

The World is Not Falling Apart – A Perspective on prices and production

A luncheon talk to GEOSCIENCE DAY, Oil & Gas Week, NL

Wade Locke, Department of
Economics, Memorial University

February 26, 2015
Johnston Geocentre

Presentation Outline

- Thank for inviting me
- NL Offshore – Interesting Facts
- Prices
- Demand and Supply
- Impact of Shale
- Breakeven Prices
- Shale Efficiency
- Shale Debt
- Conclusion

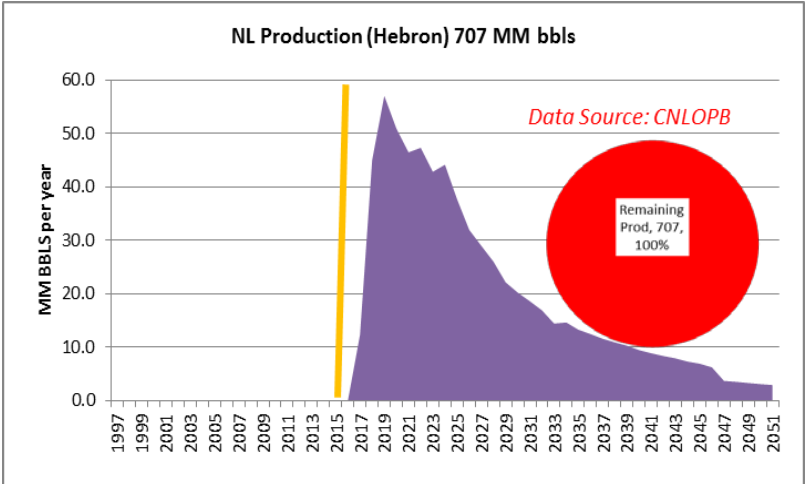
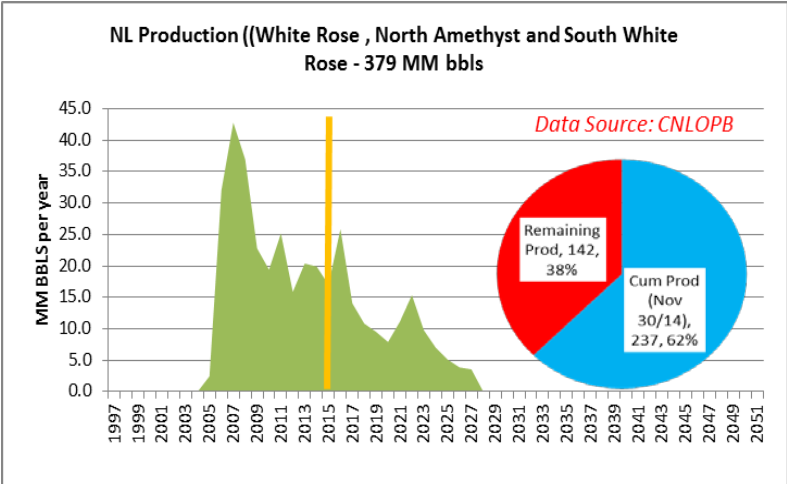
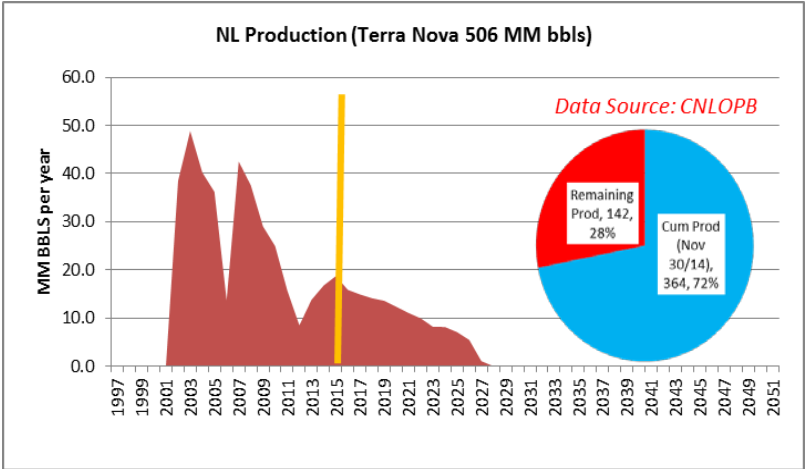
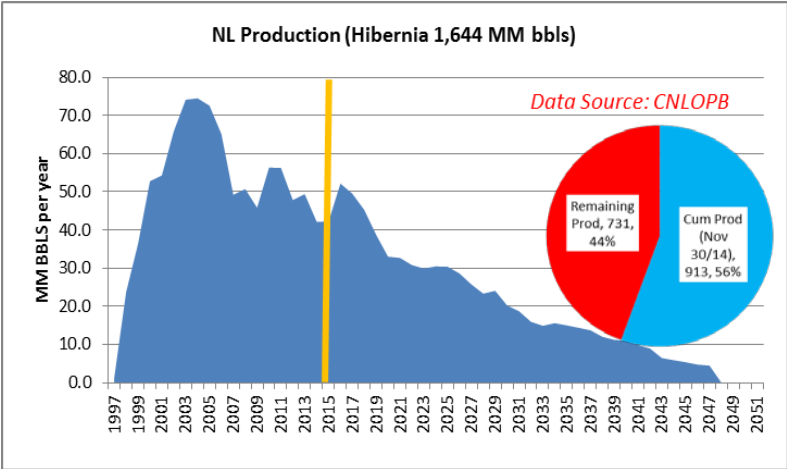
NL's Offshore – Interesting Facts

Interesting Statistics – NL Offshore

	To Nov 2014		To Dec 2012	
	Period Total	Ave Monthly	Period Total	Ave Monthly
Production (millions bbls)	1,516	7.4	1,360	7.50
Brent Price (US \$/bbl)		\$60.53		54.82
CDN/US \$		1.2045		1.2633
US \$/CDN		0.8061		0.7915
Value of Output (M \$ CDN)	\$110,139	\$534.7	\$92,670	\$552.6
Value of Output (M \$ US)	\$98,676	\$479.0	\$82,211	\$445.5
Cumulative Royalties to 2014-15 or 2012-13	\$18,395		\$14,663	
Investment (M \$ CDN)			\$33,923	
Exploration			\$6,369	
Pre-development			\$1,197	
Development			\$12,390	
Production			\$13,967	

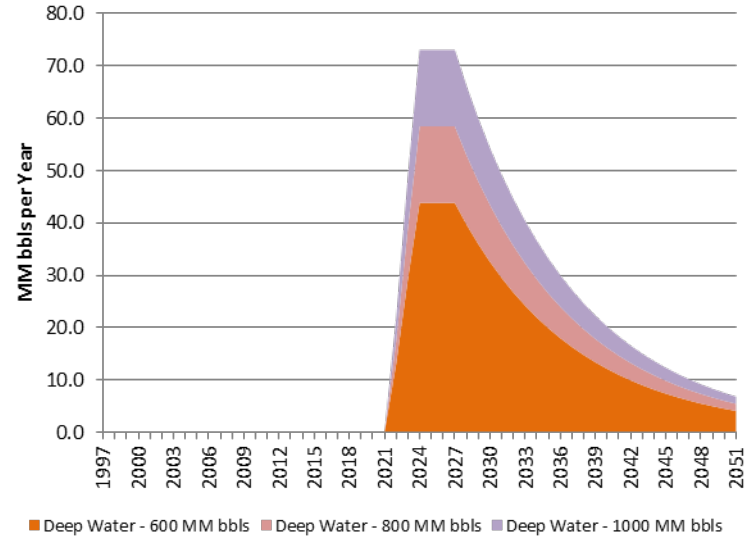
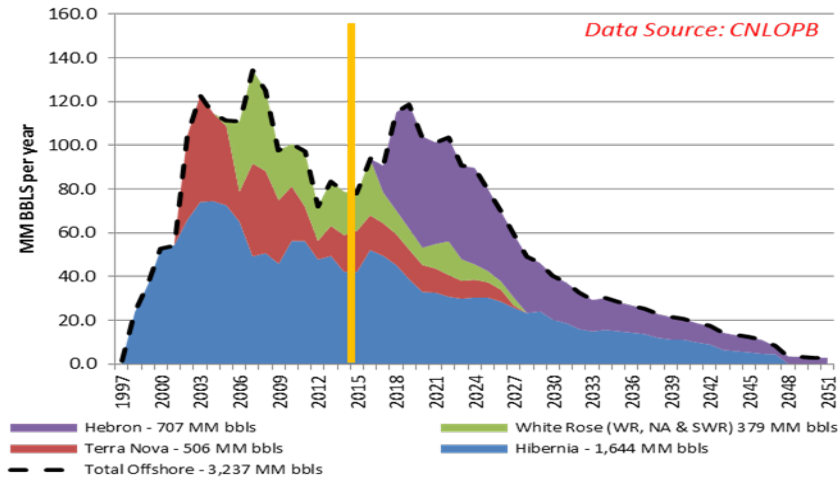
- 1.5 billion barrels of oil produced (source: CNLOPB)
- \$18.4 billion in provincial royalties to 2014-15 (public accounts & prov budgets)
- \$33.9 billion invested in offshore (source: CNLOPB)
- \$110 billion in output produced (author's calculation)

Existing and Approved Projects

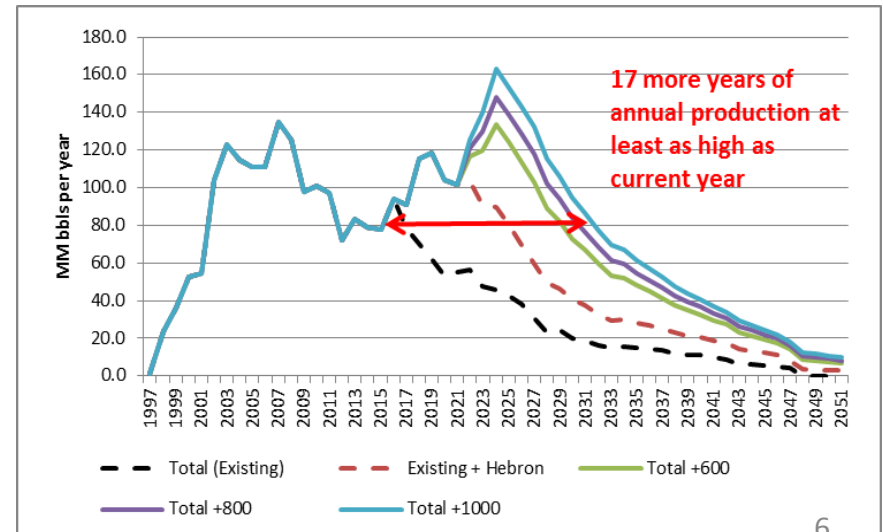


Illustrative Impact of Hypothetical Deep Water Production

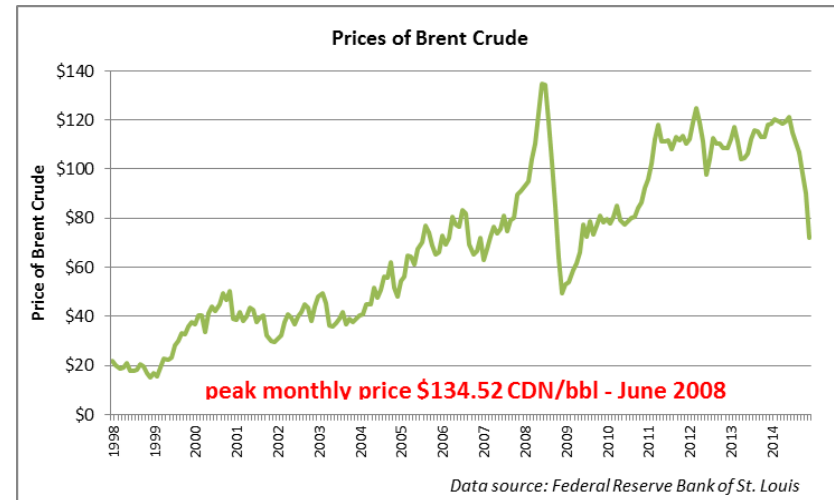
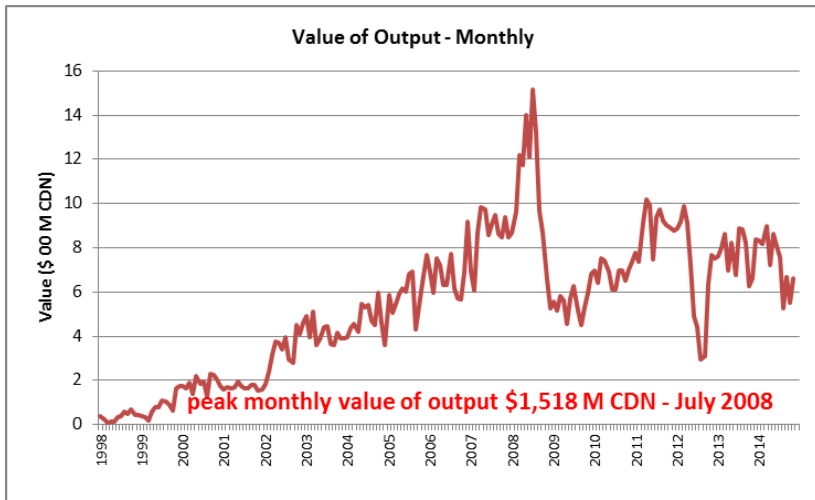
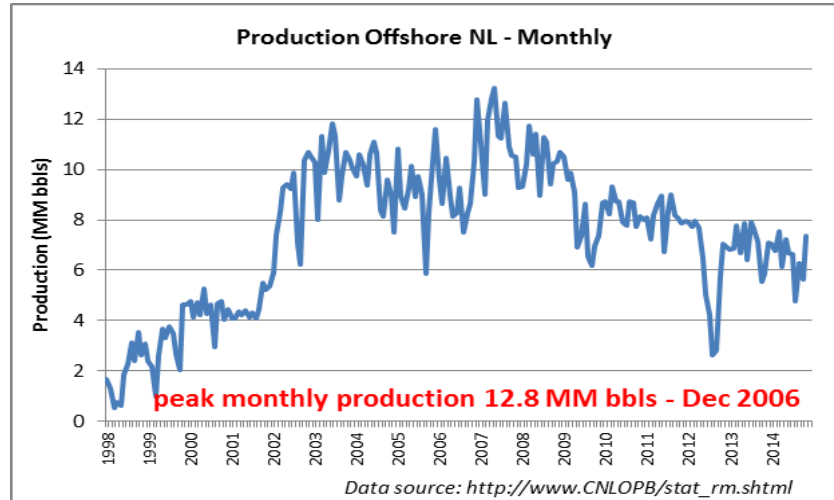
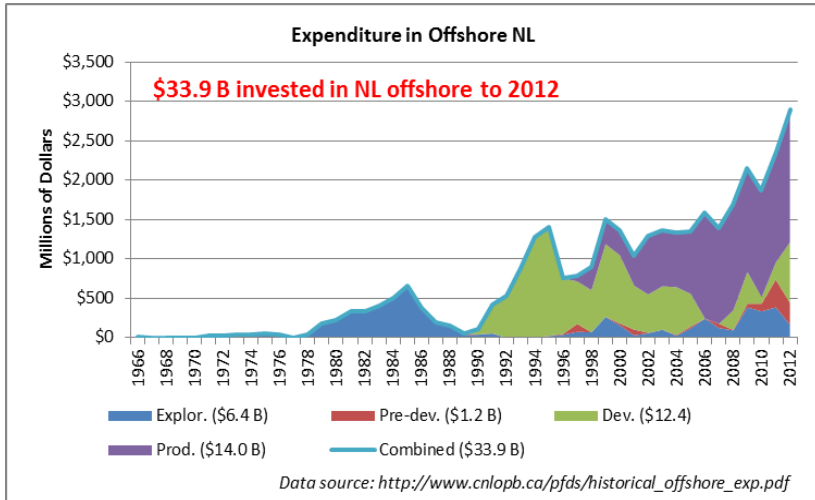
NL Production (Existing & Approved Projects)



