

“In the Eye of the Peak Oil Storm”

October 28, 2014 – THIS IS A SKETCH, NOT POLISHED OR COMPLETE

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Coyote sez: time to wake up!



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There are two main styles of denial in American politics today:

“...in *The Loss of Reality in Neurosis and Psychosis* (1924) [Freud] wrote the following: “Neurosis does not disavow the reality, it ignores it; psychosis disavows it and tries to replace it.” (p. 185) What psychosis replaces reality with is delusion....Psychotic delusion on the personal level becomes ideology at the group level; both possess the power to annihilate the Other – be it the foreigner or the domestic subversive.”

-- Dmitri Orlov, “[Peak Oil Oppositional Disorder: Neurosis or Psychosis?](#)”

Not a level field: world per capita energy consumption (from David Hughes)

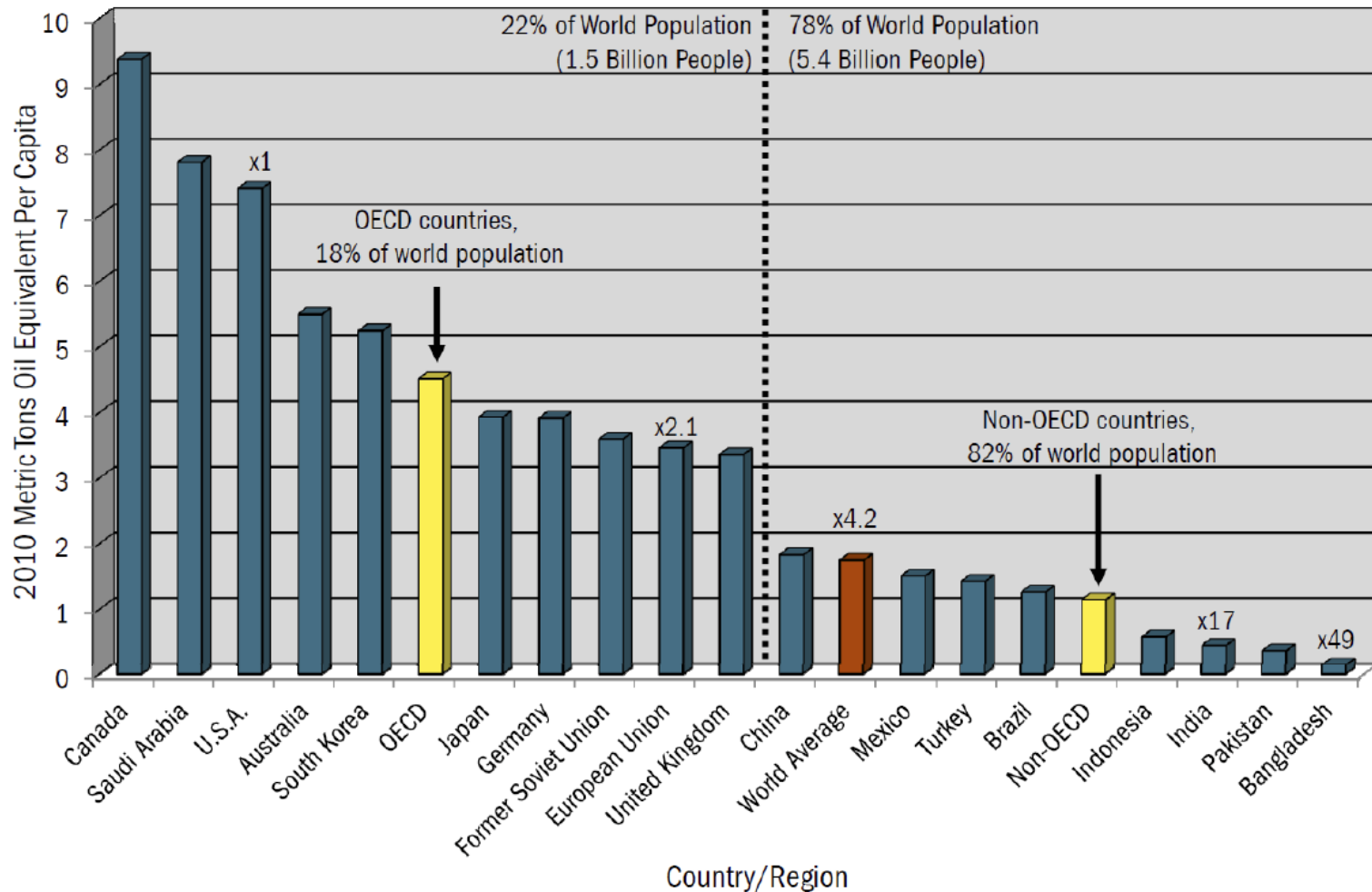


Figure 3. World per capita energy consumption by country and region, 2011.

The comparison of United States consumption to selected countries is indicated by times signs.^{4,5}

First theme: the world is very near the all-time peak in oil supplies (or perhaps past the peak, depending on the definition of “oil”). This has very serious economic and political implications.

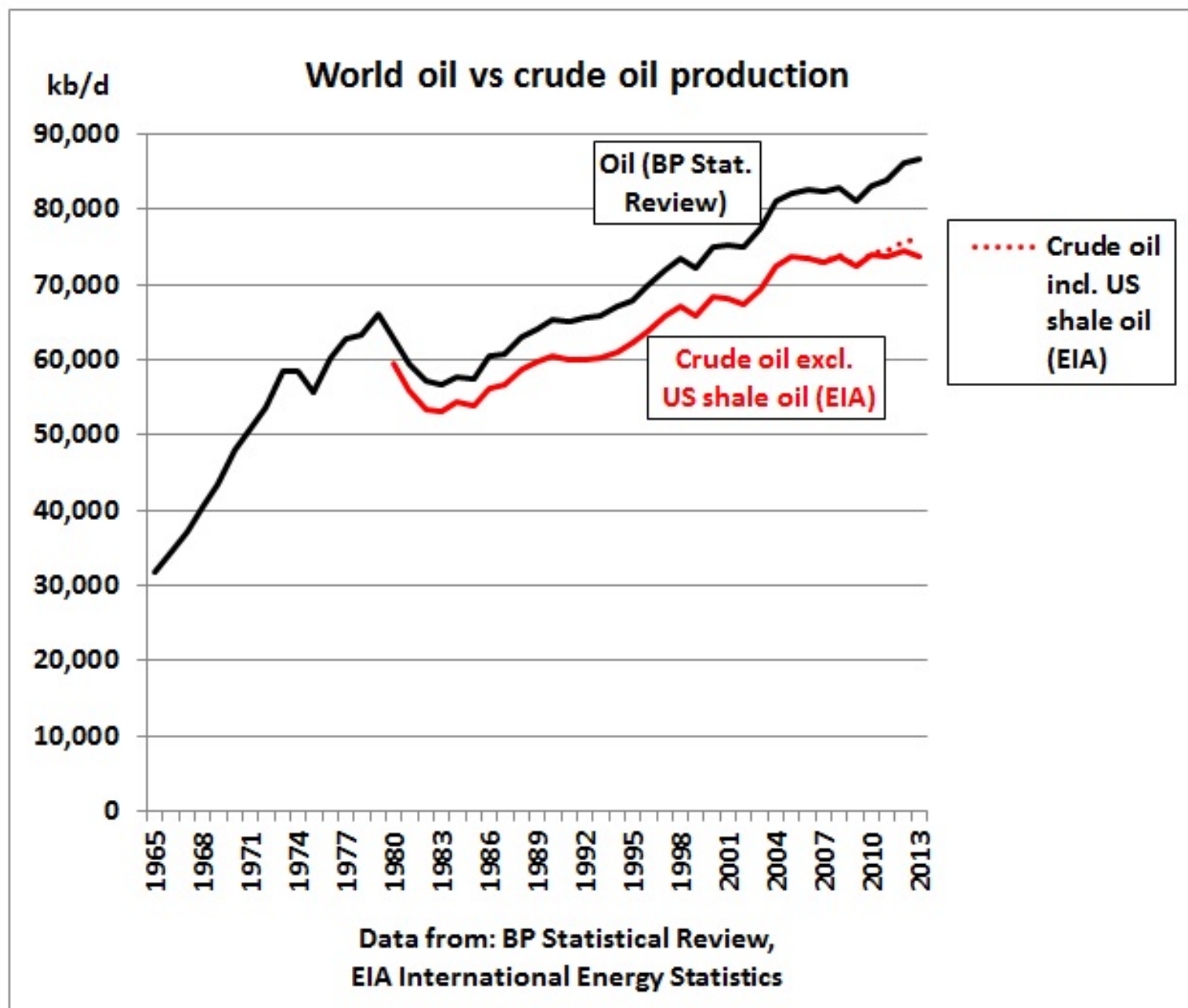
The following 10 slides are from the June 25, 2014 post “[Oil prices started to skyrocket when one quarter of global supplies went into irreversible decline](#)” on Matt Mushalik’s [excellent blog](#). From Mushalik’s introduction:

“The 2.8 fold increase in oil prices since 2004 gives us an idea what will happen when a larger percentage of countries peaks and then declines, not to mention when the global peak is reached.

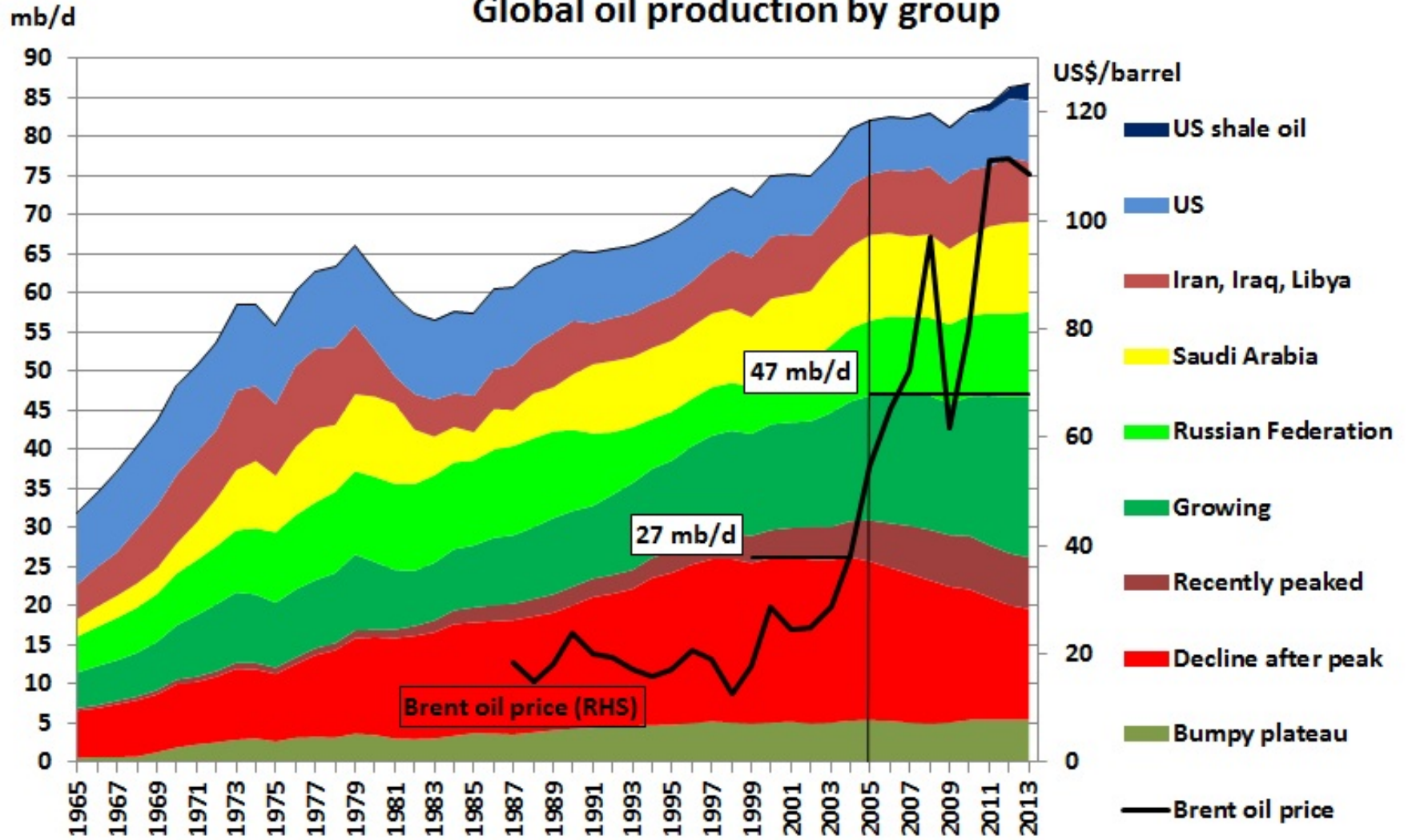
In June each year BP publishes its *Statistical Review* with data up to the preceding calendar year. BP’s definition of oil includes “crude oil, tight oil, oil sands **and NGLs (the liquid content of natural gas where this is recovered separately)** but excludes liquid fuels from other sources such as biomass and derivatives of coal and natural gas.”

Total oil production does not show a peak although growth in 2013 was just 0.6% compared to 2.6 % the year before.”

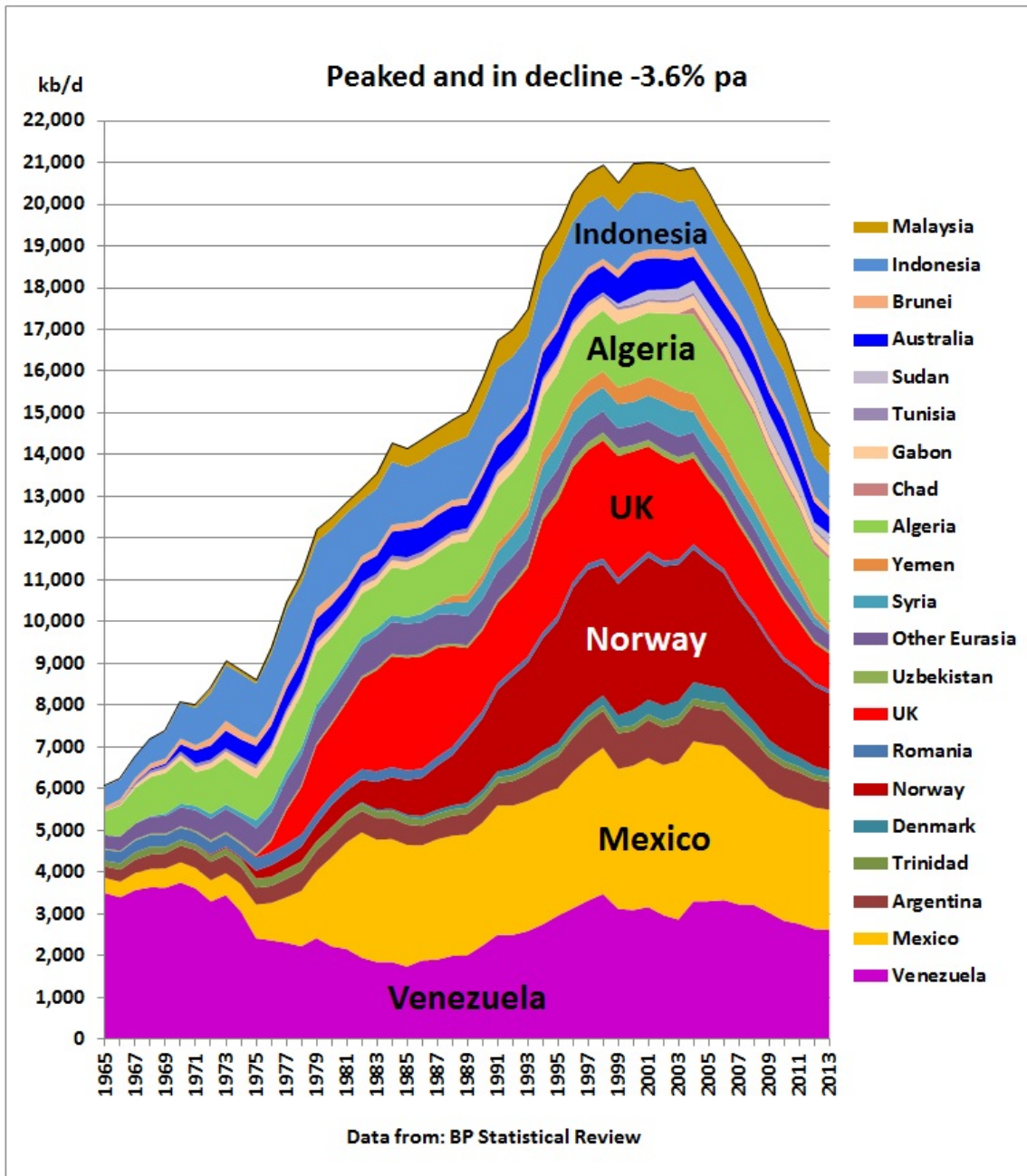
Mushalik will use BP's definition of "oil" (crude oil + condensate ["C+C"]+ dilbit + NGLs), rather than DOE's "oil" (C + C + dilbit). The contrast is shown here.

