UNCONVENTIONAL CRUDE OIL IN NORTH AMERICA

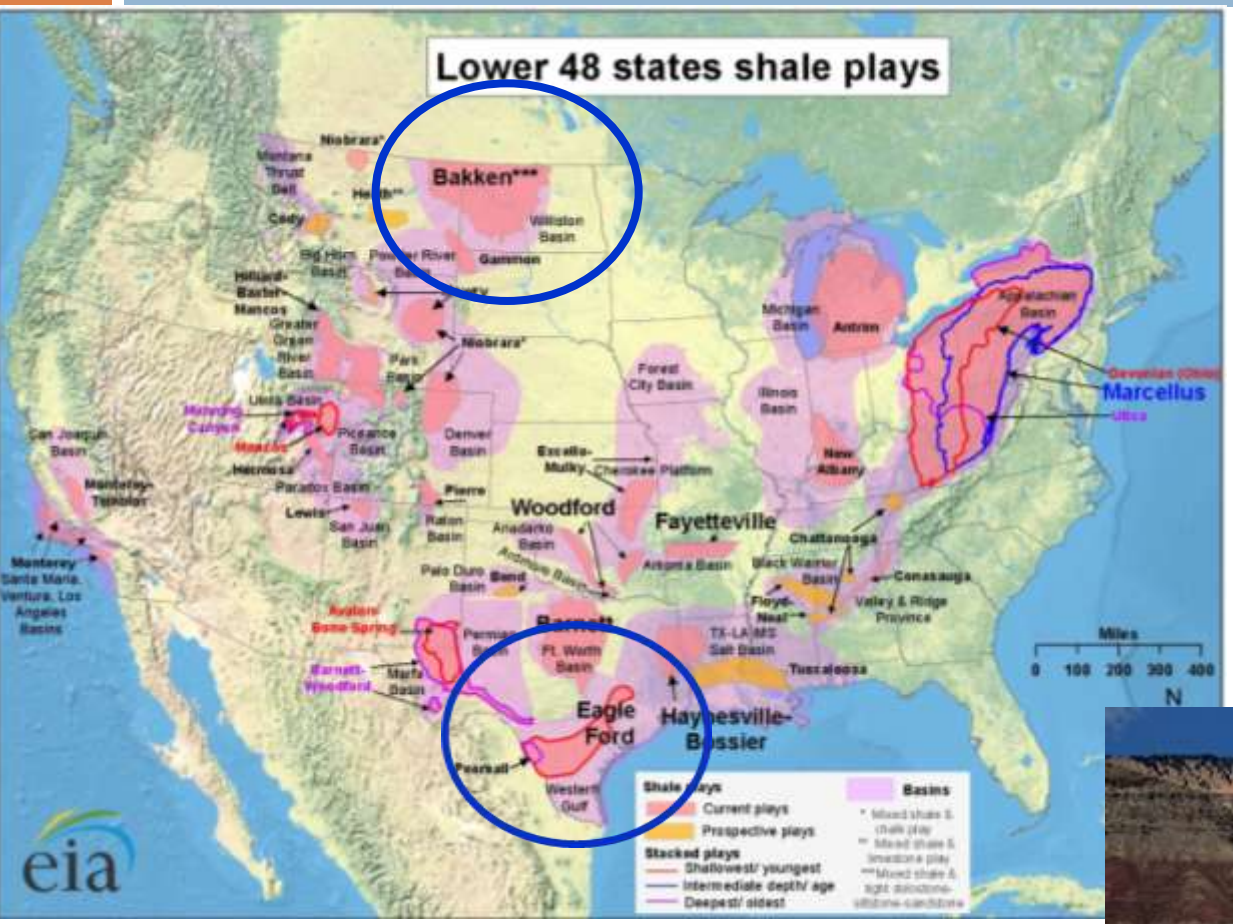
March 2013

Overview

- 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

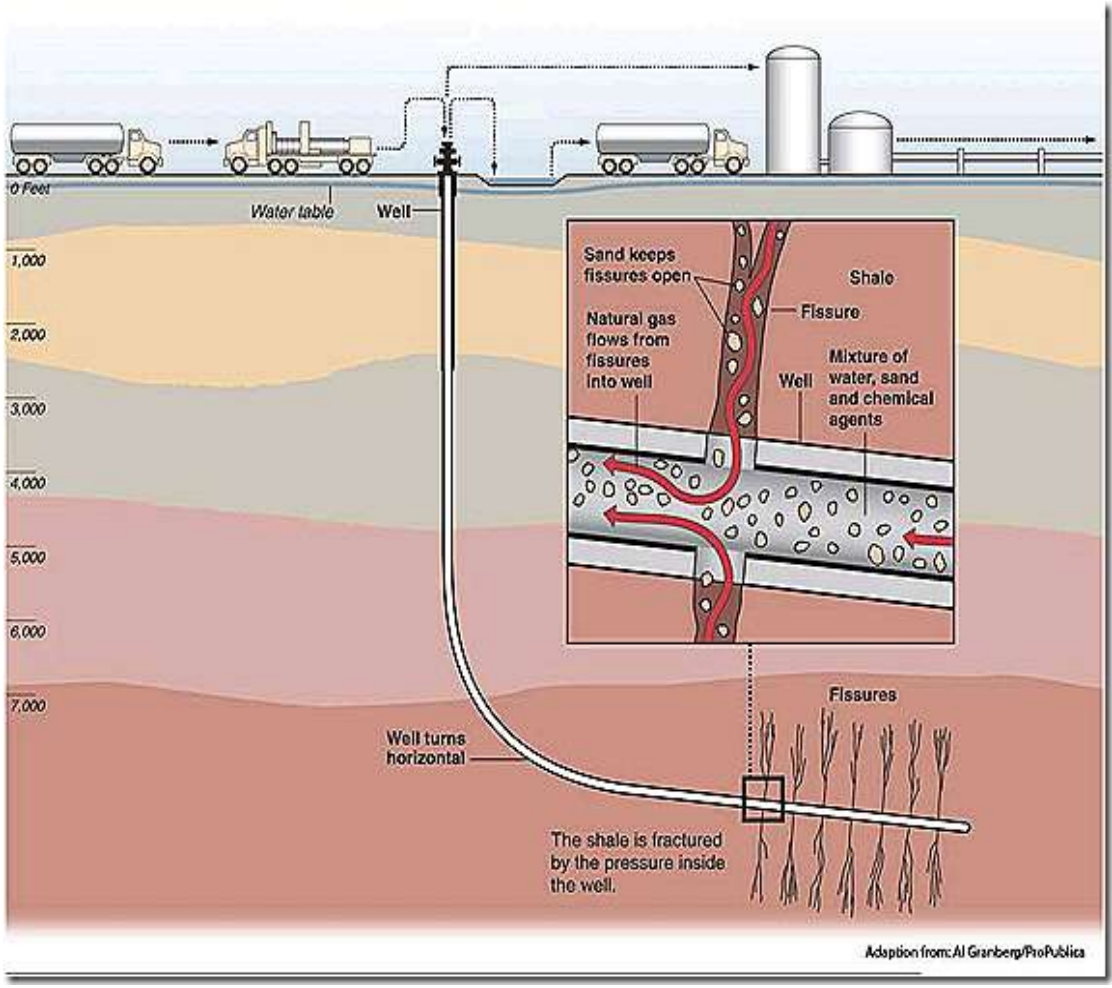


- Shale oil, also known as tight oil, is light crude oil contained in relatively low porosity and permeability petroleum-bearing formations called shales
- Percentage of pore volume (void space) in tight oil is commonly less than 10%
- Oil contained in these formations will not flow to the wellbore at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

