

# The Impact of LCFS on Oil Sands Development: Process LCA Methods

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# Outline

- Overview of the oil sands in Alberta
- Oil sands within U.S. and CA imports
- LCFS: potential LCA models
- Results from oil sands LCA: what model to choose?

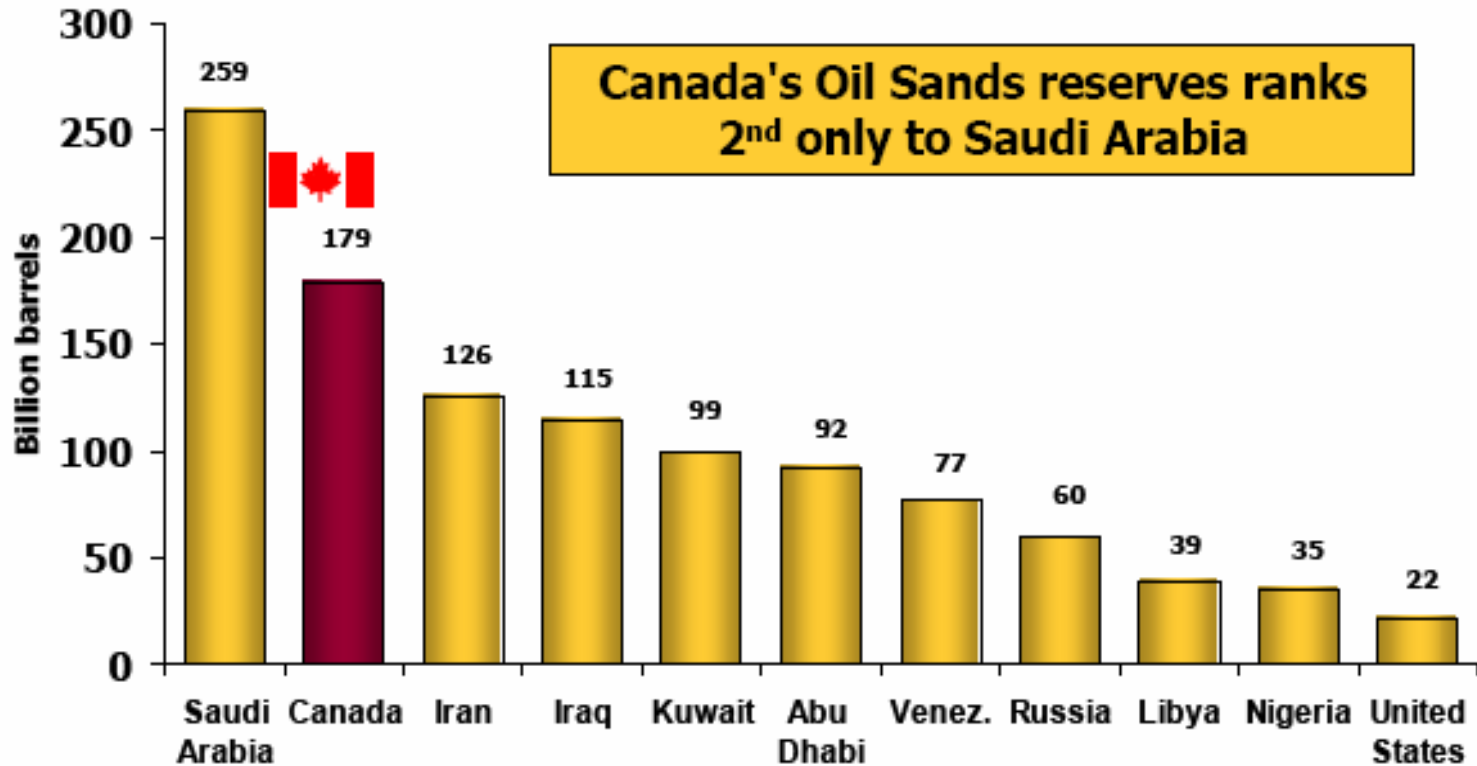
# Where?



