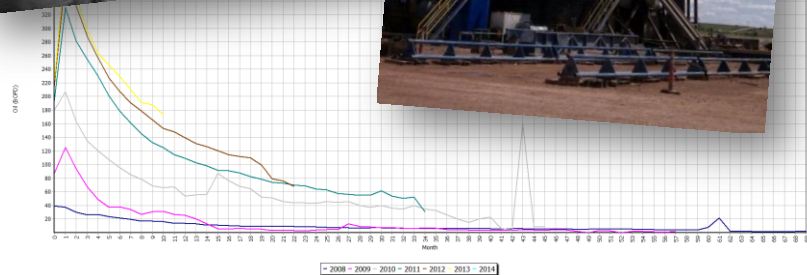


Challenges and Opportunities of the North American Petroleum Renaissance



Trisha Curtis, Director of Research, Upstream and Midstream
Lou Pugliaresi, President
Energy Policy Research Foundation, Inc. (EPRINC)
Oxford Institute for Energy Studies
January 30th, 2014



About EPRINC

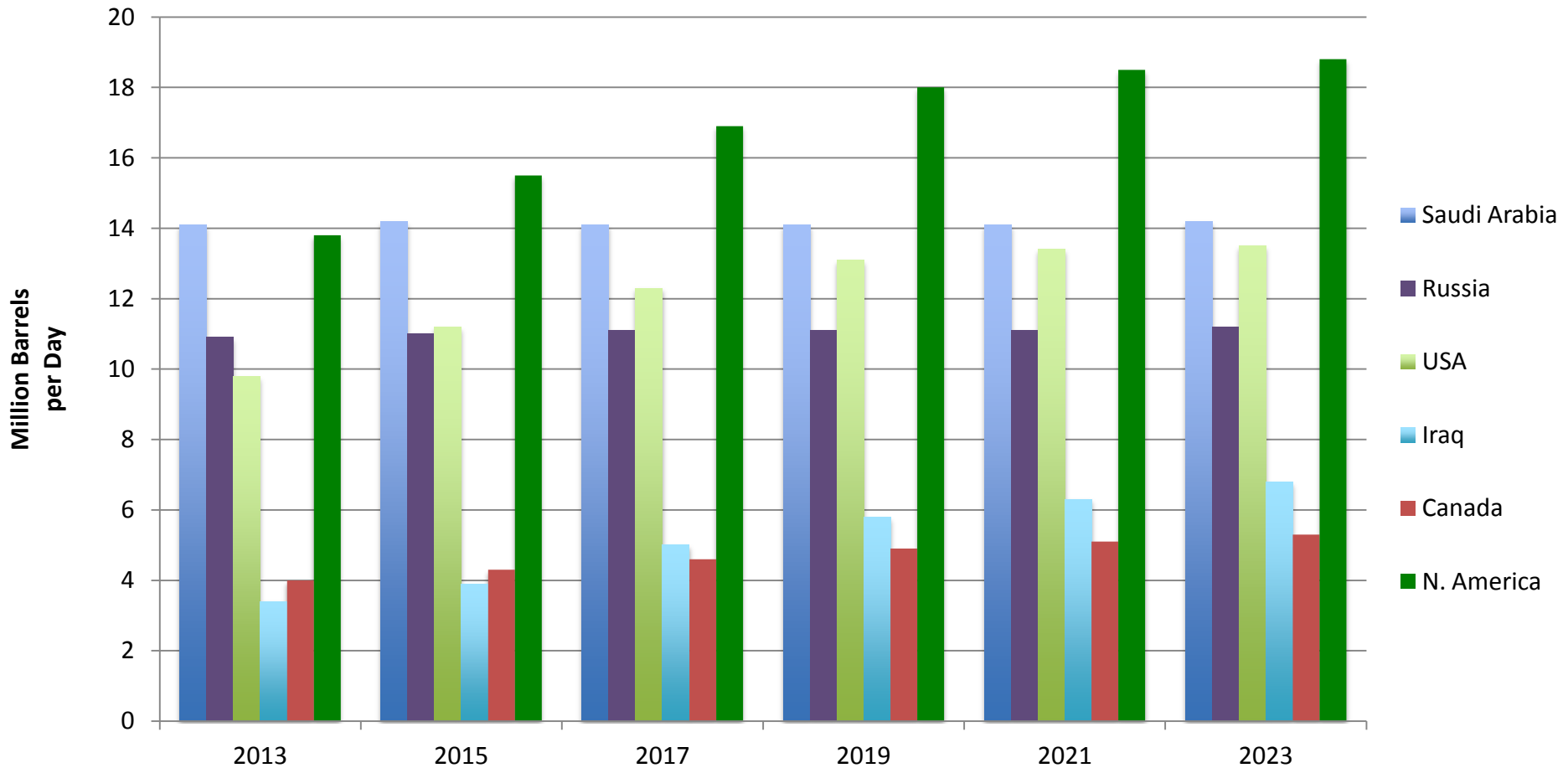
- Founded in 1944
- Not-for-profit organization that studies intersection of energy economics and public policy, with emphasis on oil, natural gas, and petroleum product markets
- Institutional support from private sector and project support from US Government
- www.eprinc.org

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

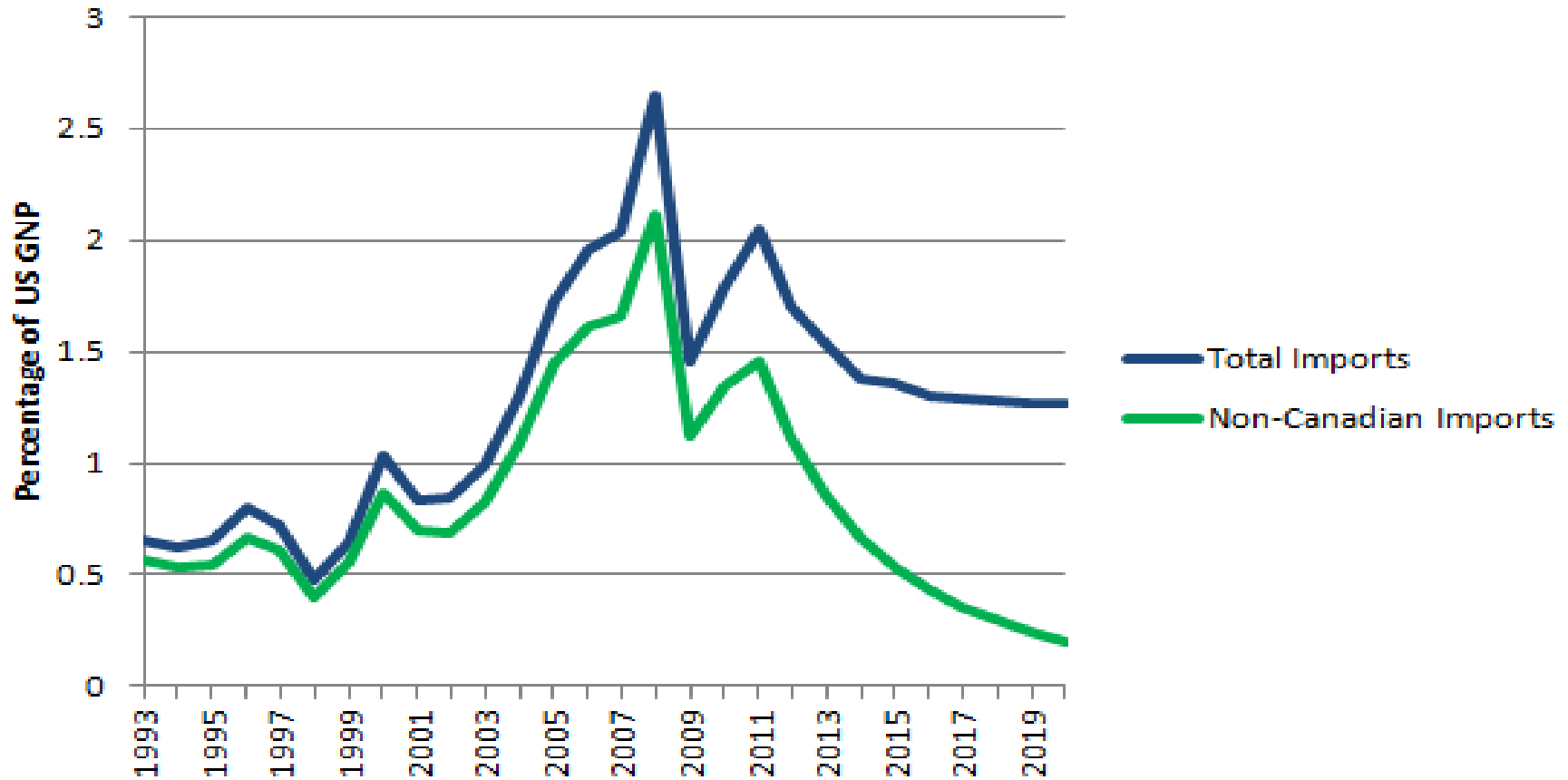


Importance of the North American Lens



Source: Wood Mackenzie (includes NGLs)

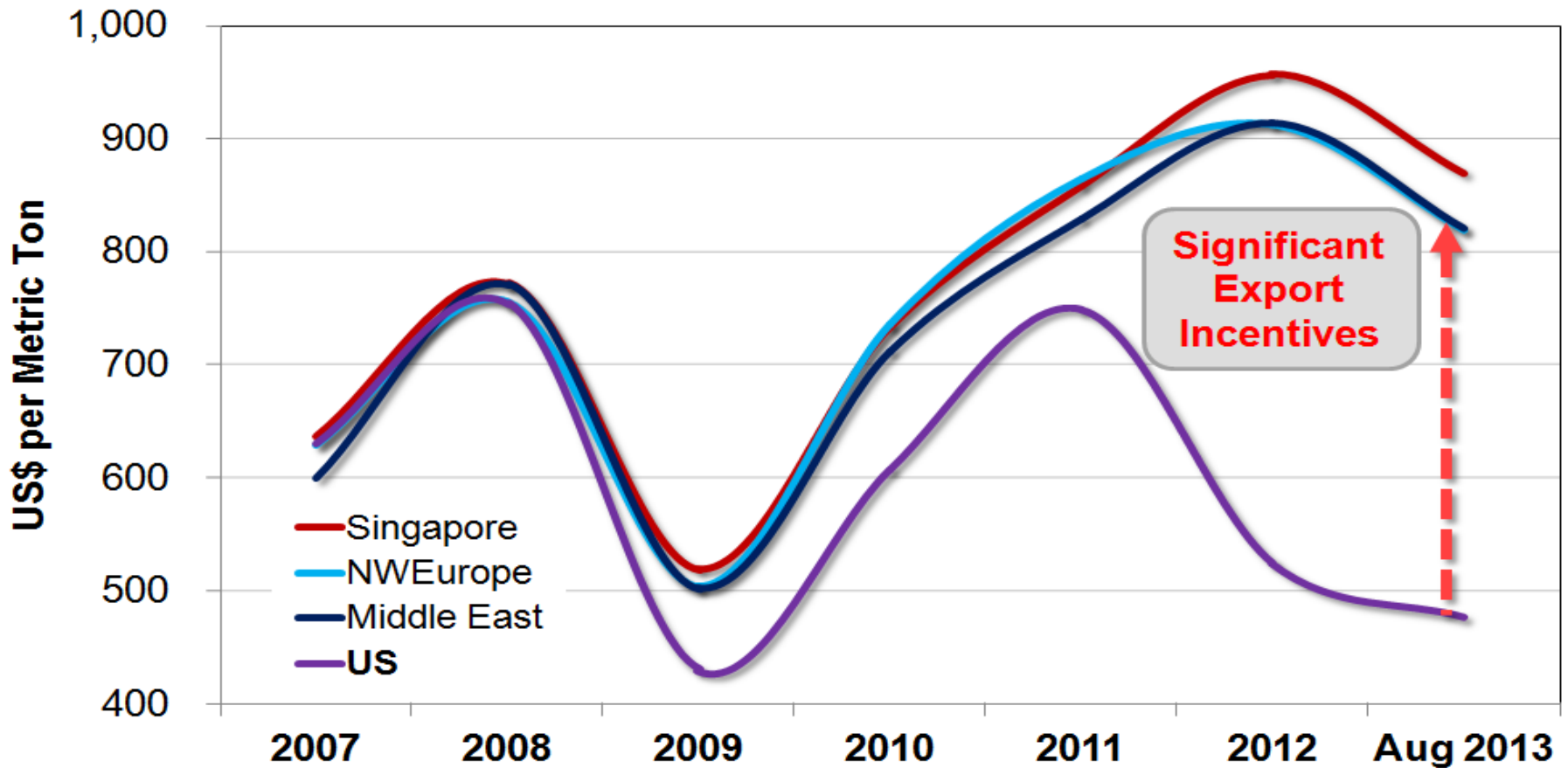
U.S. Imports of Crude Oil and Petroleum Products as a Percent of GNP