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

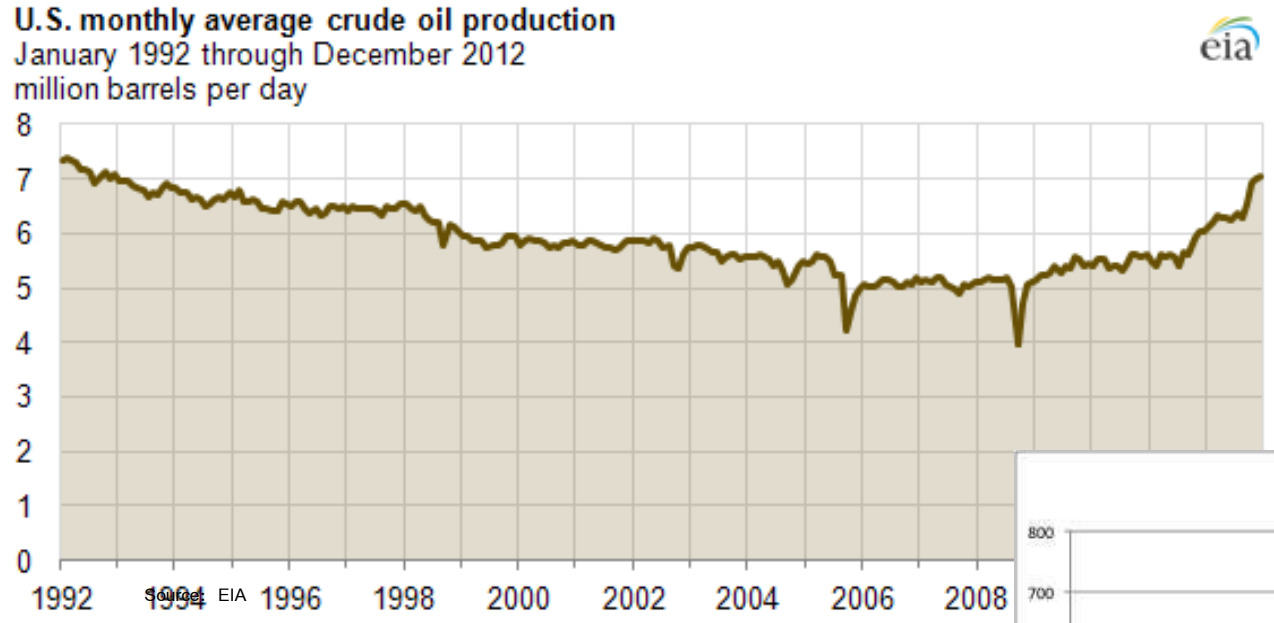
Shale Oil & Gas Extraction Technology

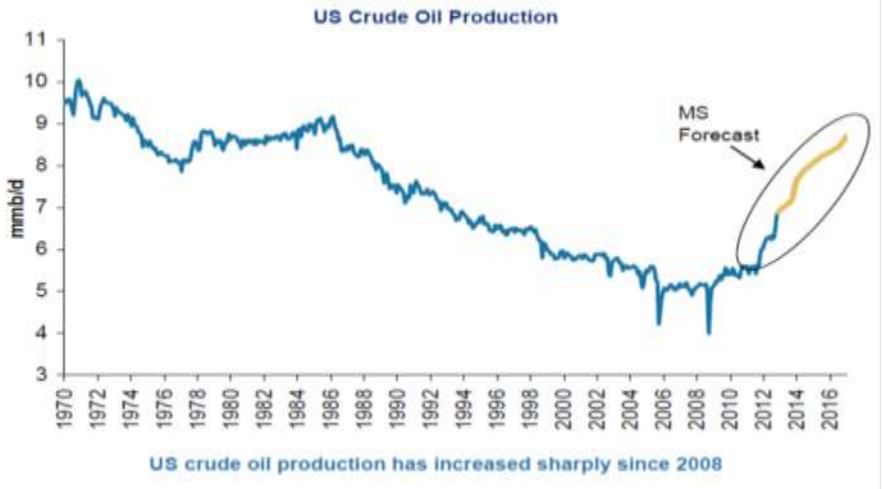
- **Horizontal drilling**
  - First drilled vertically to a predetermined depth, typically 3000-10,000 ft
  - Well is then "kicked off"(turned) at an increasing angle until it runs horizontally
  - Then drilled horizontally an additional 10,000-15,000 ft
- **Hydraulic Fracturing (Fracking)**
  - Water 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