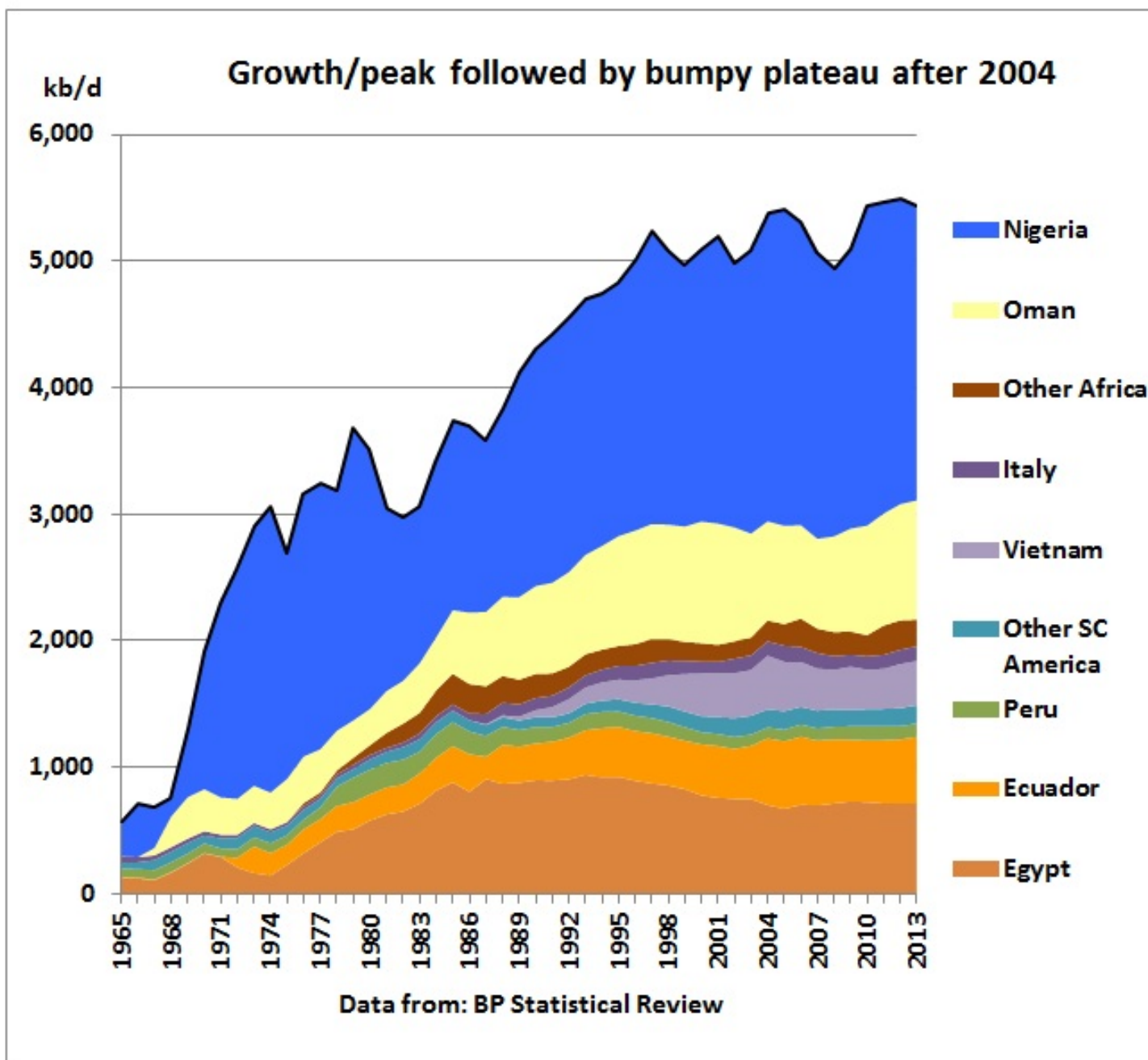


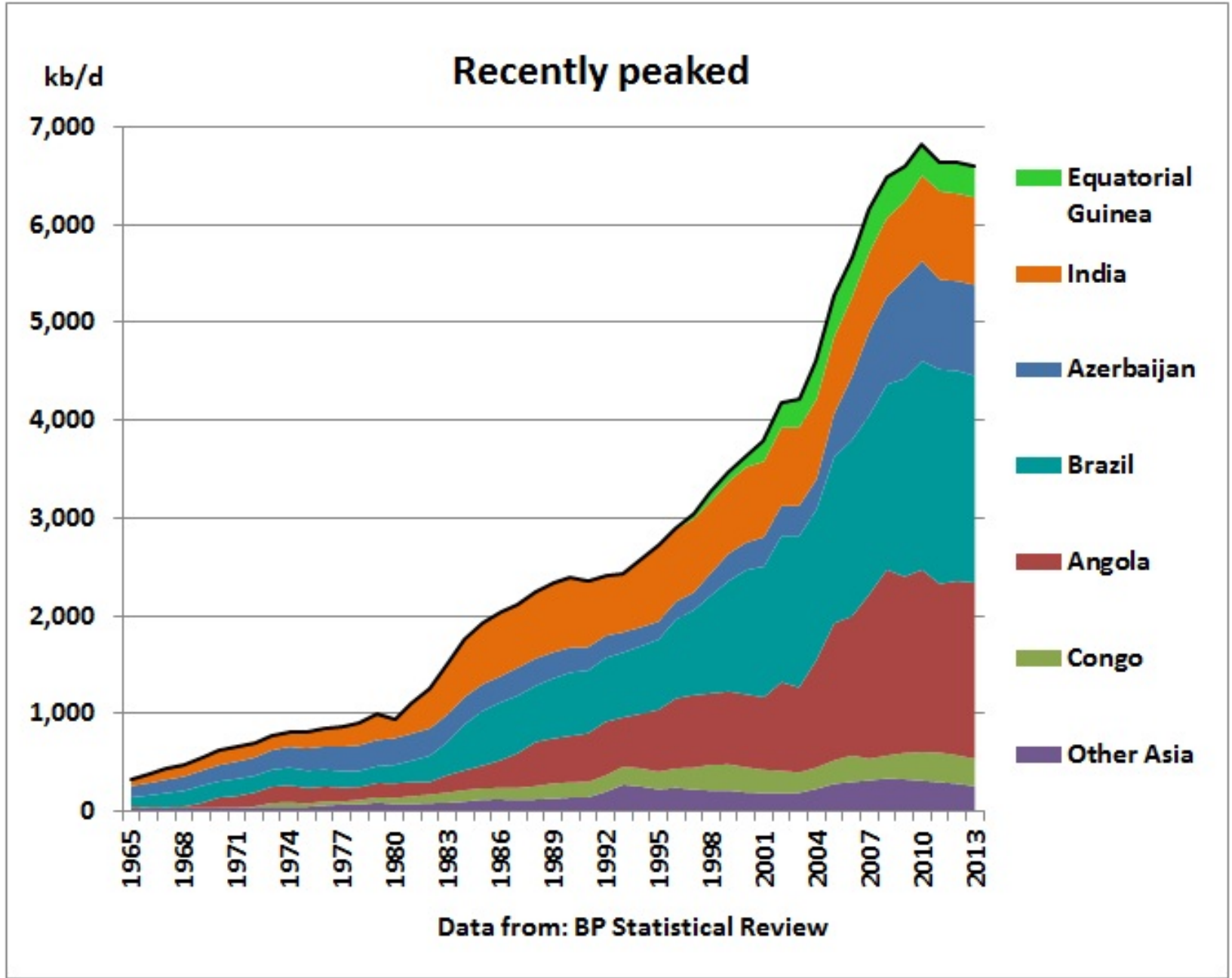
Global oil production by group



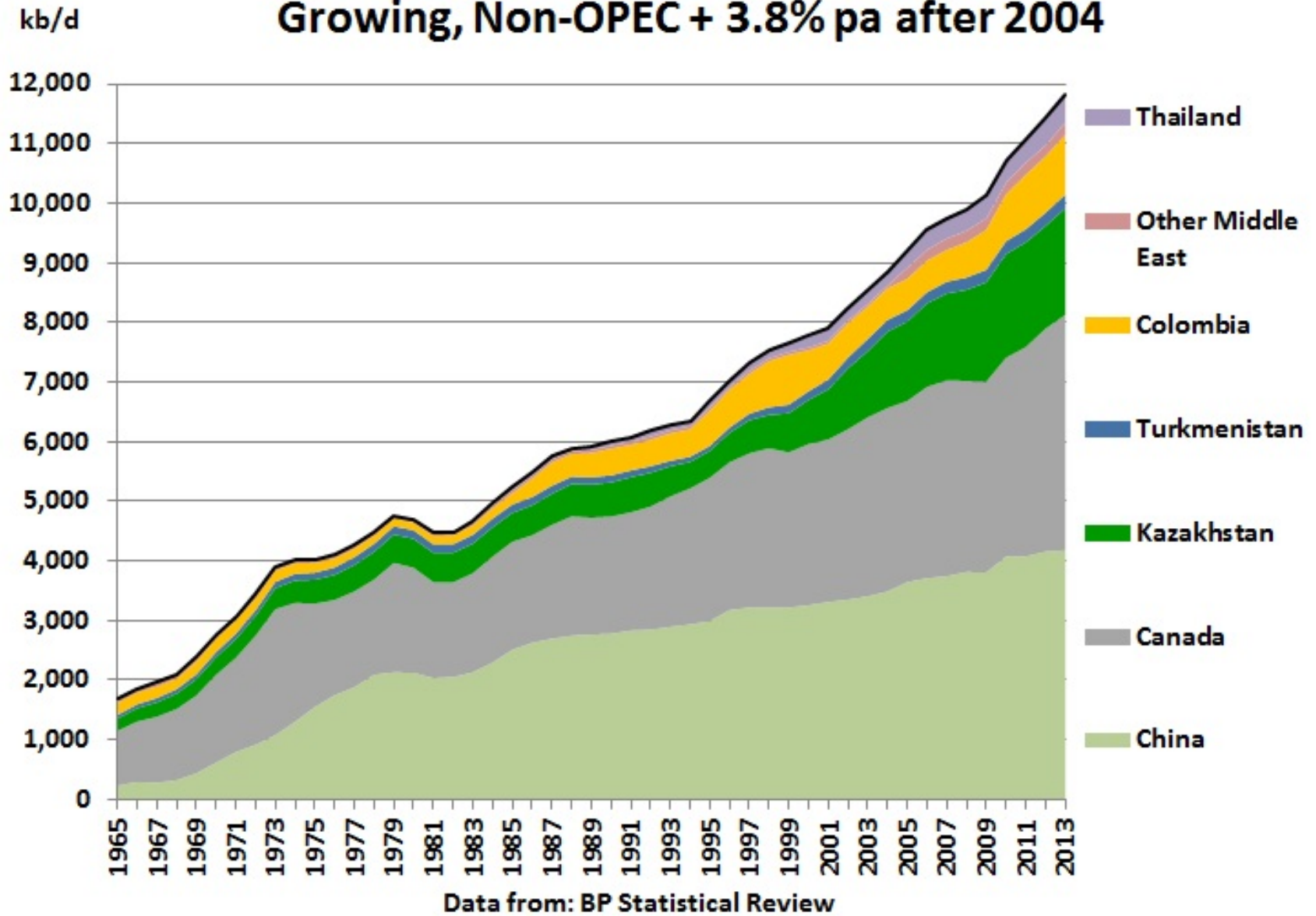
Data from: BP Statistical Review

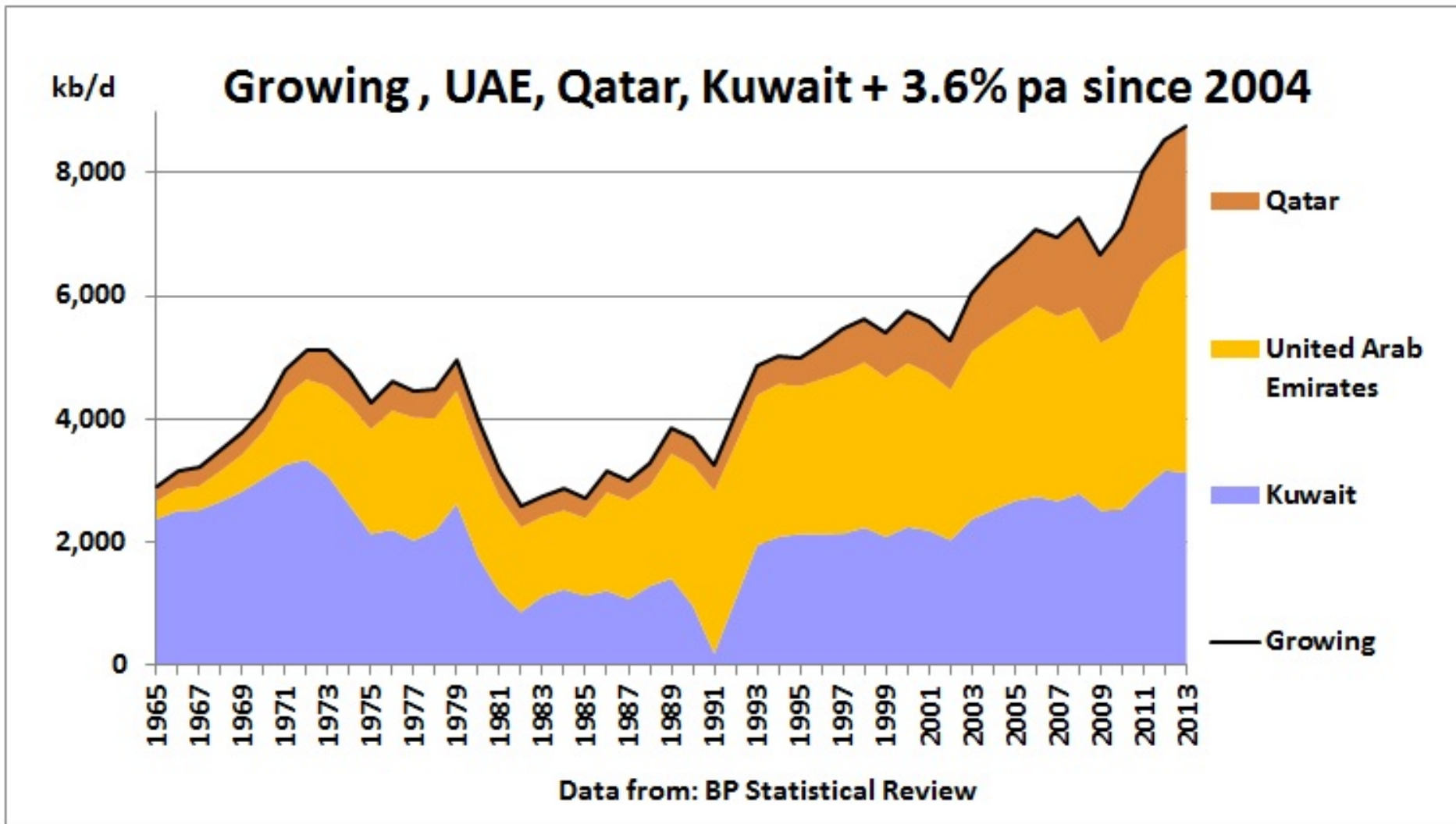




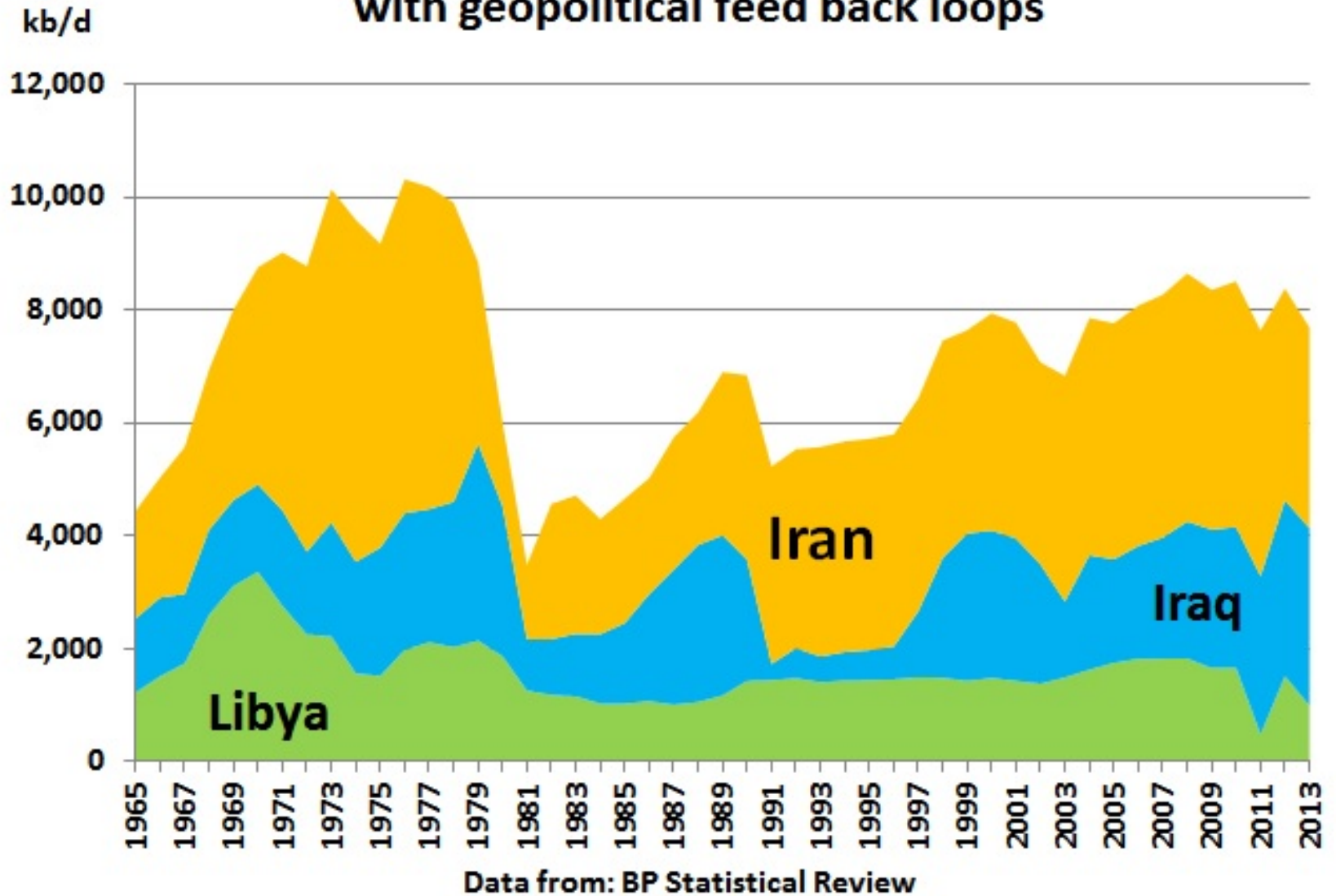


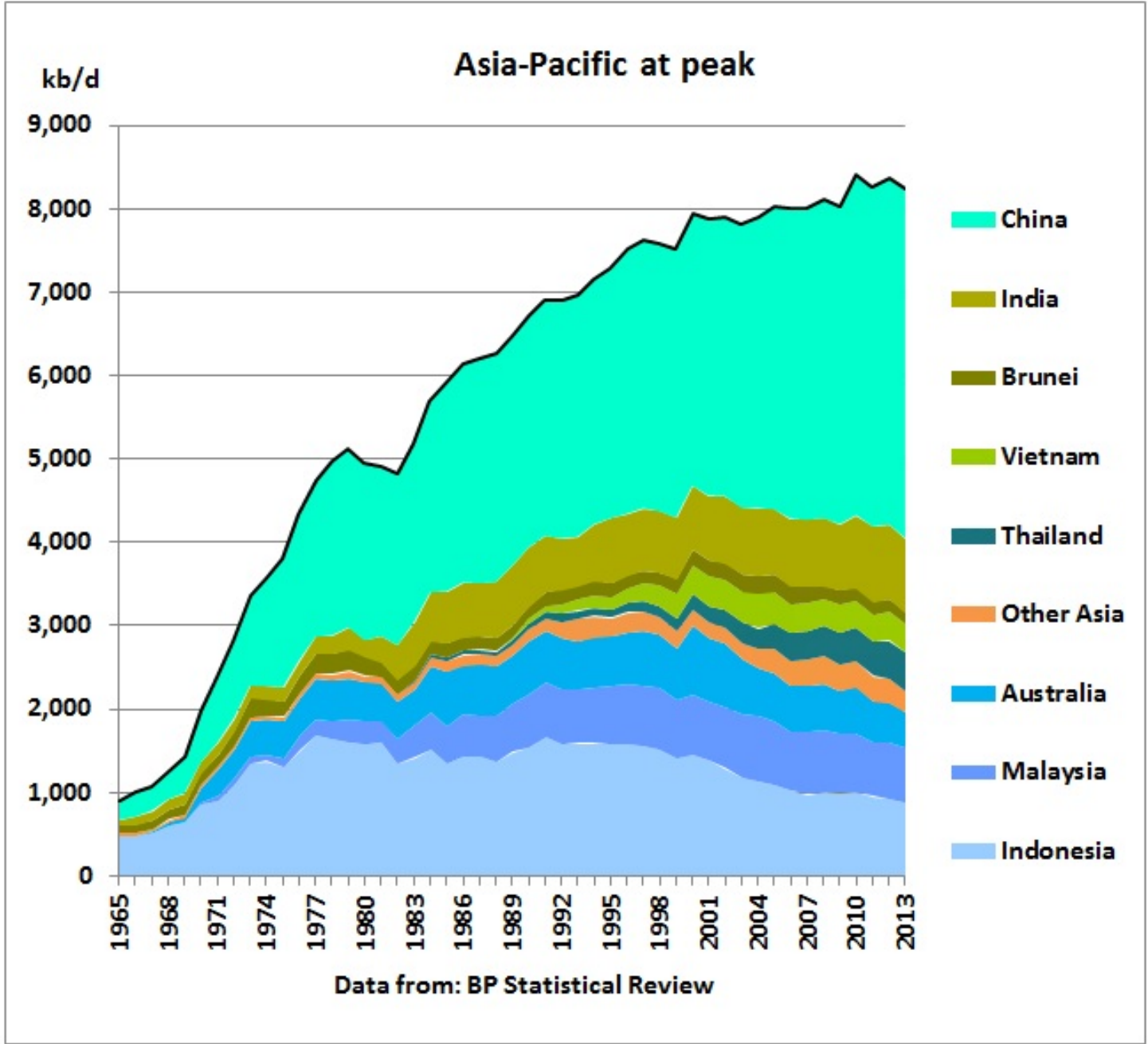
Growing, Non-OPEC + 3.8% pa after 2004

