Challenges and Opportunities of the North American Petroleum Renaissance

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EPRINC Overview

- Established in 1944
- Publishes original research on oil and gas developments
- Routinely testifies before Congress, consults with U.S. and other Gov't officials
- Brief policymakers, Hill staff on relevant energy topics
- Presents finding through industry and public forums, universities and think tanks
- Engagement with Washington Diplomatic Community – EPRINC Embassy Series

EPRINC's PRIMARY MISSION IS TO EVALUATE THE INTERACTION OF PETROLEUM ECONOMICS AND PUBLIC POLICY

EPRINC Embassy Series

Photo by Yulan Guo

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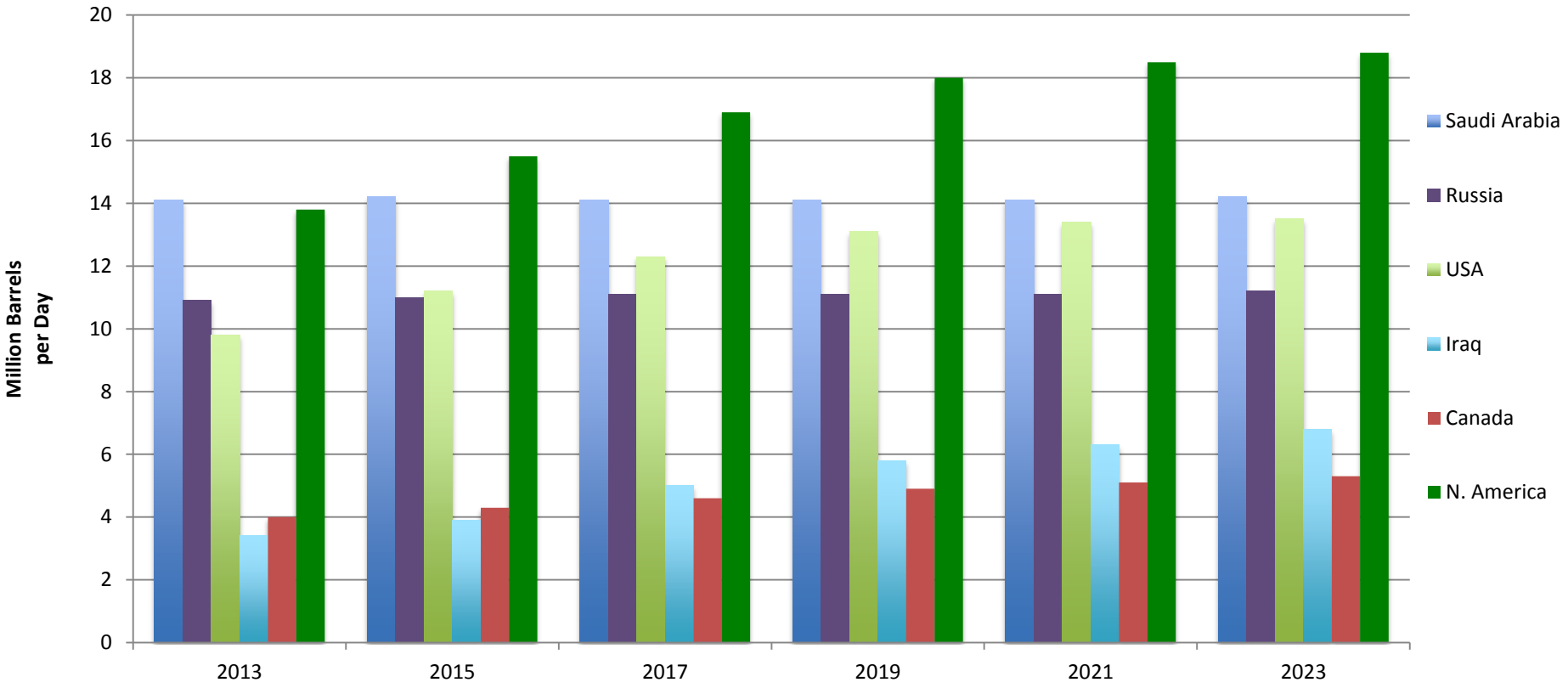
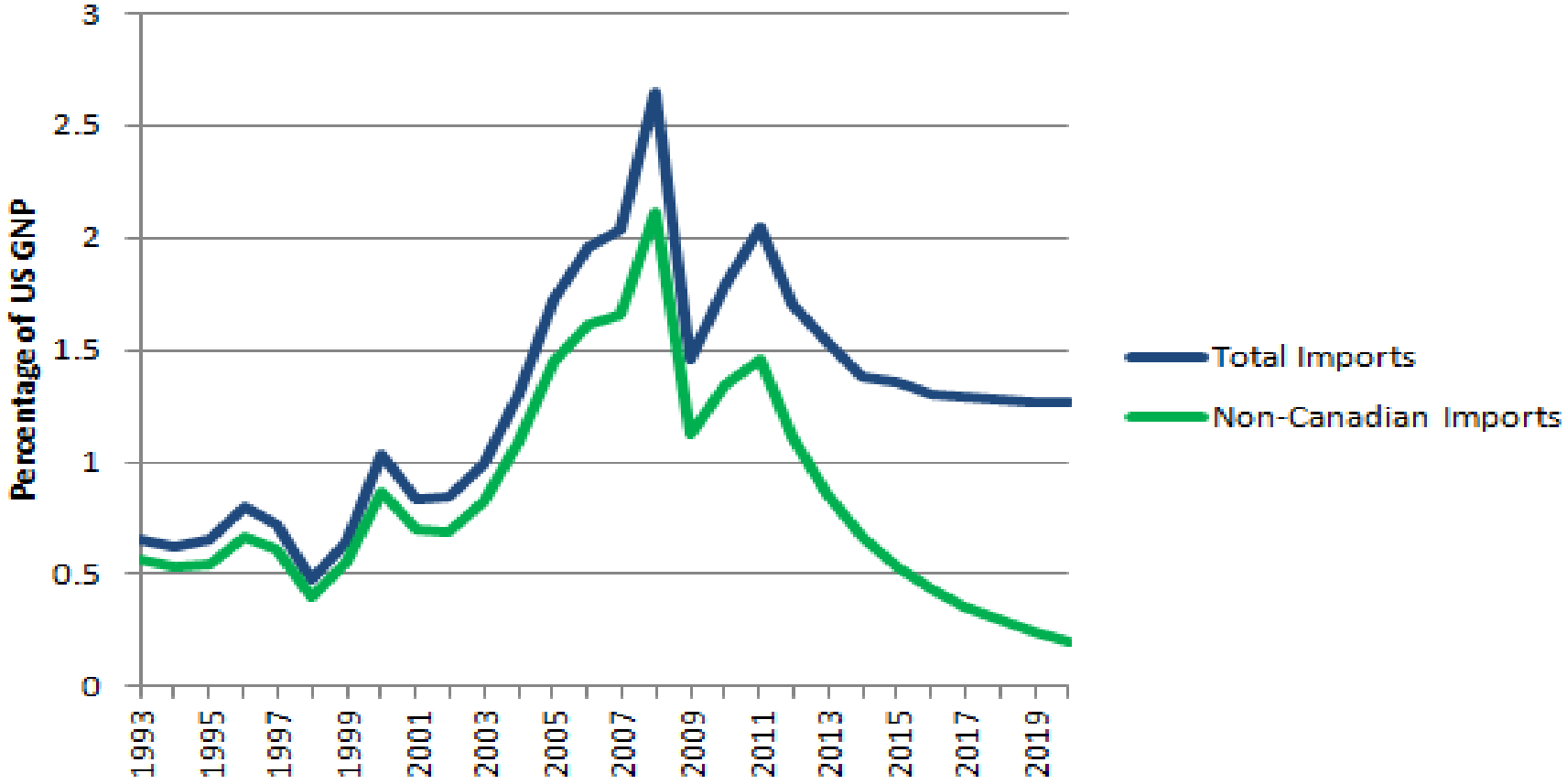
Importance of the North American Lens



Source: Wood Mackenzie (includes NGLs)

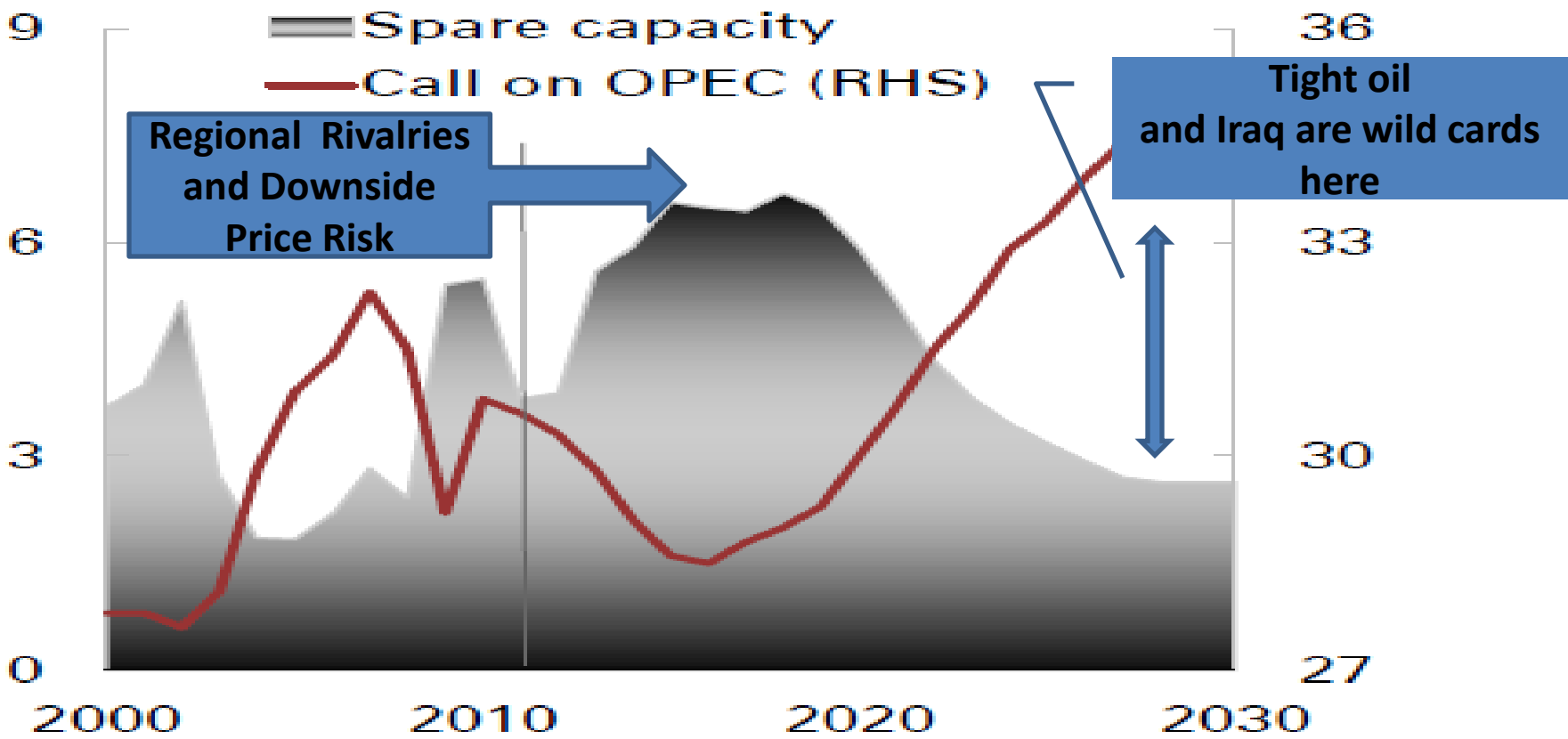
U.S. Imports of Crude Oil and Petroleum Products as a Percent of GNP



Source: EIA, EPRINC Calculations

Major Global Challenge: Managing OPEC Spare Capacity

millions of barrels/day



Outline

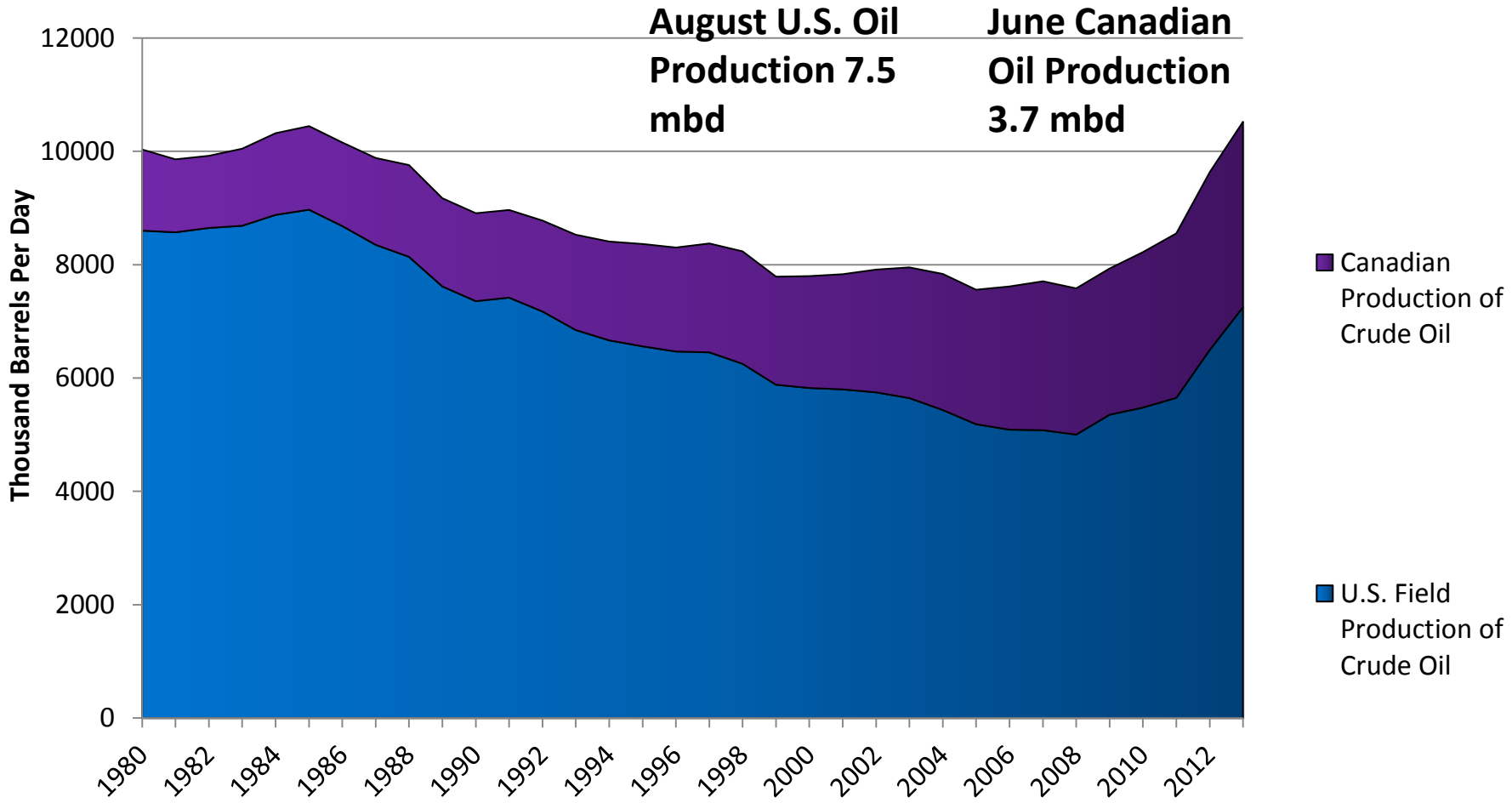
1. Breakdown of U.S. and Canadian Oil Production

