AGENDA: 13

Update on Canadian Oil Sands Crude

BOARD OF DIRECTORS SPECIAL MEETING
November 19, 2018

Victor Douglas
Manager, Rule Development and Strategic Policy

Overview

- Background
  - o What are Oil Sands
  - o Where are they found?
  - o Extraction and Processing
- Site Visits
  - o In-Situ
  - o Processing and Aerial Tour
  - o Edmonton and Vancouver Meetings
- Summary and Conclusion

What are Oil Sands

Also called “tar Sands” or “bituminous sands”

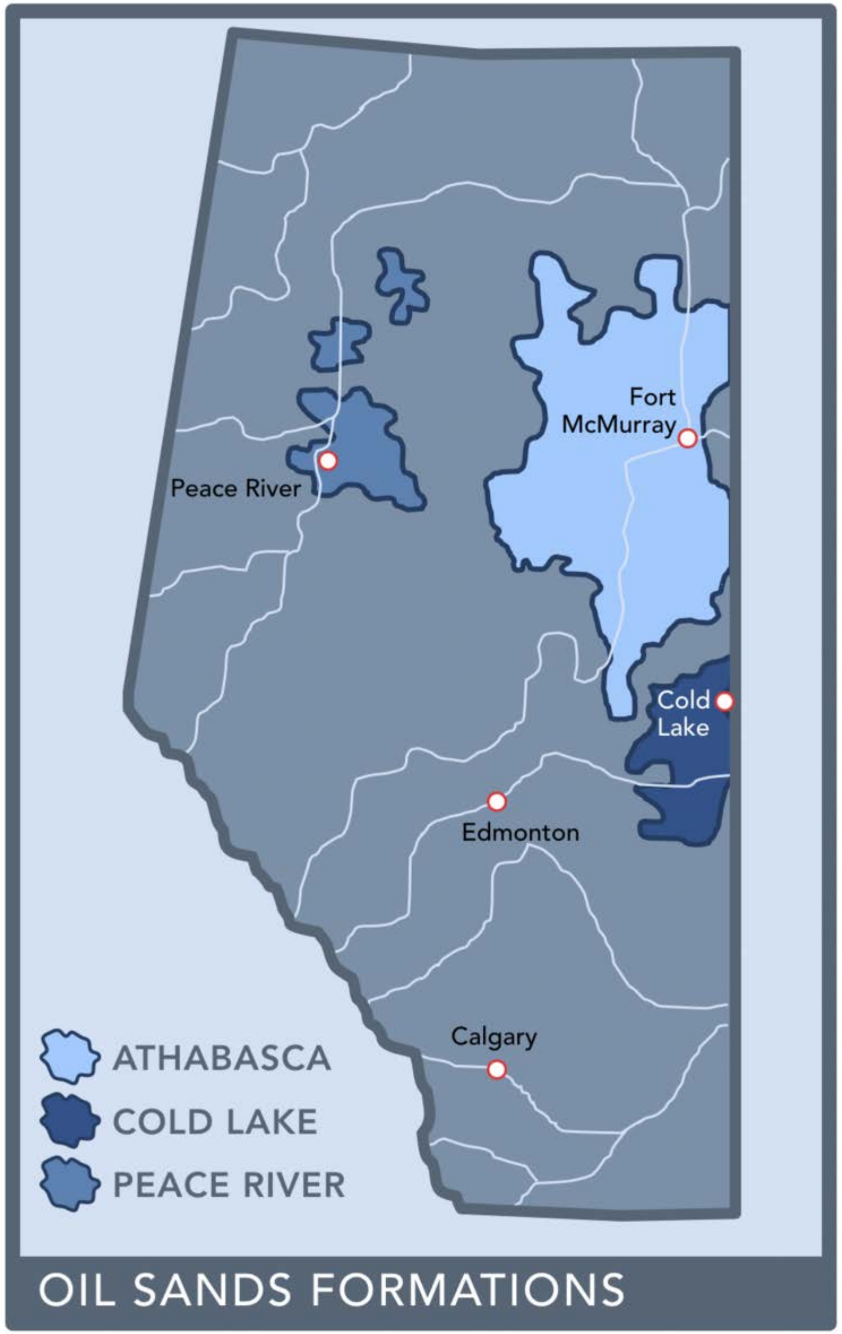
Mixture of

- bitumen (10% up to 20%)
- sand / clay (85%) and
- water (5%)

Where do "Oil Sands" Come From?

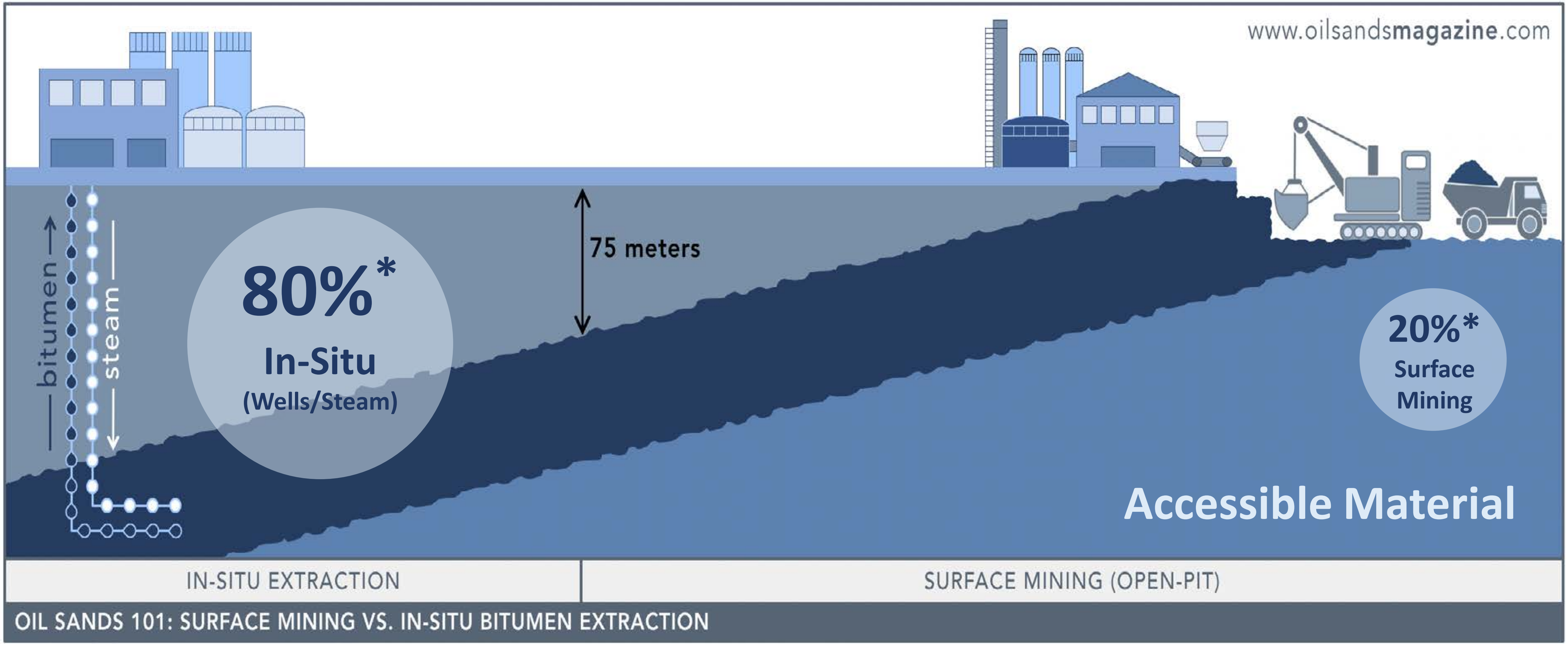
Alberta, Canada

- 3 primary areas
  - Athabasca
  - Cold Lake
  - Peace River
- 10% of World's proven reserves
  - Third largest reserve
  - 170 billion barrels
- Covers area the size of New York State
- Two types of extraction processes
  - Surface Mining
  - In Situ

