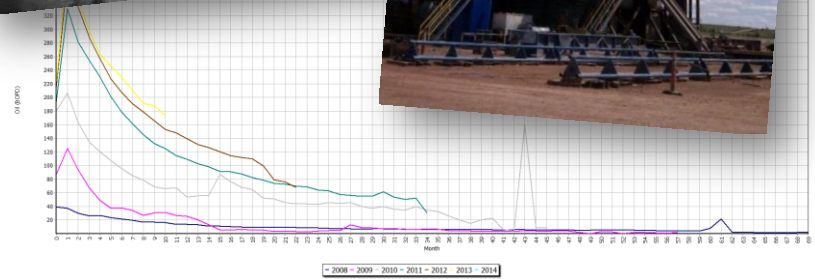


Challenges and Opportunities of the North American Petroleum Renaissance



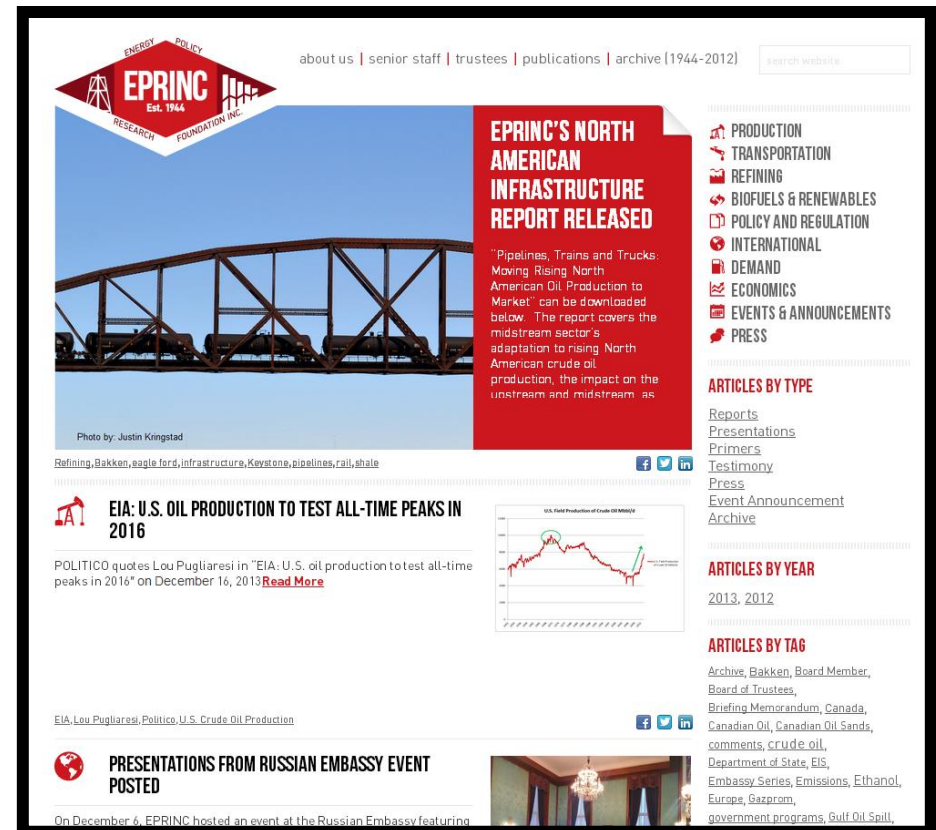
Trisha Curtis, Director of Research, Upstream and Midstream
Energy Policy Research Foundation, Inc. (EPRINC)
ESCP Europe Business School
January 31st, 2014



About EPRINC

- Founded in 1944
- Not-for-profit organization that studies energy economics and policy issues in the oil, natural gas, and petroleum product markets
- Provides objective and technical analysis on a wide range of energy issues
- Funded largely by the private sector and occasional U.S. government contracts

www.eprinc.org



EPRINC Embassy Series

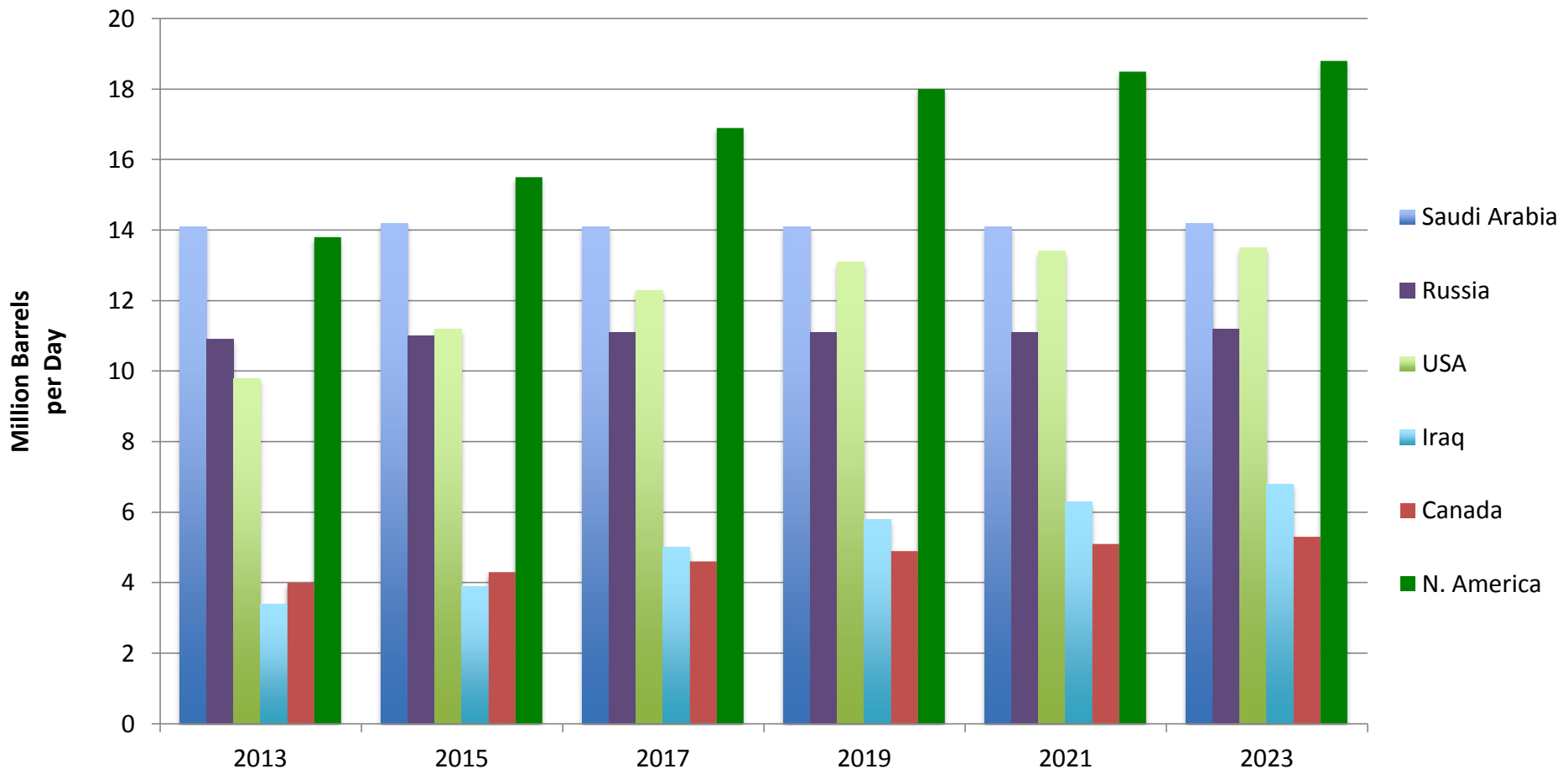
- Engagement with Washington's energy policy community
- Collaboration among the diplomatic community to provide both an interesting venue and constructive policy discussion
- The series offers an opportunity to gain a greater understanding of U.S. energy policy in an era of expanding U.S. supplies of oil and gas



Recent and Upcoming Projects/Events

- Pipelines, Trains, and Trucks
- RINs around the Rosy
 - EPA Administrator app – will be released shortly for iOS / iPhone
- Department of Defense contract: Global Implications of the North American Petroleum Renaissance
- Clingengdael Presentation
- Presentations at Chatham House and Imperial College London
- Next Embassy Event
- Collaborative research efforts with the University of Texas on petroleum exports
- Williston Basin Petroleum Conference Presentation

Importance of the North American Lens

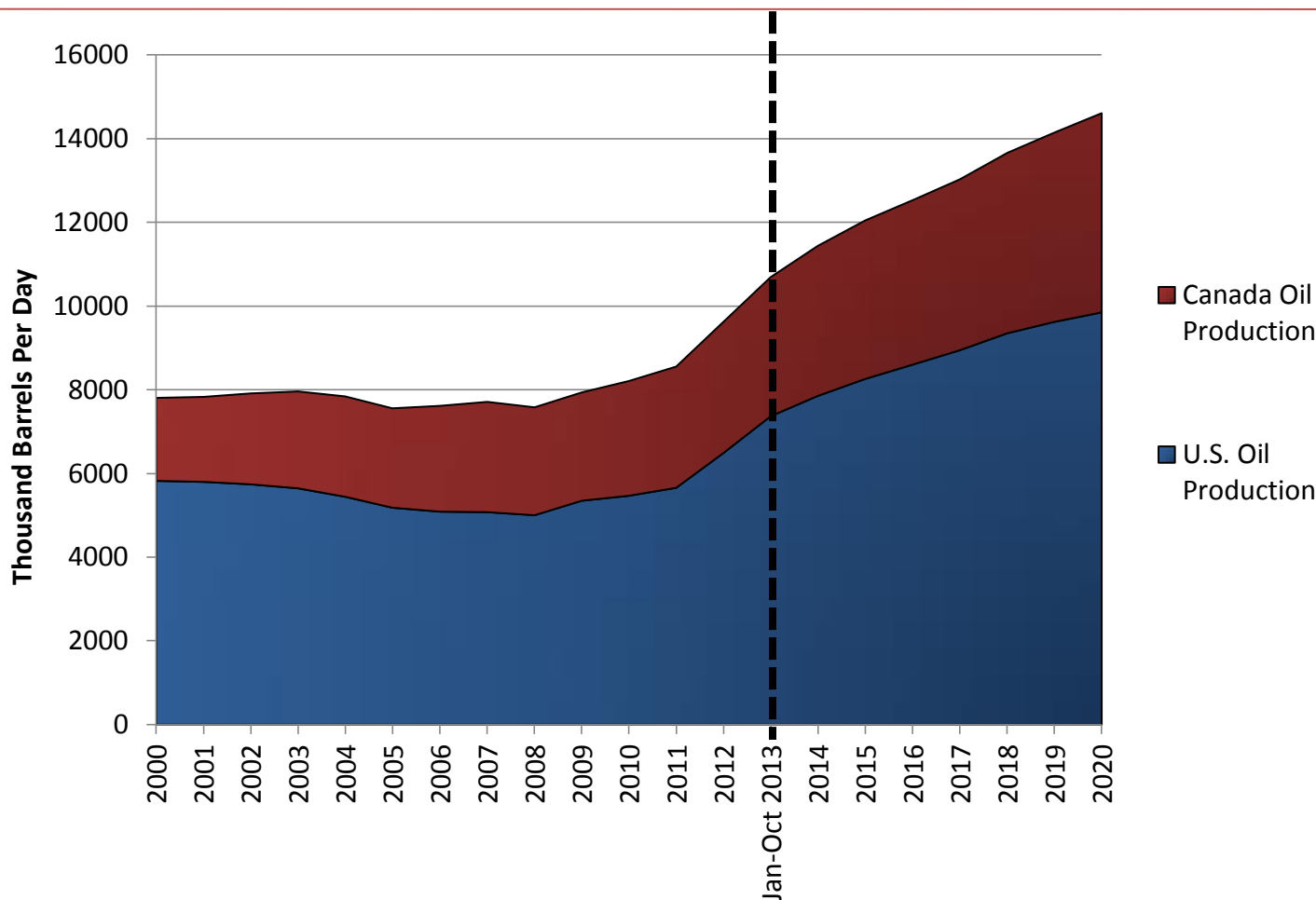


Source: Wood Mackenzie (includes NGLs)

