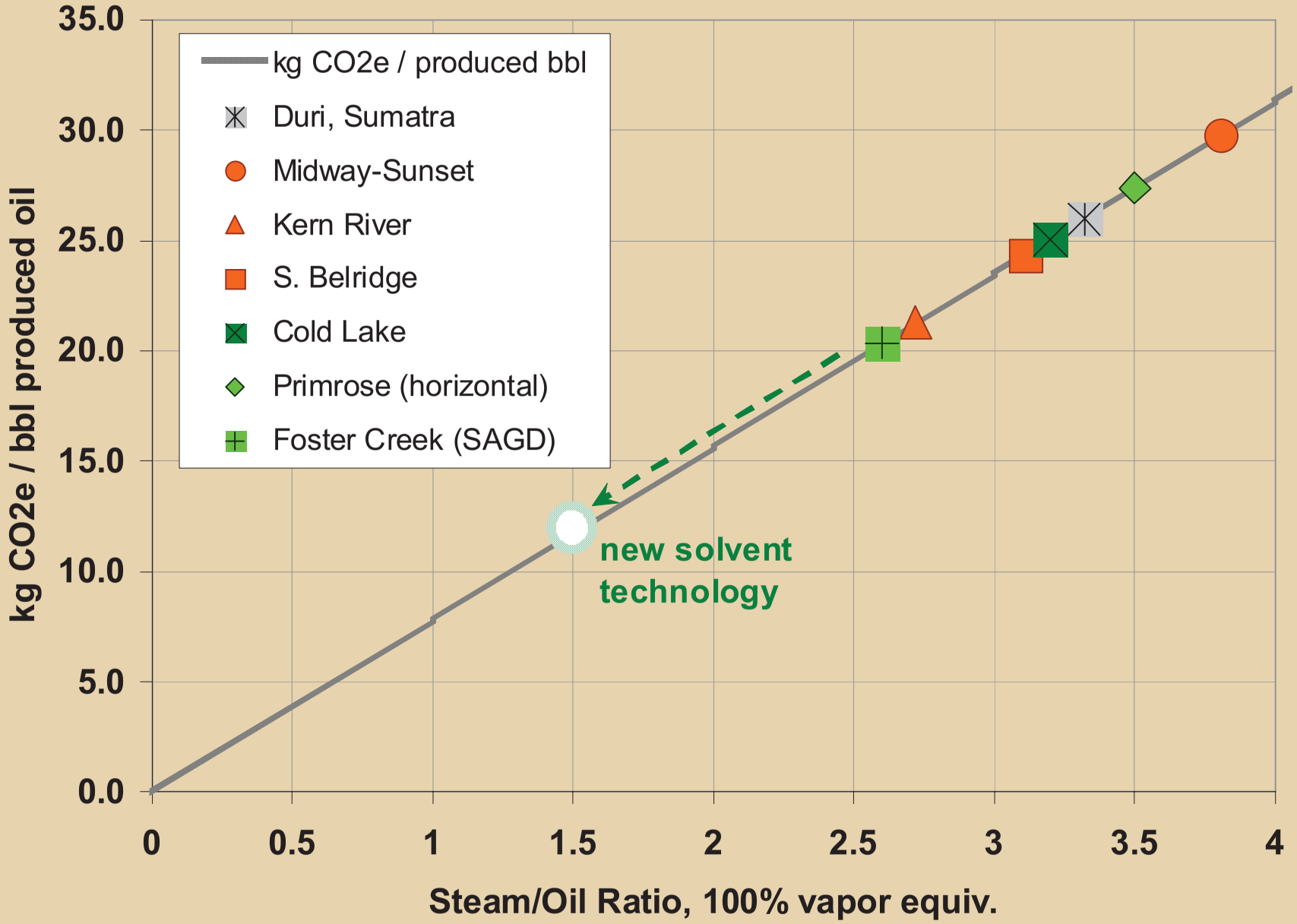
Canadian oil sands and the world



Reducing energy use

- More efficient use of energy reduces CO_2 generation proportionately:
  - Innovations in reservoir recovery will reduce energy requirements (lower Steam/Oil ratios):
    - Solvent additives to SAGD
    - Cold solvent processes
    - Variants of above
  - Facility synergies between projects
  - Cogeneration