Source: EIA, EPRINC Calculations

— emitte lucem et veritatem —

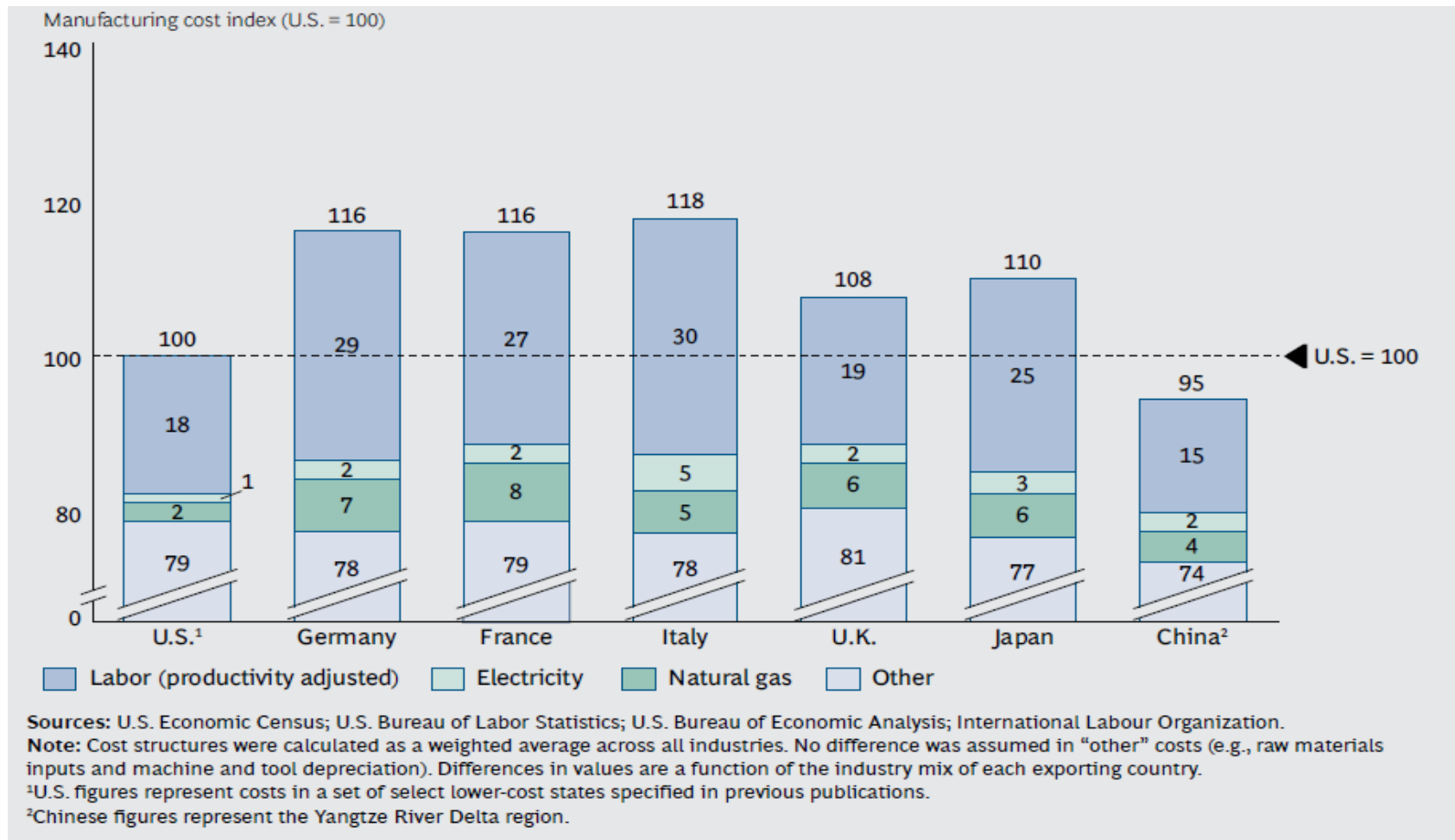
Regional Propane Prices



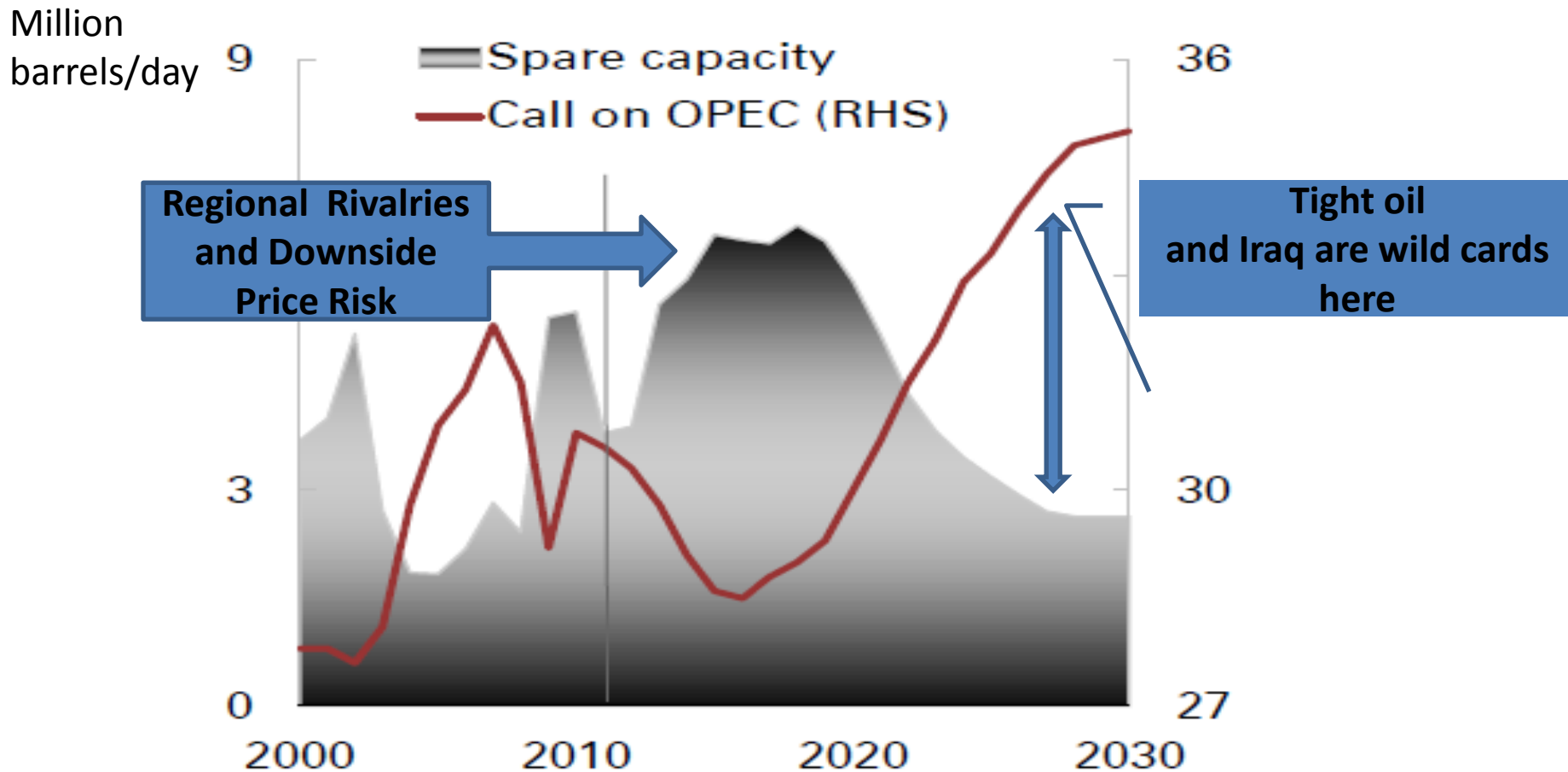
Source: KBC Advanced Technologies

— emittē lucem et veritatem —

Average Projected Relative Manufacturing Costs for 2015



Major Global Challenge: Managing OPEC Spare Capacity

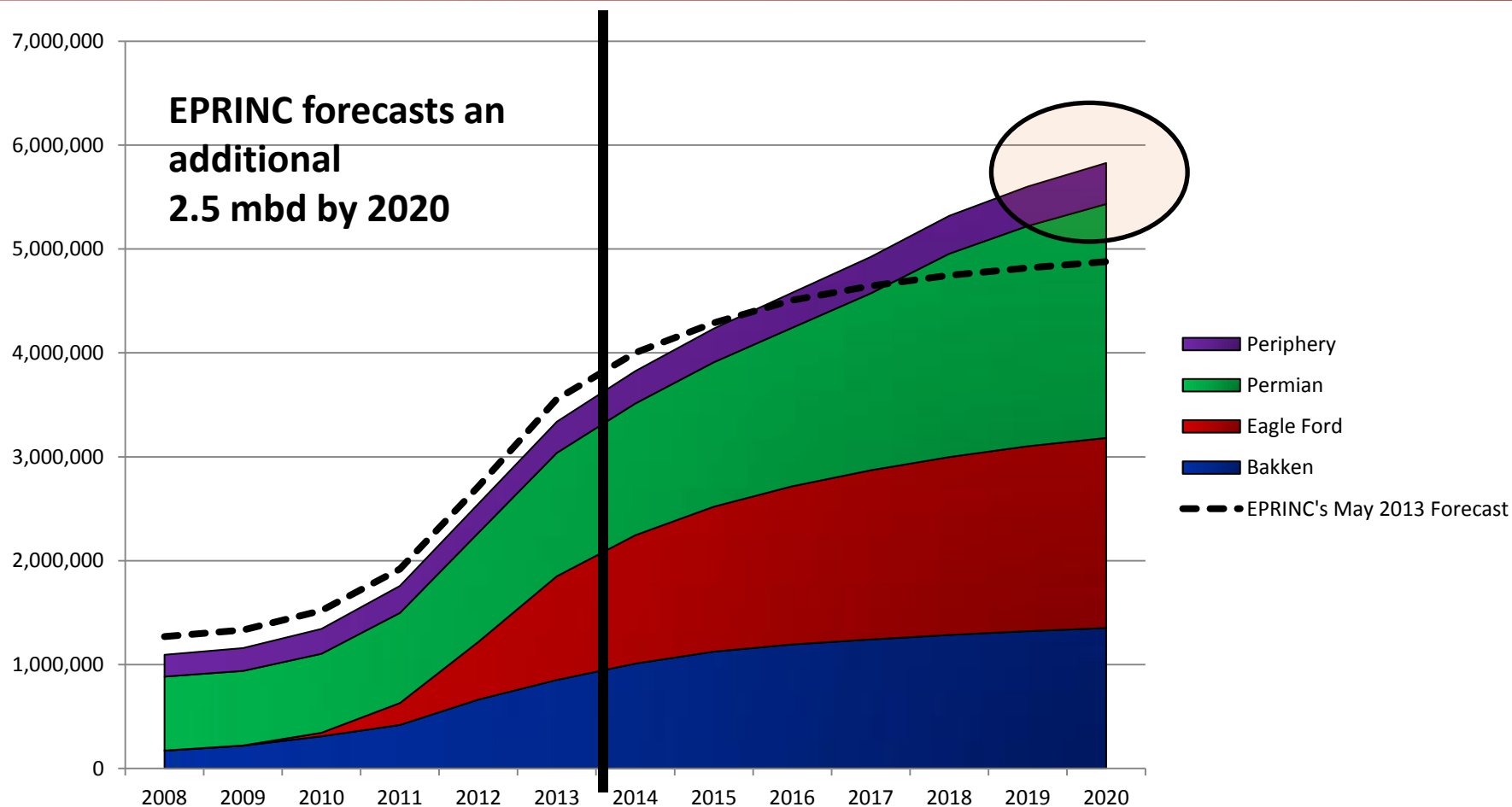


— emitte lucem et veritatem —

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
4. Global Implications and US Energy Security (discussion)

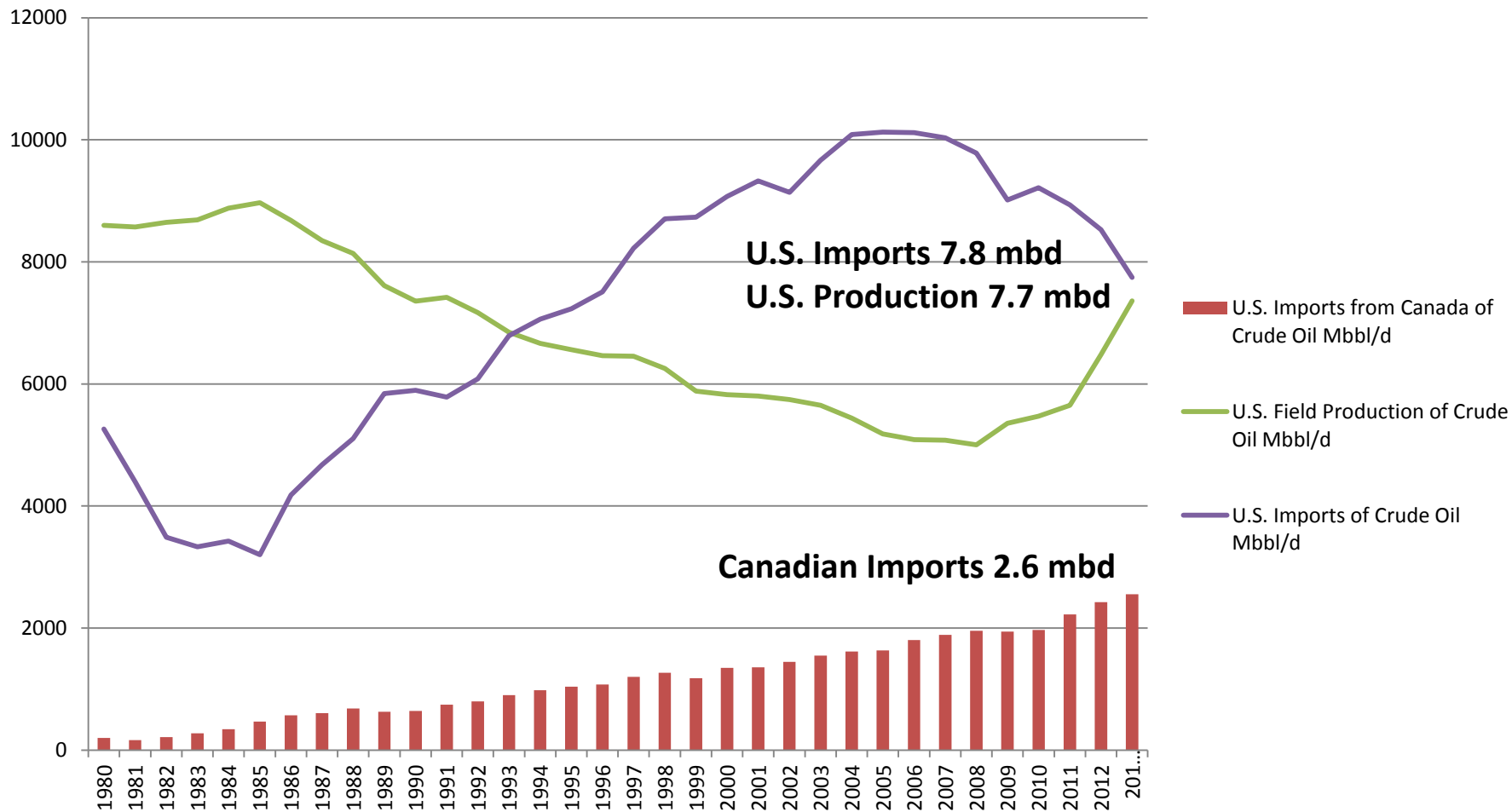
Jan 2014 EPRINC's Forecast for Major U.S. Shale Plays