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

North American Oil Production and Forecast



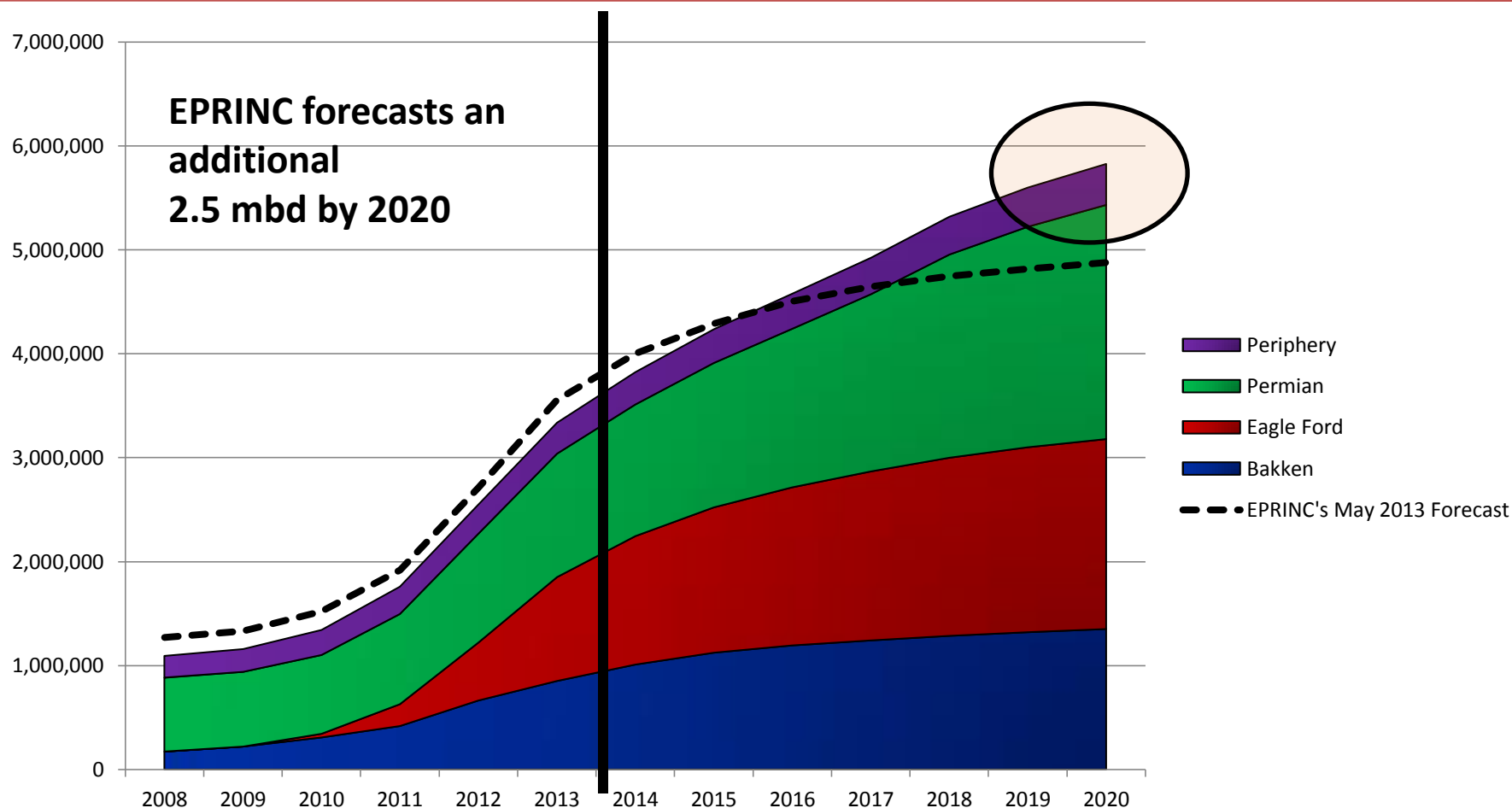
Avg 2013 Oil Production

**U.S. 7.4 mbd
Canada 3.3 mbd**

Source: EIA, Canadian CAPP forecast, EPRINC U.S. forecast, EPRINC Mexico, and EPRINC estimates

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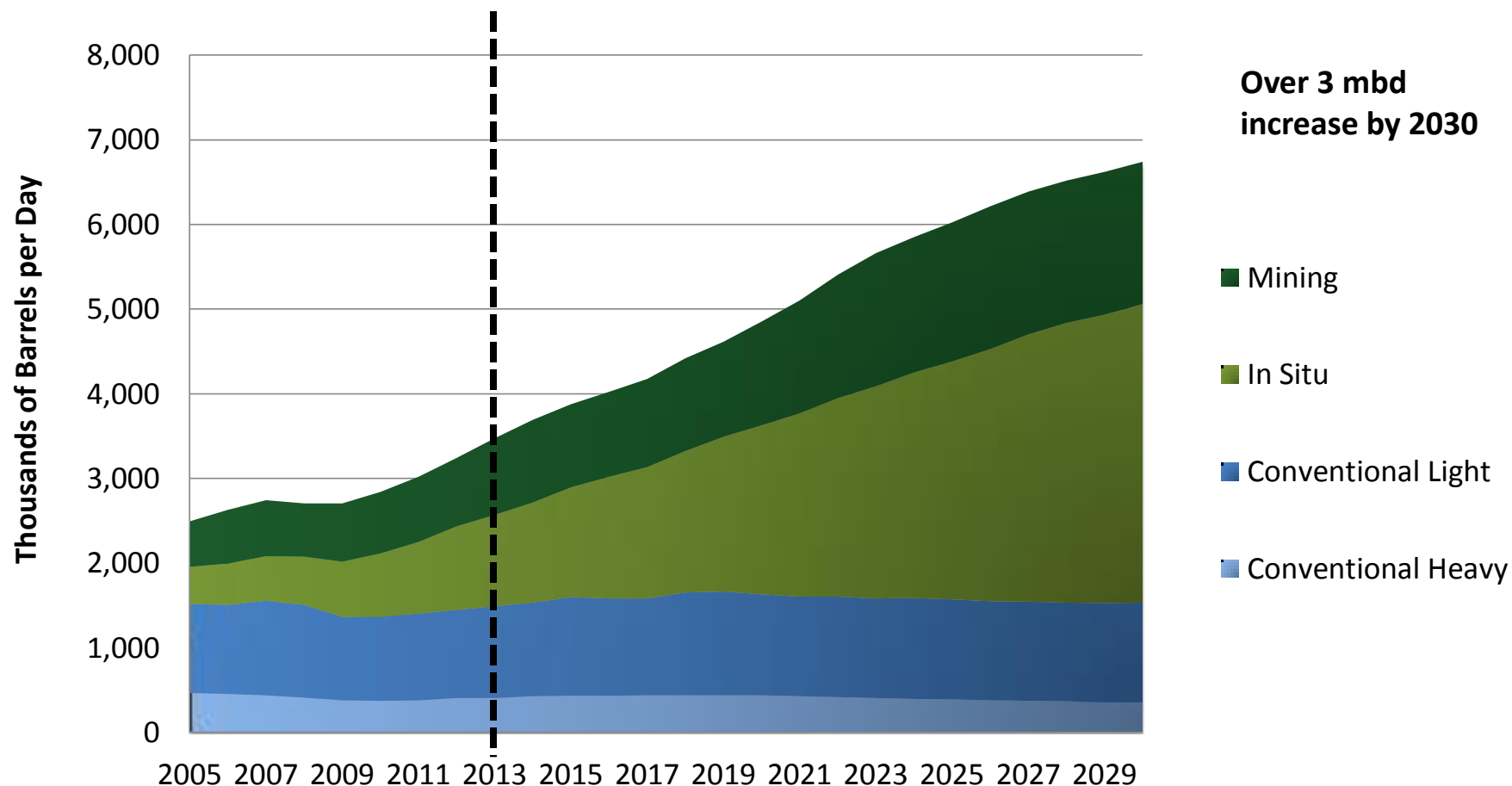
Jan 2014 EPRINC's Forecast for Major U.S. Shale Plays



Source: HPDI data with EPRINC forecast estimates

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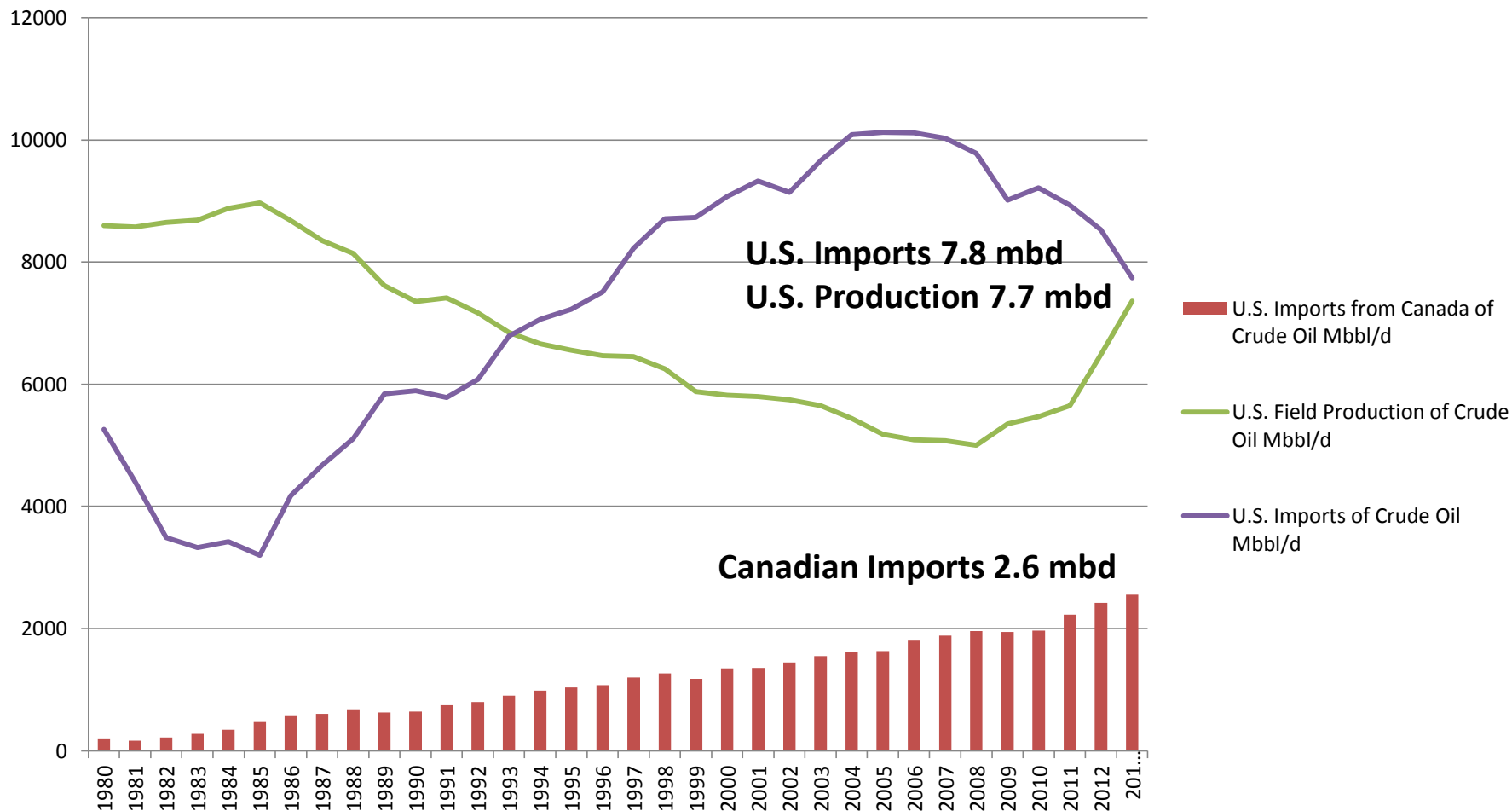
Canadian Long-Term Production Forecast



