

# UNCONVENTIONAL CRUDE OIL IN NORTH AMERICA

March 2013

# Overview

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- **What is Unconventional Oil?**
- **The dramatic change in North American Crude Production**
  - ▣ **Shale Oil in the US**
  - ▣ **Oil Sands in Canada**
- **The Importance of Logistics**
  - ▣ **Why does rail matter?**
- **Concluding Thoughts**

# Shale Oil in the United States

# Shale Oil & Gas Formations



- Shale oil, also known as tight oil, is light crude oil contained in relatively low porosity and permeability petroleum-bearing formations called shales
- Percentage of pore volume (void space) in tight oil is commonly less than 10%
- Oil contained in these formations will not flow to the wellbore at economic rates without assistance from technologically advanced drilling processes



- Over 20 Shale Oil plays exist
- Bakken & Eagle Ford are most advanced

# Shale Oil & Gas Extraction Technology

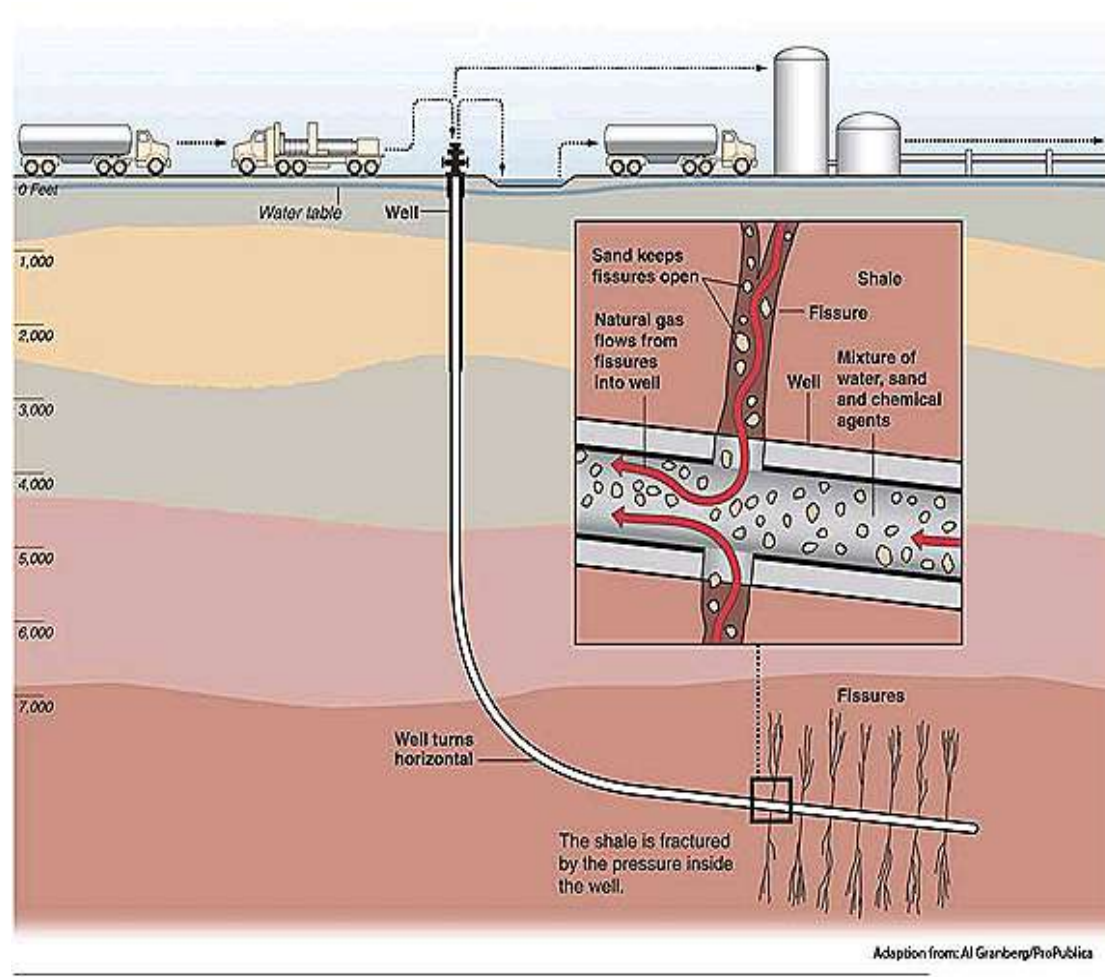
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## Horizontal drilling

- First drilled vertically to a predetermined depth, typically 3000-10,000 ft
- Well is then “kicked off”(turned) at an increasing angle until it runs horizontally
- Then drilled horizontally an additional 10,000-15,000 ft