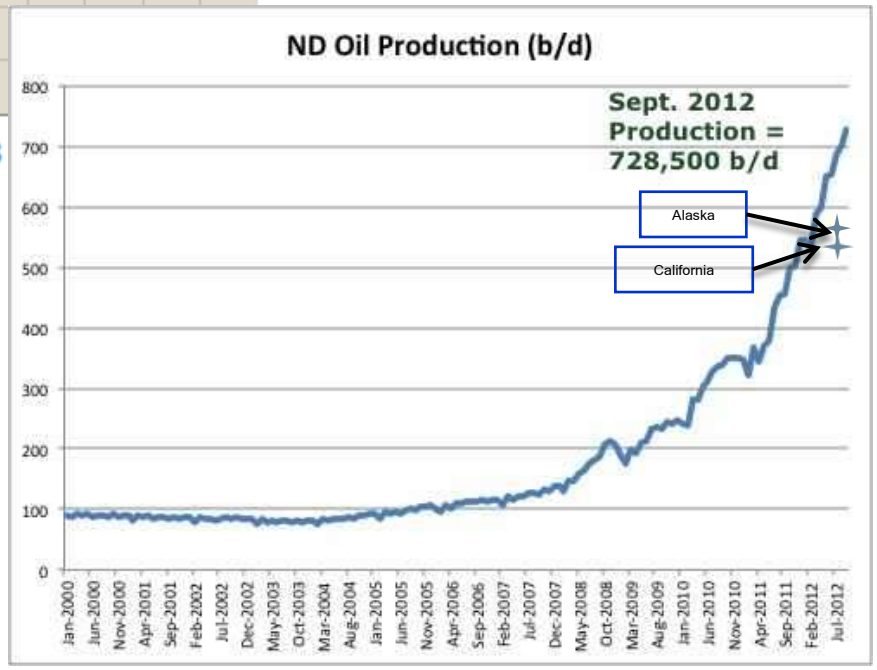


Source: Maugeri, Leonardo: "Oil: The Next Revolution"