Source: HPDI data with EPRINC forecast estimates

emite lucem et veritatem

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

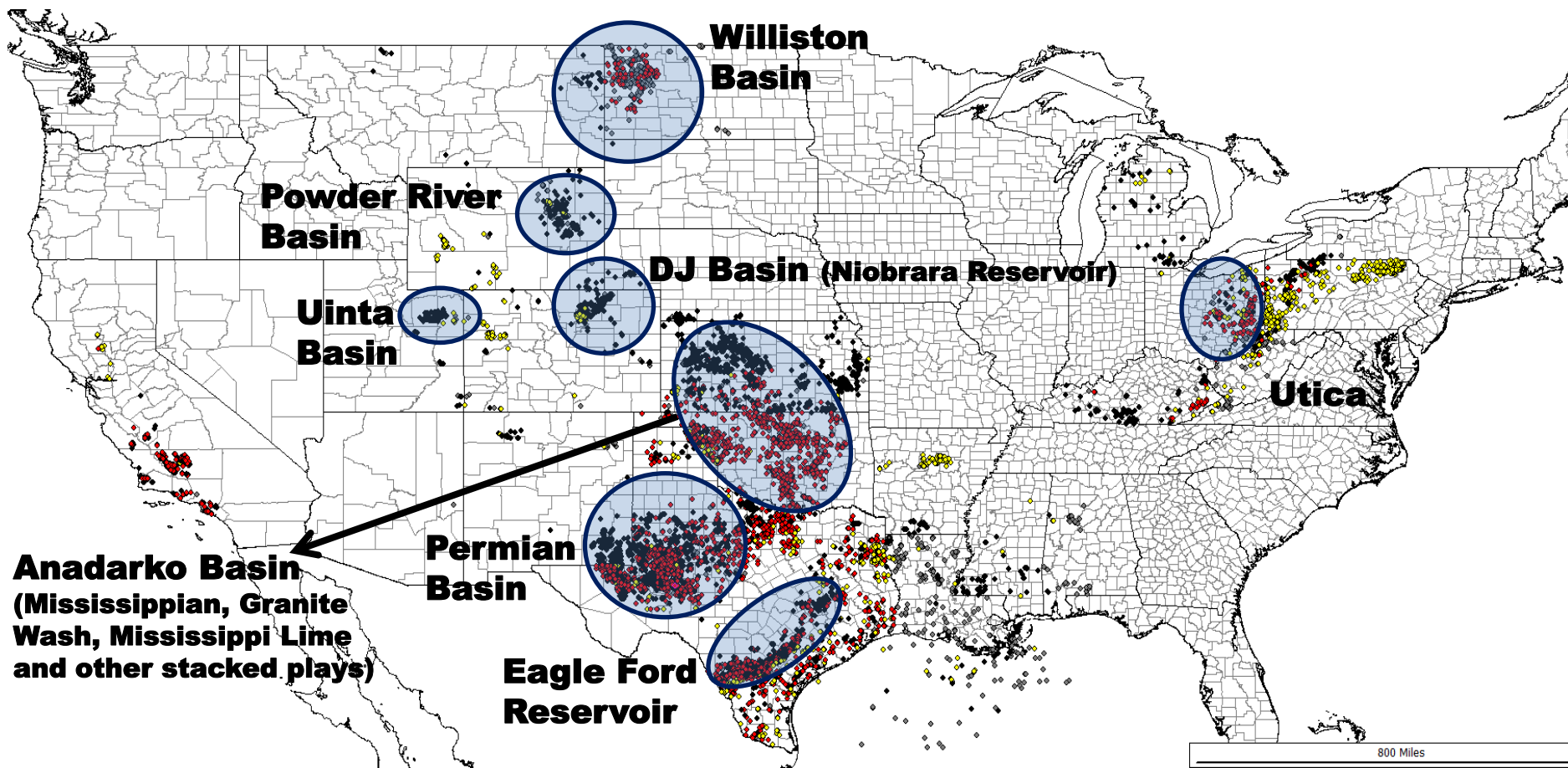


Source: EIA

emite lucem et veritatem

U.S. Activity

Permit Activity



Source: HPDI January 18 2014, Past 90 Days

— emitte lucem et veritatem —

Drilling Then and Now

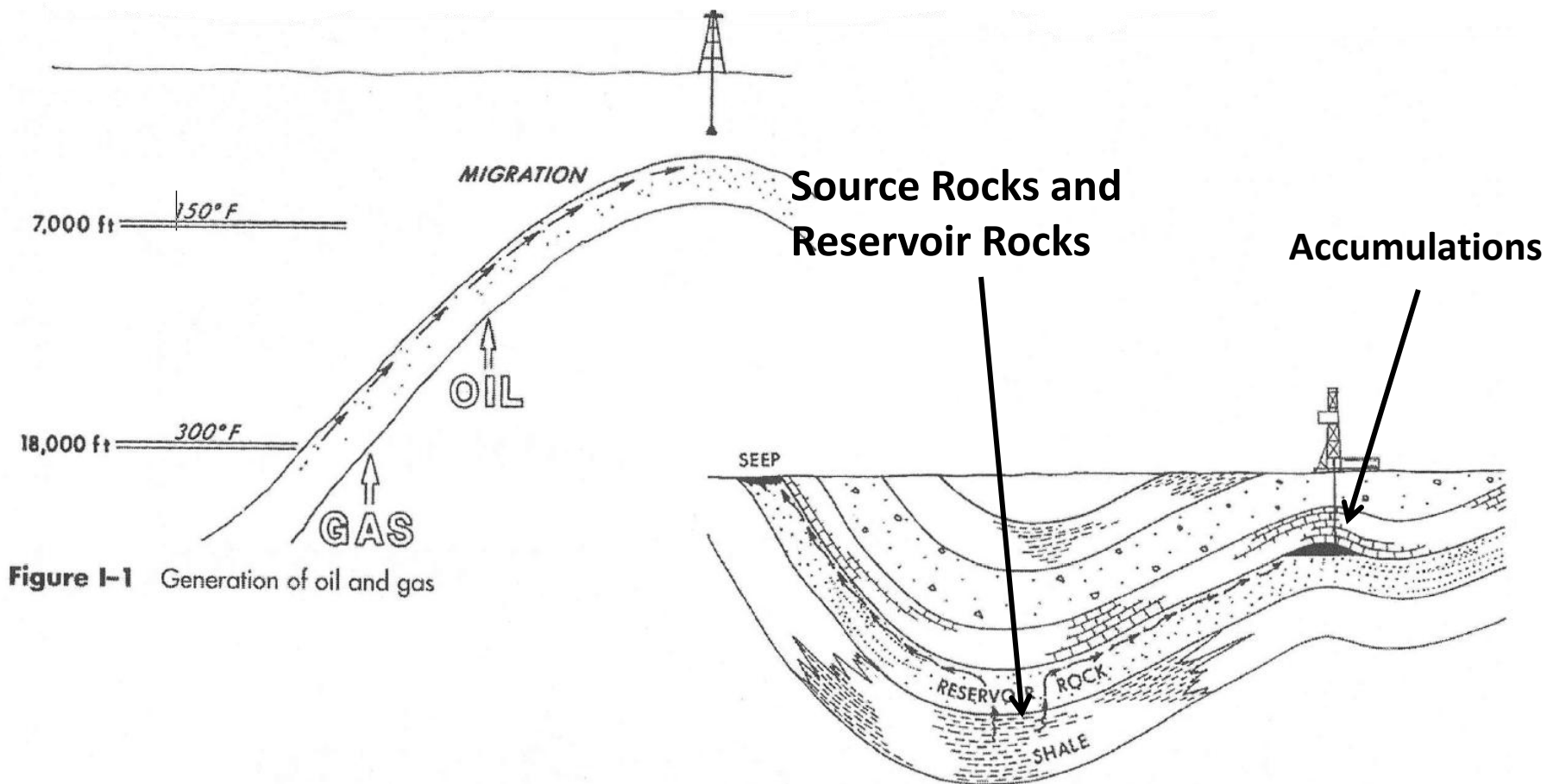


Figure 11-2 Migration of oil and gas in a sedimentary basin

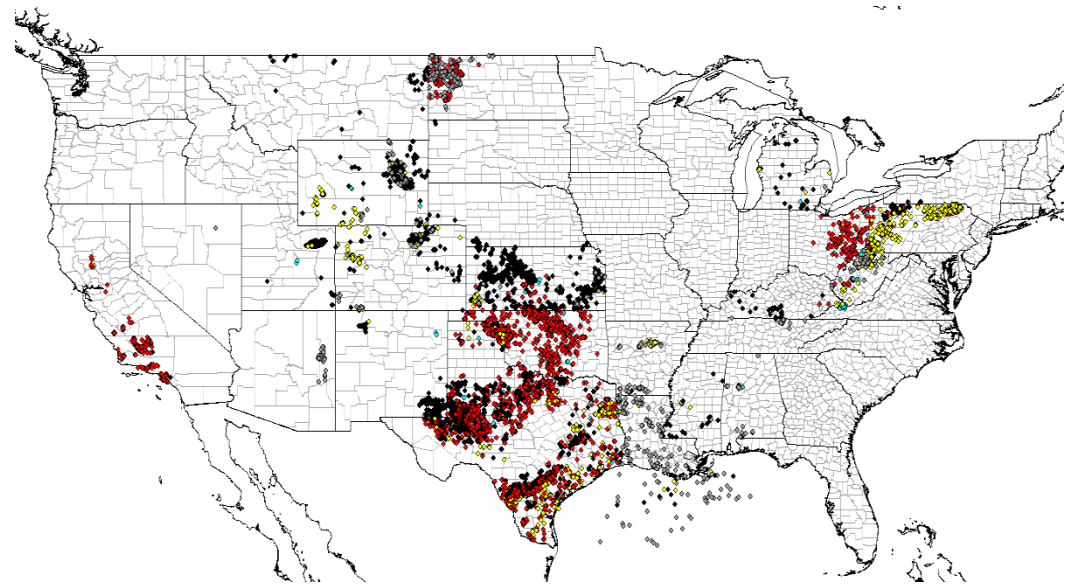
Source: From PIECE Course Workbook, Mark J Kaiser, Houston, July 2008, "Introduction to USA Petroleum Industry"

emite lucem et veritatem

North American Potential...Shale Oil Plays



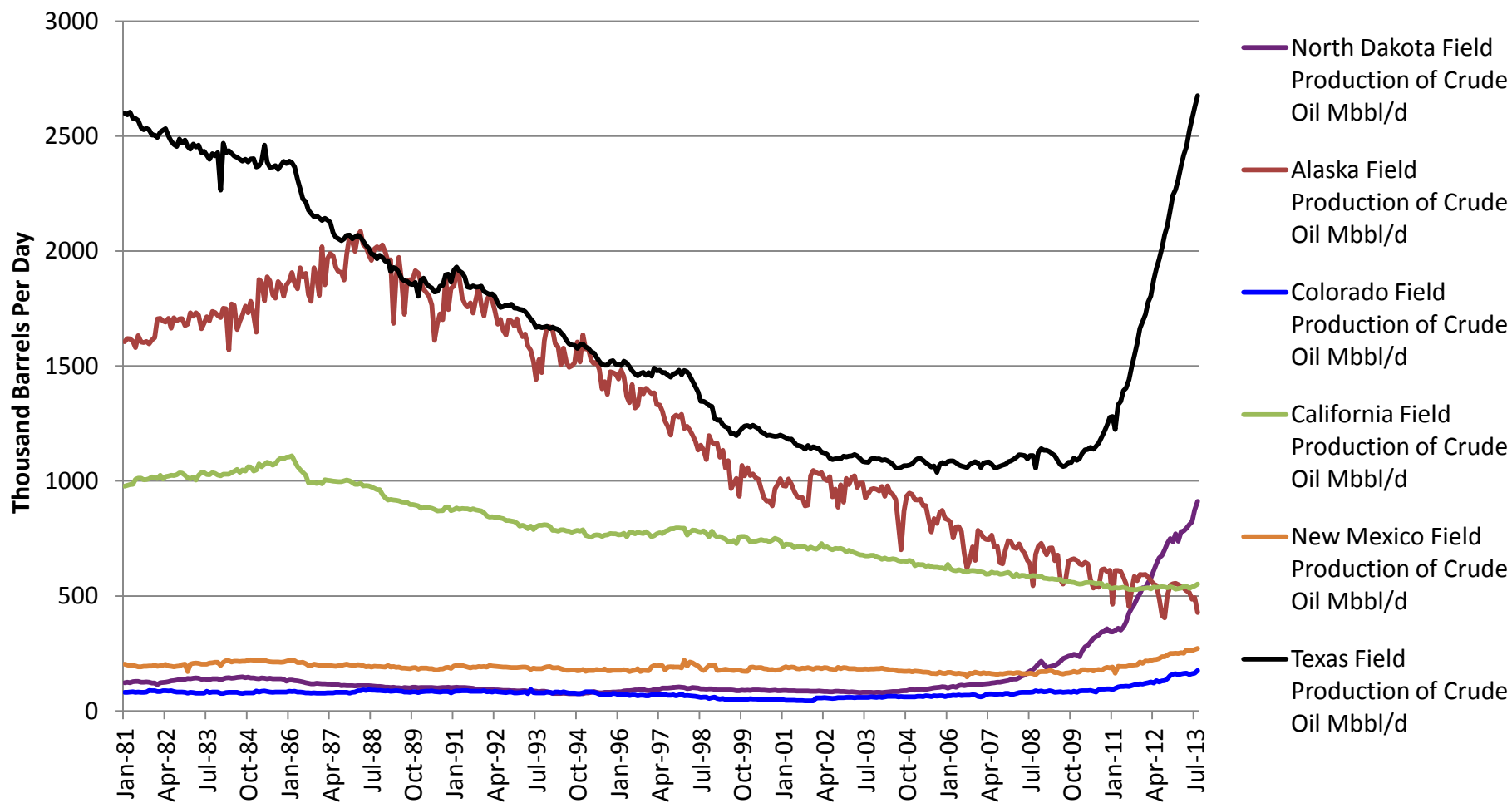
The Western Interior Seaway, approximately 75 million years ago. Image from Sampson SD, Loewen MA, Farke AA, Roberts EM, Forster CA, et al. (2010) New Horned Dinosaurs from Utah Provide Evidence for Intracontinental Dinosaur Endemism. PLoS ONE 5(9): e12292. doi:10.1371/journal.pone.0012292.