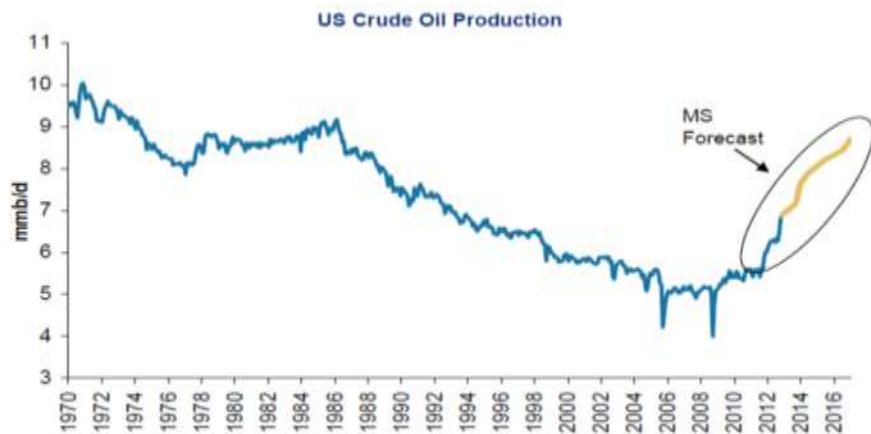
## Hydraulic Fracturing (Fracking)

- Water and additives are pumped at high pressure into the wellbore creating fractures in the reservoir
- Sand or proppants (ceramic beads) are pumped into the fissures to hold them open
- The wellbore can begin pumping oil