Source: Canadian Association of Petroleum Producers

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

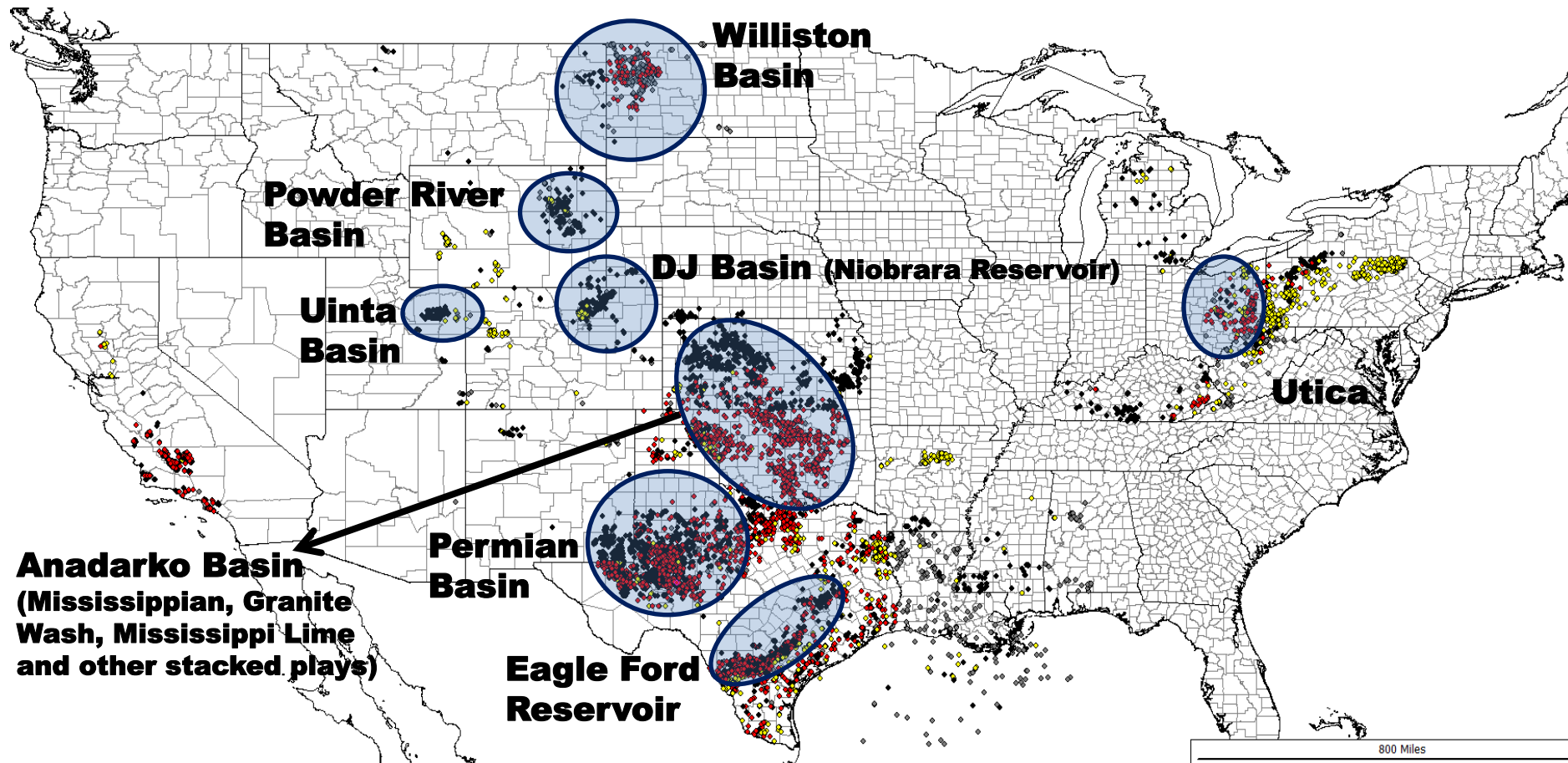


Source: EIA

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U.S. Activity

Permit Activity



Source: HPDI January 18 2014, Past 90 Days

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Drilling Then and Now

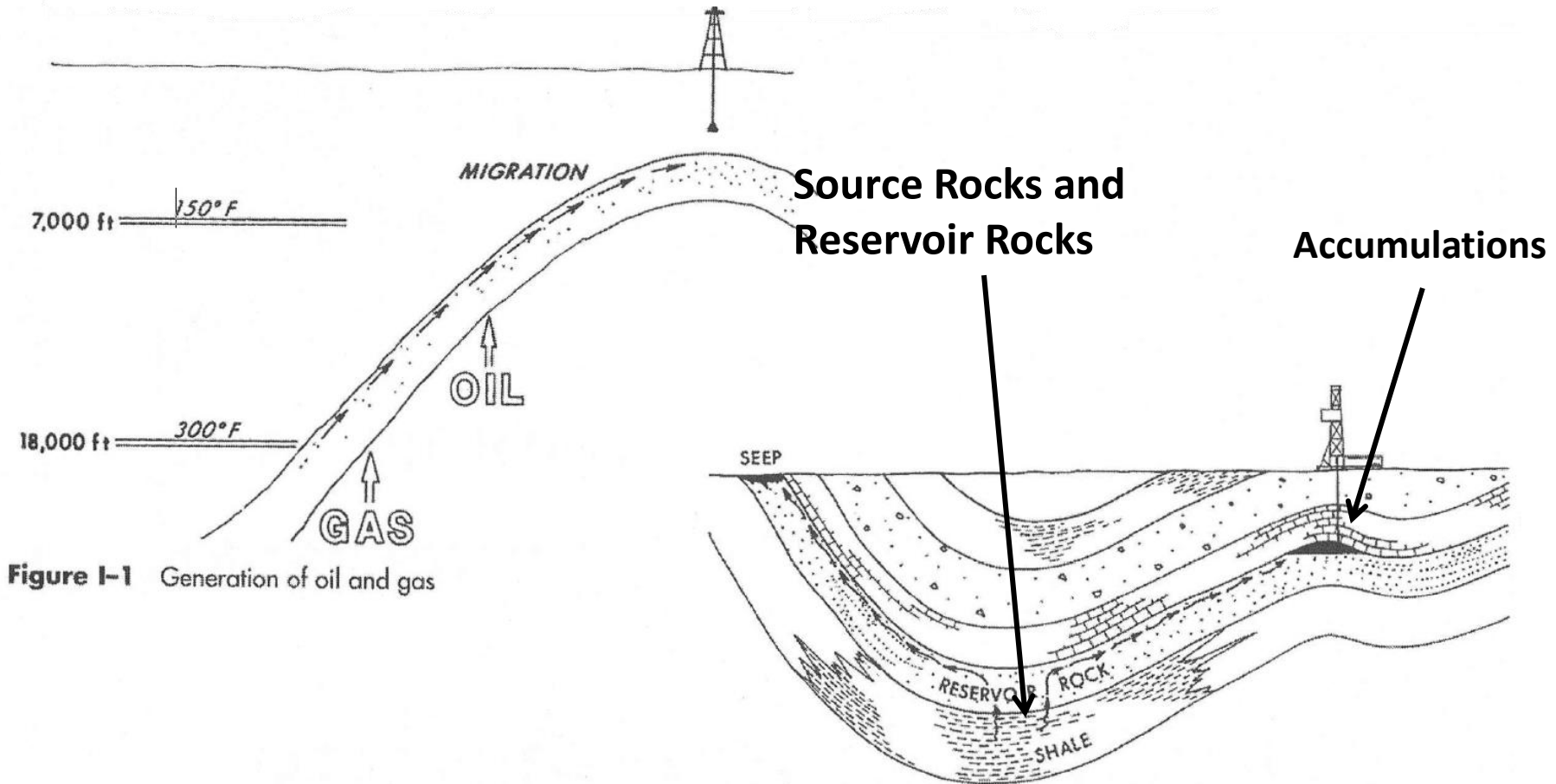


Figure 11-2 Migration of oil and gas in a sedimentary basin

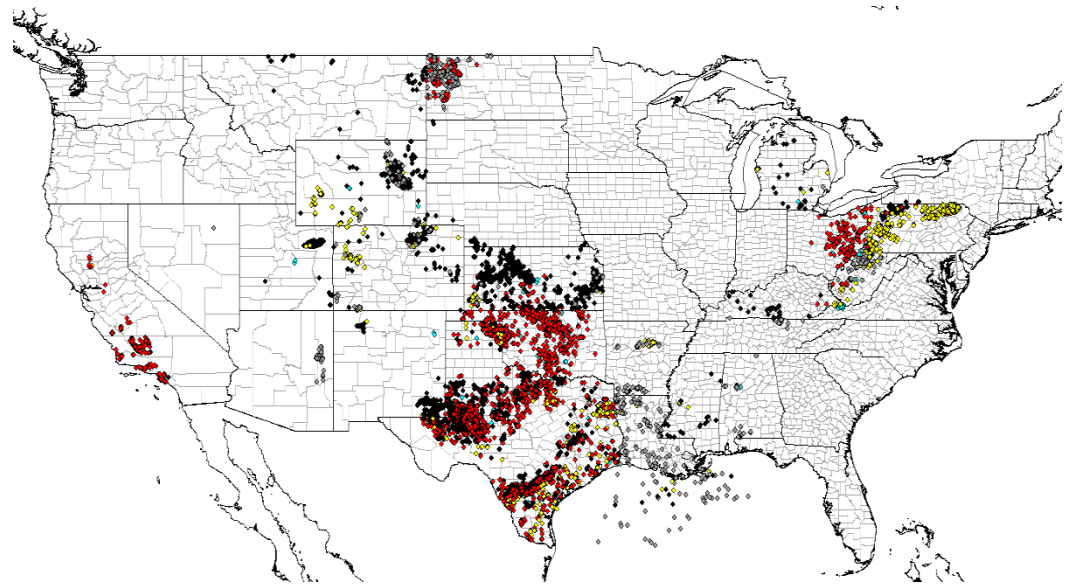
Source: From PIECE Course Workbook, Mark J Kaiser, Houston, July 2008, "Introduction to USA Petroleum Industry"

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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.



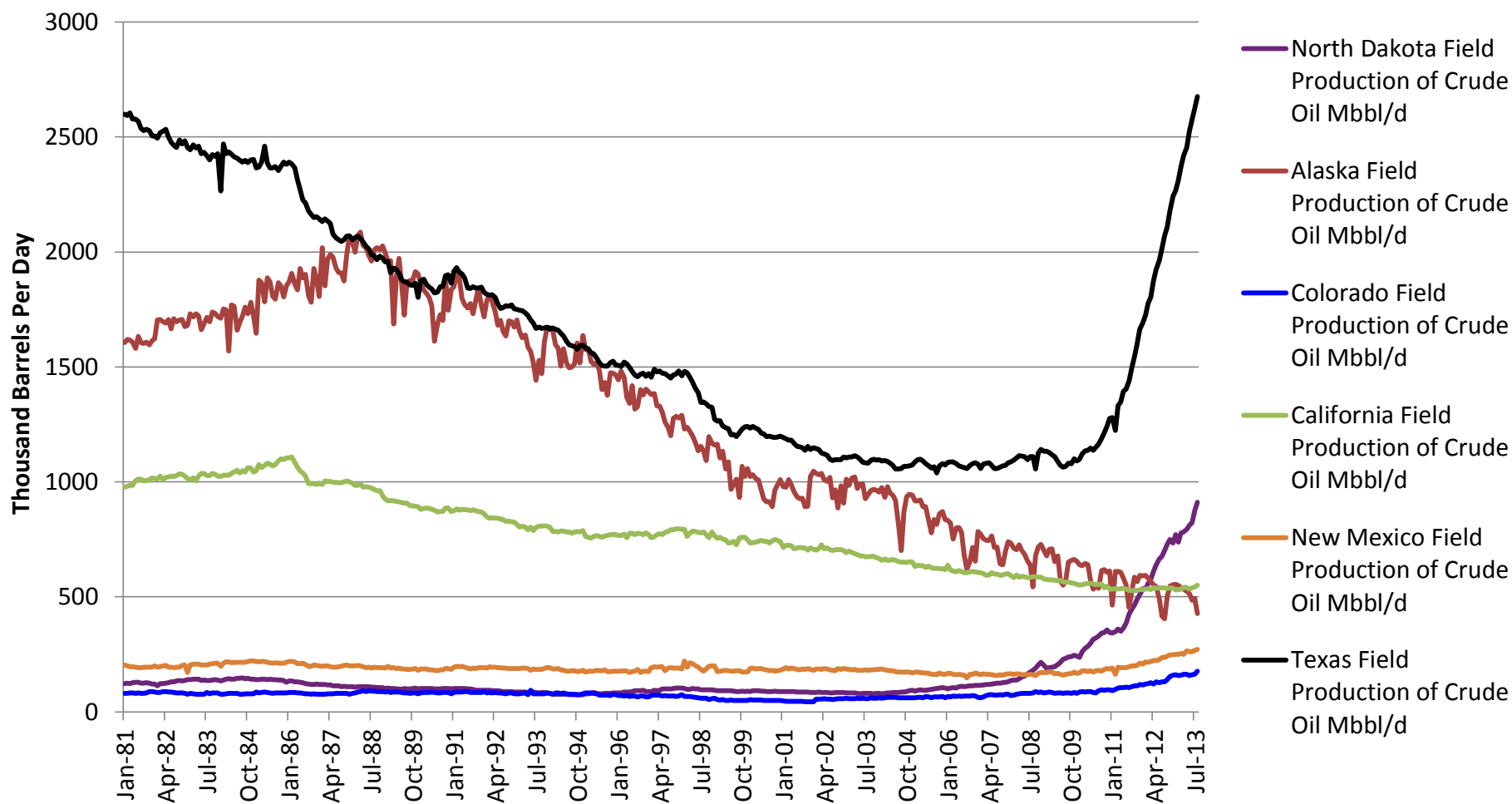
So how much oil is there...?

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

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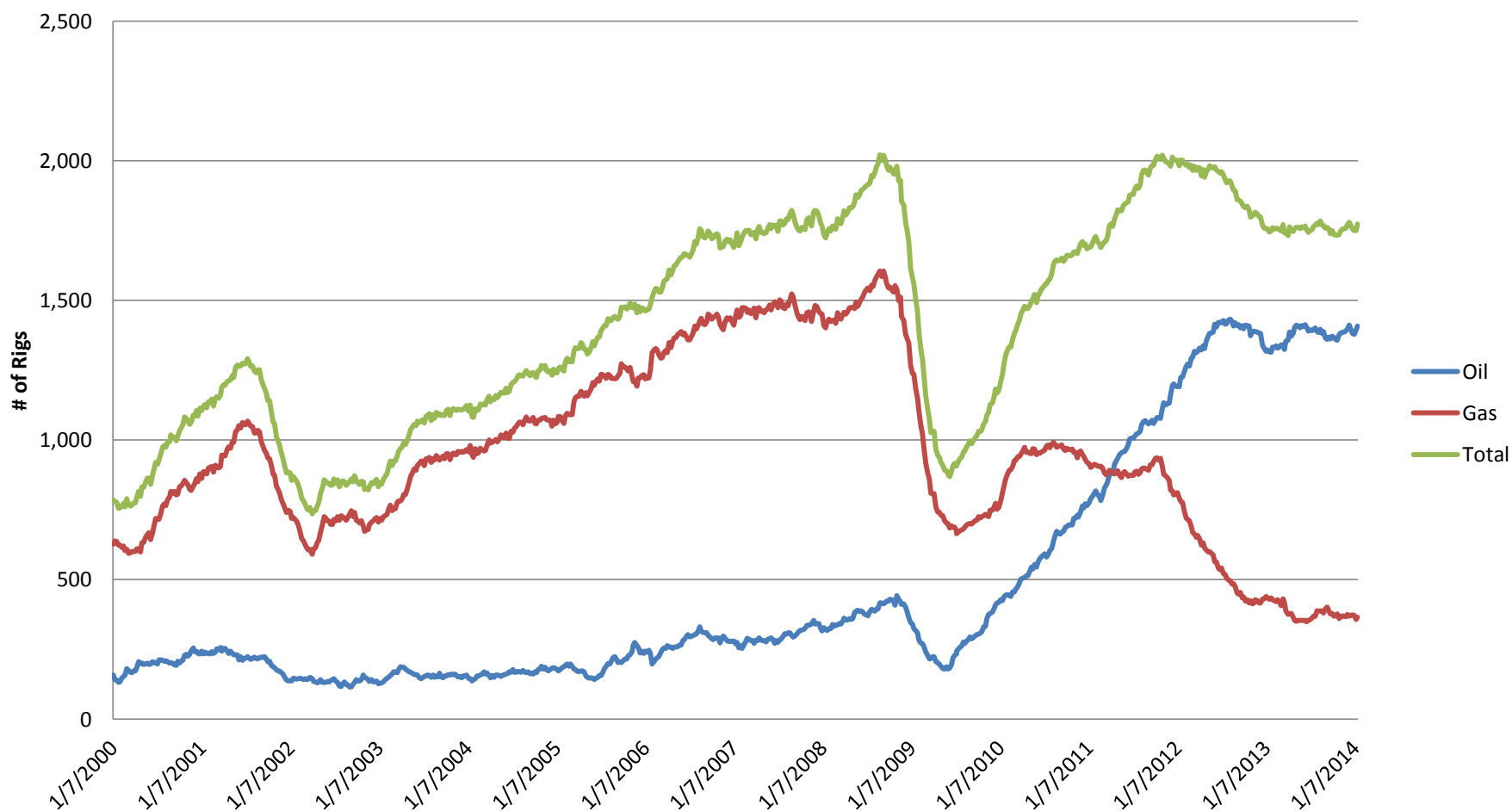
State Production Trends