- Assumed two year ramp-up, start 2021, end 2051 (30 year production)
- Four year plateau (7.3% of recoverable reserves → 120,000 per day for 600 MM bbls, 160,000 per day for 800 MM bbls and 200,000 per day for 1,000 MM bbls)
- Decline rate 9.4% per annum after plateau



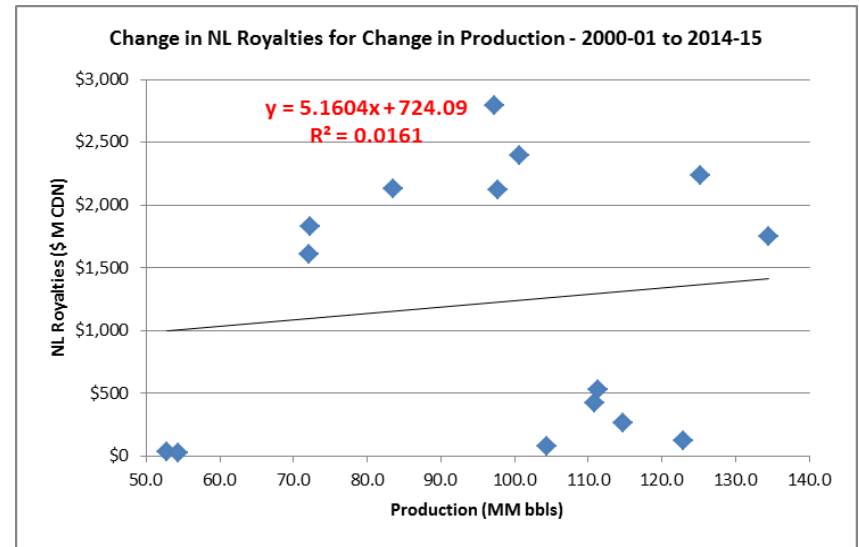
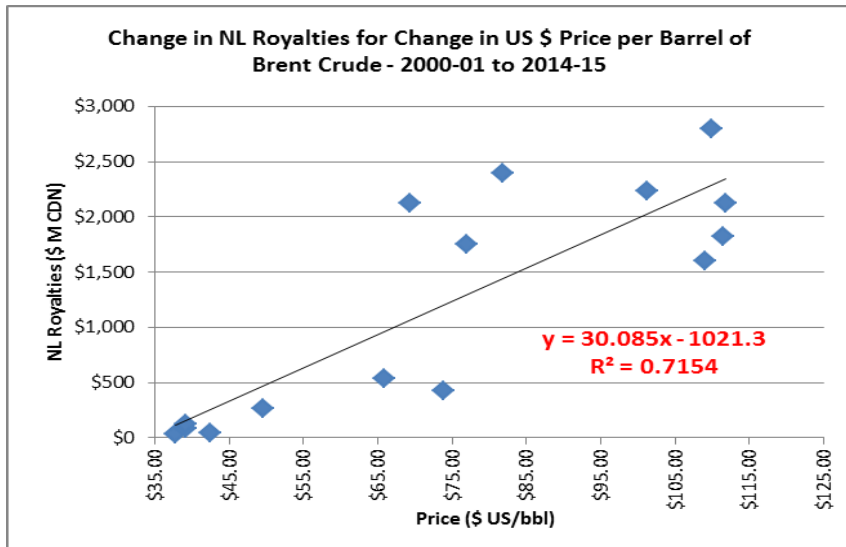
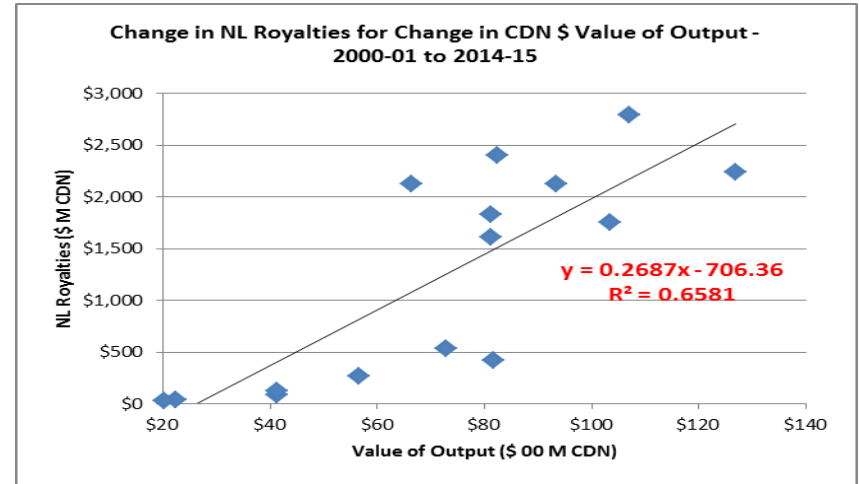
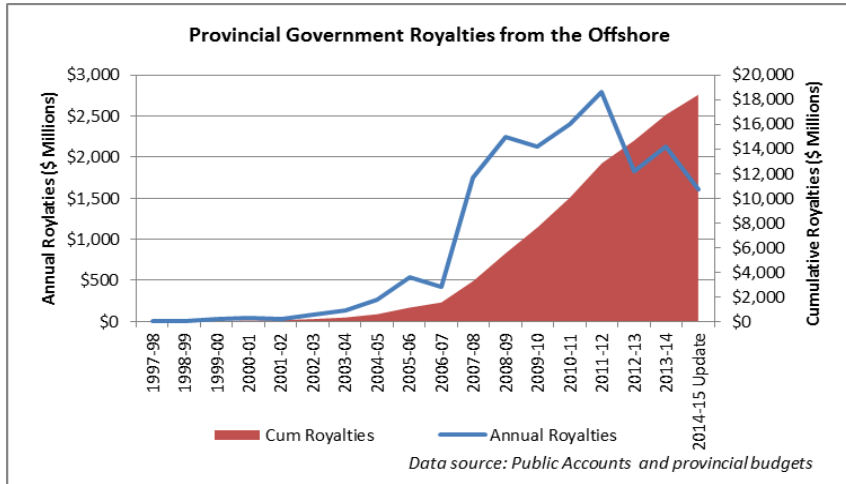
Offshore - An Illustration



Value of output = Monthly Production * Monthly Brent Price (US\$/bbl) * Exchange Rate (CDN/US \$)

1.5 Billion barrels produced with a value of \$110 Billion CDN

NL Royalties



Price and value of output are better predictors of annual royalties than production change over this period

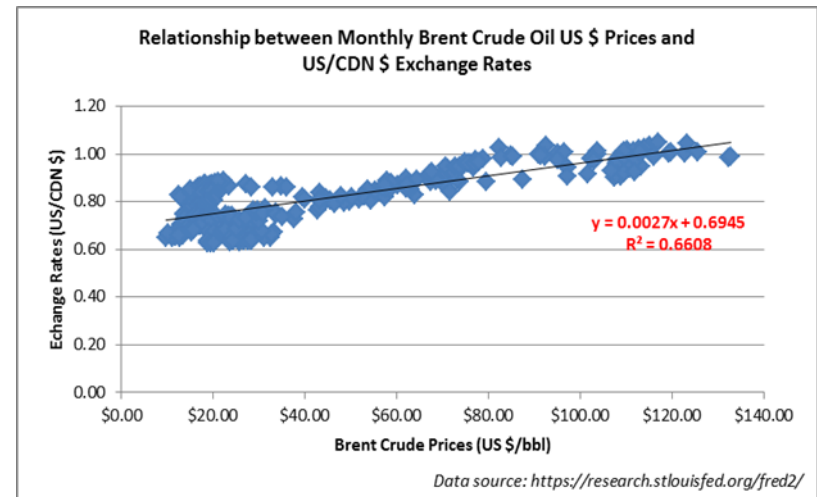
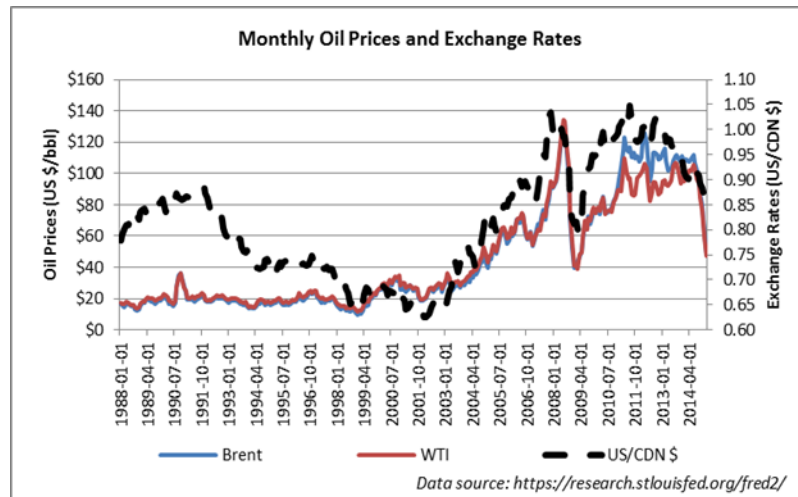
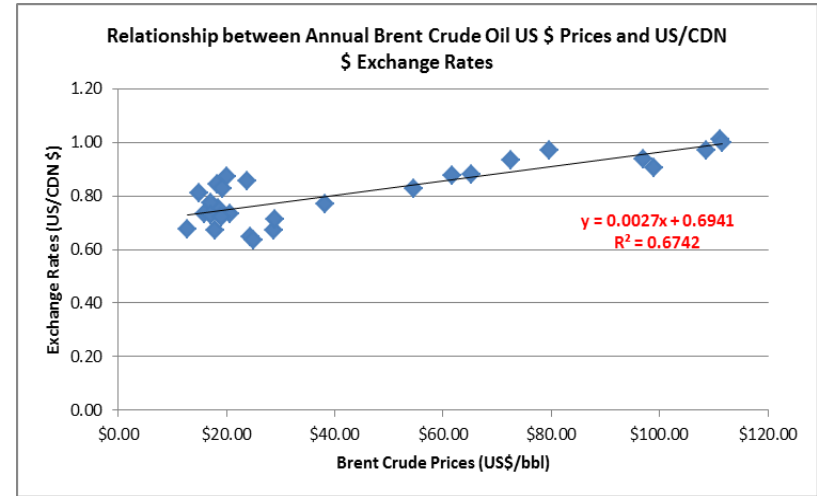
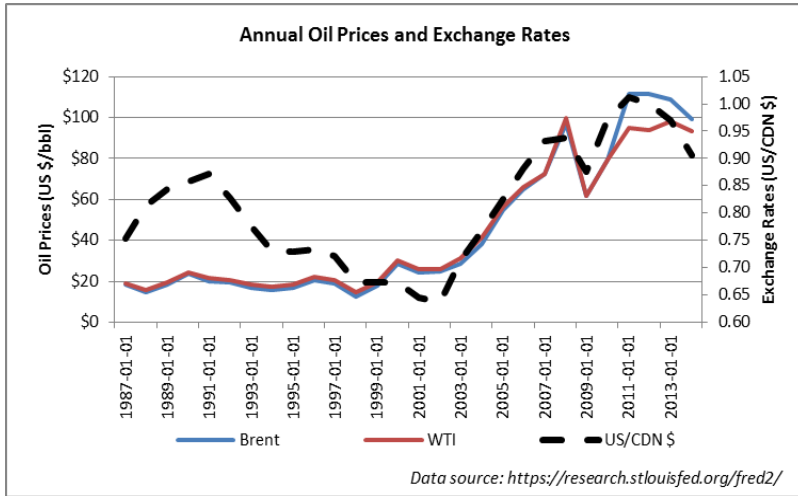
↑ \$ Price → \$30 M in royalties over this period, ↑ \$ Value → \$27 M in royalties over this period, and
 ↑ MM bbl → \$5 M in royalties over this period