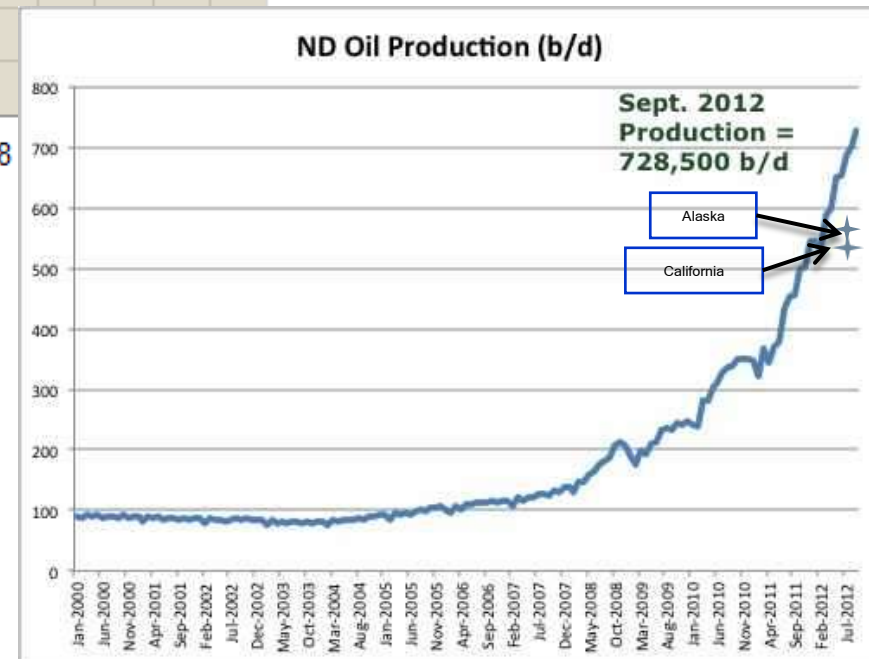


# US Production Renaissance

**U.S. monthly average crude oil production**  
 January 1992 through December 2012  
 million barrels per day



US crude oil production has increased sharply since 2008



**Sept. 2012  
 Production =  
 728,500 b/d**

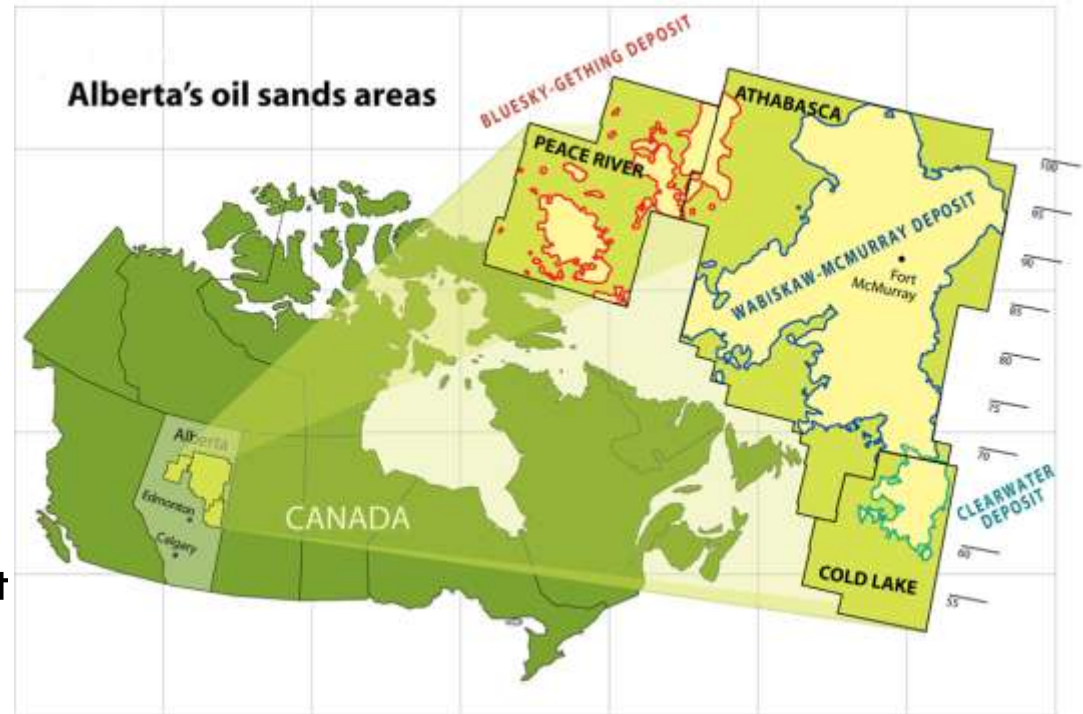
Alaska  
 California

# Canadian Oil Sands



# What are oil sands?

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- Oil sands are a type of unconventional petroleum deposit
- Loose sand or consolidated sandstone saturated with a dense and extremely viscous form of petroleum known as **bitumen**
- Sands are typically 130-200 feet deep on top of flat limestone

- In Canada, reserves are estimated at 175 billion barrels
- 80% expected to be “in-situ” recovery, 20% mined



# Oil Sands Mining

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## 1 DIG

Oil sand is scooped out of a giant mine and deposited onto massive, 400-ton trucks.

## 2 CRUSH & MOVE

Bitumen-rich sand is ground in an ore preparation plant before being sent by pipeline to the primary extraction plant.

## 3 EXTRACT

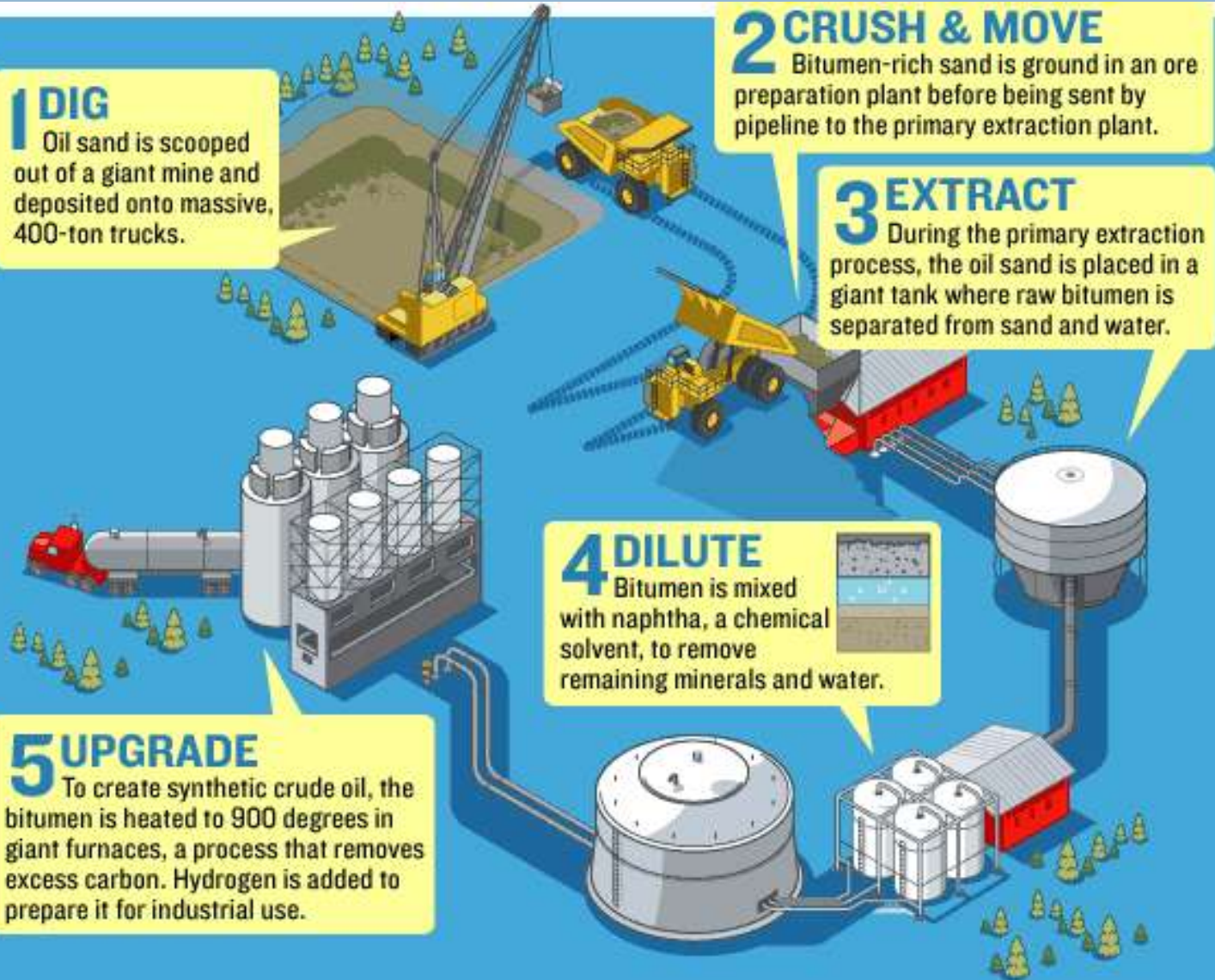
During the primary extraction process, the oil sand is placed in a giant tank where raw bitumen is separated from sand and water.