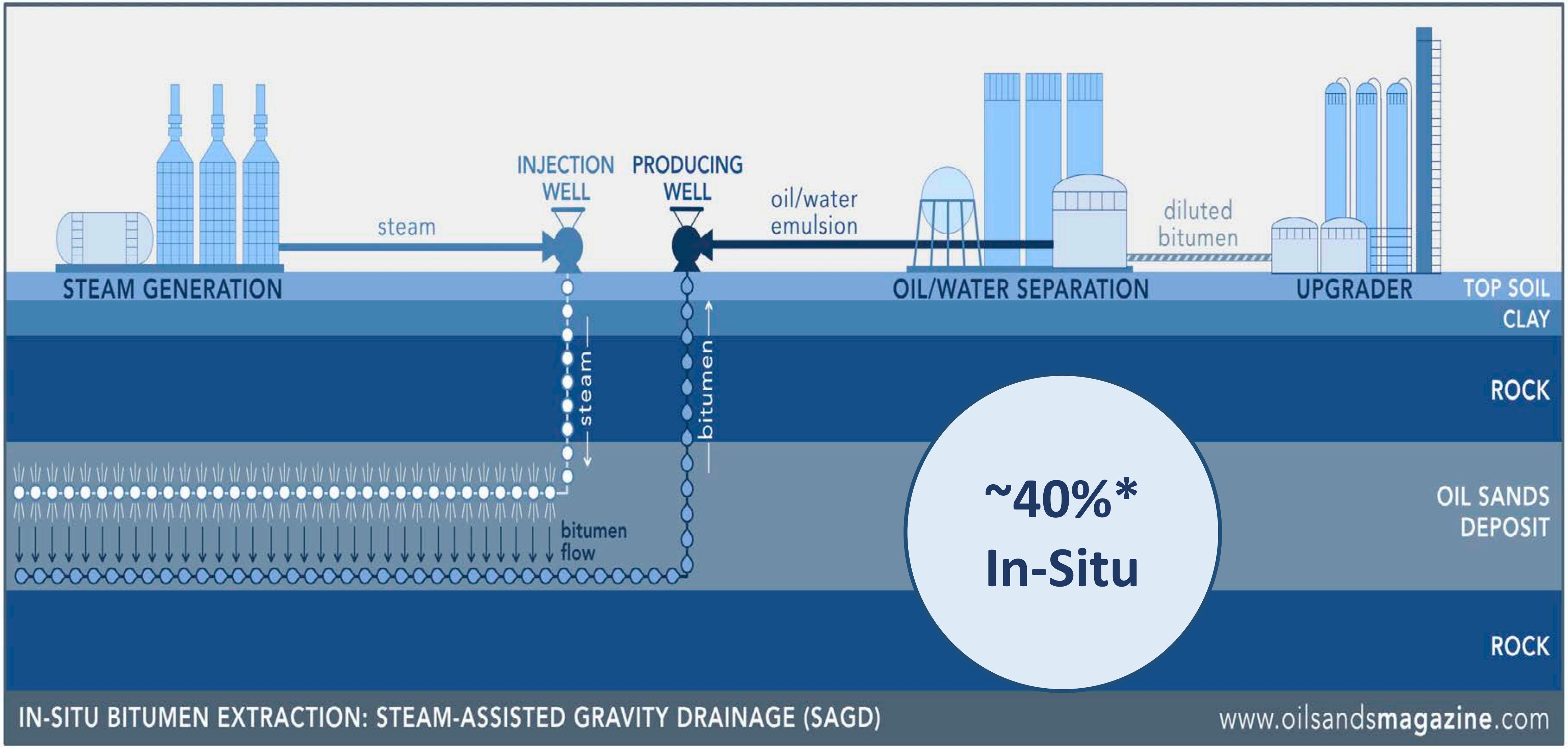


Adapted from *Oil Sands Magazine*

Oil Sands Extraction Processes
In-Situ & Surface Mining



Oil Sands Production: In-Situ

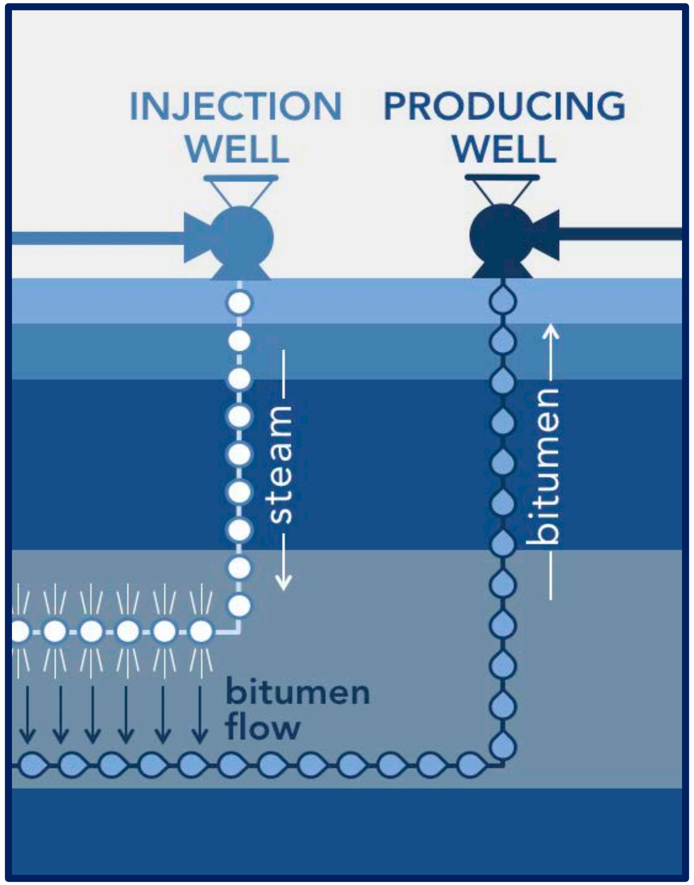


In-Situ Extraction Operations

Adapted from *Oil Sands Magazine*

In-Situ Extraction Operations

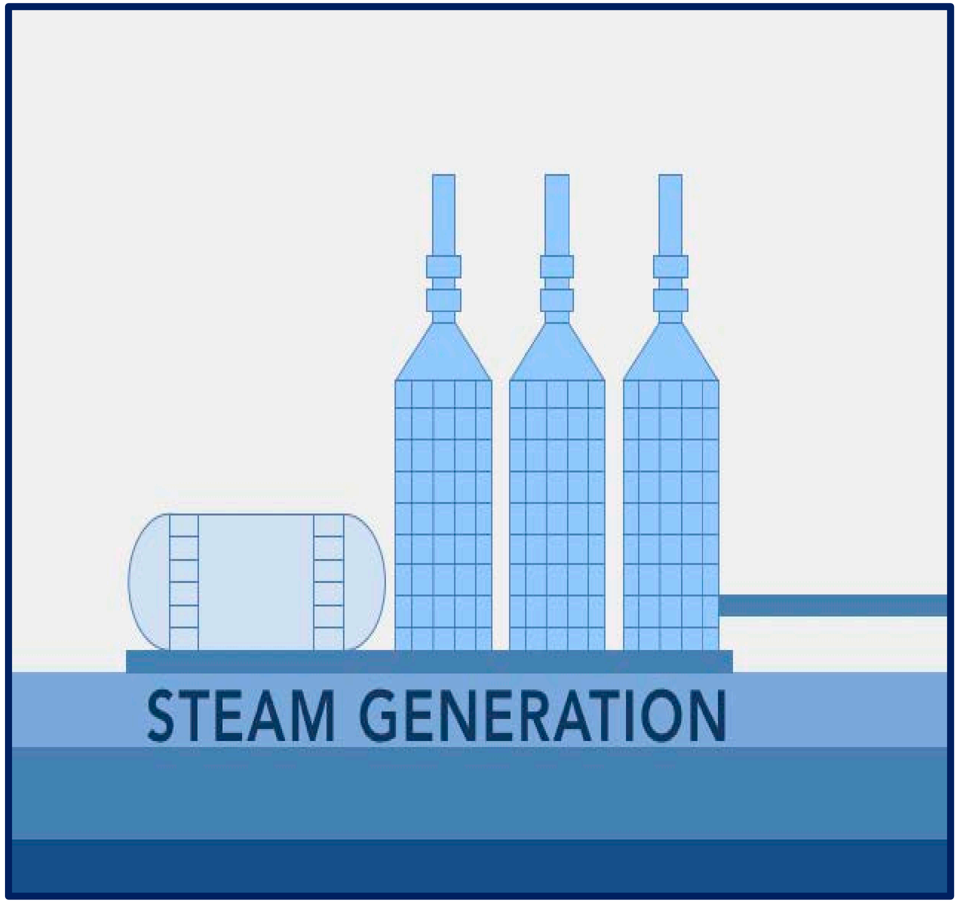
Steam Injection and Extraction Wells



Adapted from *Oil Sands Magazine*

In-Situ Extraction Operations

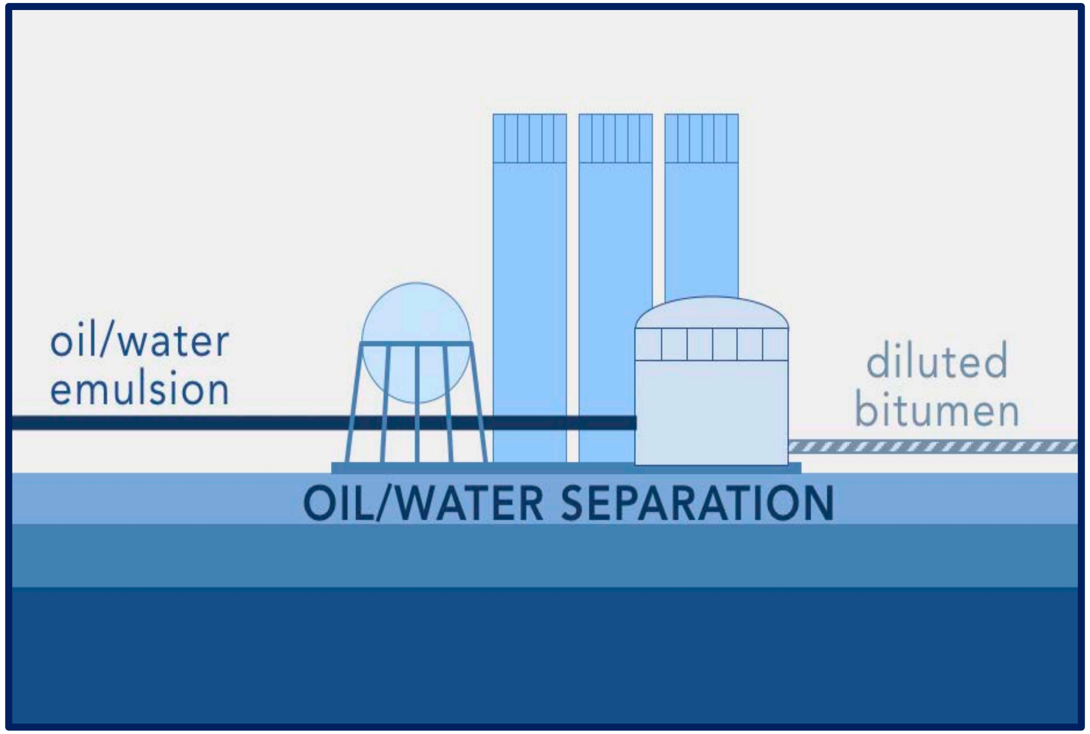
Steam Generation



Adapted from *Oil Sands Magazine*

In-Situ Extraction Operations

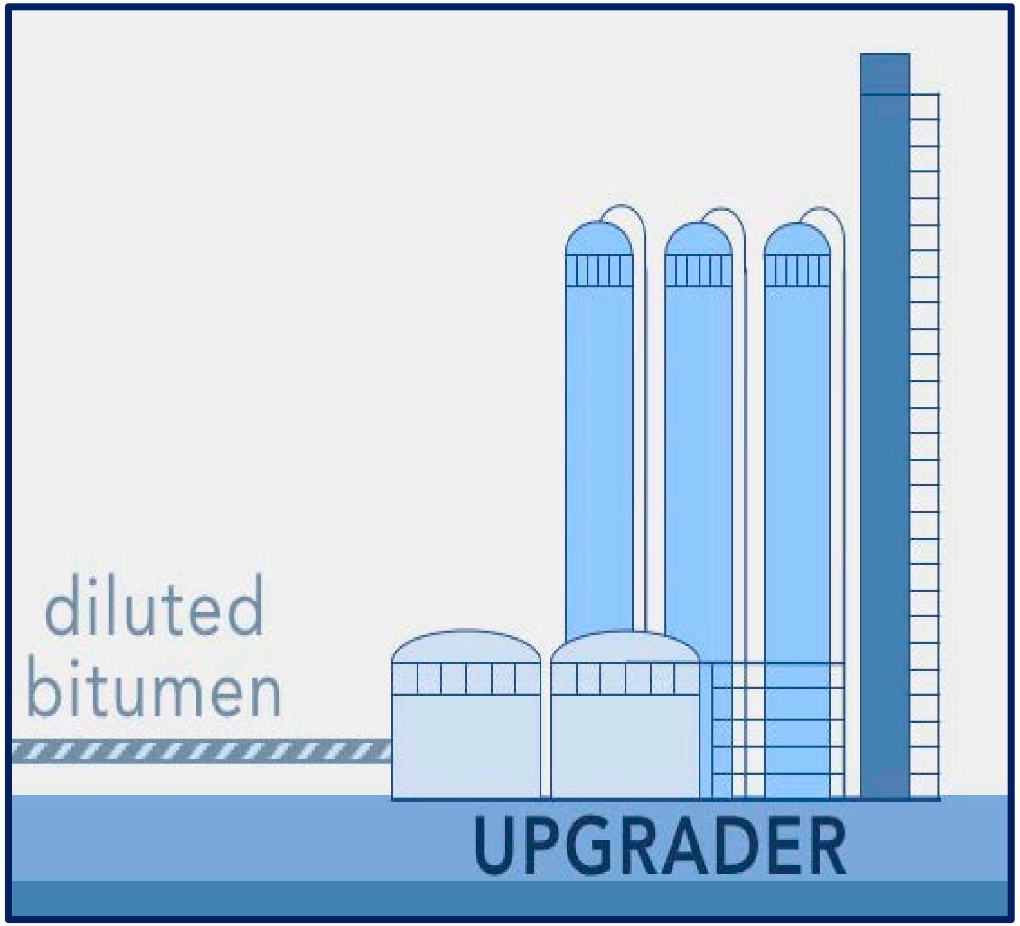
Oil / Water Separation



Adapted from *Oil Sands Magazine*

In-Situ Extraction Operations

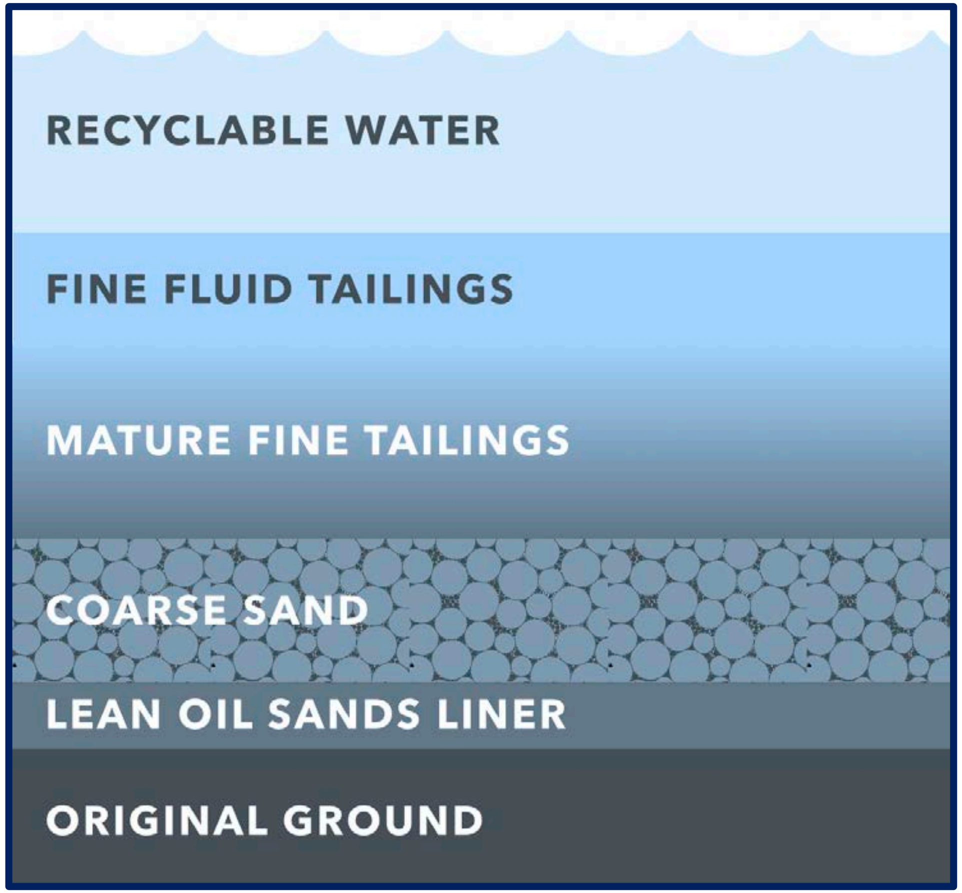
Bitumen Upgrading Operations



Adapted from *Oil Sands Magazine*

In-Situ Extraction Operations

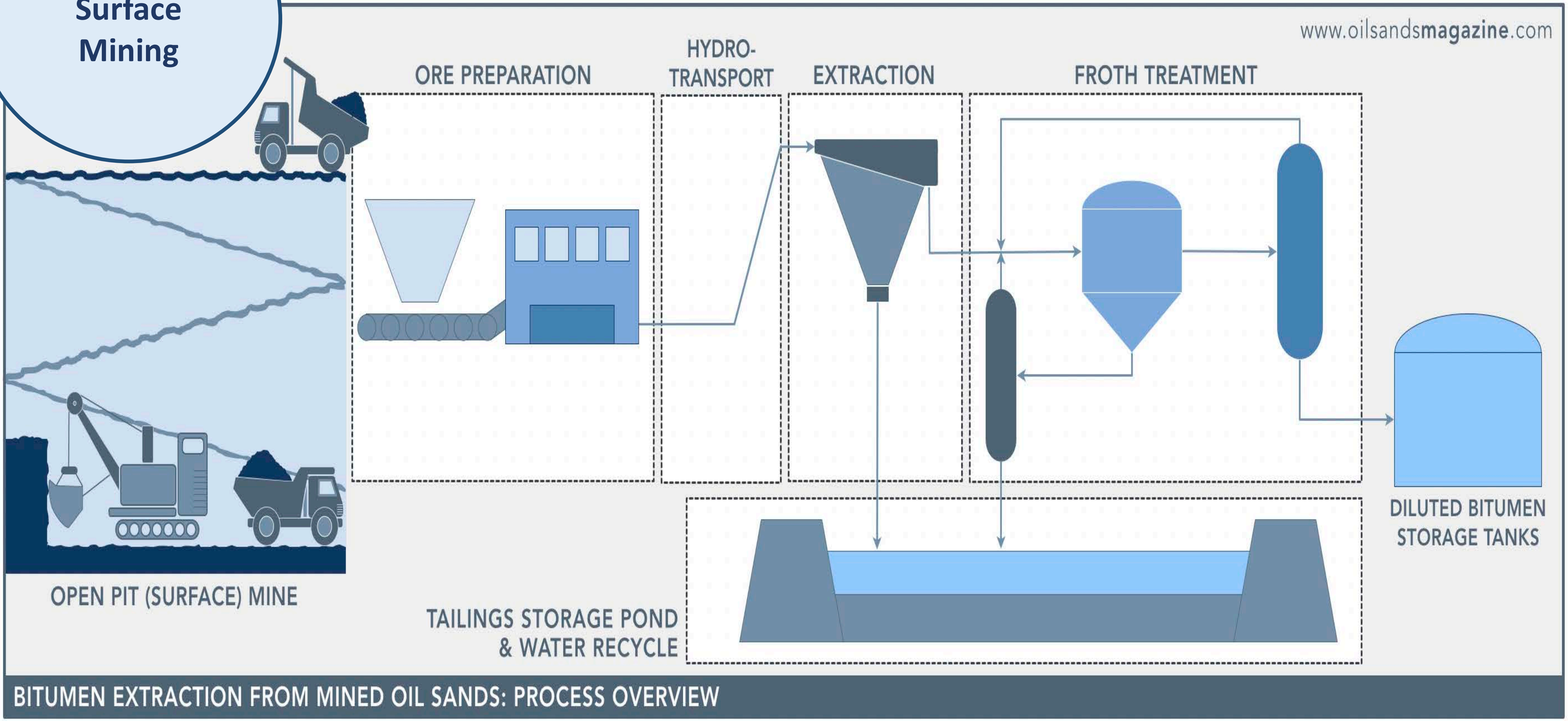
Tailings Pond



Adapted from *Oil Sands Magazine*

Oil Sands Production: Surface Mining

~50%*
Surface Mining



Adapted from *Oil Sands Magazine*

Oil Sands Production: Surface Mining

Adapted from *Oil Sands Magazine*


CEDA

Oil Sands Production: Surface Mining

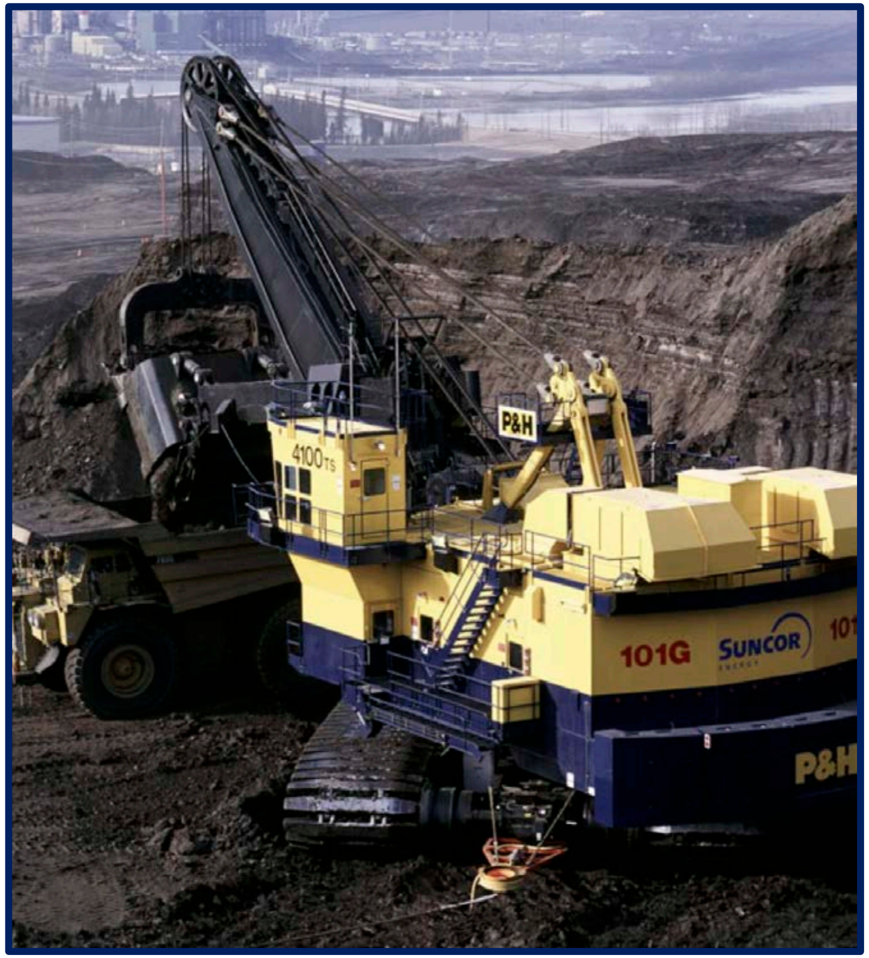