Prices

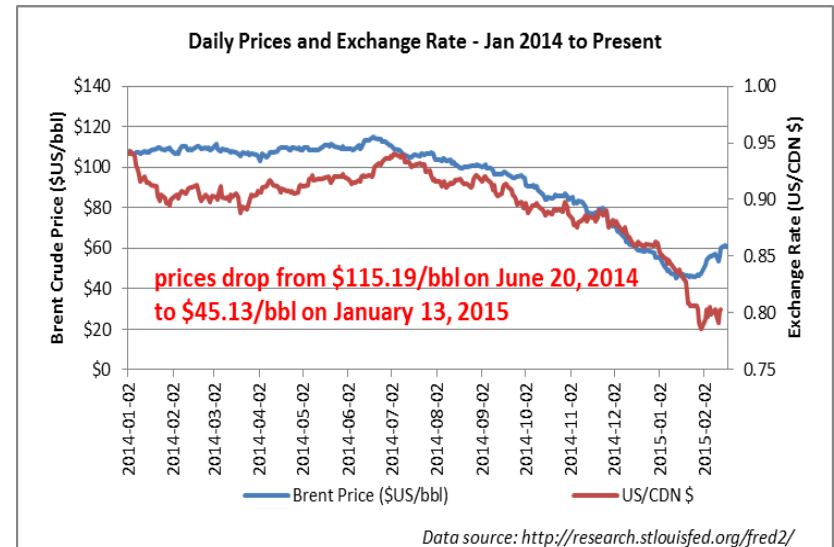
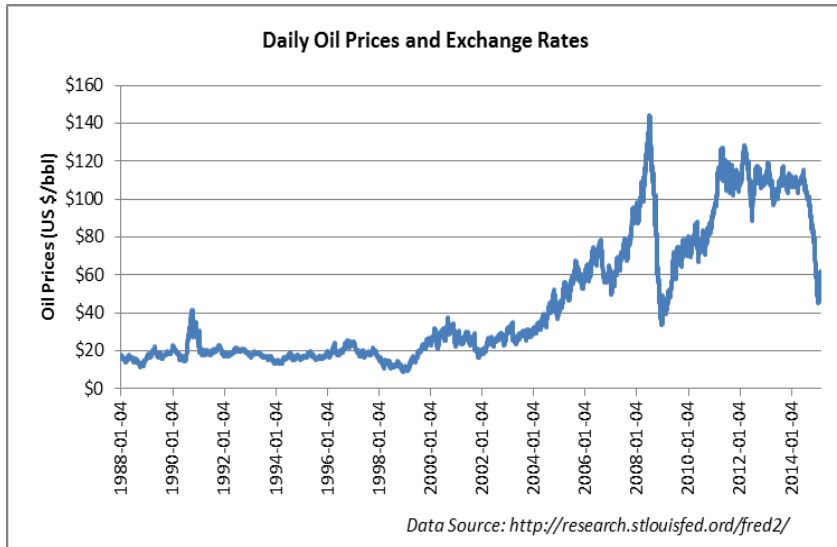
Price forecasts

- Forecast with the last year say price forecast in the range of \$90 to \$110 dollars.
- Within the last two months we have had analysis suggest prices anywhere from \$10/bbl to \$200/bbl
- They will be right – it will be in that range, but that is not helpful to anyone!
- Need to take forecasts with a lump of salt, not just a grain

Annual and Monthly Prices



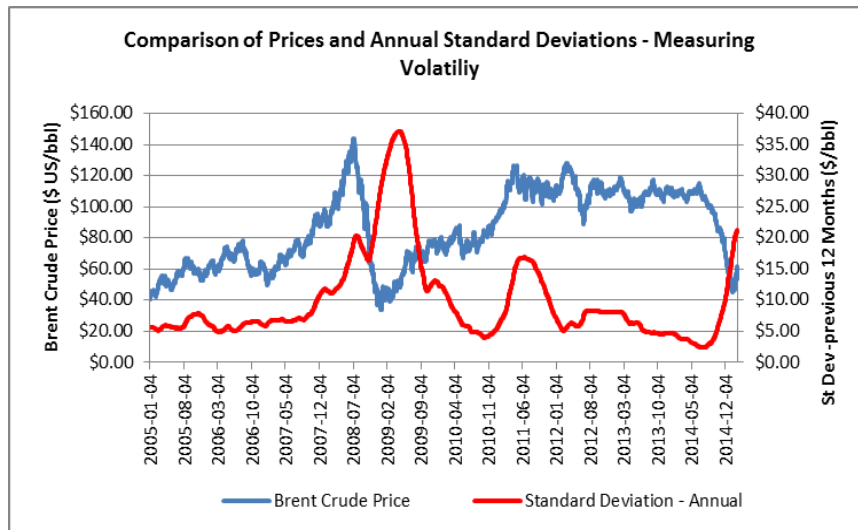
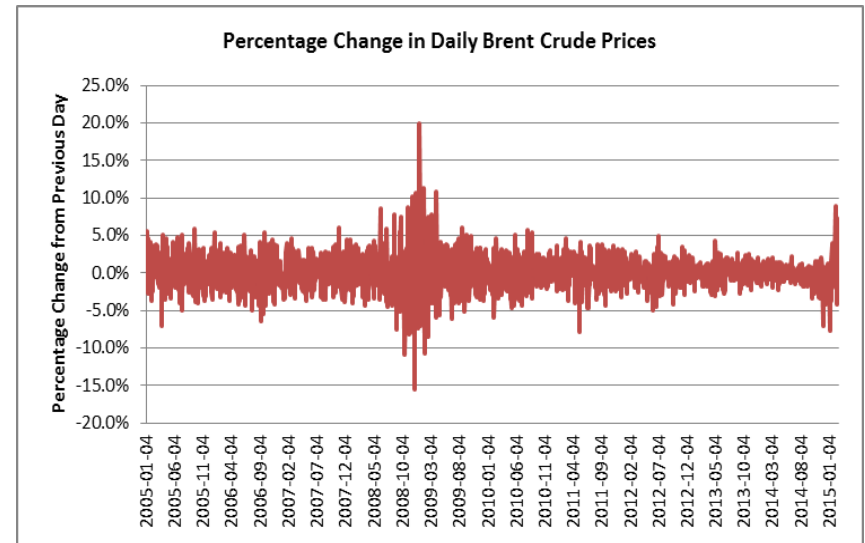
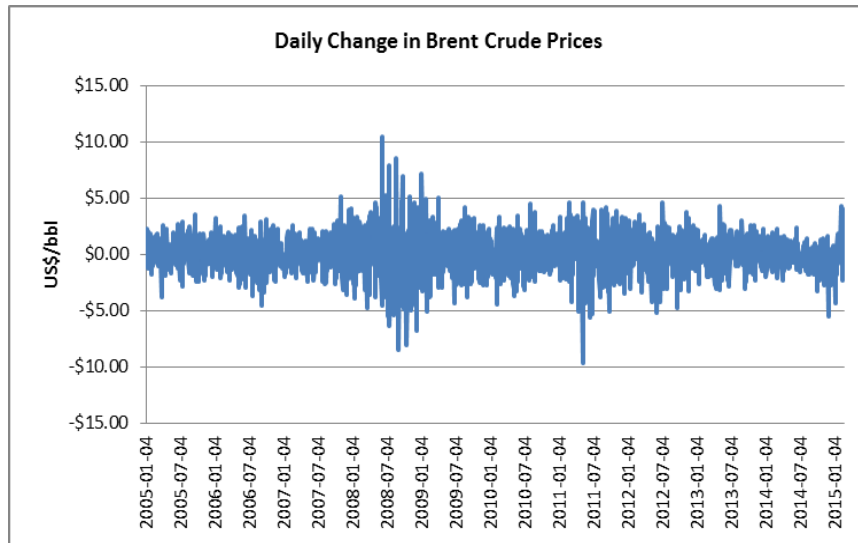
Daily Prices – Levels



In February, there has been a small turn around in prices

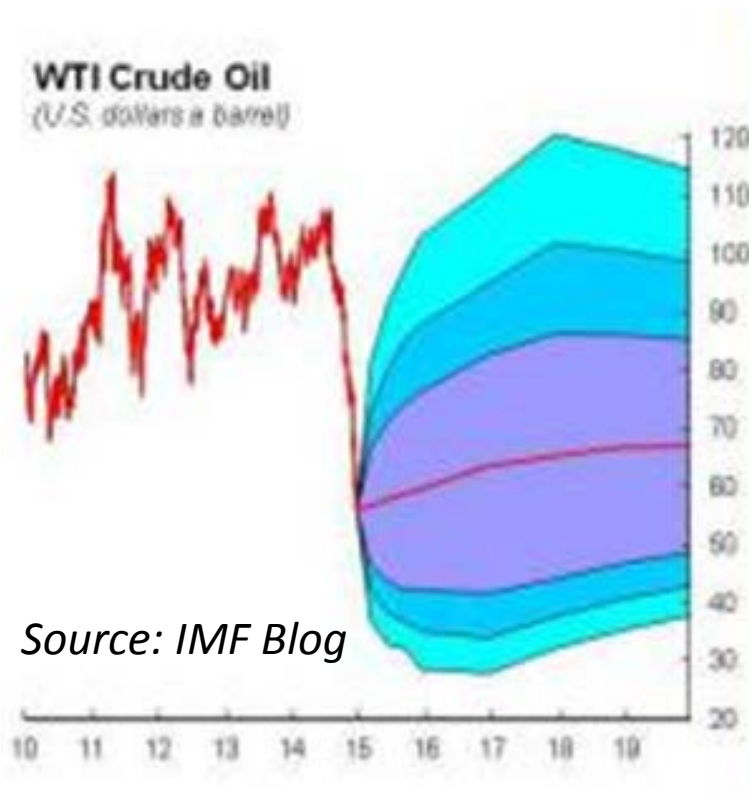
February 20, 2015, the price for Brent Crude was between \$60.22 US/bbl

Daily Prices – Levels and Volatility



Independent of how it is measured, in the recent period, volatility has increased and, as such, so has the risks associated with oil prices because the price is less predictable.

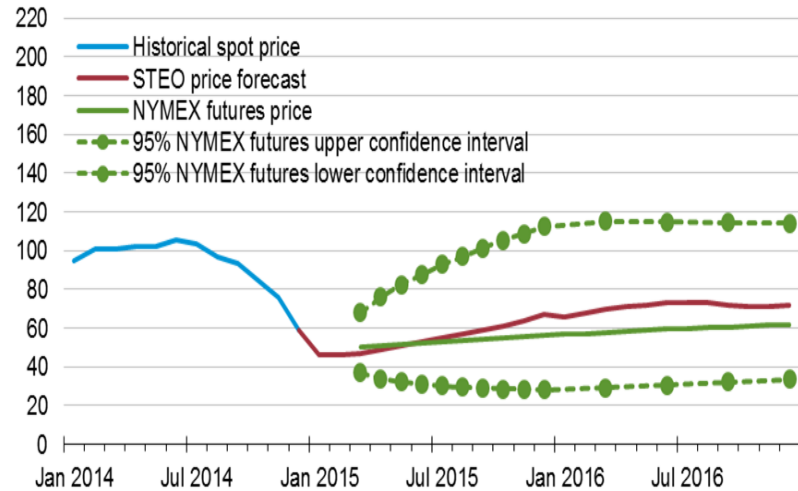
Huge Variation in Expected Future Prices



Implied distribution of future prices (based on option prices) with a 95% confidence band in 2019 is \$38 to \$115 (IMF – Jan 2015)

West Texas Intermediate (WTI) Crude Oil Price

dollars per barrel

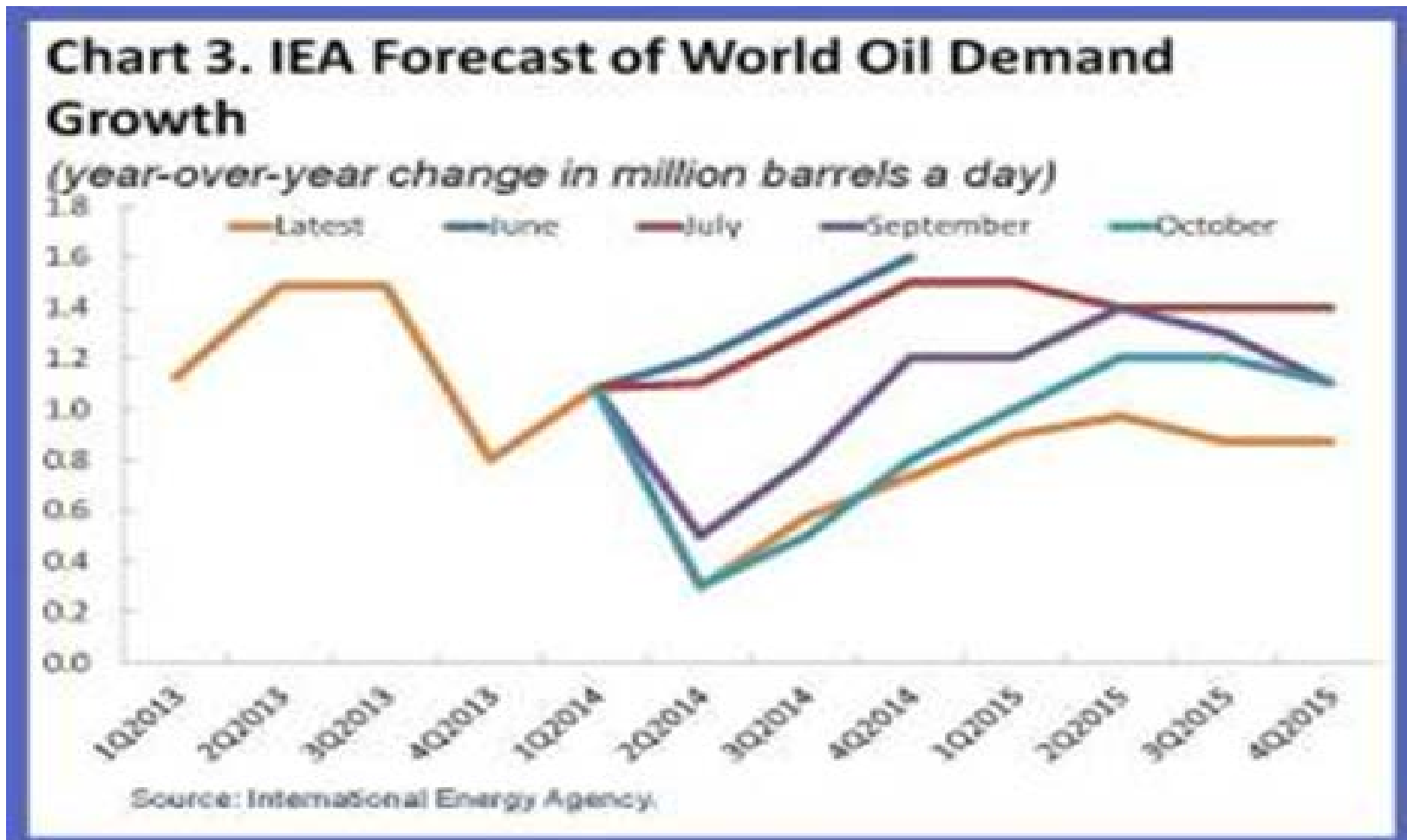


Note: Confidence interval derived from options market information for the 5 trading days ending Jan. 8, 2015. Intervals not calculated for months with sparse trading in near-the-money options contracts.