Steamflood carbon intensity vs. steam/oil ratio

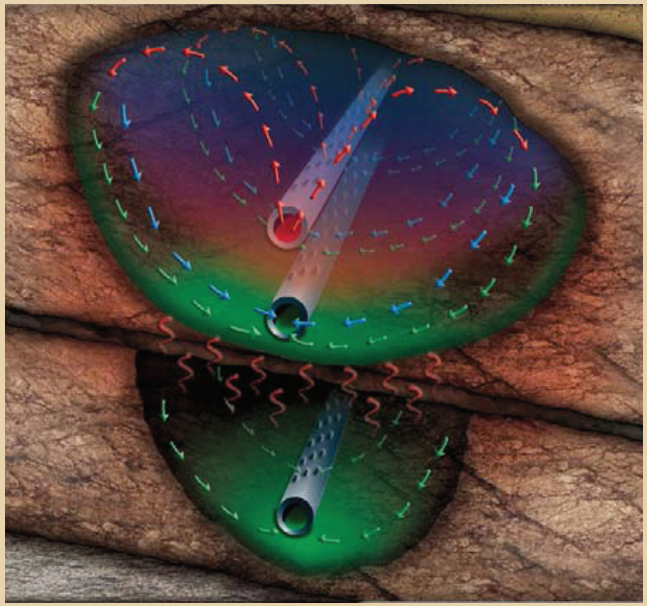


Improved performance through innovation

- Optimized reservoir exploitation
  - Optimize how steam is utilized
  - Solvent assisted processes
  - Cold solvent applications in the carbonates
- Drilling and completion operations
  - Reduce well costs and number of well pairs over life of project
- Facility engineering and construction
  - Build a template that can be repeated

- Laricina's goal is to reduce breakeven WTI oil price from $70 to less than $50

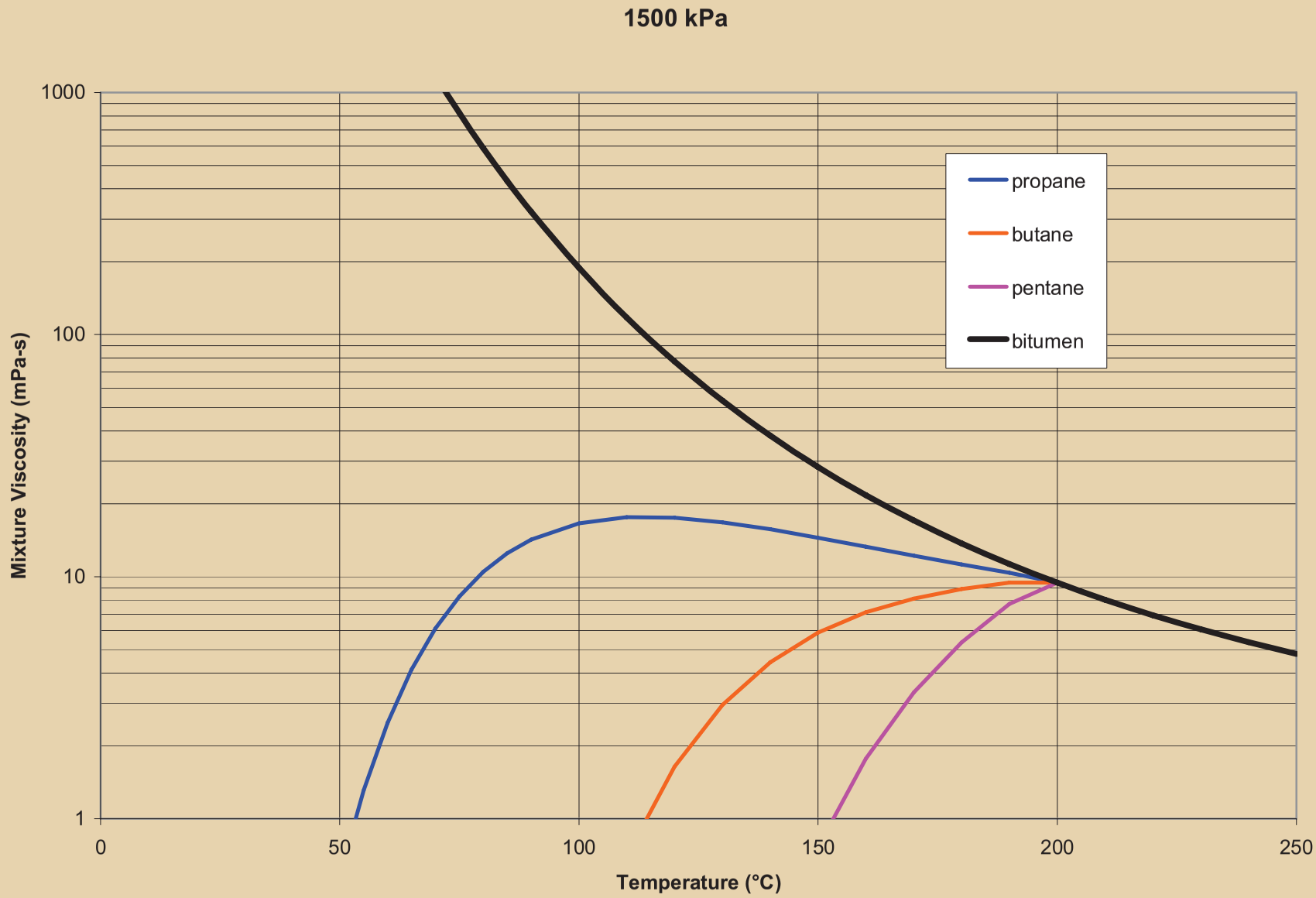
A culture of innovation:
Passive Heat Assisted Recovery Methods
(PHARM), *patent pending*