Surface Mining Equipment

Oil Sands Production: Surface Mining

Adapted from *Oil Sands Magazine*

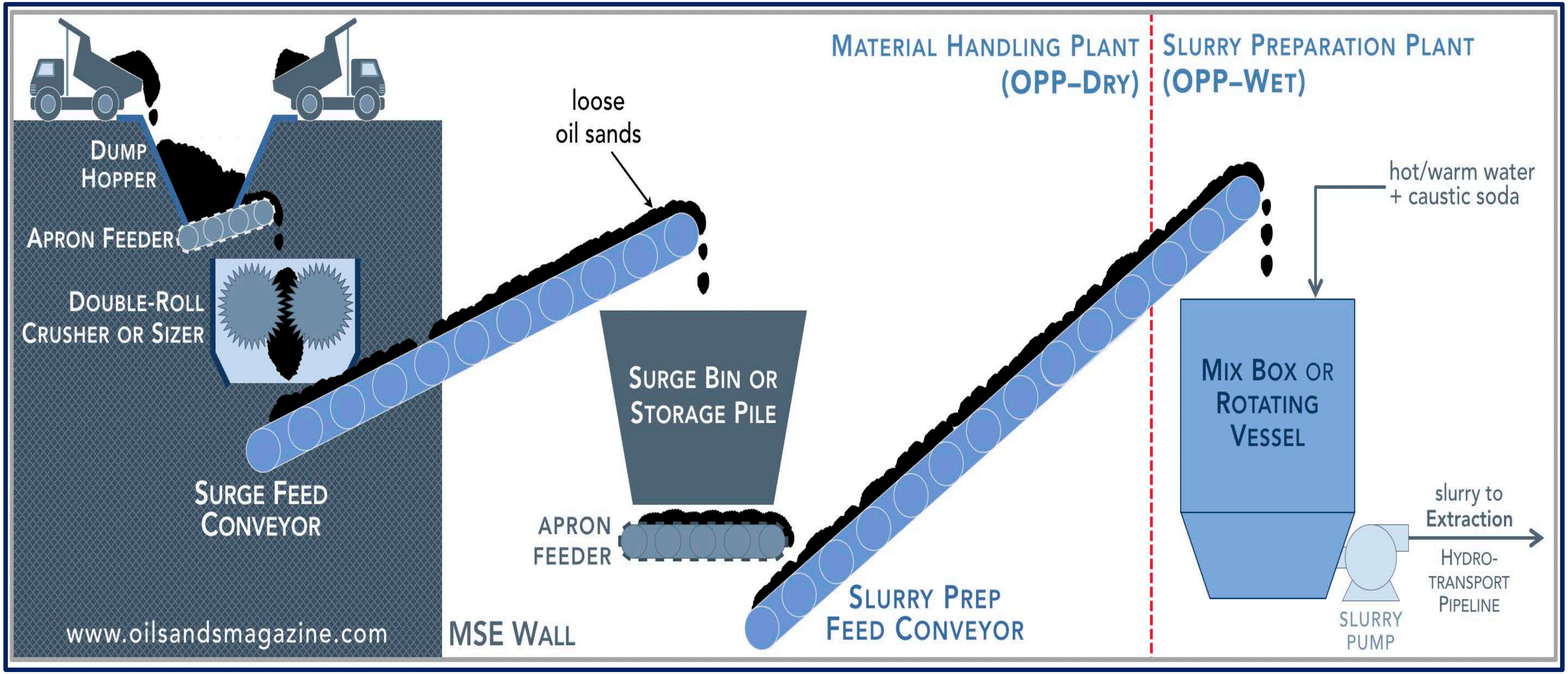
Oil Sands Production: Surface Mining

Extraction Equipment



Adapted from *Oil Sands Magazine*

Oil Sands Production: Surface Mining



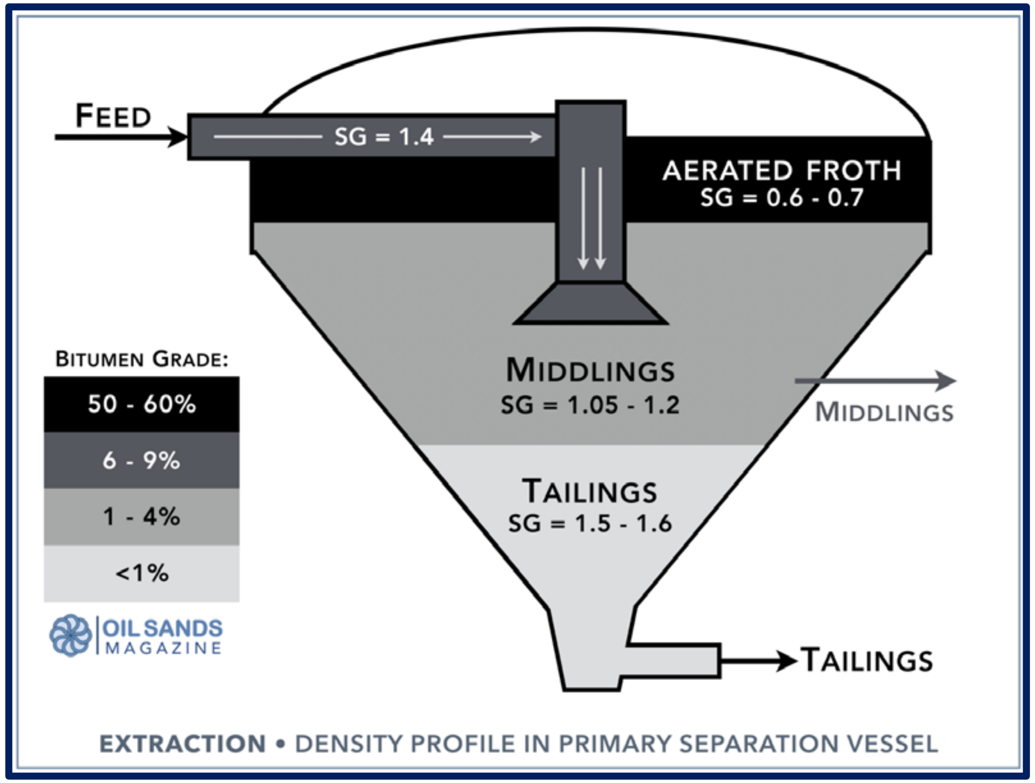
Oil Sands Production: Surface Mining

Crushing

Oil Sands Production: Surface Mining

Oil Sands Production: Surface Mining

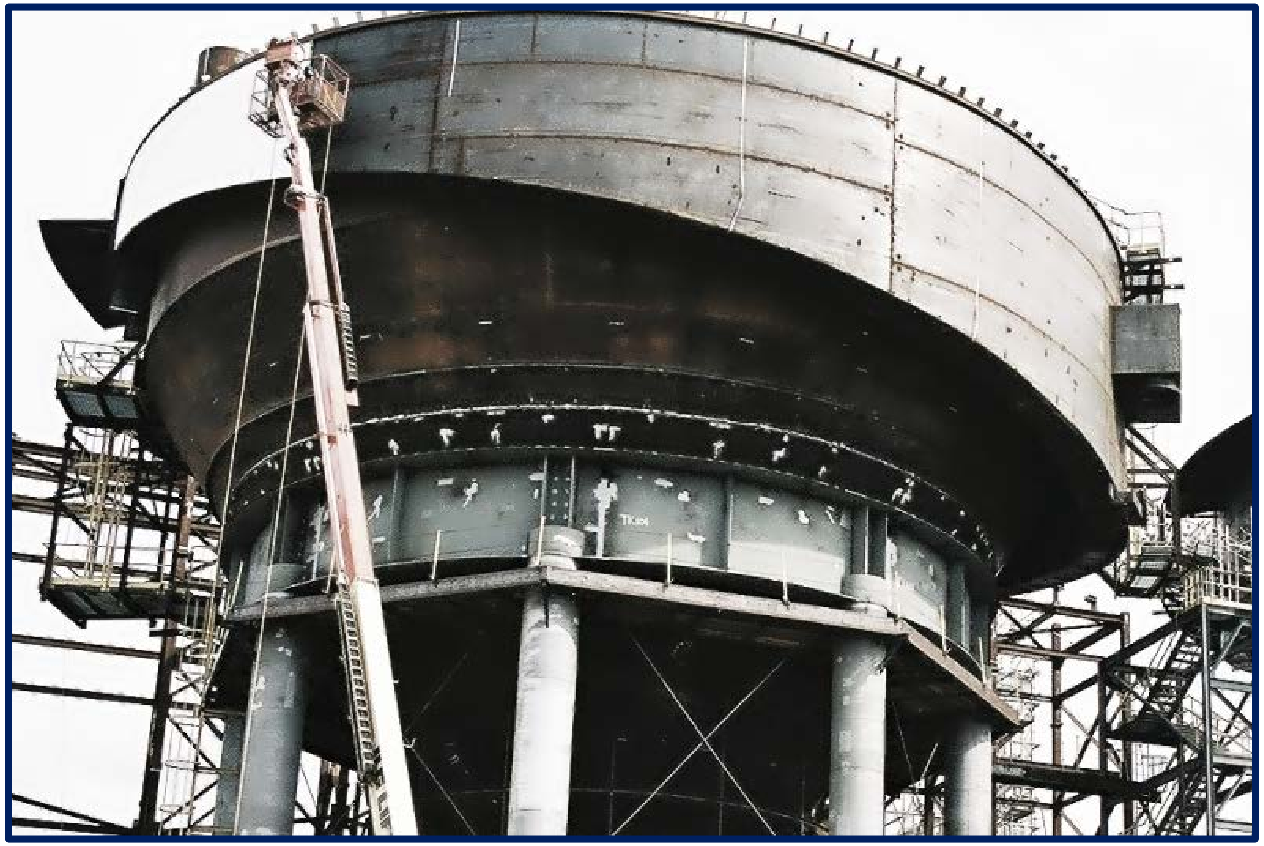
Froth Gravity Separation



Adapted from *Oil Sands Magazine*

Oil Sands Production: Surface Mining

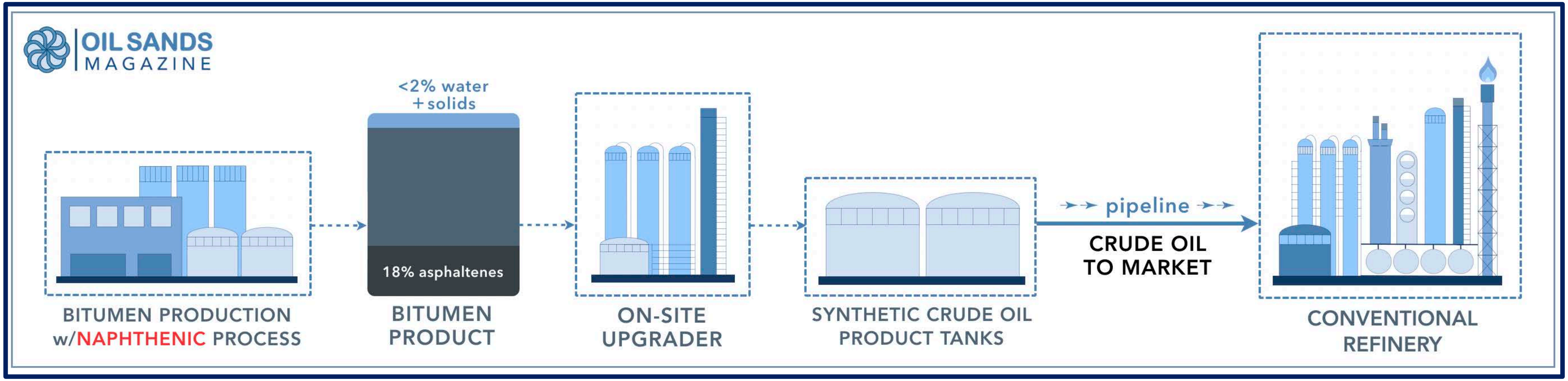
Froth Gravity Separation



Adapted from *Oil Sands Magazine*

Oil Sands Production: Surface Mining

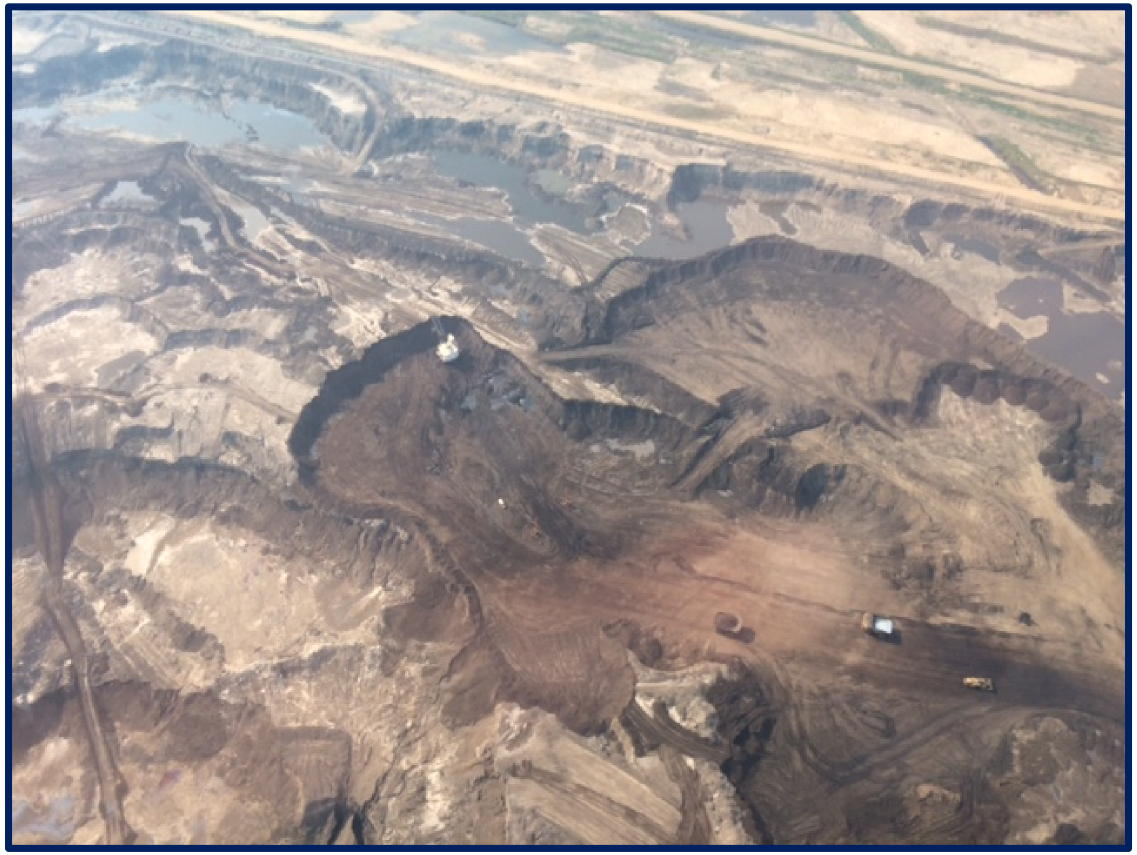
Froth Treatment and Upgrading



Restoration Efforts

Oil Sands Production
Surface Mining

Oil Sands Production: Surface Mining



Oil Sands Production: Surface Mining

Canadian Perspectives

- Stand.Earth
- Tsleil Waututh Nation
- Responsible Fossil Fuels – Pembina Institute, Edmonton
- City of Vancouver
- West Coast Environmental Law
- Union of BC Indian Chiefs
- Squamish Nation
- Kwikwasut’inuxw Haxwa’mis First Nation