US Production Renaissance

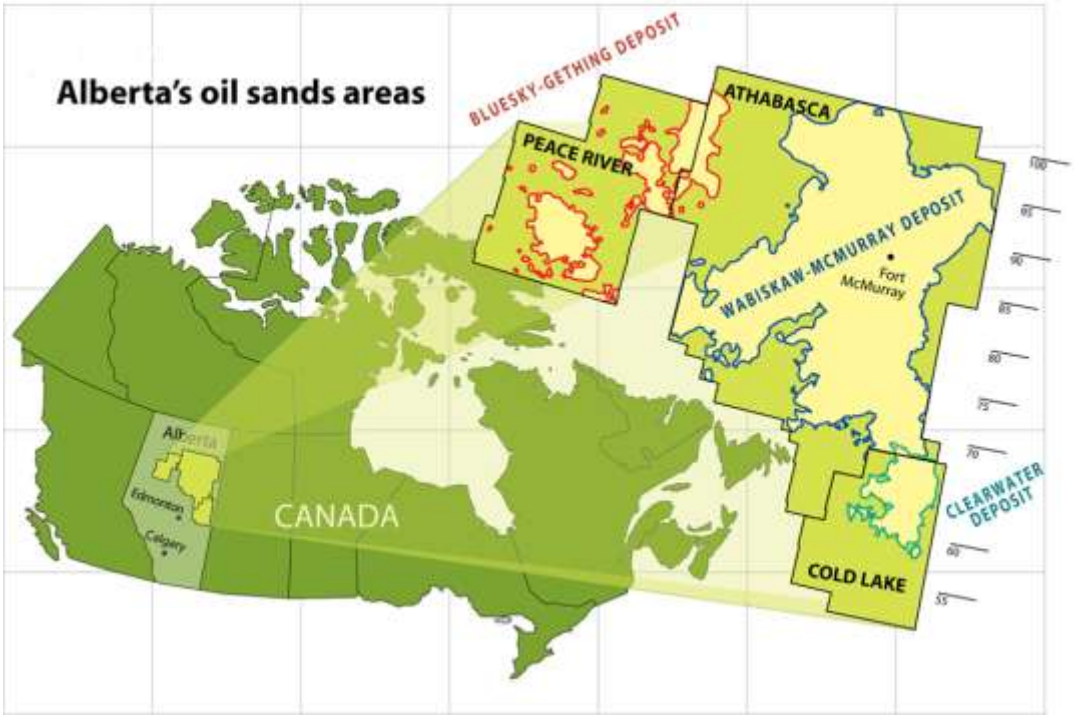






Canadian Oil Sands

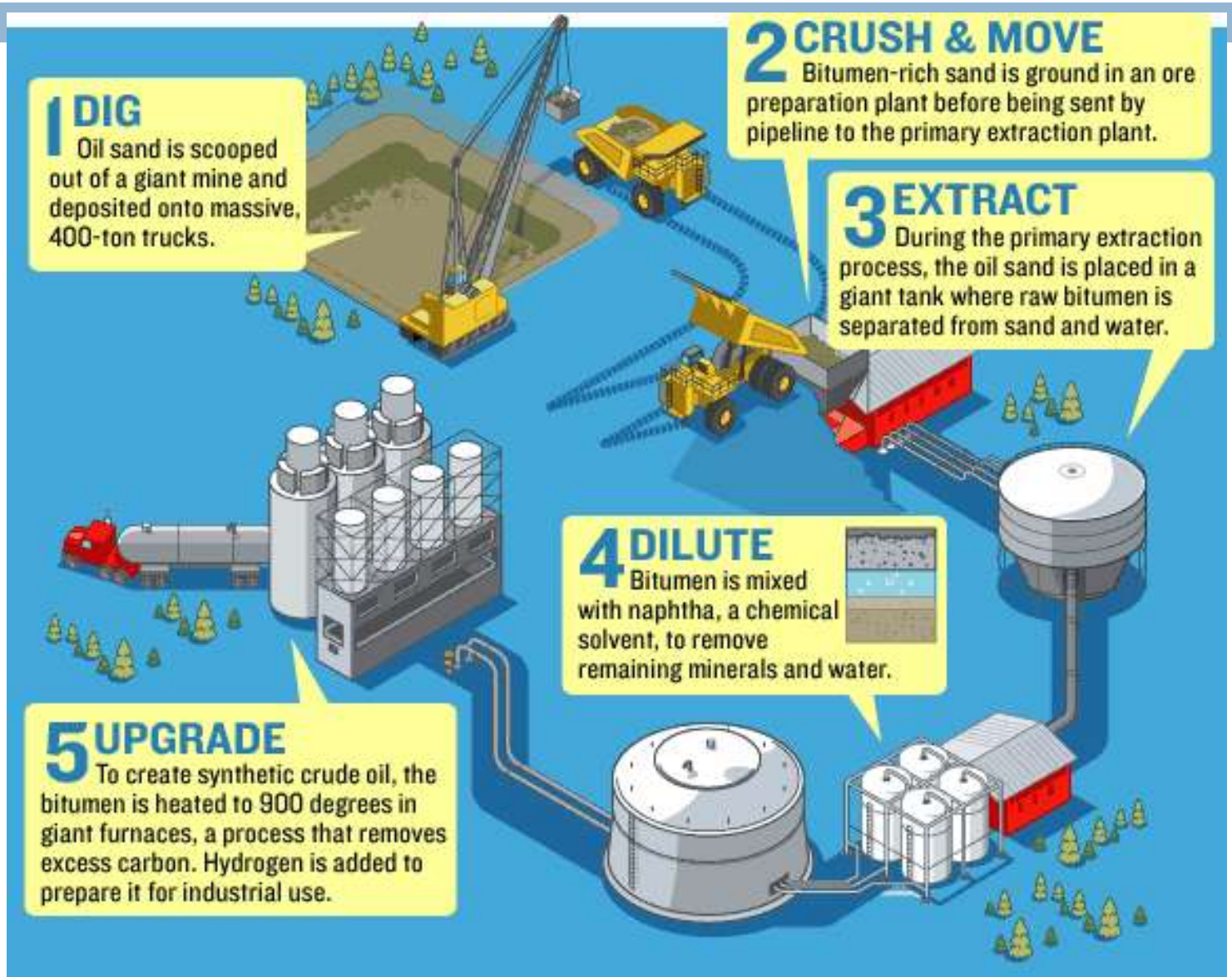
What are oil sands?



- 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

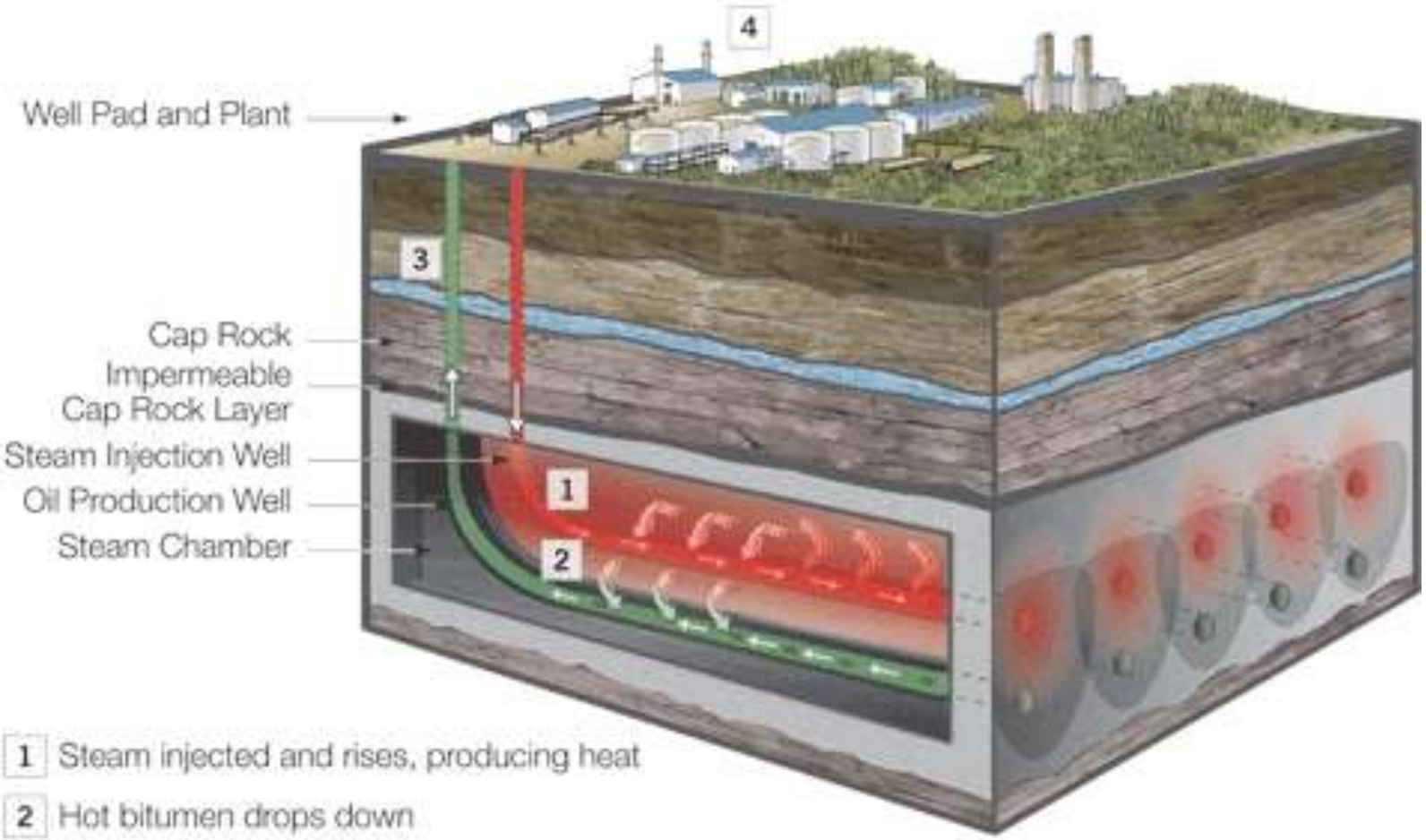
- In Canada, reserves are estimated at 175 billion barrels
- 80% expected to be "in-situ" recovery, 20% mined