Source: [http://en.wikipedia.org/wiki/Image:Athabasca\\_Oil\\_Sands\\_map.png](http://en.wikipedia.org/wiki/Image:Athabasca_Oil_Sands_map.png)

# Oil Sands Reserves

## Global Crude Oil Reserves by Country



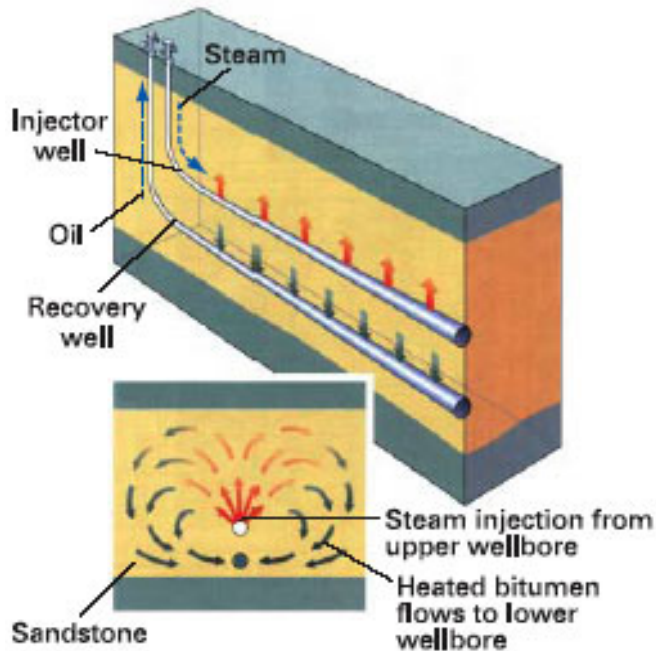
Source: Oil & Gas Journal Dec. 2004