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

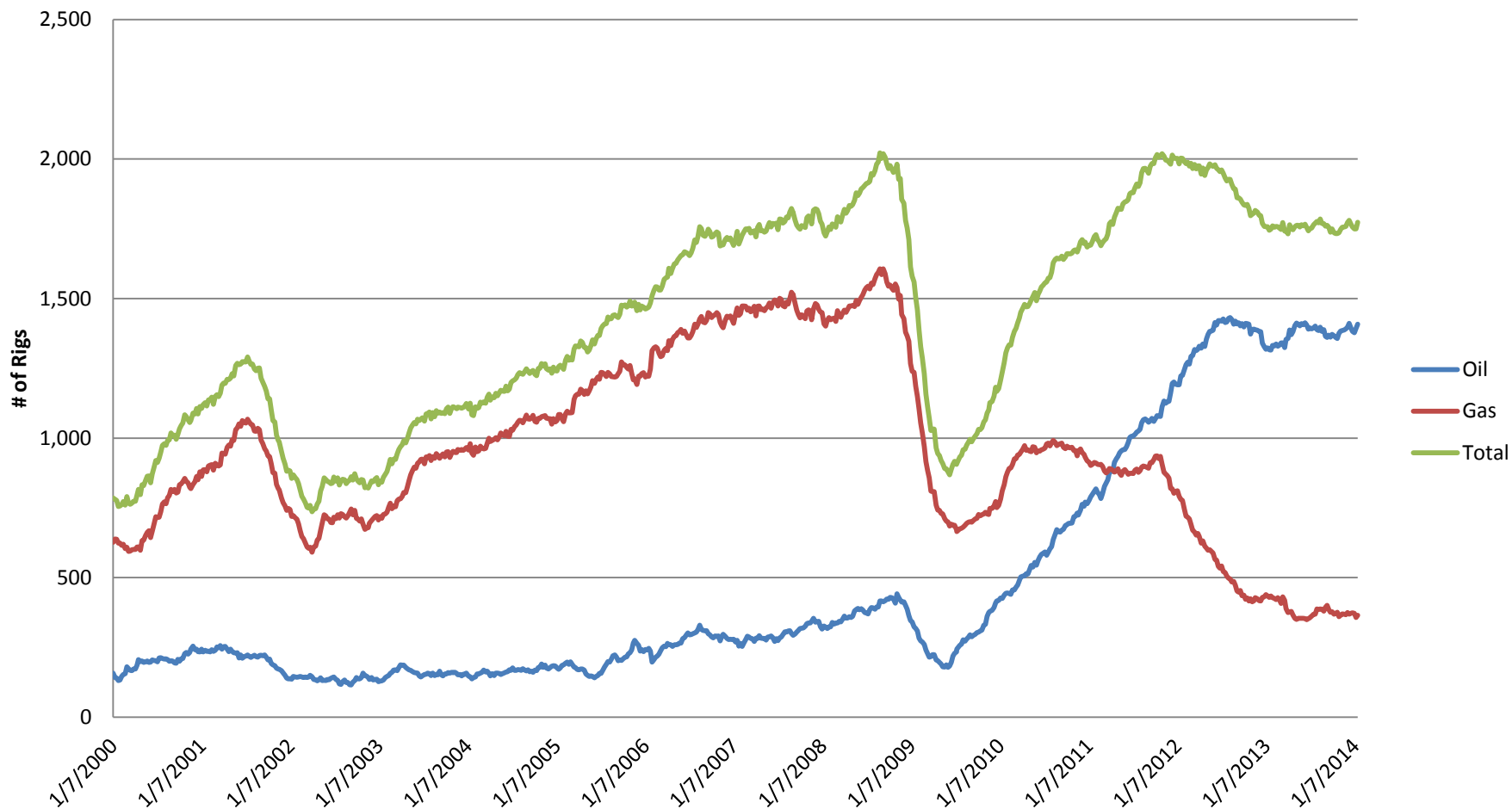
State Production Trends



Source: EIA

emite lucem et veritatem

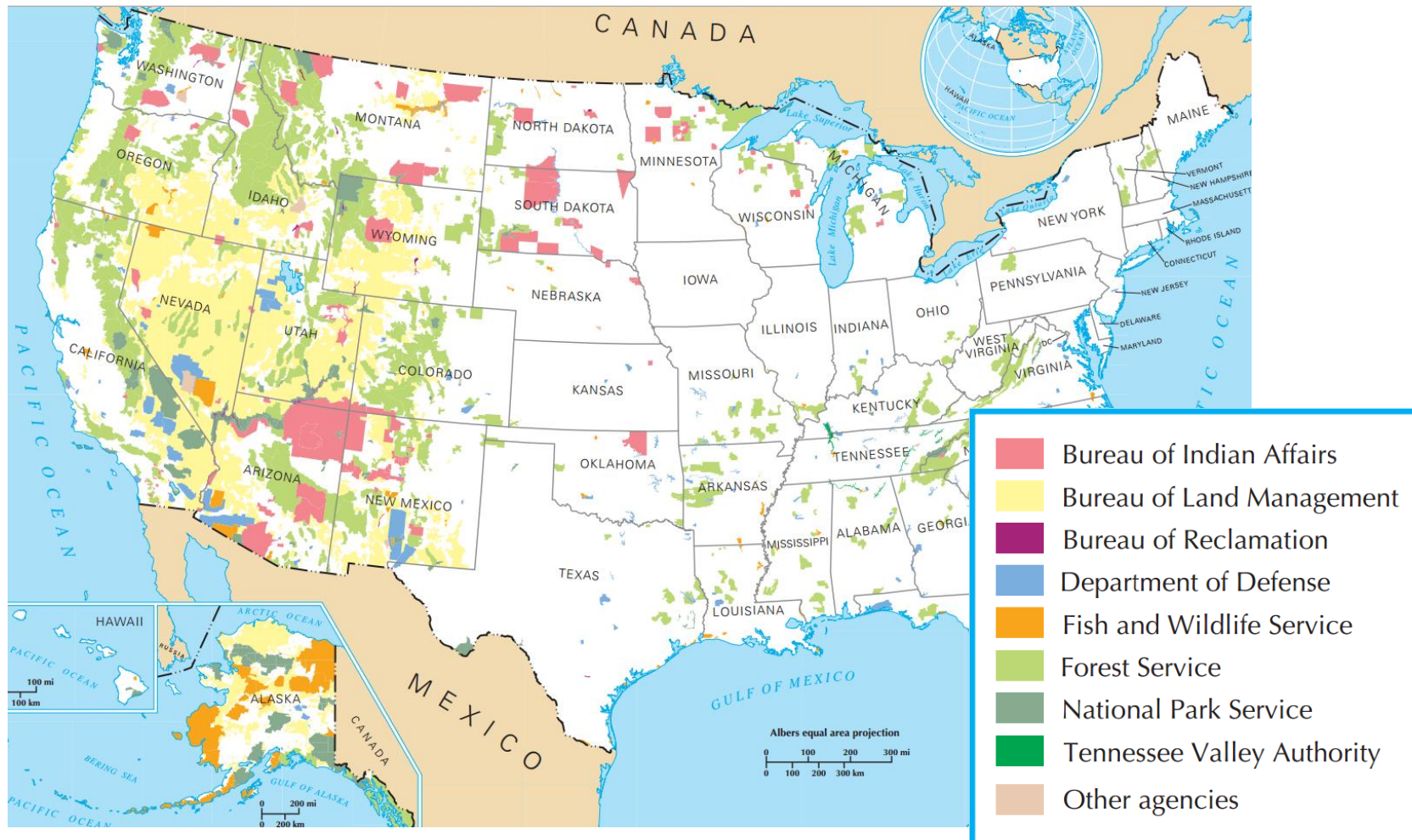
U.S. Rig Count



Source: Baker Hughes

emite lucem et veritatem

Part of the U.S. story

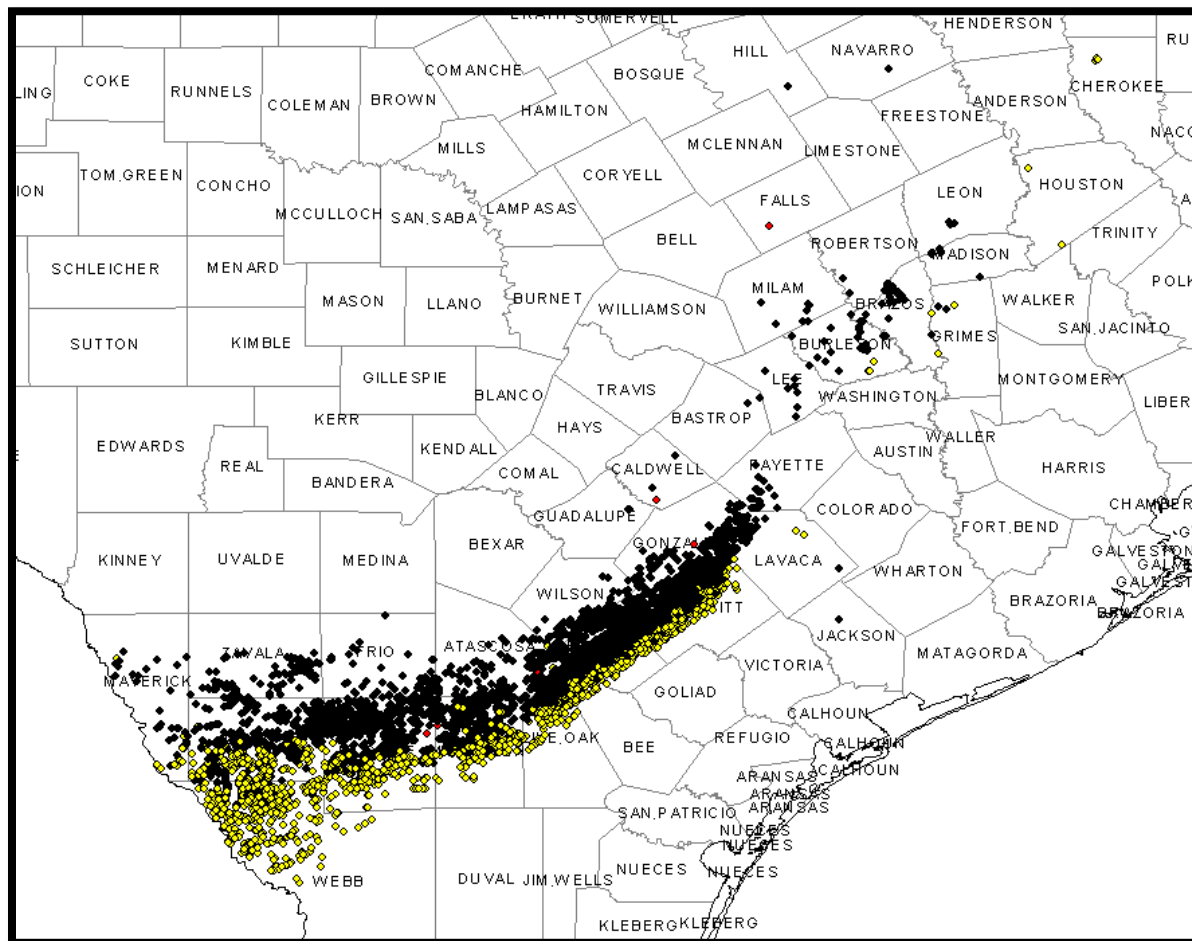


Source: NationalAtlas.gov

— emitte lucem et veritatem —

The Soaring Eagle Ford

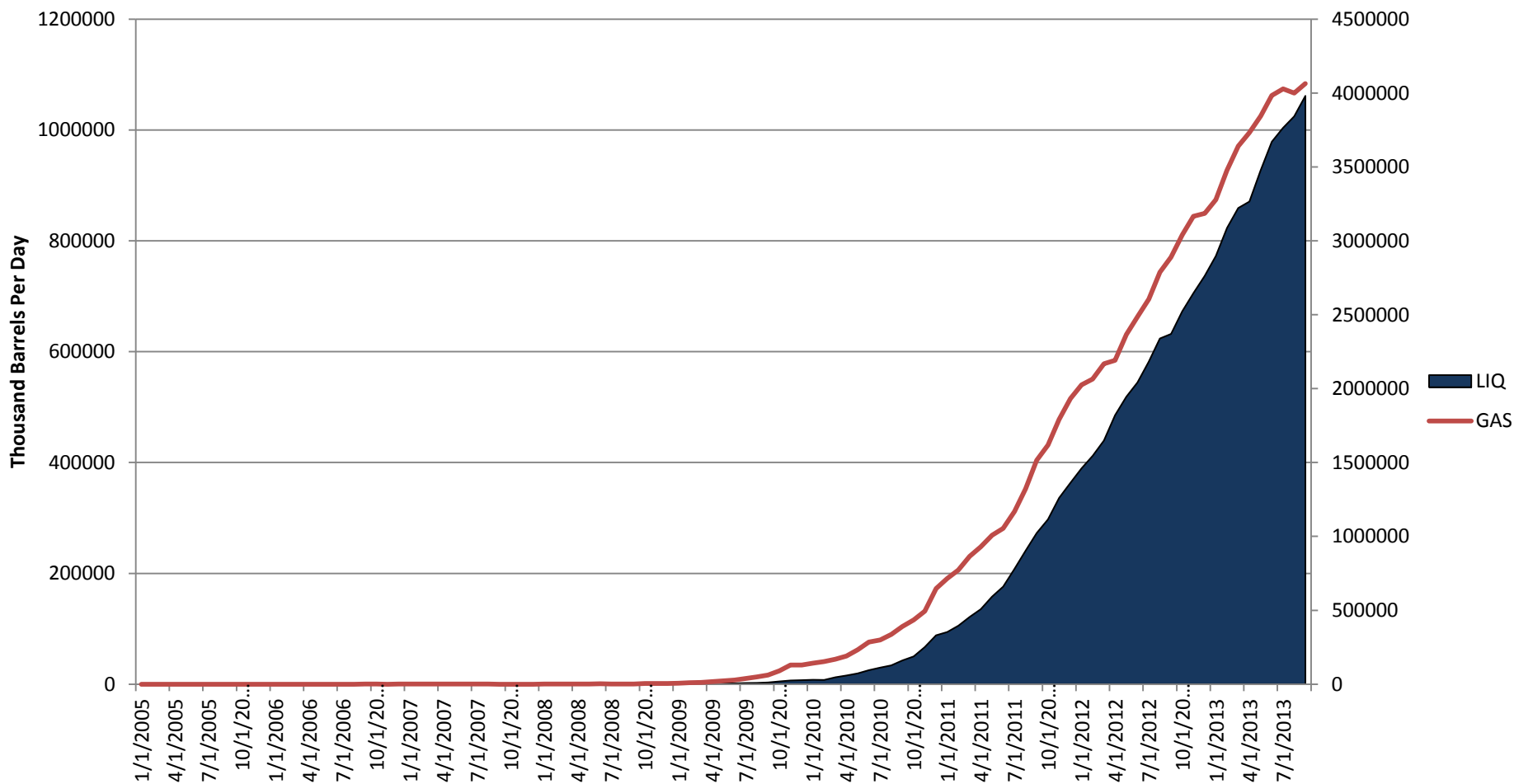
Eagle Ford Wells



Source: HPDI Nov 2013

— emite lucem et veritatem —

Eagle Ford Production

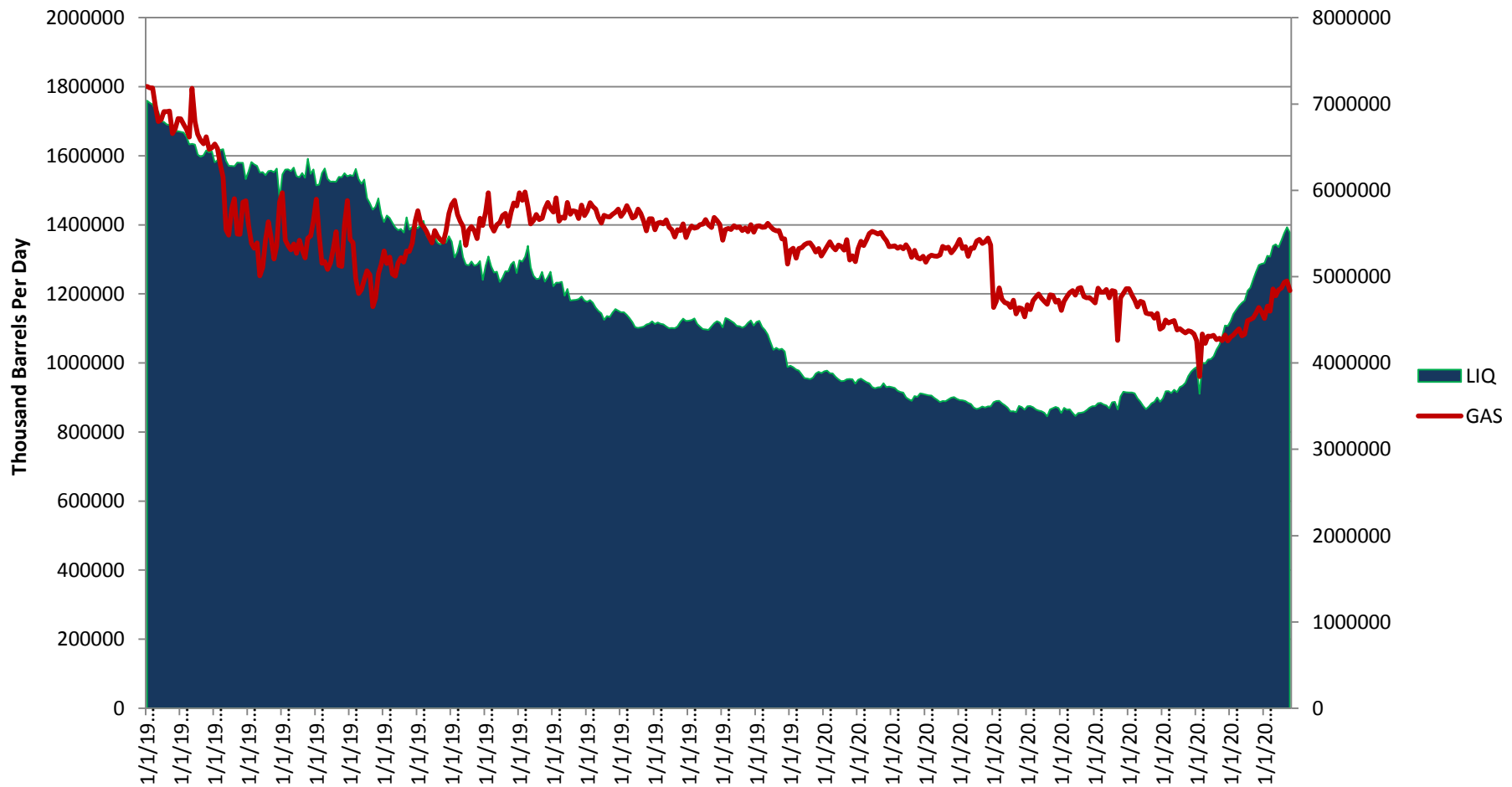


Source: HPDI Nov 2013