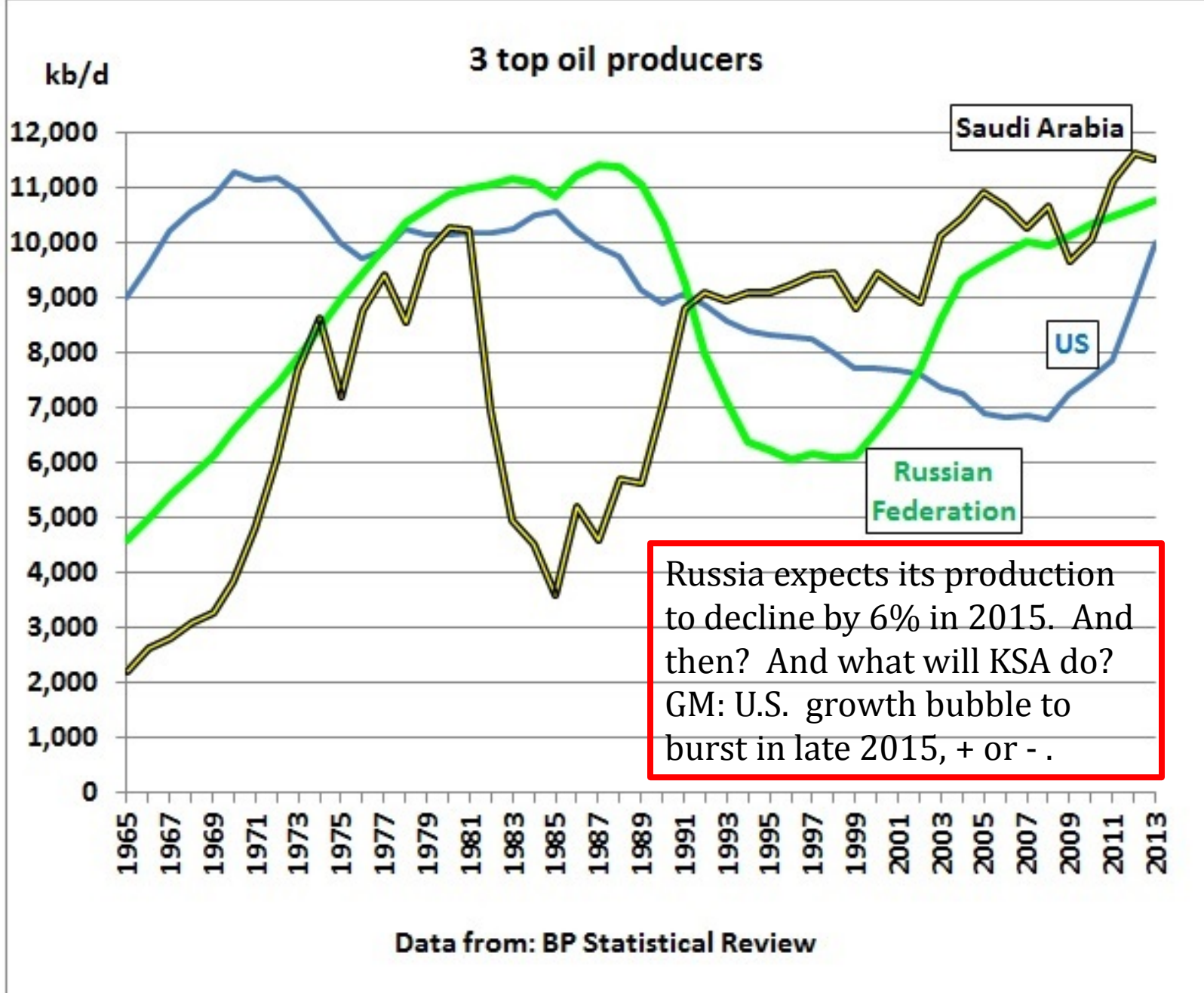




3 MENA oil producers with geopolitical feed back loops







Now switch to DOE EIA data for C+C, from [Ron Patterson's good blog](#) (2 slides)



World oil will peak when the U.S. peaks, or before. So let's look closely at the U.S.

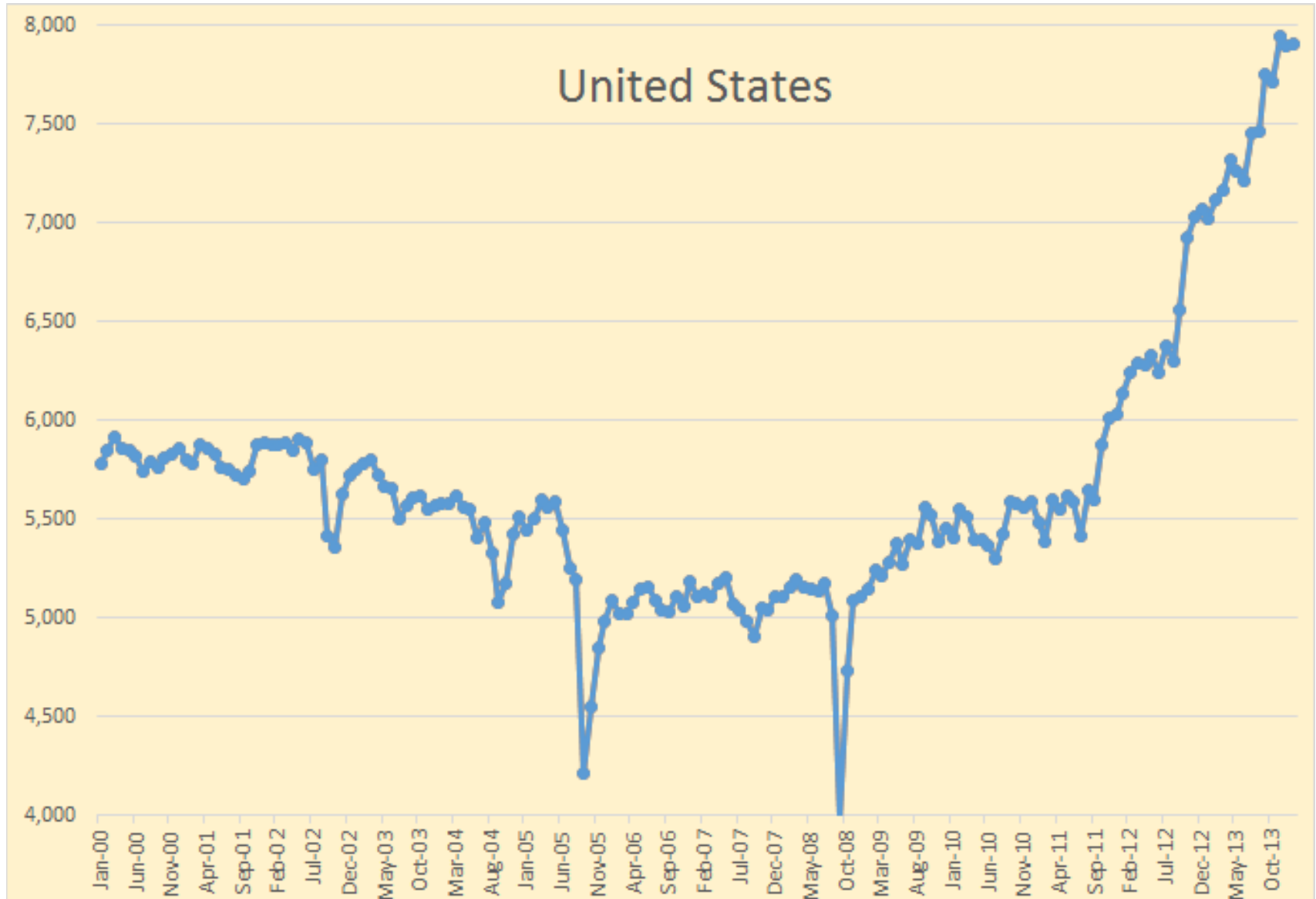
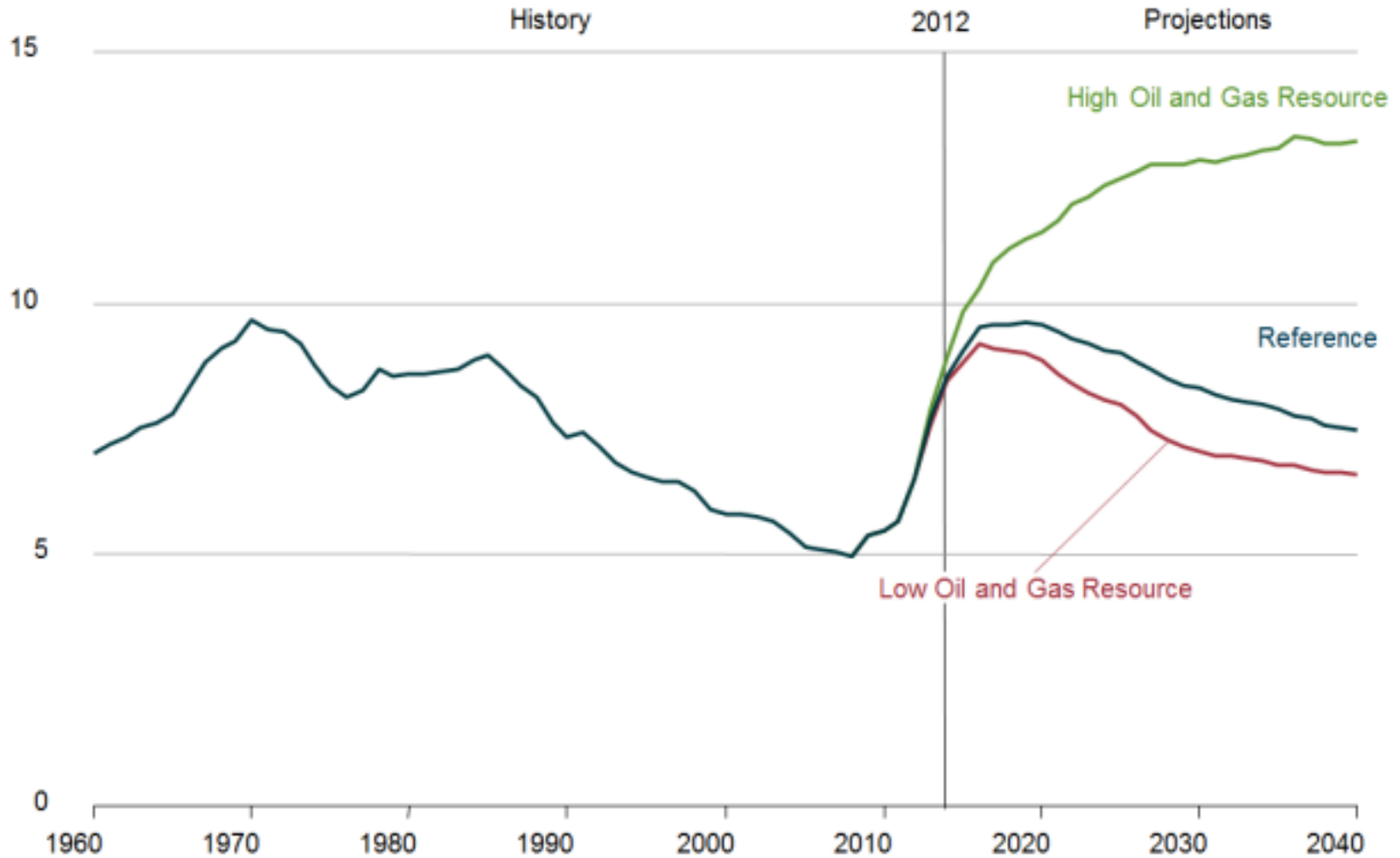
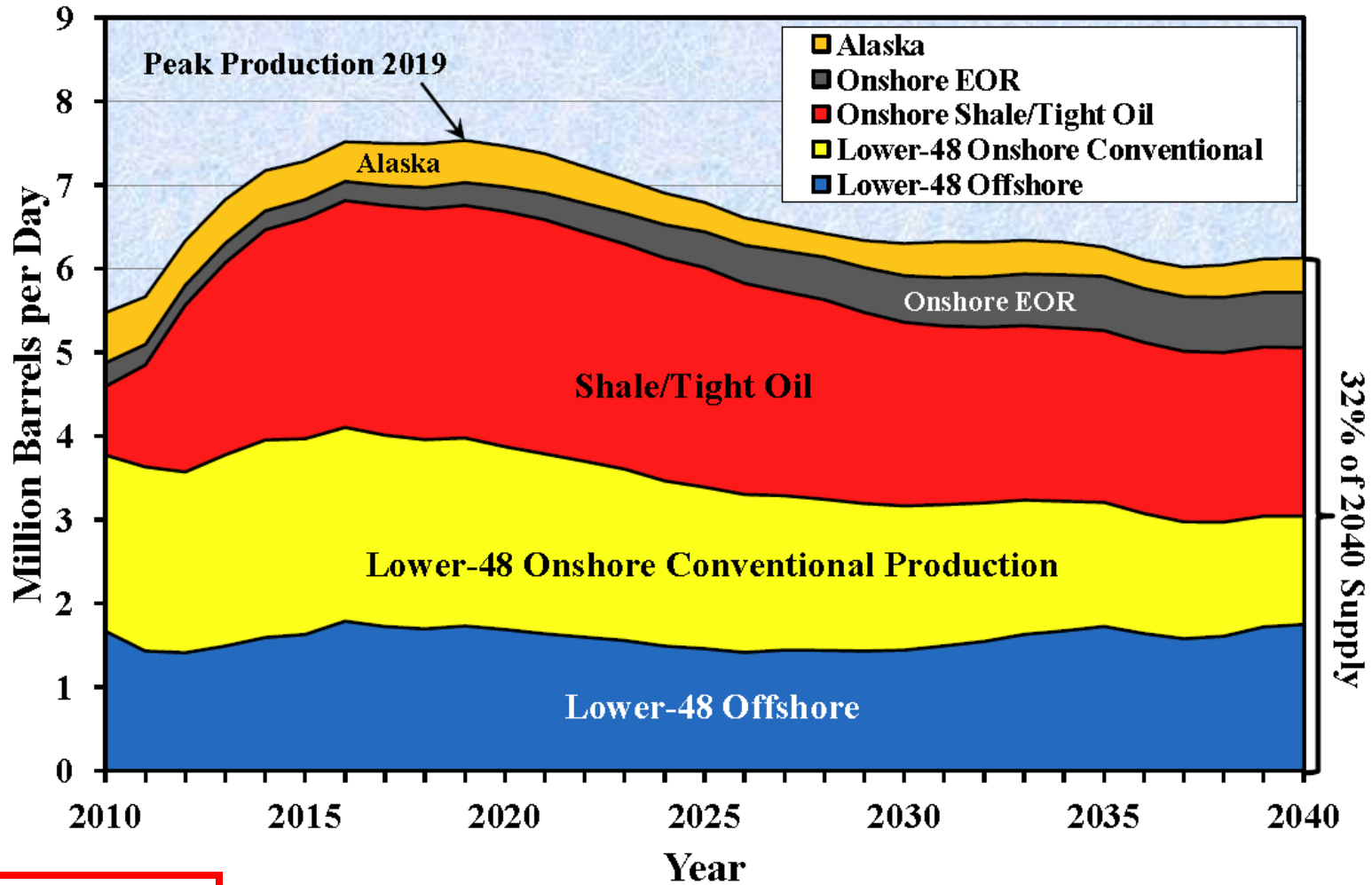