2. Infrastructure Challenges in Moving Rising Volumes of North American Crude Oil

3. Regulatory Concerns and Conclusions

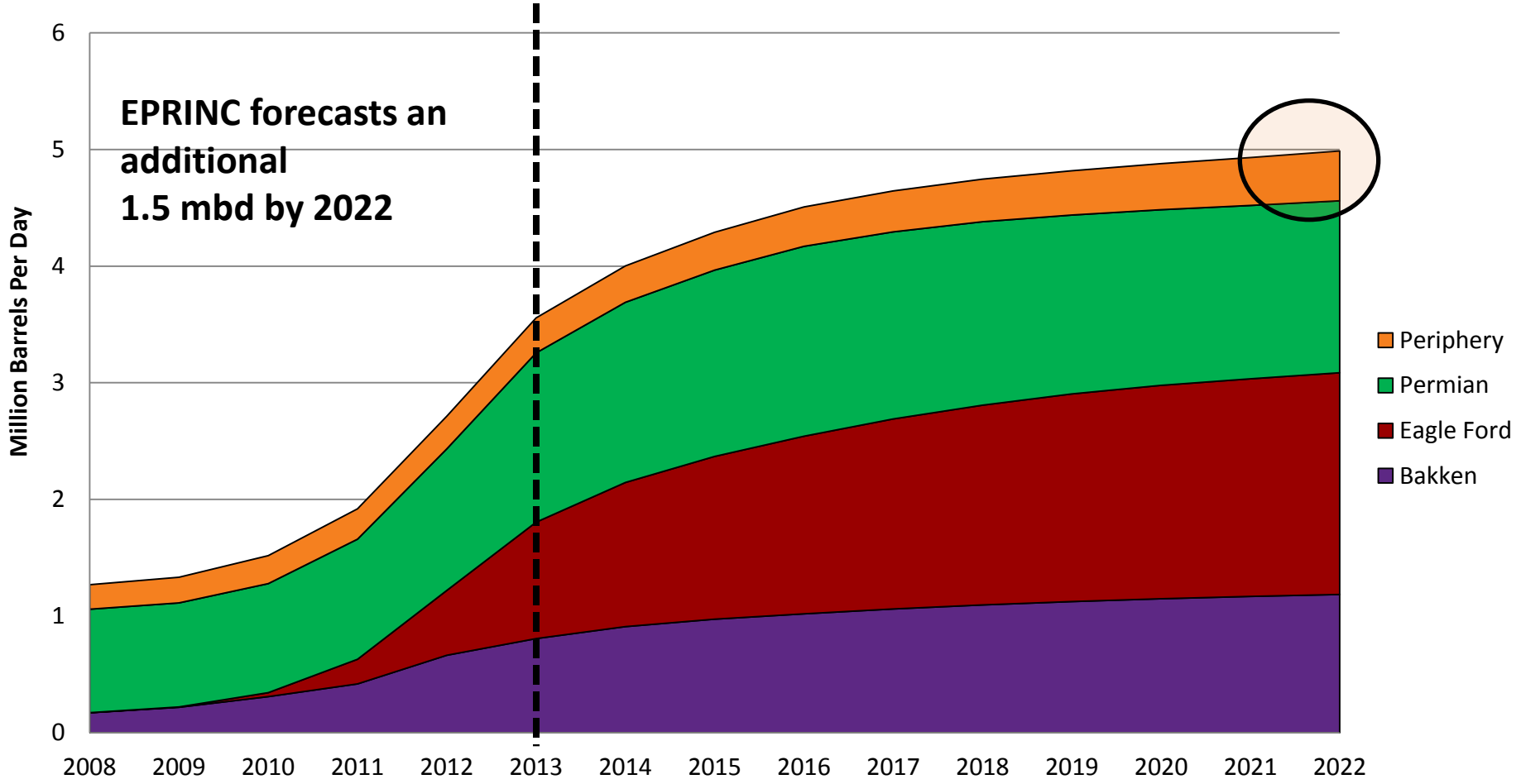
Source: EIA

North American Oil Production



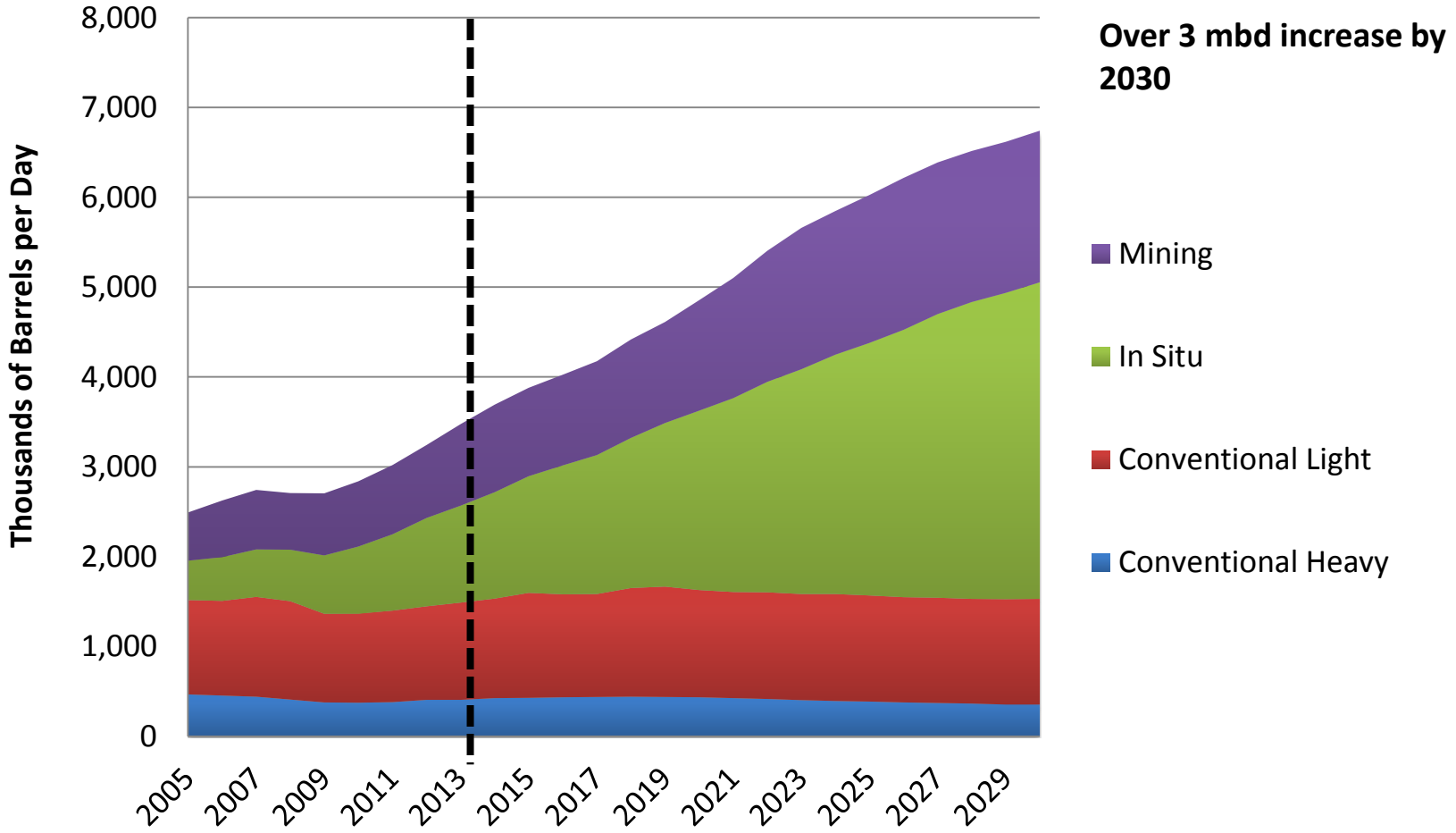
Source: EIA

EPRINC's Forecast for Major U.S. Shale Plays



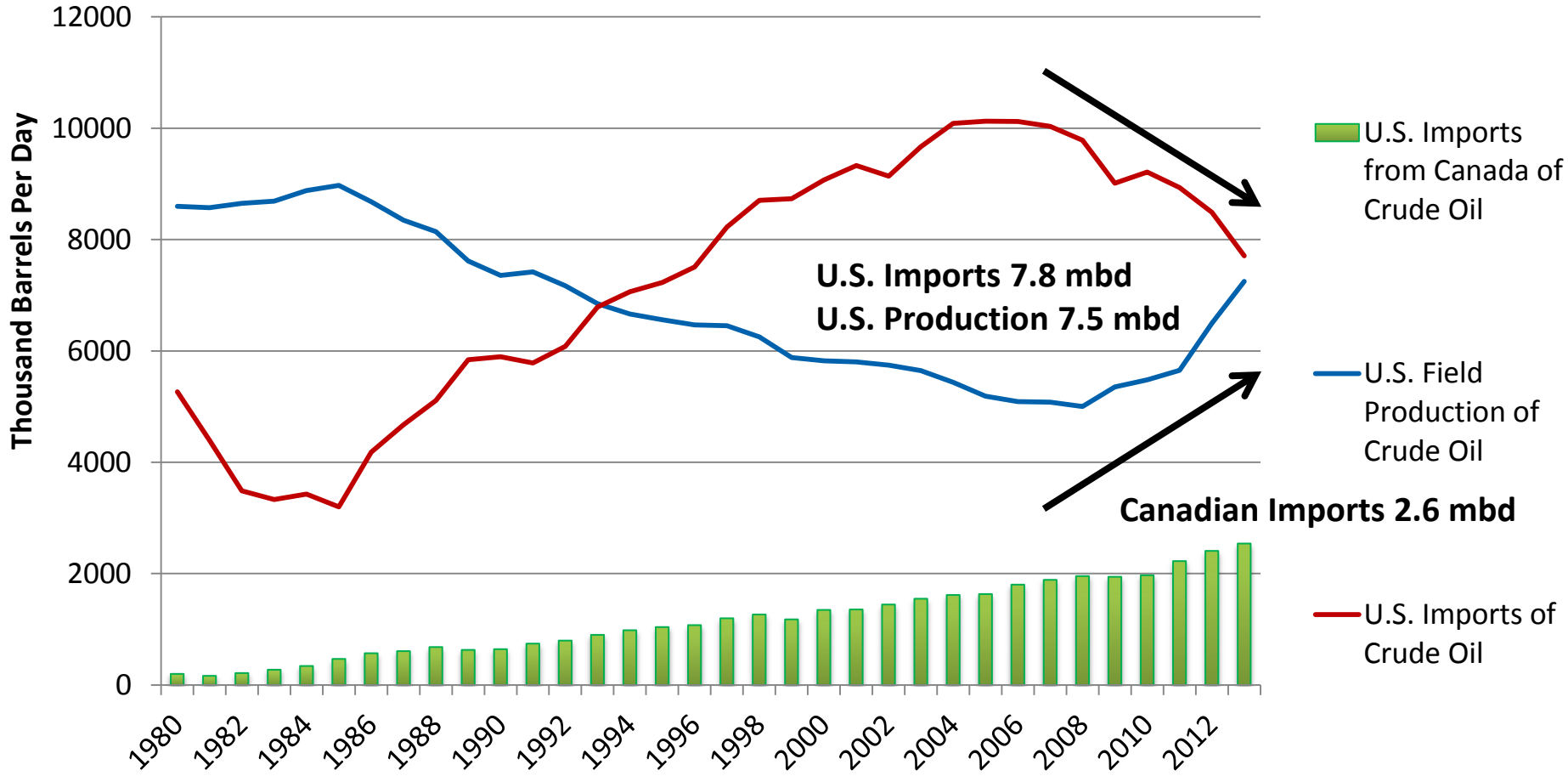
Source: HPDI data with EPRINC forecast estimates

CAPP 2013 Updated Production Forecast



Source: CAPP

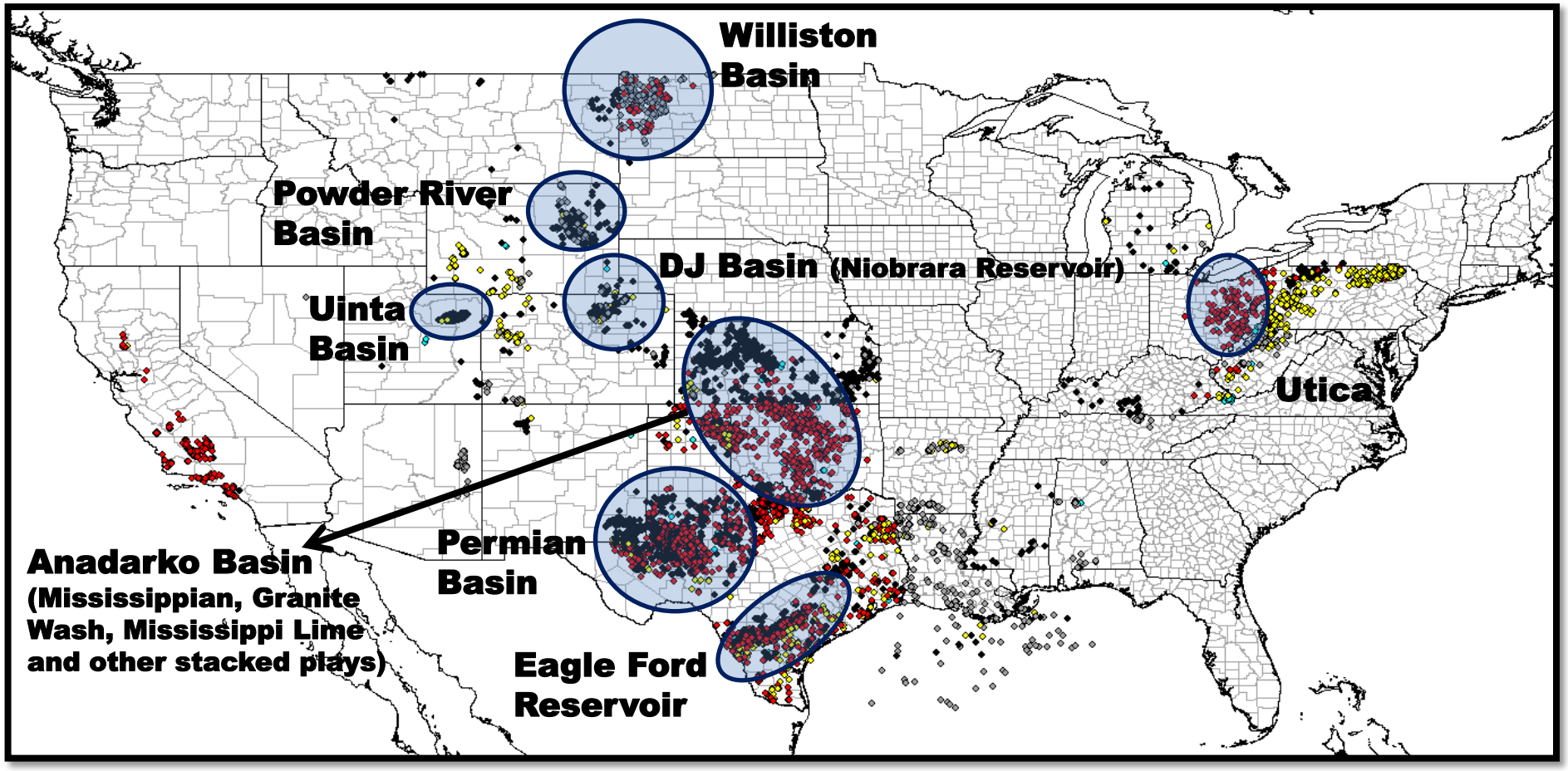
U.S. Total Imports, U.S. Production, U.S. Canadian Imports



Source: EIA

U.S. Activity

Permit Activity



Source: HPDI September 2013, Past 90 Days

Drilling Then and Now

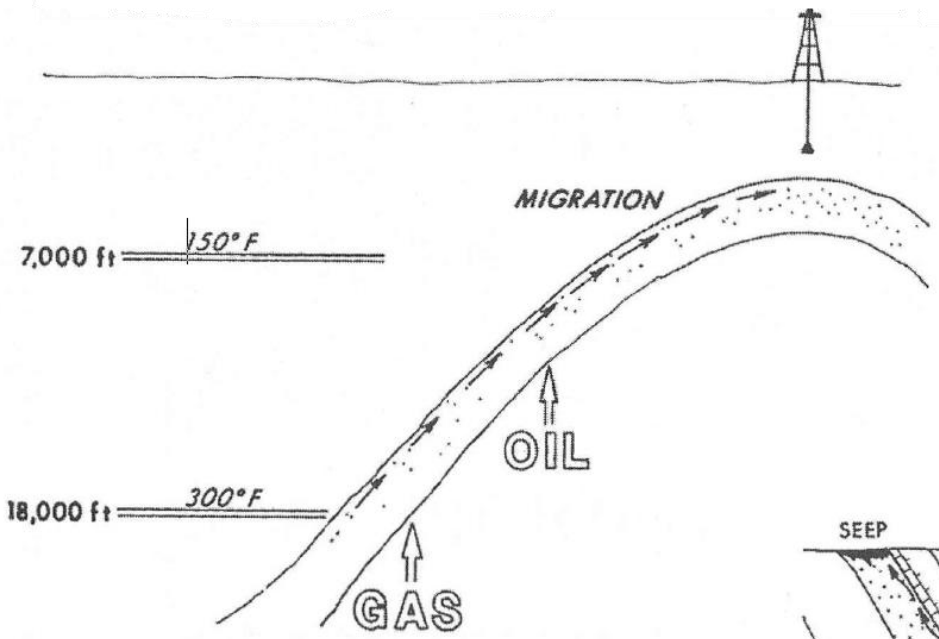


Figure I–1 Generation of oil and gas

Source Rocks

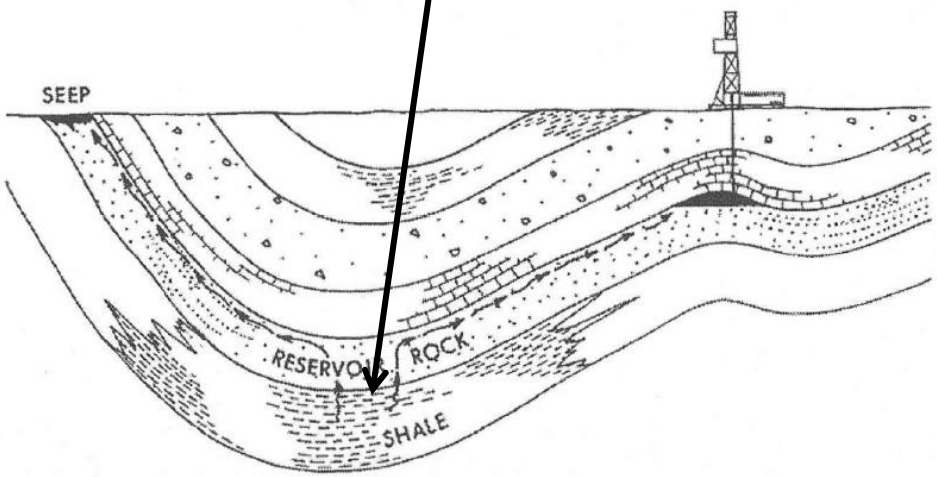
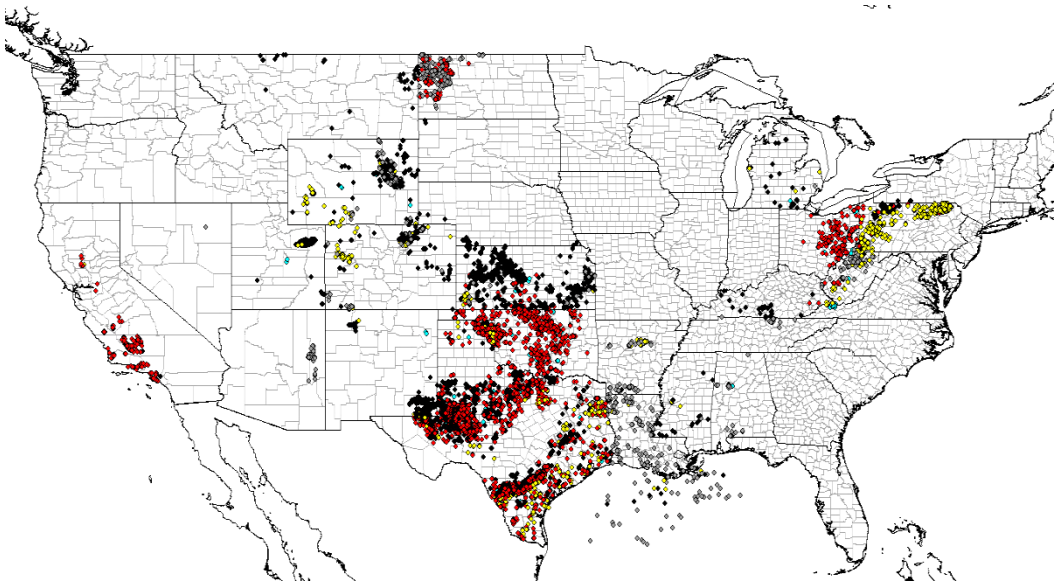


Figure 11–2 Migration of oil and gas in a sedimentary basin

Source: From PIECE Course Workbook, Mark J Kaiser, Houston, July 2008, "Introduction to USA Petroleum Industry"

North American Potential…Shale Oil Plays

The Western Interior Seaway, approximately 75 million years ago. Image from Sampson SD, Loewen MA, Farke AA, Roberts EM, Forster CA, et al. (2010) New Horned Dinosaurs from Utah Provide Evidence for Intracontinental Dinosaur Endemism. PLoS ONE 5(9): e12292. doi:10.1371/journal.pone.0012292.

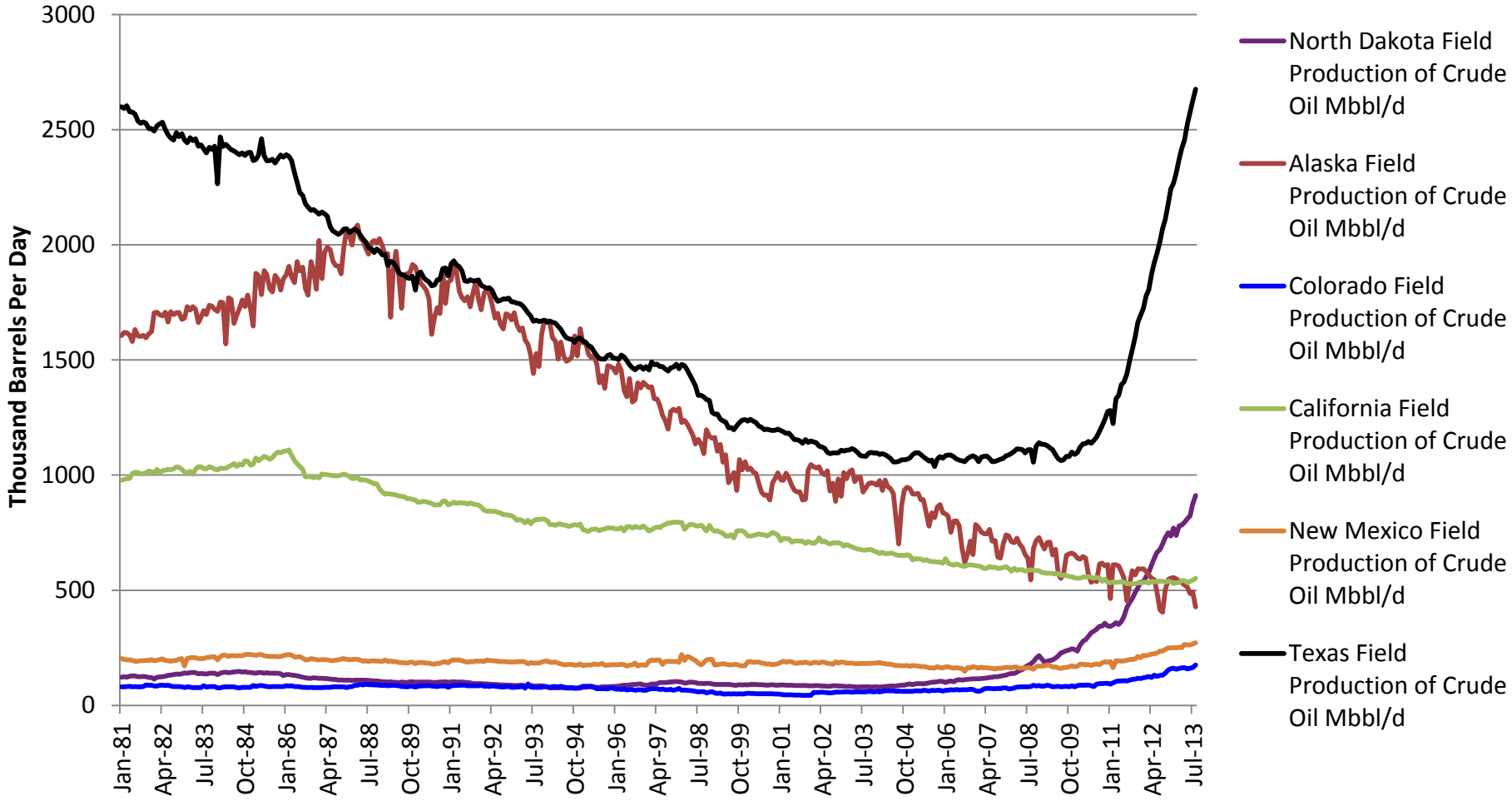


So how much oil is there…?