# Oil Sands Production Technologies



## 1. Surface Mining

## 2. In Situ

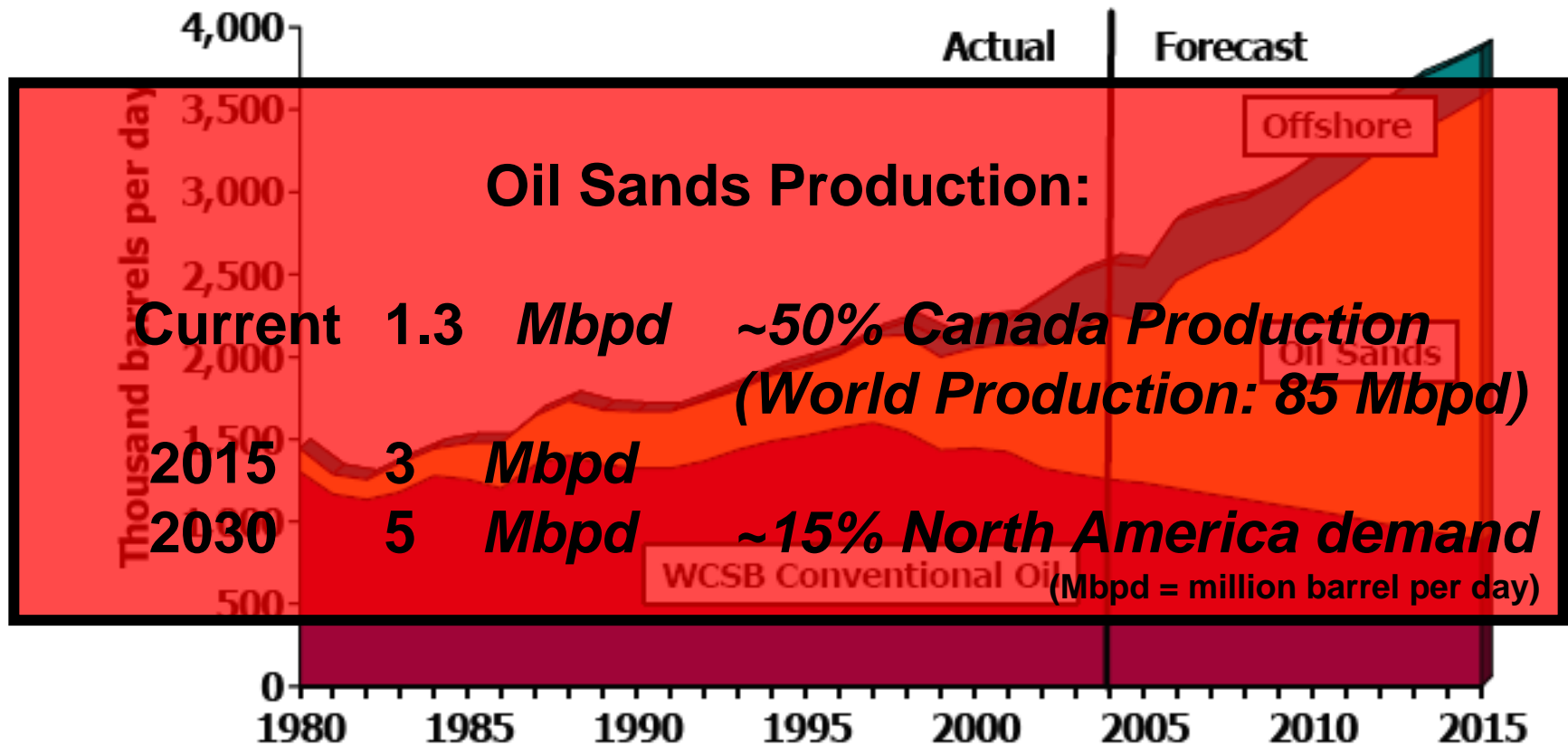


Source: [pubs.usgs.gov/fs/fs070-03/fs070-03.html](https://pubs.usgs.gov/fs/fs070-03/fs070-03.html)

Source: Suncor, 2006

# Oil Sands Production

## Canadian Oil Production



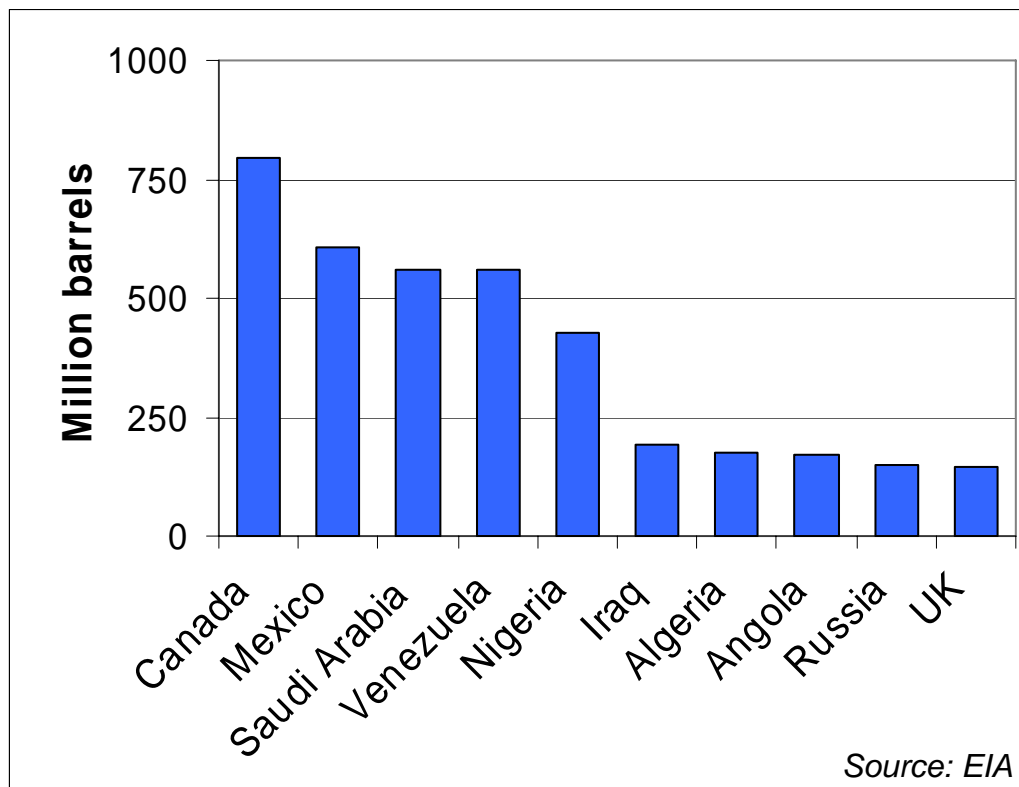
Note: WCSB = Western Canada Sedimentary Basin