emite lucem et veritatem

The Prolific Permian Basin

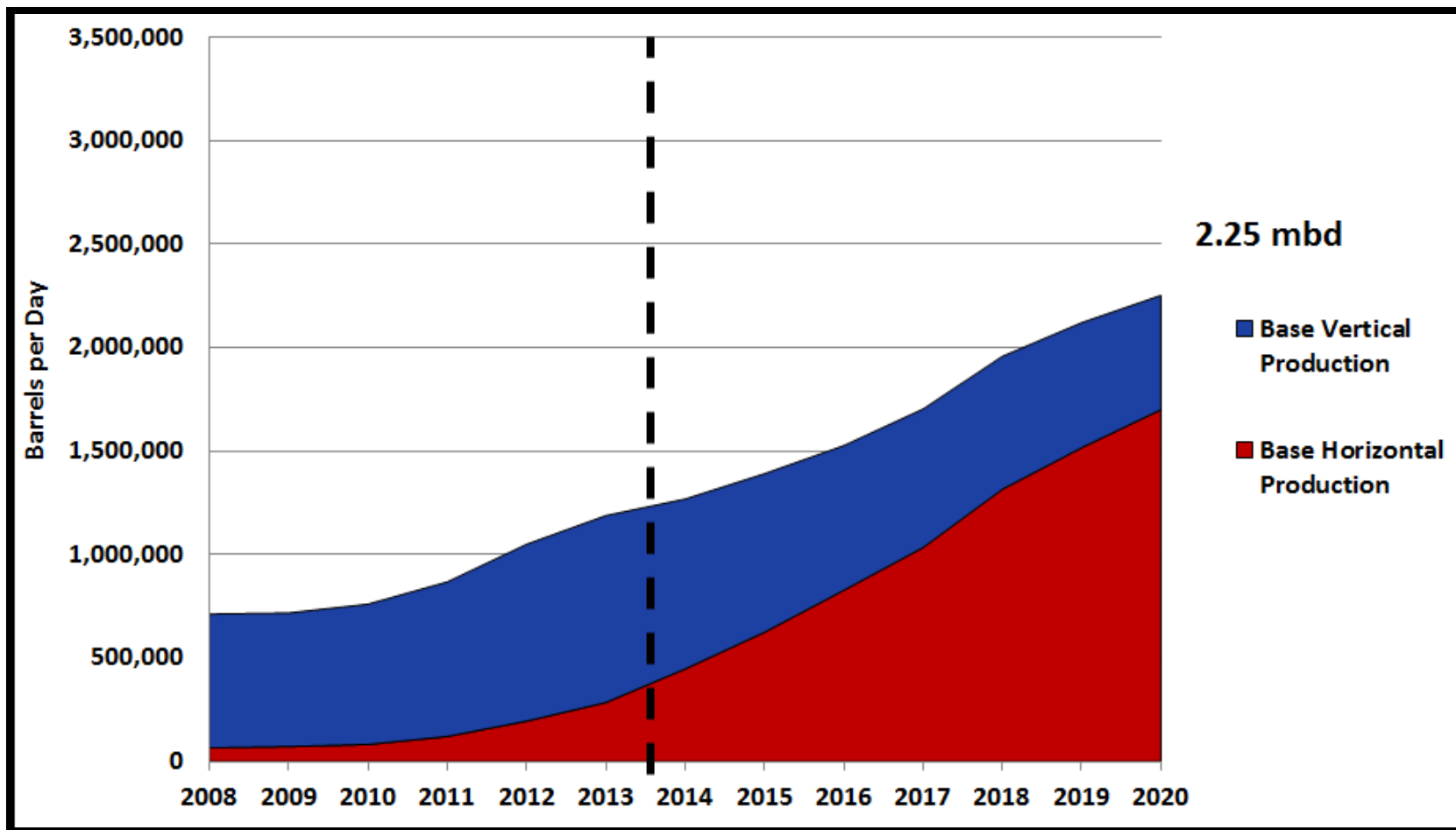
Permian Basin Production 1.38 mbd



Source: HPDI Oct 2013

emite lucem et veritatem

EPRINC November Revised Permian Forecast

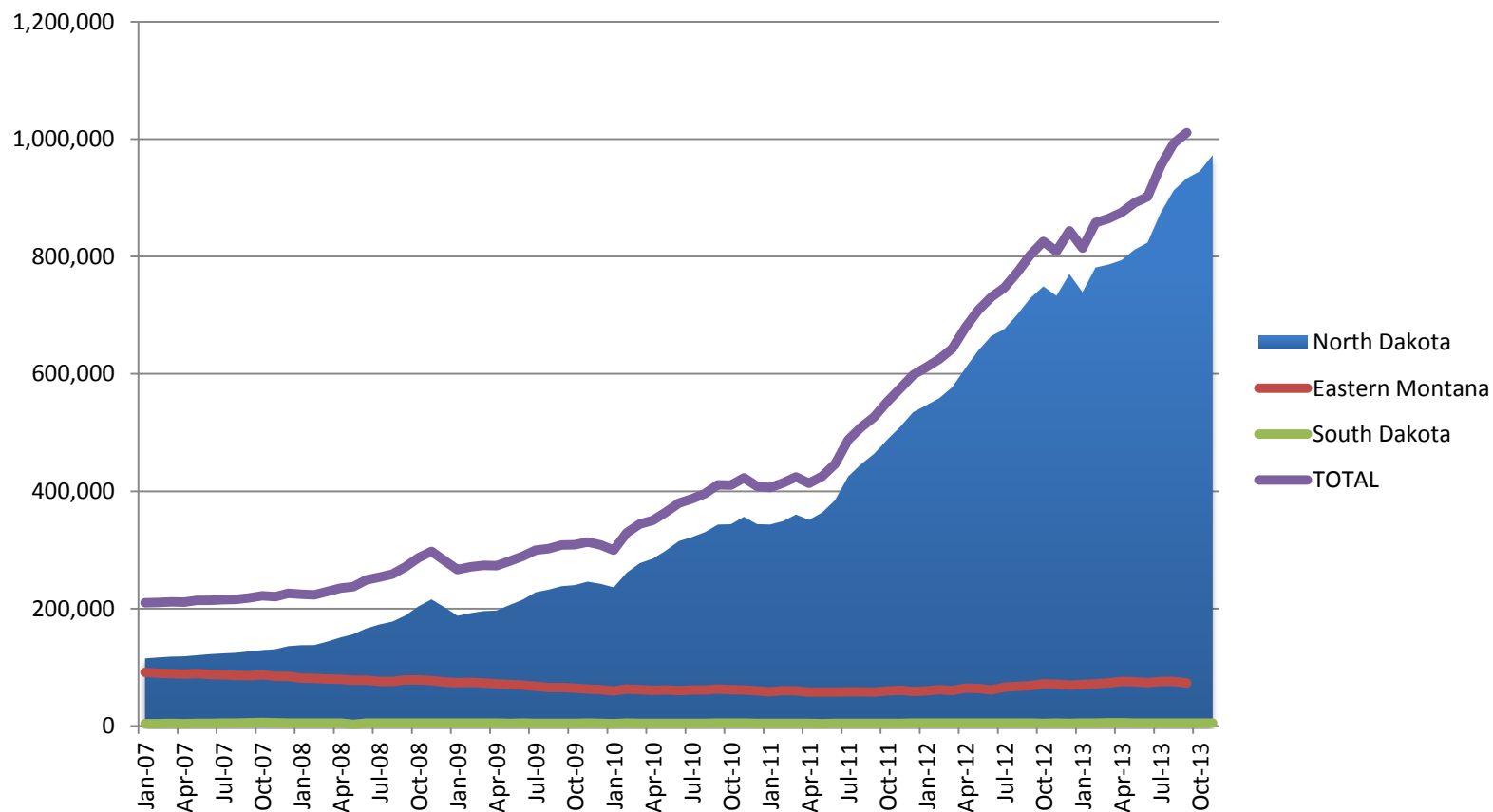


Source: EPRINC

— emitte lucem et veritatem —

Bakken

Williston Basin Production

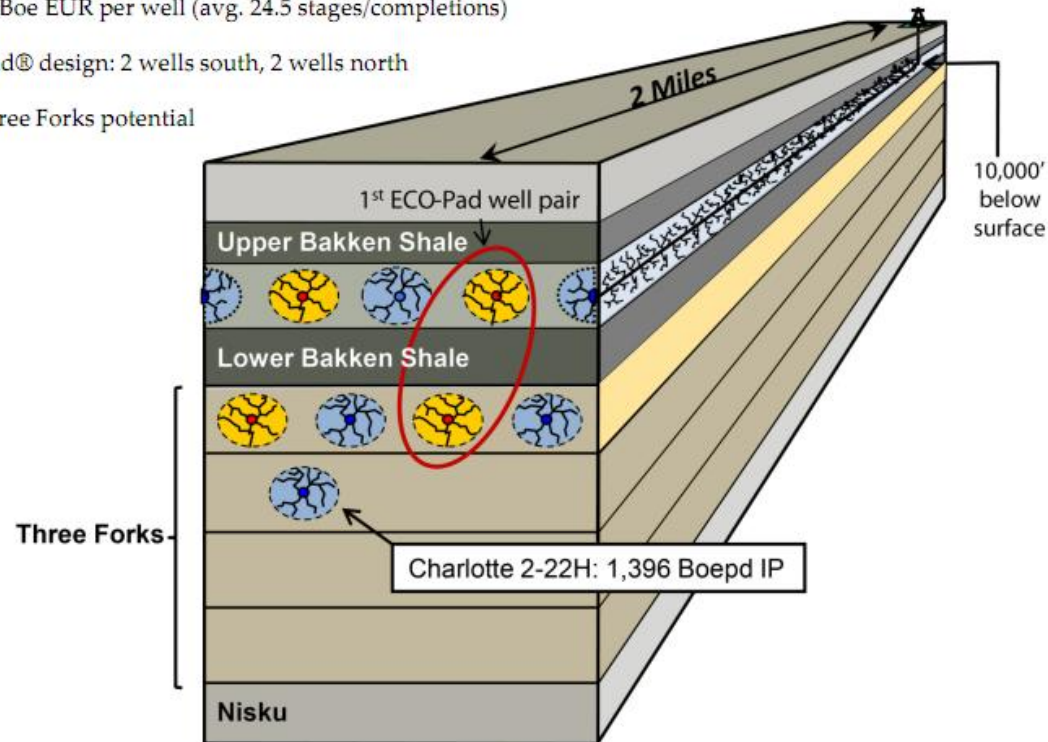


Source: NDIC

— emitte lucem et veritatem —

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



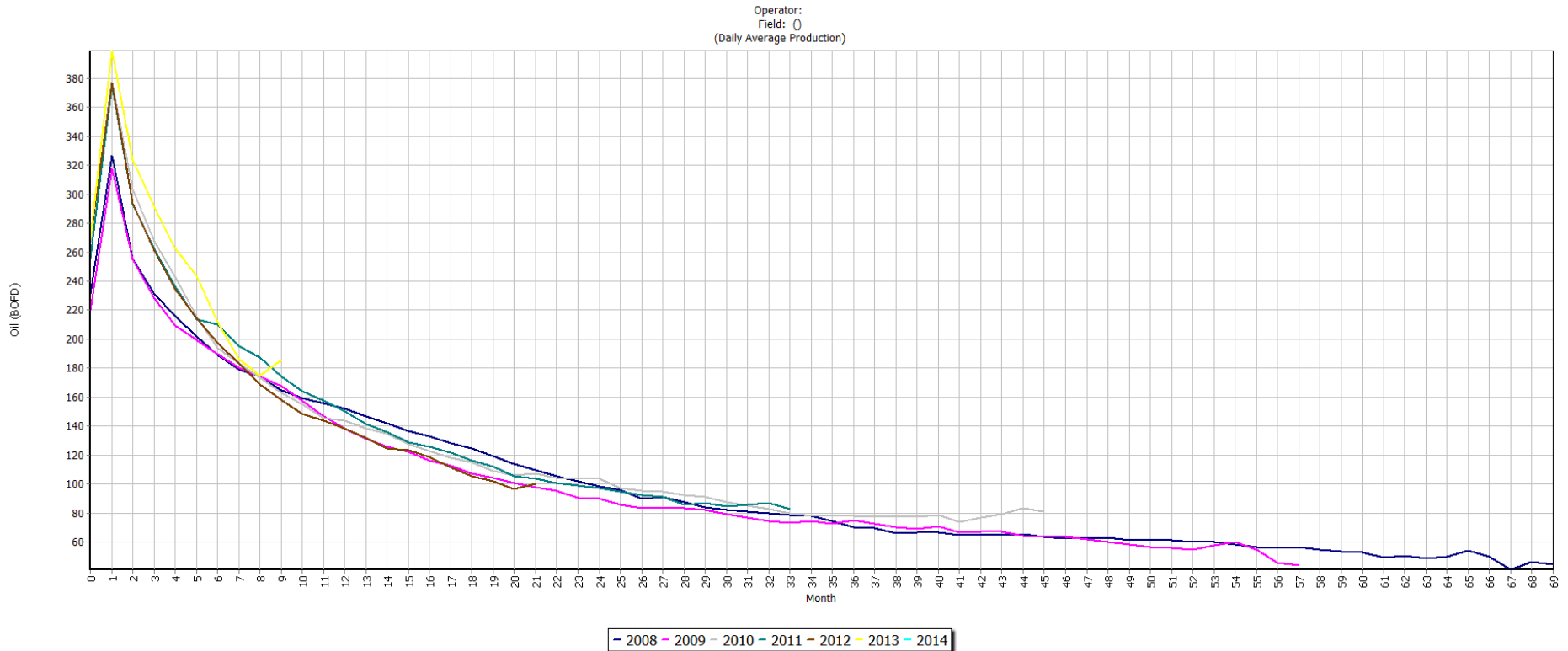
Source: Continental Resources Inc., Corporate Presentation, 2012.