- City of Burnaby

PEMBINA institute

KWIKWASUT'INUXW HAXWA'MIS

CITY OF VANCOUVER

WEST COAST Environmental Law

City of Burnaby

Tsleil-Waututh Nation
PEOPLE OF THE INLET

Skwxwú7mesh Úxwumixw
Squamish Nation

Union of BC Indian Chiefs

STAND .earth

<u>Alberta and Canadian Government Efforts</u>

- Environmental and Community-led Monitoring
- Carbon Emissions Pricing
- Capping oil sands greenhouse gas (GHG) emissions at 100 megatonnes (Mt) per year
- Reducing methane emissions province-wide by 45 per cent by 2025

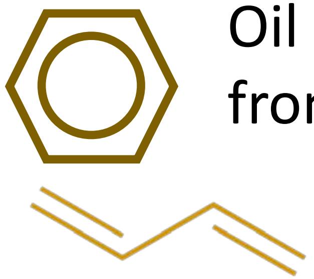
Alberta

Canada

Climate and Bay Area Environmental Concerns

Local Toxics

H_2S



Oil Sands processing may impact toxic risk from refineries.

Global GHGs

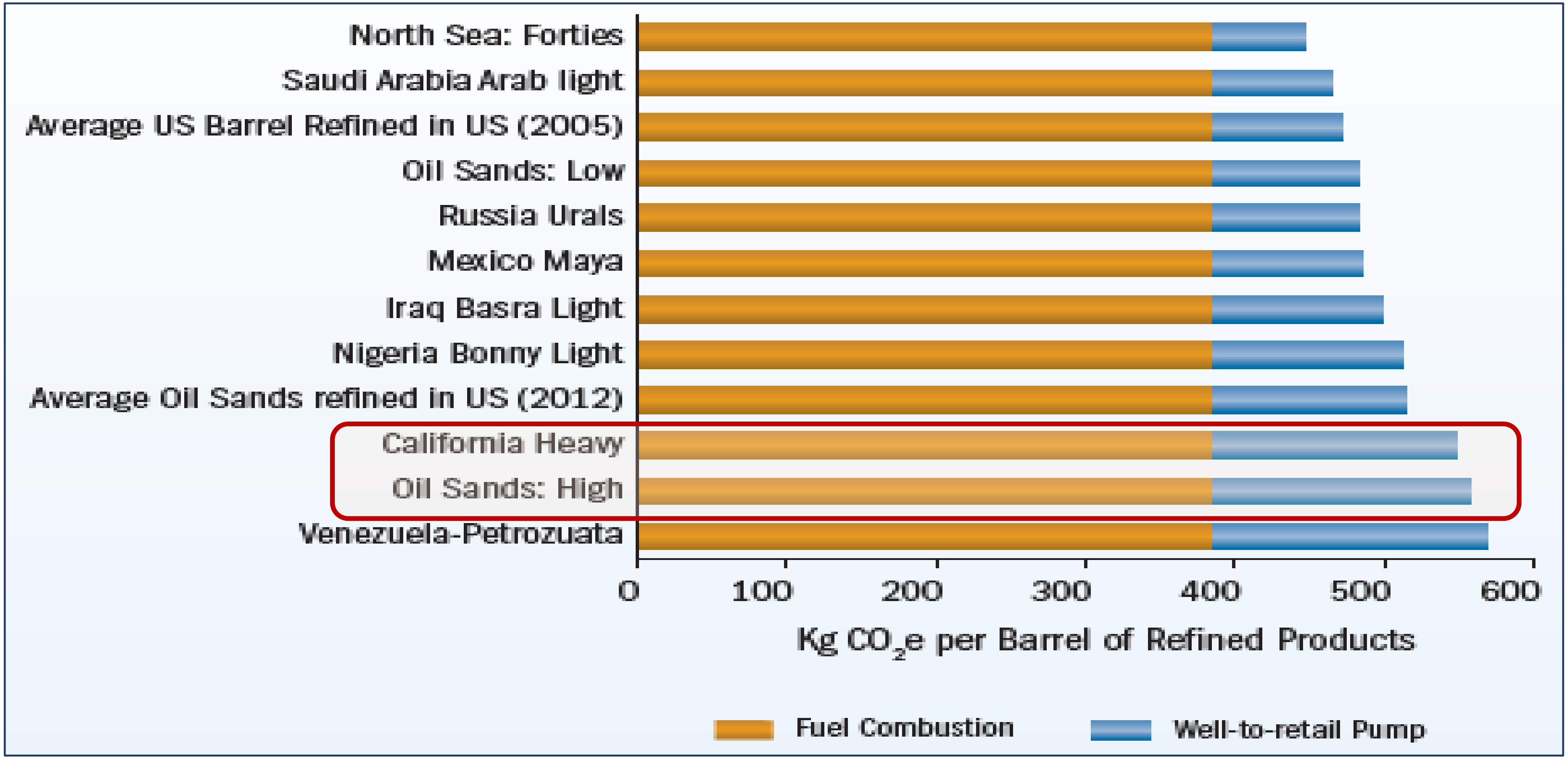
Oil Sands extraction and processing are very "carbon intensive" requiring more energy than conventional crudes, increasing GHG emissions.

Water

Increased ship traffic increases the potential for oil spills.

Oil Sands vs California Crude Oil: Carbon Intensity

Life Cycle Greenhouse Gas Emissions

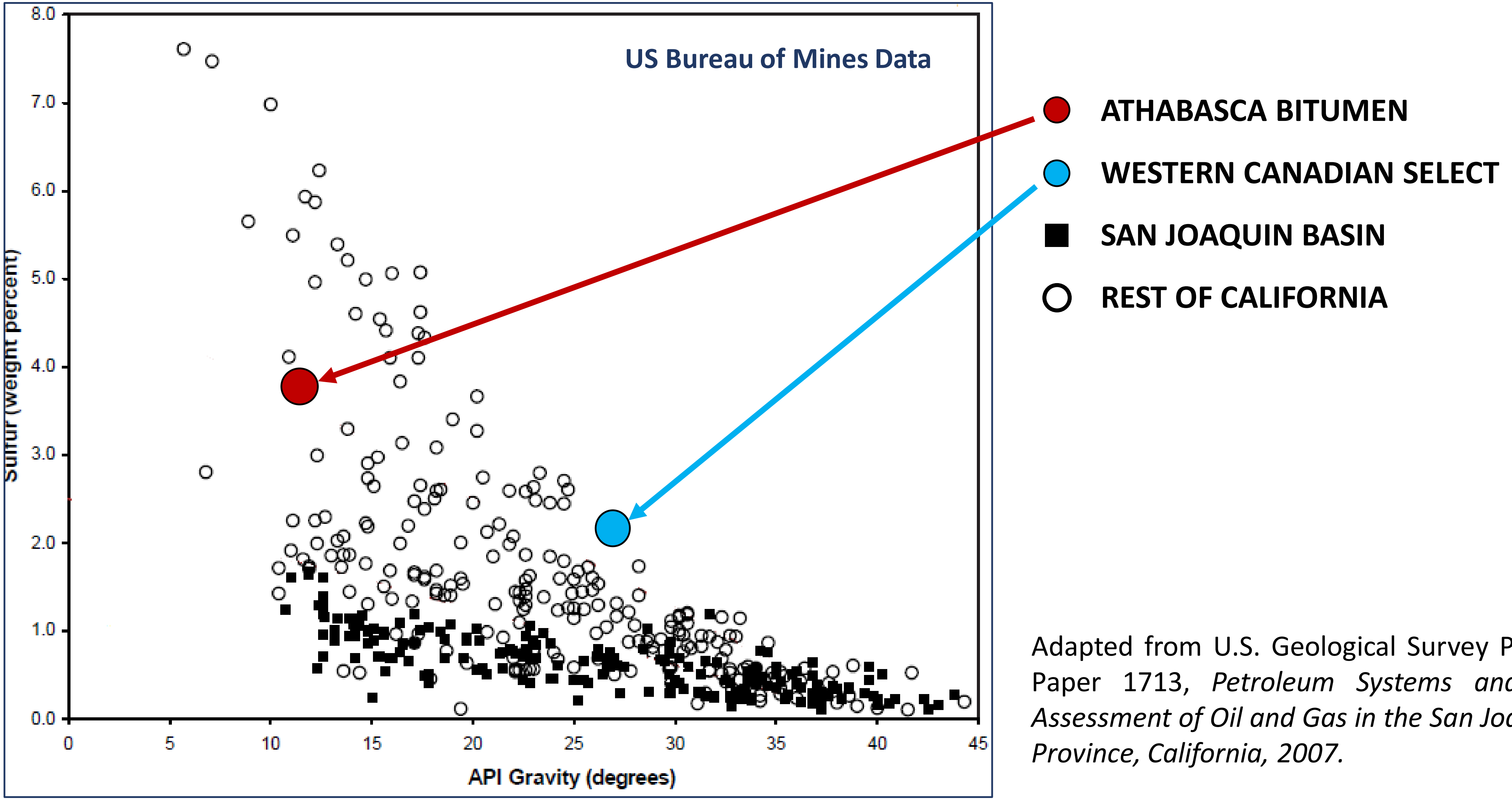


Source: IHS ENERGY, *Comparing GHG Intensity of the Oil Sands and the Average US Crude Oil*, May 2014