Source: CAPP 2005

# Crude oil imports in the U.S.

In 2005 domestic crude oil production accounted for less than a 3<sup>rd</sup> of the U.S. demand (EIA)

## US annual imports of crude oil in 2005 by countries of origin



CANADA:

1<sup>st</sup> supplier of crude oil to the U.S. (16% in 2005)

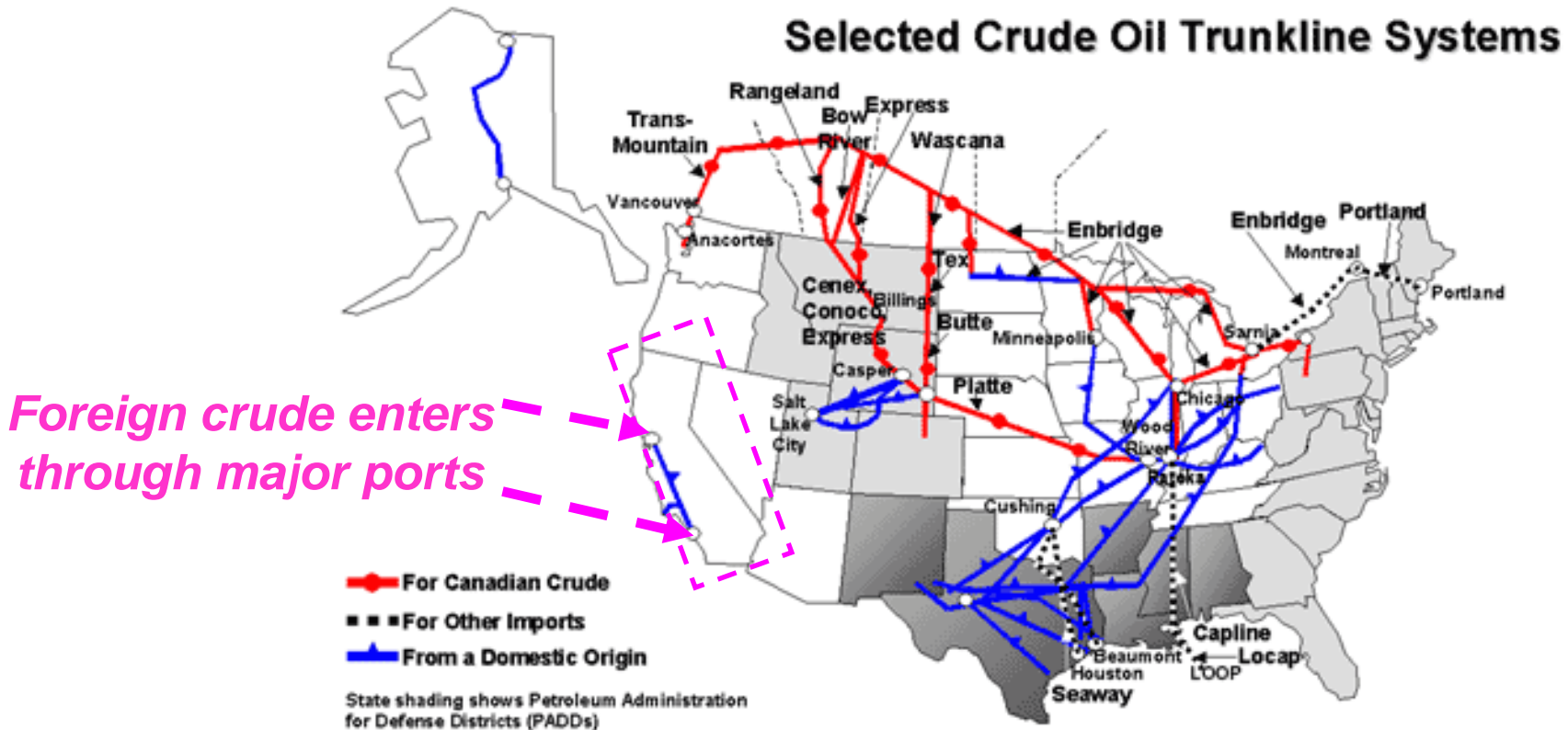
*This share could increase significantly if Canada's oil sands production triples in the next 20 years*