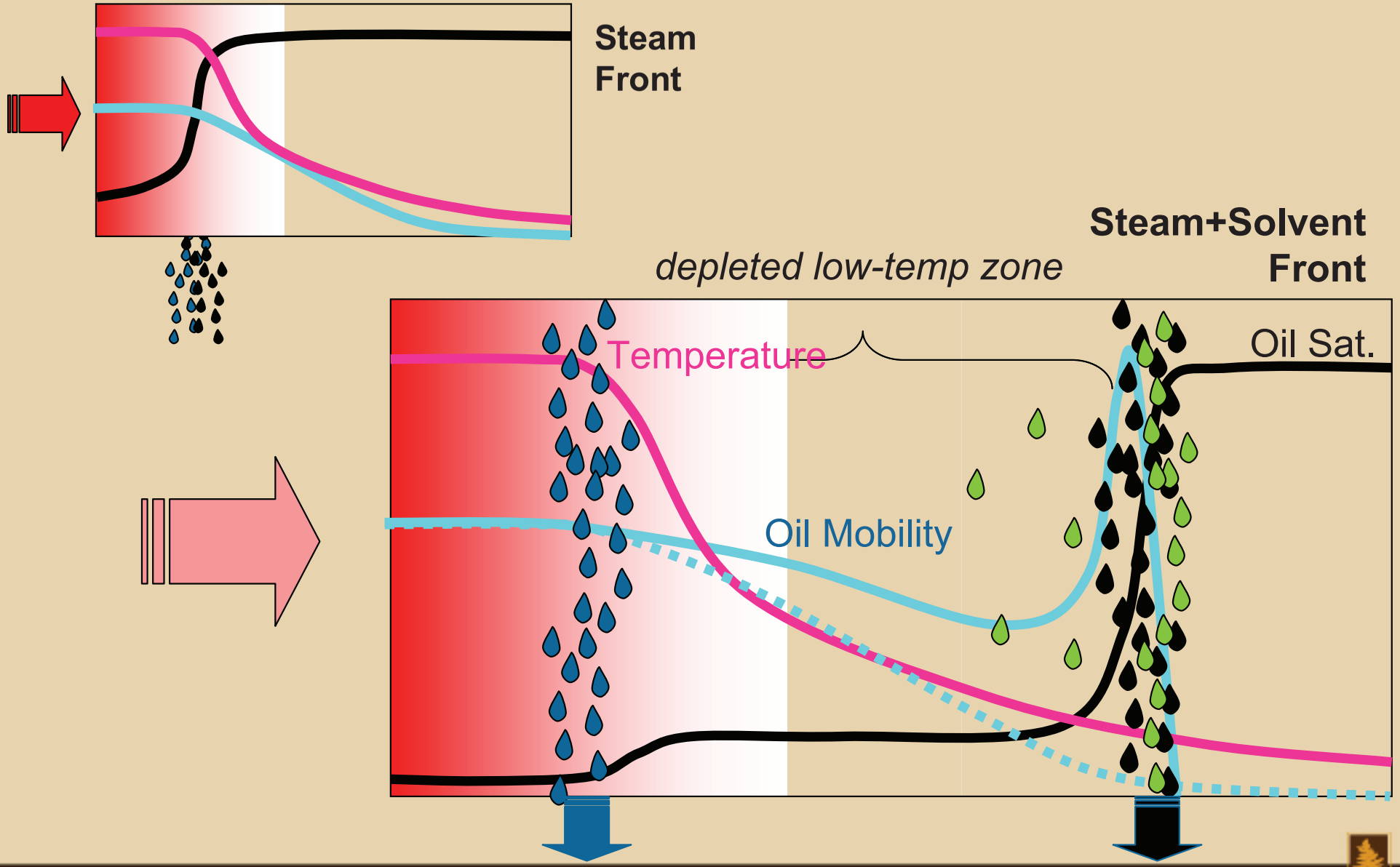
The solvent opportunity

- Higher recovery factor
  - lower residual oil saturation
- Reduced SOR:
  - lower startup capital
  - leverage steam capital going forward
  - reduced emissions, water demand
- No new hardware or applications required to implement
- Accelerated production