Figure IF2-1. U.S. crude oil production in three cases, 1960-2040

million barrels per day



U.S. Crude Oil Production Projection by Source and Region 2010-2040 (EIA 2013 Reference Case)



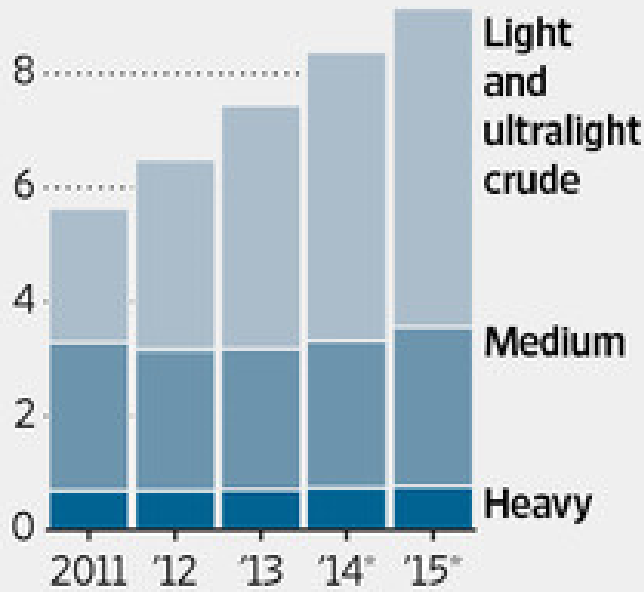
© Hughes GSR Inc, 2012

(data from EIA Annual Energy Outlook 2013, EIA, 2012; International Monetary Fund)

Oil Gauge

Production of particularly volatile light and ultralight crude is growing rapidly in the U.S.

10 million barrels a day.....



*Forecasts

Sources: Energy Information Administration; Drillinginfo; Colorado Department of Natural Resources; Railroad Commission of Texas

The Wall Street Journal

From Chris Hamilton, <http://seekingalpha.com/article/2563915-daze-of-peak-oil-or-at-least-peak-oil-production>

“There are many issues with the new "oil" production:

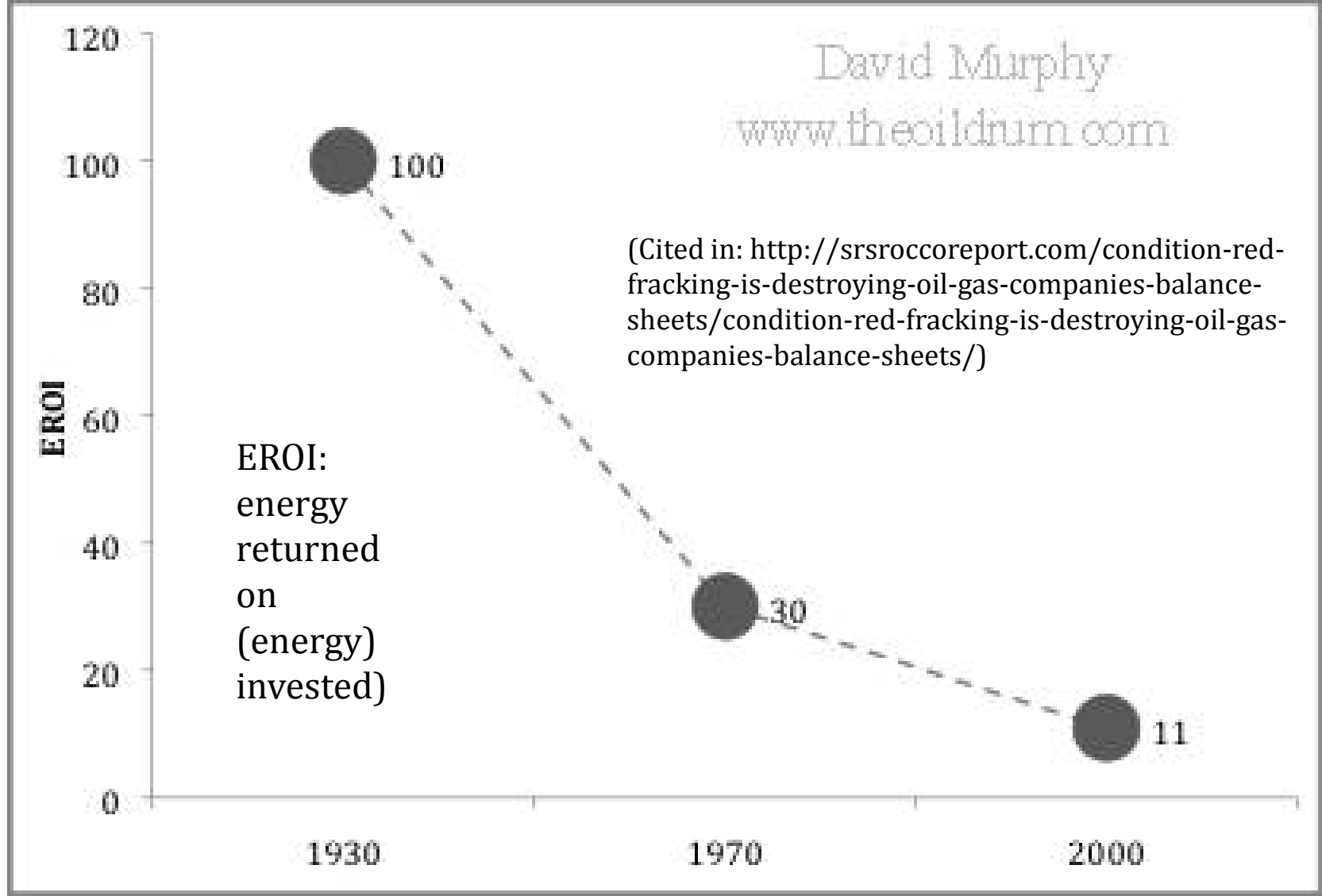
The new oil production is so "light" that a portion of it is not what we use to power our cars and trucks. The very light "condensate" portion (similar to natural gas liquids) is especially a problem.

Oil refineries are not necessarily set up to handle crude with so much volatile materials mixed in. Such crude tends to explode, if not handled properly.

These very light fuels are not very flexible, the way heavier fuels are. With the use of "cracking" facilities, it is possible to make heavy oil into medium oil (for gasoline and diesel). But using very light oil products to make heavier ones is a very expensive operation, requiring "gas-to-liquid" plants.

Because of the rising production of very light products, the price of condensate has fallen in the last three years. If more tight oil production takes place, available prices for condensate are likely to drop even further. Because of this, it may make sense to export the "condensate" portion of tight oil to other parts of the world where prices are likely to be higher. Otherwise, it will be hard to keep the combined sales price of tight oil (crude oil + condensate) high enough to encourage more tight oil production.

2009 through 2013 saw a rapid increase in US production, almost entirely from low quality, high cost new tight oil sources while conventional high-quality, low-cost production maintained its long, gradual decline.”



It is thought by some closest to these numbers that this last efficiency is approaching the minimum needed to maintain this society – its infrastructure, machines, economy, and people.



July 29, 2012
Fracking Beaver County, Pa



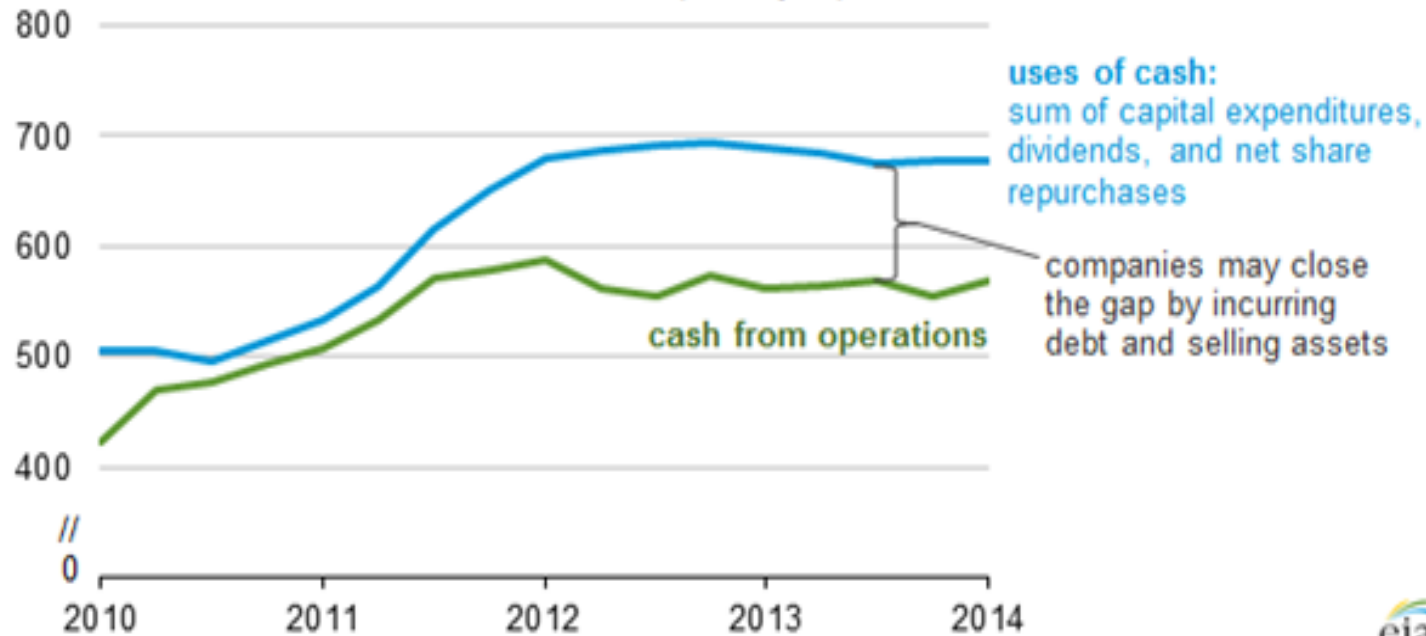
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Major energy companies' cash from operations and uses of cash

billion 2014 dollars, annualized values from quarterly reports



In 2010, the hole left behind by fracking was only \$18 billion. During each of the last three years ('11-'13), the gap was over \$100 billion/yr. This is the chart of an industry with apparently steep and permanent negative free cash-flows: This is the huge problem with Fracking shale oil and gas. Due to the extremely high annual decline rates of the typical shale oil or gas well, companies must continue to spend a great deal of capital expenditures to replace what was lost. It's known as the DRILLING TREADMILL... once you start, you can't get off. In one year the top 127 oil and gas companies spent \$110 billion more on capital expenditures than they received from operations. So, they acquired \$106 billion in additional debt (a large percentage through the Junk Bond Market) and sold assets to make up the difference. This is not a sustainable business model. (Chris Hamilton, <http://seekingalpha.com/article/2563915-daze-of-peak-oil-or-at-least-peak-oil-production>)

Summary by Gail Tverberg, with her comments as to prospects

Leading Crude Oil Producers First Quarter 2014

Rank	Country	Million Barrels per Day	Prospects
1	Russia	10.1	Decline
2	Saudi Arabia	9.8	Unstable
3	United States	8.1	Bubble
4	China	4.2	Flat; Decline?
5	Canada	3.5	Increase
6	Iraq	3.3	Unstable
7	Iran	3.3	Unstable
8	United Arab Emirates	2.8	Unstable
9	Kuwait	2.7	Unstable
10	Mexico	2.5	Decline

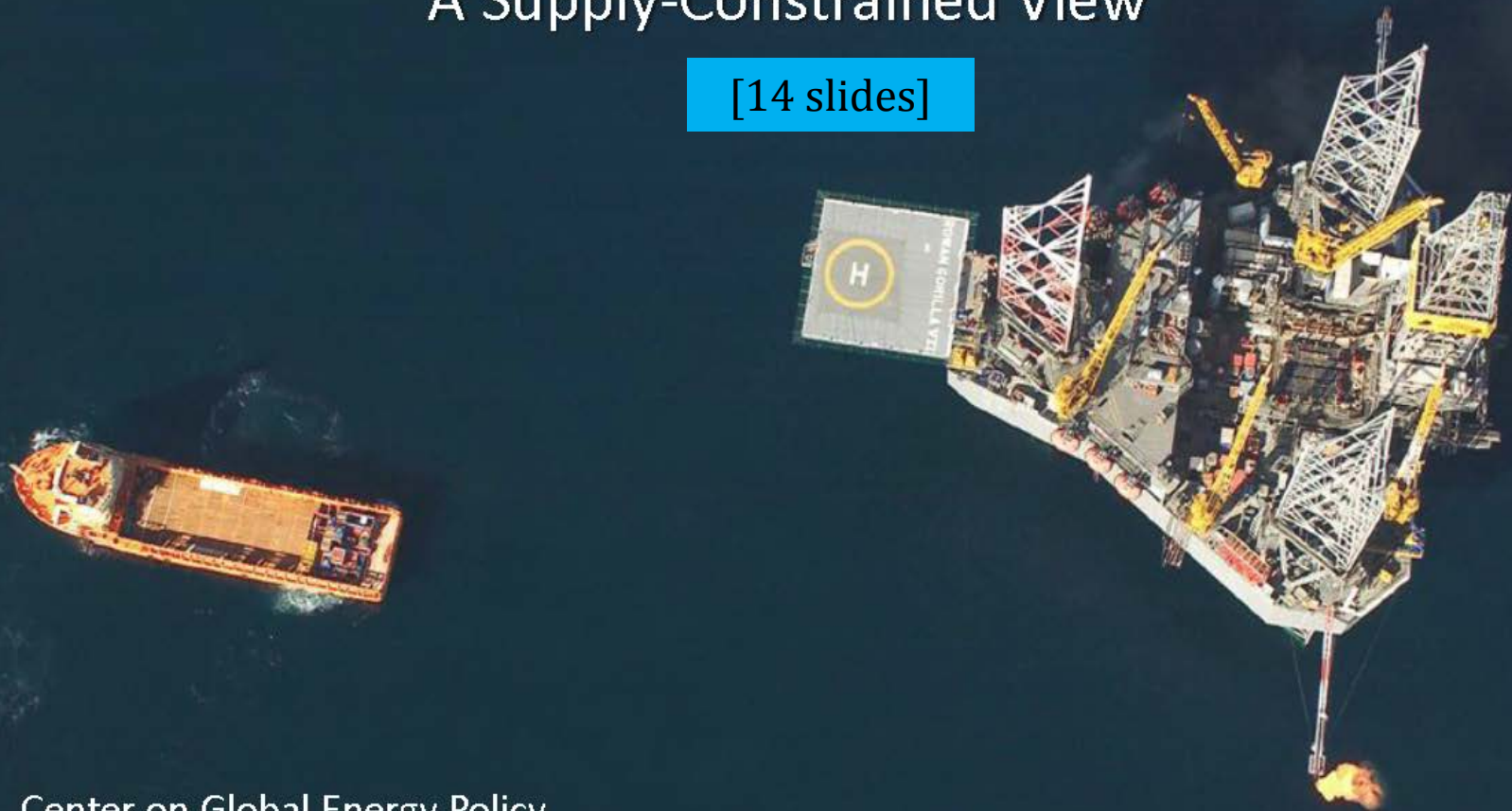
Based on EIA Data

<http://ourfiniteworld.com/2014/07/23/world-oil-production-at-3312014-where-are-we-headed/>

Oil and Economic Growth

A Supply-Constrained View

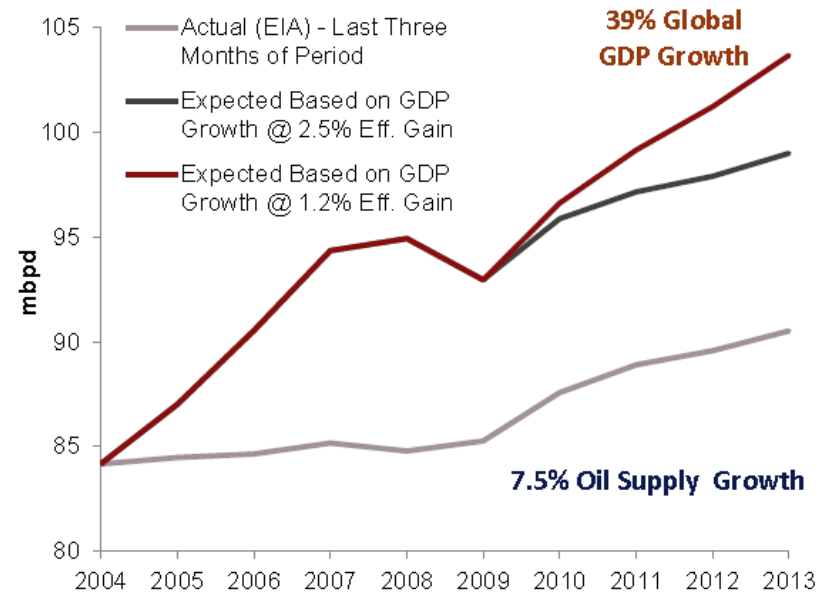
[14 slides]