# California crude oil market

2005 demand: 674 million barrels

40% domestic, 20% Alaska, 40% foreign  
(CA Energy Commission)

### Selected Crude Oil Trunkline Systems



# California Low Carbon Fuel Standard

## **Reduce carbon intensity of fuel use by 10% by 2020**

- Measure emissions from a “full” life cycle
- In grams of CO<sub>2</sub> eq. per MJ of transportation fuel
- Compliance by blenders, refiners and importers
- Gov to pick performance standards (not technologies)

*If successful this policy is likely to spread (other States, Canada, etc.)*

## **Need for a comprehensive LCA framework**

**Challenges**: How to implement? How to monitor and account for upstream GHG emissions (boundary issues)? What model to use?

# California LCFS - models

Available U.S. LCA models for fuel analysis:

- **REET1-8a** (Argonne)

  - Publicly available; more biofuel pathways

  - California version developed by TIAX for the AB1007 study

- **LEM** (Delucchi)

  - More extensive treatment of land use impacts

→ *Different results from both models. Which one to choose?*

The oil sands in REET1.8a:

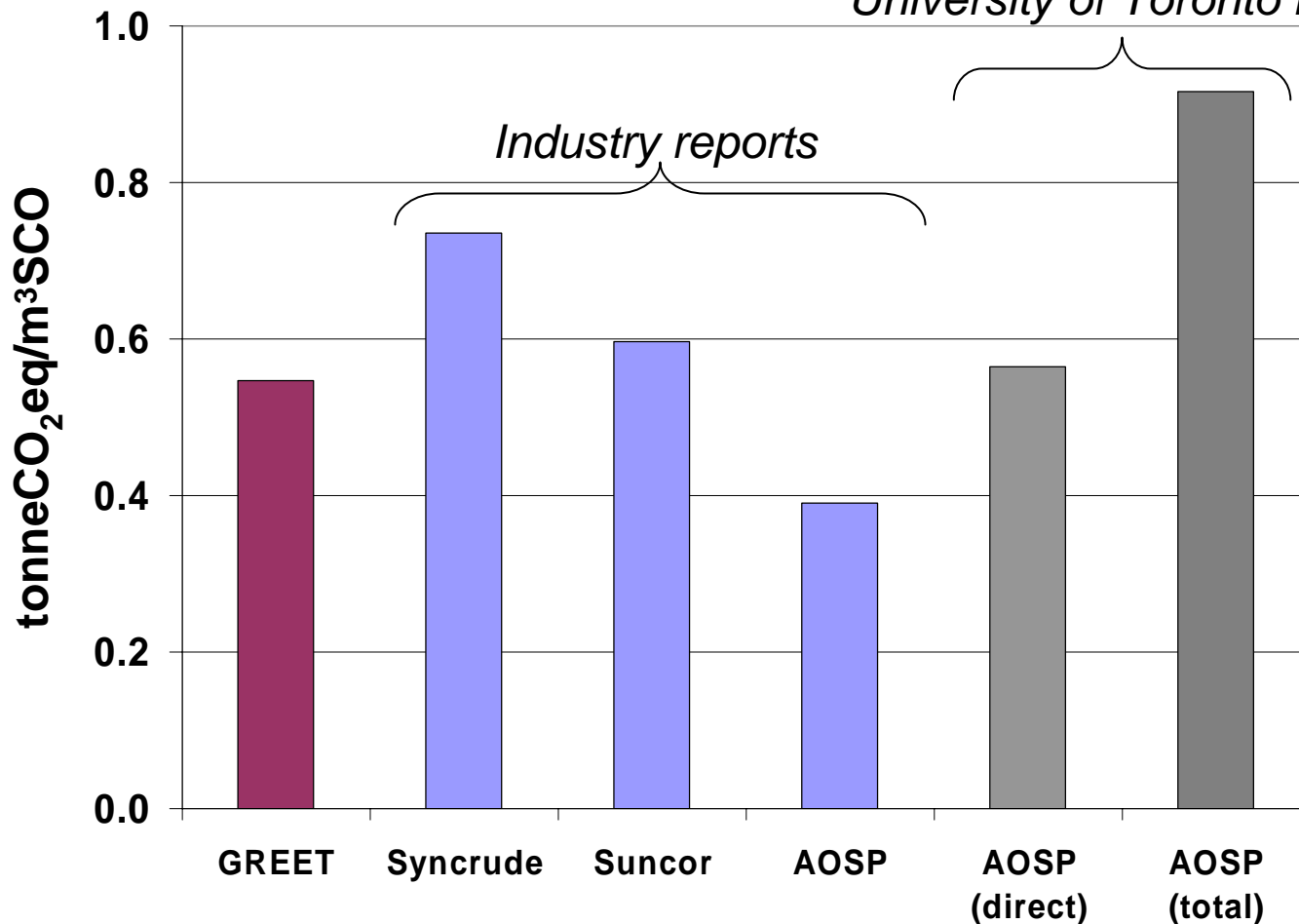
- Two main pathways: surface mining and in situ
- With/without upgrading
- *Are data representative of current technologies?*