Oil Sands Mining



Source: Suncor

Steam Assisted Gravity Drainage (SAGD)



1 Steam injected and rises, producing heat

2 Hot bitumen drops down

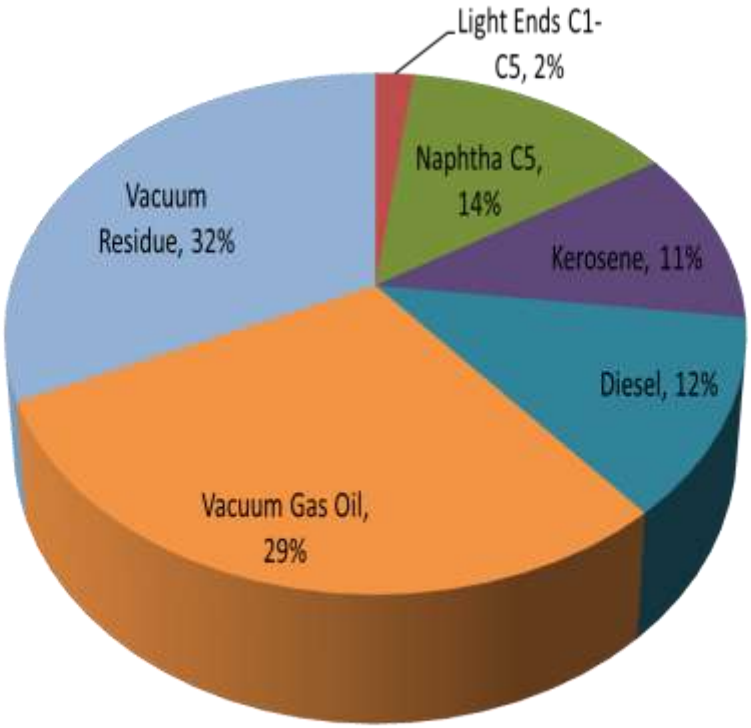
3 Hot bitumen emulsion produced from lower well