Source: EIA

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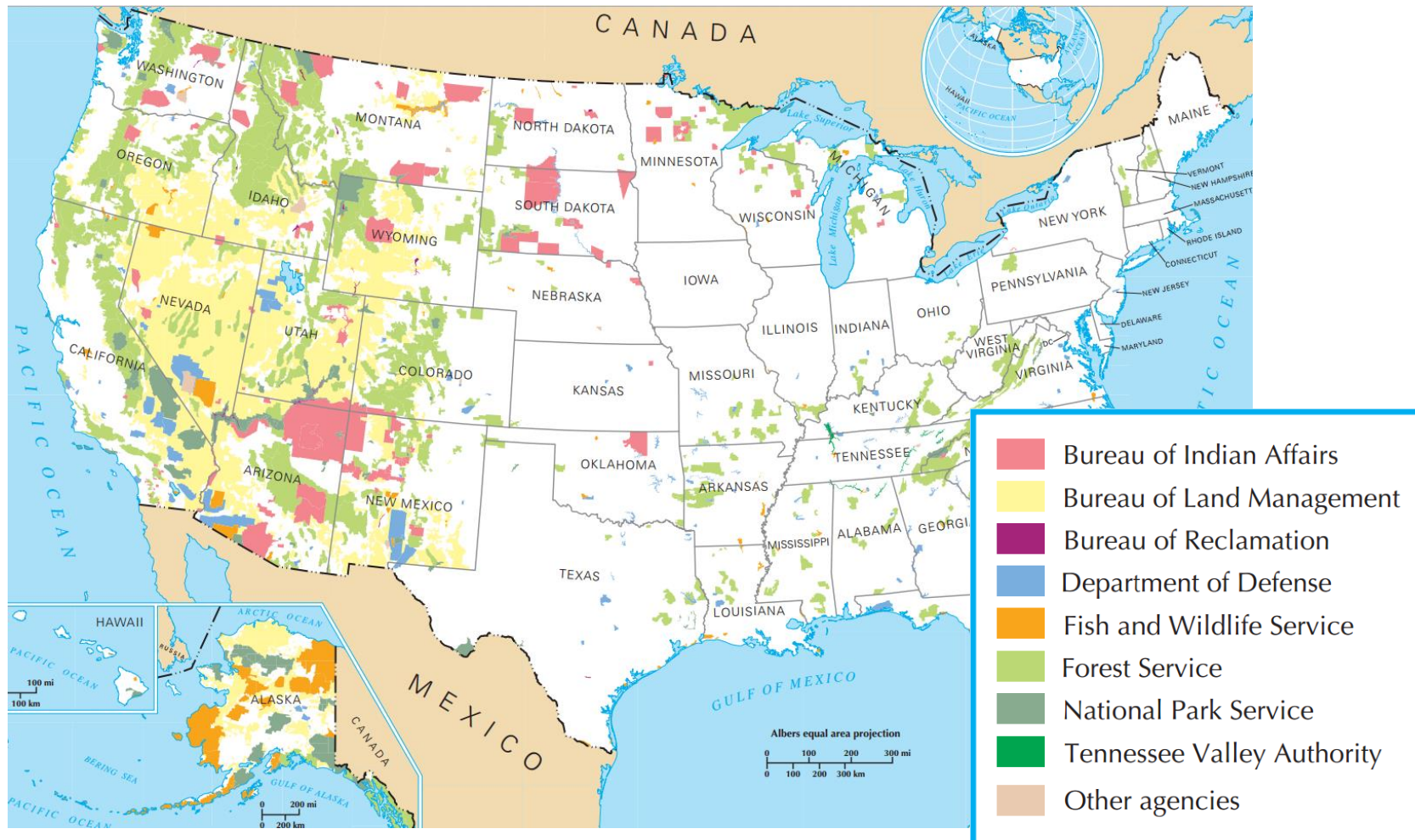
U.S. Rig Count