Center on Global Energy Policy
School of International and Public Affairs
Columbia University
11th February 2014

Steven Kopits
Managing Director
Douglas-Westwood / New York

- Oil demand historically increases by $0.75 * \text{GDP growth}$ (inherent demand growth)
- Implies 23%+ oil consumption growth from 2004-2013
- Actual oil supply growth was only 7.5%
- By 2008, the world economy was missing a quantity equal to the output of Saudi Arabia
- Today, compared to 2004 Q4, we're missing a Saudi Arabia and an Iraq
- That's why oil is expensive



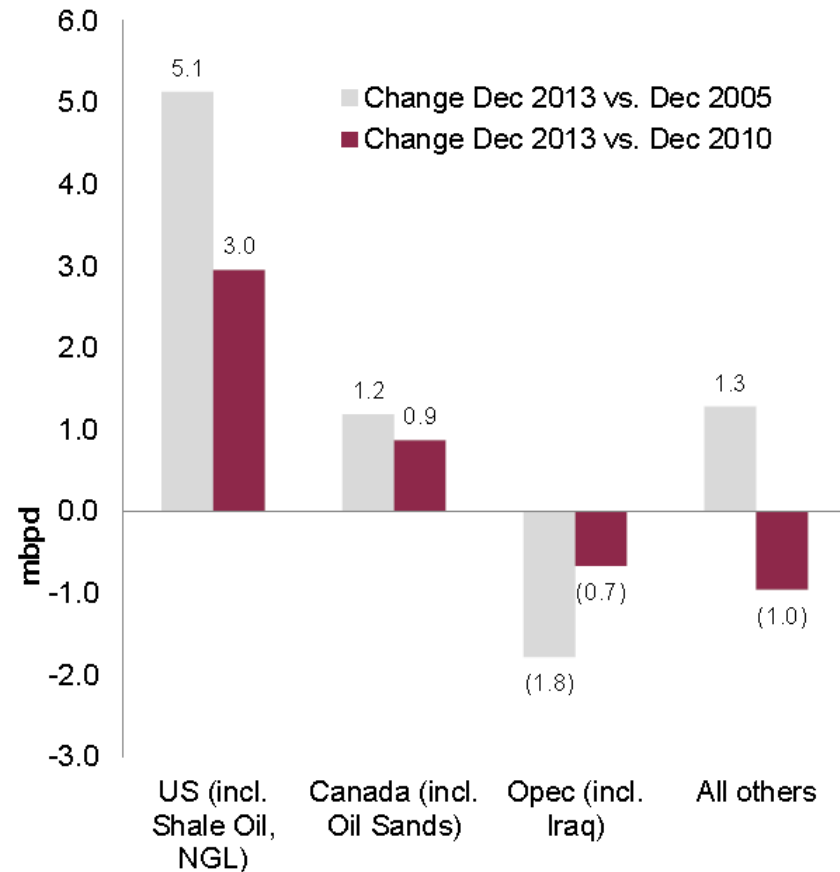
Observed Oil Supply; and Oil Demand anticipated based on GDP growth

Source: EIA, IMF, Douglas-Westwood analysis

- *Demand growth = GDP growth – 1.2% annual efficiency gain without oil price pressure*
- *Demand growth = GDP growth – 2.5% annual efficiency gain with oil price pressure at recent levels*

- Total production up 5.8 mbpd since 2005, of which 1.7 mbpd is OPEC NGL's (non-crude)
- OPEC liquids production (crude + NGL) is unchanged since 2005
- US unconventional liquids (shale oil and NGL) up 5.1 mbpd—literally all net crude oil production growth—since 2005.
- Canadian oil sands up 1.2 mbpd from 2005
- Legacy, conventional system still peaked in 2005.
- Oil supply growth *entirely* leveraged to unconvensionals

Liquids Supply Since 2005

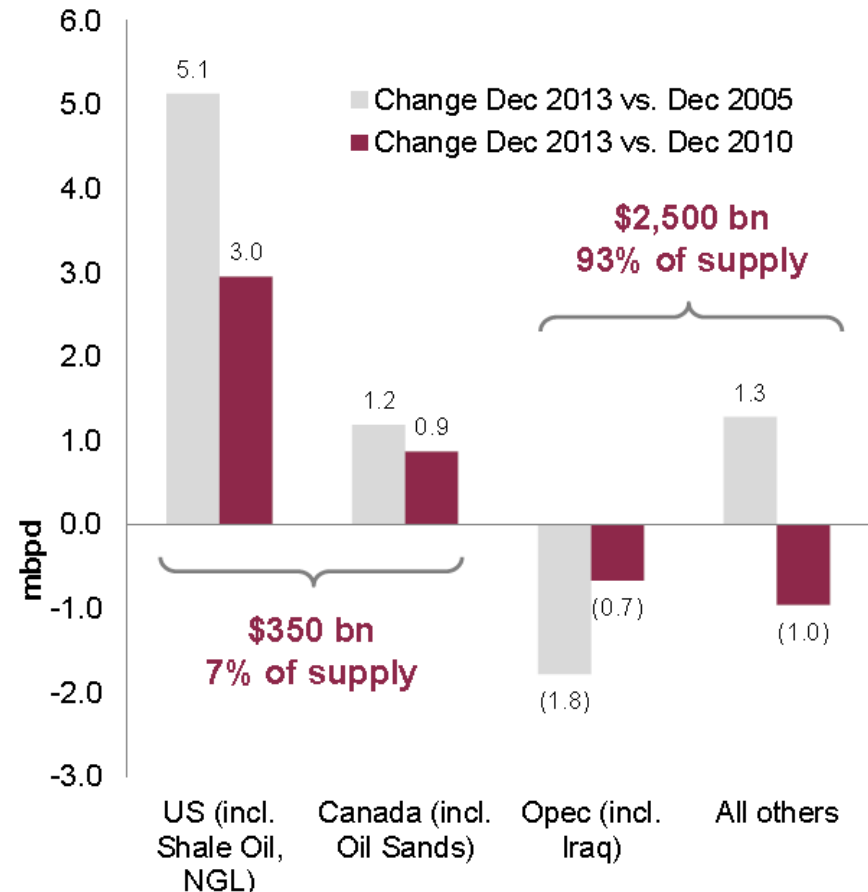


World Liquids Production Growth, 2005-2013, Oct-Dec averages, excludes OPEC NGLs

Source: EIA STEO

- Total spend since 2005 on upstream exploration and production:
 - \$4 trillion**
- Of which, \$350 bn on US and Canadian unconventional oil and gas...
- ...and another \$150 bn on LNG and GTL
- \$3.5 trillion was spent maintaining the 2005 legacy oil and gas system
- About \$2.5 trillion* was spent on legacy crude oil production—94% of the petroleum liquids supply today.
- Result: legacy oil production has fallen by 1 mbpd
- Peak oil for legacy system: still 2005
- For comparison: '98-'05, \$1.5 trillion spend added +8.6 mbpd crude production
- Compared to '98-'05 period, vaporized GDP of Germany

Liquids Supply Since 2005

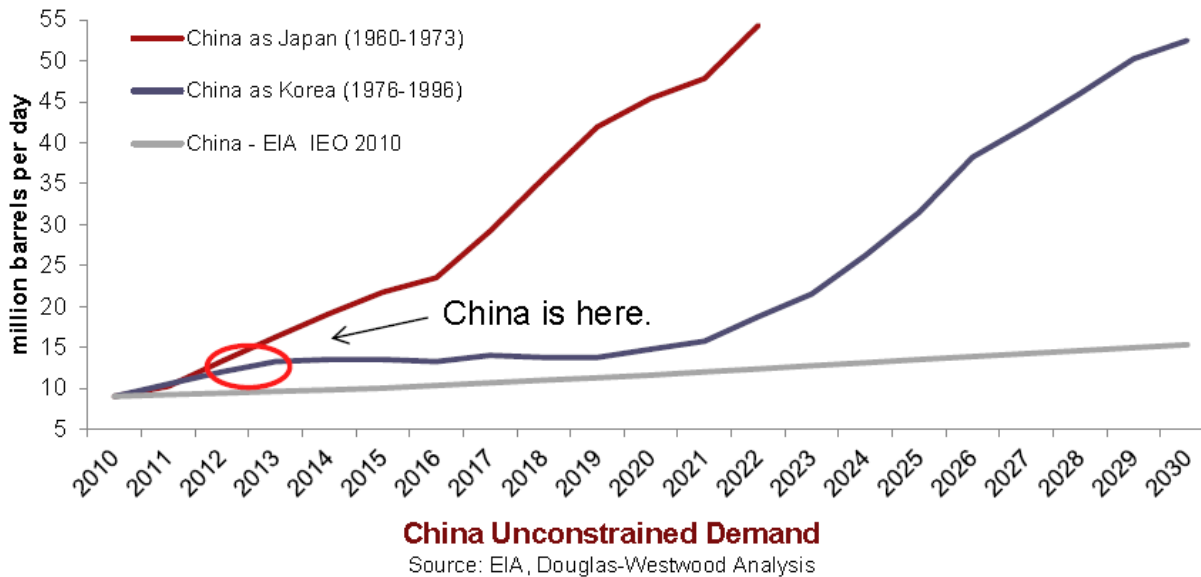


World Liquids Production Growth, 2005-2013, Oct-Dec averages, excludes OPEC NGLs

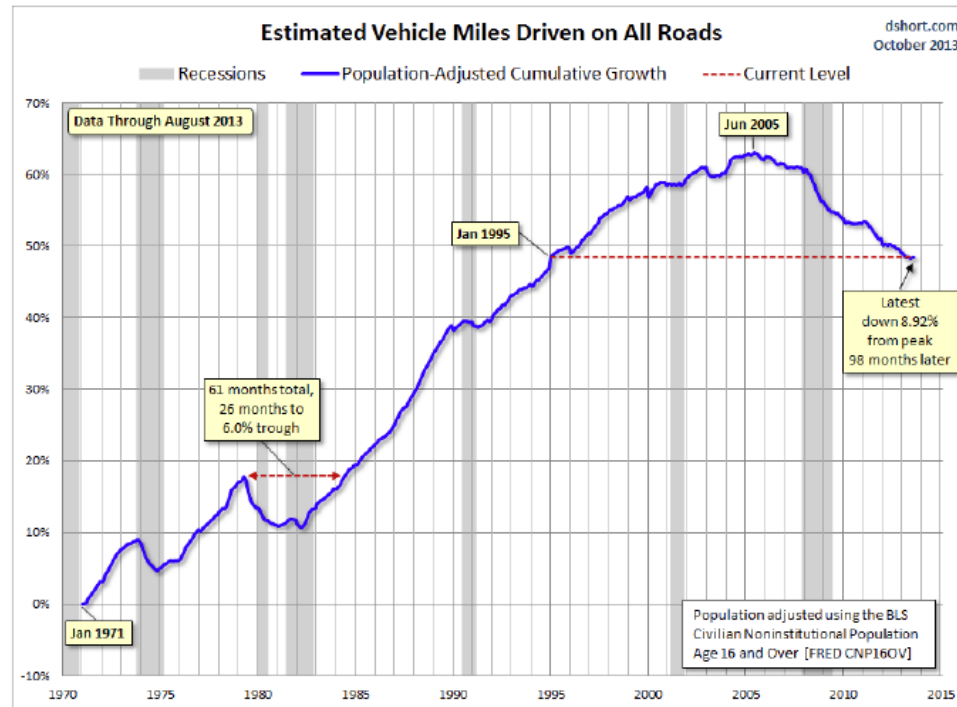
Source: EIA STEO, Barclays, DW Analysis

* GDP of Germany is \$3.5 trn, Italy \$2.0 trn

China Key Driver of Oil Demand Growth



- How far? Japan, Korea, Taiwan: 0.5-0.6x US oil consumption per capita
- When? S curve is 20-30 years—about one generation
- Potential is enormous—50 mbpd in 2030 versus 10.5 now (if the oil supply were available; US is at 18.5 mbpd now)
- Total non-OECD demand growth to 2030 could be 60 mbpd—2/3 as much as total production today.
- How does this translate in 0.8% growth?

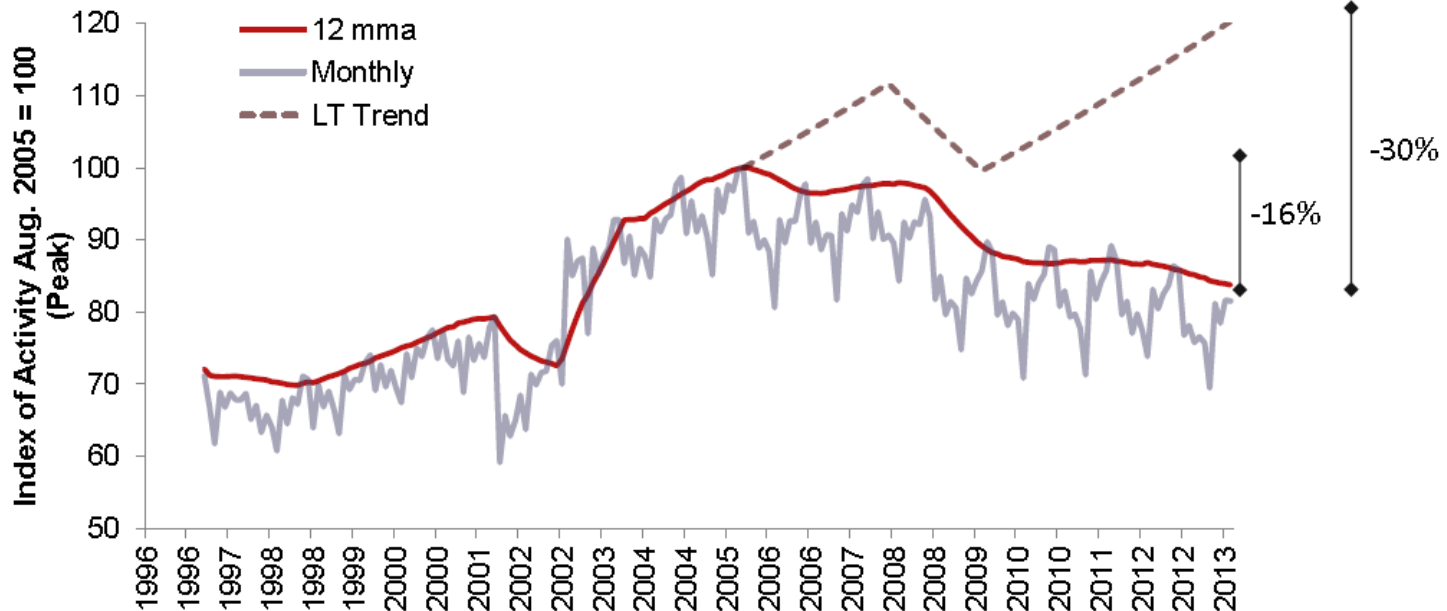


US Vehicle Miles Driven

Source: DS Short, US Department of Transportation

- Peak driving was 2005—not 2007!
- The US has lost mobility as it has lost oil consumption
- New hires in the US cannot use any more oil—and this affects mobility
- 1 in 6 cars missing from the road

And it's not just cars: US Airline Departures

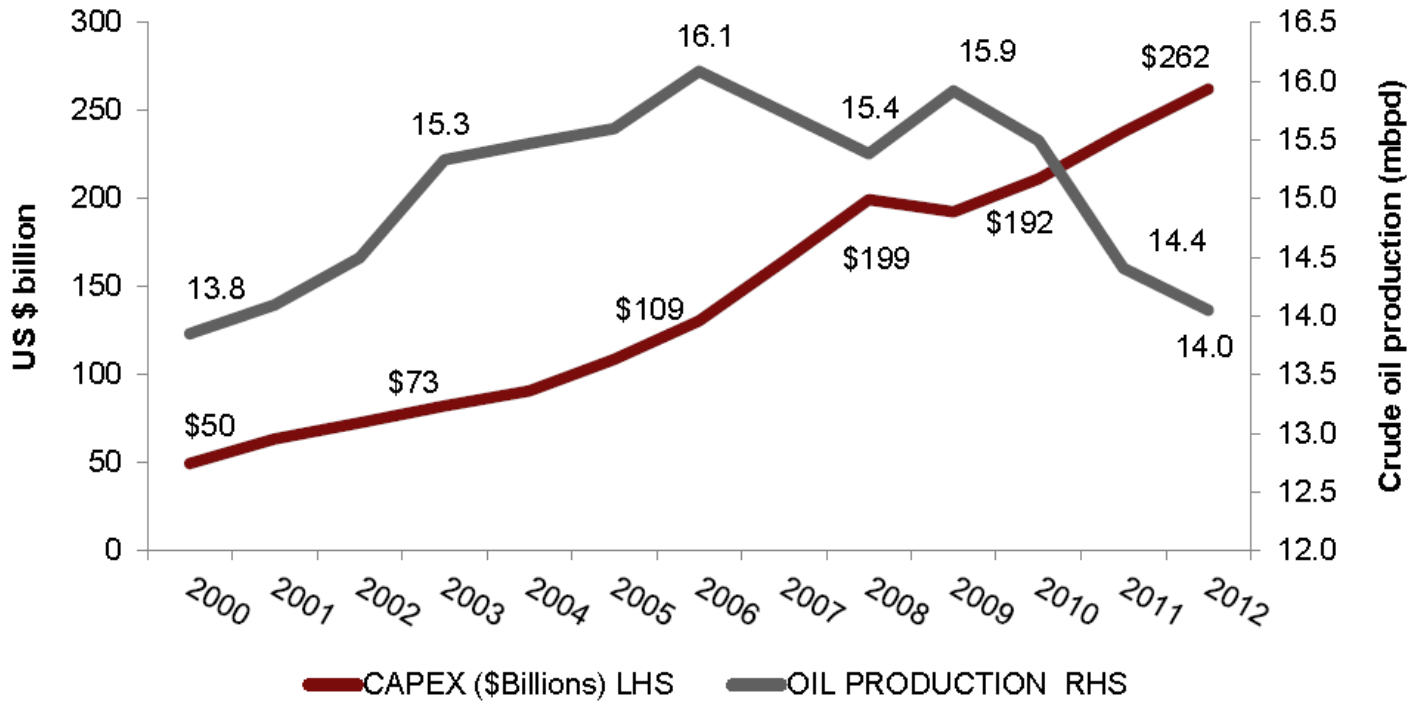


US Commercial Airlines (System) Departures: Peak = 100 (Aug. 2005)

Source: US Department of Transportation, Douglas-Westwood analysis

- US commercial airline departures are 16% below their 2005 peak...
- ...and departures are 30% below trend (even allowing for recession)
- For every two aircraft taking off from US airports, one is missing
- And the trend continues to decline.