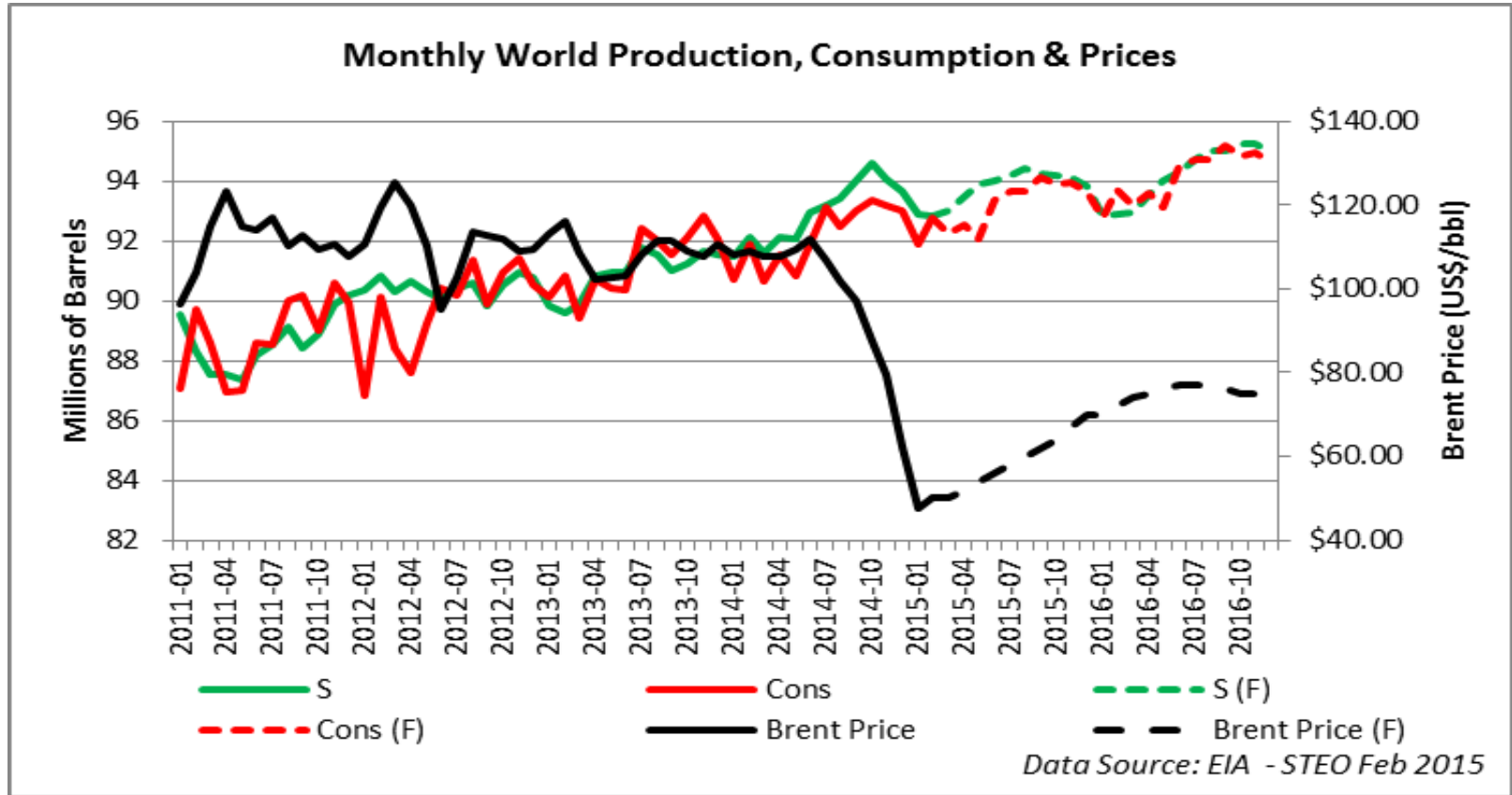
Source: Short-Term Energy Outlook, January 2015.

Implied distribution of future prices (based on option prices) with a 95% confidence band in Dec2016 is \$40 to \$102 (EIA – Feb 2015)

Demand Forecast Change almost monthly – Tremendous Uncertainty and Volatility

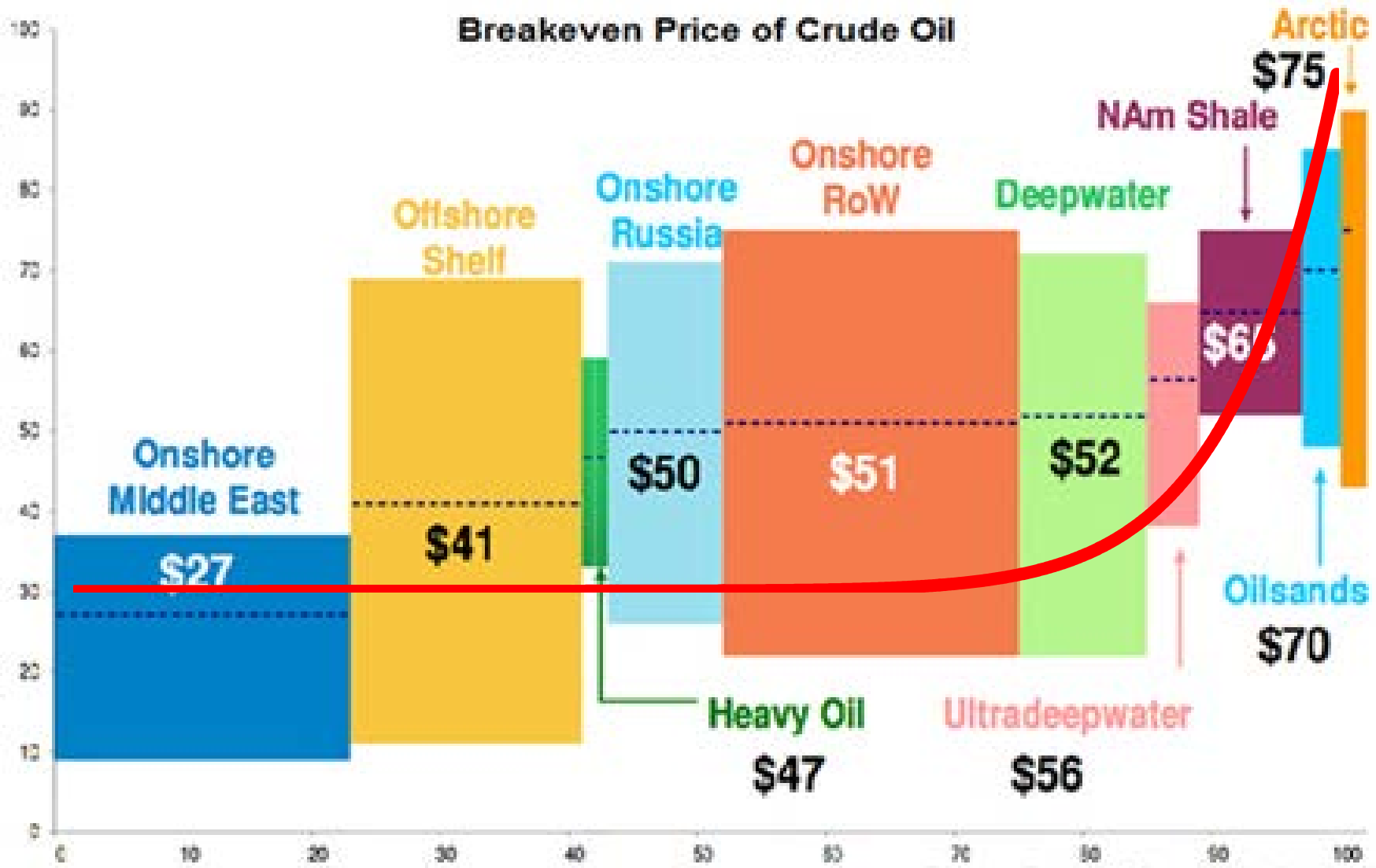


EIA Price Forecast



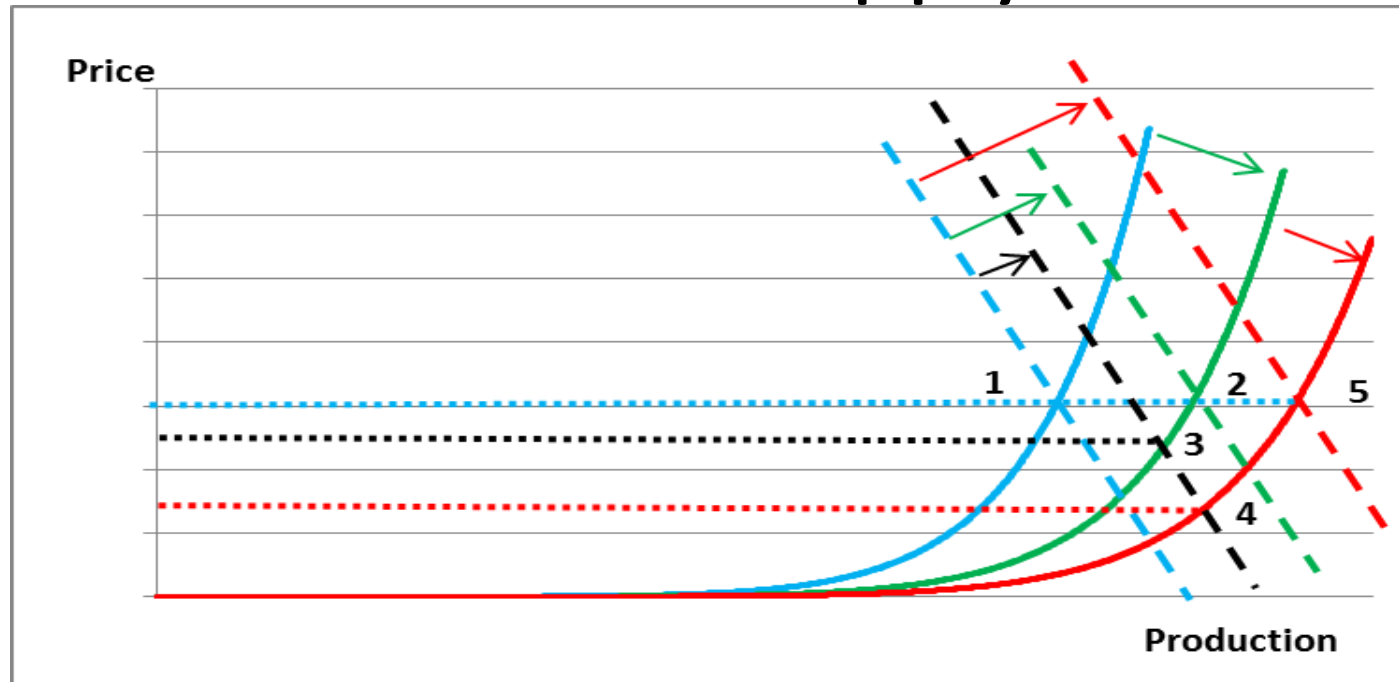
Prices forecast to reach approximately \$76/bbl by end of 2016 according to EIA STEO (Feb 2015)

Demand and Supply



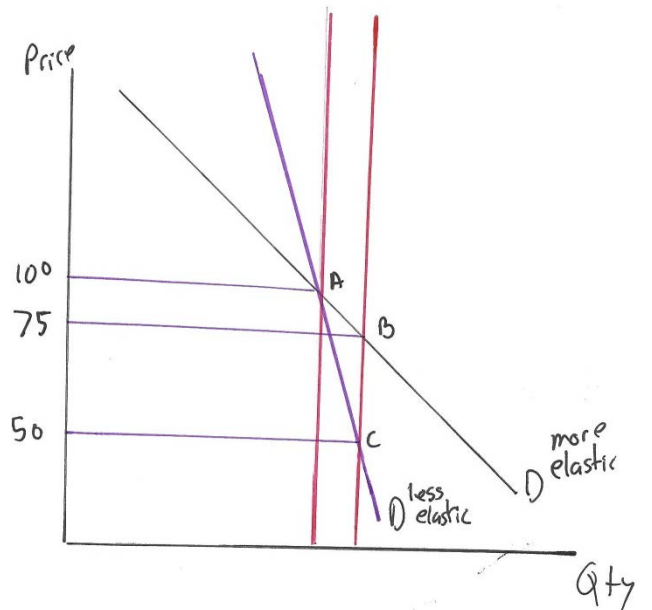
Source of Breakeven Chart is Market Realist

Demand and Supply for Oil



1. Situation before 2014 (\$100-110),
2. S and D expected to grow – small impact on price
3. demand growth not as much as expected (Europe, Japan, China) and inventories starting to build and price fall
4. US shale more productive than expected (fuel by high prices and debt), inventory growth reaches historic levels, OPEC protects market share and prices collapse
5. Demand recovery will eventually swamp the impact of shale