Source: Baker Hughes

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Part of the U.S. story

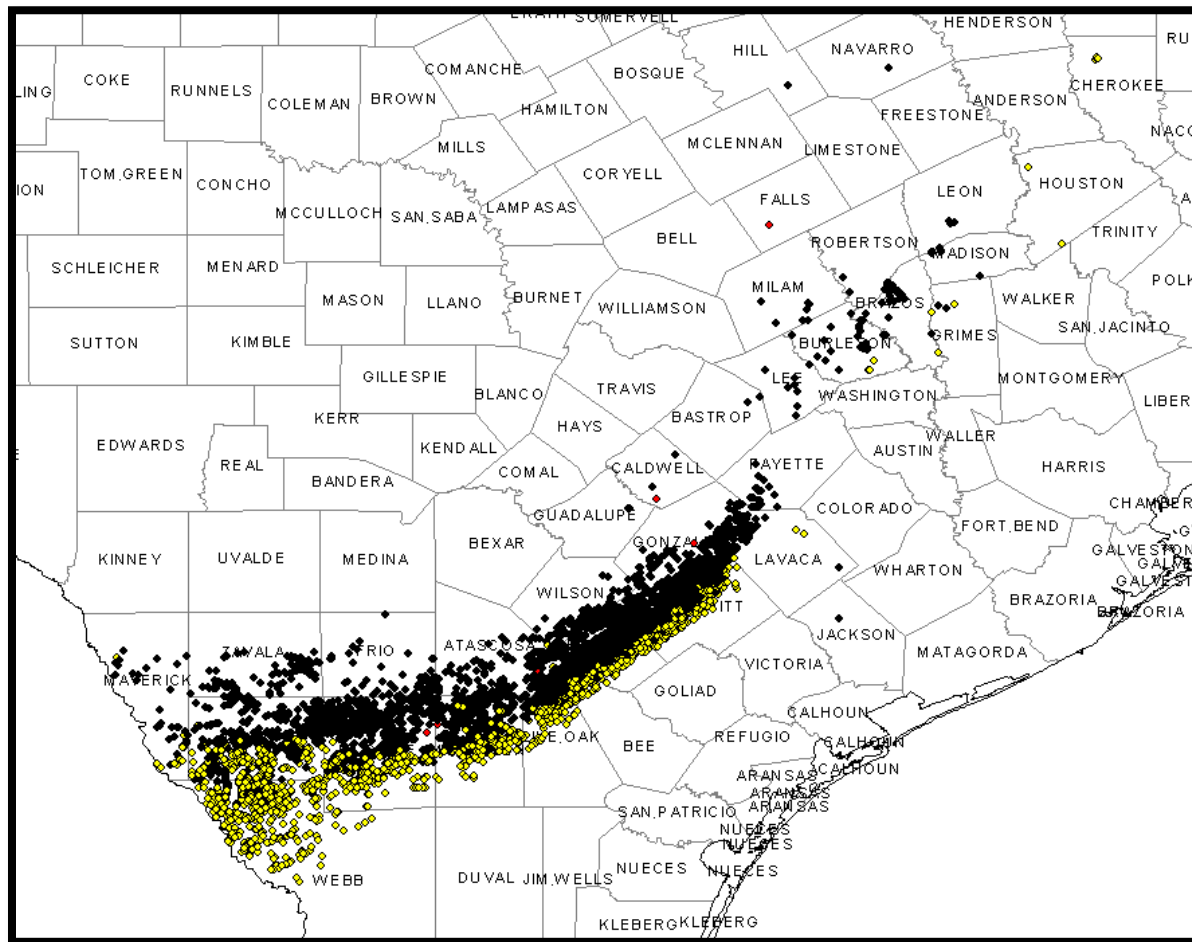


Source: NationalAtlas.gov

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The Soaring Eagle Ford

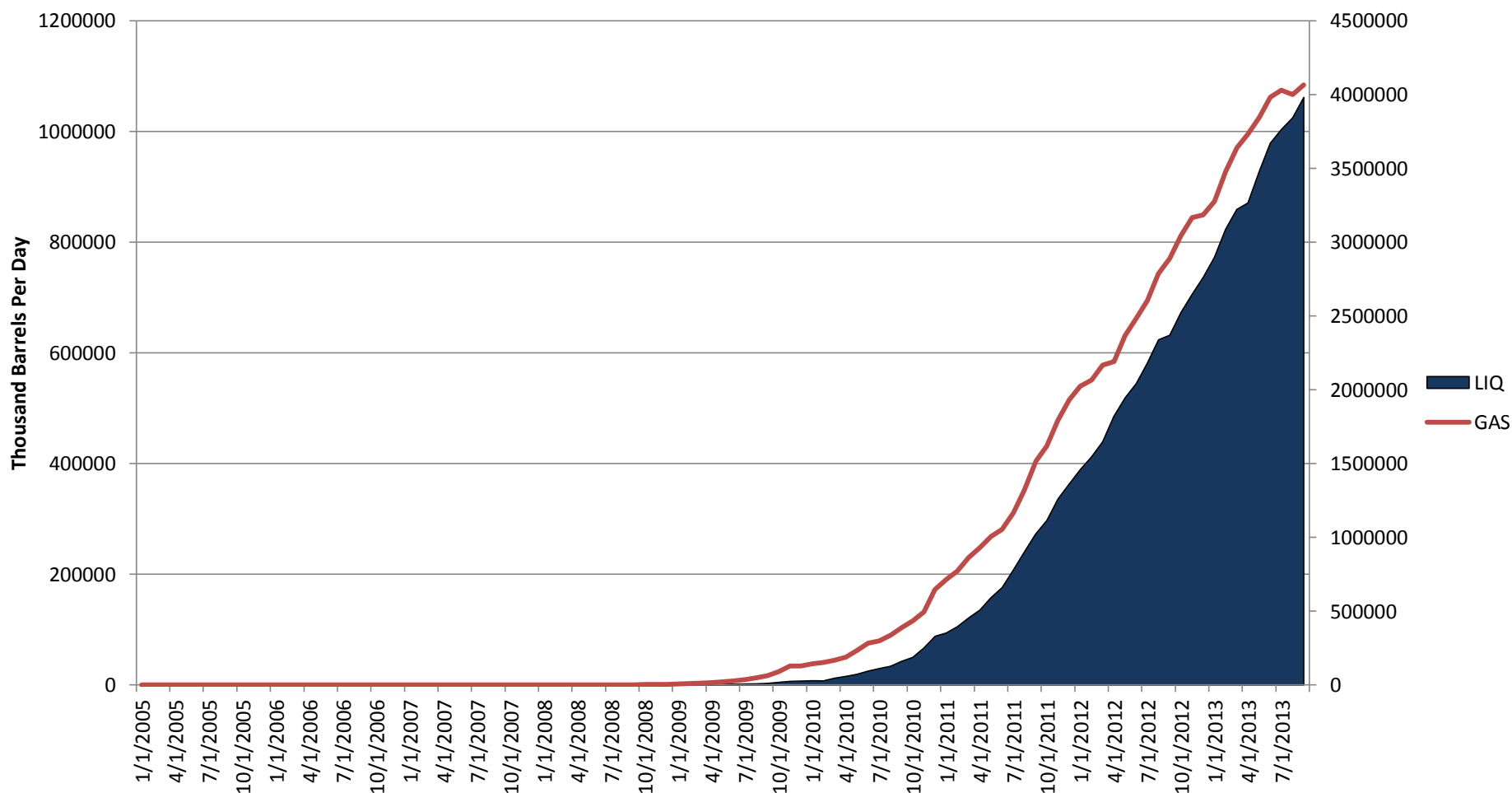
Eagle Ford Wells



Source: HPDI Nov 2013

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Eagle Ford Production

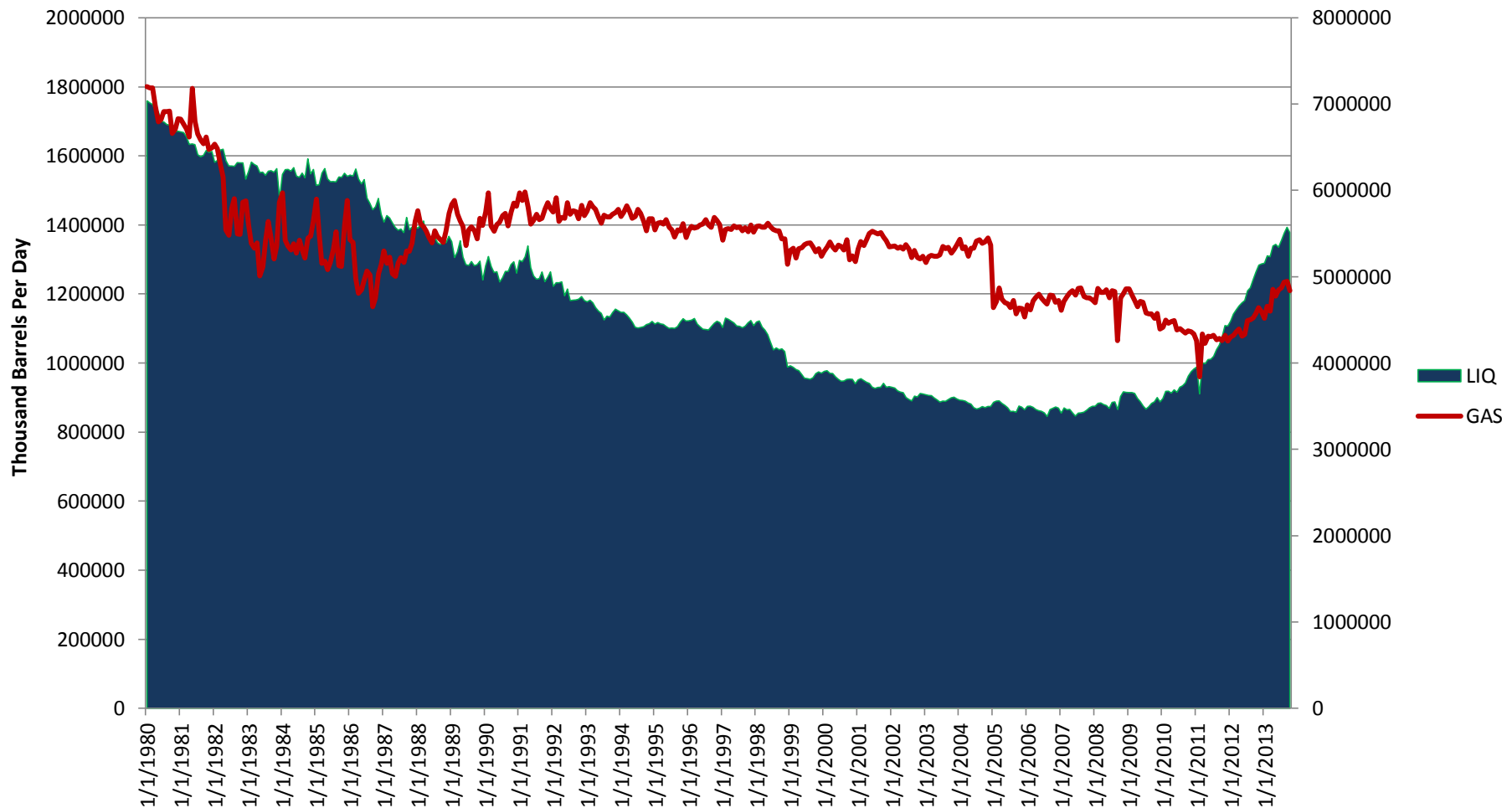


Source: HPDI Nov 2013

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The Prolific Permian Basin

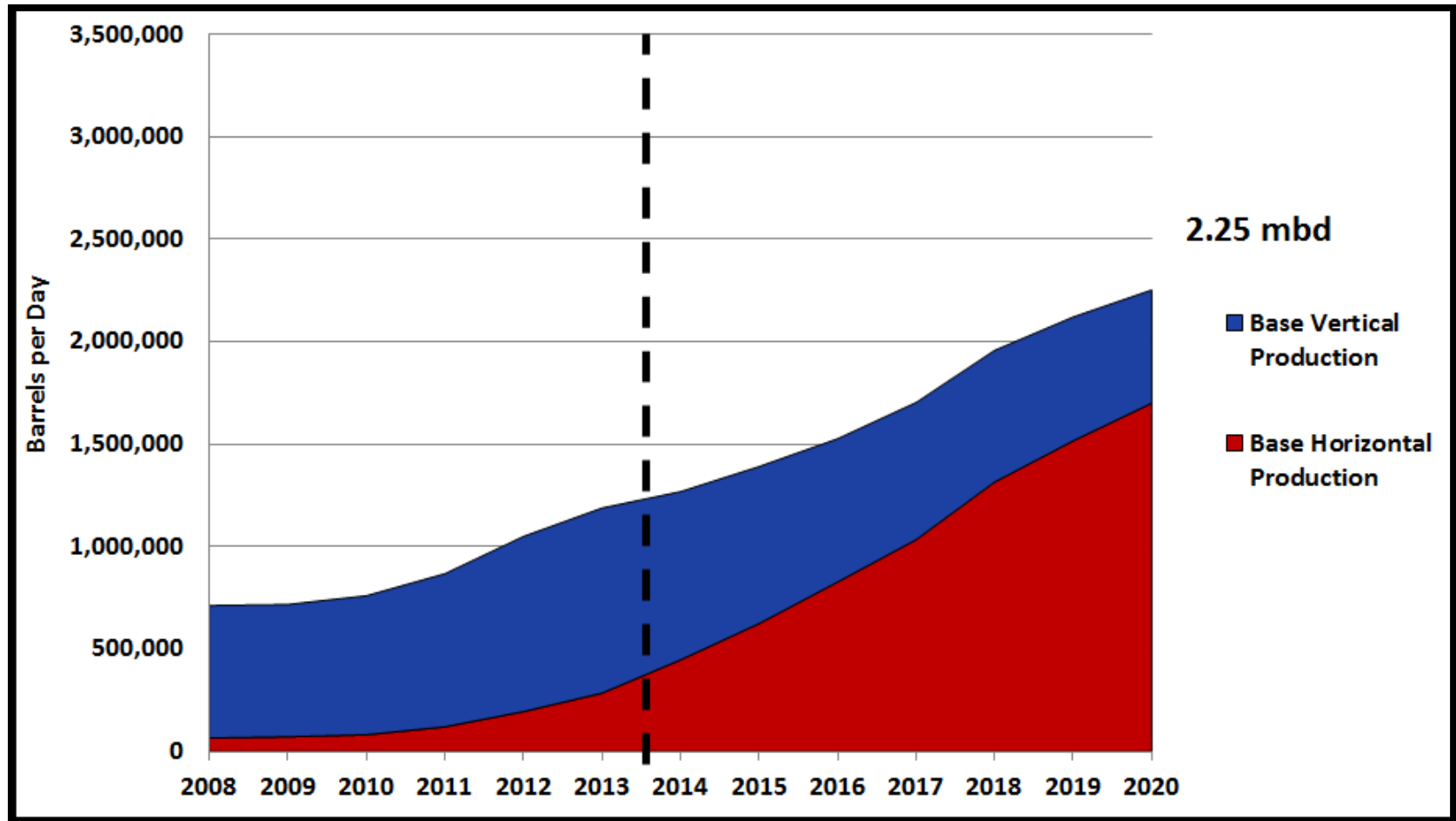
Permian Basin Production 1.38 mbd



Source: HPDI Oct 2013

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EPRINC November Revised Permian Forecast

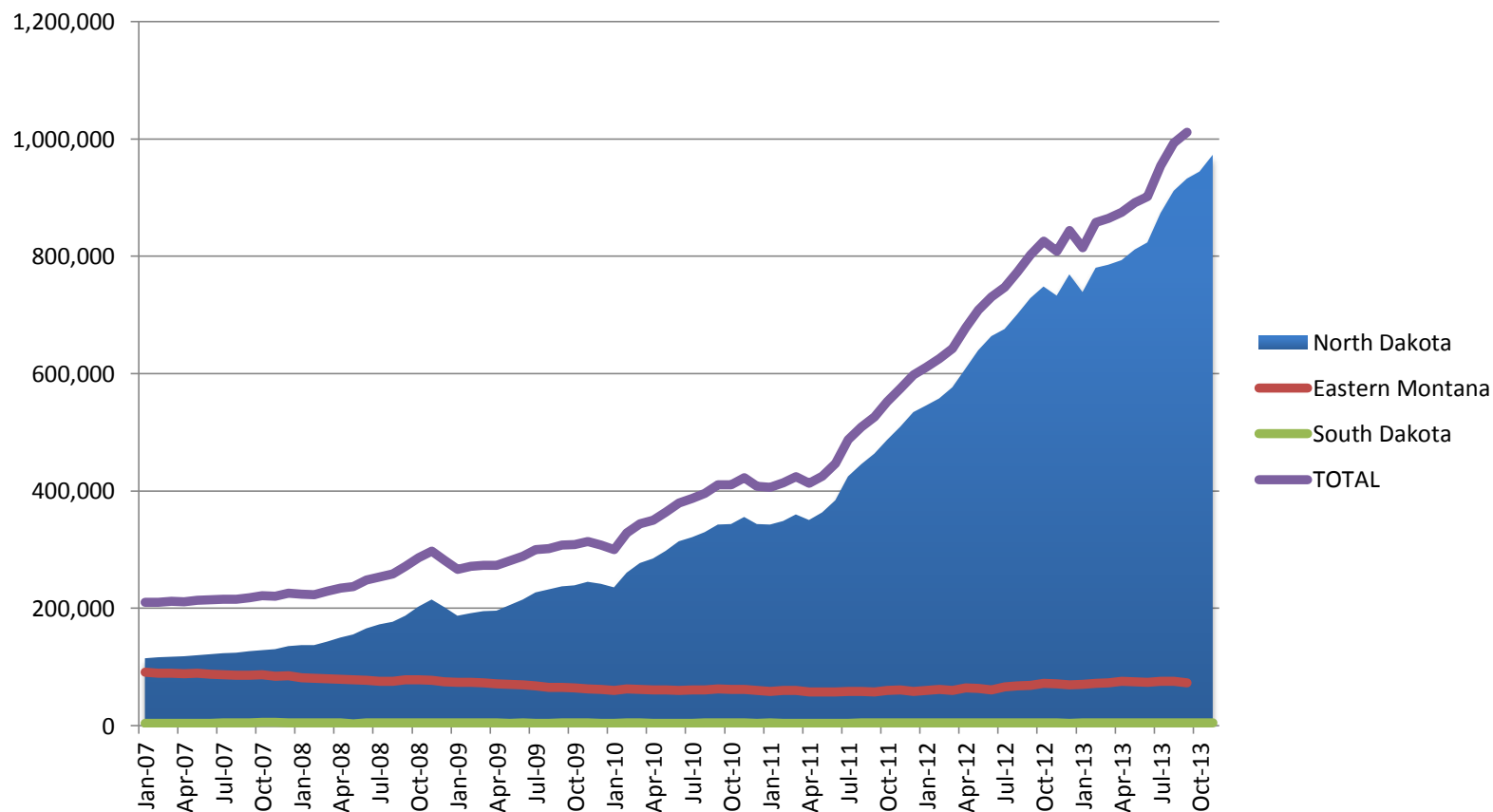


Source: EPRINC

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Bakken: The Case Study

Williston Basin Production

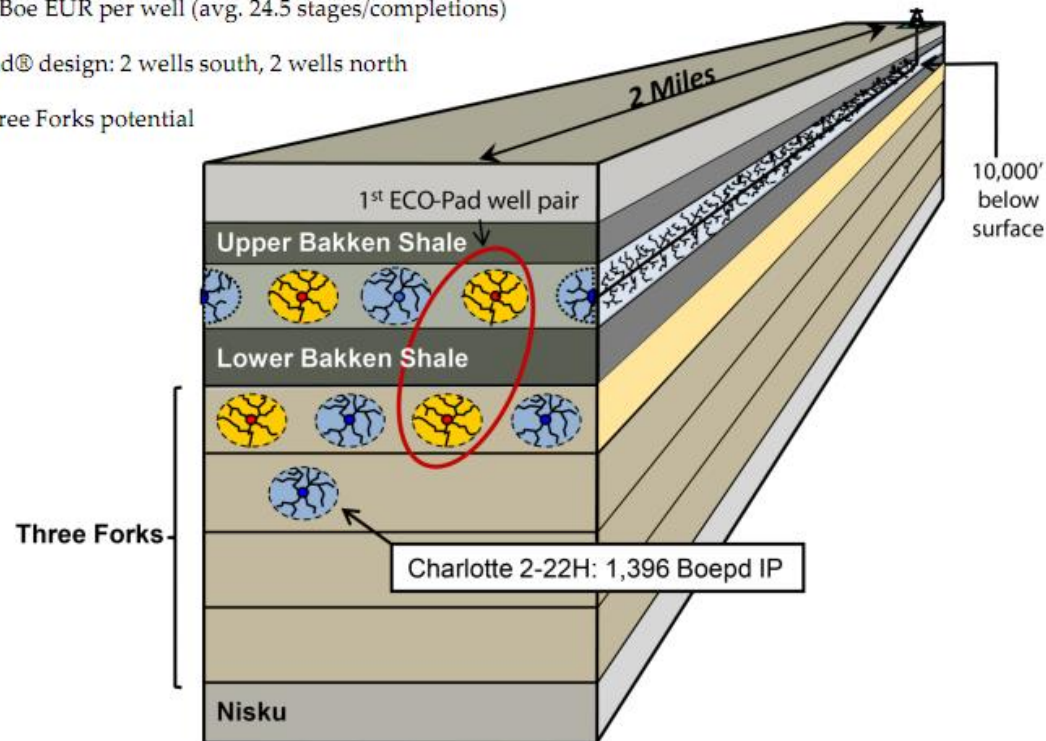


Source: NDIC

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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



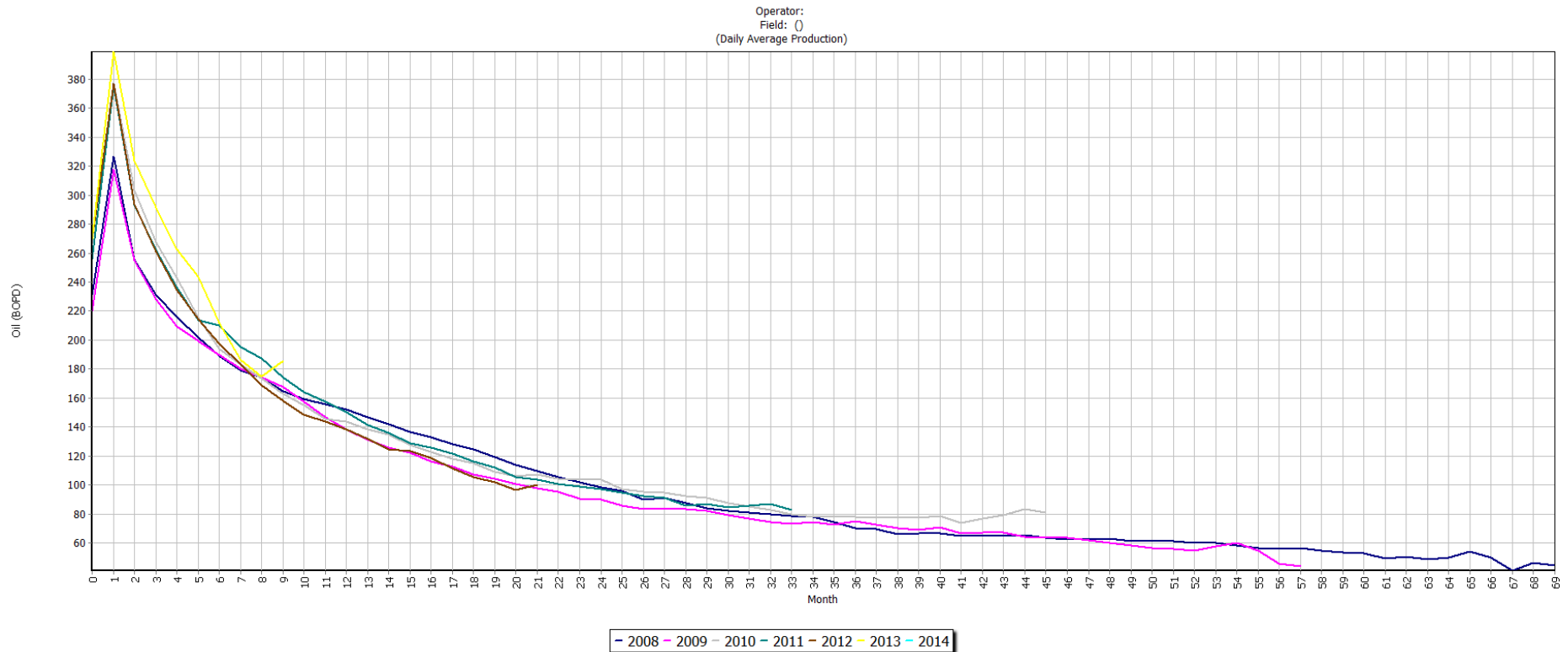
Source: Continental Resources Inc., Corporate Presentation, 2012.