Oil Sands vs California Crude Oil: API Gravity

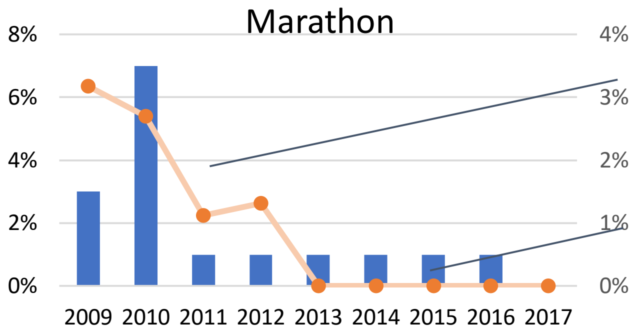
Adapted from *Oil Sands Magazine*

Oil Sands vs California Crude Oil: Sulfur v. Density



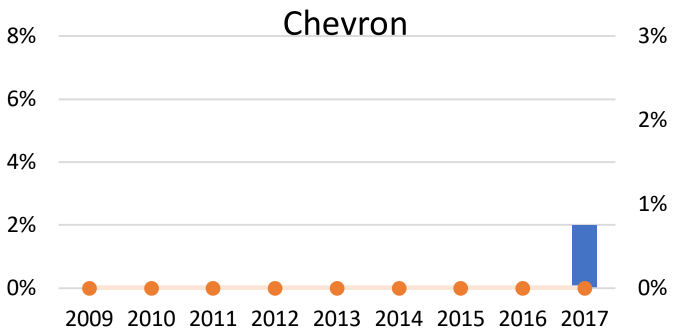
Adapted from U.S. Geological Survey Professional Paper 1713, *Petroleum Systems and Geologic Assessment of Oil and Gas in the San Joaquin Basin Province, California, 2007.*

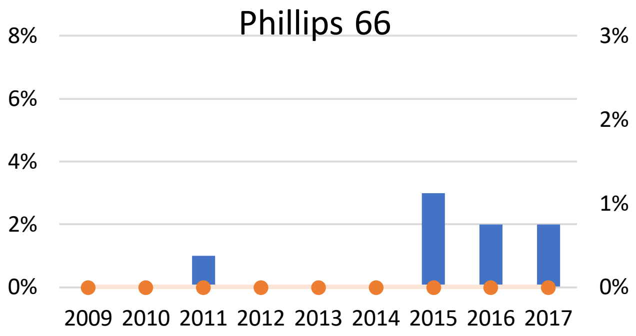
Canadian Crude Oil Imports

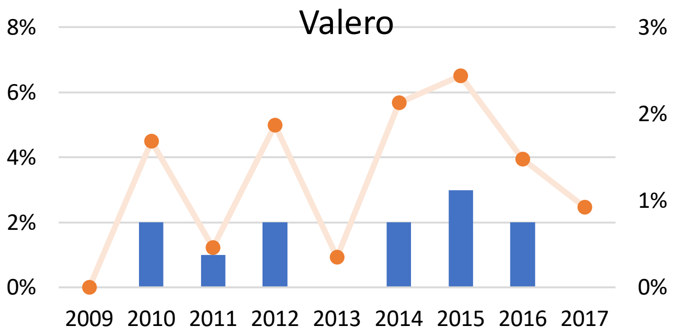


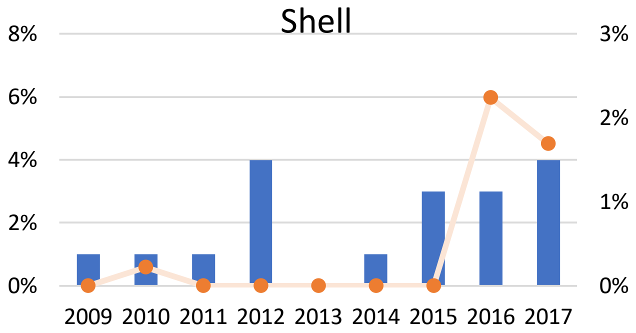
Line: imported Canadian crude oil with properties similar to Oil Sands

Bars: total imported Canadian crude oil









Source:
District analysis of U.S. EIA Imports Data

$$\% \text{ of Operable Capacity} = \frac{\textit{Canadian Imports with Oil Sands Properties}}{(\textit{Operable Capacity} \ x\ 365)}$$

$$\% \text{ of Operable Capacity} = \frac{\textit{Total Canadian Imports}}{(\textit{Operable Capacity} \ x\ 365)}$$

Mitigating Bay Area Environmental Concerns

Local Toxics

- **Track Emissions with Crude Slates** (Regulation 12, Rule 15)
- **Reduce Significant Health Risks** (Regulation 11, Rule 18)
- **Control Technology for Toxics** (Regulation 2, Rule 5)
- **AB 617 Community Health Protection Programs**

Global GHGs

CALIFORNIA AIR RESOURCES BOARD

- **Low Carbon Fuel Standard**
- **Cap and Trade**
- **Rule 13-1: Significant Methane Releases**

Water

CALIFORNIA DEPARTMENT OF FISH & WILDLIFE

- **Office of Spill Prevention and Response**

Conclusion

In Summary:

- Oil Sands extraction has significant local environmental impacts
- Oil Sands crude similar to composition and impacts from California Crude
- Approximately 4% of crude refined in the Bay Area comes from Canada
- Significant regulatory framework in place in the Bay Area; we will need to continue monitoring crude imports
- Regulatory changes may be necessary if emissions increase
- Continued use of fossil fuels in California will impact climate change

Canadian Tar Sands: Issues for BAAQMD to consider

AGENDA: 13

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FORMERLY FORESTETHICS

Tzeporah Berman, BA MES LLD
Adjunct Professor York University
International Campaigns Director

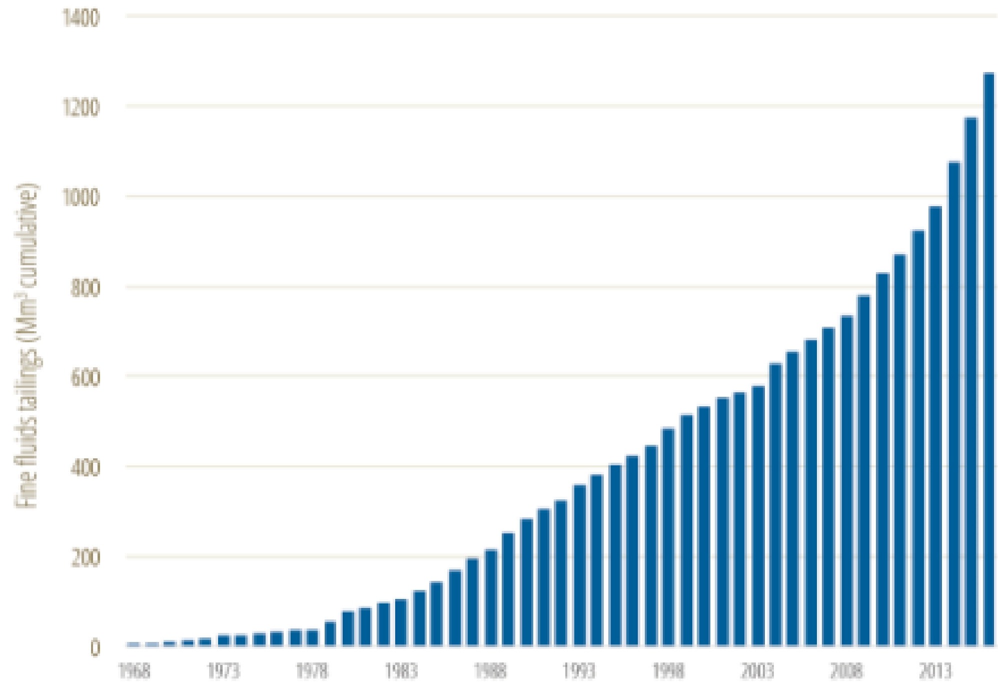
Photo: David Dodge Copyright © The Pembina Institute

Surface Mining

Deposits less than 100 m from surface

Total oilsands region = 142,200 km^2
Surface mineable area = 4,800 km^2

Tailings ponds volume reached 1,271,000,000 cubic metres in 2016



Source: Government of Alberta

PEMBINA institute

pembina.org/oil-sands/tailings-ponds


250 Million Litres per day

Photo: © Garth Lenz

Toxic compounds present in tailings waste

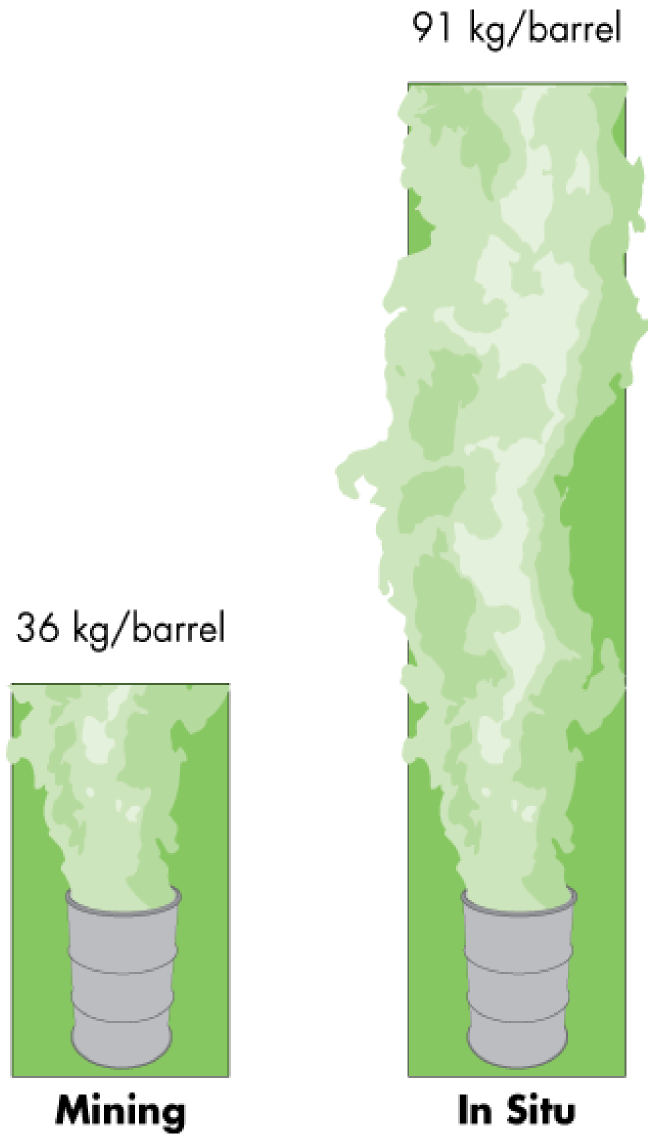
- Contain residual bitumen, cyanide, napthenic acids, heavy metals
- Possible contamination of surface water and groundwater systems – seeping 2.9 million USG per day
- Toxic air pollutants such as methane, VOCs and H_2S emissions