Price Adjustment



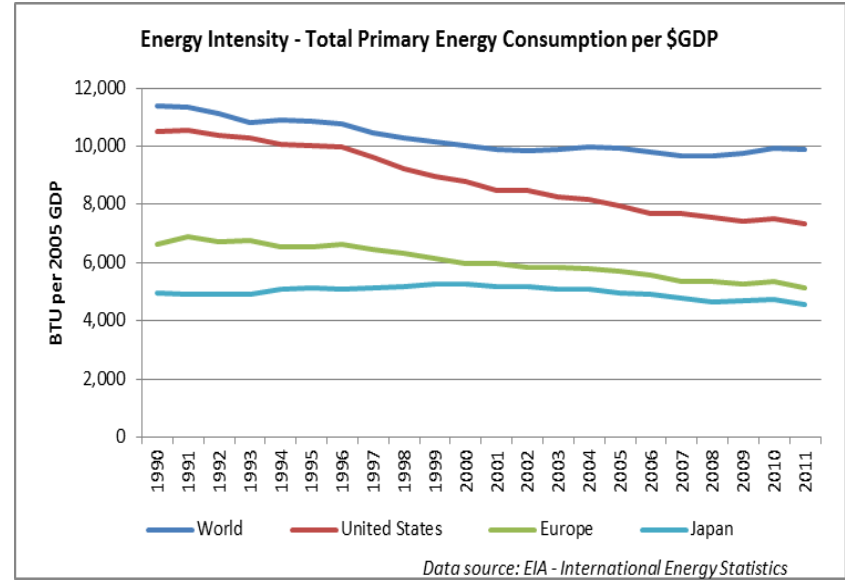
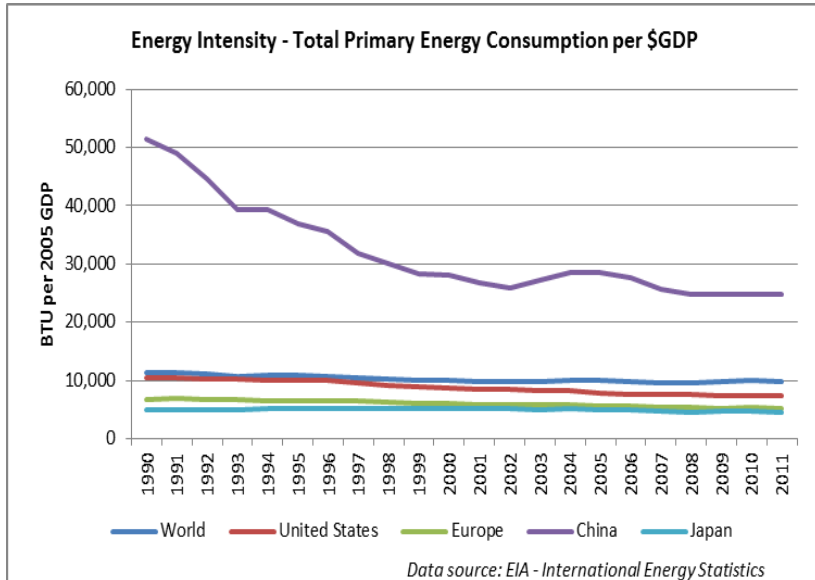
$$\eta = \frac{\frac{\Delta Q}{Q}}{\frac{\Delta P}{P}} \cong 0.1$$

this implies

$$\frac{\Delta P}{P} = \frac{\Delta Q}{Q} * \frac{1}{\eta} = 2\% * \frac{1}{0.1} \cong 20\%$$

Since the over-supply was around 2% of the market 1.5 to 2 million barrels per day on a 93 to 94 million barrels per day supply, if demand, and only demand, were to increase by 2%, then price should have dropped by 20 to 25%, not 60%

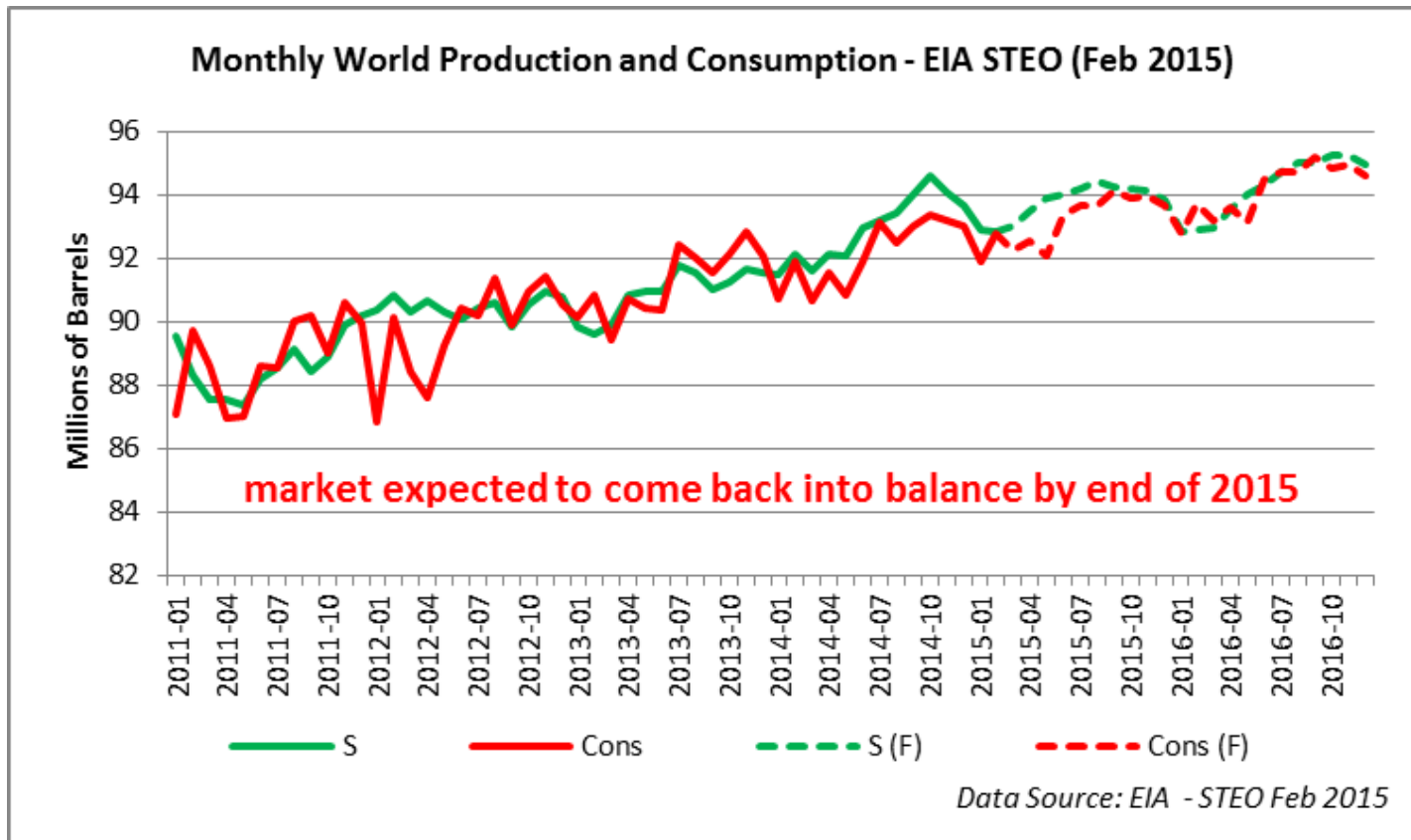
Changing Energy Intensity



	Change in intensity from 2001 to 2011
World	0.24%
United States	-13.60%
Europe	-13.62%
China	-7.97%
Japan	-11.91%

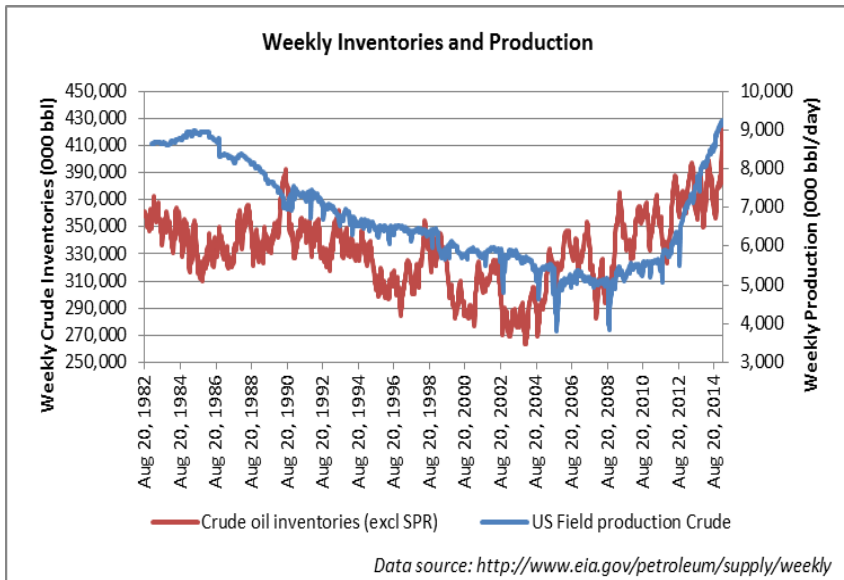
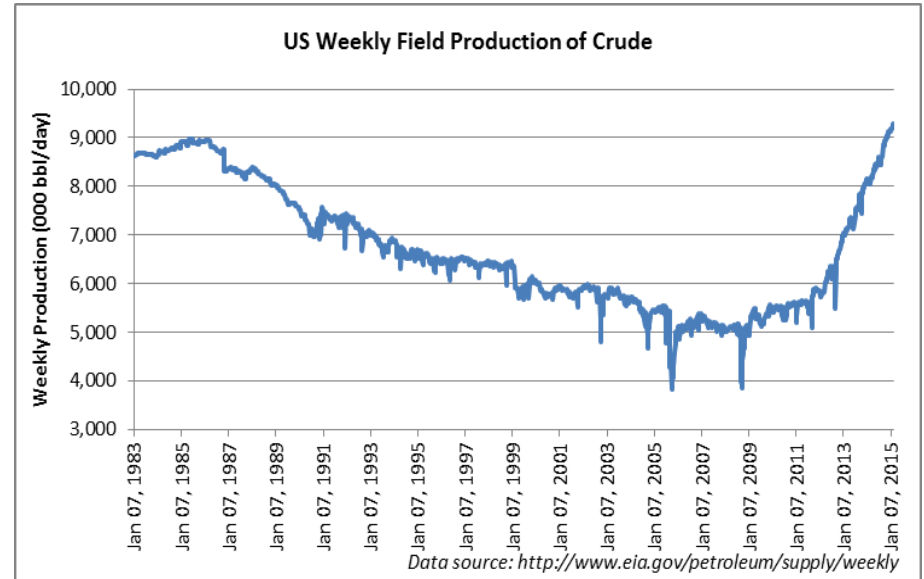
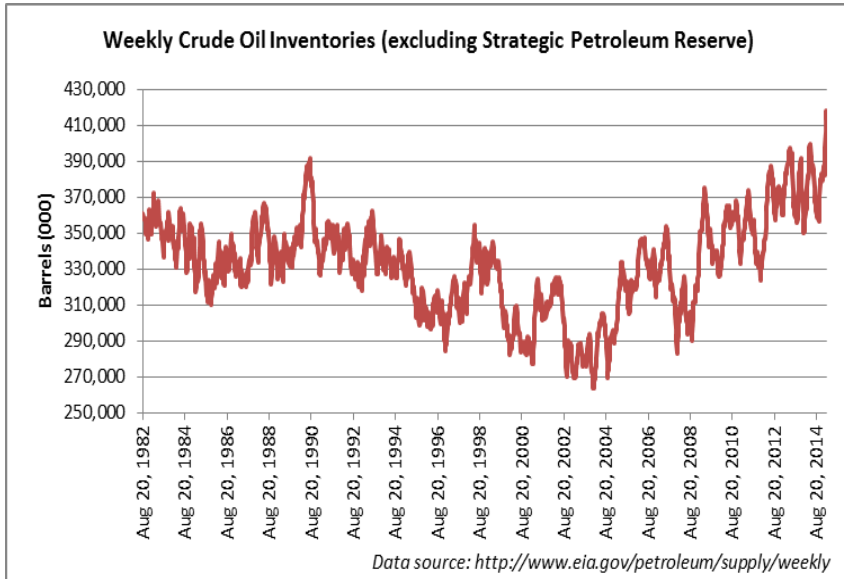
Energy intensity has fallen in bigger consuming countries and demand would be more inelastic as a fall in price might not stimulate the same increase as in earlier periods

Supply and Demand



Note: Japan and Europe accounted for almost the entire decline in 2014

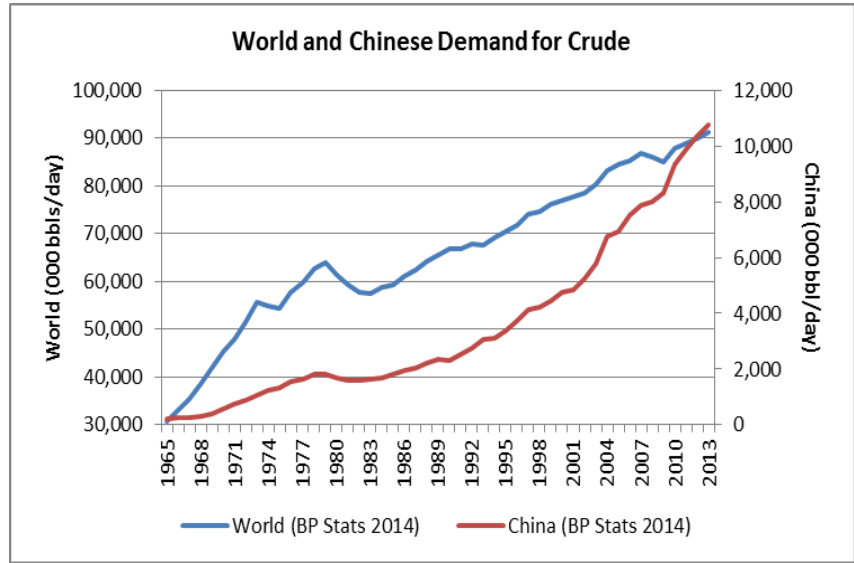
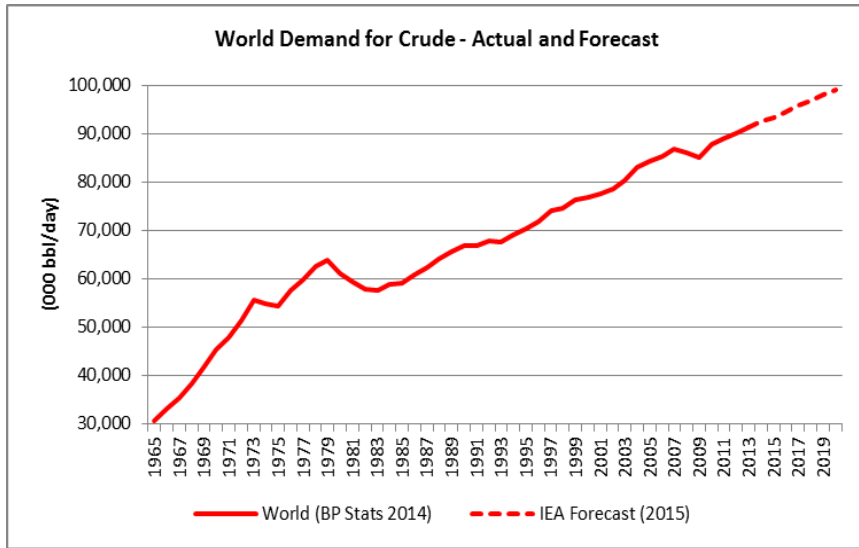
Weekly US Crude Oil Inventories and Production