Bakken Reserve Estimates	Barrels
1995 USGS	151 million
2008 USGS	4.3 billion
2010 NDIC	Add 1.9 billion (Three-Forks Addition)
January 2011 ND State Officials	11 billion (North Dakota alone)
Continental Resources	20 billion
….Pending USGS Update	???? billion

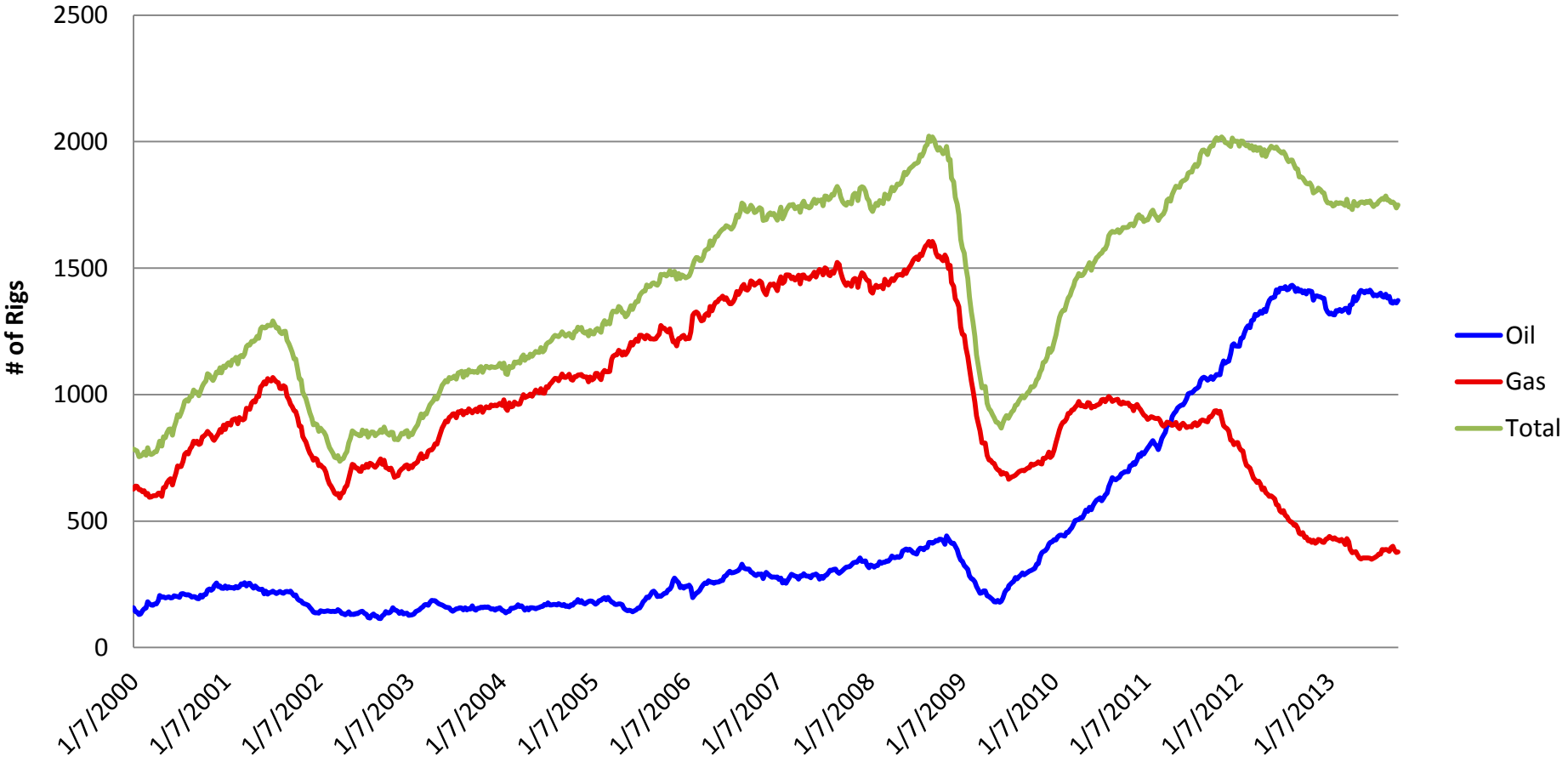
Source: EPRINC

State Production Trends



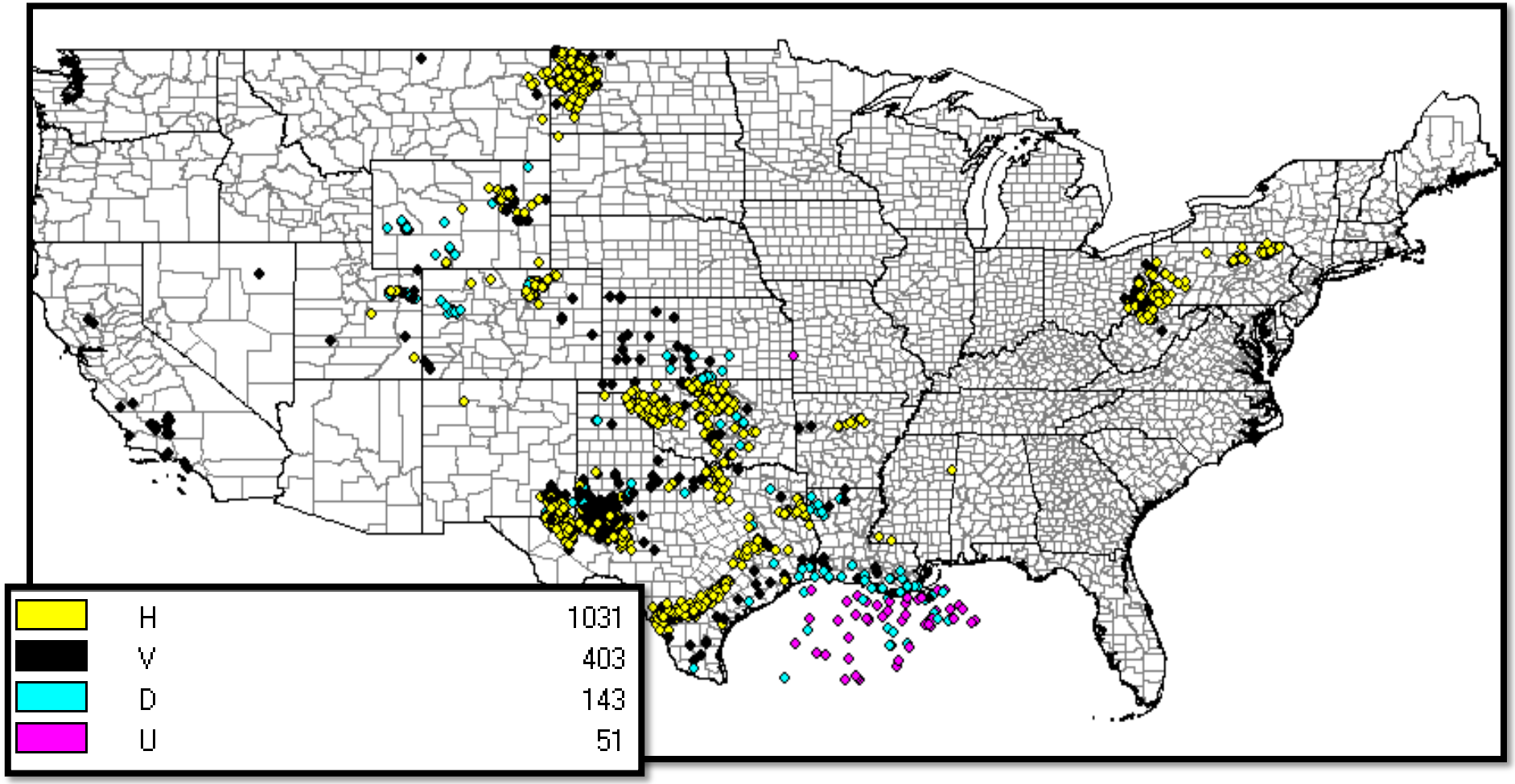
Source: EIA

U.S. Rig Count



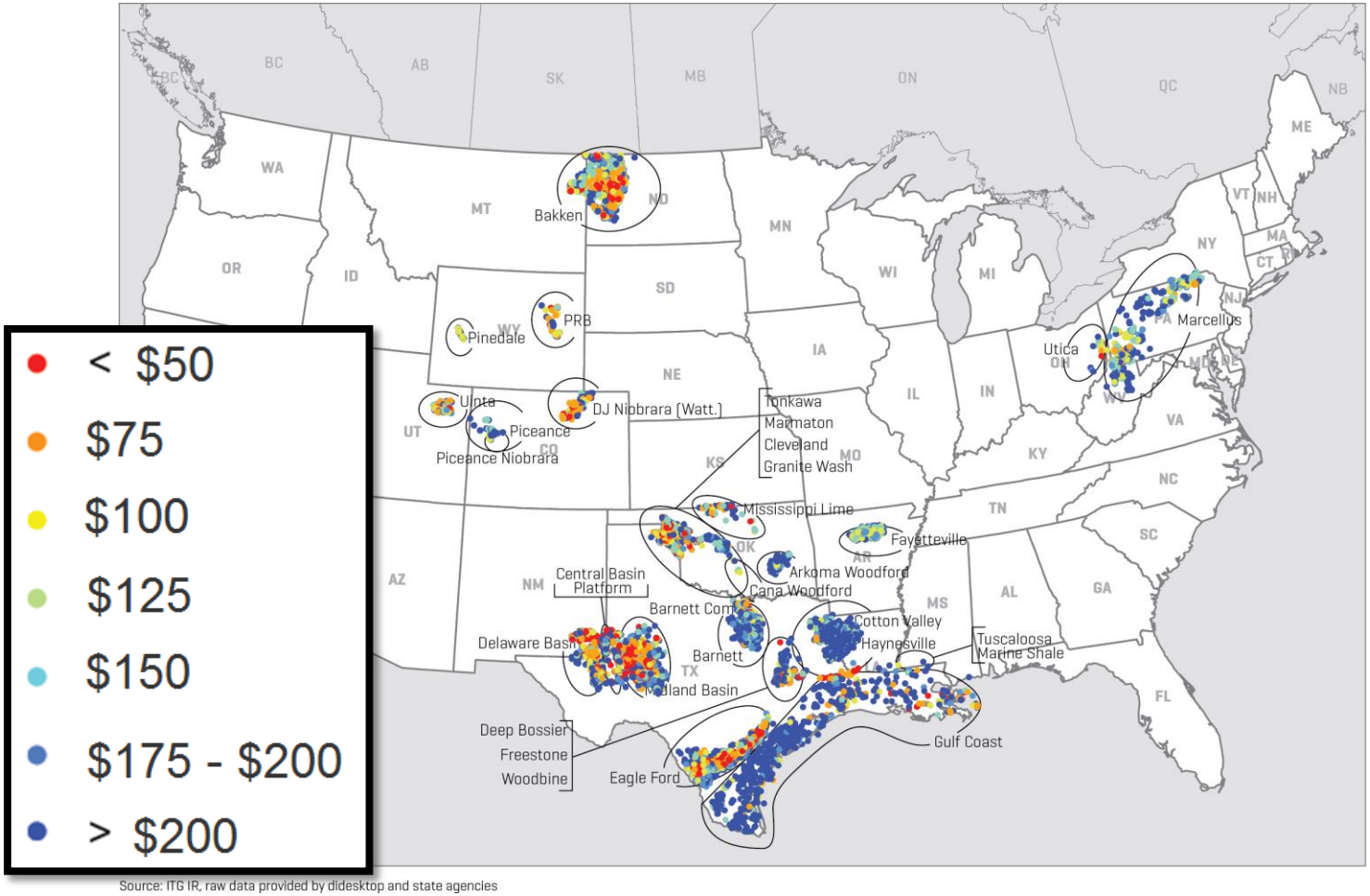
Source: Baker Hughes

U.S. Rig Activity by Drill Type



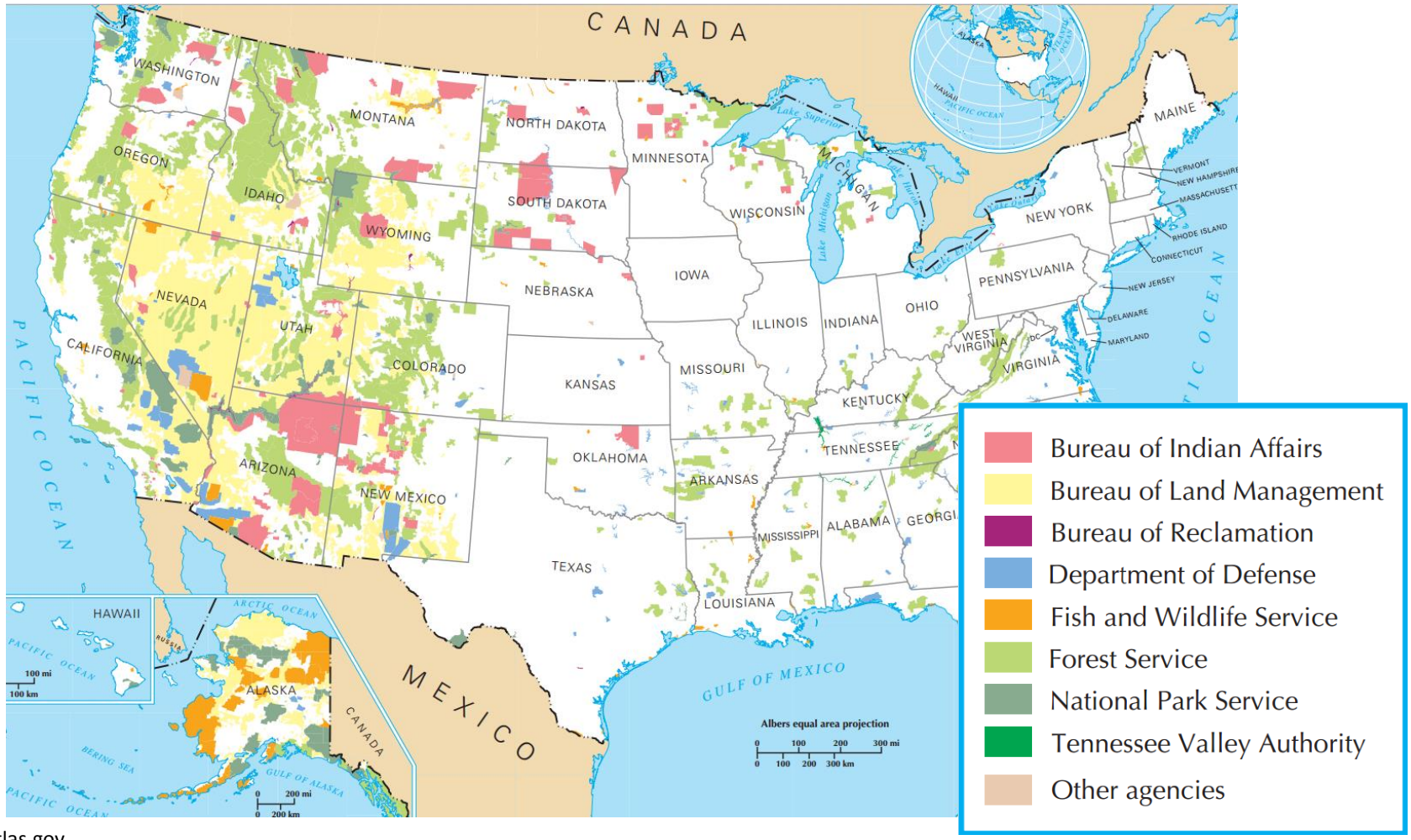
Source: HPDI Nov 2013 – Not 100% Complete

Shale Oil Play Break Even Costs



Source: ITG Investment Presentation Nov 2012

U.S. Federal Land Map

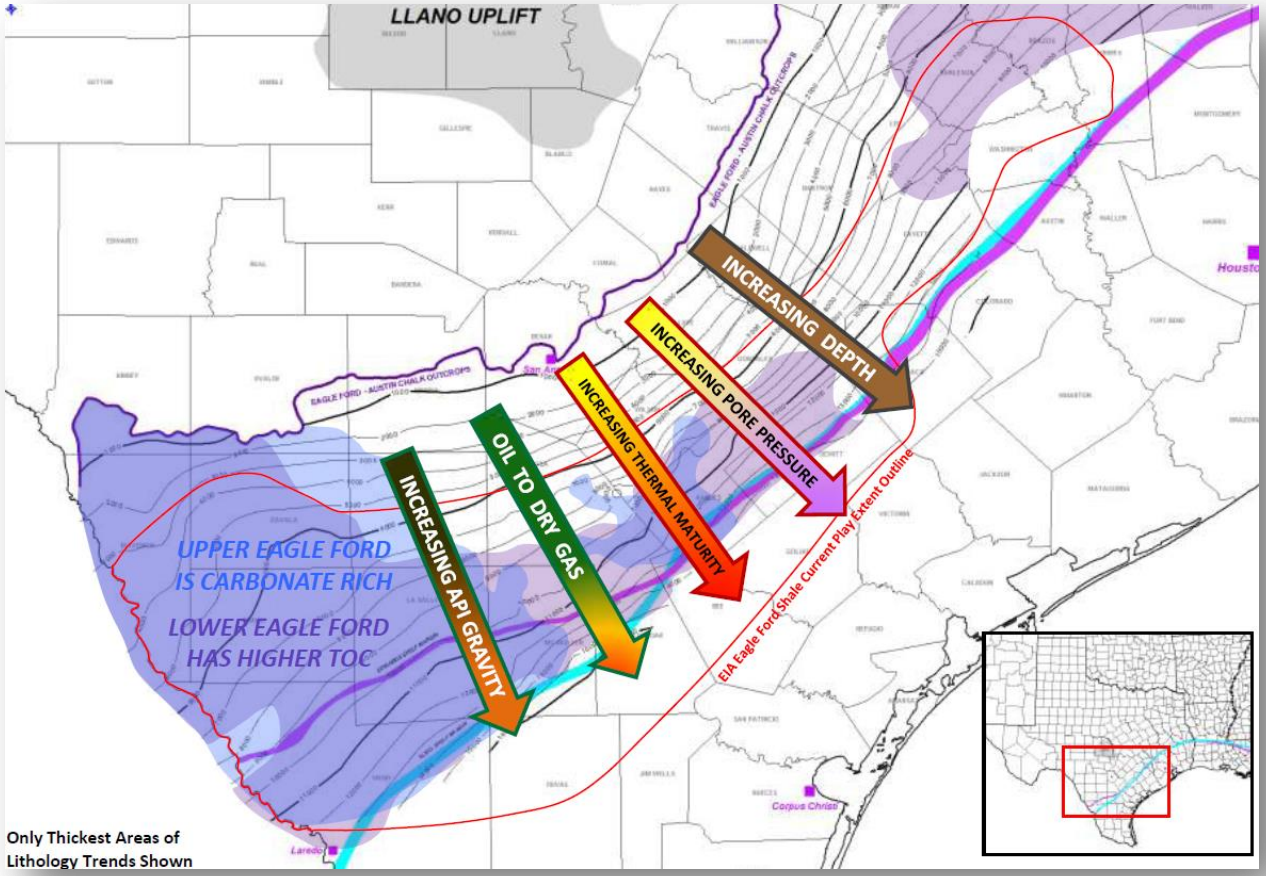


Source: NationalAtlas.gov

The Soaring Eagle Ford

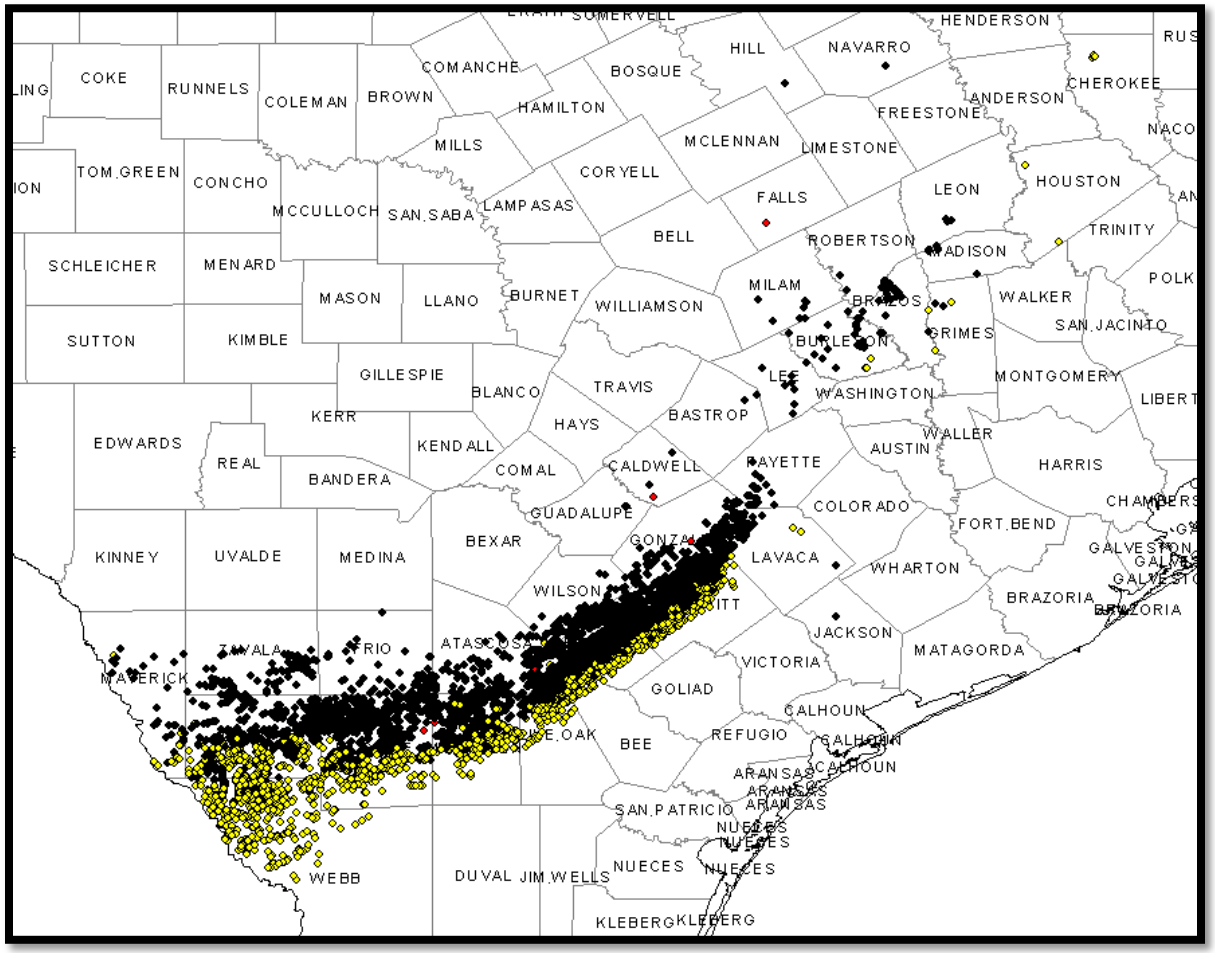
Geology of the Eagle Ford

Age (Ma)	System	Series	Stage	Formation Name
	Cretaceous	Upper	Maastrichthian	Escondido
				Olmos
70			Campanian	San Miguel
75				
80				Anacacho
85			Santonian	Austin Chalk
			Coniacian	
90			Turonian	Upper Eagle Ford
95			Cenomanian	Lwr Eagle Ford
				Buda
				Del Rio
100		Lower	Albian	Georgetown
105				Edwards
110				Glen Rose
115			Aptian	
120				Pearsall