# “Well-To-Gate” Results

## Mining & Upgrading Greenhouse Gas Emissions

Well-To-Gate: from oil extraction to entrance gate of the refinery

*University of Toronto LCA*

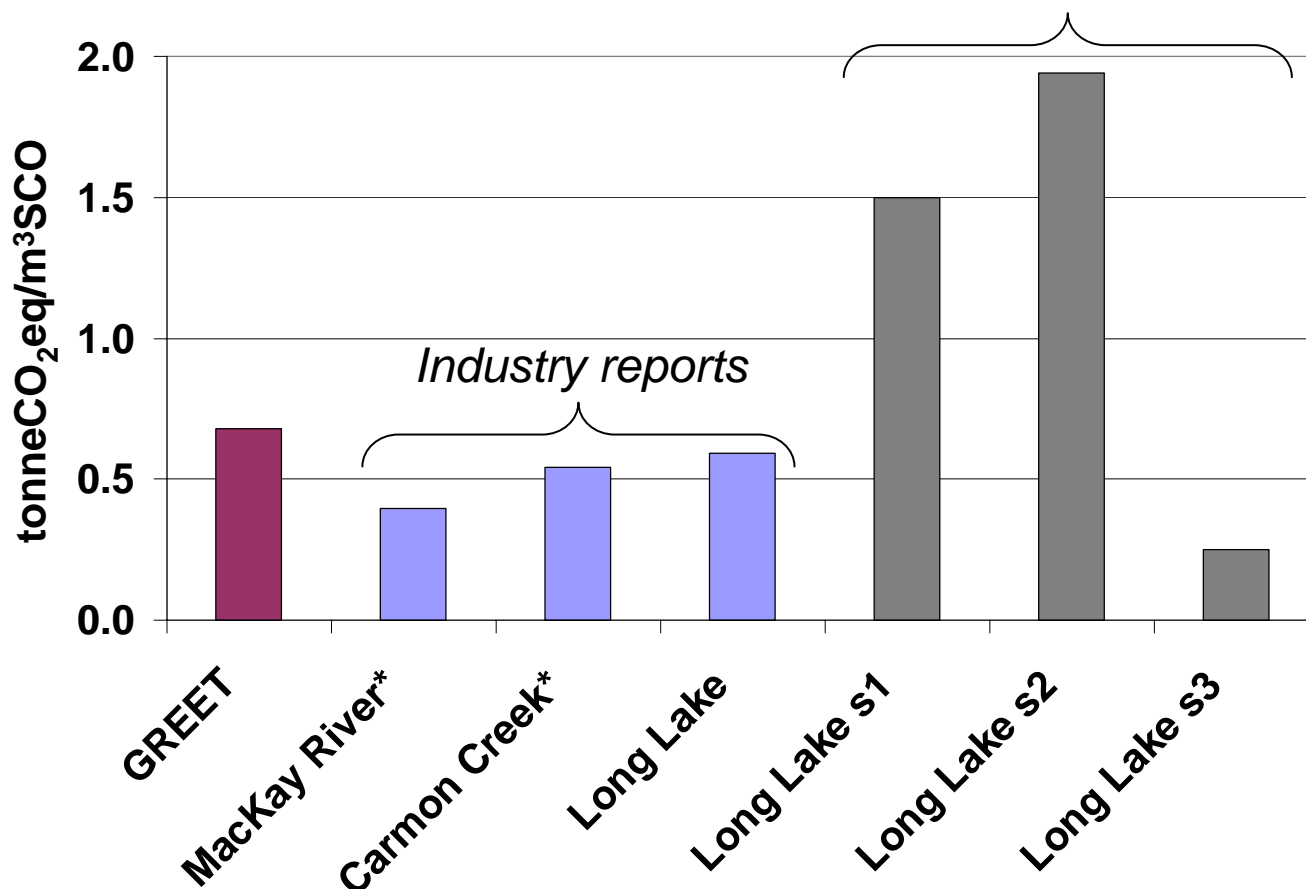


AOSP: Albian Oil Sands Project

# “Well-To-Gate” Results

## In situ & Upgrading Greenhouse Gas Emissions

*University of Toronto LCA*



UofT LCA scenarios:

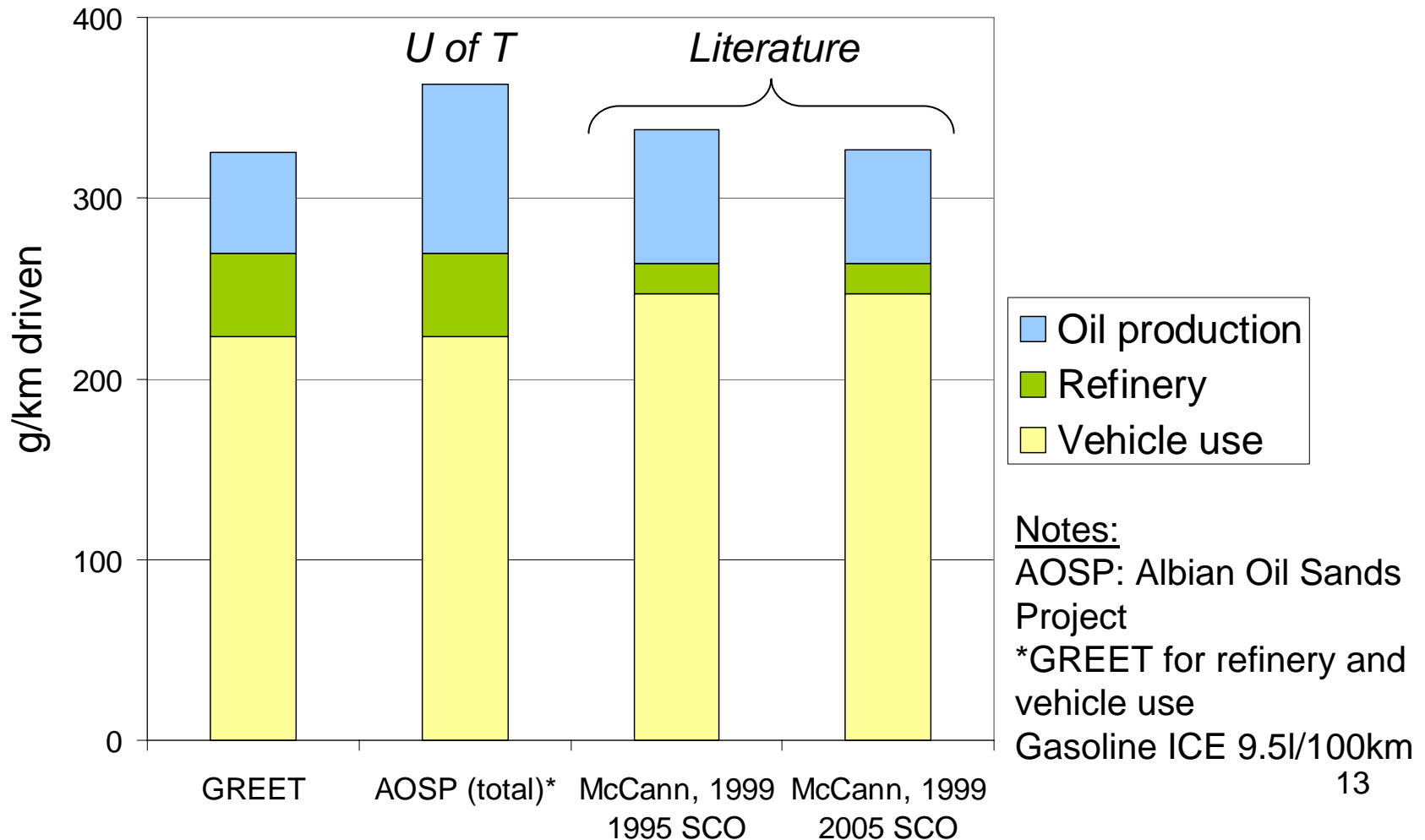
- s1: asphaltene gasification;  
extra electricity to grid
- s2: asphaltene gasification;  
no surplus electricity
- s3: natural gas;  
extra electricity to grid

\* Upgrading from GREET

# Well-To-Wheel GHG emissions

Well-To-Wheel: from oil extraction to vehicle use

Pathway: Reformulated Gasoline from surface Mining & Upgrading



# Conclusions

- Uncertainty in the future share of oil sands within CA crude mix; should be considered in the LCFS
- Industry in rapid expansion & developing technologies: LCA standards need to be updated before becoming LCFS default values
- Overall benefit: legislation such as the LCFS will lead to more transparency from oil sands companies

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***Thank you***

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# Discussion Questions

- What are the implications of the LCFS for the LCA community?
- What are the primary challenges of LC-based regulation?
- What is the role of process vs. hybrid LCA?
- How will carbon accounting be done for biomass supply? geologic storage? emissions offsets?
- Other LCA issues for the LCFS that Alex F. has not identified?
- Your ideas....