Weekly inventories and production are historic levels and this is depressing prices

Concern that prices may need to be lowered to clear inventories

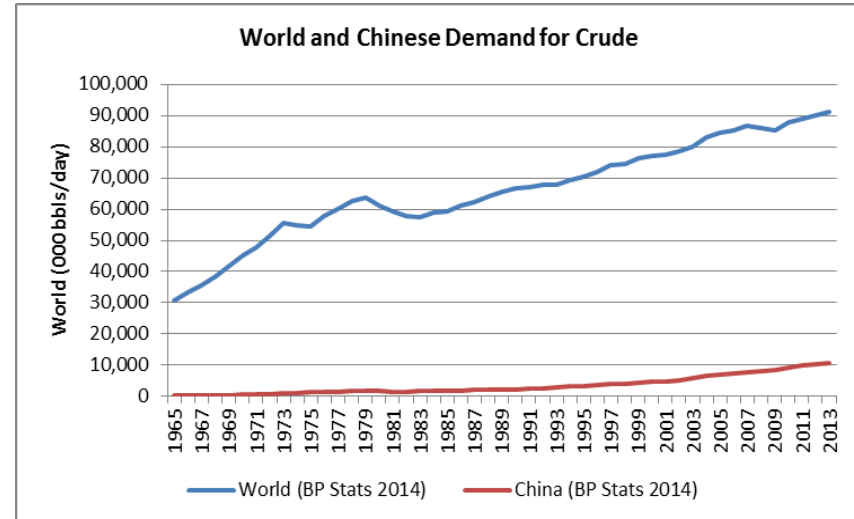
World Demand for Crude



World demand expected to reach 100 million barrels per day in 2020

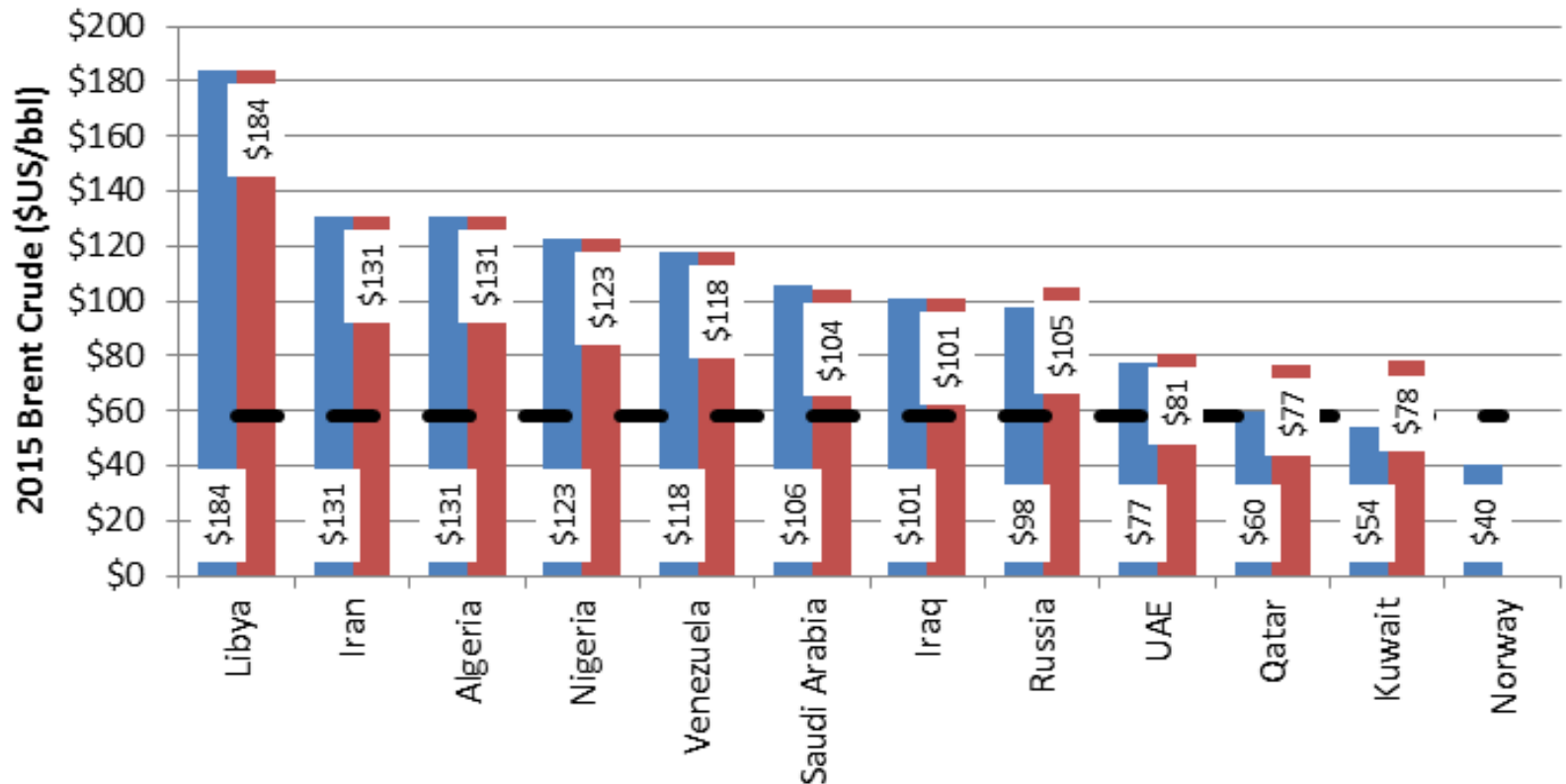
Growth in China's demand having big influence on demand and prices in recent years and growth now starting to slow

China's growth expected to fall below 7%, the weakest growth more than two decades



Fiscal Breakeven Prices

Fiscal Breakeven Brent Crude - 2015

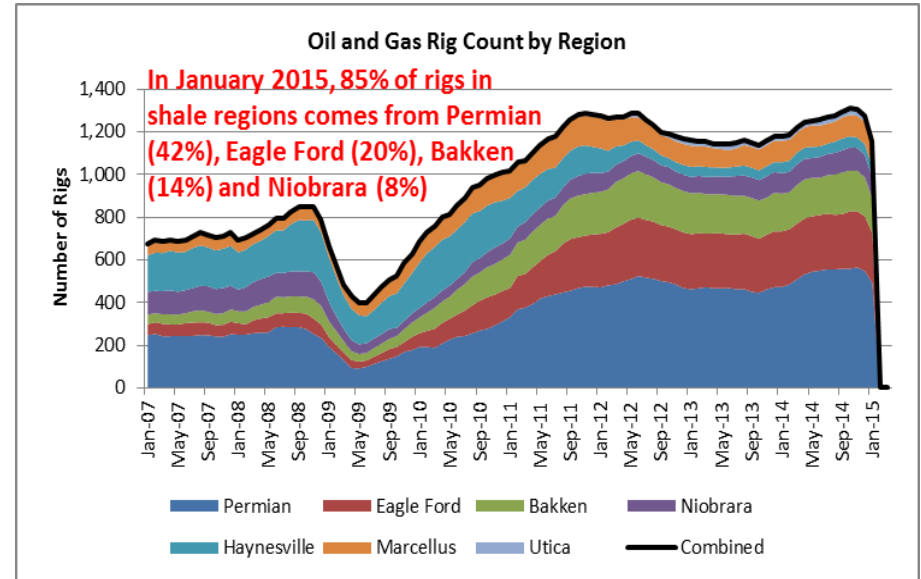
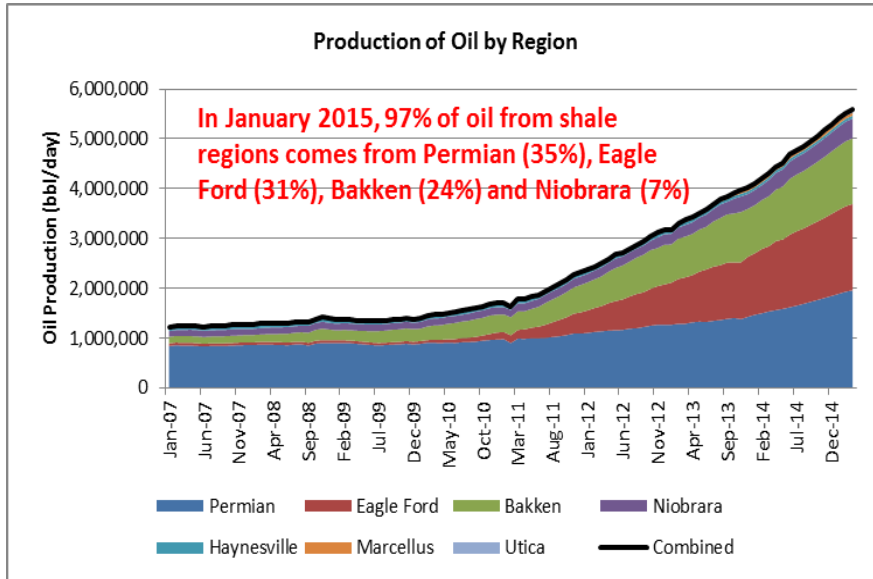


Data source: <http://graphics.wsj.com/oil-producers-break-even-prices/> & <http://www.bbc.com/news/business-30814122>

Most producers need higher prices than \$60 to balance budget

Impact of Shale Oil

Shale Oil



The overwhelming majority of production and activity associated with shale oil comes from four regions

the Permian Basin

the Eagle Ford Basin

the Williston (Bakken) Basin

the Niobrara Basin

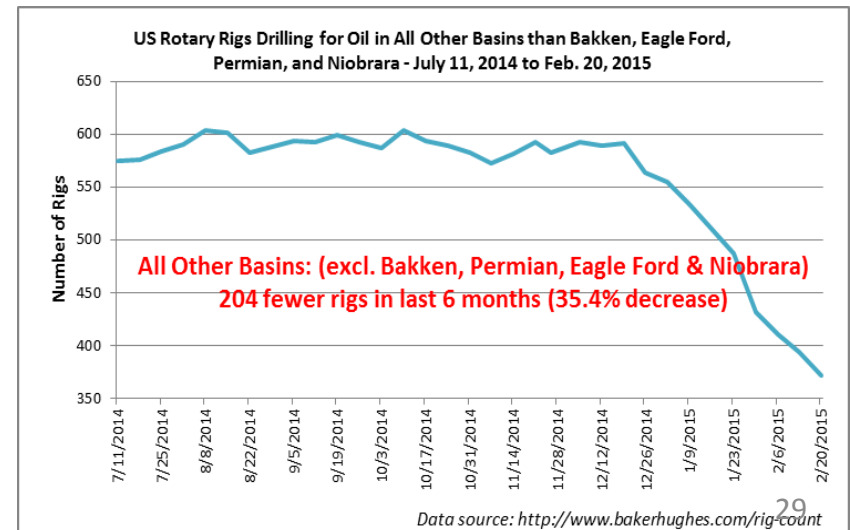
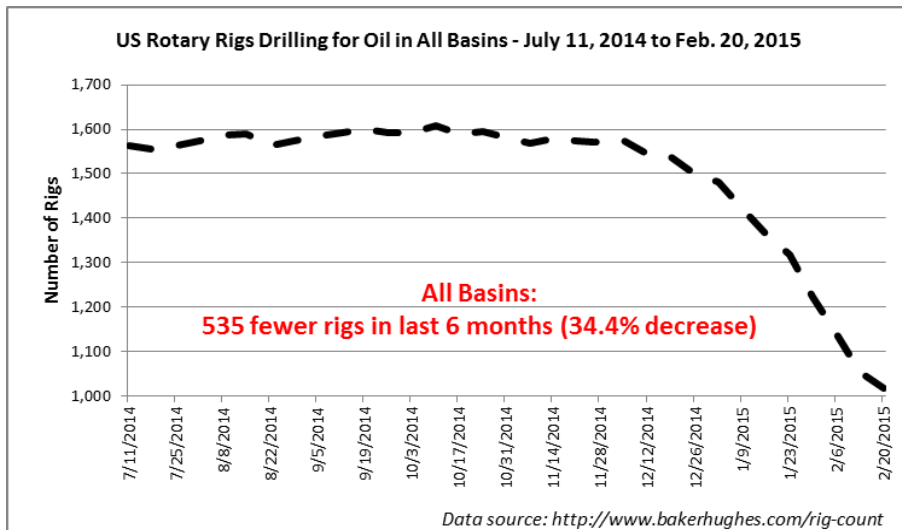
US Rig Counts (Drilling for Oil and Gas)

- There were 1,310 rotary rigs operating in the US for the week ending February 20, 2015
 - 77.79% (1,019) looking for **oil** and 22.06% (289) looking for gas
 - 95.88% (1,256) on **land** and 4.12% (54) offshore
 - 74.73% (797) **horizontal**, 15.50% (203) vertical, and 9.77% (128) directional
- Of the 1,056 oil rigs, the majority were in shale basins
 - 11.97% (122) **Bakken**, 13.84% (141) **Eagle Ford**, 2.45% (25) **Niobrara**, 35.23% (359) **Permian**, and 36.51% (371) **Other basins** (including Haynesville, Utica and Marcellus)
- Note sweet spots can have an EUR 10 times higher than lower production areas within a play