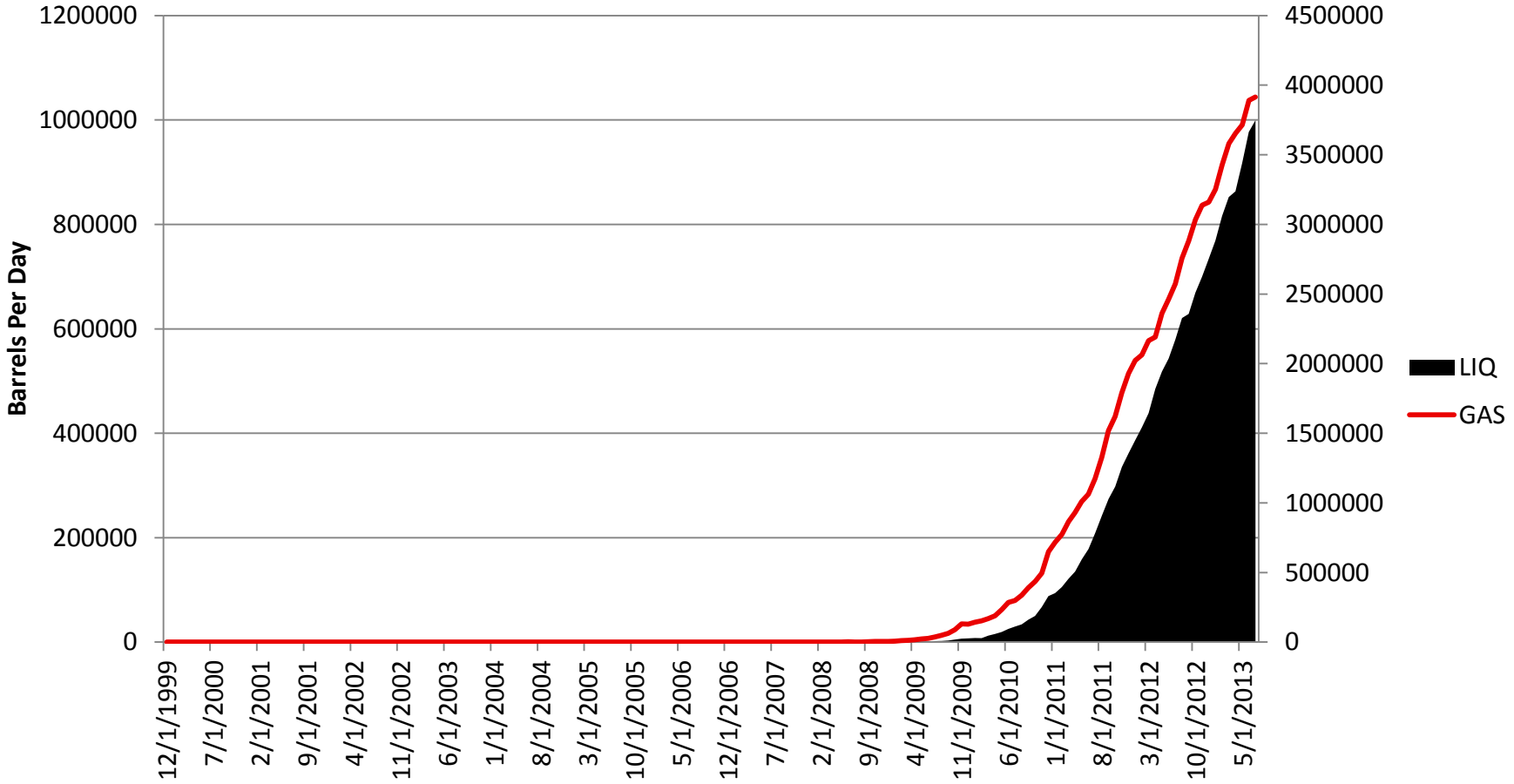
Source: Momentum Oil and Gas LLC, DUG Eagle Ford Conference Presentation Oct 2011

Eagle Ford Wells



Source: HPDI Nov 2013

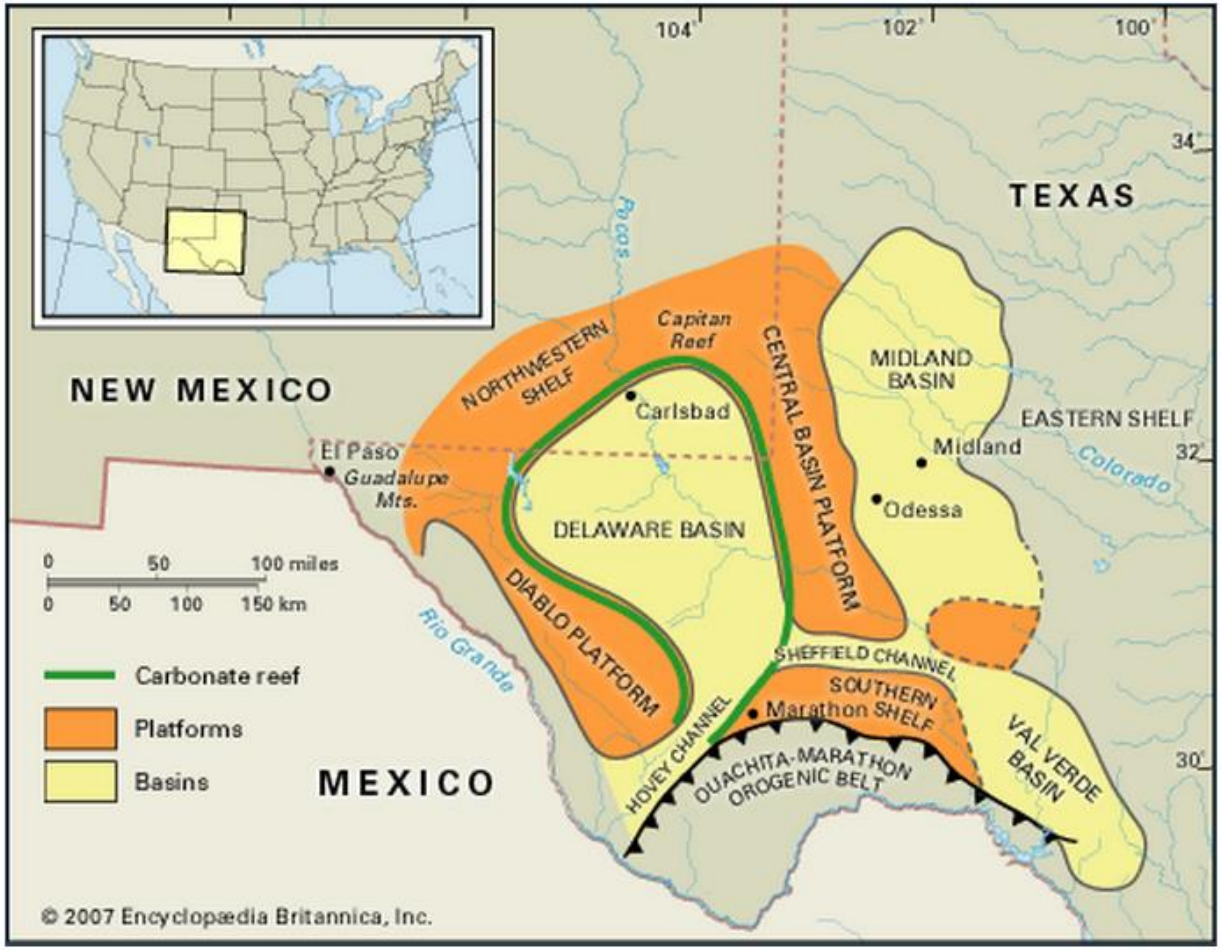
Eagle Ford Production



Source: HPDI Nov 2013

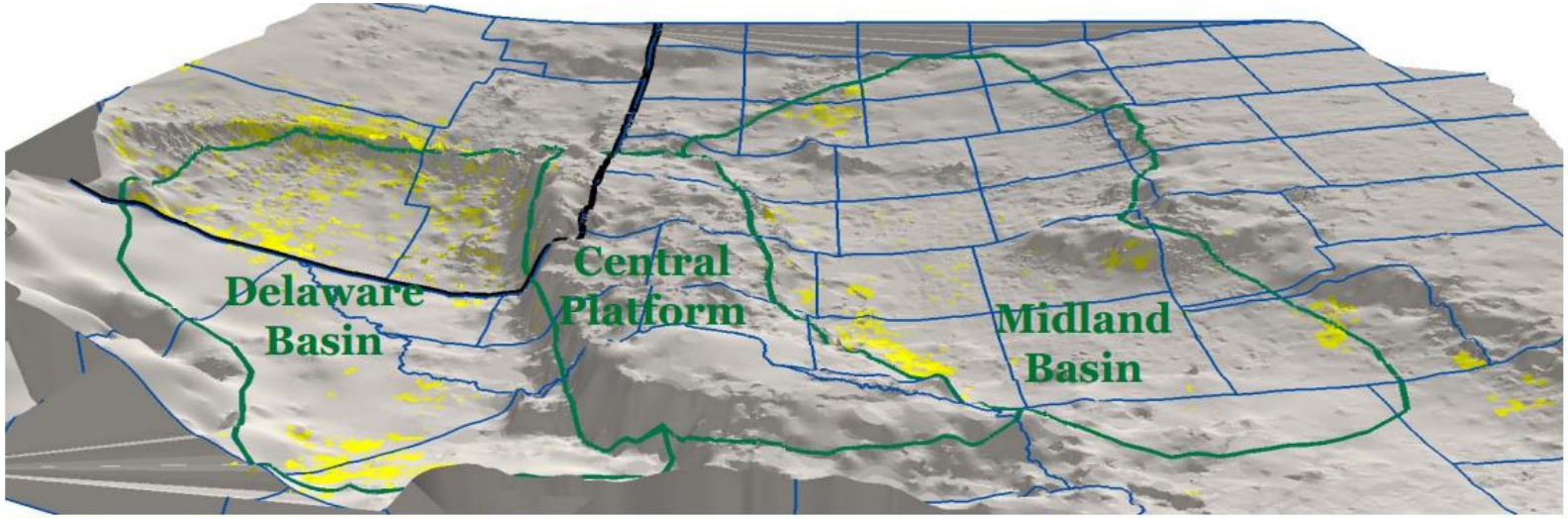
The Prolific Permian Basin

Breakdown of the Permian Basin Province



Source: *Permian Basin*. Map. *Encyclopædia Britannica Online*. Web. 17 Jan. 2012. <http://www.britannica.com/EBchecked/media/94328/Map-of-the-basins-reefs-and-platforms-that-make-up>.

Permian Basin Stratigraphy



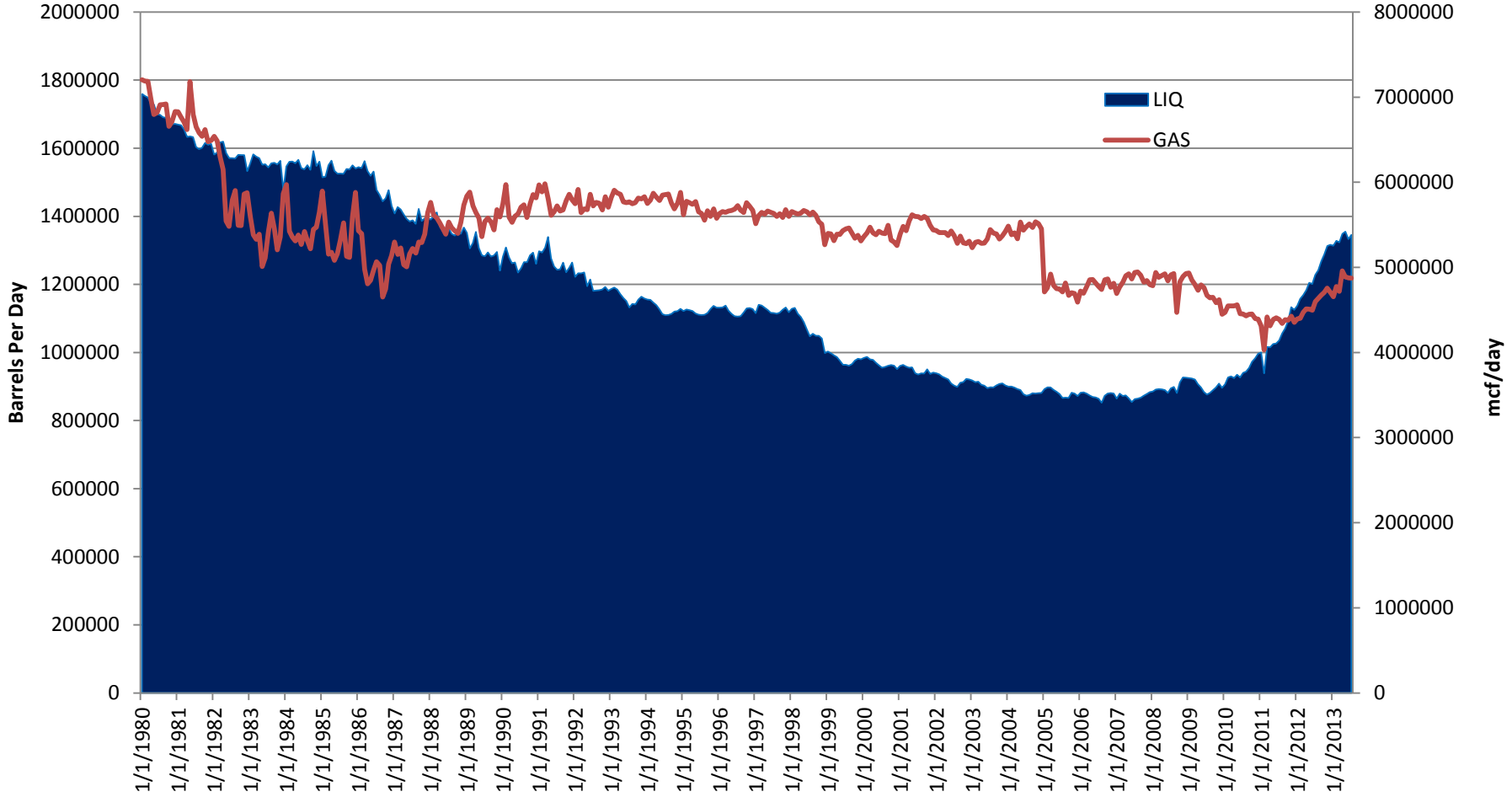
PERIOD	SERIES	DELAWARE BASIN FORMATION
GUADALAUPE	DELAWARE GROUP	LAMAR BELL CANYON
		CHERRY CANYON
		BRUSHY CANYON
LEONARD	UPPER AVALON SHALE	
	LOWER AVALON SHALE	
	1ST BONE SPRING	
	2ND BONE SPRING	
	3RD BONE SPRING	
WOLFCAMP	WOLFCAMP	
PENN	PENNSYLVANIAN	

PERIOD	SERIES	CENTRAL PLATFORM FORMATION
GUADALAUPE	WHITE-HORSE	TANSILL
		YATES
		7 RIVERS
		QUEEN
		GRAYBURG
	WARD	SAN ANDRES
		GLORIETA
LEONARD	YESO	PADDOCK
		BLINEBRY
		TUBB
		DRINKARD
	ABO	
WOLFCAMP	WOLFCAMP	HUECO
		BURSUM
PENN	PENNSYLVANIAN	

PERIOD	SERIES	MIDLAND BASIN FORMATION
GUADALAUPE	WHITE-HORSE	TANSILL
		YATES
		7 RIVERS
		QUEEN
		GRAYBURG
	WARD	SAN ANDRES
		GLORIETA
LEONARD	CLEAR FORK	UPPER LEONARD
	UPPER SPRABERRY	
	LOWER SPRABERRY	
	DEAN	
WOLFCAMP	WOLFCAMP	
PENN	PENNSYLVANIAN	

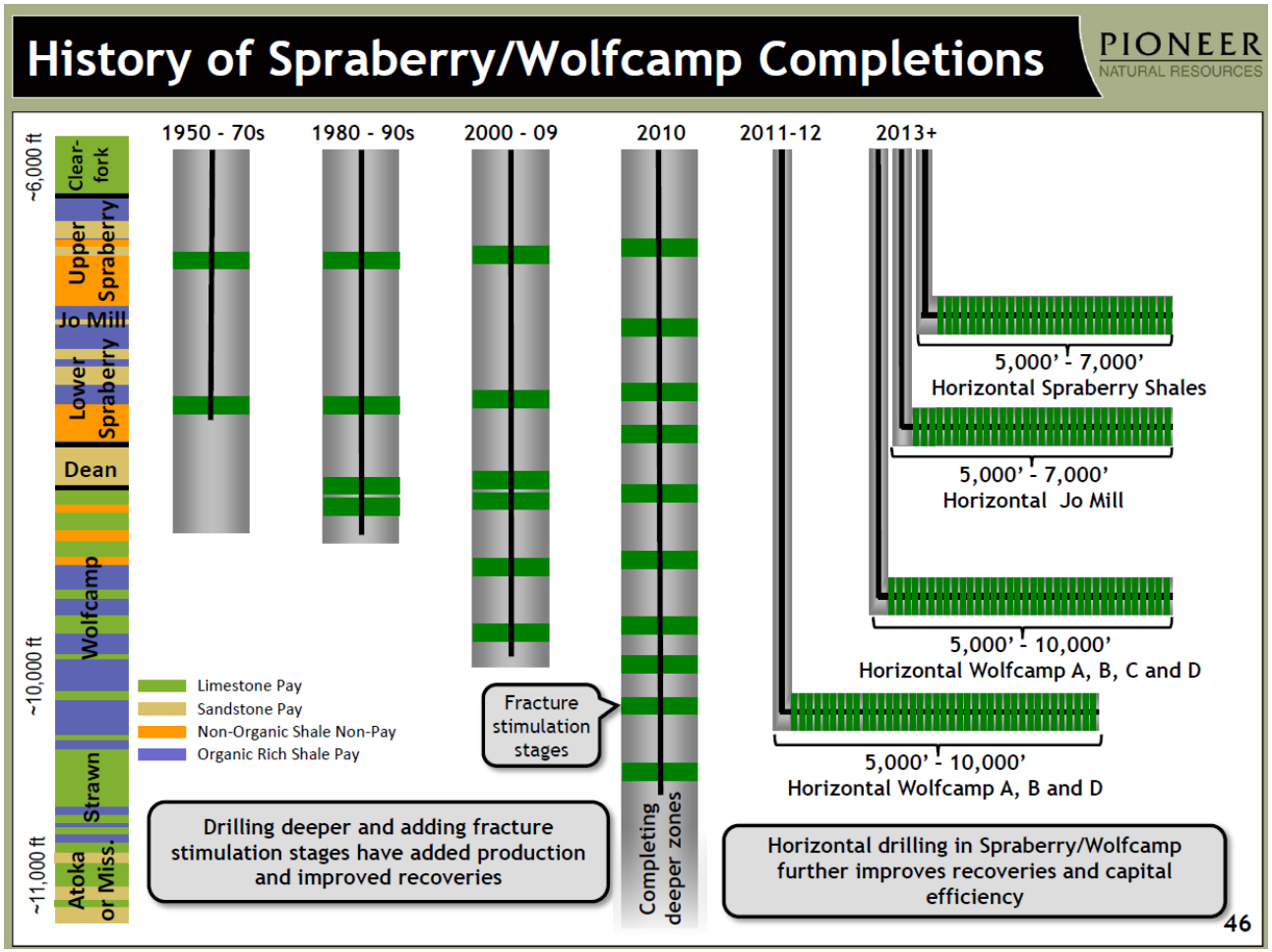
Source: Concho Resources 2nd Quarter 2013 Investor Presentation