## 4 DILUTE

Bitumen is mixed with naphtha, a chemical solvent, to remove remaining minerals and water.

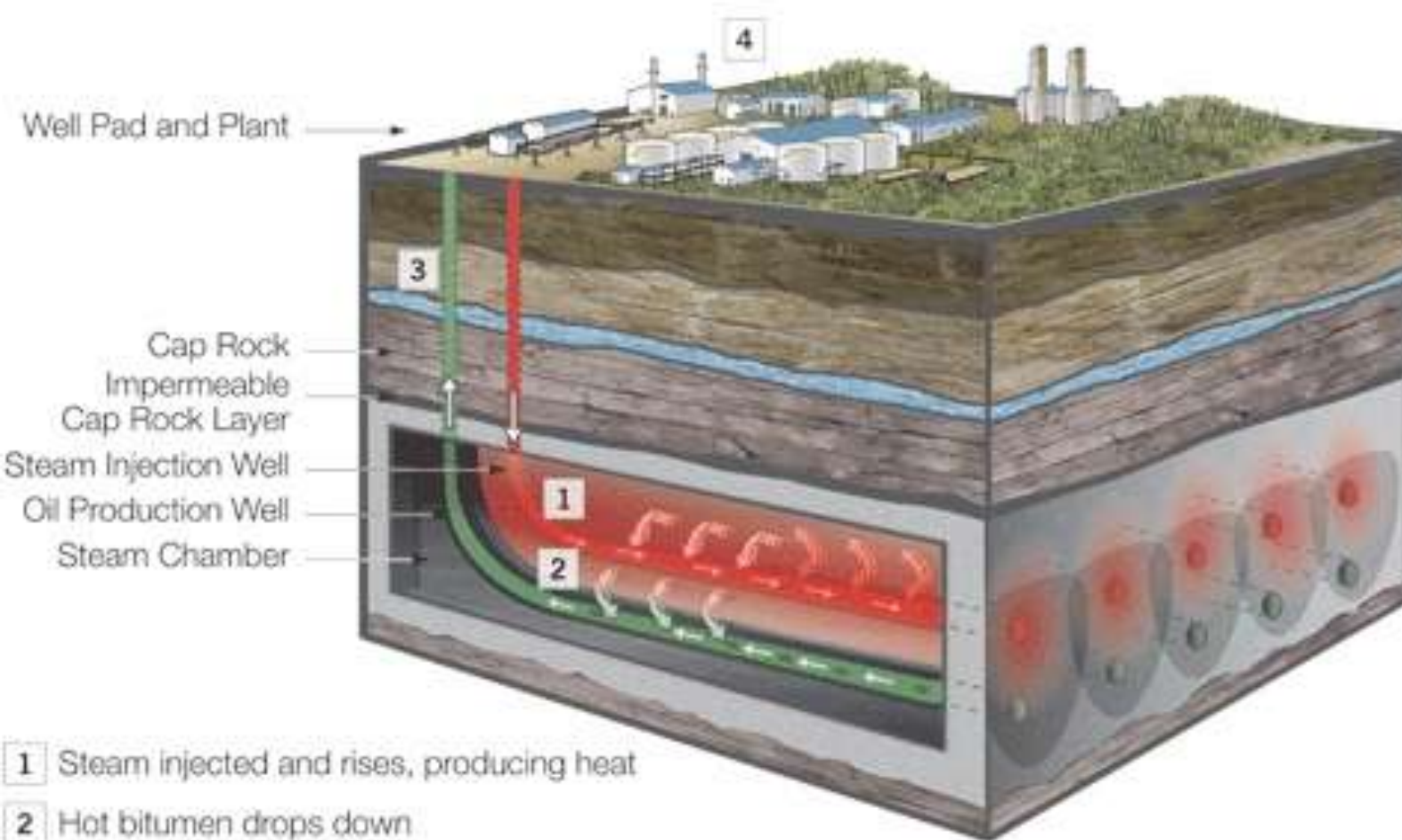
## 5 UPGRADE

To create synthetic crude oil, the bitumen is heated to 900 degrees in giant furnaces, a process that removes excess carbon. Hydrogen is added to prepare it for industrial use.