4 Bitumen and hot water separated at surface; dilbit sold, water cleaned and recycled

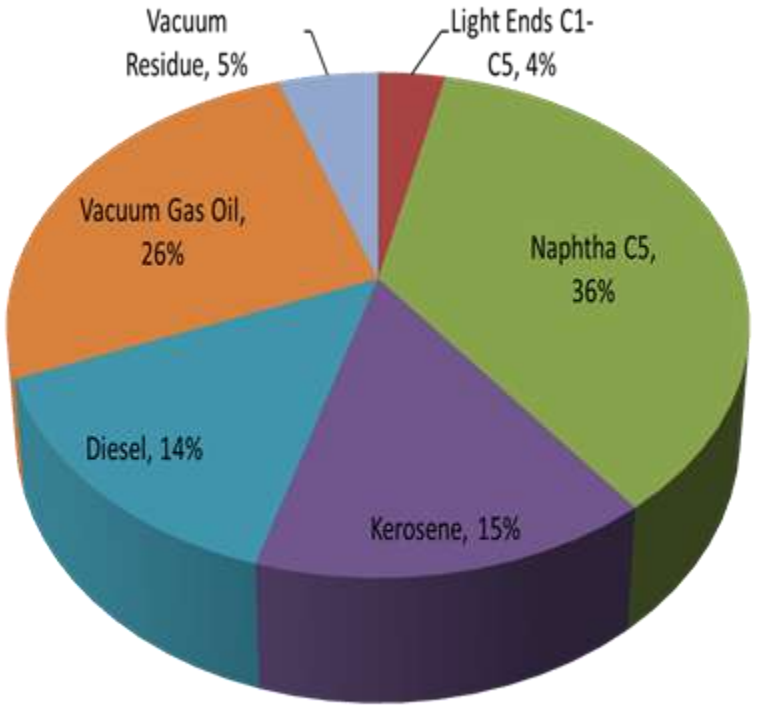
Source: RRResearch

Typical Yields – CN Heavy vs. Bakken

Canadian Heavy Yields

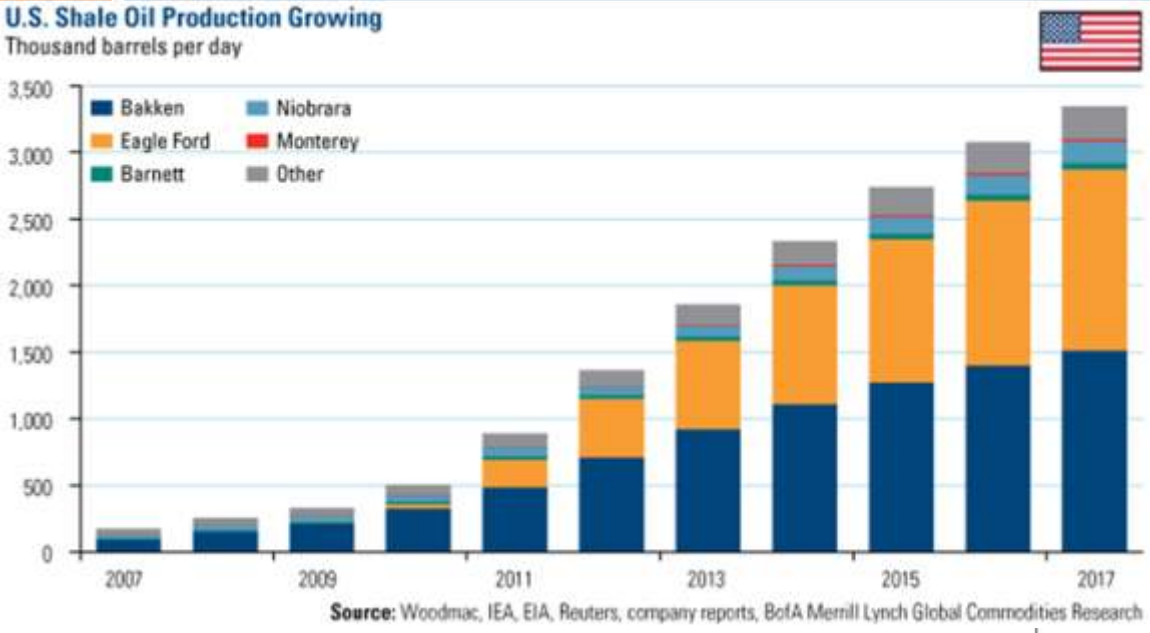