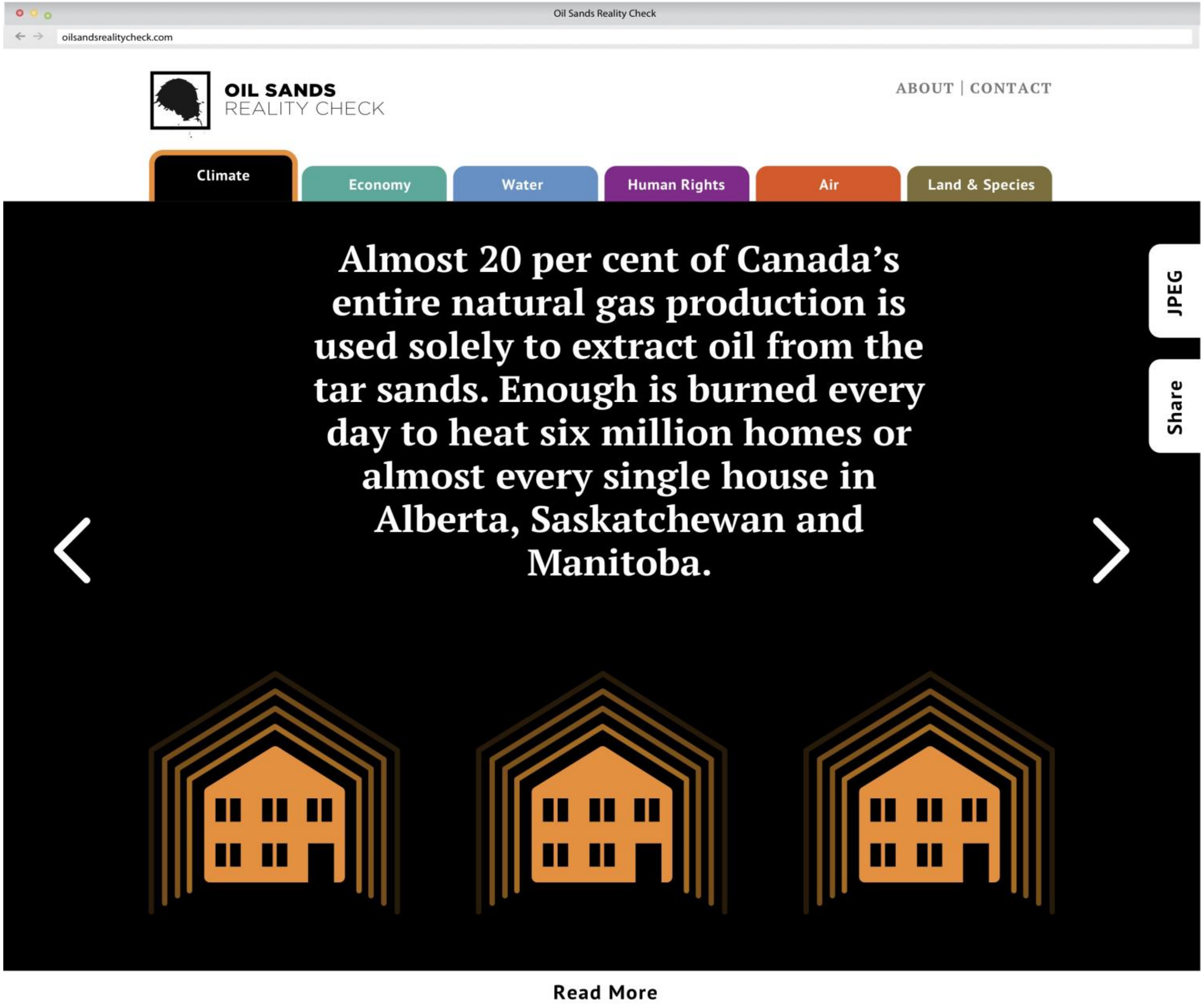
In situ

Steam drilling for deep oilsands deposits

80% of total oilsands region is suitable for in situ developments

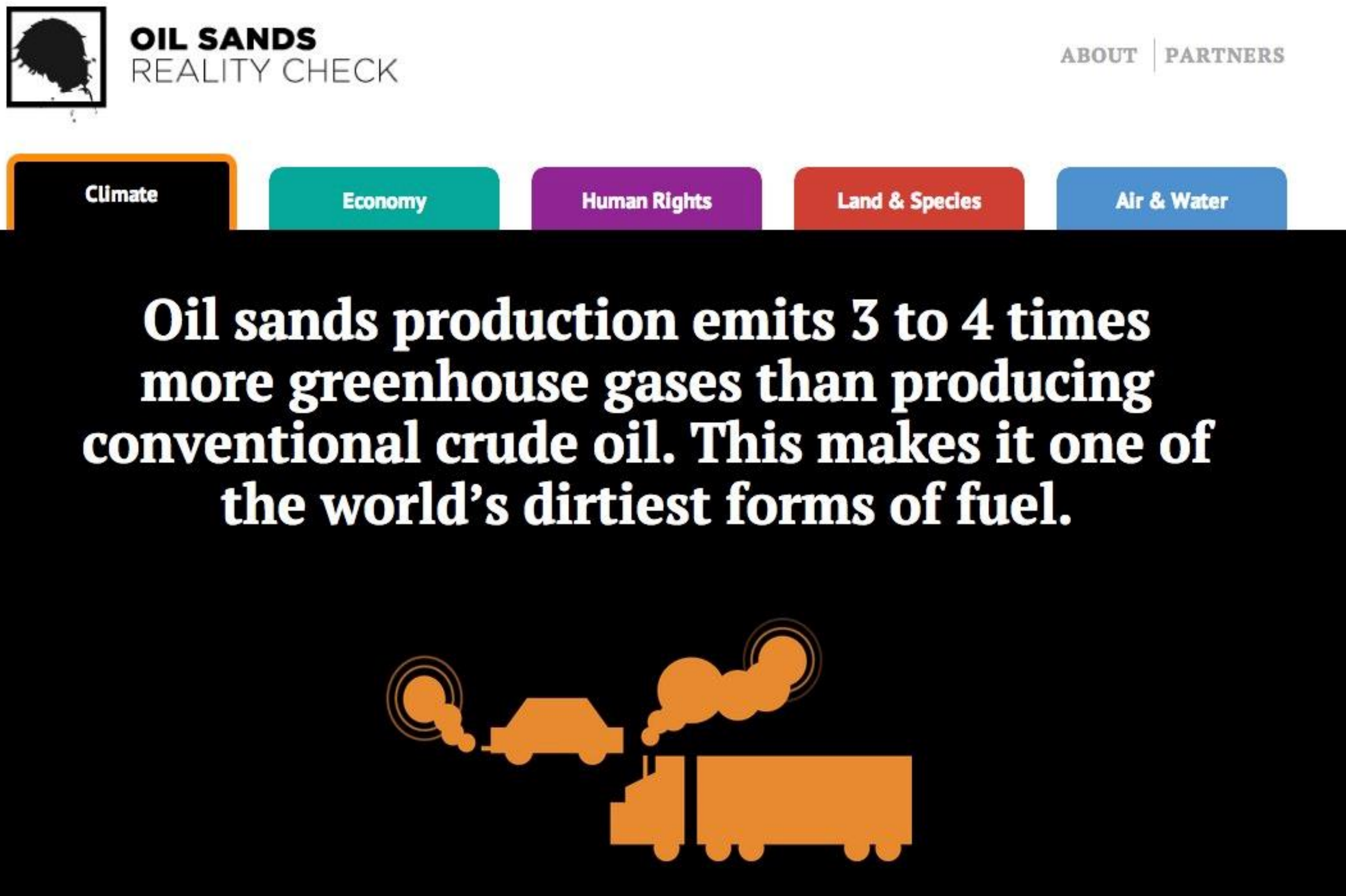
In situ produces a dirtier barrel





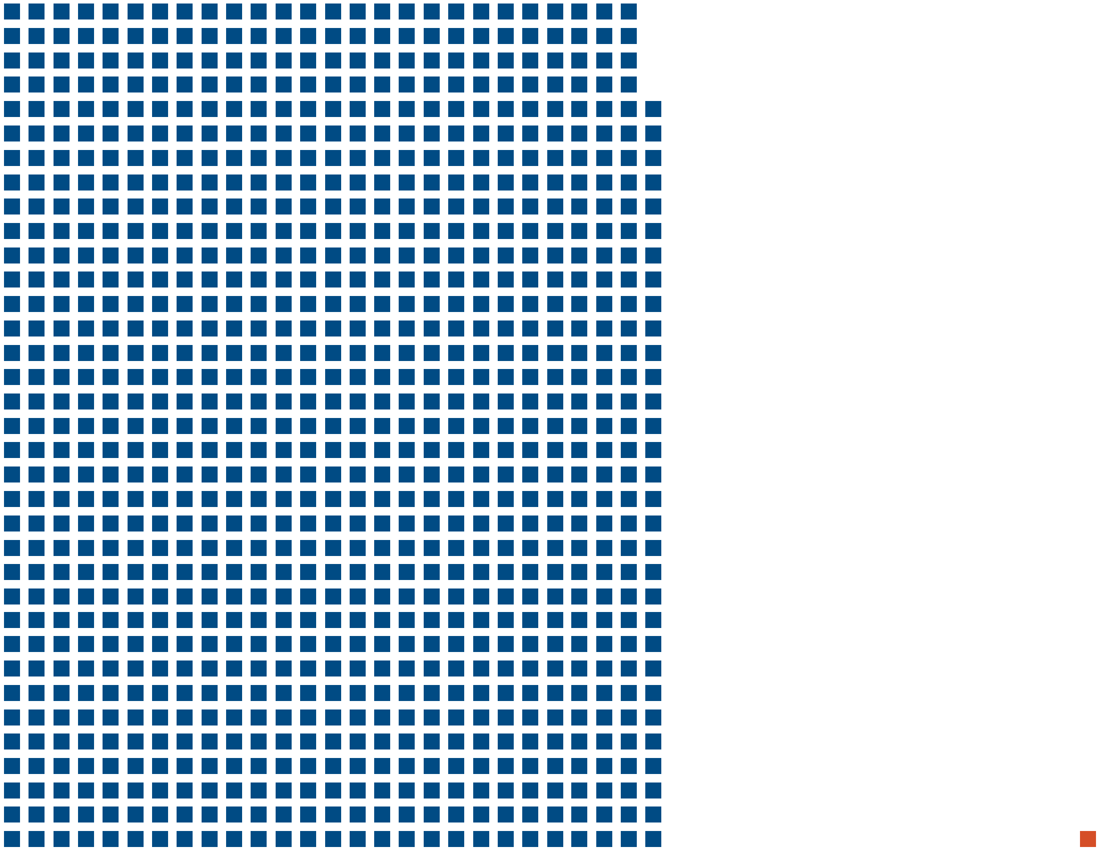
2.38 Billion cubic feet per day

Oil Sands Reality Check



The boreal forest is a crucial habitat for wolves, grizzly bear, lynx and moose. Woodland caribou populations in the region have declined by 50 per cent over the past 10 years and studies predict caribou will become extinct if approved tar sands projects are implemented.

One square represents the area of 100 hectares (ha) of land



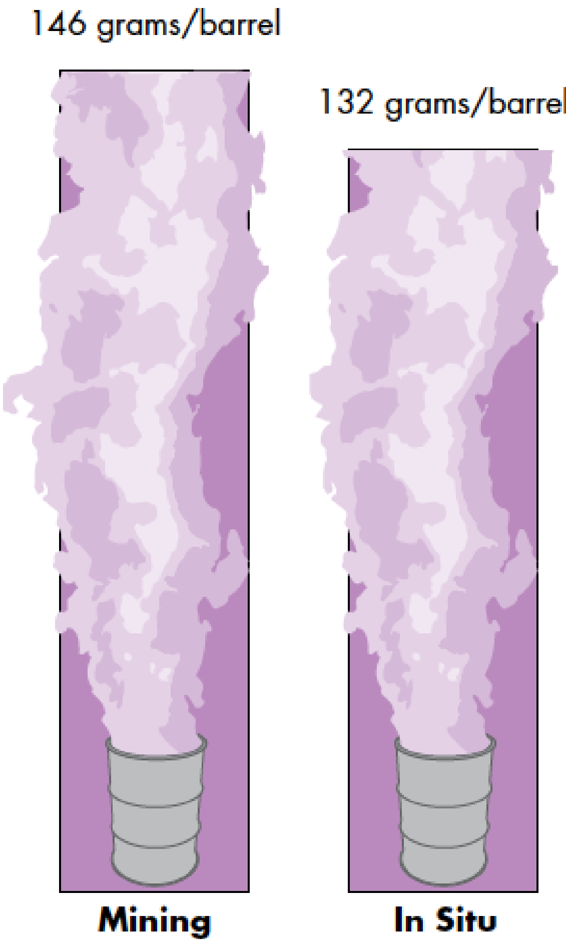
Active area of the land mined for oilsands (94,095 ha)

Area of the land mined for oilsands certified as reclaimed and returned to the province (104 ha)

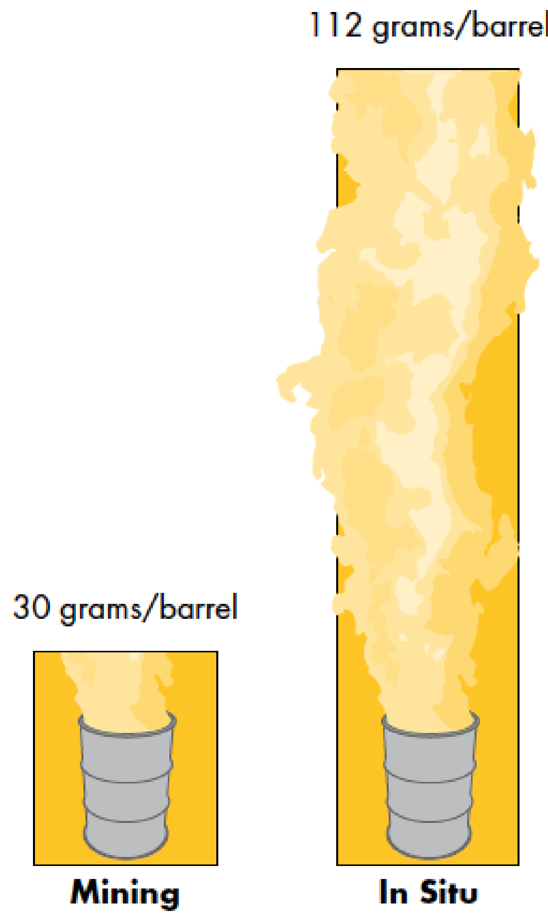
Air quality

Photo: David Doge, Pembina Institute

NO_x emissions per barrel



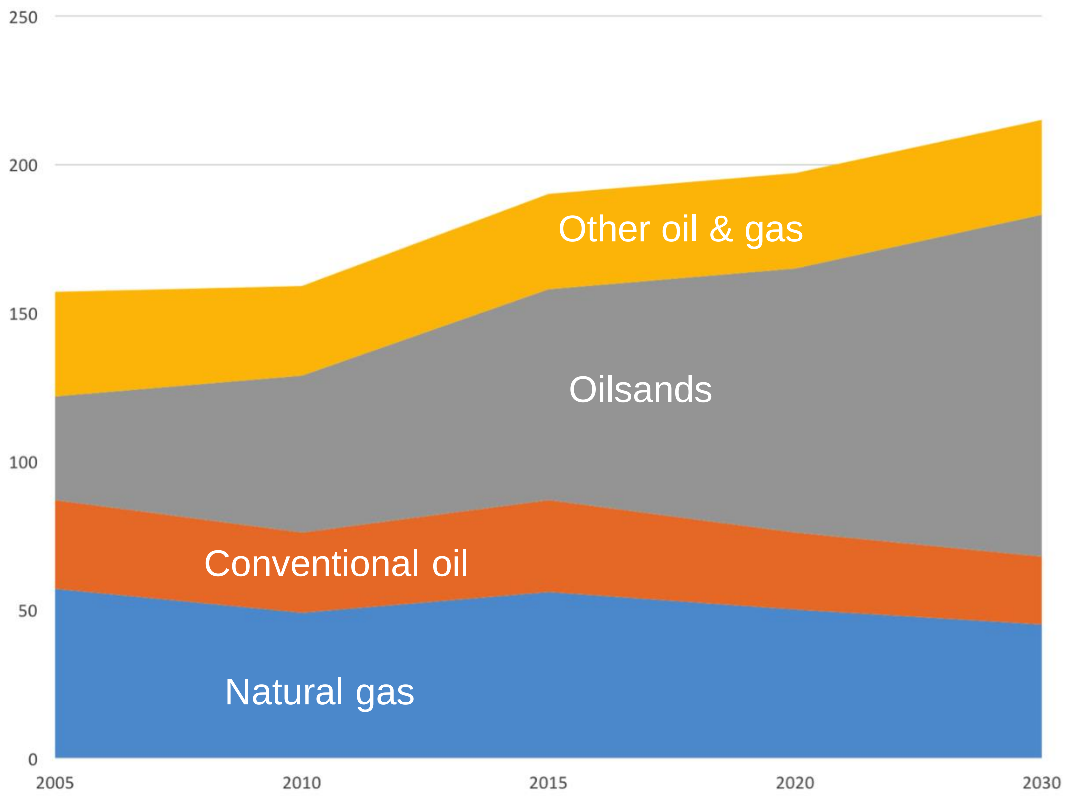
SO_2 emissions per barrel



Sulphur dioxide and nitrogen oxides are major contributors to acid rain formation