Permian Basin Production 1.3 mbd



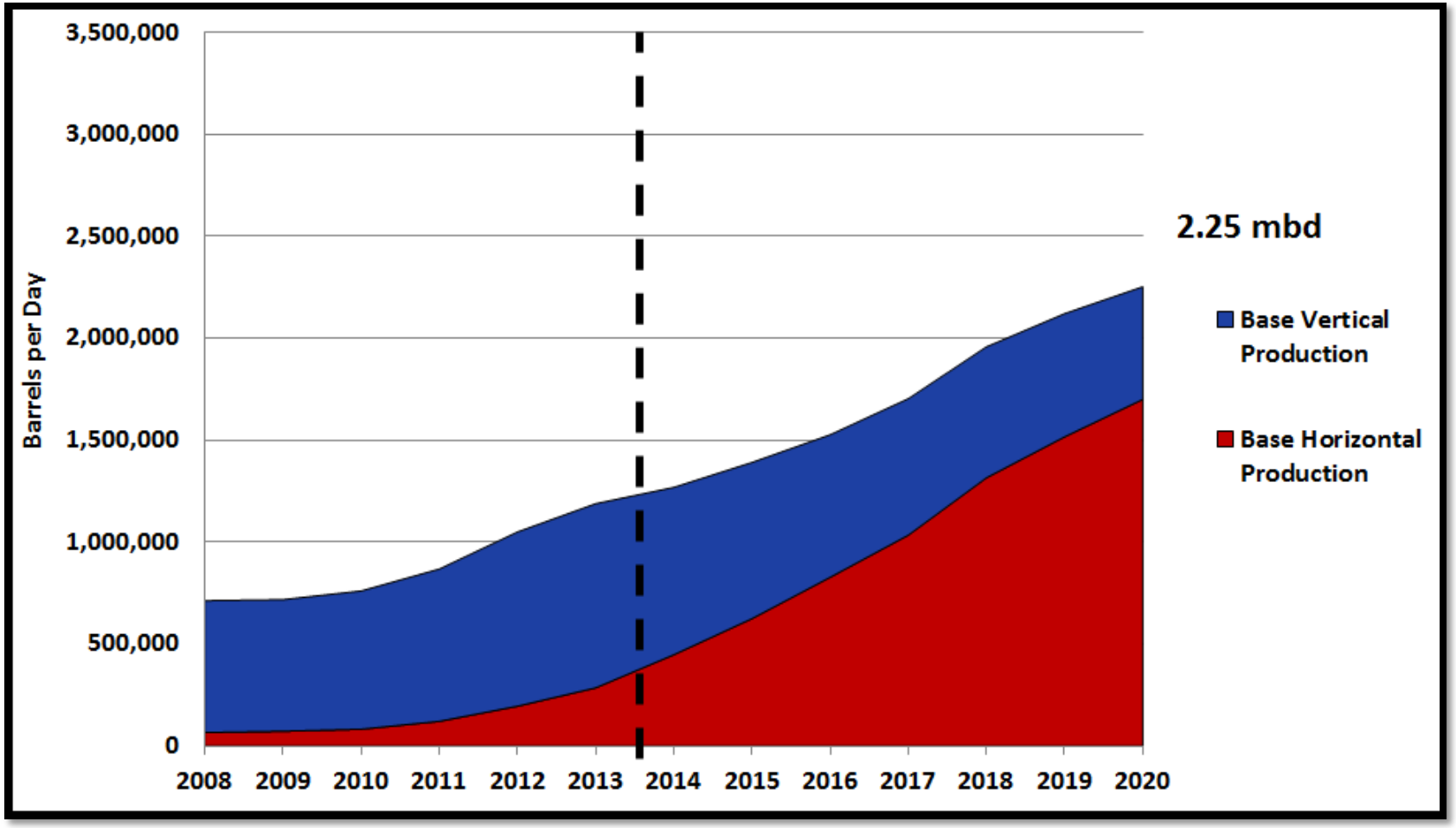
Source: HPDI Oct 2013

Vertical and Horizontal Progression



Source: Pioneer Natural Resources Oct 2013 Investor Presentation

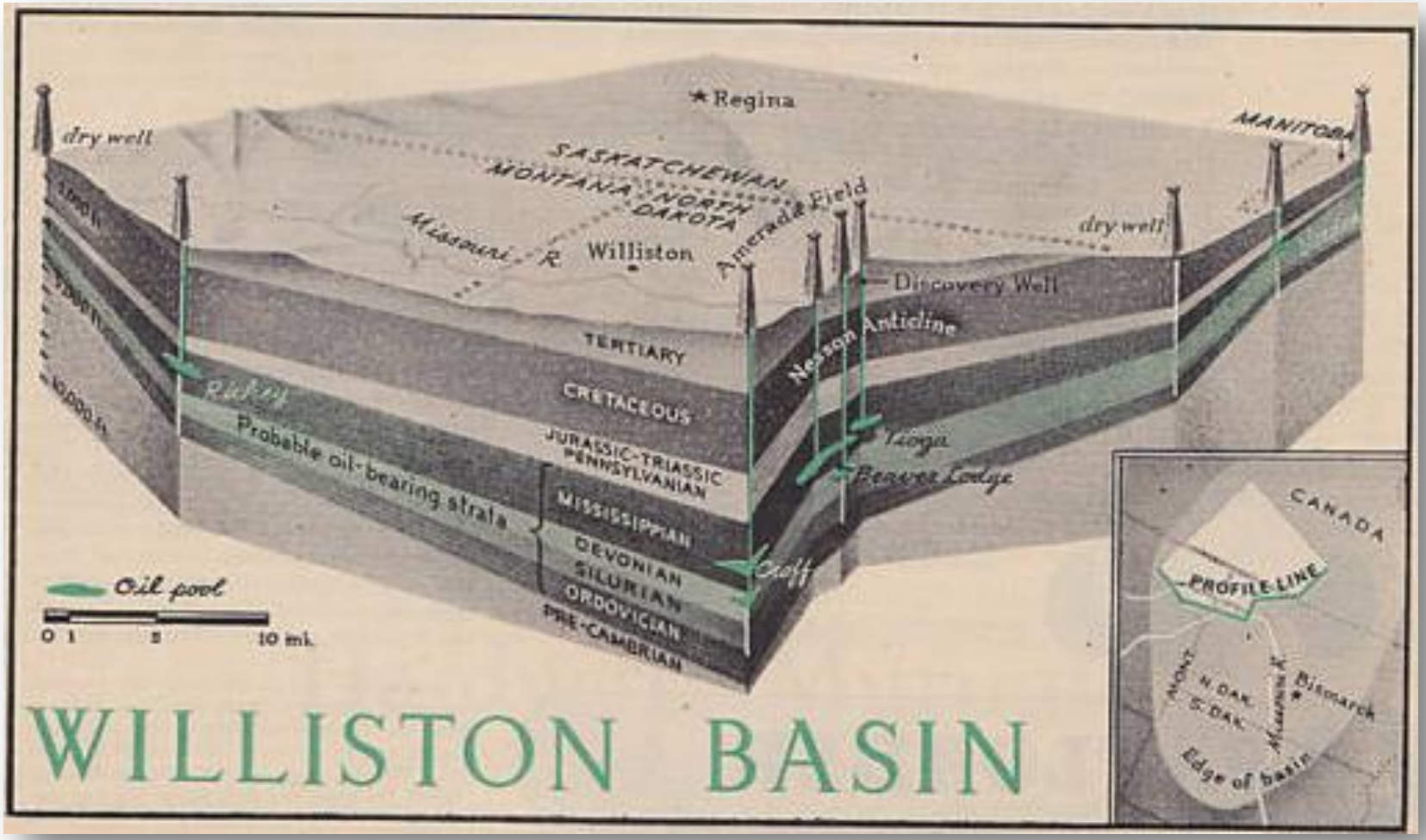
EPRINC November Revised Permian Forecast



Source: EPRINC

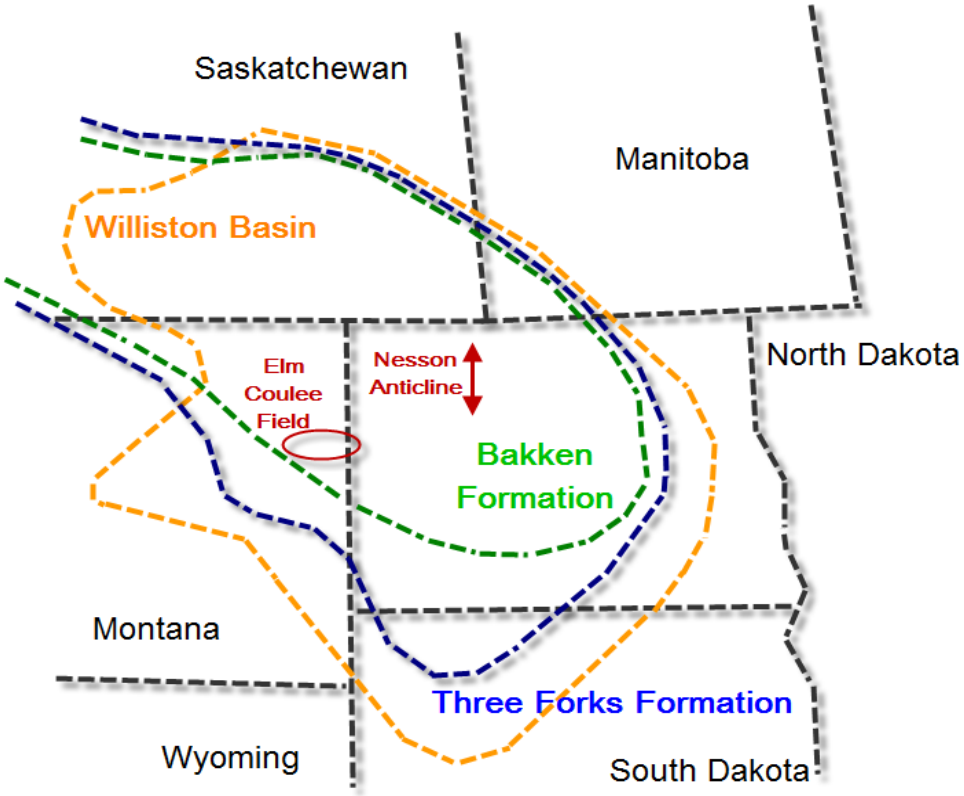
Bakken: The Case Study

Long History of the Williston Basin

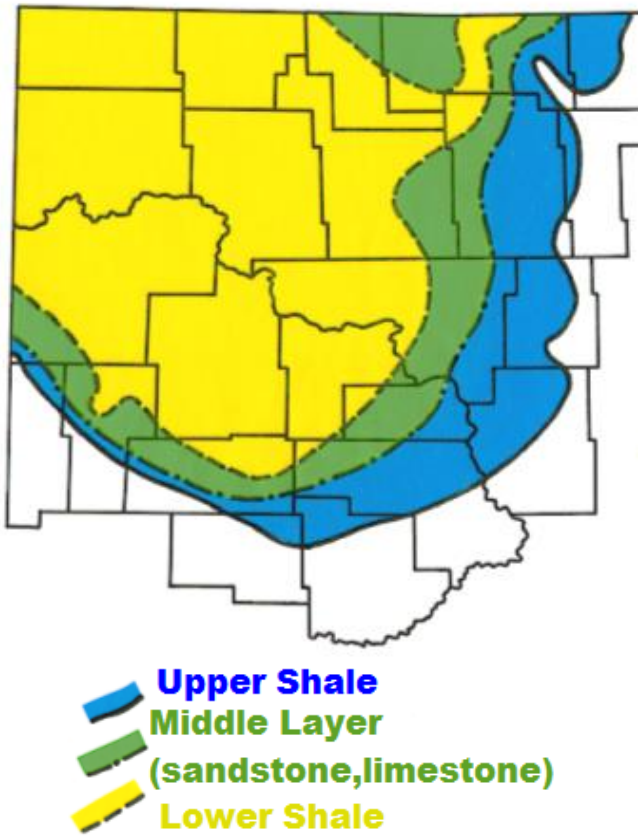


Source: Time Magazine 1952

Bakken Basics

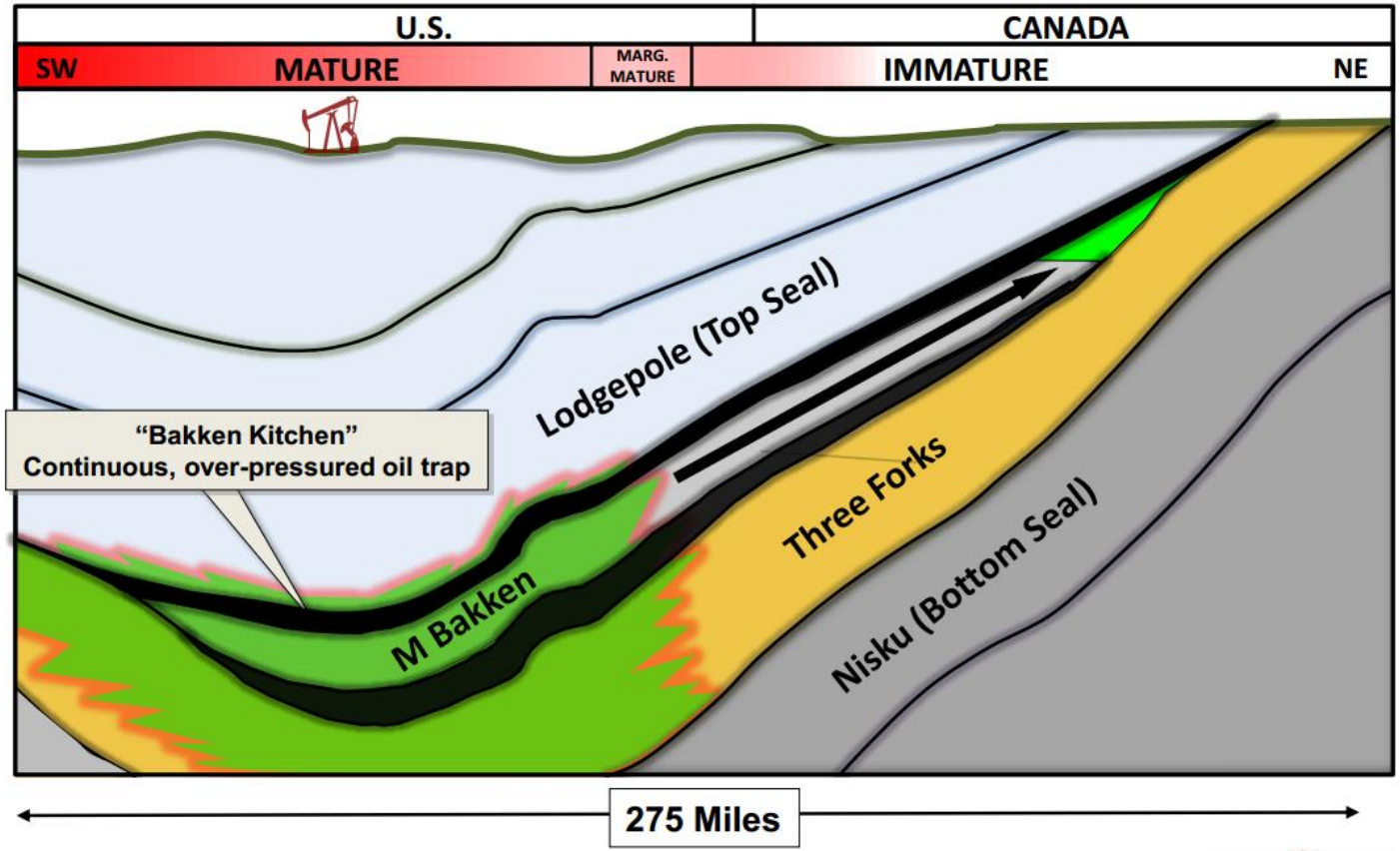


Source: EPRINC Diagram



Source: Julie LeFever Presentation

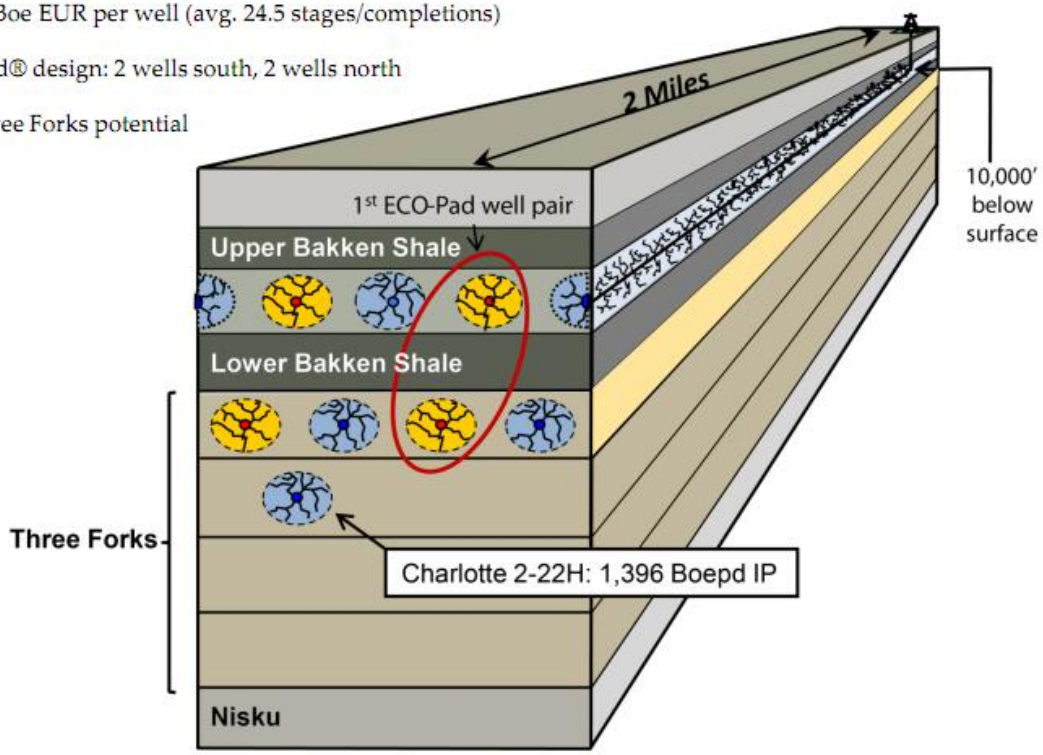
Bakken Geology



Continental RESOURCES

Bakken Drilling

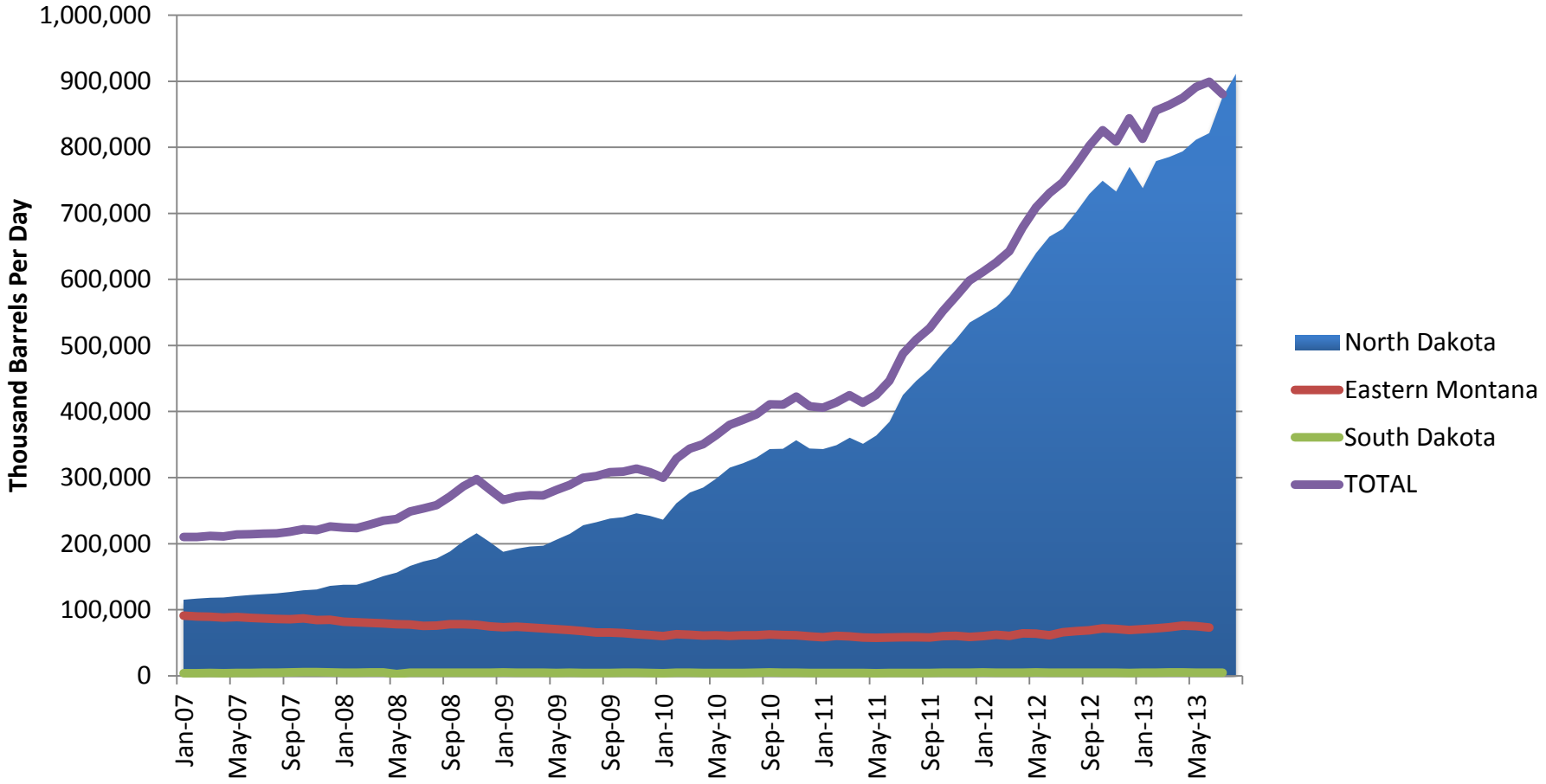
- Original dual-zone development plan
  - 8 wells per 1,280 acres – 4MB, 4TF
  - 603,000 Boe EUR per well (avg. 24.5 stages/completions)
  - ECO-Pad® design: 2 wells south, 2 wells north
- Additional Three Forks potential



Source: Continental Resources Inc., Corporate Presentation, 2012.