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

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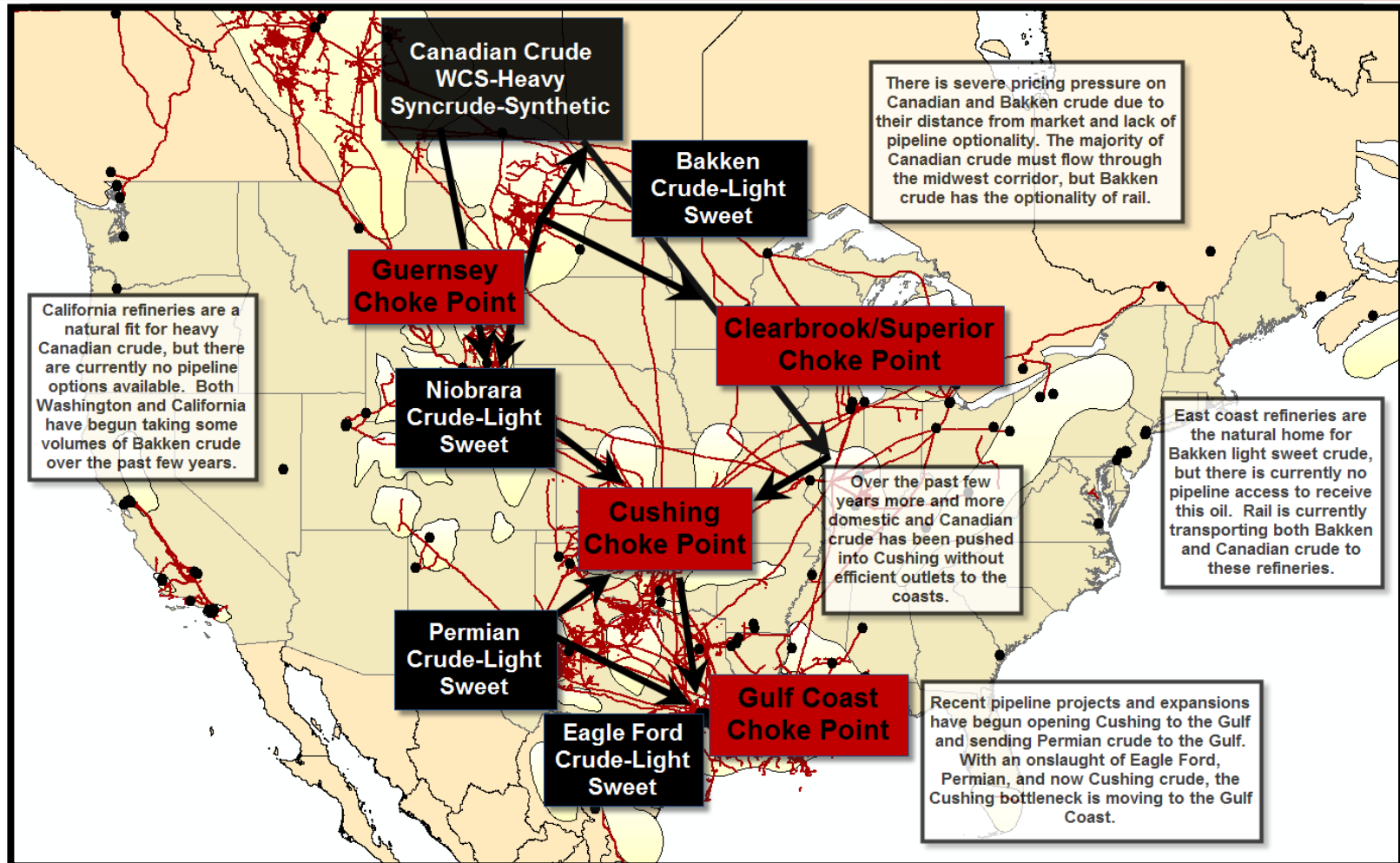
Decline Rates



Source: HPDI, Bakken

Infrastructure Challenges

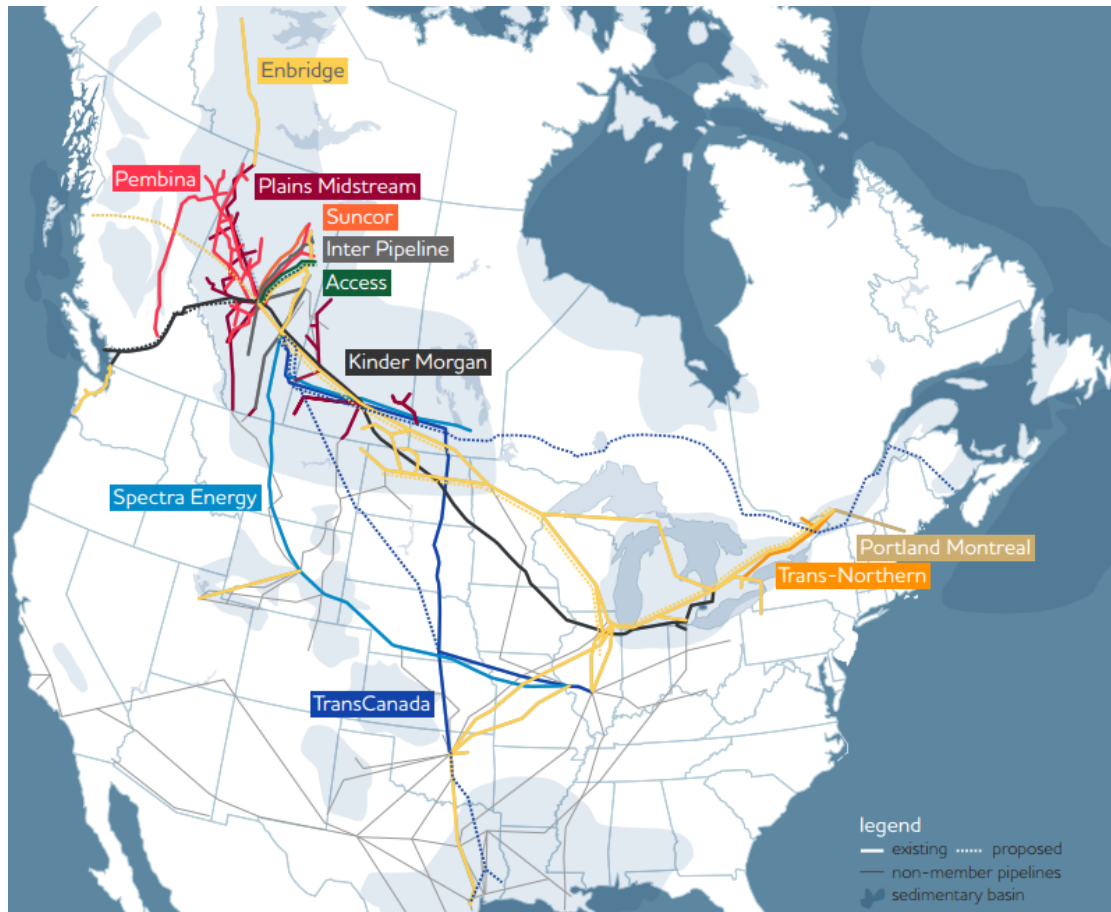
Pipeline Choke Points



Source: EPRINC Choke Point Map using Hart ArcGIS Mapping software

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All Canadian Pipeline Export Options are Full

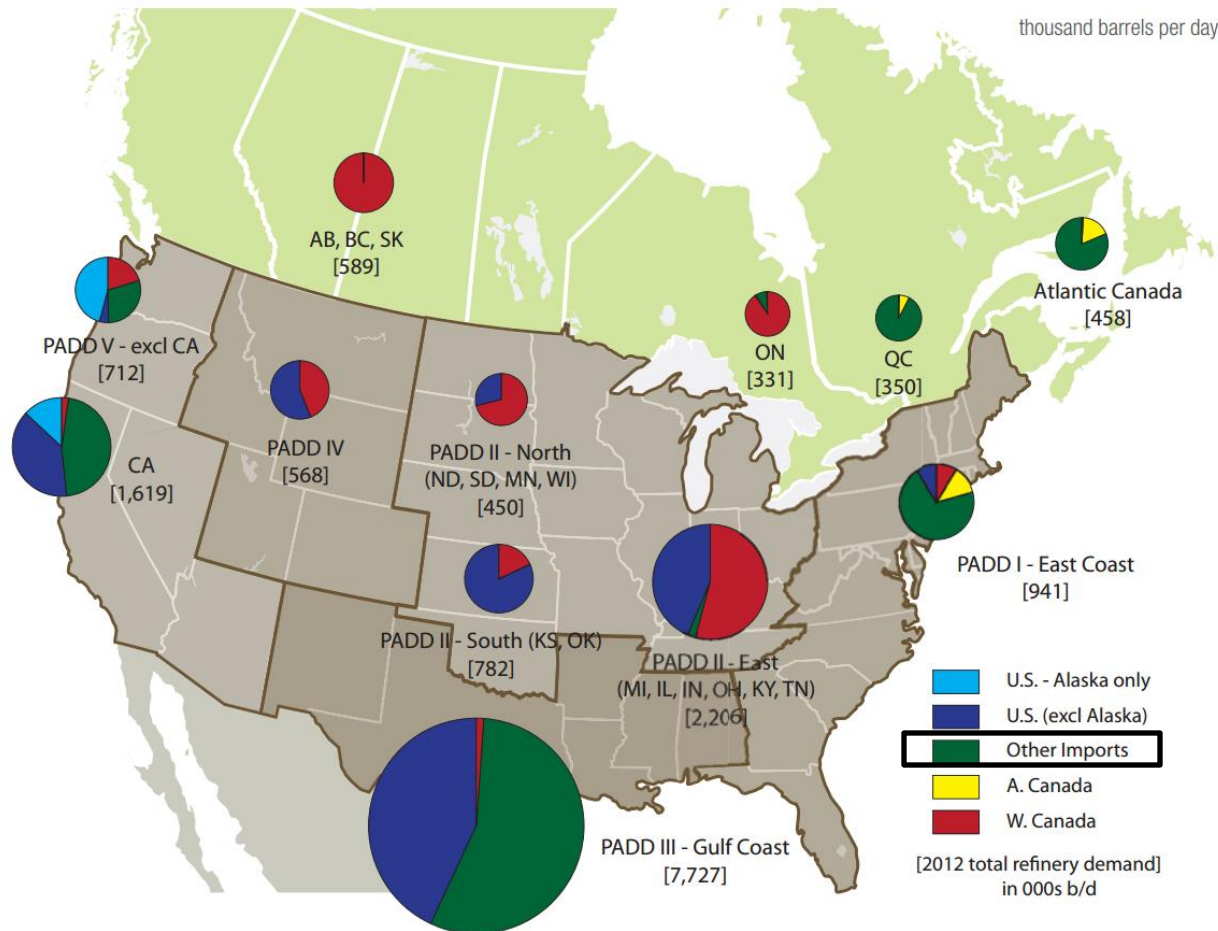


- **Kinder Morgan's** Transmountain line off BC coast - currently 300,000 b/d capacity-recent announcements to expand up to 800,000 b/d (early 2017)
- **(Now Spectra)** Platte line to Wood River 280,000 b/d-full
- **Enbridge** mainline system currently transporting over 1.5 mbd with potential capacity around 2.5 mbd—Northern Gateway off BC coast planned 525,000 b/d, several other planned expansions, light oil access +400,000 b/d
- **TransCanada's** Keystone 581,000 b/d-full—XL would add 700,000 b/d, Energy East Pipeline Project 500 to 800k

Source: Canadian Energy Pipeline Association

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Market Saturation

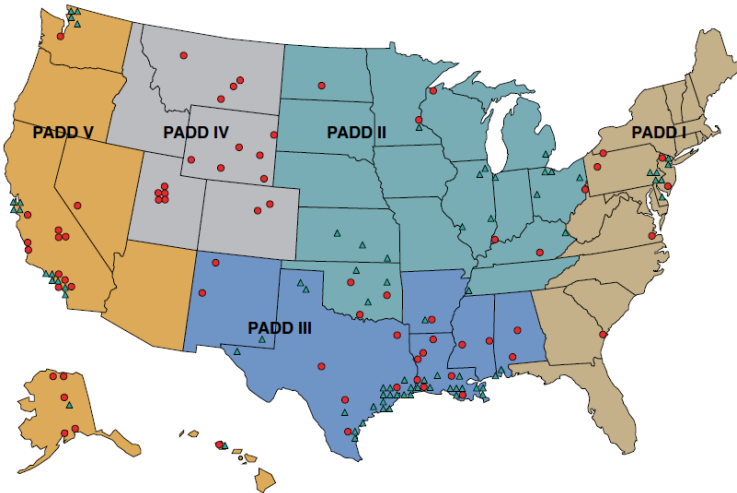


Sources: CAPP, CA Energy Commission, EIA, Statistics Canada

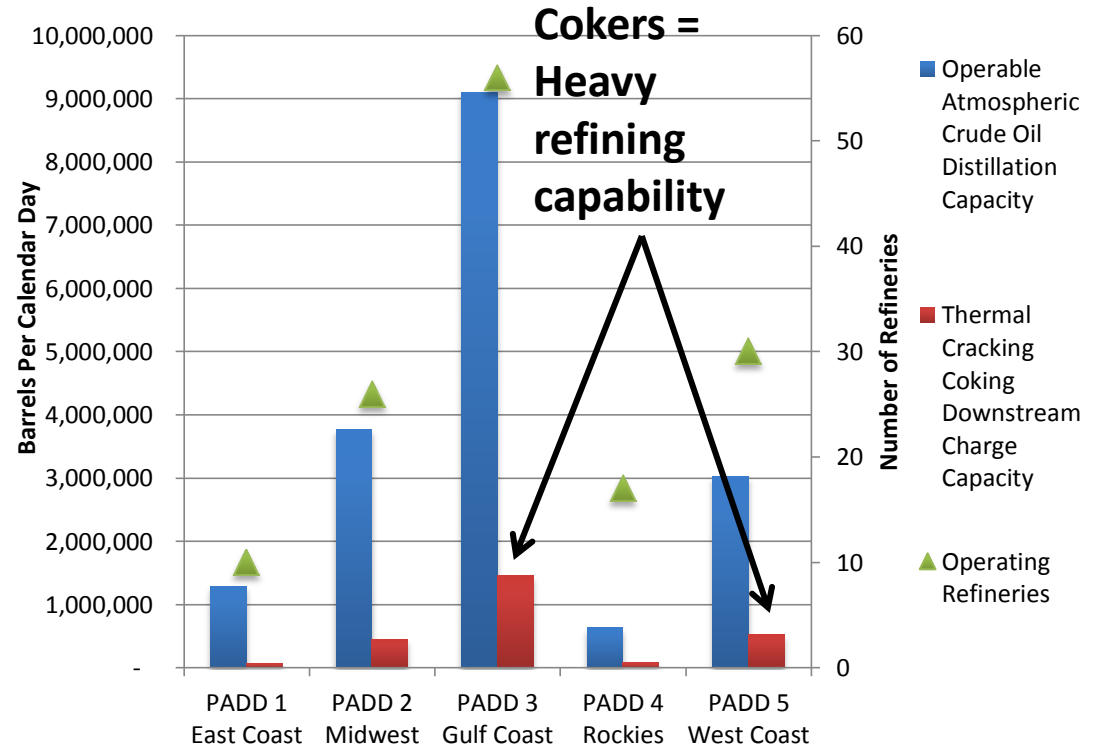
Source: CAPP Crude Oil Forecast June 2013