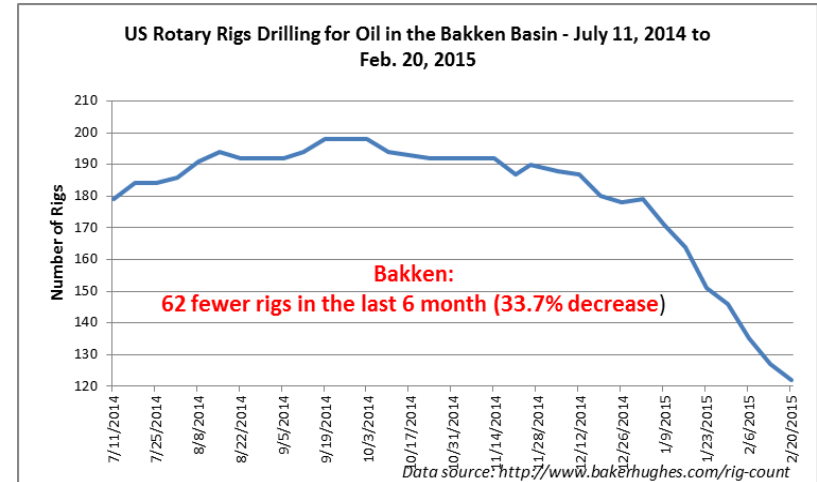
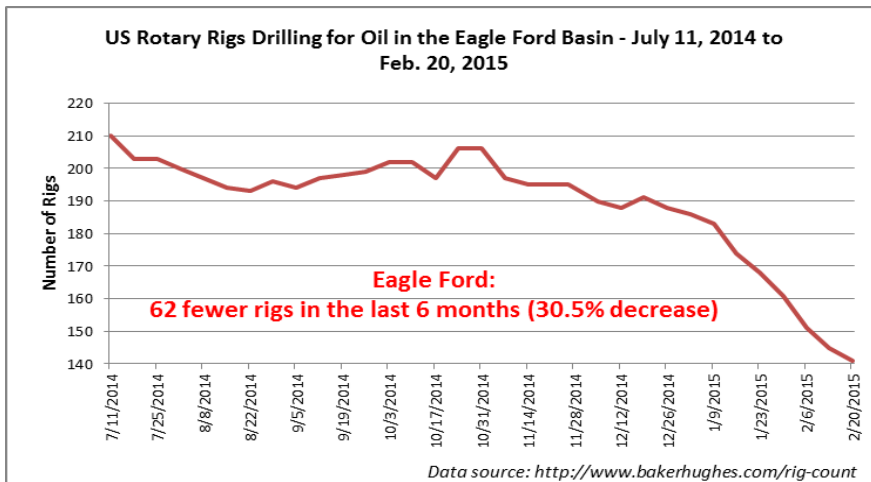
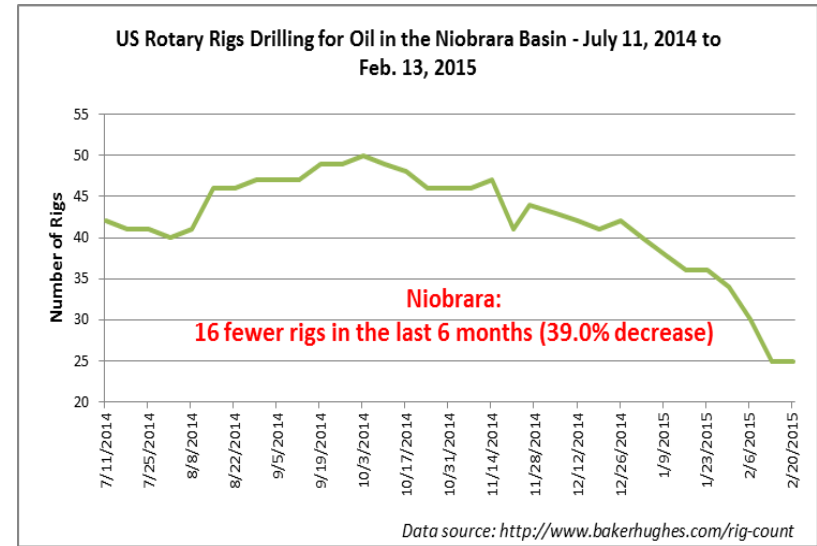
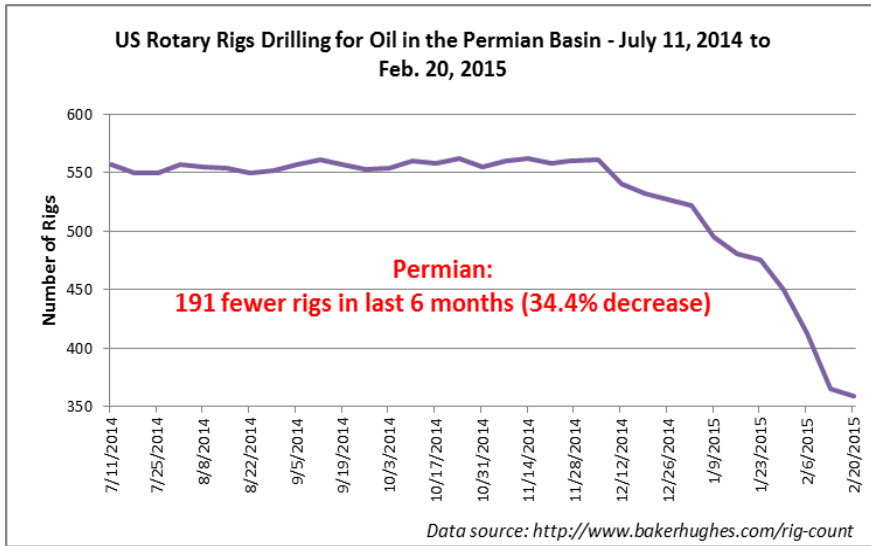
US Rig Count – All Basin and All Basins other than Eagle Ford, Permian, Bakken and Niobrara Basins

	Bakken (Williston)	Eagle Ford	Niobrara	Permian	Other Basins	Total
change from one month ago	-29	-27	-11	-116	-115	-298
change from three months ago	-65	-54	-16	-199	-221	-555
change from six months ago	-62	-62	-16	-191	-204	-535
change from one year ago	-52	-50	-12	-123	-169	-406
change from two year ago	-65	-34	2	-96	-117	-310
change from three year ago	-82	-10	4	-97	-68	-253
change from four year ago	-36	95	15	12	135	221

	Bakken (Williston)	Eagle Ford	Niobrara	Permian	Other Basins	Total
change from one month ago	-19.2%	-16.1%	-30.6%	-24.4%	-23.6%	-22.6%
change from three months ago	-35.1%	-25.8%	-41.9%	-36.0%	-37.3%	-35.3%
change from six months ago	-33.7%	-30.5%	-39.0%	-34.7%	-35.4%	-34.4%
change from one year ago	-29.9%	-26.2%	-32.4%	-25.5%	-31.2%	-28.5%
change from two year ago	-34.8%	-19.4%	8.7%	-21.1%	-23.9%	-23.3%
change from three year ago	-40.2%	-6.6%	19.0%	-21.3%	-15.5%	-19.9%
change from four year ago	-22.8%	206.5%	150.0%	3.5%	57.0%	27.7%

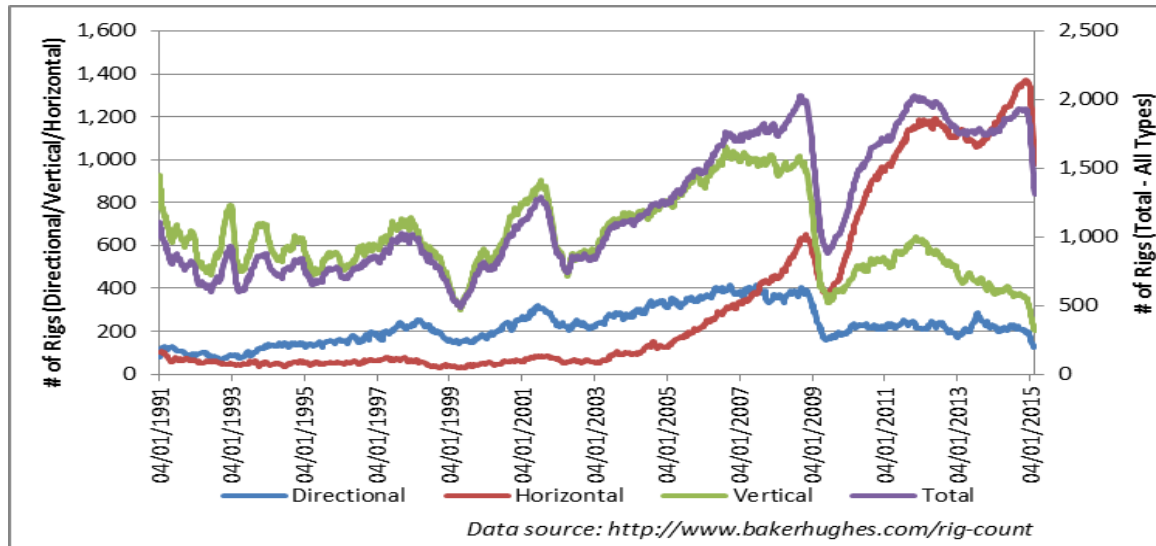


US Rig Count – Rigs Drilling for Oil by Basin



Rigs in shale basin decline by more than one-third in 6 months, but decline in last month is slowing (23% fall last month relative to 34% for the 6 month period)

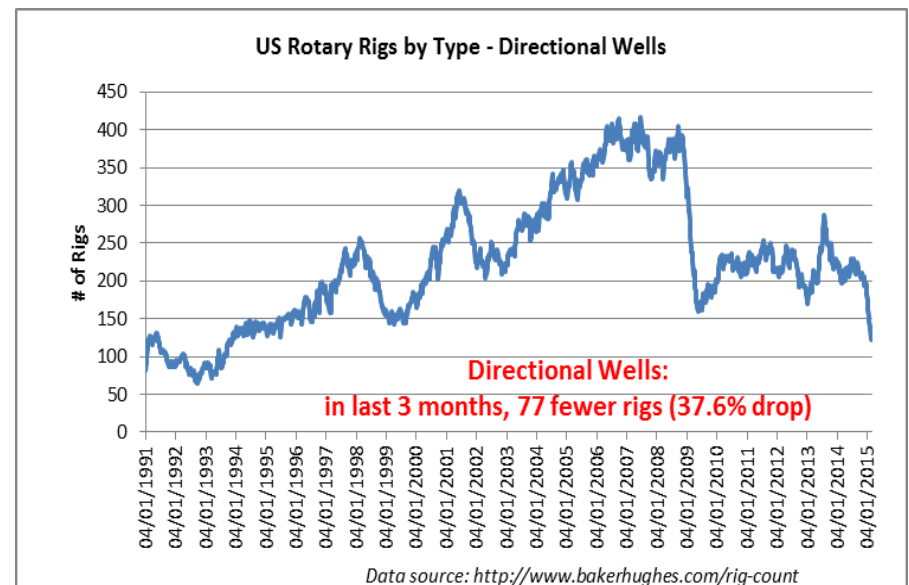
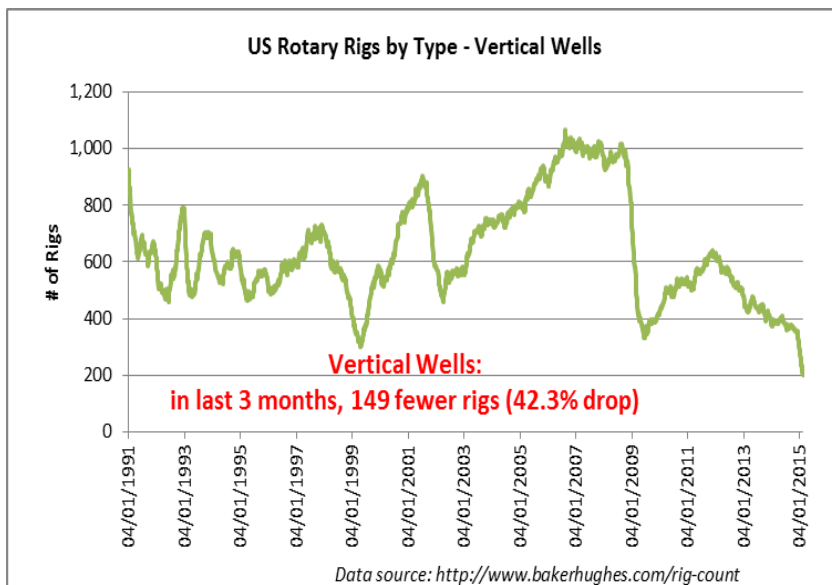
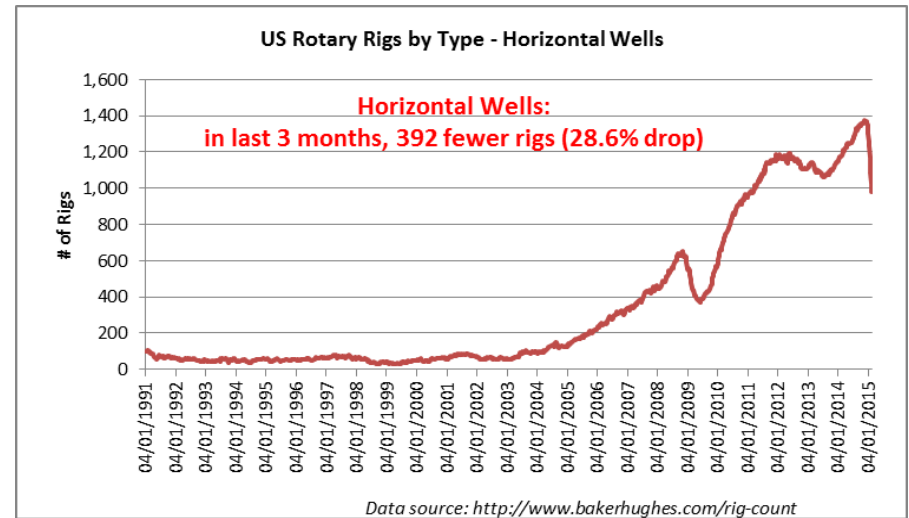
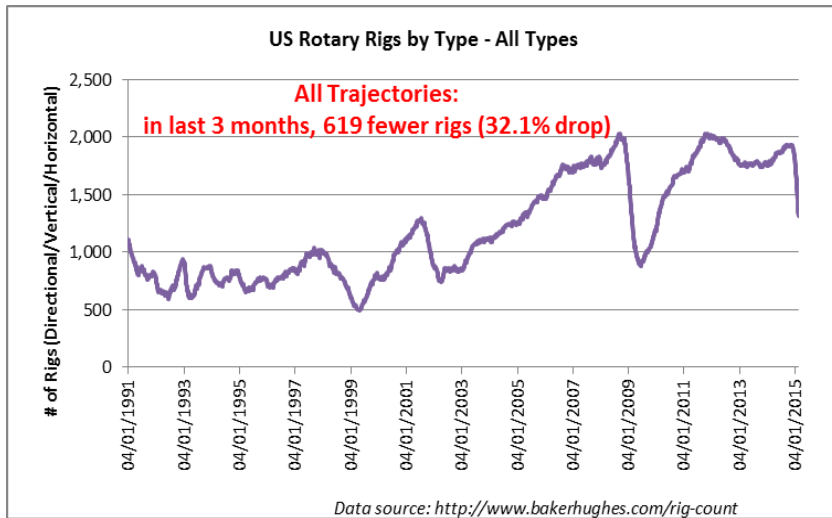
US Oil and Gas Rigs by Trajectory