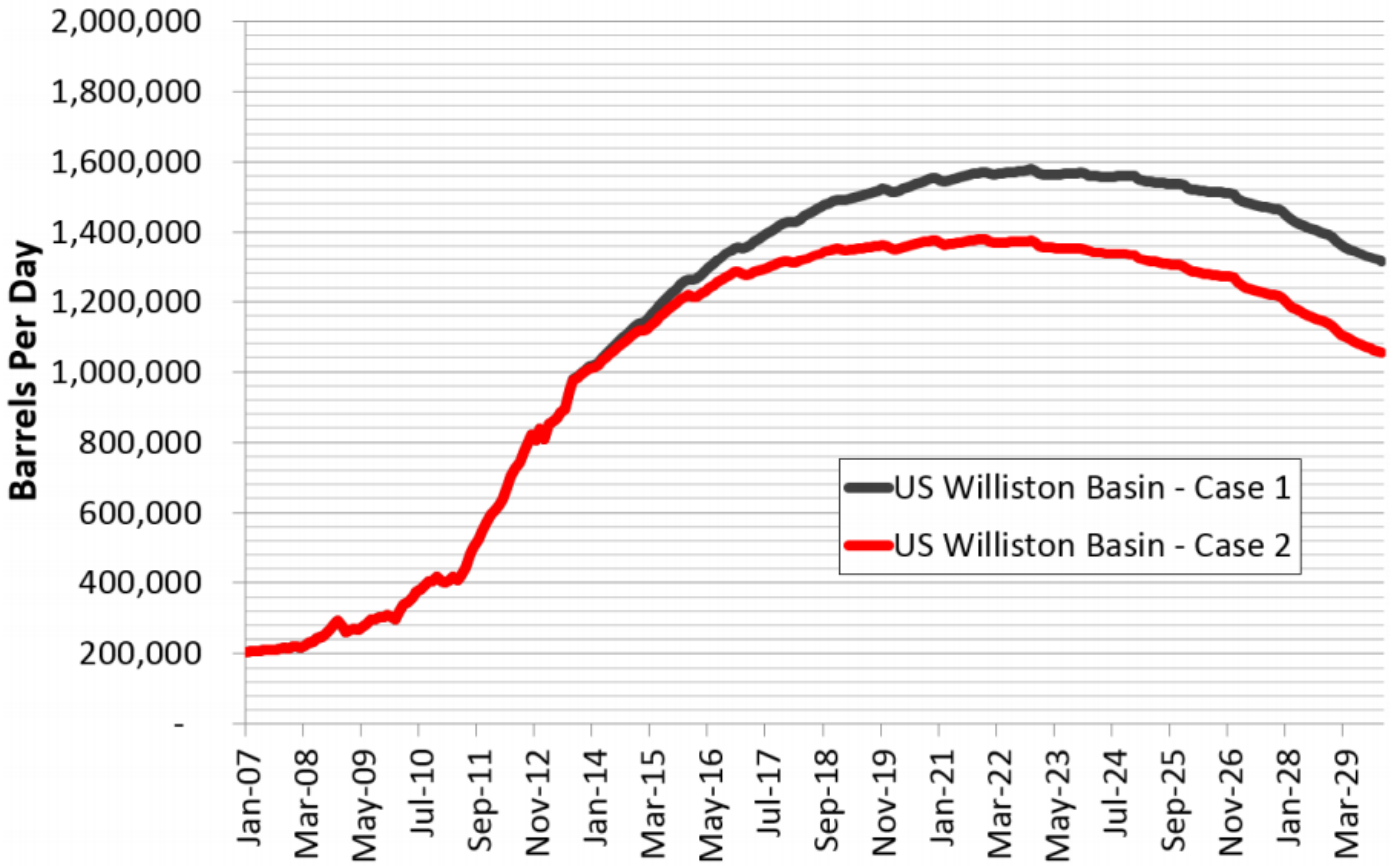
Source: Triangle Petroleum Corporation, Presentation Bakken Product Markets and Take-Away Denver Jan 31-Feb 1 2012

Williston Basin Production



Source: NDIC

Possible Production Figures

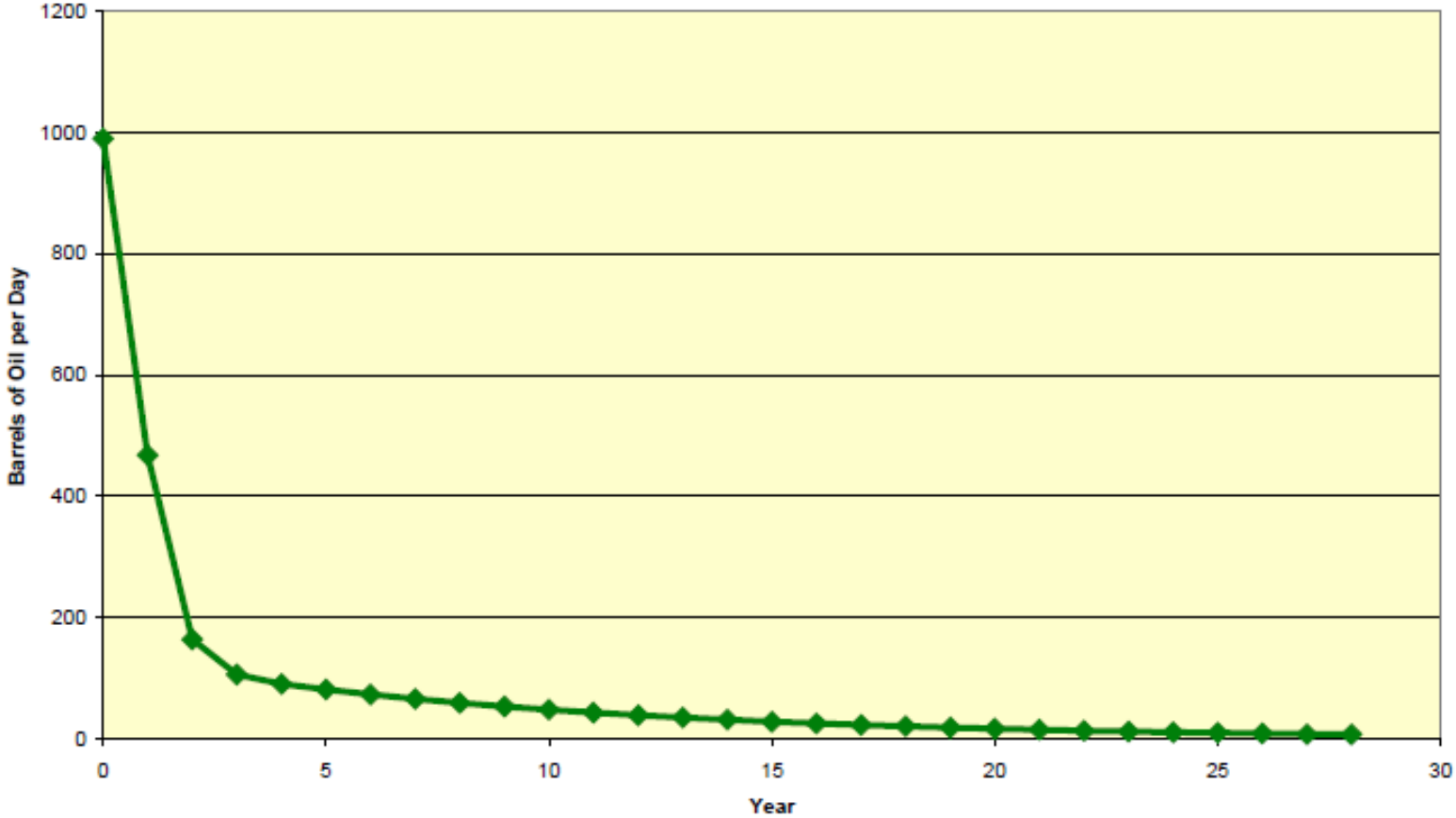


Production forecast is for visual demonstration purposes only and should not be considered accurate for any near or long term planning.

JJ Kringstad - North Dakota Pipeline Authority

Source: NDPA

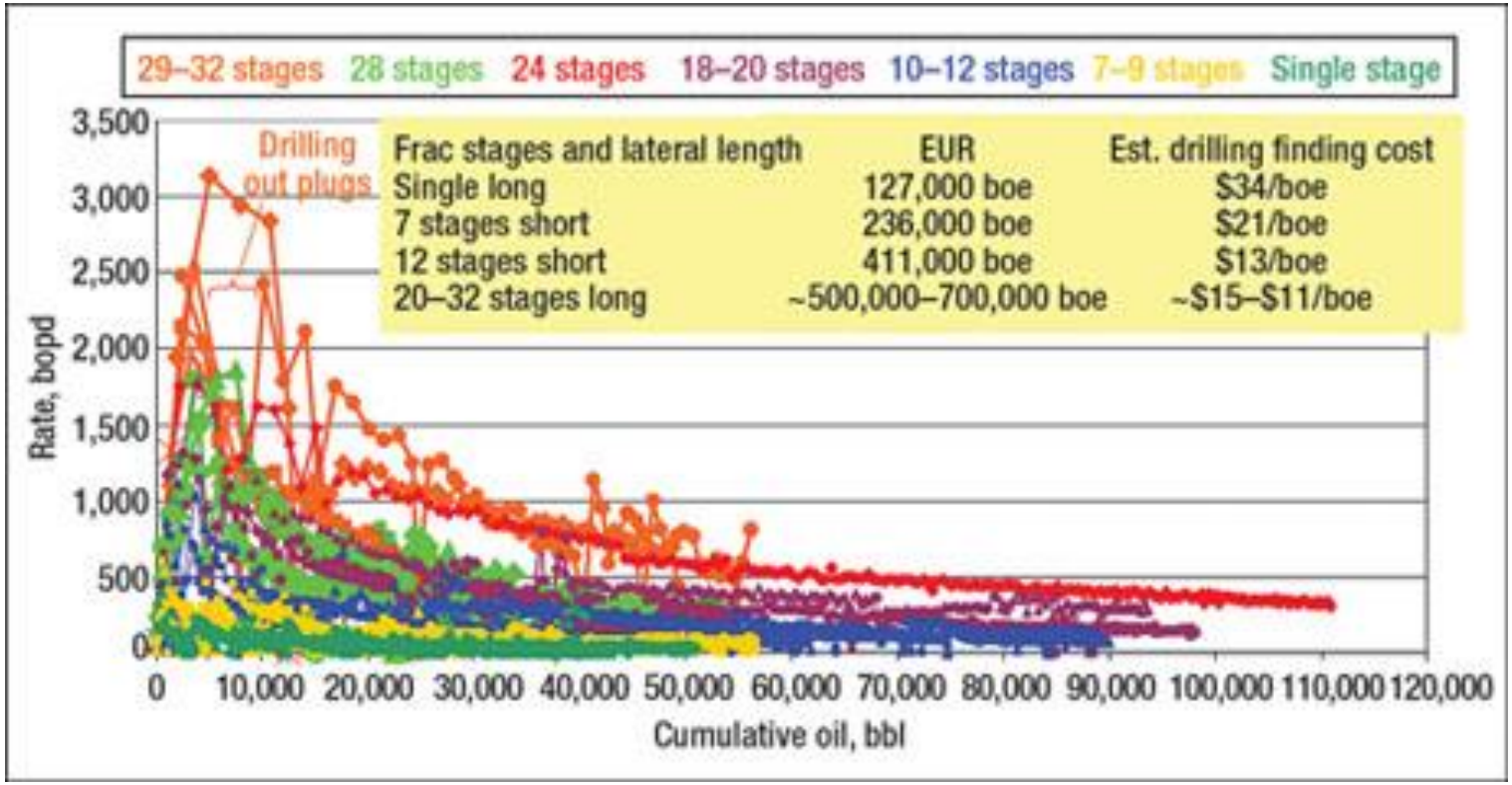
Decline Rates



Source: Lynn Helms, ND Dept. of Mineral Resources, NDPC Meeting Sept. 2011 Medora ND

Unlocking the Rocks

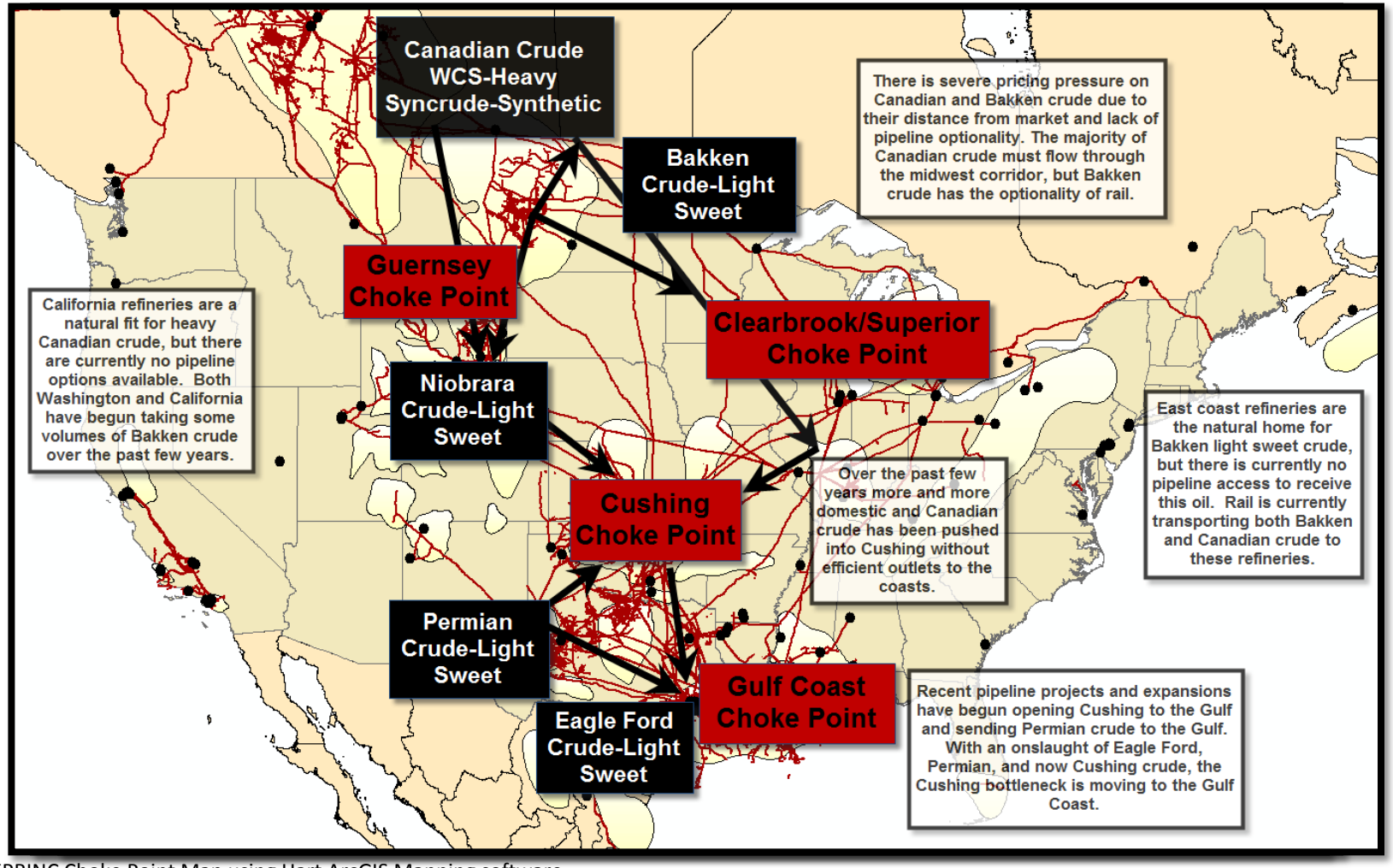
Combining longer laterals with an increasing number of frac stages yields higher EURs is a short time period.



Source: Brigham Exploration via *World Oil*

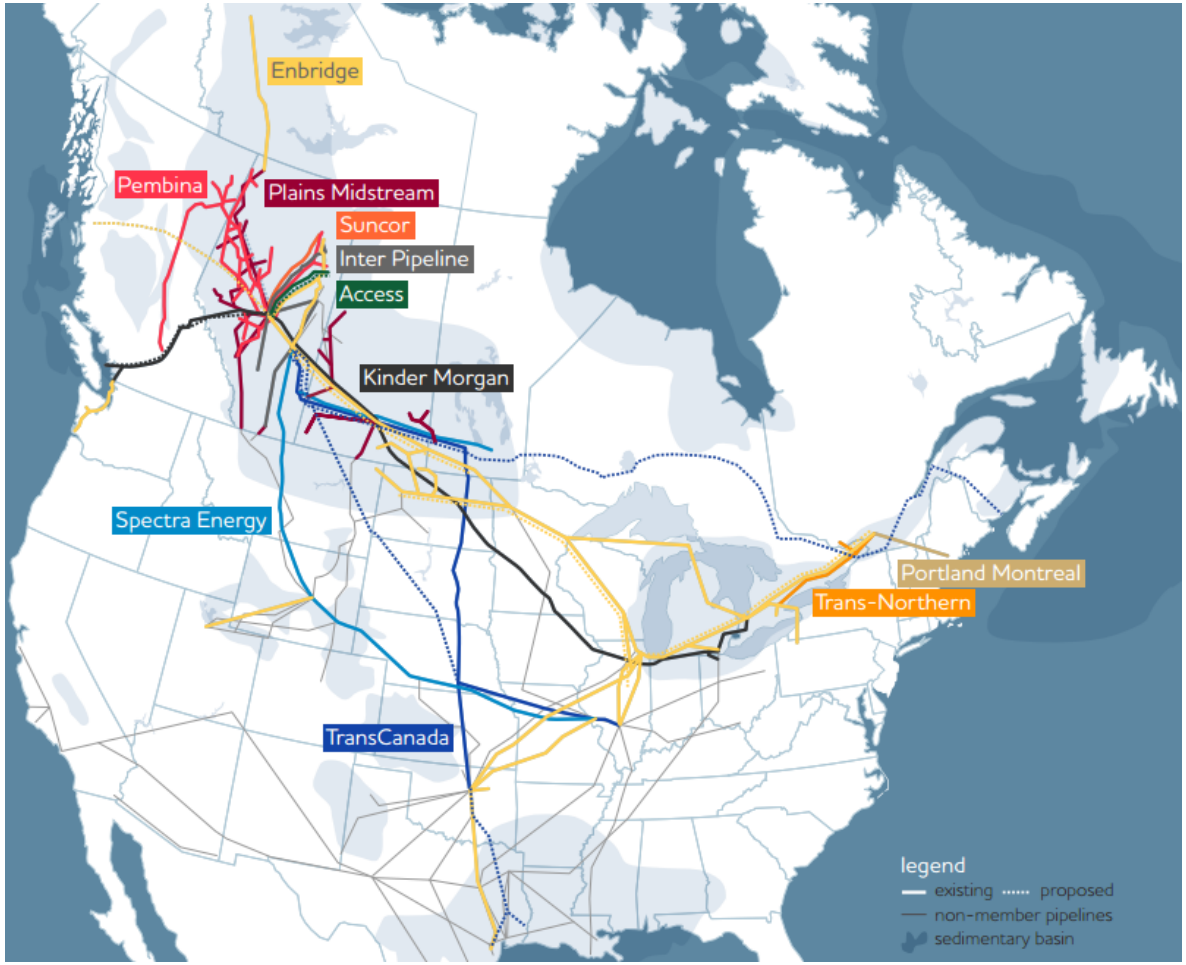
Infrastructure Challenges

Pipeline Choke Points



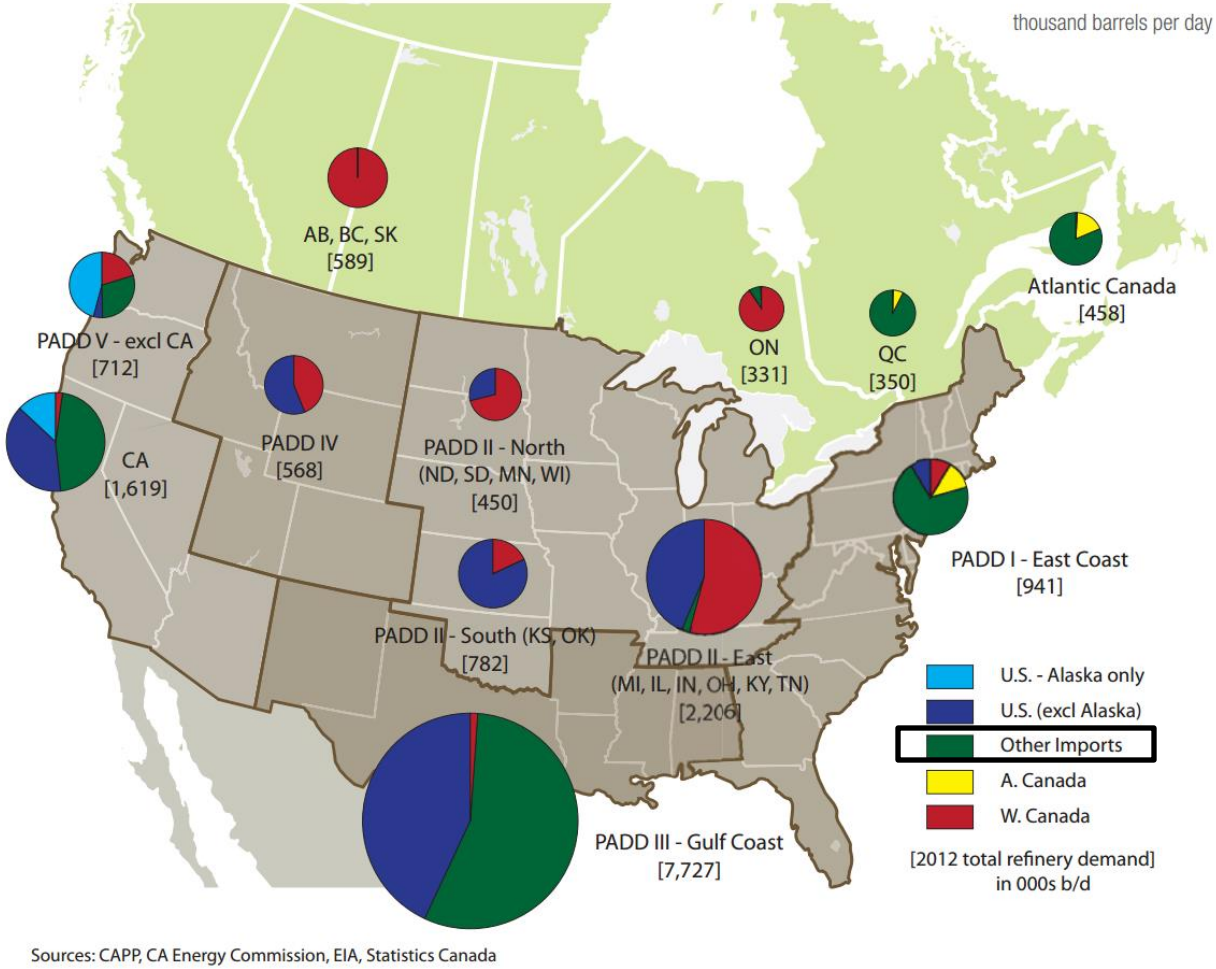
Source: EPRINC Choke Point Map using Hart ArcGIS Mapping software