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



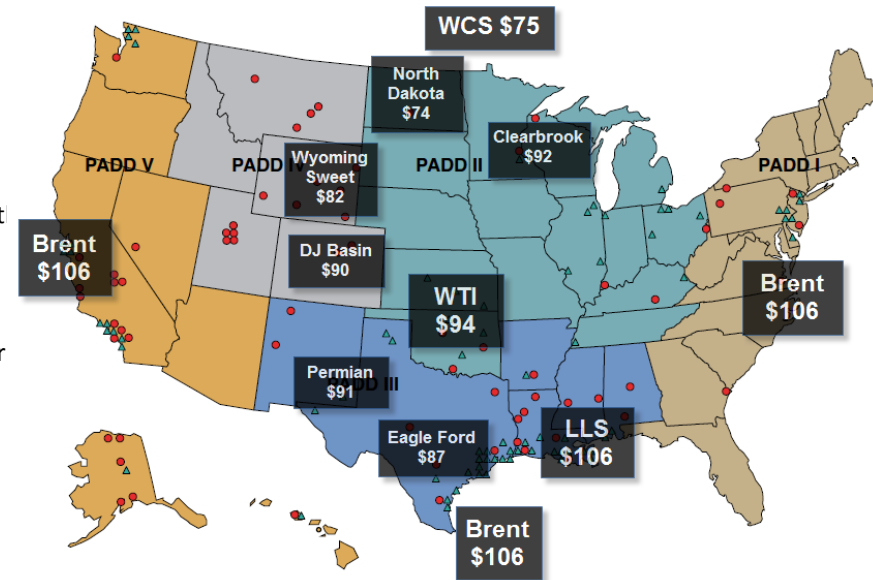
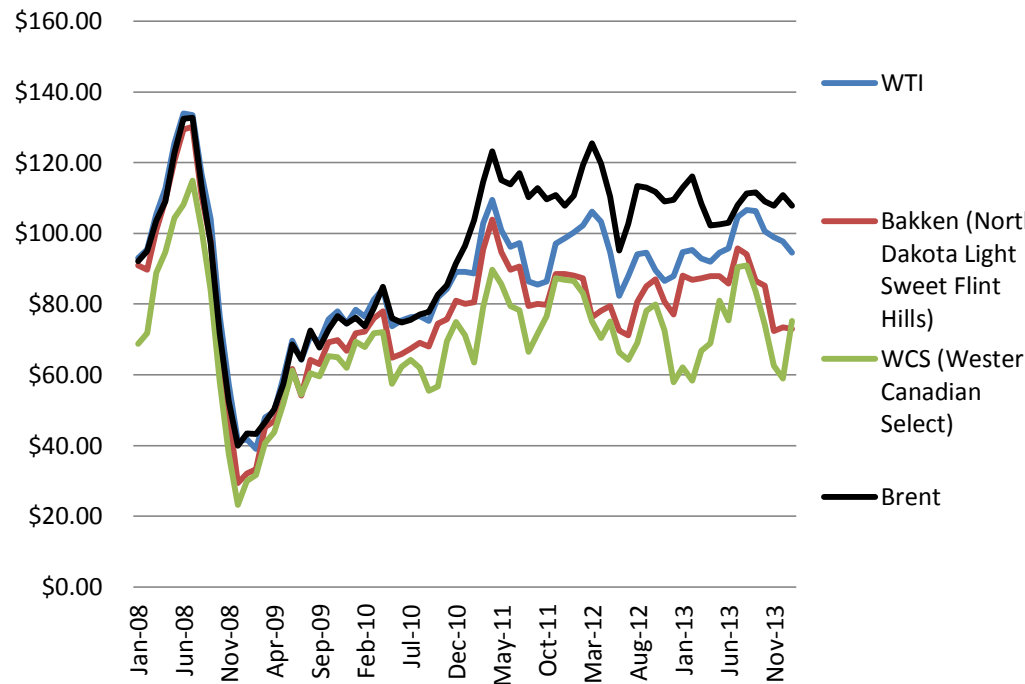
Total Coking Capacity vs. Atmospheric Crude Distillation Capacity by PADD



Source: AFPM map, EIA data for graph

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Regional Pricing Disparities



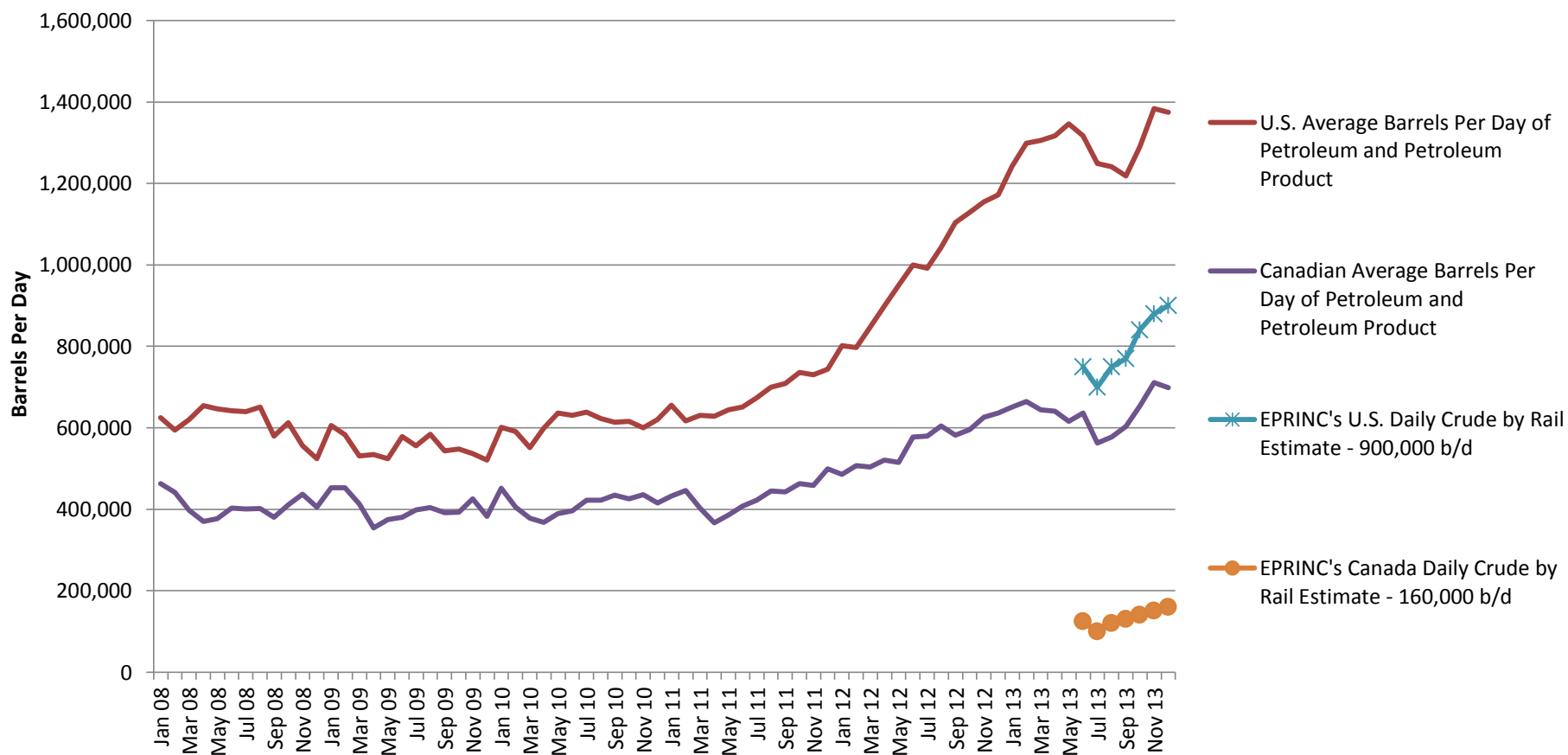
- **Western Canadian Select -\$18.50 to WTI**

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

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The Rise of Rail

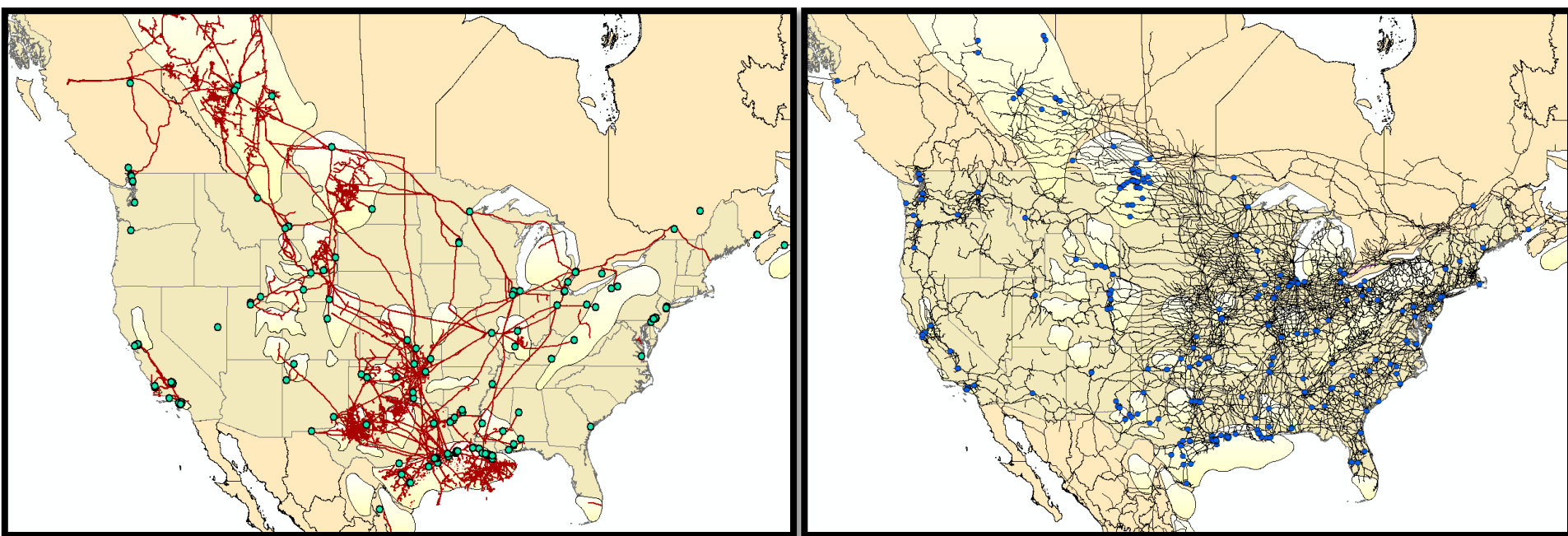
Daily Crude by Rail Shipment in U.S. and Canada



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).

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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

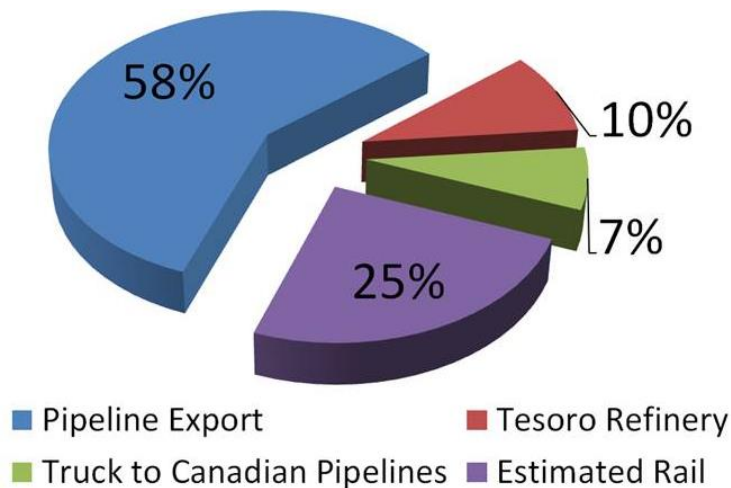
- New markets
- Diversification
- Neat Barrels
- Nimble - Quickly adjustable
- Optionality for Canadian and U.S. crude, NGLS, and other petroleum products