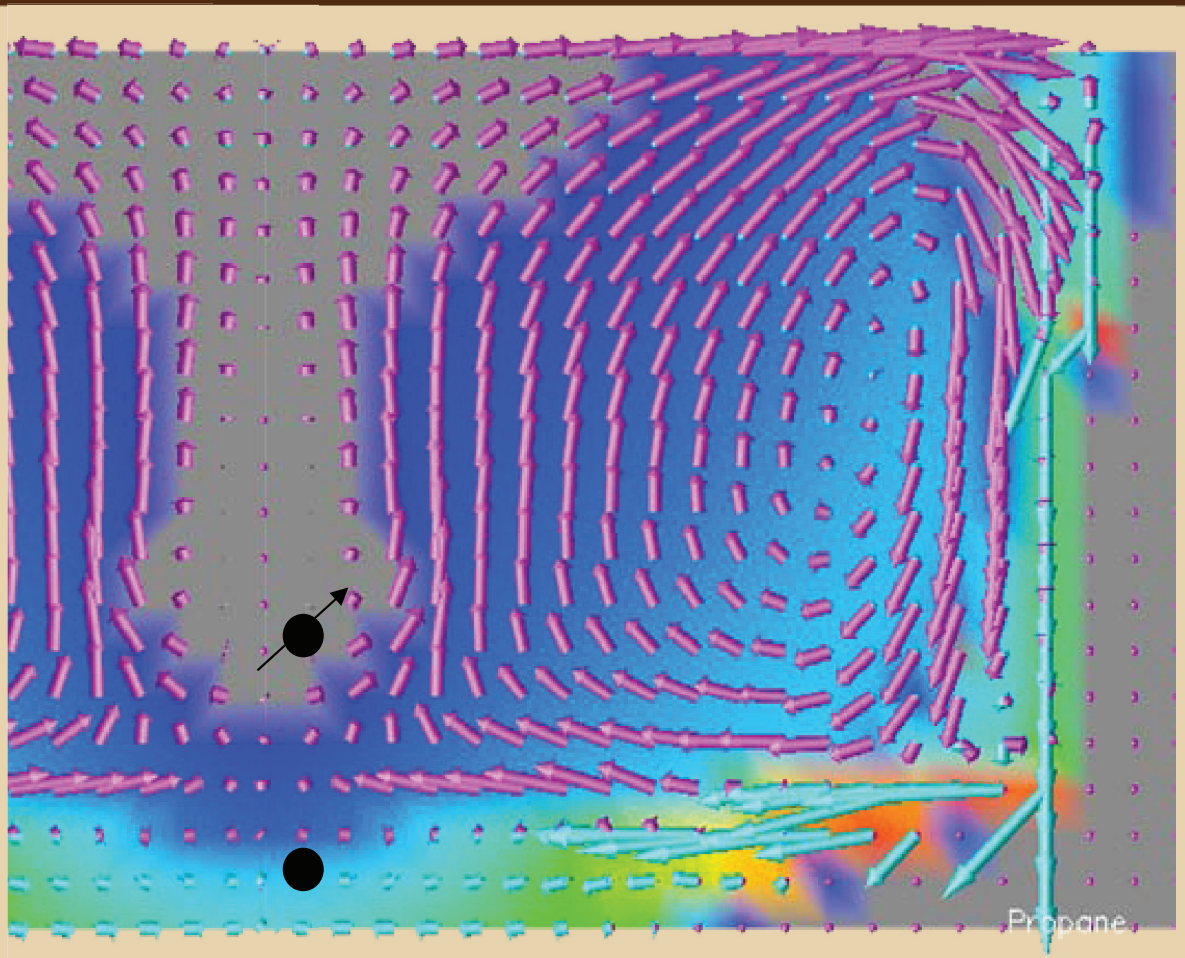
Solvents – lowering the viscosity



Solvent mechanisms



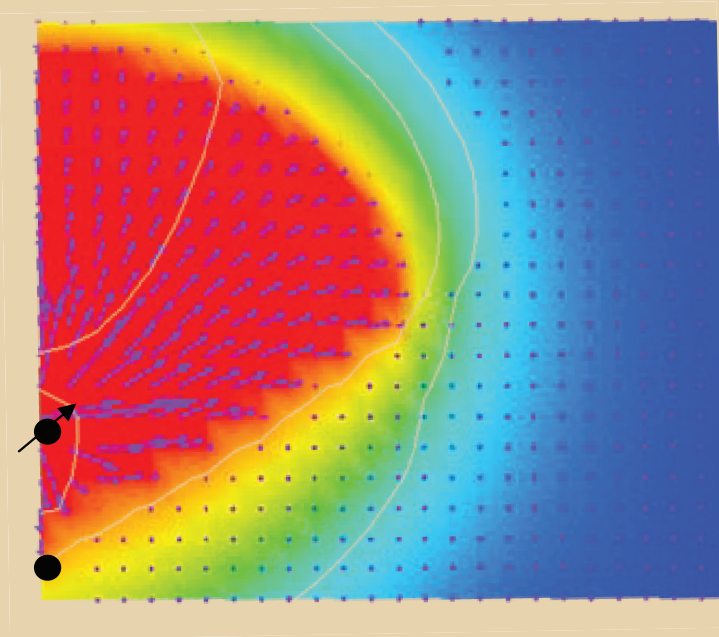