# Steam Assisted Gravity Drainage (SAGD)

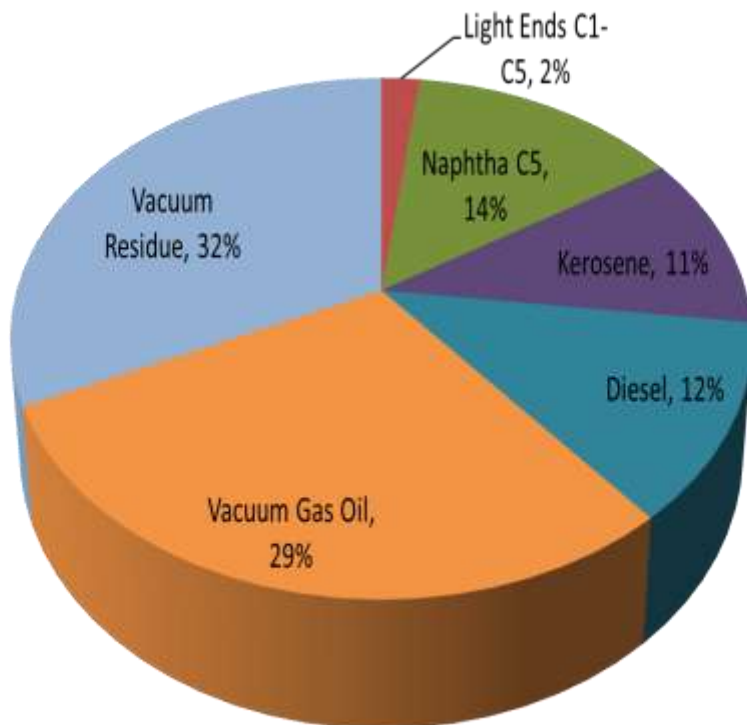
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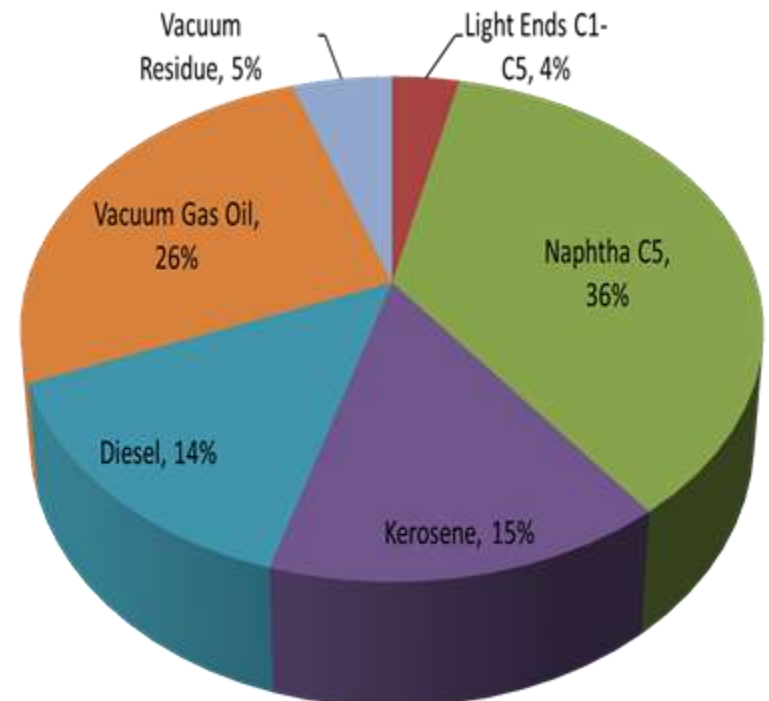
- 1 Steam injected and rises, producing heat
- 2 Hot bitumen drops down
- 3 Hot bitumen emulsion produced from lower well
- 4 Bitumen and hot water separated at surface; dilbit sold, water cleaned and recycled