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

emite lucem et veritatem

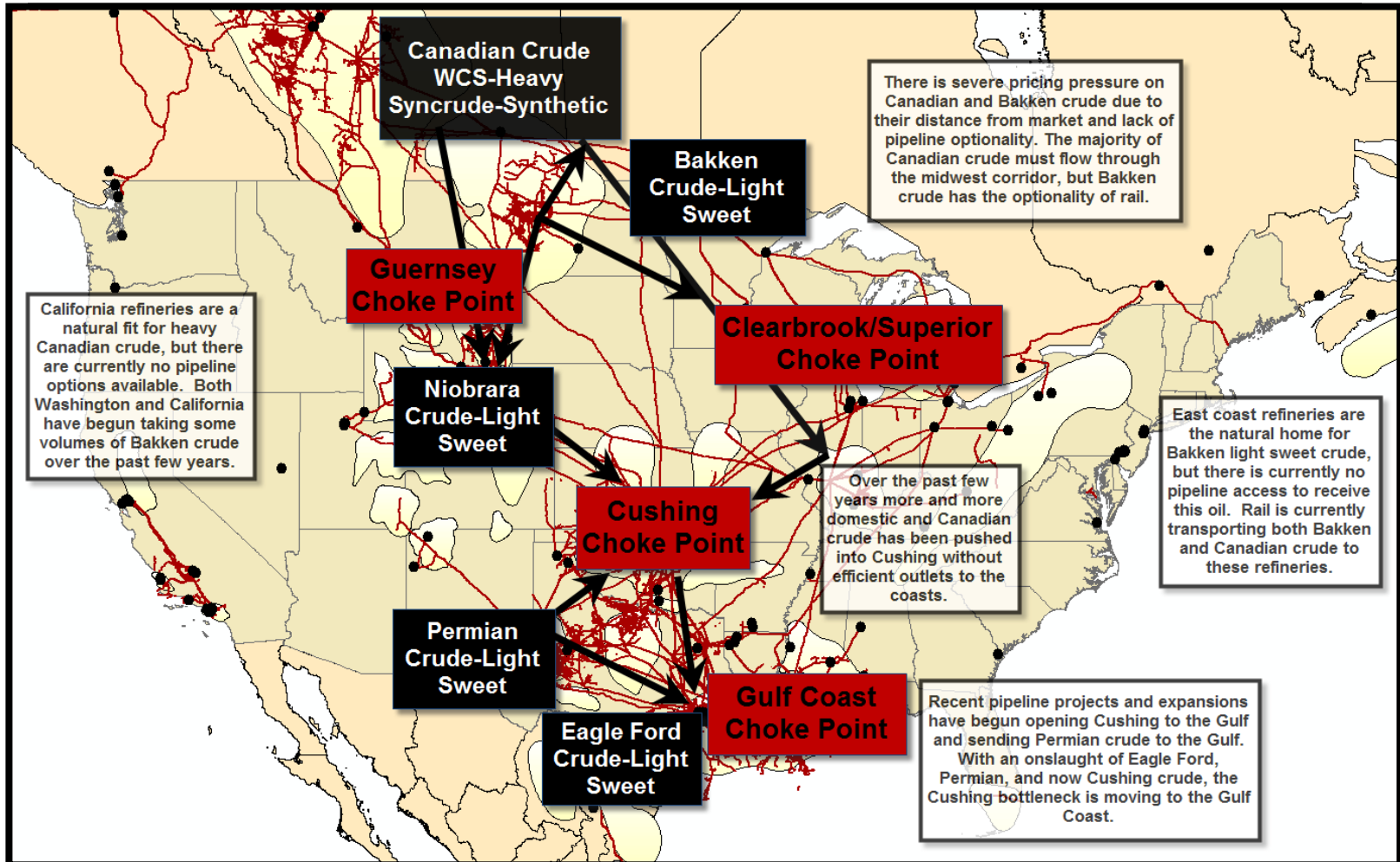
Decline Rates



Source: HPDI, Bakken

Infrastructure Challenges

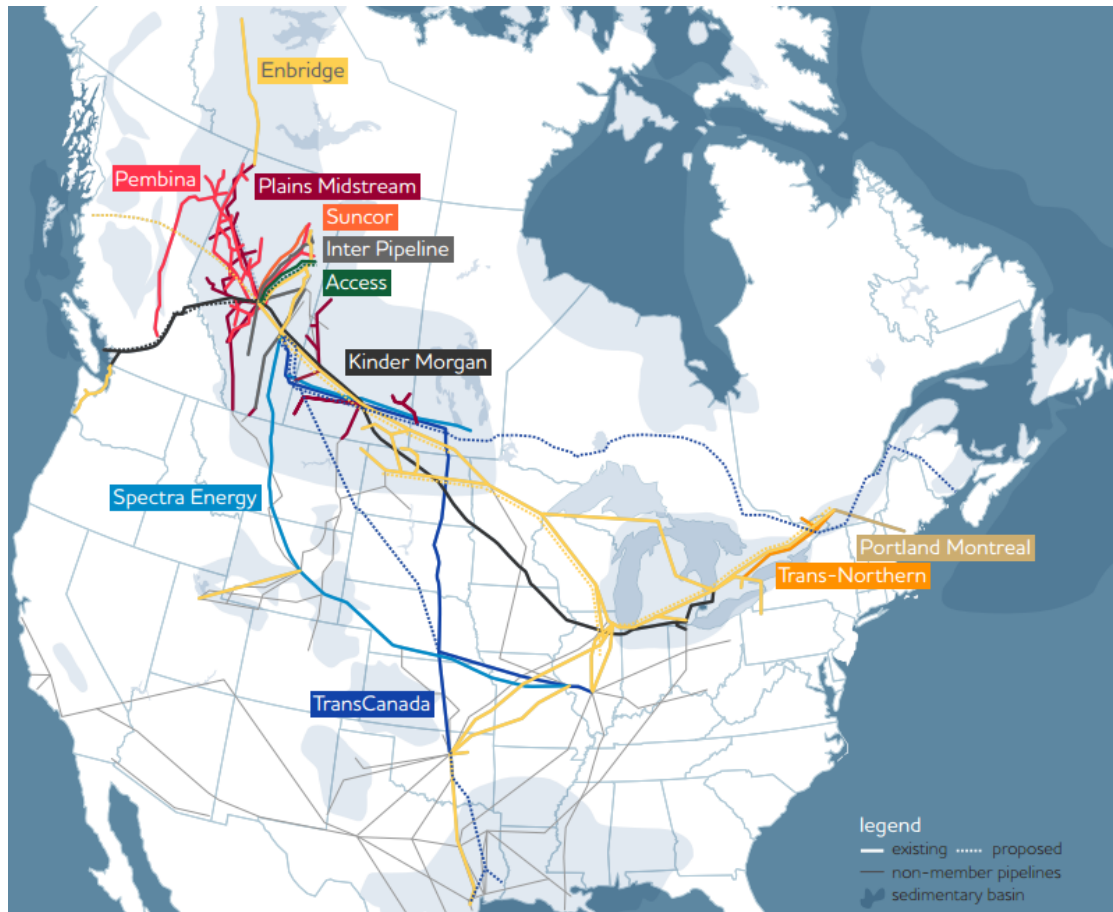
Pipeline Choke Points



Source: EPRINC Choke Point Map using Hart ArcGIS Mapping software

— emitte lucem et veritatem —

All Canadian Pipeline Export Options are Full

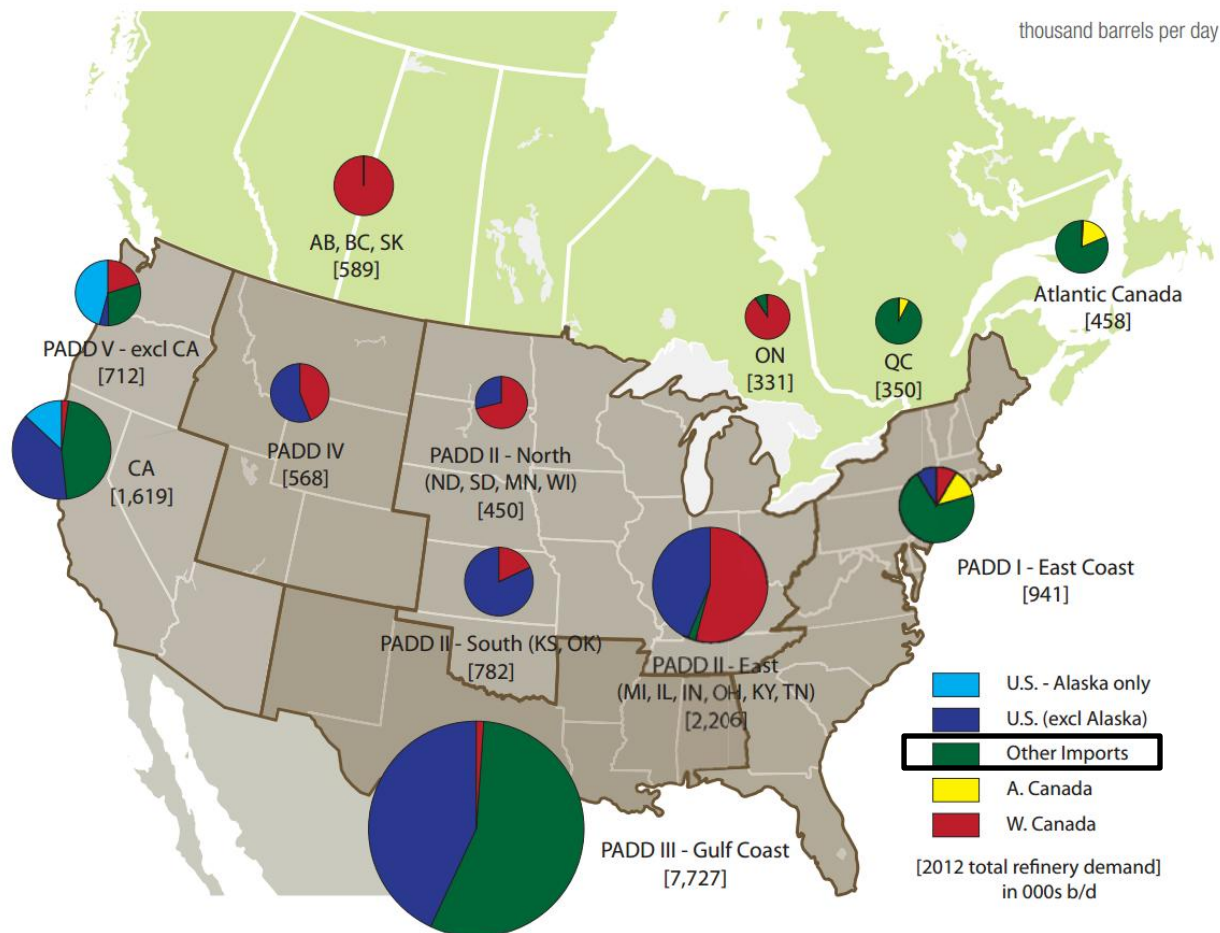


- **Kinder Morgan's** Transmountain line off BC coast - currently 300,000 b/d capacity-recent announcements to expand up to 800,000 b/d (early 2017)
- **(Now Spectra)** Platte line to Wood River 280,000 b/d-full
- **Enbridge** mainline system currently transporting over 1.5 mbd with potential capacity 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

— emitte lucem et veritatem —

Market Saturation

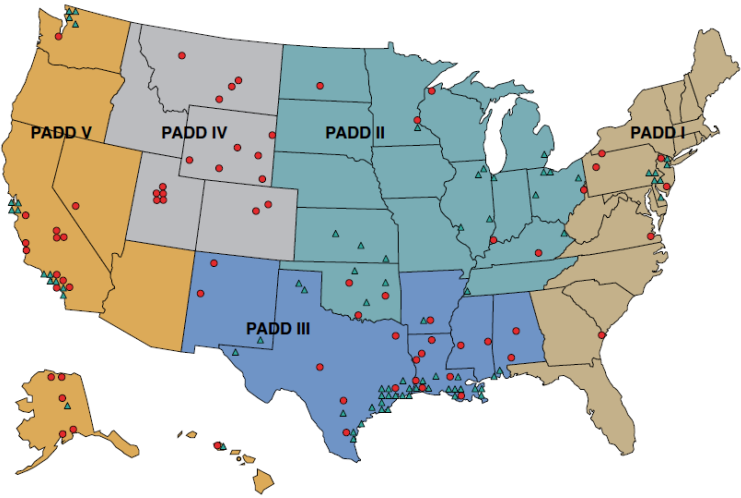


Sources: CAPP, CA Energy Commission, EIA, Statistics Canada

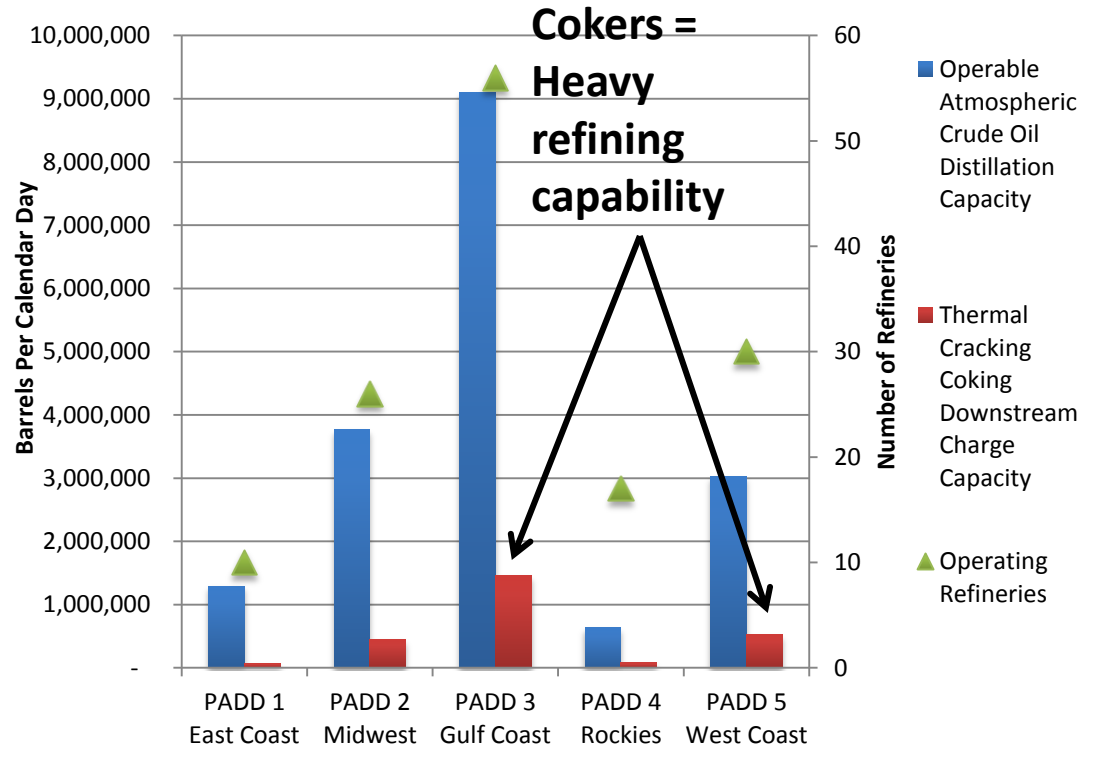
Source: CAPP Crude Oil Forecast June 2013