HAPPENING NOW
Fort McMurray Wildfire

GHG forecast from oil and gas

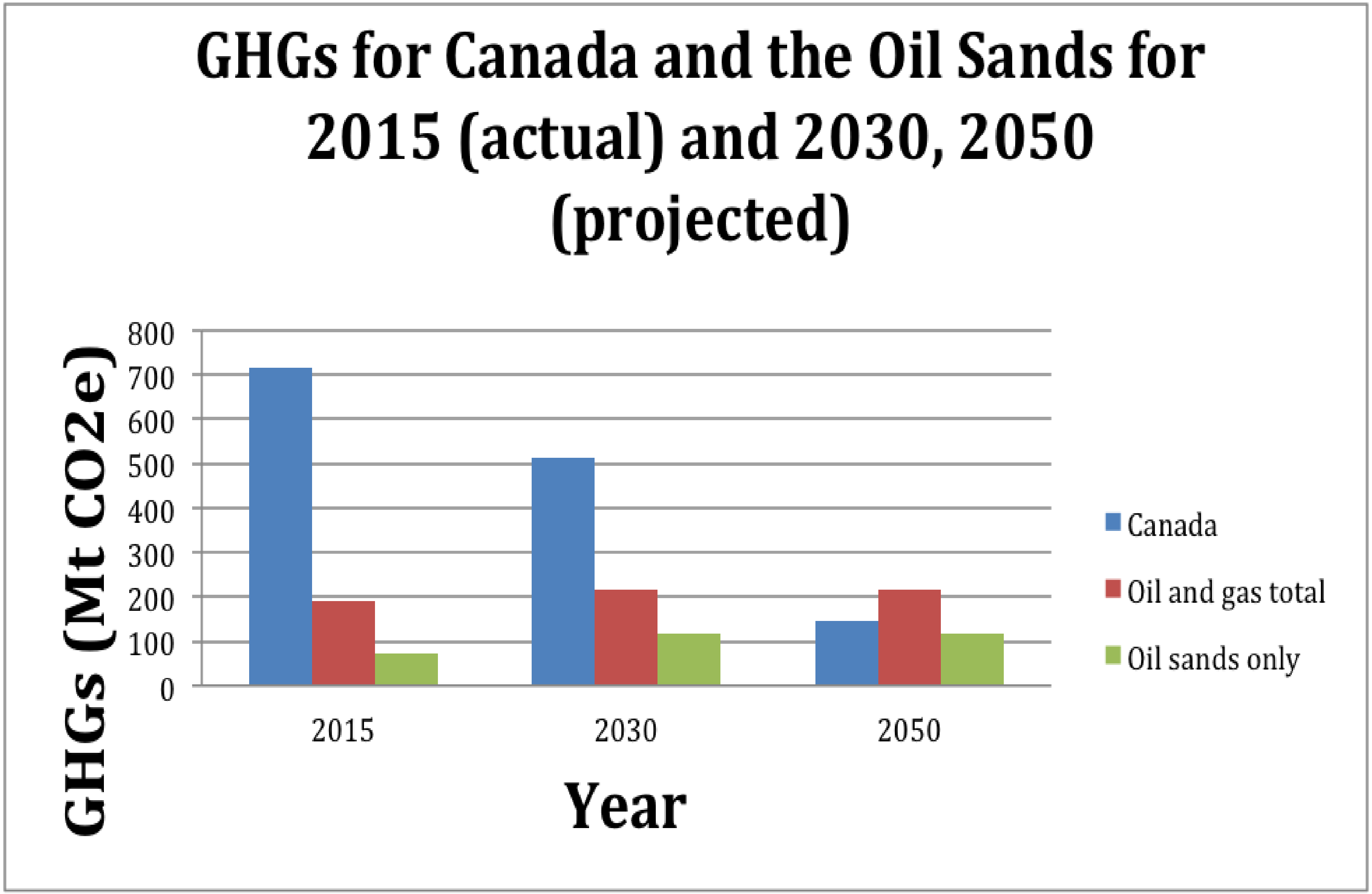


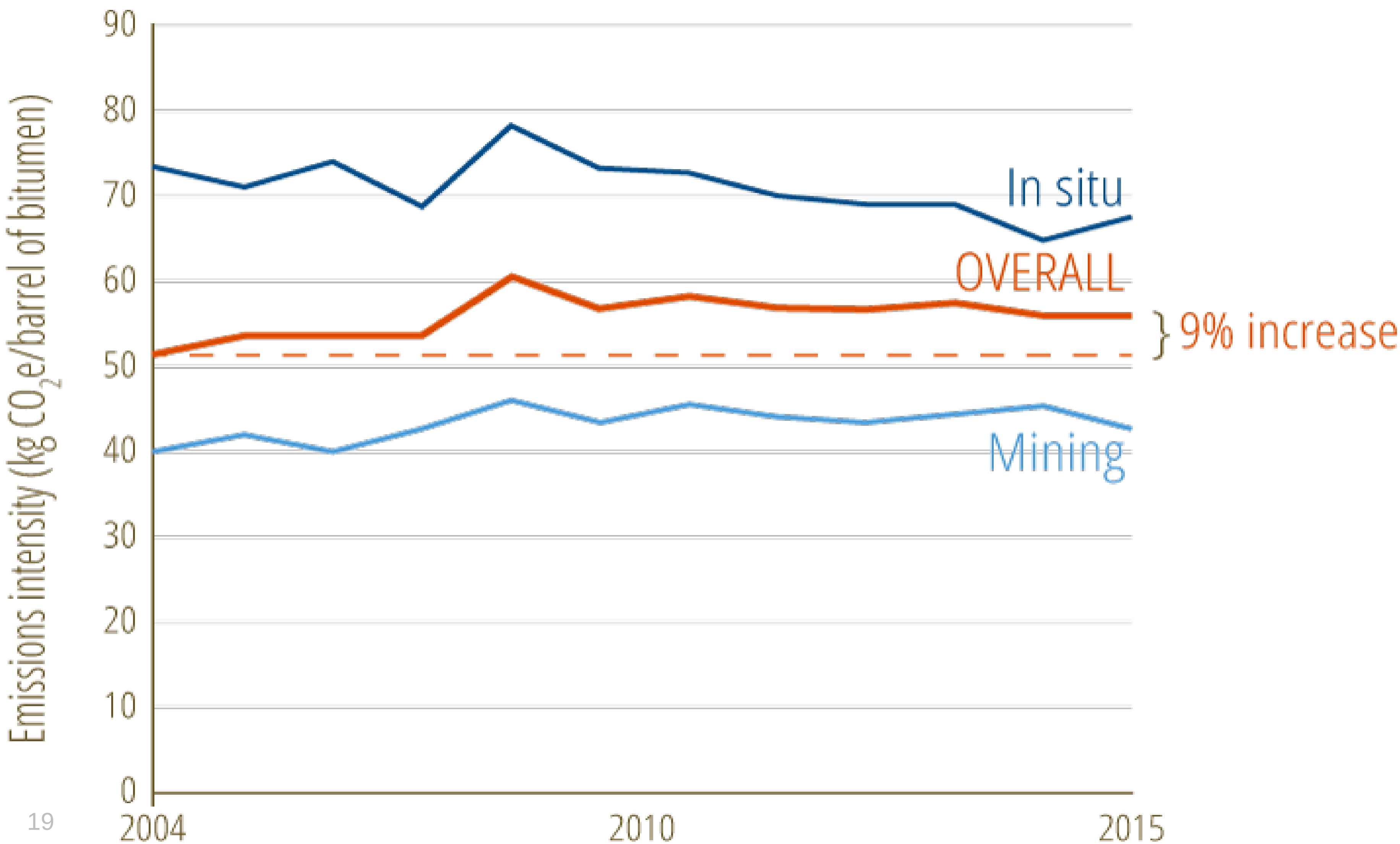
Source: Environment and Climate Change Canada

GHGs from oil and gas increase by 13% between 2015 and 2030 (but +62% for oil sands).

Emissions from oil and gas production will represent **42% (215 Mt) of Canada's carbon budget in 2030** (517 Mt).

Oilsands emissions are the core of the issue

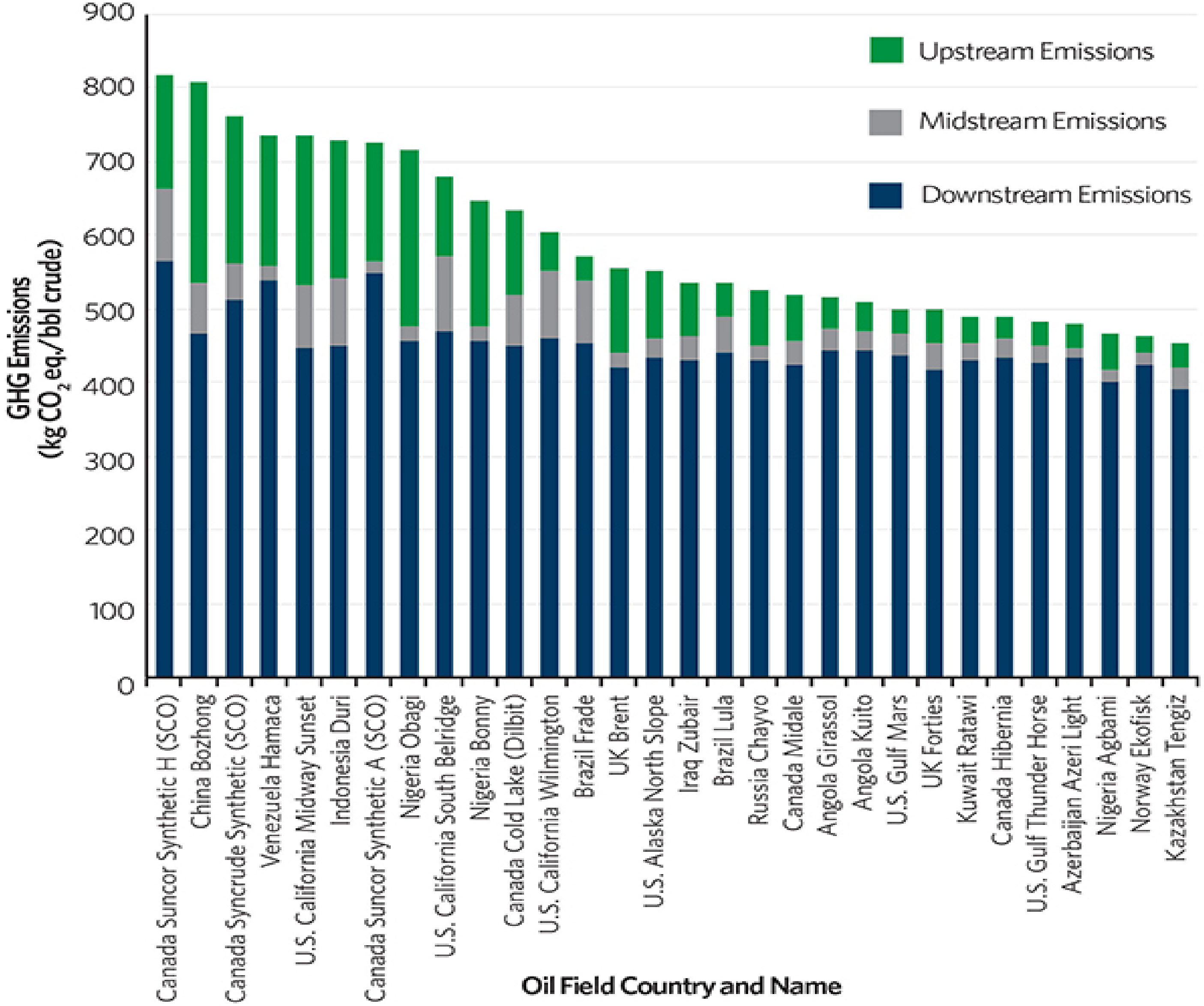

GHGs for Canada and the Oil Sands for 2015 (actual) and 2030, 2050 (projected)
GHGs (Mt CO2e)
800
700
600
500
400
300
200
100
0
2015
2030
2050
Year
Canada
Oil and gas total
Oil sands only



90
80
70
60
50
40
30
20
10
0
Emissions intensity (kg CO_2e/barrel of bitumen)
In situ
OVERALL
} 9% increase
Mining
2004
2010
2015