All Canadian Pipeline Export Options are Full



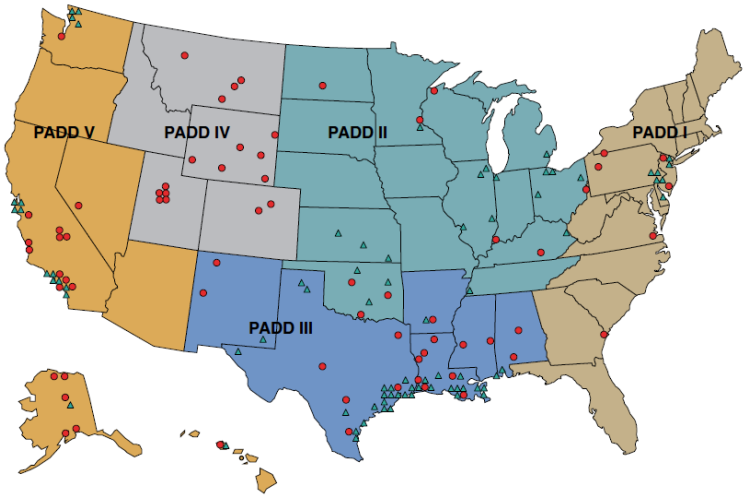
Source: Canadian Energy Pipeline Association

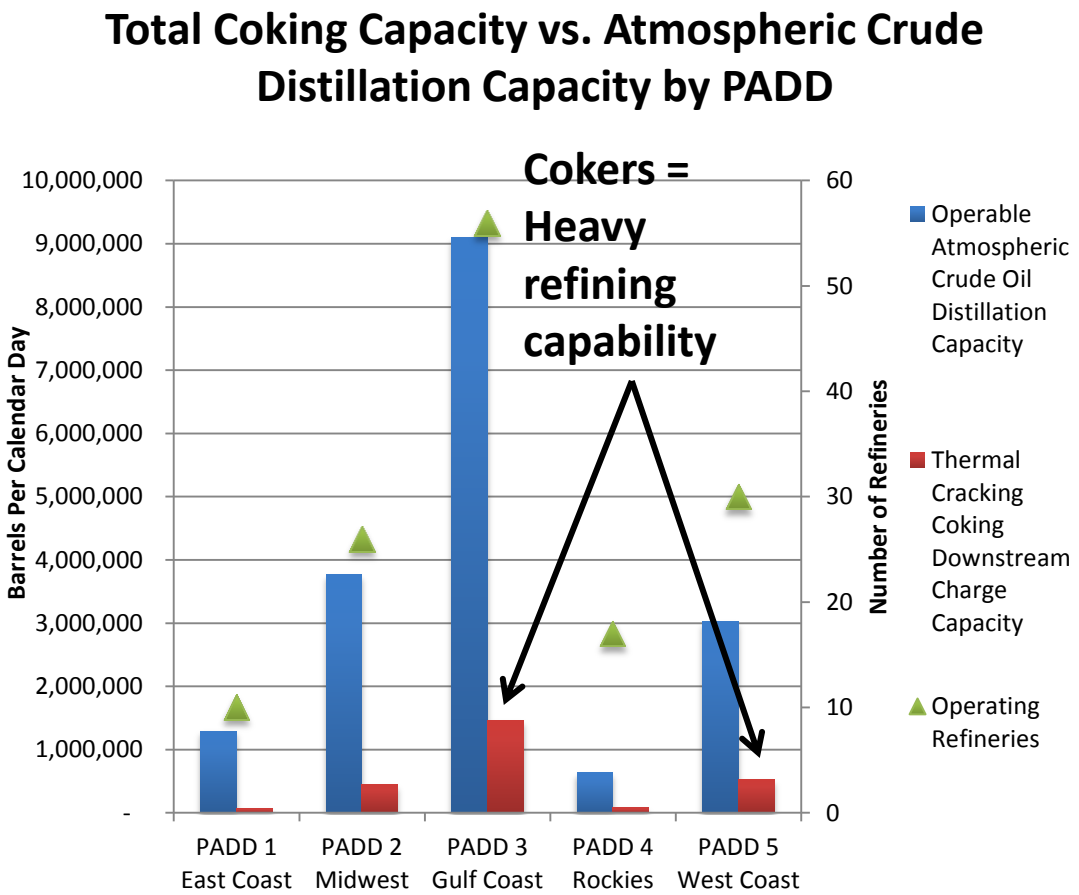
Market Saturation



Source: CAPP Crude Oil Forecast June 2013

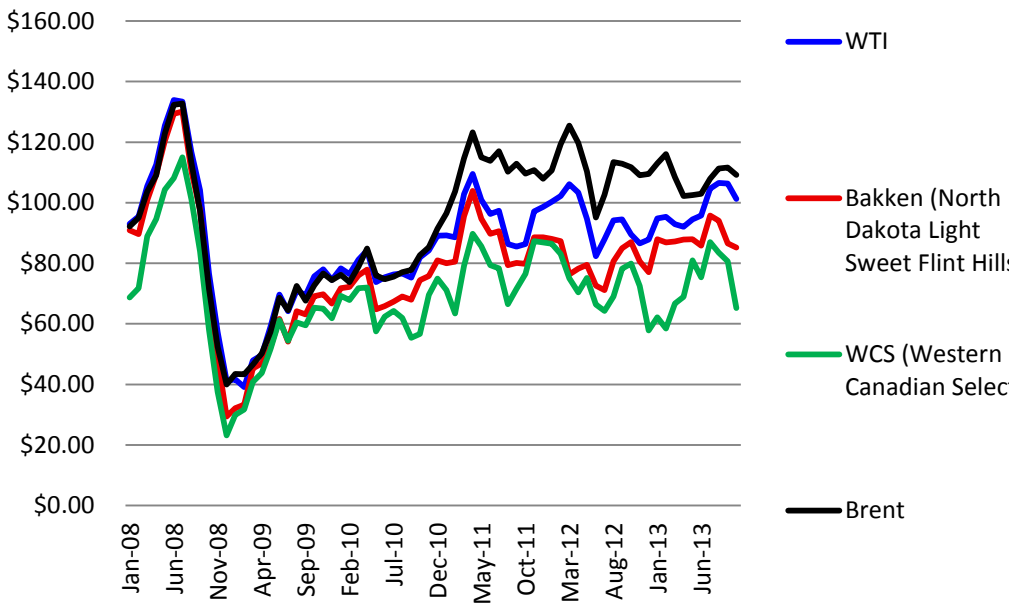
Where light sweet Bakken and heavy (blended bitumen) needs to go…

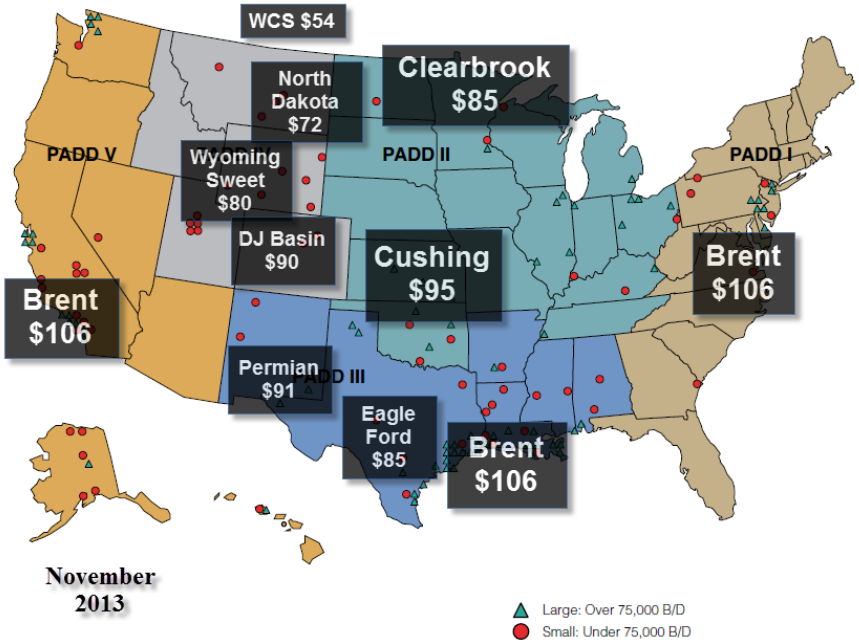




Source: AFPM map, EIA data for graph

Regional Pricing Disparities





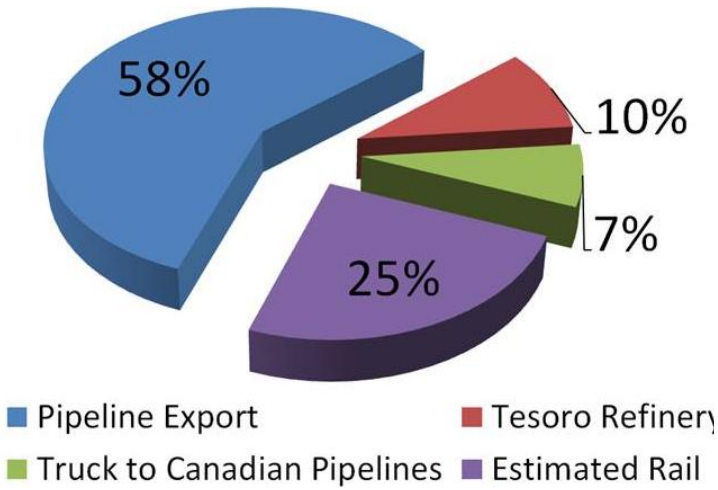
- **Western Canadian Select -$41 to WTI**

Source: Flint Hills, EIA, CME Group, and estimates

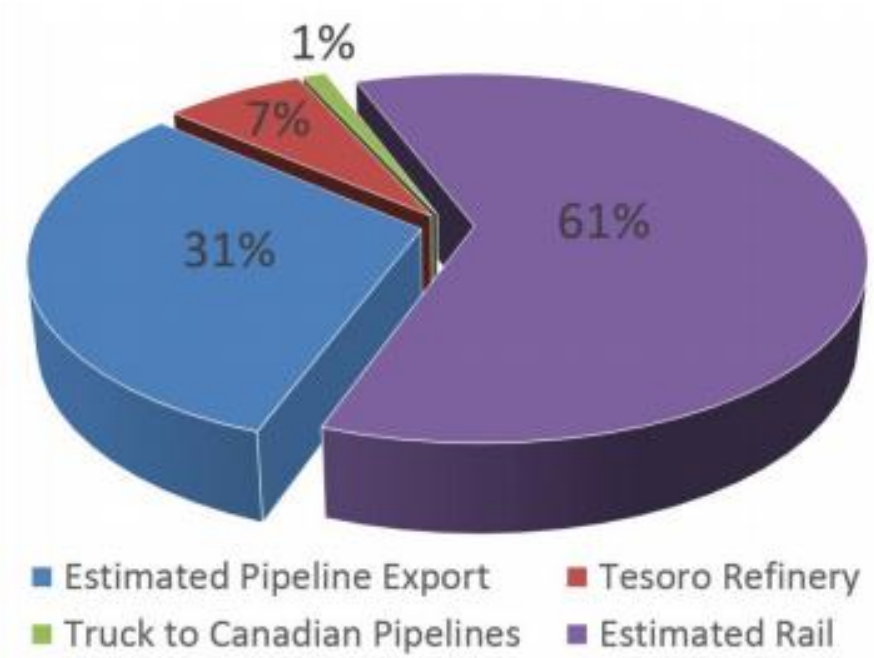
The Rise of Rail

North Dakota Crude Oil Transport

January 2012 Estimates

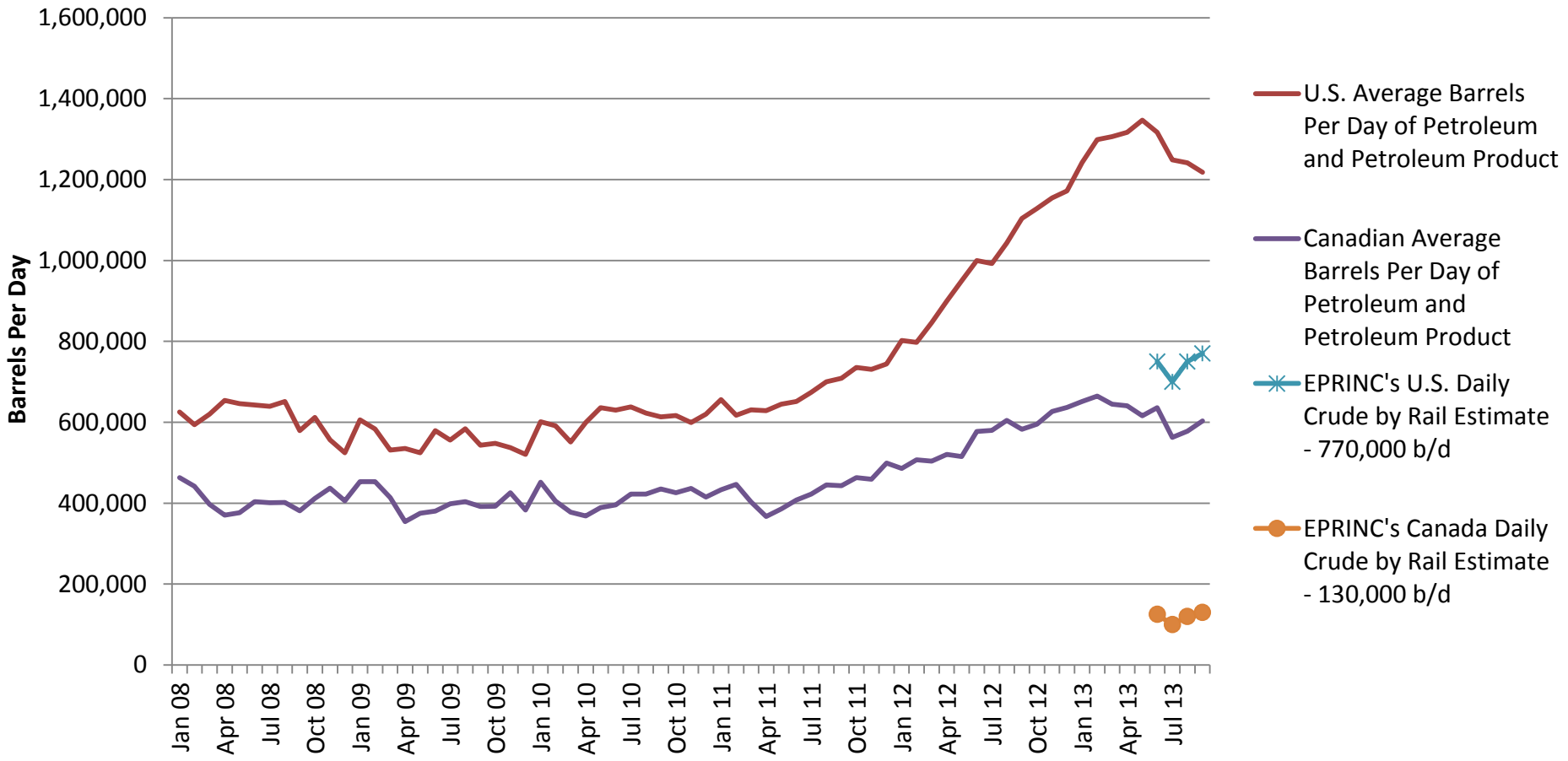


August 2013 Estimates



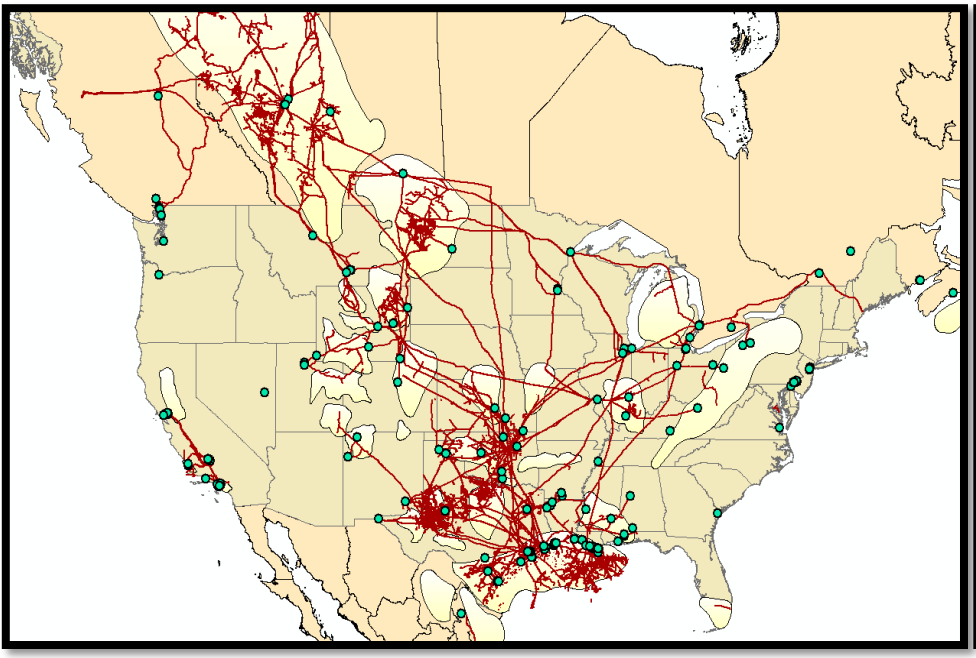
Source: North Dakota Pipeline Authority

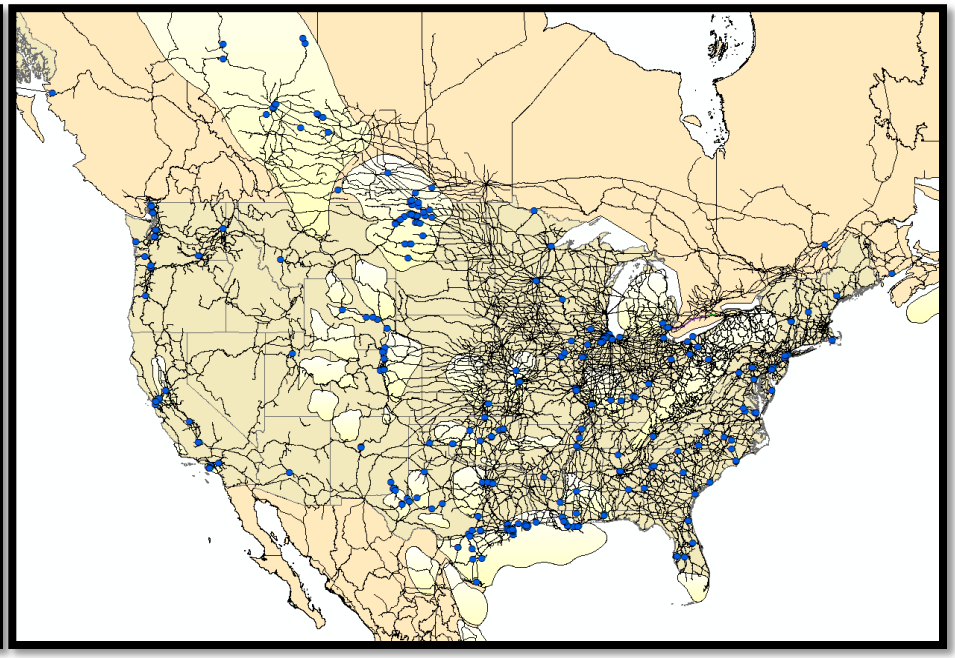
Daily Crude by Rail Shipment in U.S. and Canada



Source: AAR; Crude and petroleum product includes liquefied gases, asphalt, fuel oil, lubricating oil, jet fuel, etc. U.S. operations exclude U.S. operations of CN and CP. Canadian operations include CN and CP and their U.S. operations. One carload holds 30,000 gallons (or 714.3 barrels).