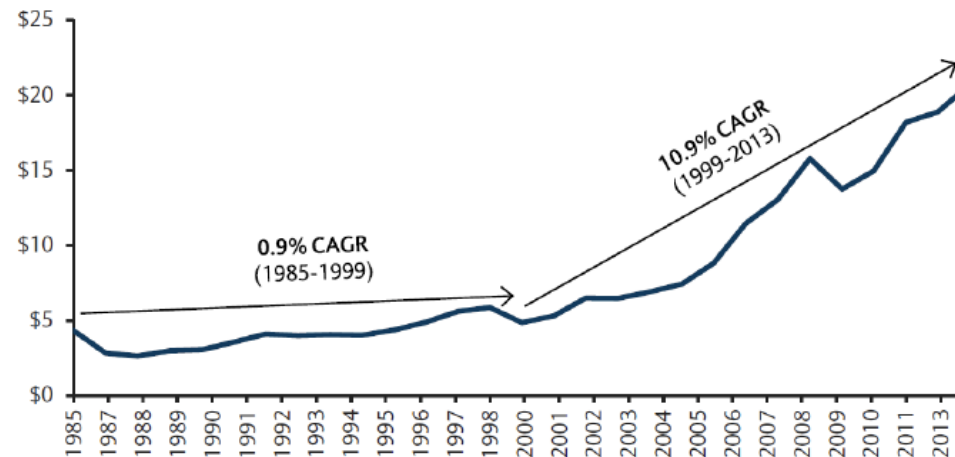
Listed Oil Majors: Capex and Crude Oil Production



Crude Oil Production and Capex

Combined data for BG, BP, COP, CVX, ENI, OXY, PBR, RDS, STO, TOT, XOM
 Source: Bloomberg via Phibro Trading LLC

- Oil production has faltered, even as capex has soared
- Capex productivity has fallen by a factor of five since 2000
- Observed decline trend now approaching 5% per year



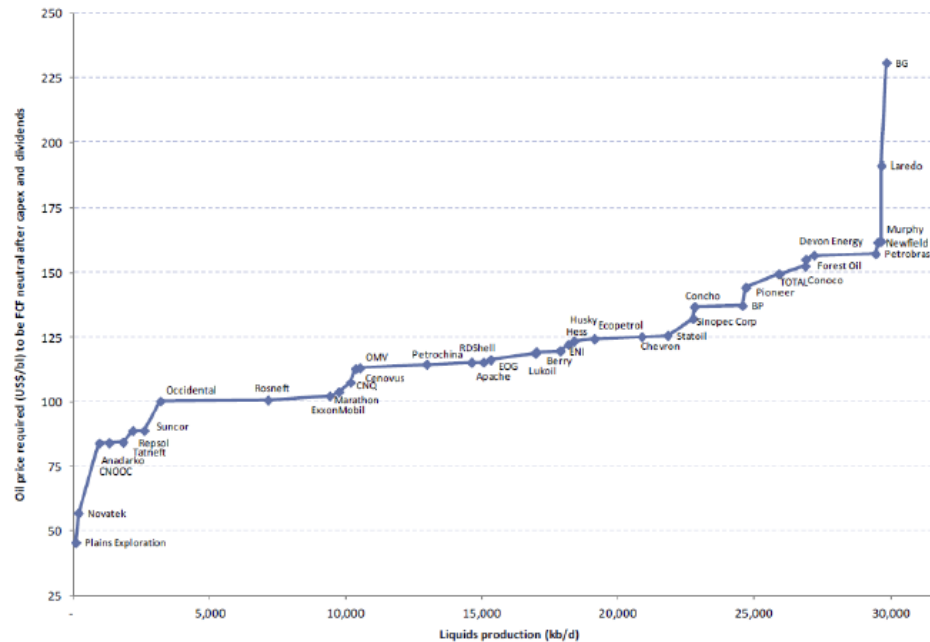
Source: IEA, Barclays Research

E&P Capex per Barrel

Source: Barclays Capital

- Profits have lagged because costs are rising faster than revenues. E&P capex per barrel has been rising nearly 11% per year.
- Brent oil prices have been largely flat.
- A number of projects have consequently been deferred, cancelled or return for re-evaluation.

The Industry Needs \$100+ Oil Prices



Oil Price Required by Oil Companies to be Free Cash Flow Neutral After Capex and Dividends

Source: Goldman Sachs

- Costs have outpaced revenues by 2-3% per year. Profitability is down 10-20%.
- The vast majority of public oil & gas companies require oil prices of over \$100/bbl to achieve positive free cash flow under current capex and dividend programs
- Nearly half of the industry needs more than \$120/bb. The 4th quartile, where most US E&Ps cluster, needs \$130/bbl or more.

FT

Oil majors under pressure to curb spending

RIGZONE

Hess Cuts 2014 Capital Budget

WSJ

Statoil to Postpone 2020 Production Target

CREDIT SUISSE

Rigs Will Be Stacked Next Year

BG GROUP **B**

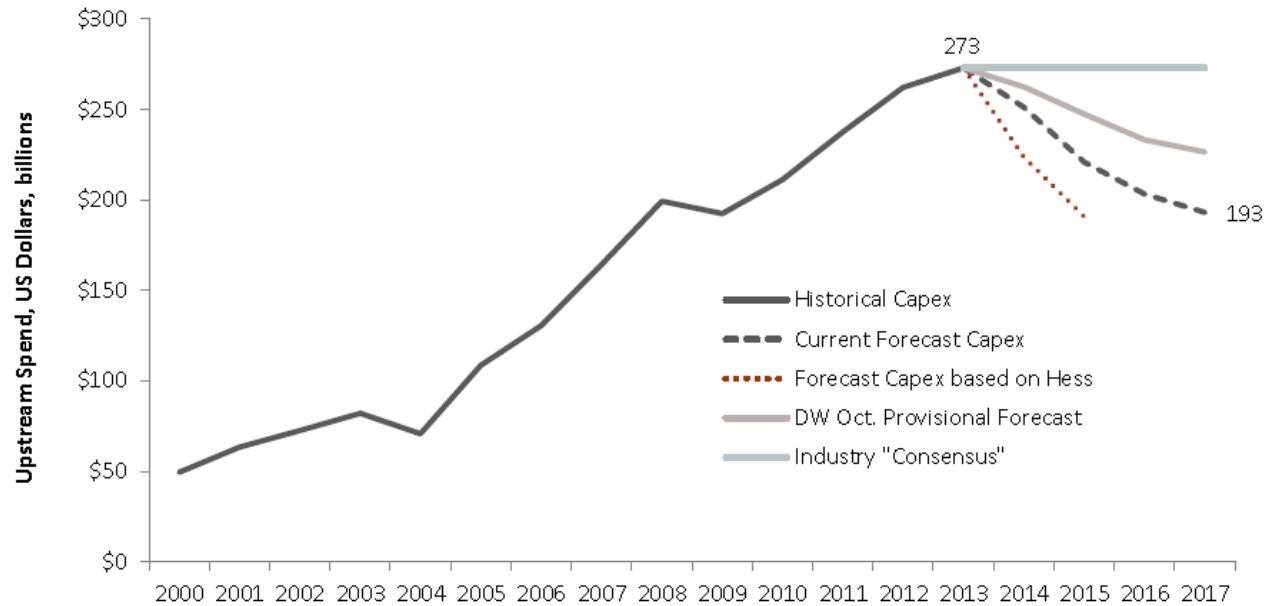
Capex Set to decline



Chevron Lowers Capital Expenditure for 2014, Shifts Focus to Shale Gas

- Statoil Chief Executive Helge Lund -- cut costs \$1.3 billion a year starting in 2016 in a bid to counter escalating oil sector costs.
- Chevron -- 5% decrease in 2014 Capex from \$42 billion in 2013.
- Hess capex down 30% over two years
- Shell capex down 20% for 2014.
- BG expects 2015-2016 capital expenditure to fall to \$8-10 bn from \$12 bn(BG est.) in 2013.

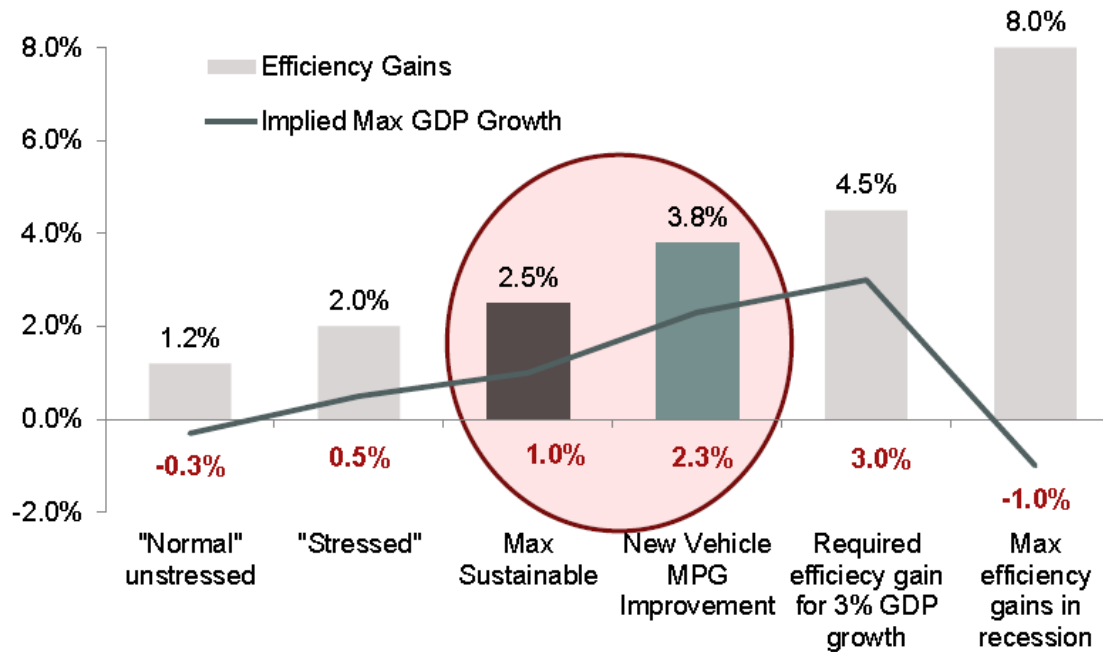
Listing Oil Majors: Capex



Historical and Forecast Crude Oil Production and Capex (Provisional, subject to Revision)

Combined data for BG, BP, COP, CVX, ENI, OXY, PBR, RDS, STO, TOT, XOM
 Source: Bloomberg via Phibro Trading LLC

- Capital discipline now a key theme at oil majors
- Cash flow growth over production growth
- Implies unraveling
- Substantial deterioration in outlook since October 2013
- Oil majors face a very challenging climate



- In normal times, oil efficiency in GDP increases by 1.2% / year
- In "stressed" times, 2.0% is possible
- For six recent quarters, US efficiency up 3.8% -- 2.3% GDP growth
- OECD GDP growth probably capped at 1.0-2.0%
- A constrained oil supply is reducing OECD GDP growth by 1-2%

- Demand-constrained models dominate thinking about oil demand, supply, prices and their effect on the economy
- The data have not supported these models in recent years; the data *do* fit a supply-constrained model
- A supply-constrained approach will not be applicable if China falters, US short term latent demand is sated, and oil supply growth is robust.
- For a supply-constrained model to be valid, oil must be holding back GDP growth *as an implicit element of model construct.*
- If the supply-constrained approach is right, then GDP growth depends intrinsically on increasing oil production.
- Without such increases, OECD GDP growth will continue to lag indefinitely, with a long-term GDP growth rate in the 1-2% range entirely plausible, and indeed, likely.
- In turn, if this is true, then current national budget deficit levels and debt levels will prove unsustainable, and a second round of material and lasting adjustment will be necessary.

An aerial photograph of a large offshore oil rig, likely the Deepwater Horizon, situated in the middle of a dark, choppy sea. The rig is a complex of steel structures, including a tall derrick, several cranes, and a central white building. The water is turbulent with white-capped waves. The text 'Thank you' is overlaid in the top right corner in a large, white, sans-serif font.

Thank you

Heroic efforts such as this to get oil are not working.

This is the unaffordable, dying paradigm that is sinking industrial civilization – and a life-supporting climate.

Steven Kopits
Managing Director
New York, NY

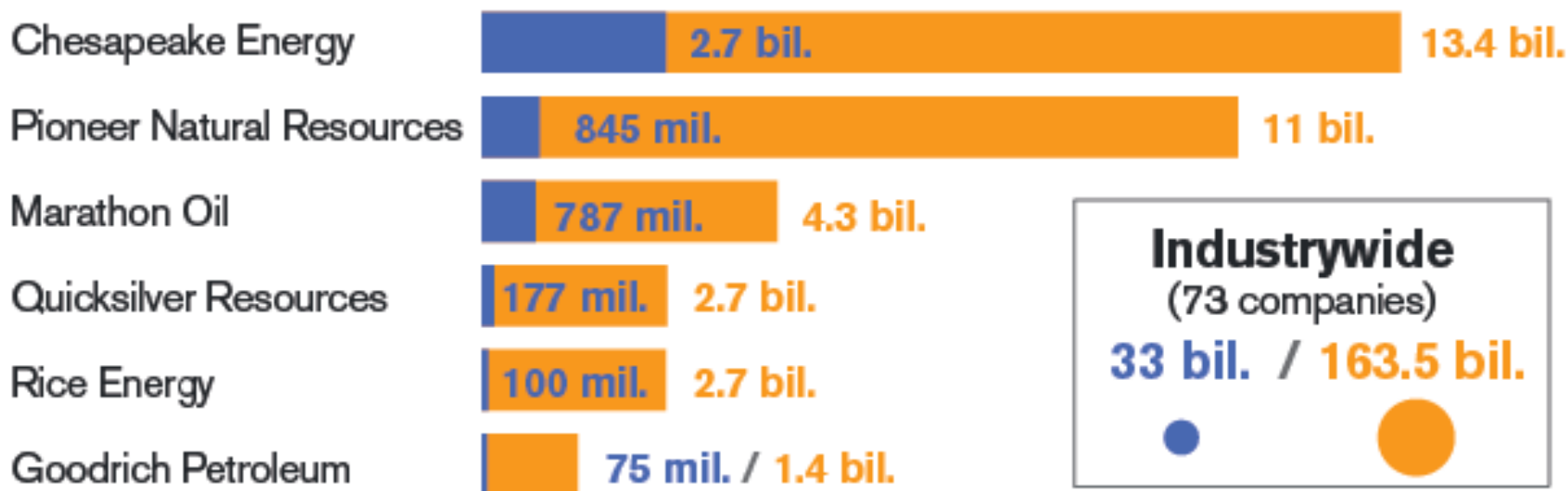


Bike Lane, Washington DC, August 2014. We can live with this paradigm. We can't live without it.

Selling the Shale Boom

An analysis of 73 shale drillers found that almost all reported higher oil and gas prospects to investors than to the Securities and Exchange Commission (SEC). These six companies illustrate the range of estimates within the industry.

■ Reserves reported to the SEC **■ Resources presented to investors**
(selected examples in barrels of oil equivalent)



Source: Company presentations and SEC filings

Bloomberg Visual Data

<http://www.bloomberg.com/news/2014-10-09/ceos-tout-reserves-of-oil-gas-revealed-to-be-less-to-sec.html>

And now this:

Oil price will fall to \$70 US a barrel in 2015, Goldman Sachs says

World is producing more than it needs, thanks to boom in shale oil, bank says

Pete Evans, [CBC News](#) Posted: Oct 27,

One of the world's leading investment banks says the benchmark price of North American oil is going to fall even further, to \$70 US a barrel by next spring.