FIGURE 12

Total GHG Emissions for 30 Phase 1 OCI Test Oils

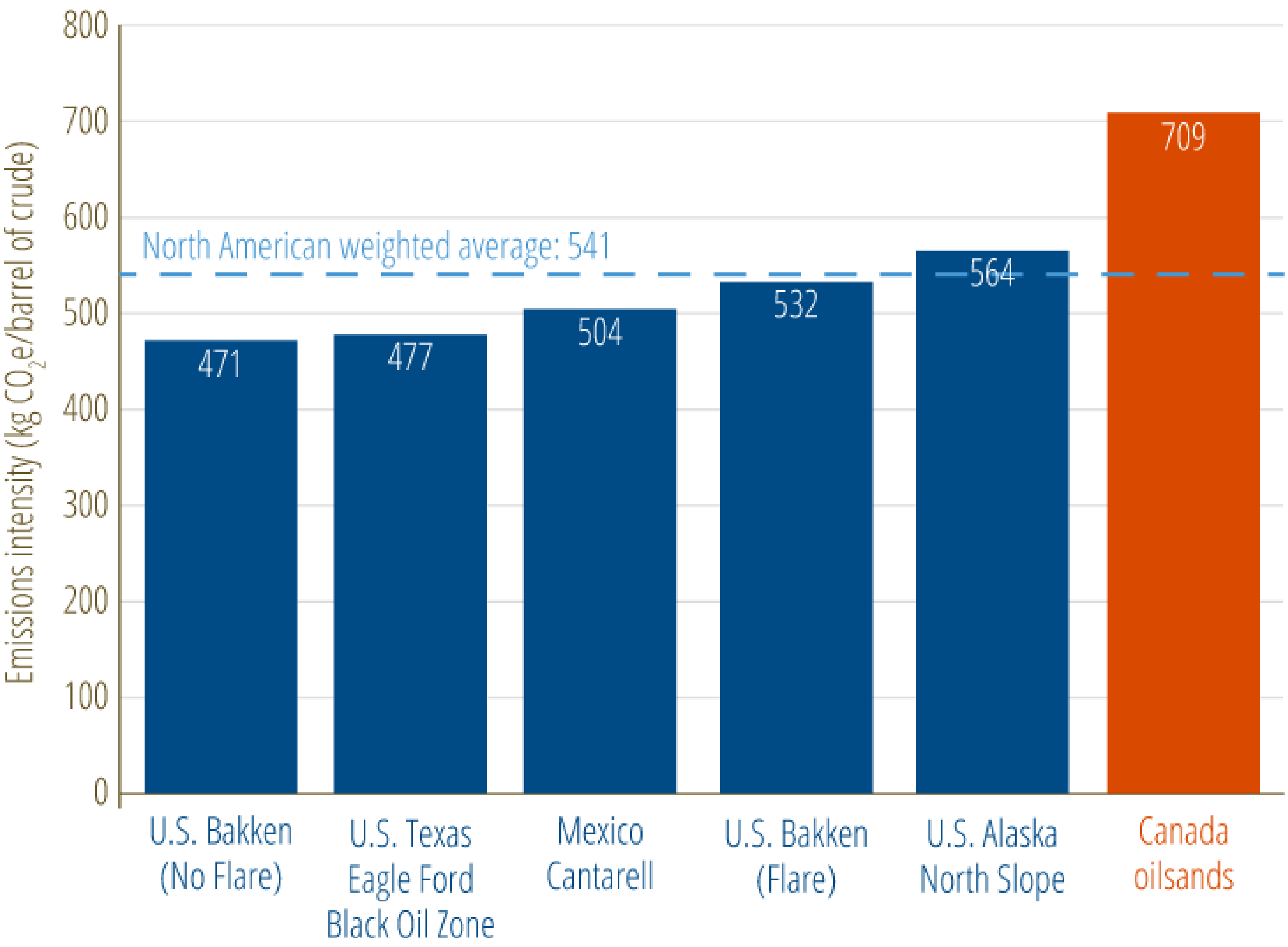


Source: Authors' calculations

Note: Unlike the other OCI test oils, Cold Lake dilbit is not composed of a full barrel of oil.

Source: Carnegie Endowment

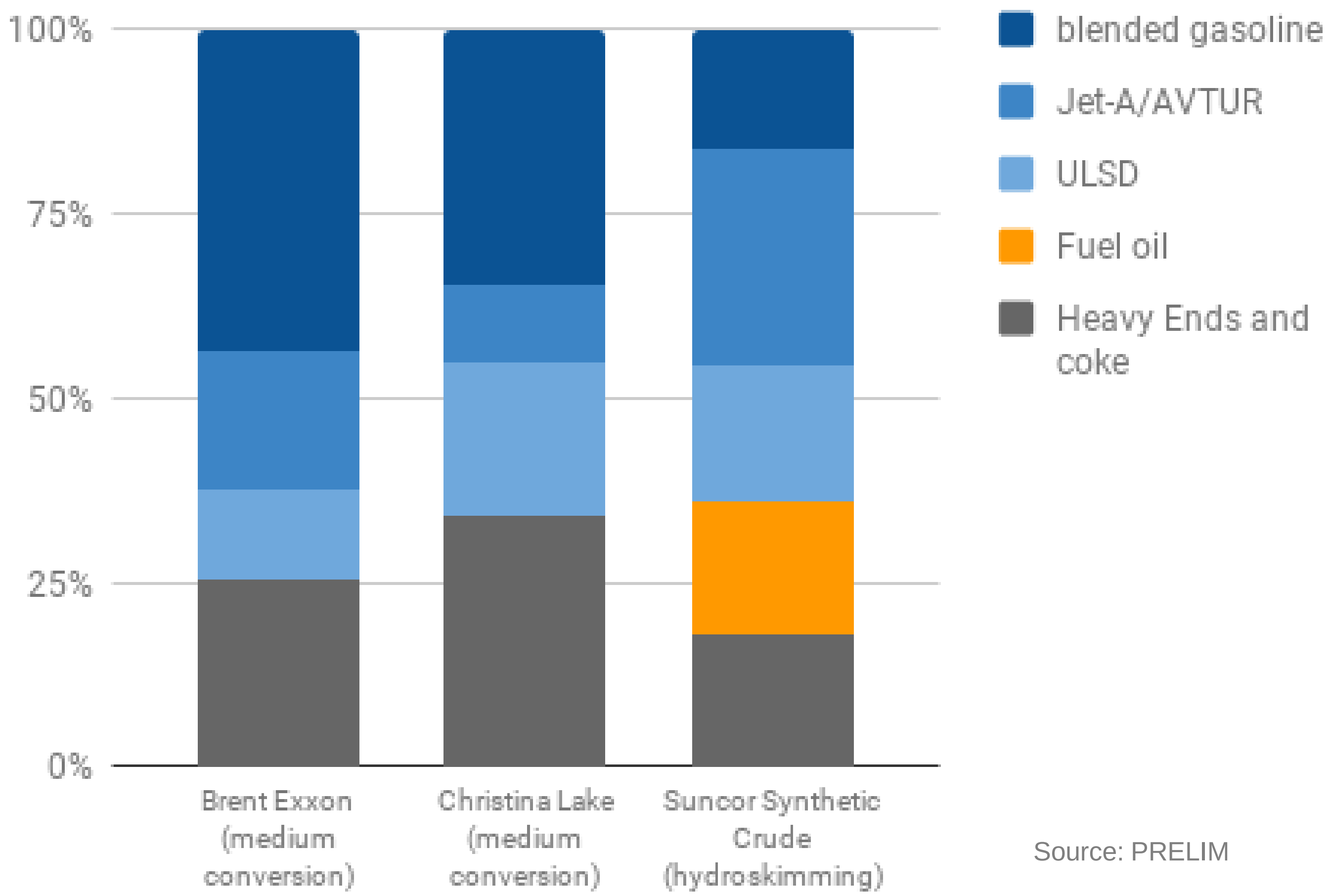
Carbon-intensive source of oil



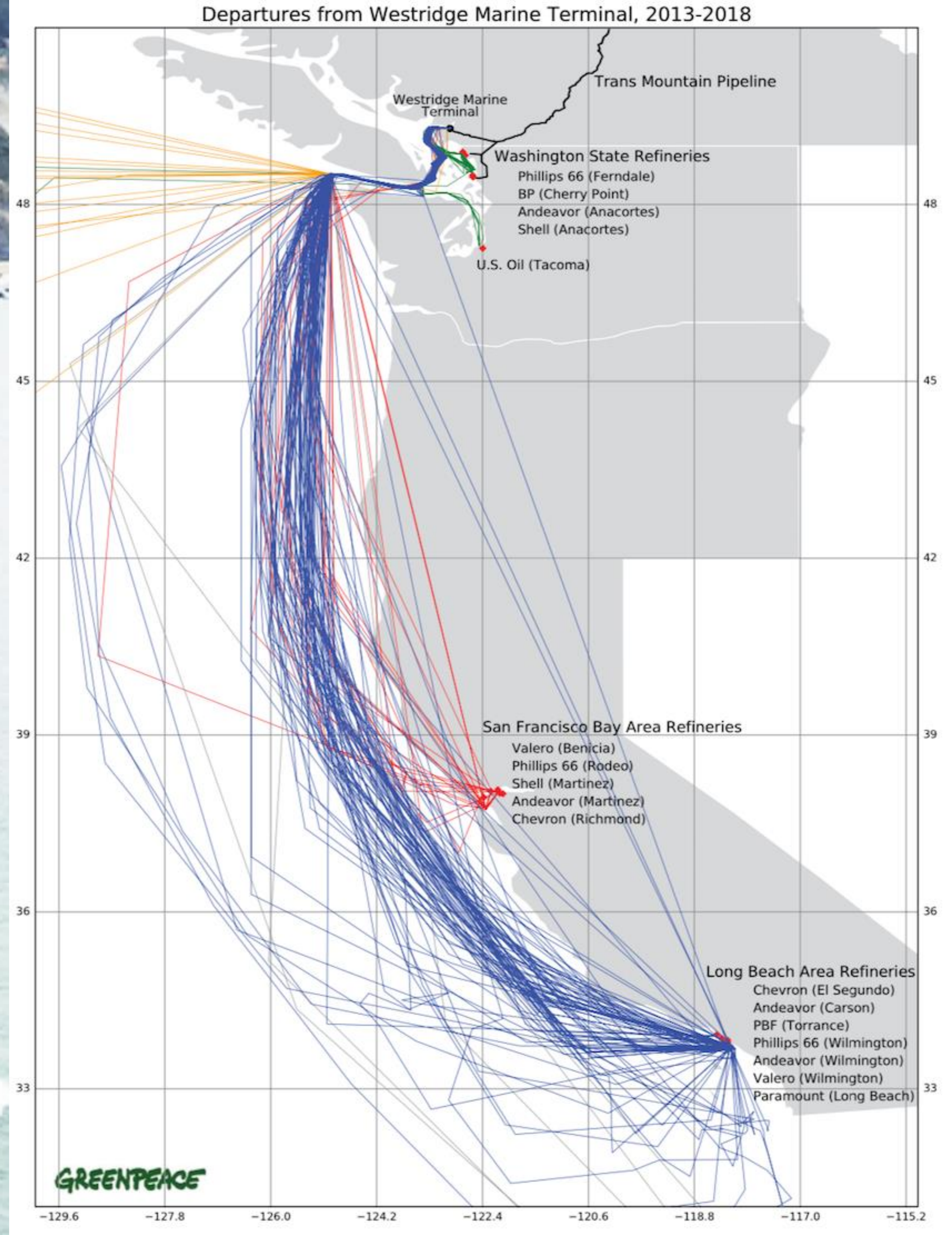
Source: Carnegie Endowment

Low grade crude = lesser value

Extra heavy oil, contains higher levels of sulphur



Source: PRELIM


Departures from Westridge Marine Terminal, 2013-2018
Trans Mountain Pipeline
Westridge Marine Terminal
Washington State Refineries
Phillips 66 (Ferndale)
BP (Cherry Point)
Andeavor (Anacortes)
Shell (Anacortes)
U.S. Oil (Tacoma)
San Francisco Bay Area Refineries
Valero (Benicia)
Phillips 66 (Rodeo)
Shell (Martinez)
Andeavor (Martinez)
Chevron (Richmond)
Long Beach Area Refineries
Chevron (El Segundo)
Andeavor (Carson)
PBF (Torrance)
Phillips 66 (Wilmington)
Andeavor (Wilmington)
Valero (Wilmington)
Paramount (Long Beach)
GREENPEACE
48
45
42
39
36
33
−129.6
−127.8
−126.0
−124.2
−122.4
−120.6
−118.8
−117.0
−115.2

Summary of Ozone Seasons

Year	National 8-Hour	State 1-Hour	State 8-Hour
2015*	5	4	11
2016	15	5	15
2017	6	6	6
2018	3	2	3

Spare the Air Alerts: 6/22/18, 6/23/18, 6/30/18, 7/26/18, 8/8/18, 8/9/18, 8/18/18, 8/19/18, 8/23/18, 8/24/18, 9/3/18, 9/25/18, 9/26/18

Days > 0.070 ppm 8-hour NAAQS: 8/3/18, 8/9/18, 8/18/18

***Based on NAAQS of 0.075 ppm that was in place during that year**

Winter $PM_{2.5}$ Seasons

Year	Days > 35 µg/m^3	Winter Spare the Air Alerts
2015/2016	0	1
2016/2017	0	7
2017/2018	8	19
2018/2019	11	11

- **Spare the Air Alert Called for: 11/8/18 – 11/18/18**
- **Days > 35 µg/m^3 24-hr NAAQS: 11/8/18 – 11/18/18**

Calendar Year Summary

Year	National Ozone Exceedances	Days > 35 µg/m^3 due to Wildfires ($PM_{2.5}$)	Total Days > 35 µg/m^3 ($PM_{2.5}$)
2014	5*	0	3
2015	5*	3	9
2016	15	0	0
2017	6	14	18
2018	3	13	17

For Ozone - Days > 0.070 ppm 8-hour NAAQS: 08/03/18, 8/9/18, 8/18/18

*** Based on NAAQS of 0.075 ppm that was in place during those years**

For Wintertime - Days > 35 µg/m^3 24-hr NAAQS: 12/15/17, 12/24/17, 12/30/17, 12/31/17, 1/1/18, 1/2/18, 1/3/18, 1/4/18, 11/8/18 – 11/18/18

(Other exceedances occurred due to wildfires)