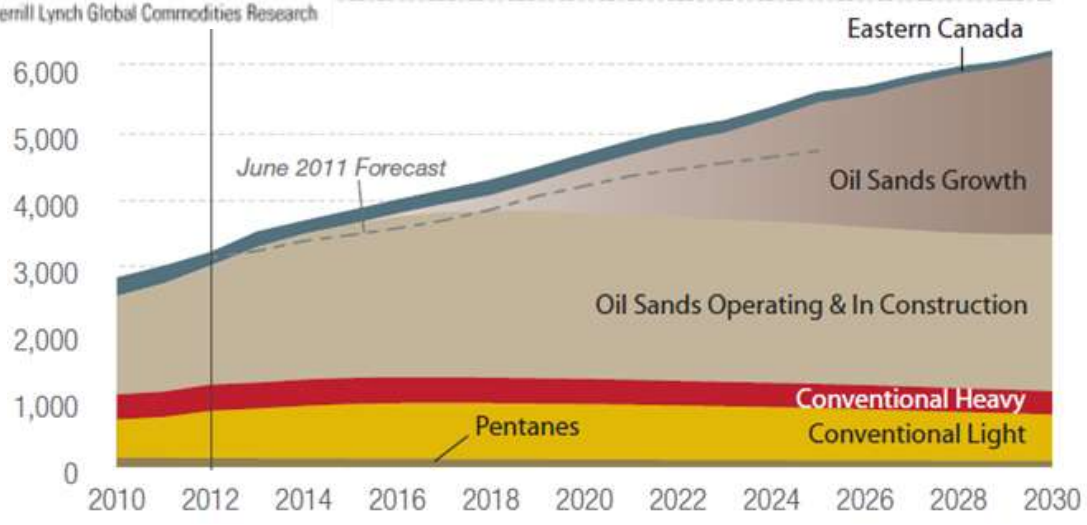
Bakken Blend Yields



Changes in North American Crude Logistics

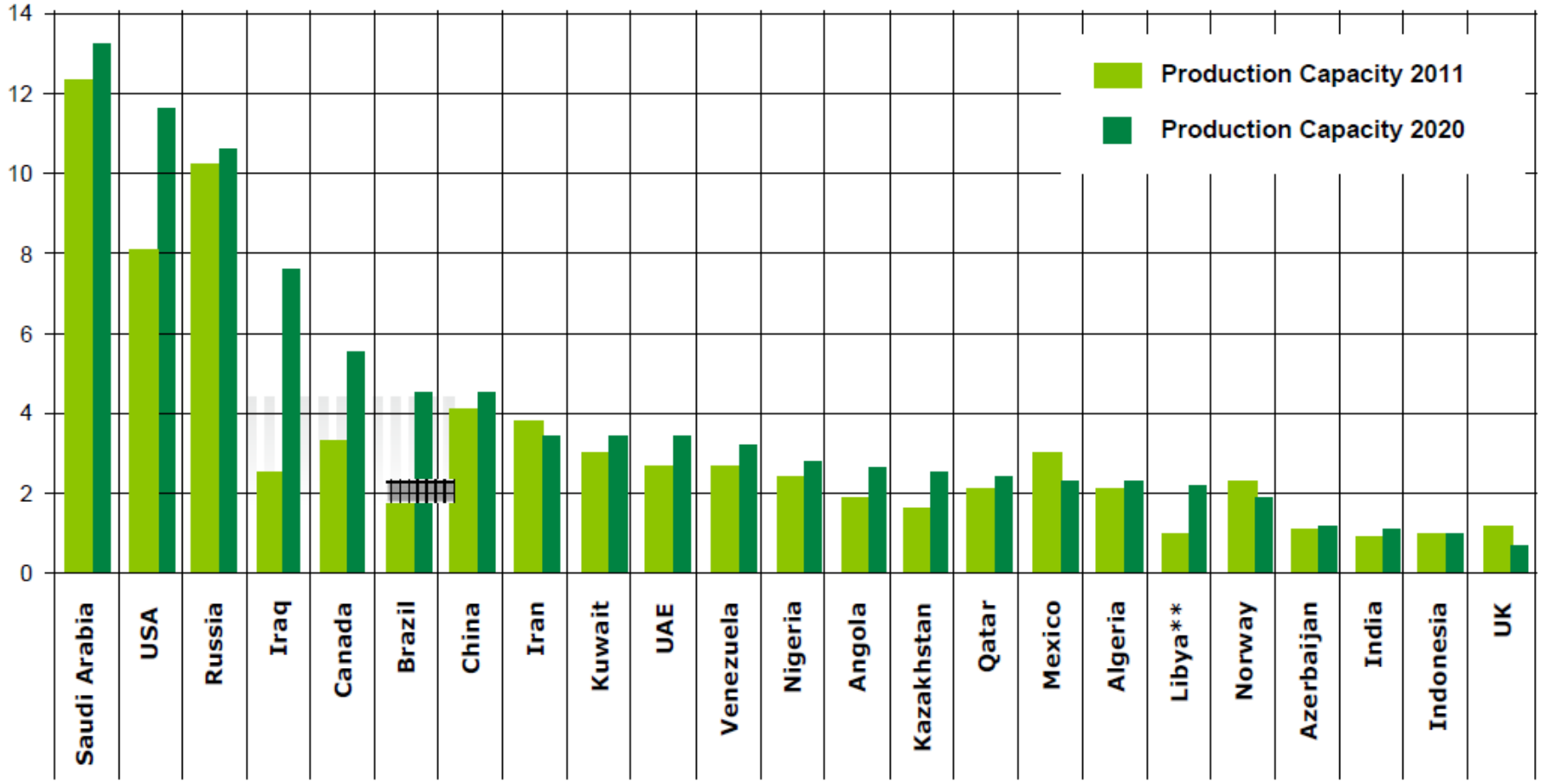
US Shale & Canadian Growth Forecasts





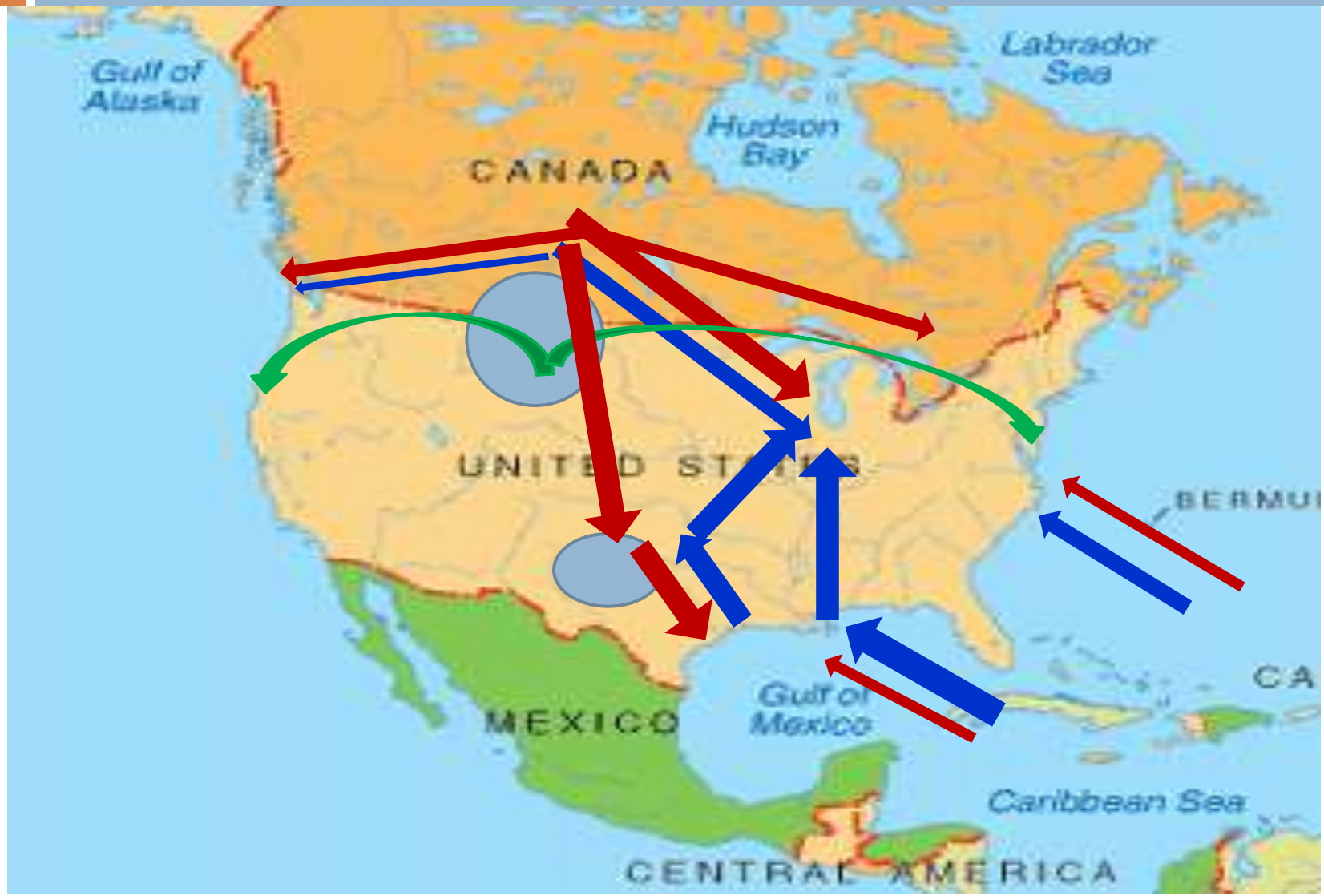
Largest production growth occurs in the Western Hemisphere