Steam-driven solvent reflux



Solvent-Cyclic SAGD (SC-SAGD)

w/Propane

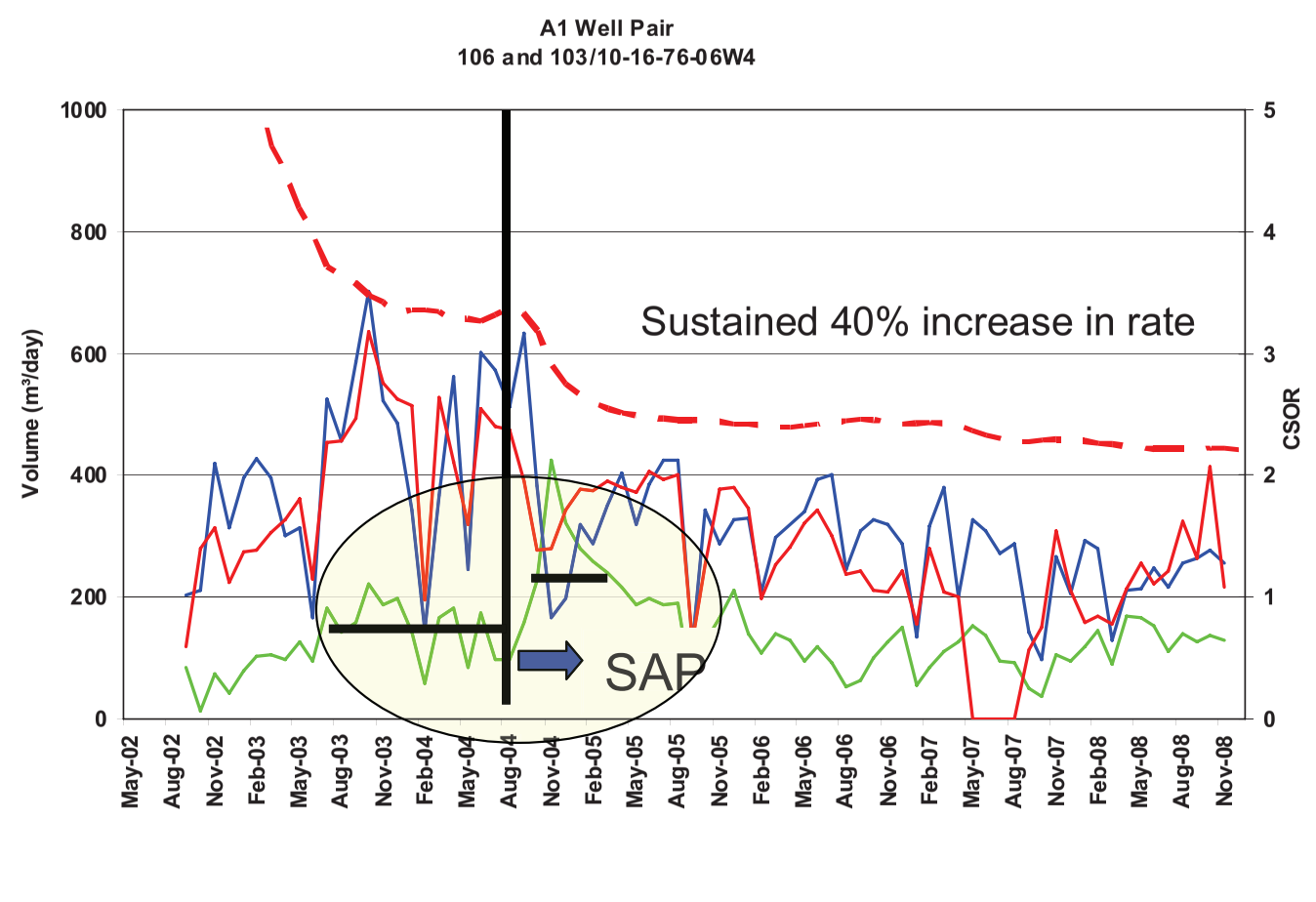
cf. SAGD:



After the first year, SC-SAGD is really a steam-enhanced solvent process, rather than solvent added to steam.

EnCana Christina Lake SAP project

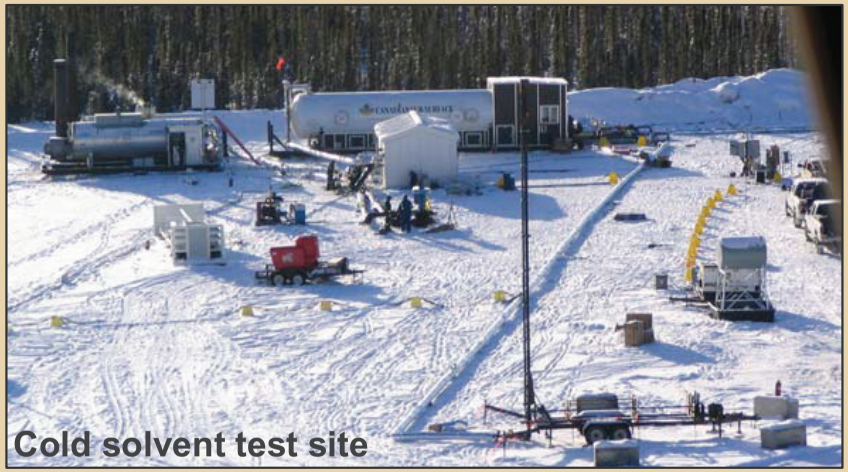
- EnCana SAP Process
  - 1 y steam (ceiling rise)
  - Add butane with a slight decrease in steam
  - Produce for 2-4 years at 40% higher rates
  - Circulate dry gas to recover remaining solvents



Cold solvent production test

- Follow-up cold solvent test was executed in winter 2009
  - 10 times larger than 2008 test
  - Produced bitumen at steady rates for 6-8 weeks
- Main objective of the test was to gather production fluid data, compositions, and pressure data, to improve predictive capability of numerical models
- Findings consistent with 2008 test
  - Extremely high reservoir permeability, both vertical and horizontal
    - Better than the "best" of the McMurray
  - Connectivity between the 'C' and 'D' zones
  - Bitumen was mobilized and produced
- Data from 2009 test will outline scope for further solvent-based projects at Saleski

2009 Saleski Cold Solvent Test



Cold solvent test site

Solvent injection system

Produced bitumen

Conclusions

- Going forward, most new oil sands development in Alberta will be *in situ* projects
- Environmental impacts from *in situ* projects will be environmentally responsible w.r.t.:
  - absolute/cumulative local impacts
  - an exacting regulatory environment
  - international norms & intensities

Conclusions

- Carbon dioxide emissions from Alberta *in situ* oil sands development will exceed the life-cycle emissions due to conventional crude sources, by at most 10%
- SAGD (steam) technology is about to get a big boost from solvent additives, cutting emissions by as much as half
- *In situ* plants make natural cogeneration hosts, and by replacing coal-fired power, would render *in situ* bitumen carbon-equivalent to any source of crude

Oil Sands in the Environment