# Typical Yields – CN Heavy vs. Bakken

### Canadian Heavy Yields



### Bakken Blend Yields



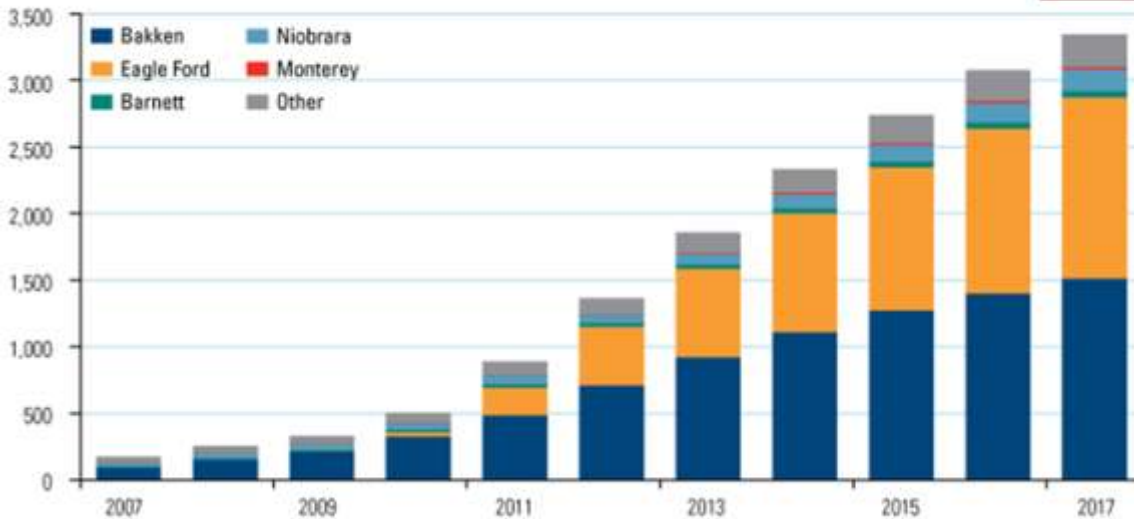
# Changes in North American Crude Logistics

# US Shale & Canadian Growth Forecasts

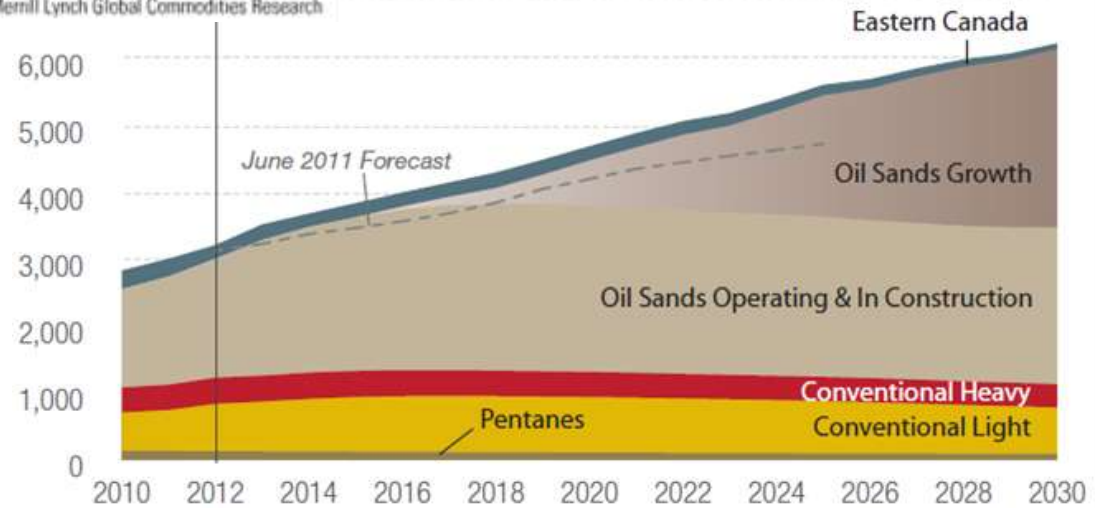
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**U.S. Shale Oil Production Growing**