— emitte lucem et veritatem —

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



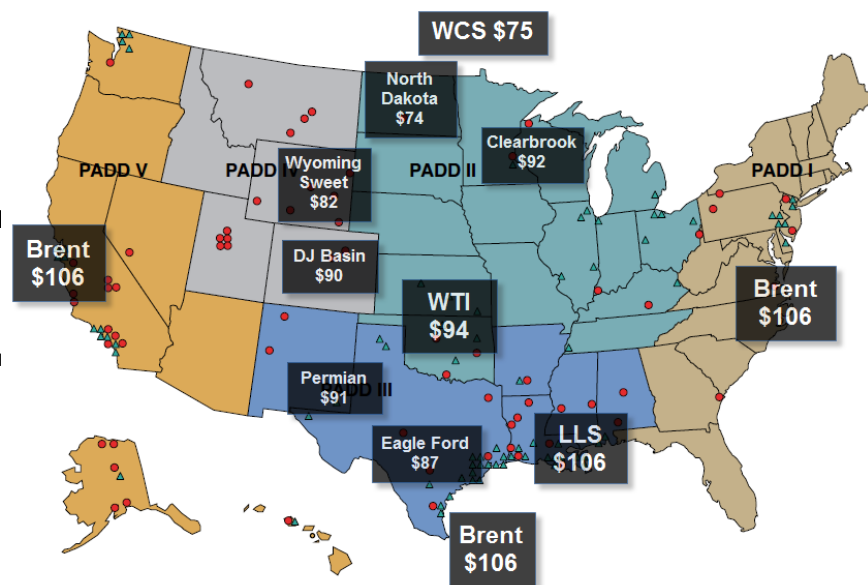
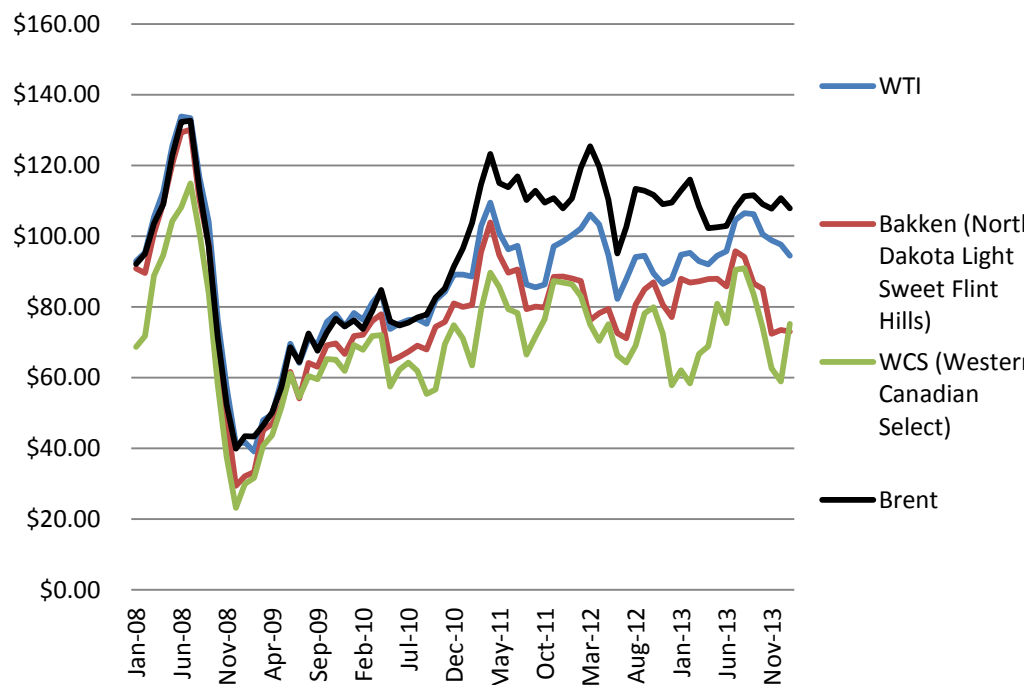
Total Coking Capacity vs. Atmospheric Crude Distillation Capacity by PADD



Source: AFPM map, EIA data for graph

— emitte lucem et veritatem —

Regional Pricing Disparities



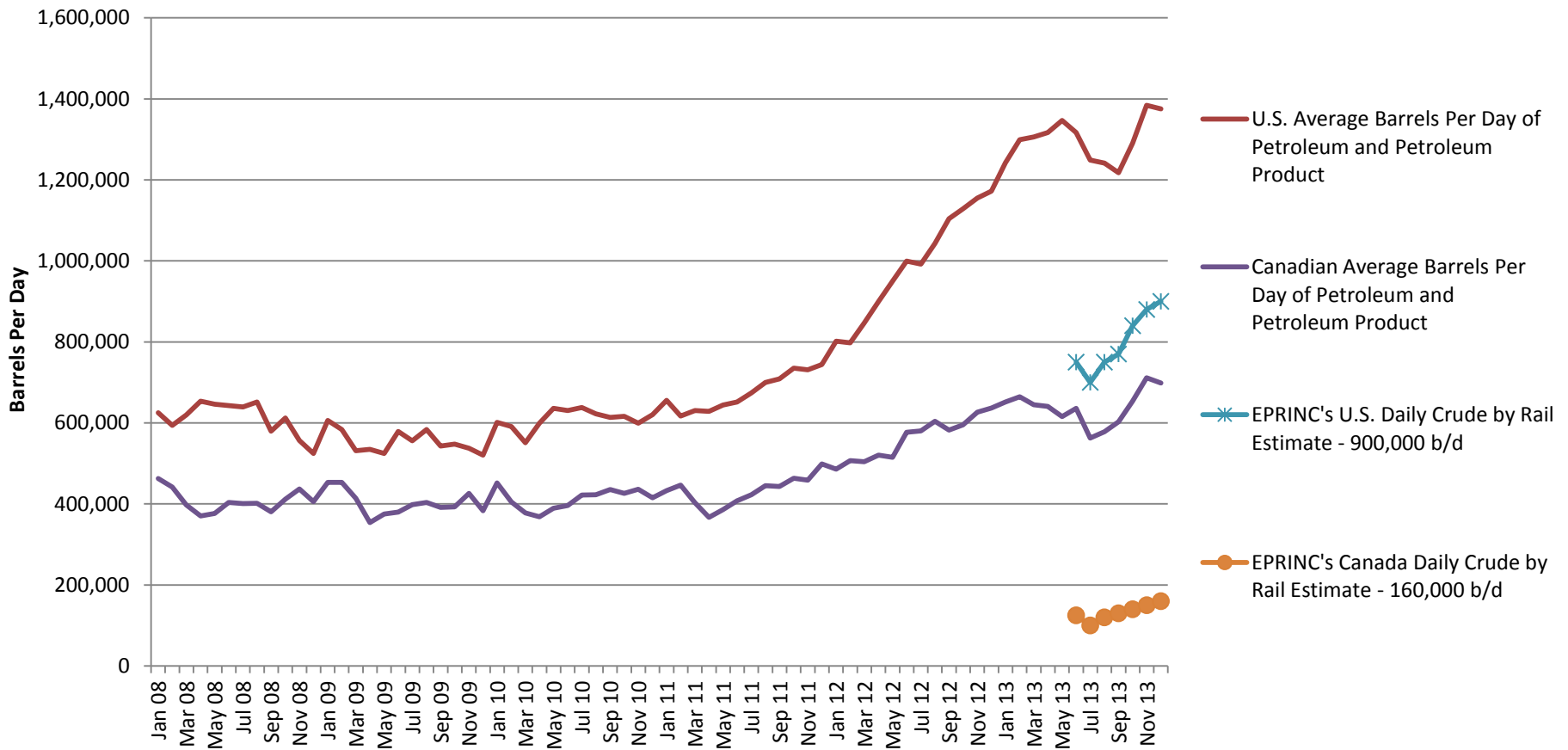
- **Western Canadian Select - \$18.50 to WTI**

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

emite lucem et veritatem

The Rise of Rail

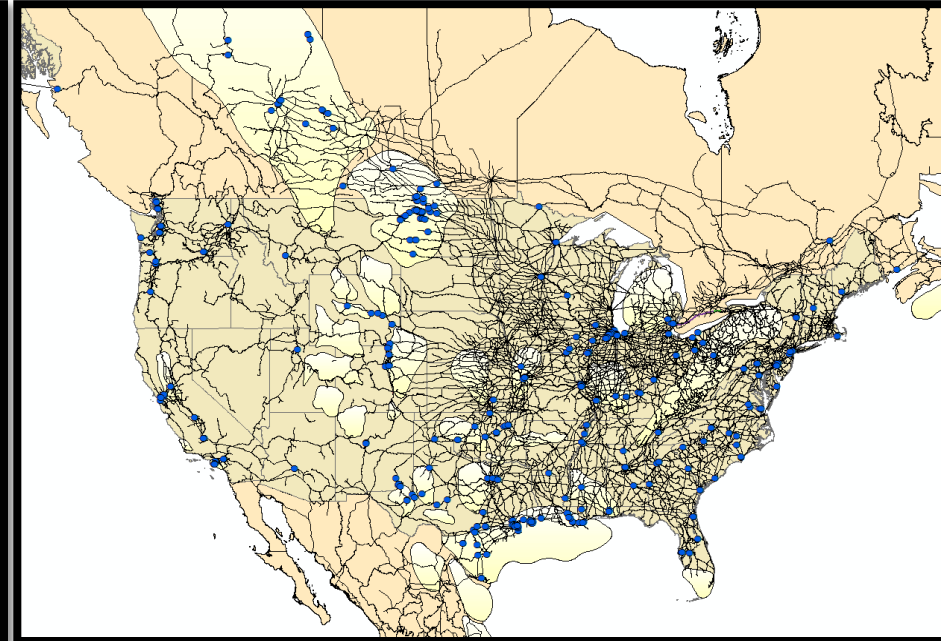
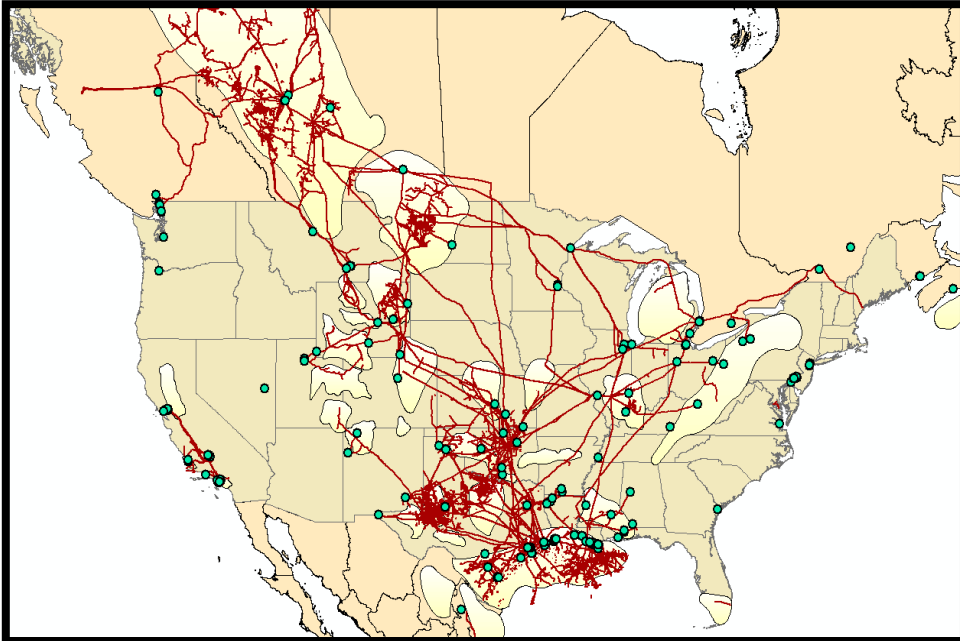
Daily Crude by Rail Shipment in U.S. and Canada



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).

emite lucem et veritatem

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

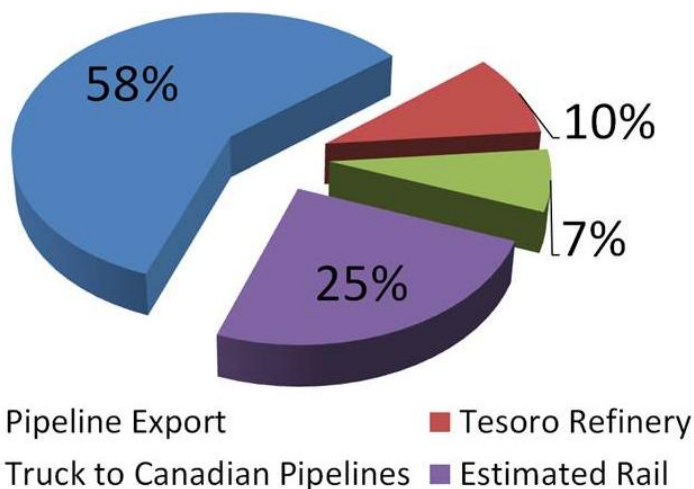
- New markets
- Diversification
- Neat Barrels
- Nimble - Quickly adjustable
- Optionality for Canadian and U.S. crude, NGLS, and other petroleum products

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

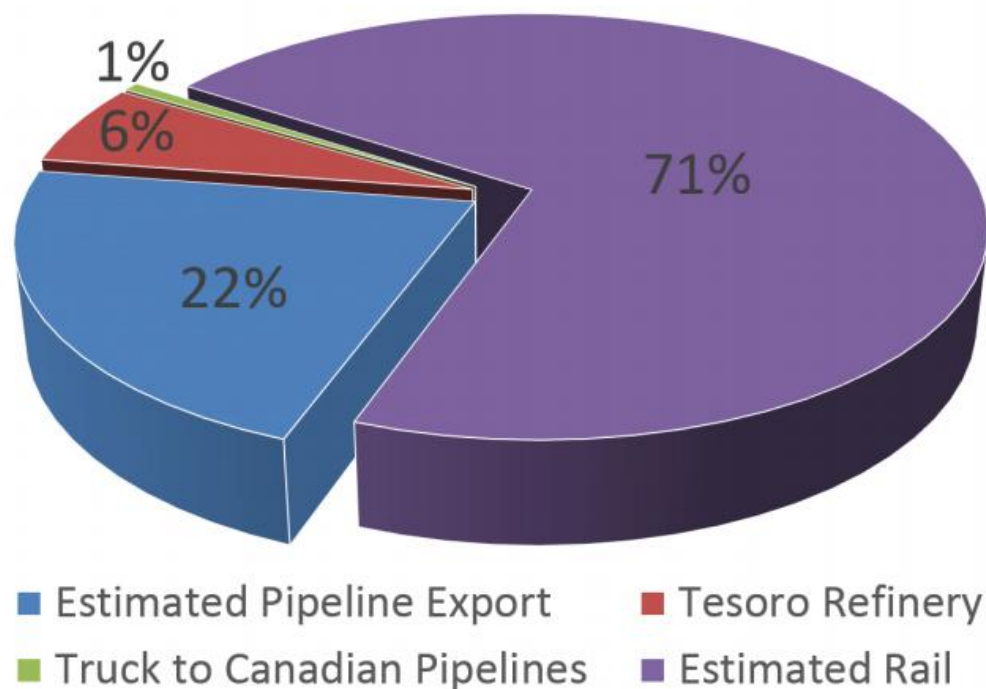
— *emitte lucem et veritatem* —

North Dakota Crude Oil Transport

January 2012 Estimates



November 2013 Estimates



Source: North Dakota Pipeline Authority

— emitte lucem et veritatem —

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.