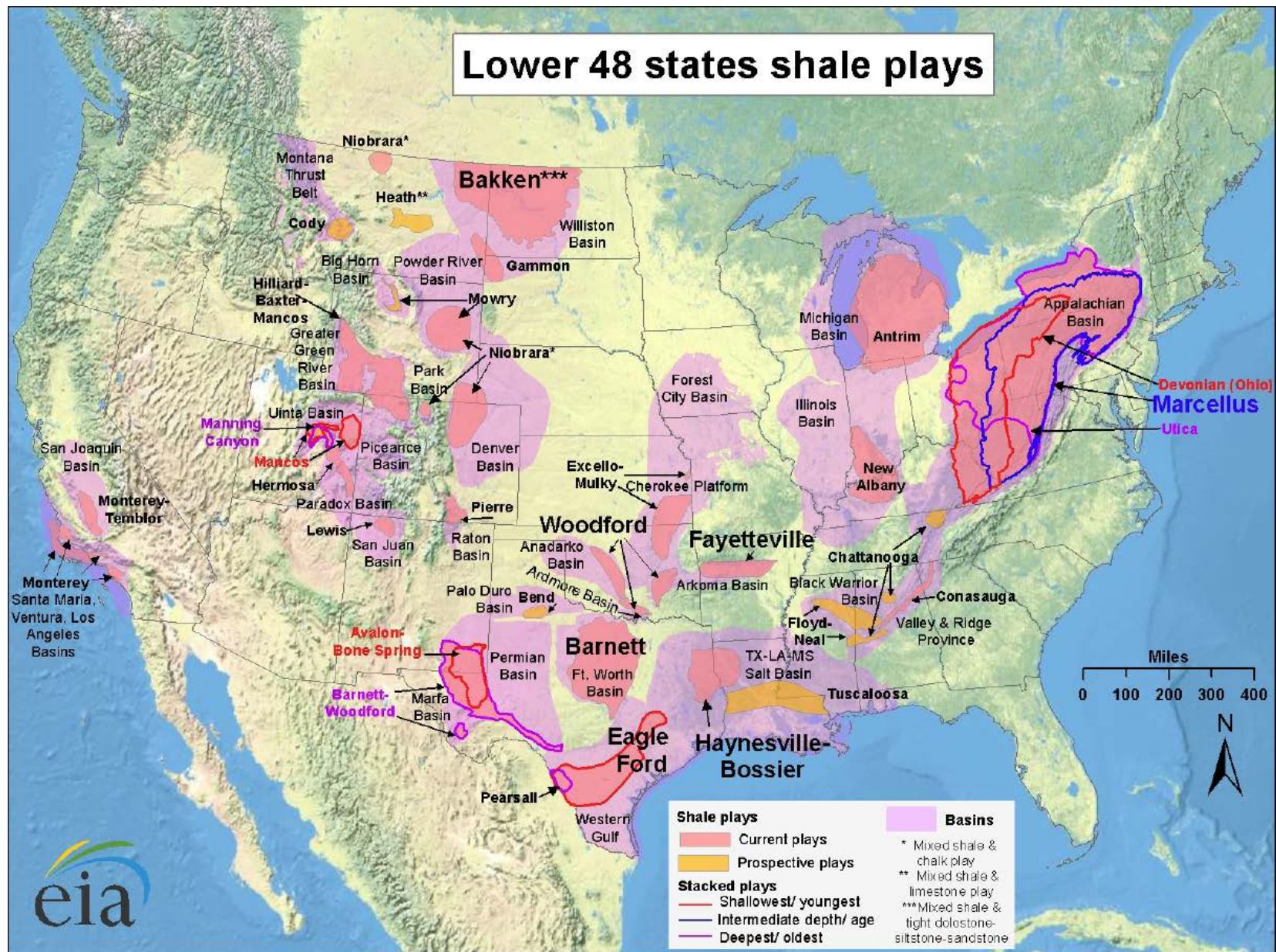
Investment bank Goldman Sachs slashed its forecast late Sunday night for both West Texas Intermediate (known as WTI) and Brent crude — the two most common types of oil used and sold in North America and Europe.

Goldman Sachs says WTI will go for \$75 a barrel in the first three months of 2015. Brent, meanwhile, will change hands at \$85 a barrel. Both forecasts are down \$15 from what the bank was last expecting. And both are forecast to slip even lower in the second quarter — historically a seasonally low time for oil prices — before rebounding a little in the summer of 2015....

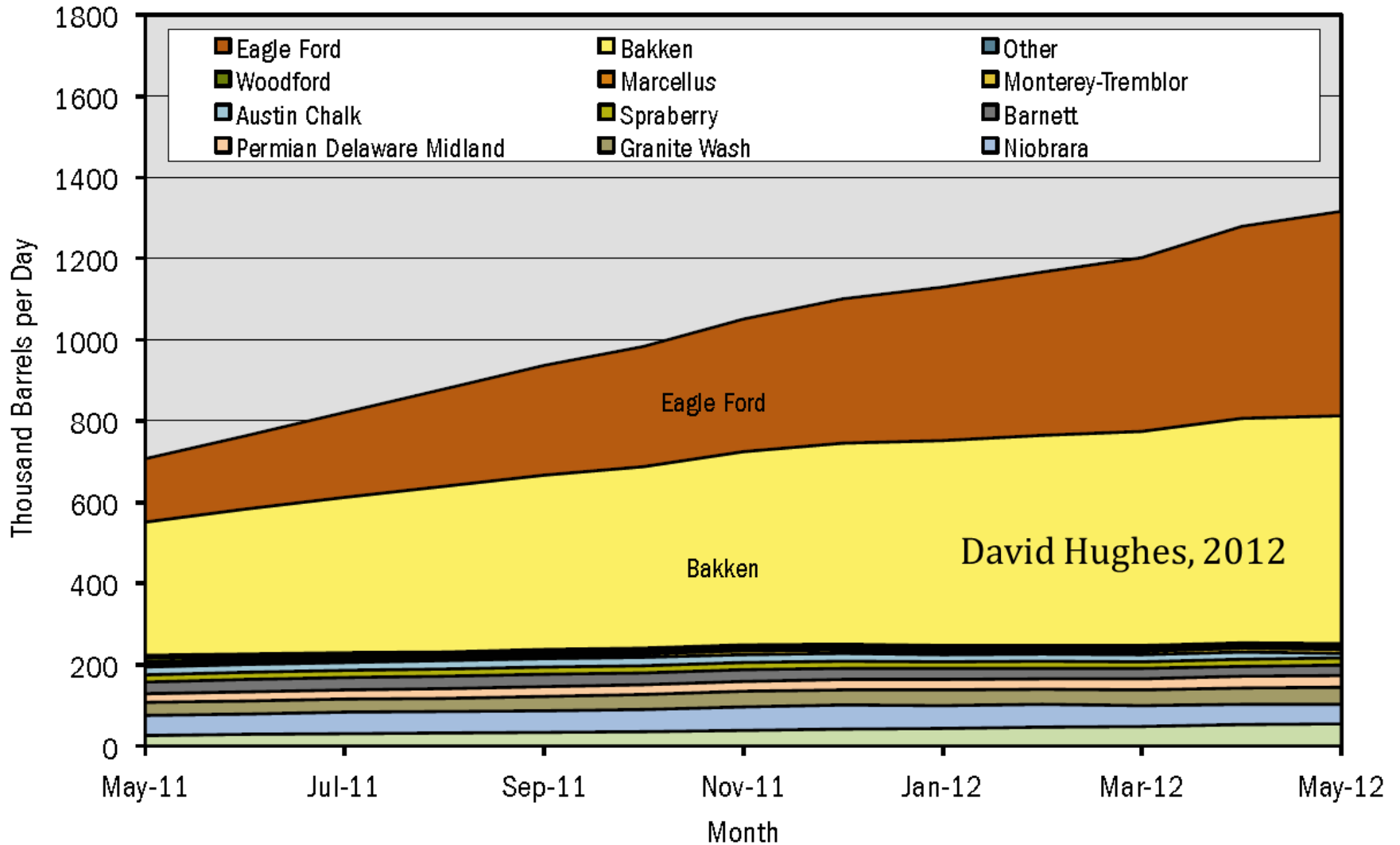
Currently, WTI is trading just below \$80 US. That's down from more than \$100 a barrel as recently as four months ago.

<http://www.cbc.ca/news/business/oil-price-will-fall-to-70-us-a-barrel-in-2015-goldman-sachs-says-1.2814041>

The next 3 slides are from David Hughes, *Drill Baby Drill*, 2012.



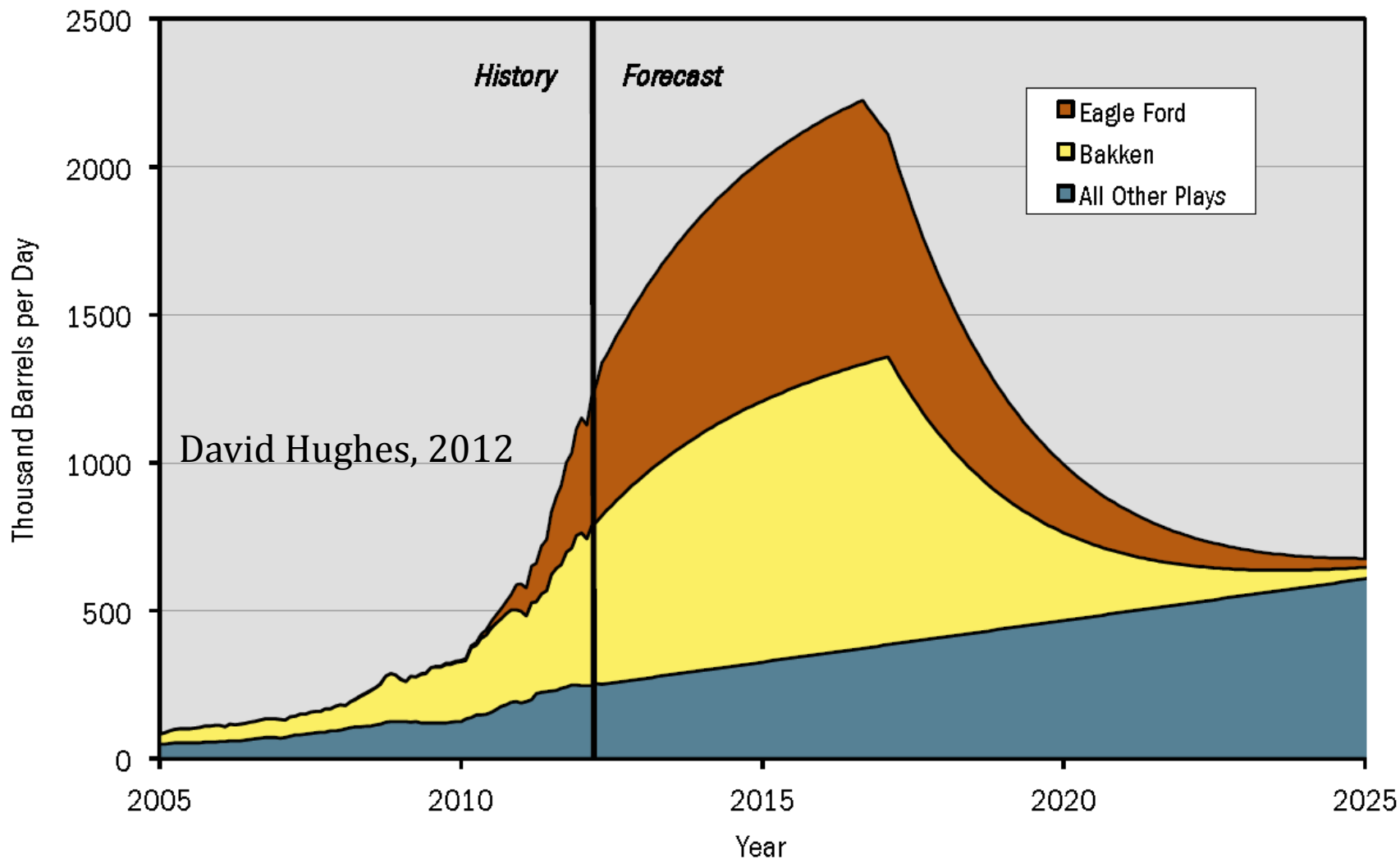
Tight oil production by play, May 2011 through May 2012



David Hughes, 2012

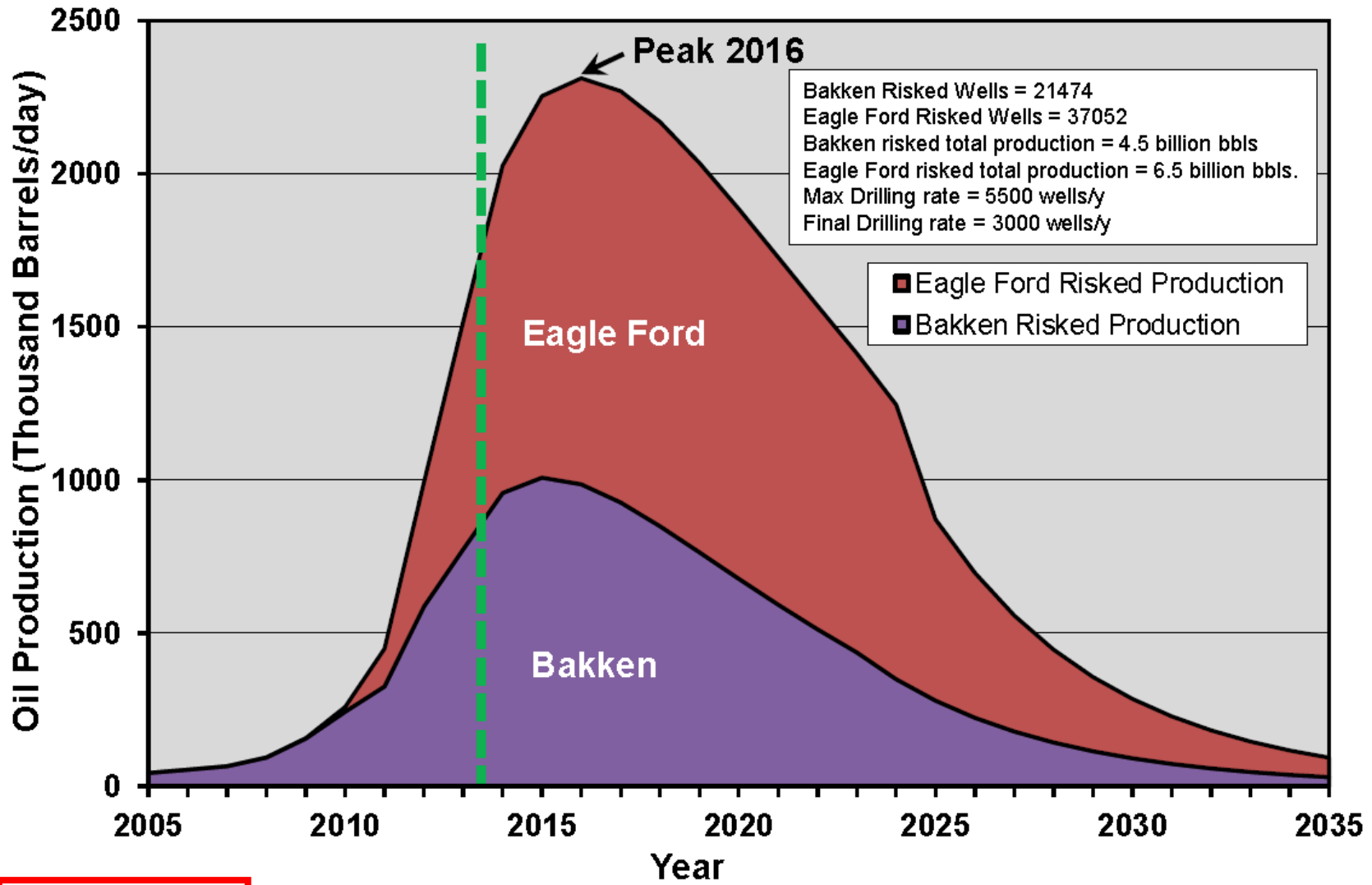
The Bakken and Eagle Ford are clearly unique among tight oil plays in the United States.

Projection of tight oil production by play in the U.S. through 2025



Based on vintaged type curve production, the number of drilling locations projected by the EIA for the Bakken and Eagle Ford plays, and the assumption of continued recent growth rates in the other plays.

Bakken and Eagle Ford Oil Production – Declining Drilling Rate Risked at 80% for locations, 2005-2035



© Hughes GSR Inc, 2013

(data from Drillinginfo, October, 2013)

October 29, 2014

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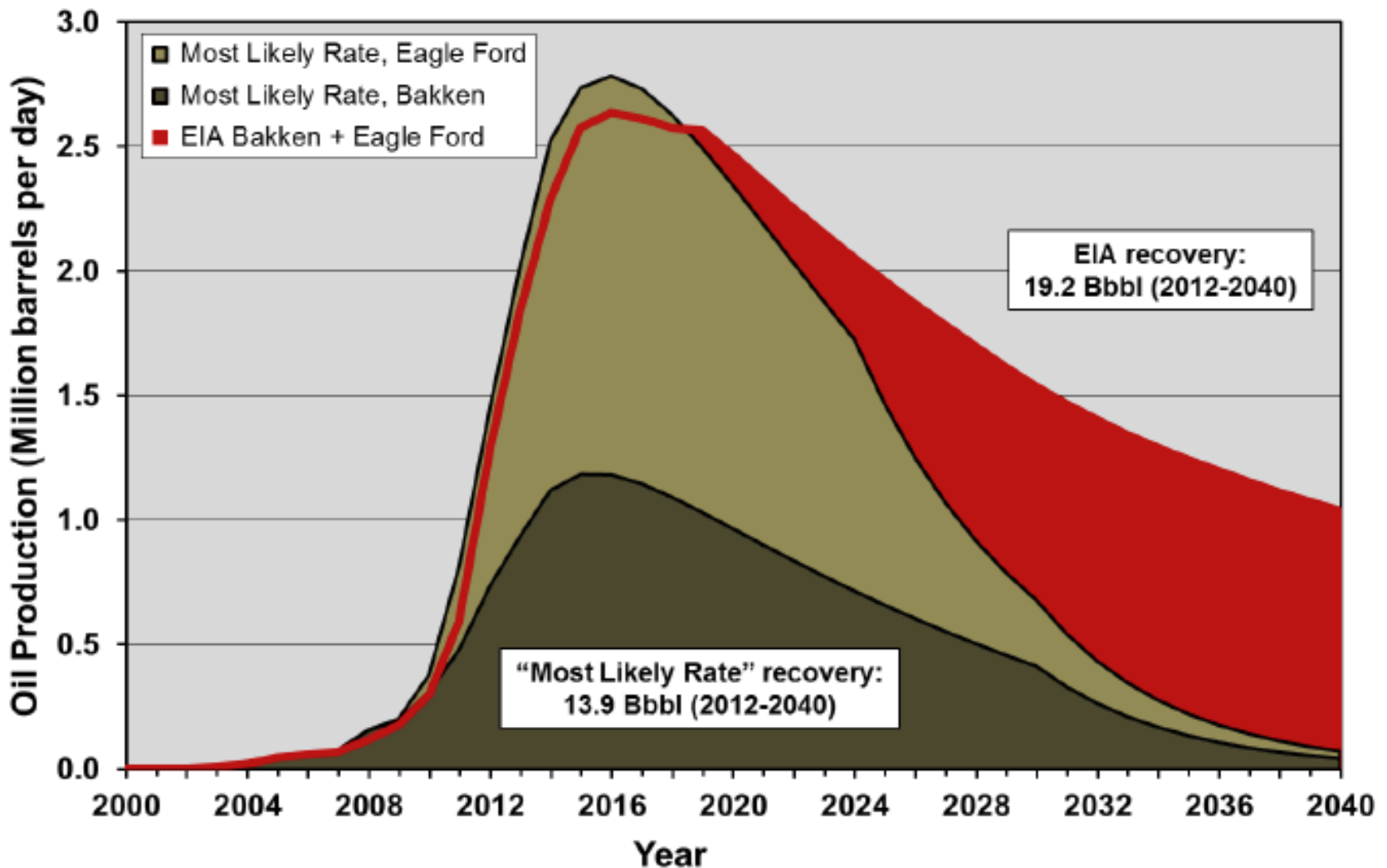