Thousand barrels per day



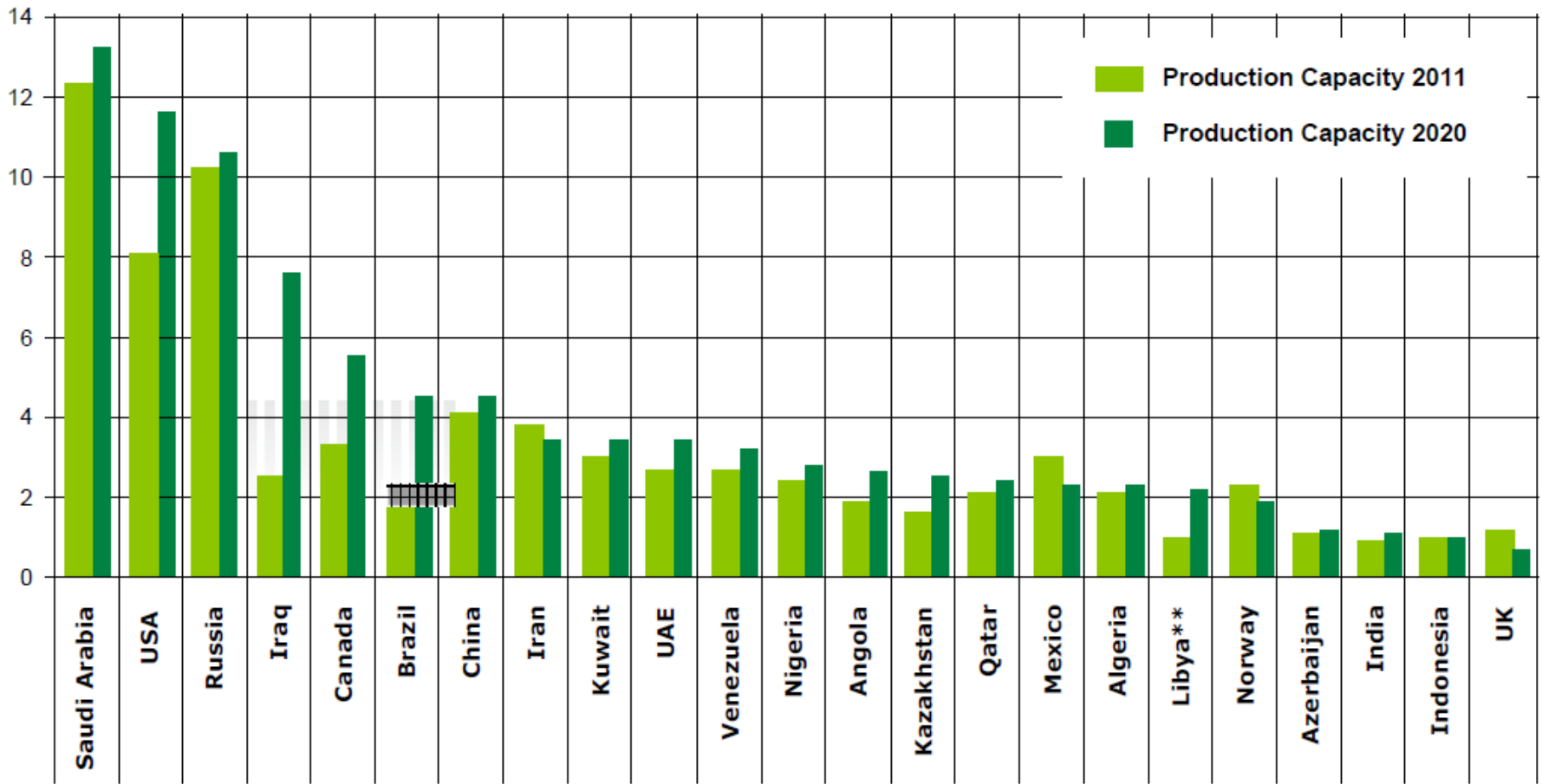
Source: Woodmac, IEA, EIA, Reuters, company reports, BofA Merrill Lynch Global Commodities Research