Pipeline and Rail





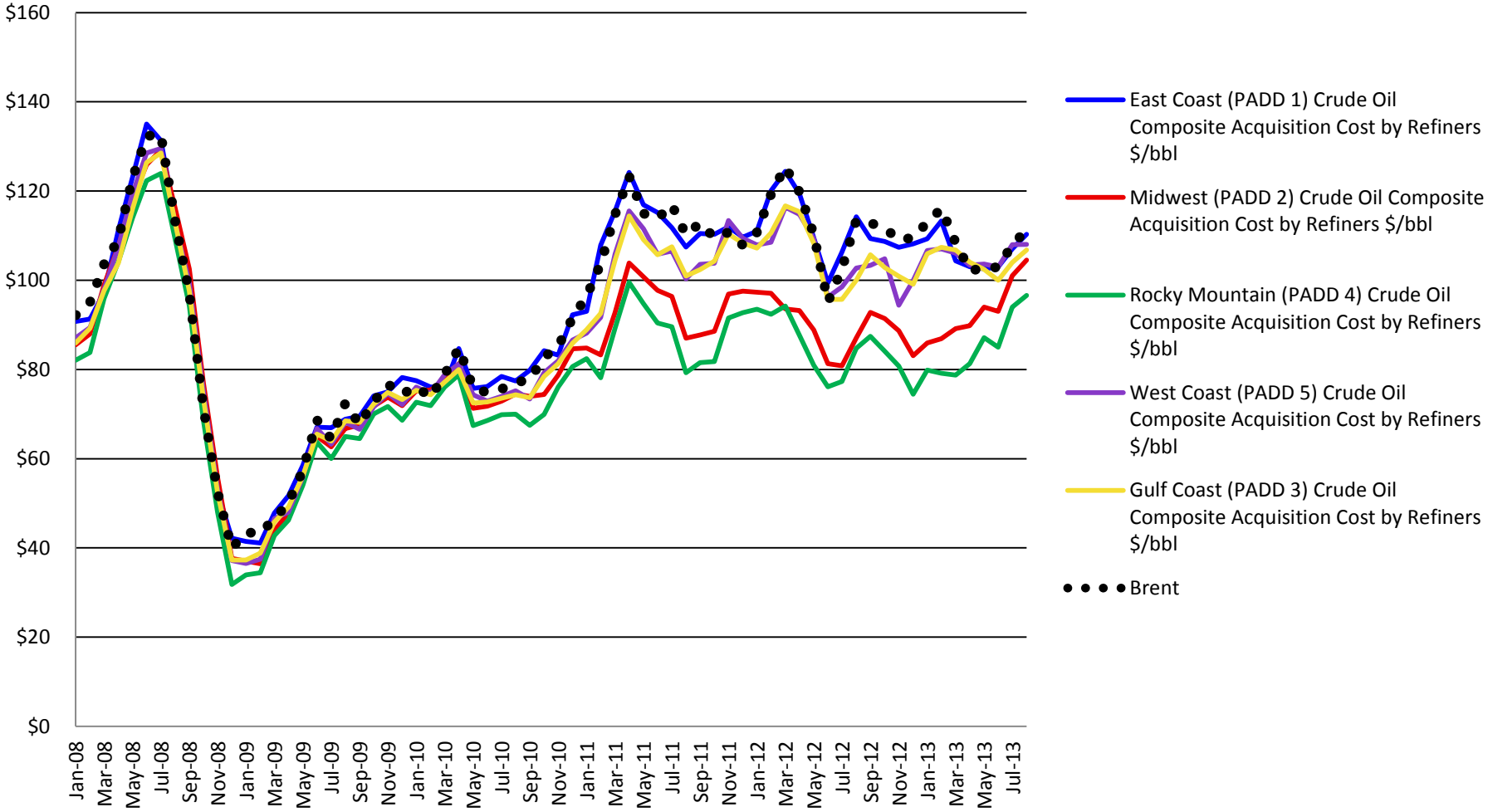
- **Severely limited due to lack of Keystone XL and lack of historical build out to the coasts – system designed to import into the Gulf and move up**

- **New markets**
- **Diversification**
- **Neat Barrels**
- **Nimble - Quickly adjustable**
- **Optionality for Canadian and U.S. crude, NGLS, and other petroleum products**

Source: EPRINC Maps using Hart Energy data and ArcGIS Mapping software

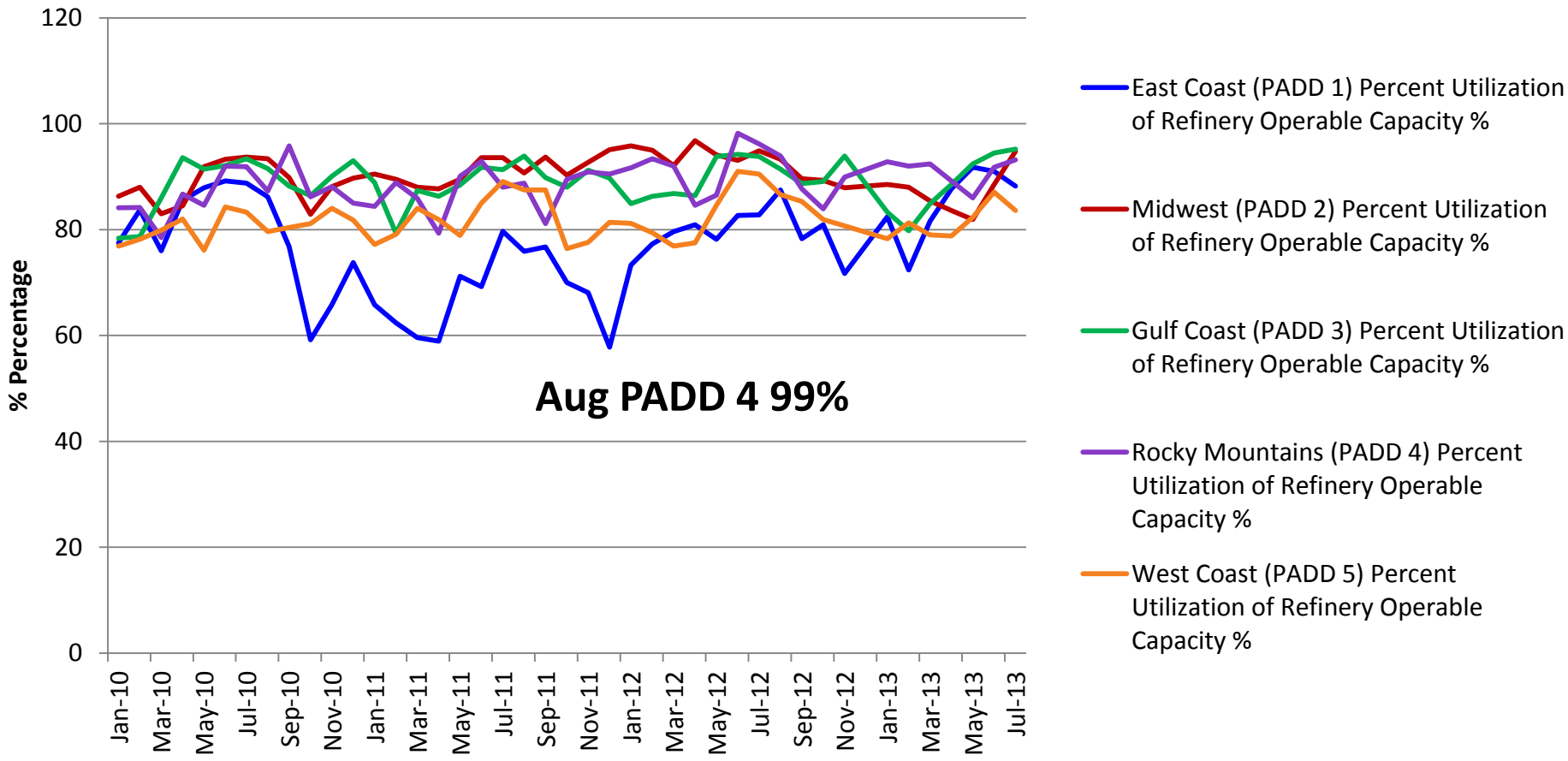
Refineries Benefit

Refinery Acquisition Cost of Crude Oil



Source: EIA

Refinery Utilization by PADD

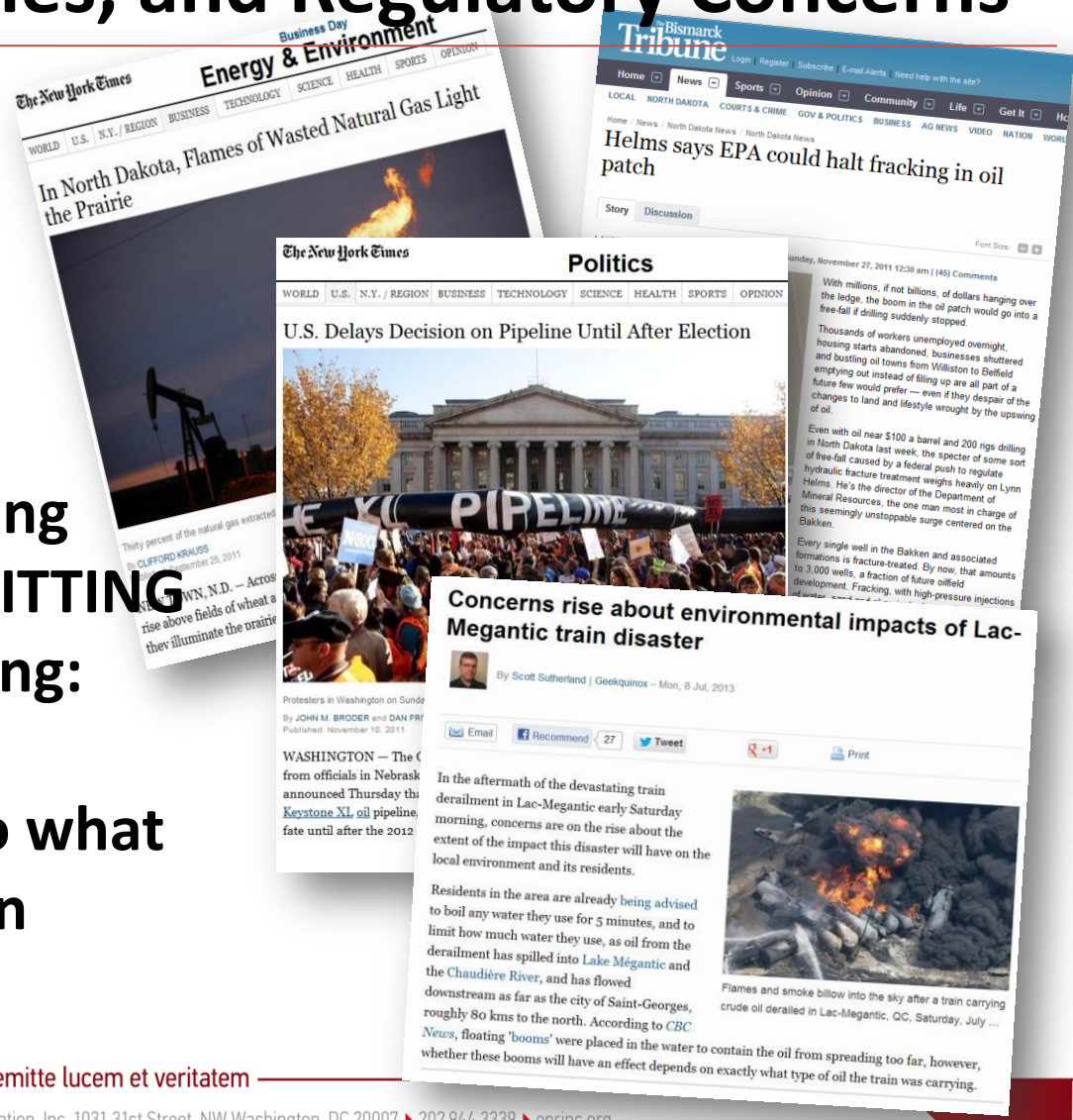


Source: EIA

Regulatory Concerns and Conclusions

Potential Issues, Hurdles, and Regulatory Concerns

- Oil prices
- Water Usage – Fracking and Recycling
- Oil spills (rail and pipeline)
- Environmental Concerns
- Regs on Federal Land-Fracking
- Infrastructure Delays-PERMITTING
- Lack of prudent policy making: failing to connect what is happening on the ground to what is understood in Washington
- Costs incurred



Conclusions

- Since 2008 the U.S. and Canada have added over 3 mbd of crude to global production, helping offset issues in Libya and the Middle East.
- Pipelines are being built, but right now their is tightness in the system and an increasing need for Gateway, XL, and other Coastal options for US and Canadian crude.
- Bakken crude has to get to the U.S. East and West Coasts (via rail) and heavy Canadian needs to get to the Gulf and West Coast (via pipeline and rail).
- Roughly 7.7 mbd of new capacity (as estimated by EPRINC) is comprised of pipeline reversals, expansions, twinning, repurposing, and retrofitting. There are serious regulatory and permitting hurdles which deserve consideration.
- Even with a narrowing spread, rail is a serious option for US producers distanced from refining centers, especially Bakken and Canadian crude—markets exist where pipelines do not (especially with XL delay and Gateway uncertainty).
- Market has changes for producers and refiners with optionality, market and regulatory uncertainty
- Rail will be here in the long term, the question is simply how much and where.
- Refineries are going to play a vital role in this renaissance as they adapt to high volumes of light sweet and heavy crude oils.

APPENDIX

Natural Gas Flaring


The New York Times

Business Day

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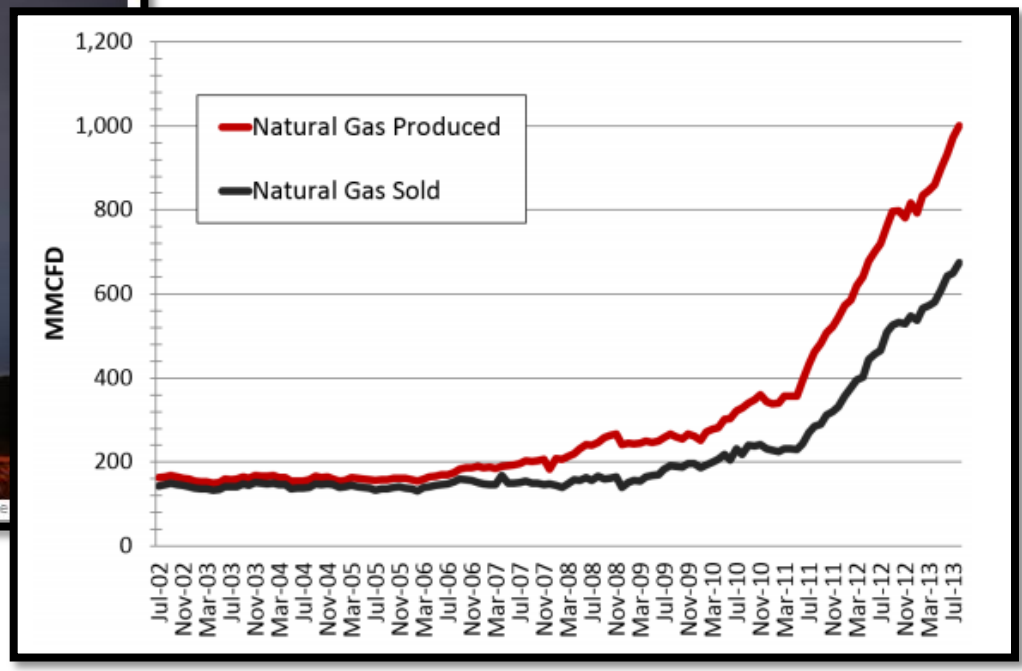
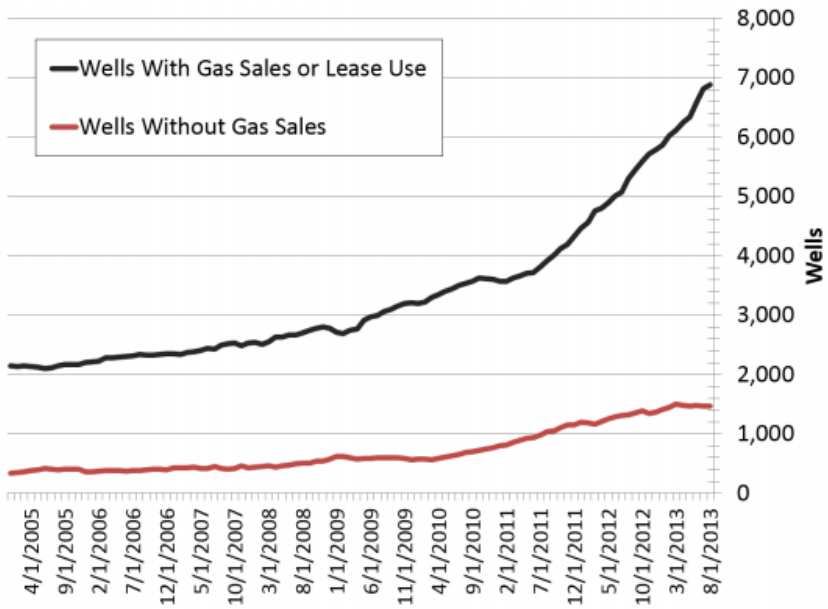
In North Dakota, Flames of Wasted Natural Gas Light the Prairie

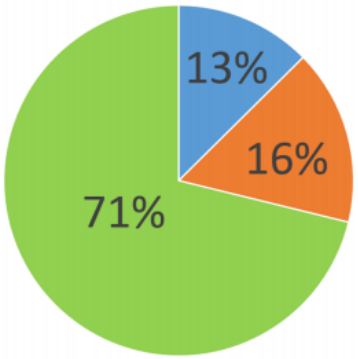
Jim Wilson/The



Source: NDPA

Why?

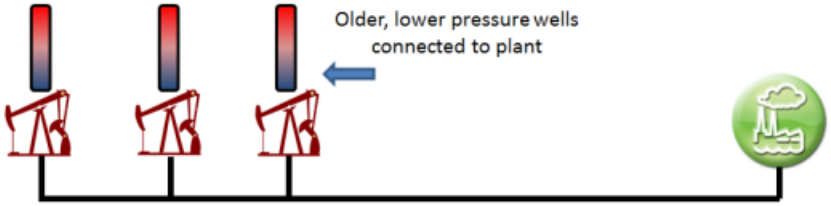


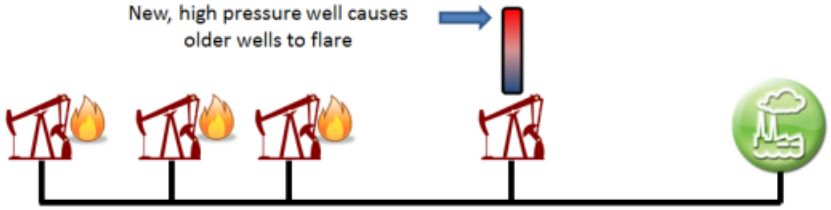


GREEN – % of gas captured and sold
Orange – % flared from wells with at least one mcf sold.
Blue – % flared from zero sales wells

Simple Terms

GREEN – Gas is sold to consumers
Orange – Challenges on existing infrastructure
Blue – Lack of pipelines





Source: NDPA

Value of an Oil Well in North Dakota

Typical 2012 North Dakota Bakken well will produce for 29 years (enhanced oil recovery efforts could extend the life of the well)

In those 29 years the average Bakken well:

- Produces approximately 580,000 barrels of oil
- Generates over $22 million net profit
- Cost $8,500,000 to drill and complete (up from 7.3 last year)

- Pays approximately $4,610,000 in taxes
    - $2,200,000 gross production taxes
    - $2,000,000 extraction tax
    - $410,000 sales tax
    - Pays royalties of $7,925,000 to mineral owners
    - Pays salaries and wages of $1,500,000
    - Pays operating expenses of $2,300,000

Source: ND Department of Mineral Resources 2012 Presentation

Cost of Oil Sands Production

Estimated Initial Capital Expenditure (CAPEX) and Threshold[a] Prices for New Oil Sands Projects

	CAPEX ($Cdn / bbl of capacity, Cdn$2010)	**Economic Threshold** (WTI US$ equivalent / bbl, US$2010)
Mining, Extraction and Upgrading	$85,000-$105,000	$85-$95
Mining and Extraction Only (No upgrading)	$60,000-$75,000	$65-$75
Steam-assisted Gravity Drainage (SAGD)/Cyclic Steam Stimulation (CSS)	$25,000-$40,000	$50-$60

(a) Includes a realistic after-tax rate of return, commonly in the order of 10 to 15%.

Source: "Canada's Energy Future: Energy Supply and Demand Projections to 2035." Nov 2011. NEB

Source: PacWest Consulting