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

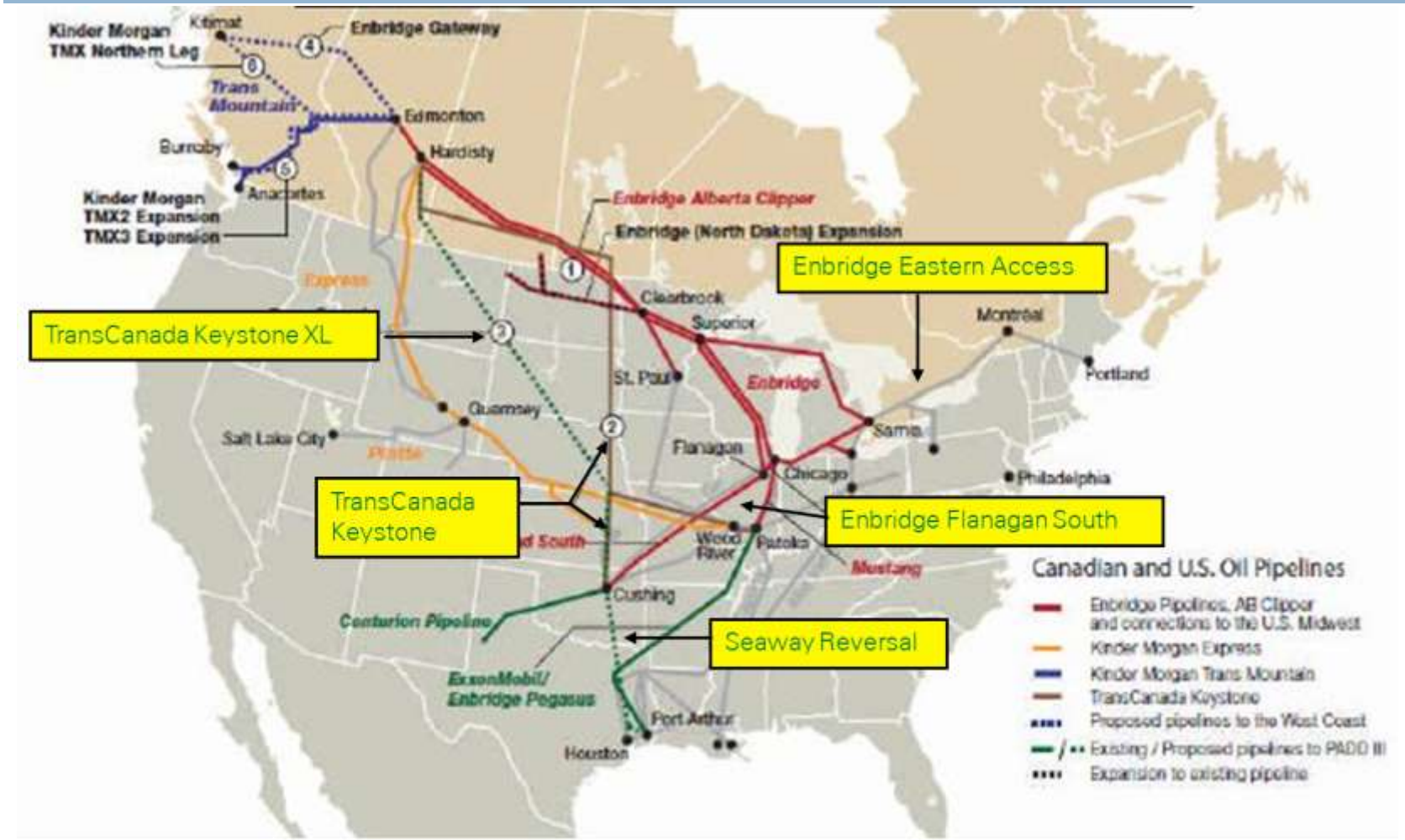


Source: Maugeri, Leonardo: "Oil: The Next Revolution"

Resulting in a Fundamental Shift in Global Crude Flows



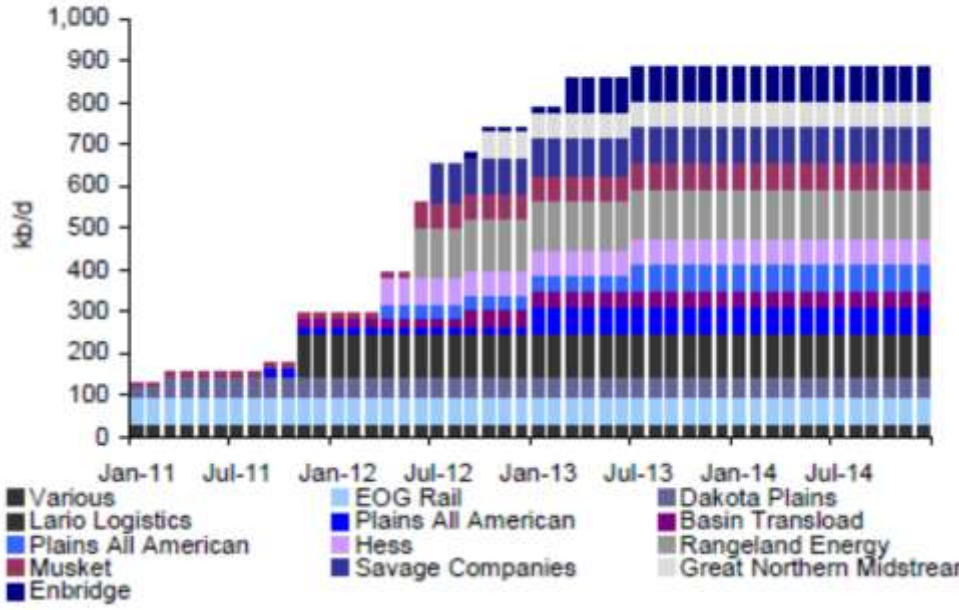
Crude Pipeline Expansions



Source: CAPP

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: Morgan Stanley

Source: Continental Resources

Some Key Thoughts and Questions

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?