# Largest production growth occurs in the Western Hemisphere

**Figure 2:** Country-by-country evolution of oil production capacity to 2020  
(First 23 countries)





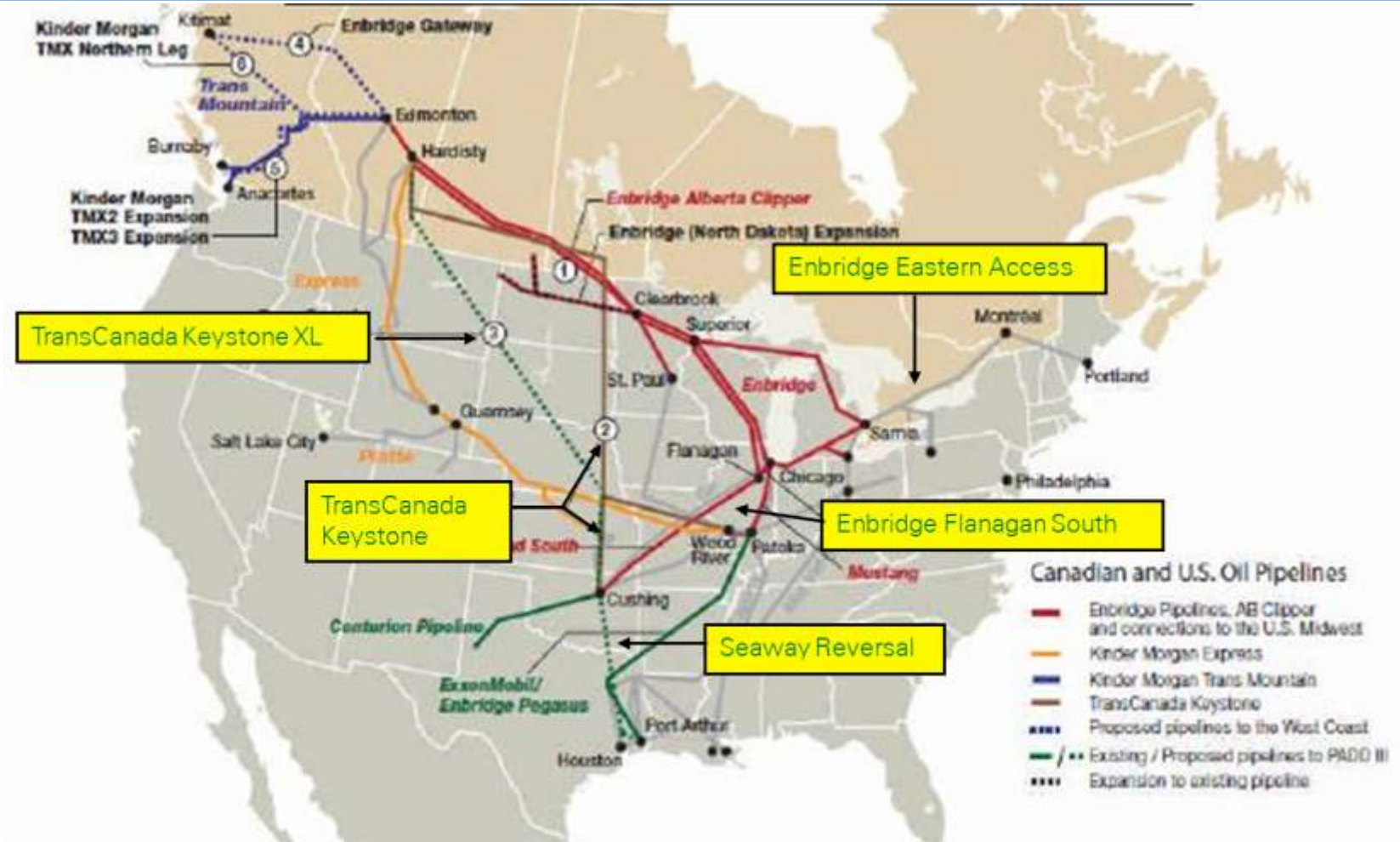
# Resulting in a Fundamental Shift in Global Crude Flows

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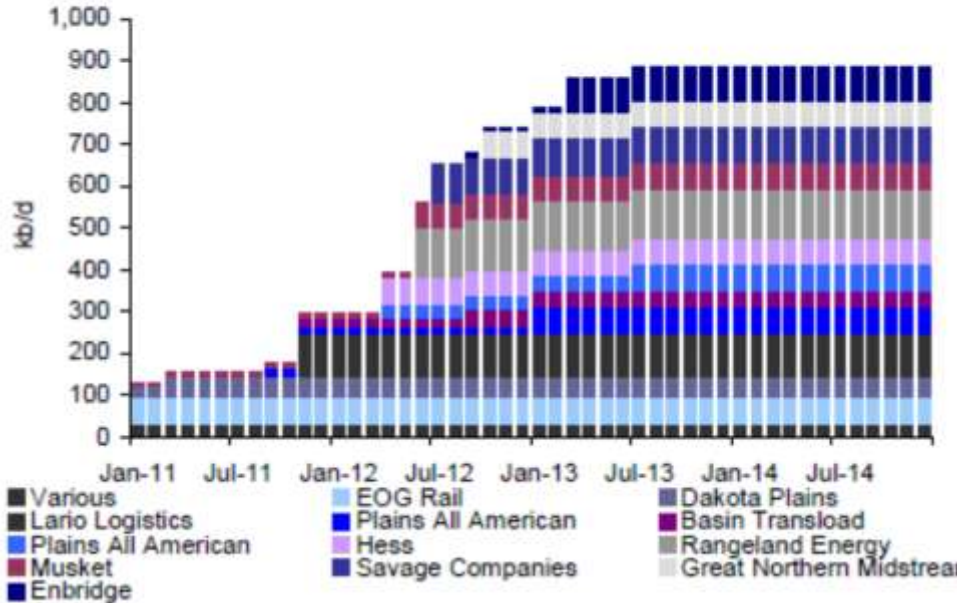
# Crude Pipeline Expansions

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# Rail infrastructure growth has been explosive

- Rail has filled the gap in pipeline infrastructure
- Rail has lower upfront costs, faster execution
- Comes with higher long-term variable cost



Source: Continental Resources



Source: Morgan Stanley

# Some Key Thoughts and Questions

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## **Concluding Thoughts:**

- North American production is here to stay
- The global balance of crude has changed
- “Energy Self Reliance” – moving from fantasy to reality, but inevitably linked to the global market

## **Questions for the Future:**

- Will the price of crude rise, hold or fall?
- Will logistics keep pace with production?
- What will be the global geopolitical responses?

Questions?