Figure 2-95. “Most Likely Rate” scenarios (“Realistic” cases) of Bakken and Eagle Ford tight oil production compared to the EIA reference case, 2000 to 2040.¹⁵⁷

<http://postcarbon.org/drilling-deeper> (Hughes, 2014)

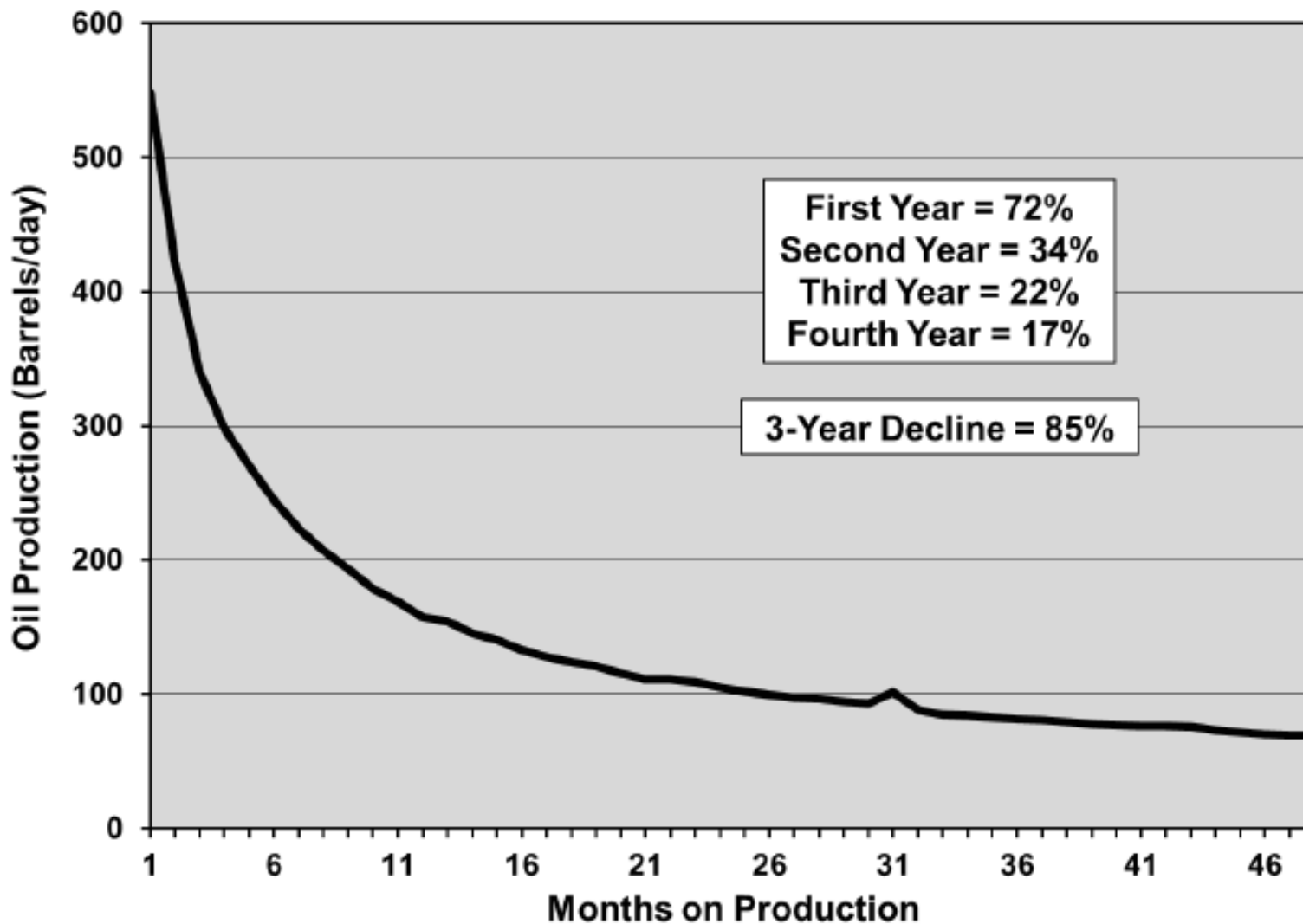


Figure 2-13. Average decline profile for horizontal tight oil wells in the Bakken play.²⁵

Decline profile is based on all horizontal tight oil wells drilled since 2009.

<http://postcarbon.org/drilling-deeper> (Hughes, 2014)

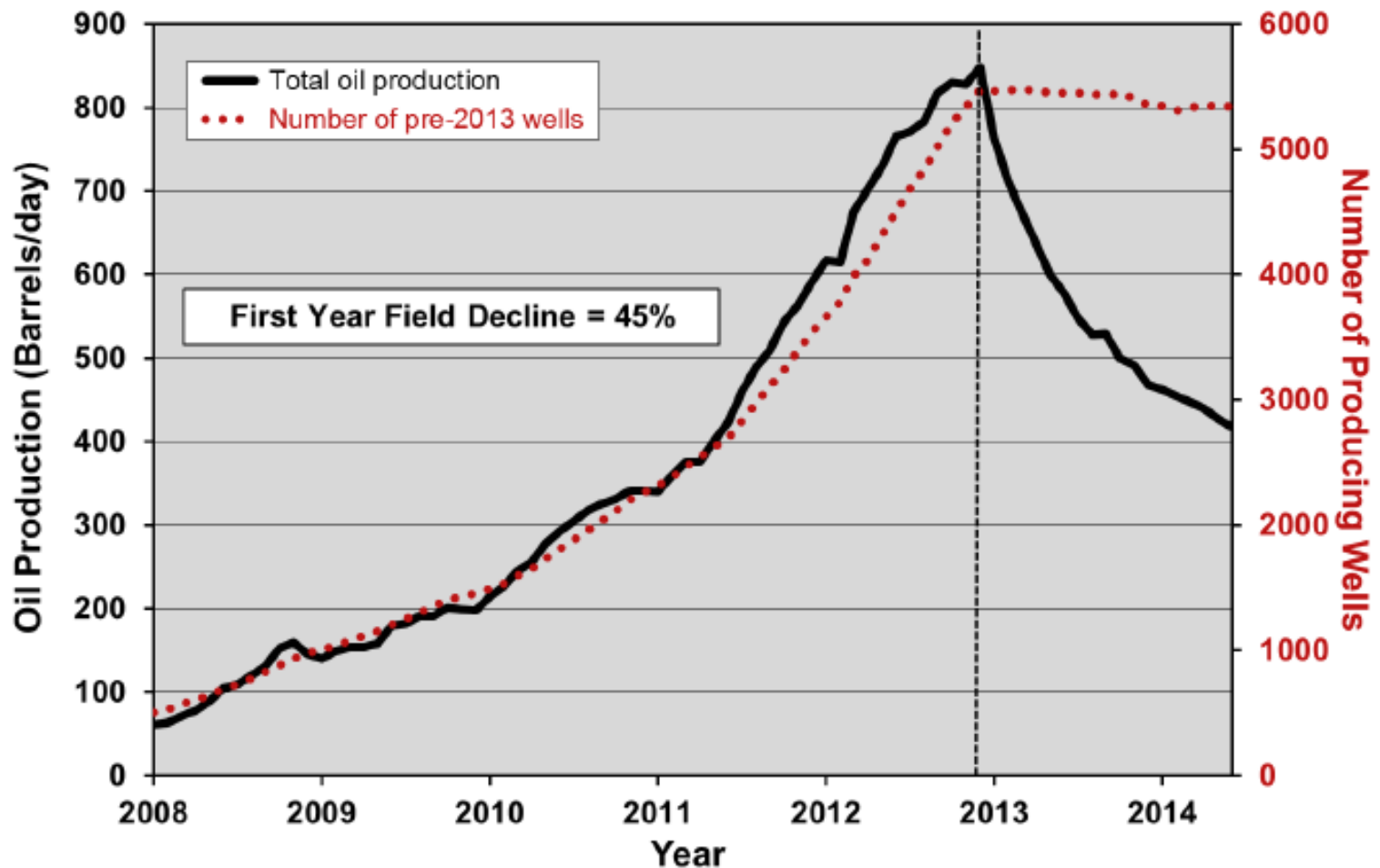


Figure 2-14. Production rate and number of horizontal tight oil wells in the Bakken play prior to 2013.²⁷

In order to offset the 45% field decline rate, 1,470 new wells per year producing at 2013 levels would be required.

<http://postcarbon.org/drilling-deeper> (Hughes, 2014)

From "Tipping Point: Near-Term Systemic Implications of a Peak in Global Oil Production – An Outline Review," David Korowicz, 2010

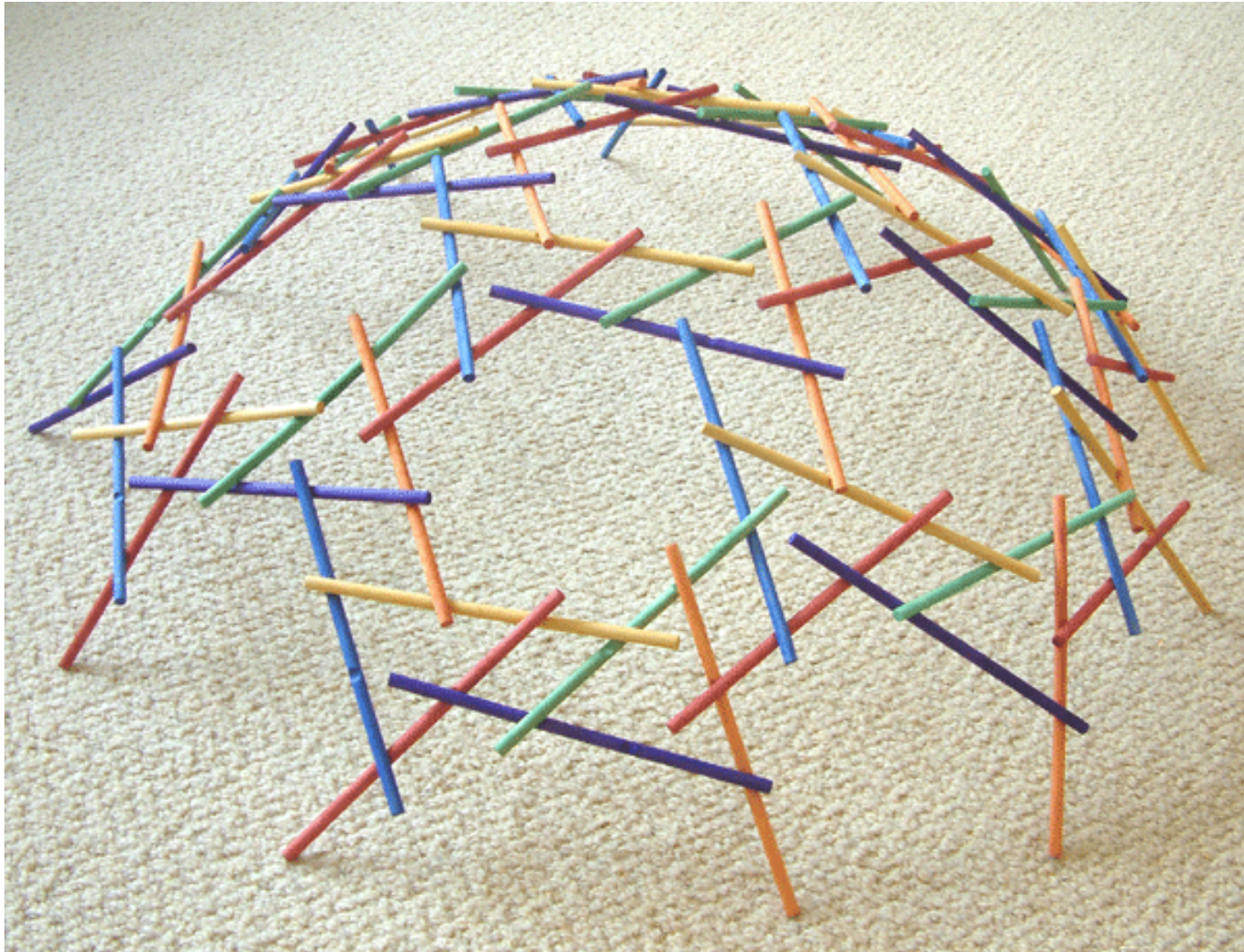
<http://www.feasta.org/2010/03/15/tipping-point-near-term-systemic-implications-of-a-peak-in-global-oil-production-an-outline-review/>

This will evolve as a systemic crisis; as the integrated infrastructure of our civilisation breaks down. It will give rise to a multi-front predicament that will swamp governments' ability to manage. It is likely to lead to widespread disorientation, anxiety, severe welfare risks, and possible social breakdown. The report argues that a managed 'de-growth' is impossible.

We are at the cusp of rapid and severely disruptive changes. From now on the risk of entering a collapse must be considered significant and rising. The challenge is not about how we introduce energy infrastructure to maintain the viability of the systems we depend upon, rather it is how we deal with the consequences of not having the energy and other resources to maintain those same systems. Appeals towards localism, transition initiatives, organic food and renewable energy production, however laudable and necessary, are totally out of scale to what is approaching.

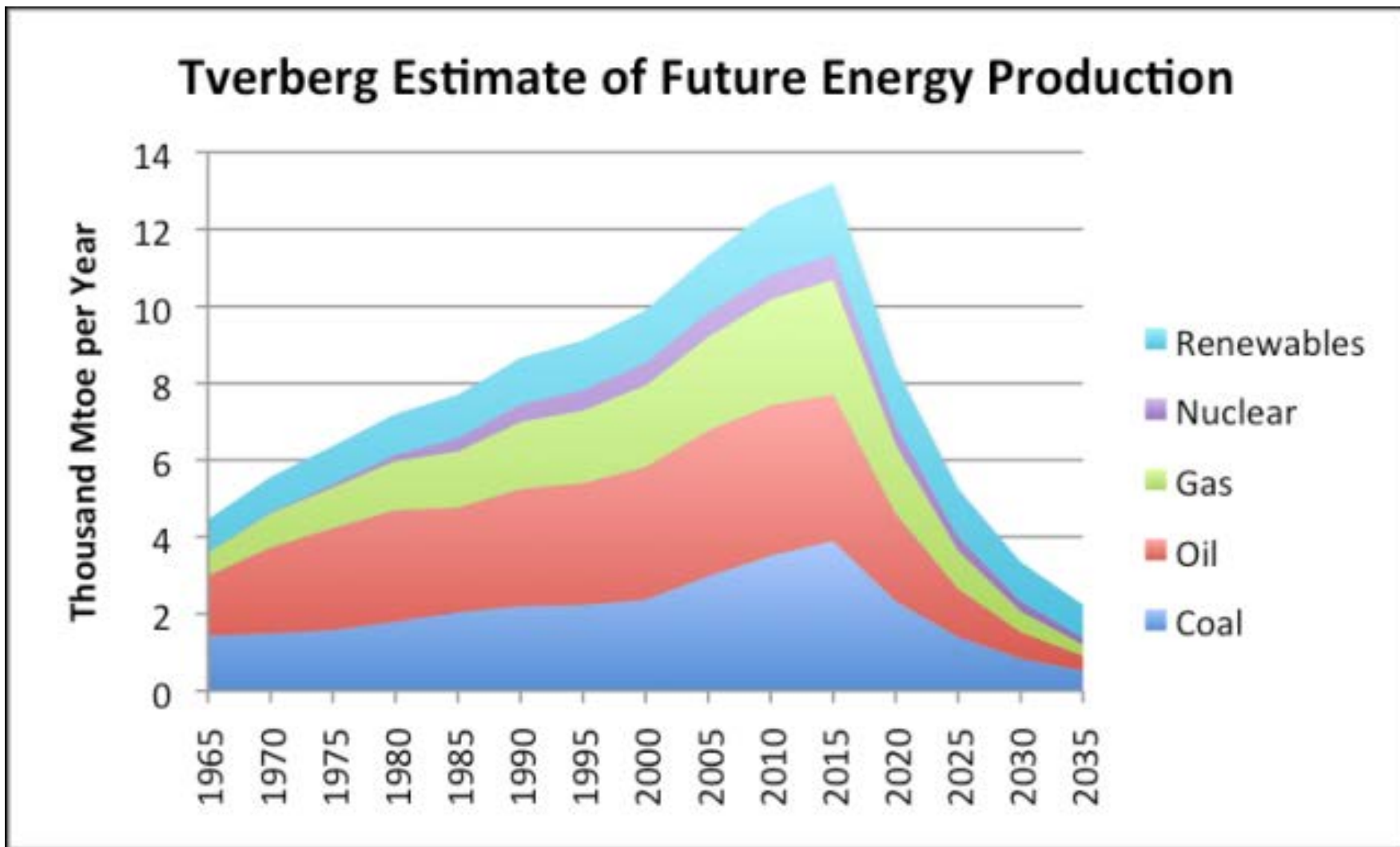
There is no solution, though there are some paths that are better and wiser than others. This is a societal issue, there is no 'other' to blame, but the responsibility belongs to us all. What we require is rapid emergency planning coupled with a plan for longer-term adaptation.

Gail Tverberg's metaphor for a highly financialized industrial economy



<http://ourfiniteworld.com/2014/09/21/low-oil-prices-sign-of-a-debt-bubble-collapse-leading-to-the-end-of-oil-supply/>

Like Korowicz, Tverberg's view of our civilization's stability is highly pessimistic.



<http://ourfinitemworld.com/2014/09/21/low-oil-prices-sign-of-a-debt-bubble-collapse-leading-to-the-end-of-oil-supply/>