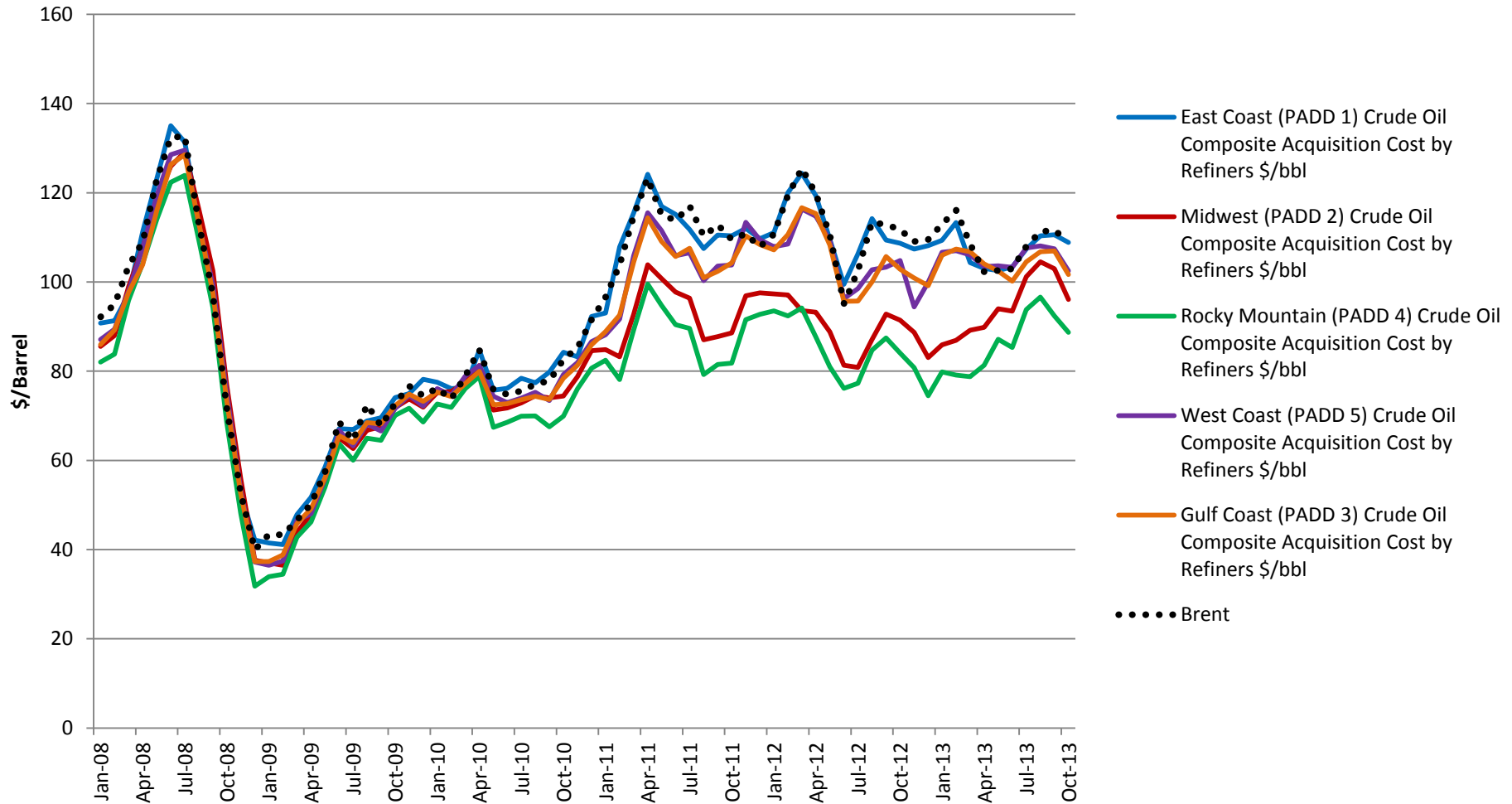
LAC MAGENTIC: AP PHOTO/THE CANADIAN PRESS, PAUL CHIASSON



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

Refineries Benefit

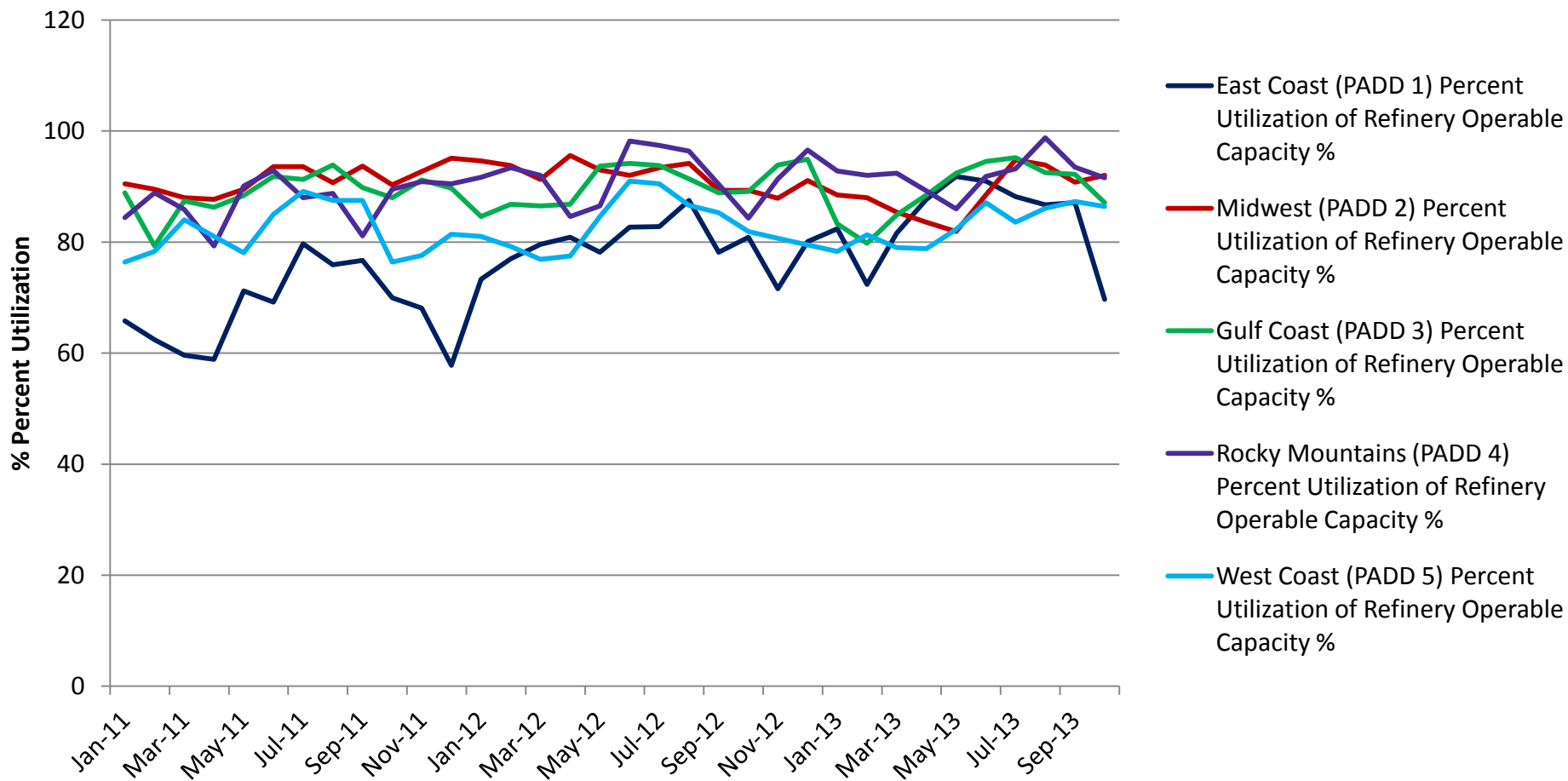
Refinery Acquisition Cost of Crude Oil



Source: EIA

— emitte lucem et veritatem —

Refinery Utilization by PADD



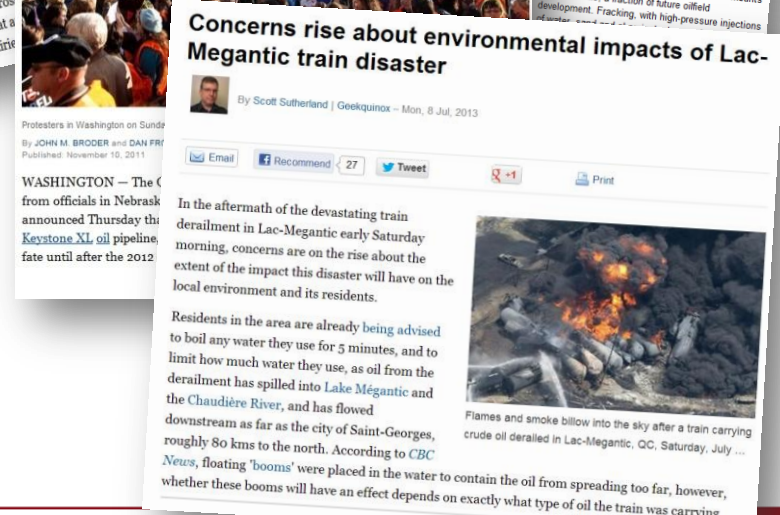
Source: EIA

emite lucem et veritatem

Regulatory Concerns

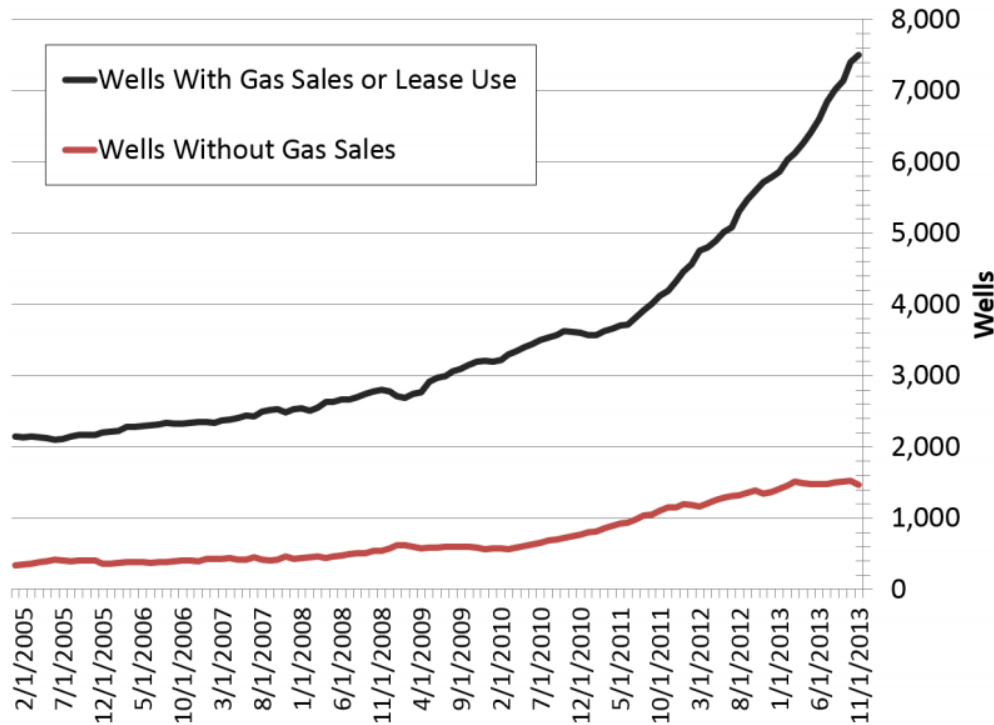
Potential Issues, Hurdles, and Regulatory Concerns

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



— emitte lucem et veritatem —

Natural Gas Flaring

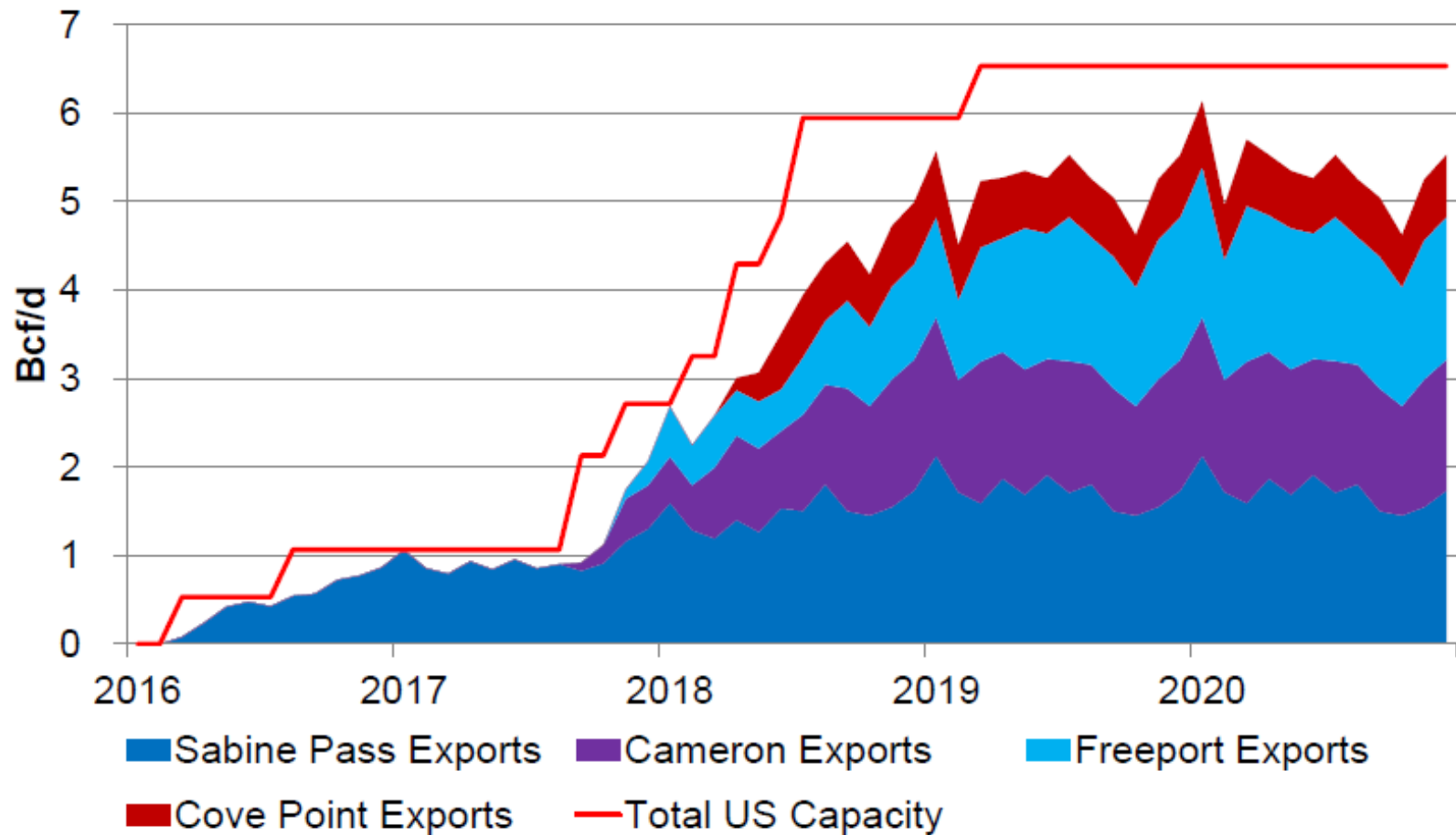


Source: NDPA

— emitte lucem et veritatem —

APPENDIX

US LNG Export Scenario



Source: Bentek

— emittē lucem et veritatem —

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