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

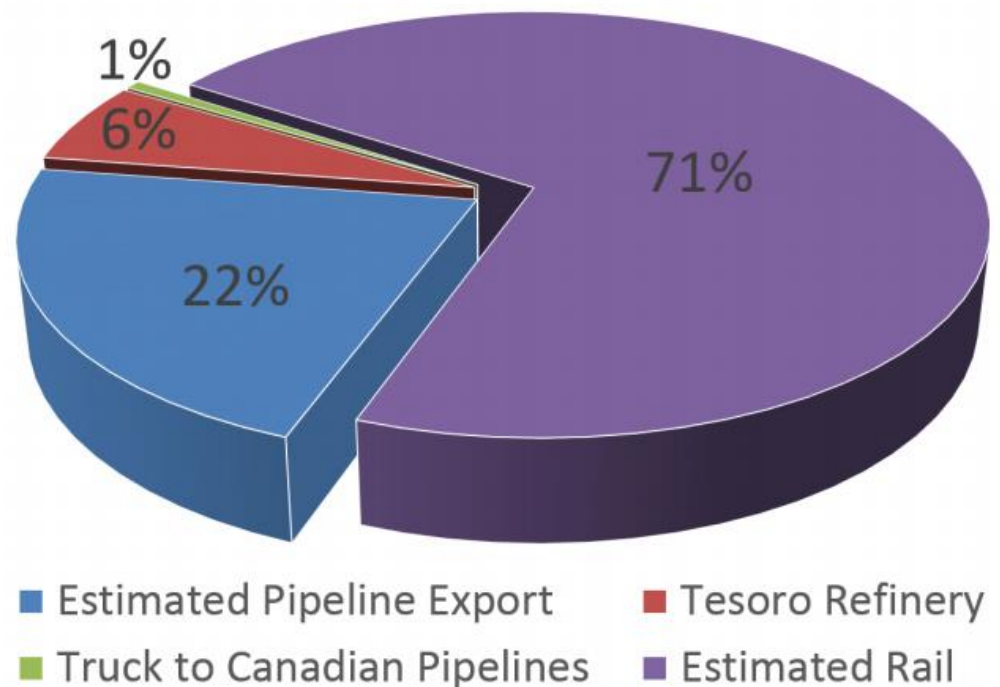
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North Dakota Crude Oil Transport

January 2012 Estimates



November 2013 Estimates



Source: North Dakota Pipeline Authority

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Crude by Rail Accidents

- July 6, 2013, a run-away train crashed and exploded in Lac-Mégantic, Quebec, killing 47 people and destroying parts of the town
- November 8, 2013, about 12 cars derailed in a unit train of 90 cars carrying crude oil near Aliceville, Alabama (45 miles SW Tuscaloosa). Nobody was injured, but three of the cars exploded.
- December 30, 2013, a train hauling grain derailed near Casselton, (SE) ND hitting a 106 car unit train of crude oil which caused 18 crude tank cars to derail causing a massive explosion and fireball
- January 7, 2014, a Canadian National train jumped tracks in Plaster Rock, New Brunswick. 15 cars derailed and caught fire. The train was carrying propane and crude oil from Western Canada
- January 20, 2014, a CSX train derailed in Pennsylvania on a railroad bridge and close a busy expressway (Schuylkill), but did not leak any crude oil.



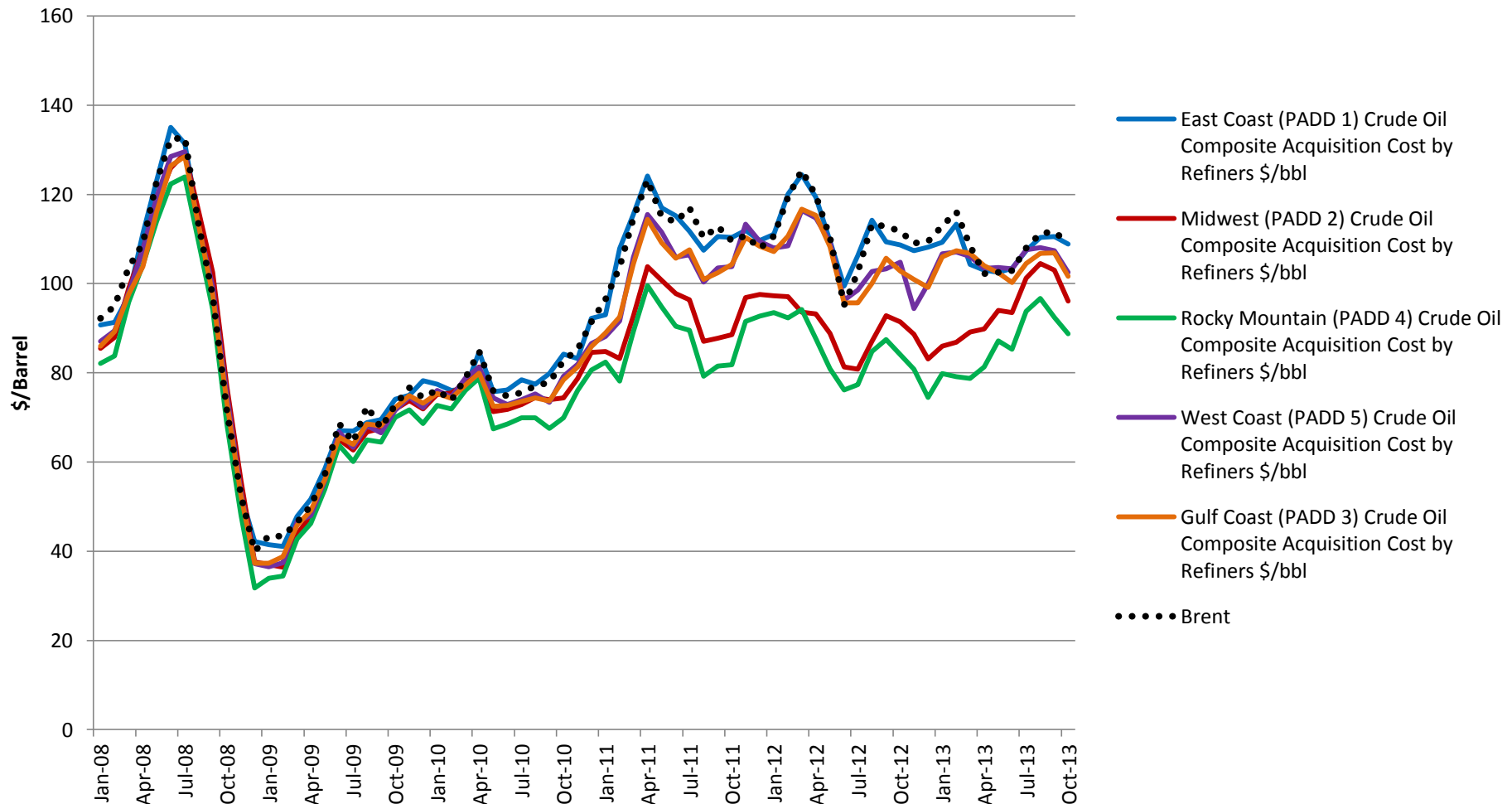
LAC MAGENTIC: AP PHOTO/THE CANADIAN PRESS, PAUL CHIASSON



http://usnews.nbcnews.com/_news/2013/12/30/22113442-mile-long-train-carrying-crude-oil-derails-explodes-in-north-dakota?lite

Refineries Benefit

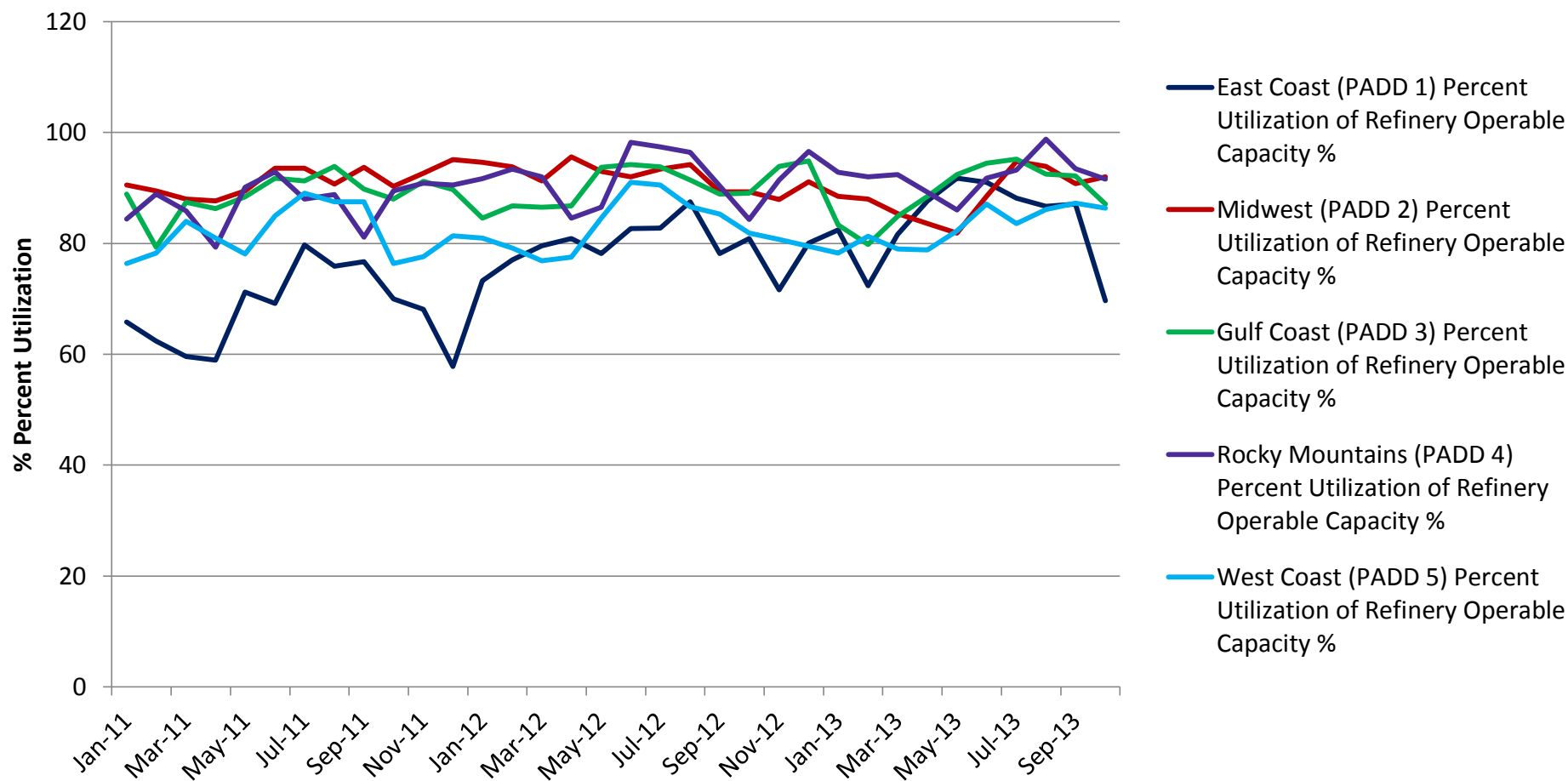
Refinery Acquisition Cost of Crude Oil



Source: EIA

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Refinery Utilization by PADD



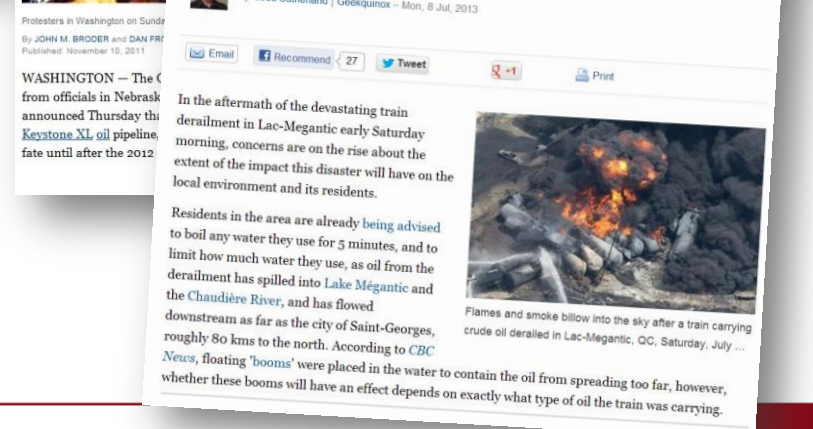
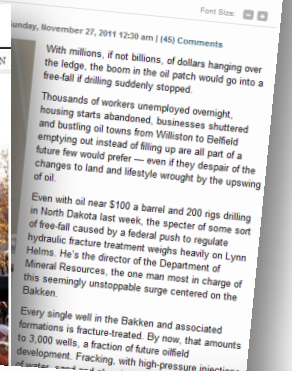
Source: EIA

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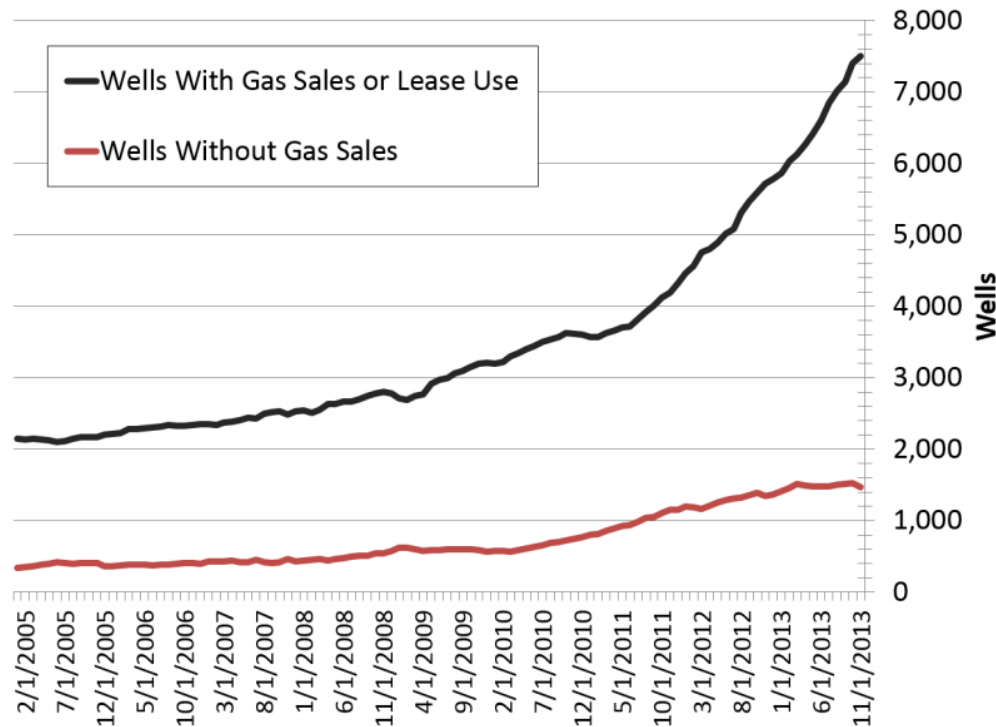
Regulatory Concerns

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
- Costs incurred from such delays
- Crude Oil Exports



Natural Gas Flaring



Source: NDPA

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