- All types of rigs have been falling recently, including those exploiting shale oil (i.e., vertical in the Permian and horizontal elsewhere)
- Horizontal rigs (primarily shale) became the majority of US rigs after March 2010

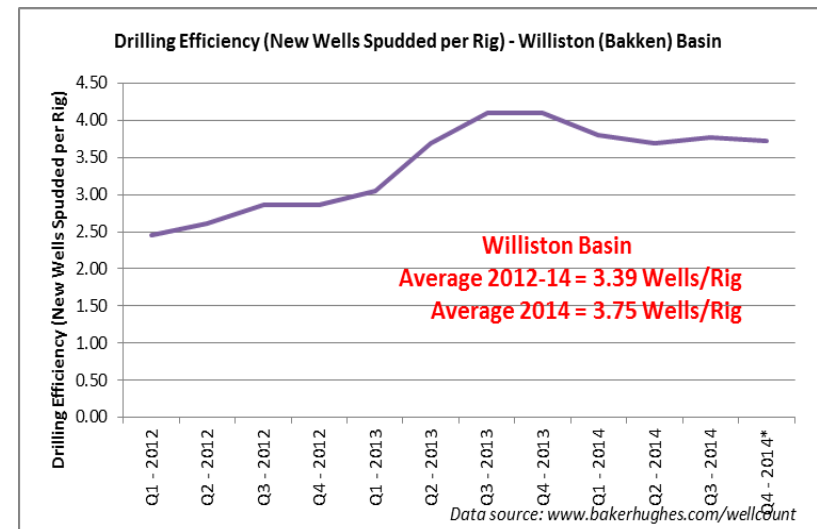
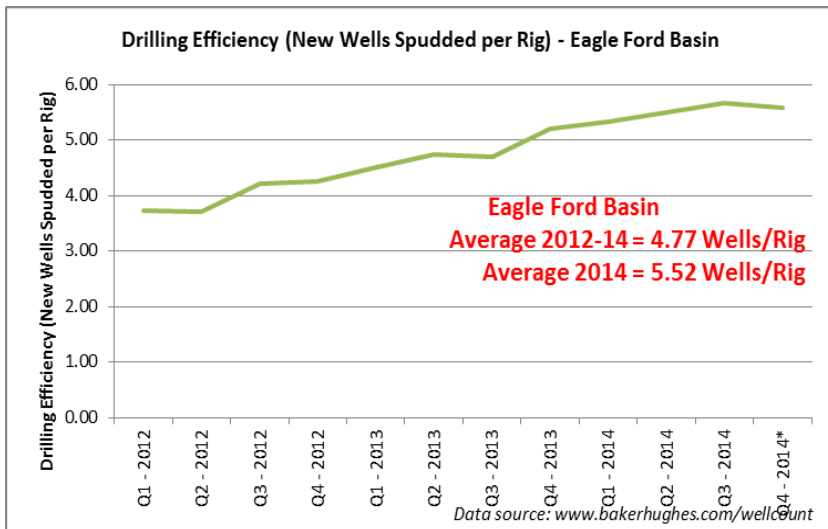
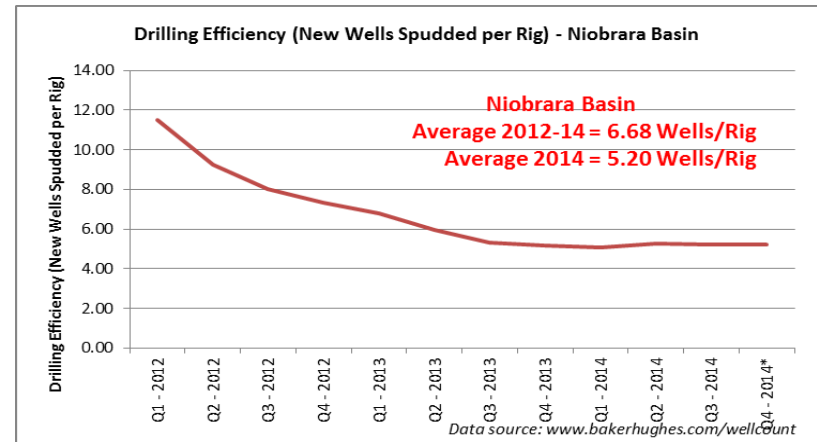
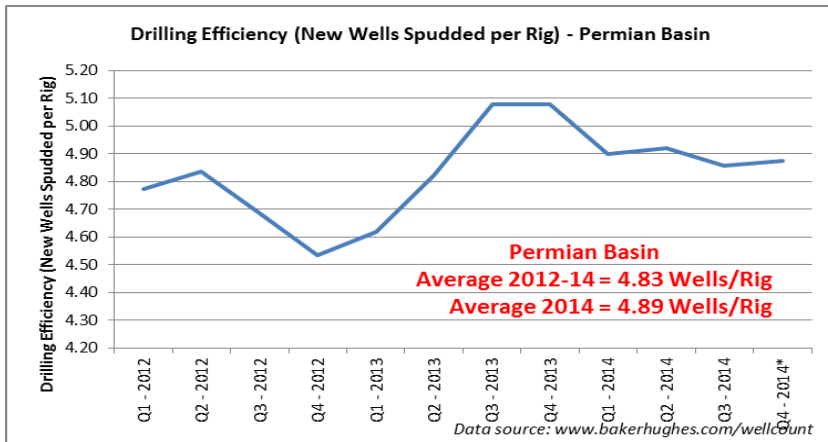
Change in Rig Numbers				
	Directional	Horizontal	Vertical	Total
1 month	5	-46	-7	-48
3 months	-77	-392	-149	-619
6 months	-81	-342	-163	-586
12 months	-69	-203	-189	-461
Percentage Change in Number of Rigs				
	Directional	Horizontal	Vertical	Total
1 month	4.07%	-4.49%	-3.33%	-3.53%
3 months	-32.6%	-28.6%	-42.3%	-32.1%
6 months	-38.8%	-25.9%	-44.5%	-30.9%
12 months	-35.0%	-17.2%	-48.2%	-26.0%

US Rigs by Trajectory

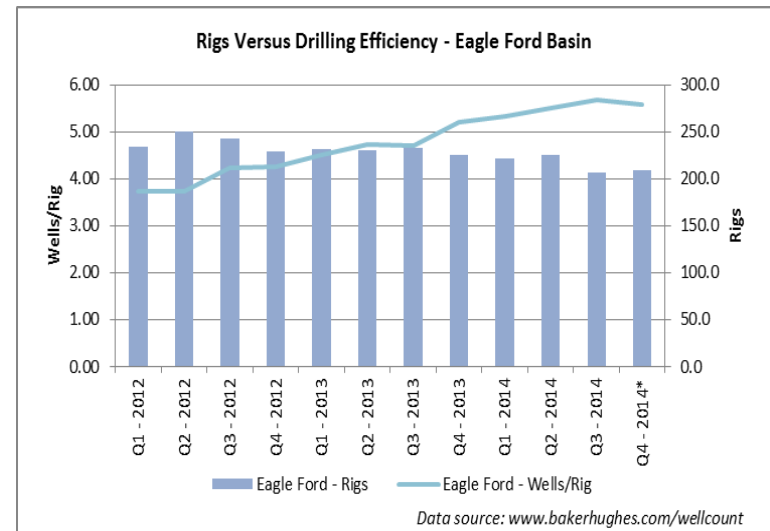
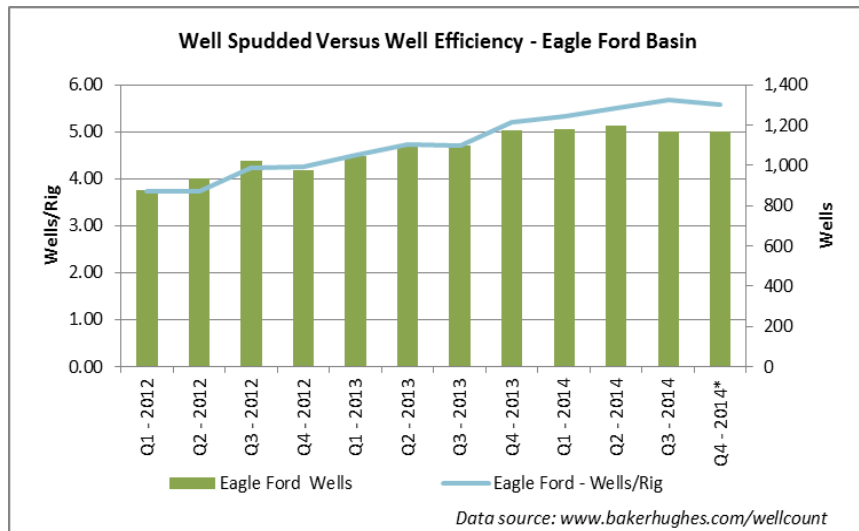
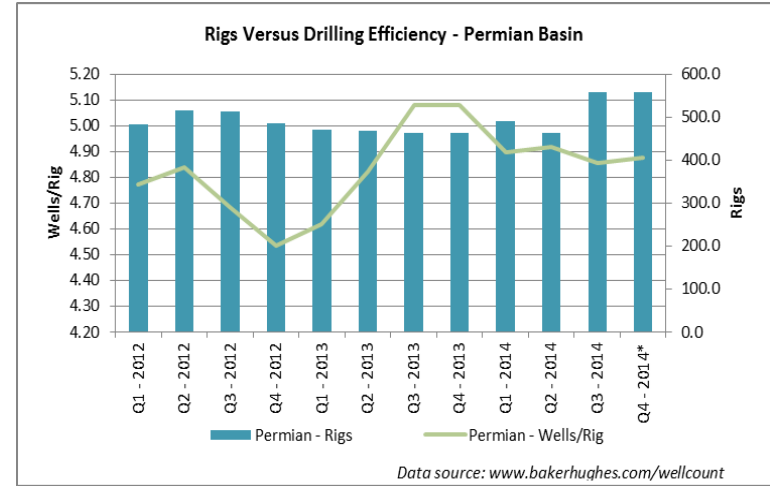
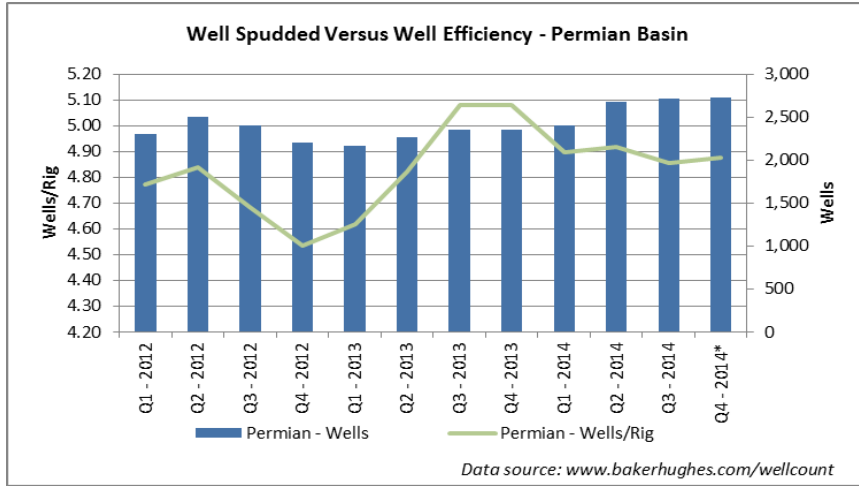


Clearly, horizontal rigs are falling as well and those are primarily shale oil

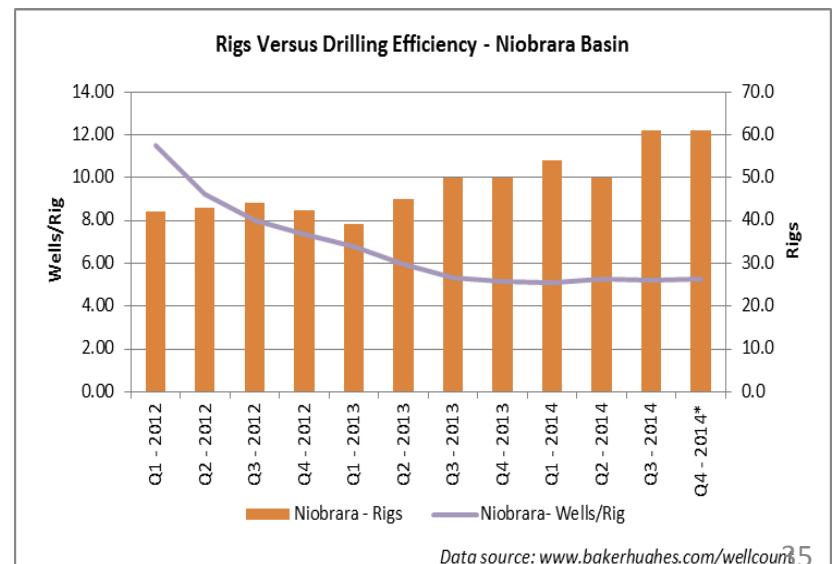
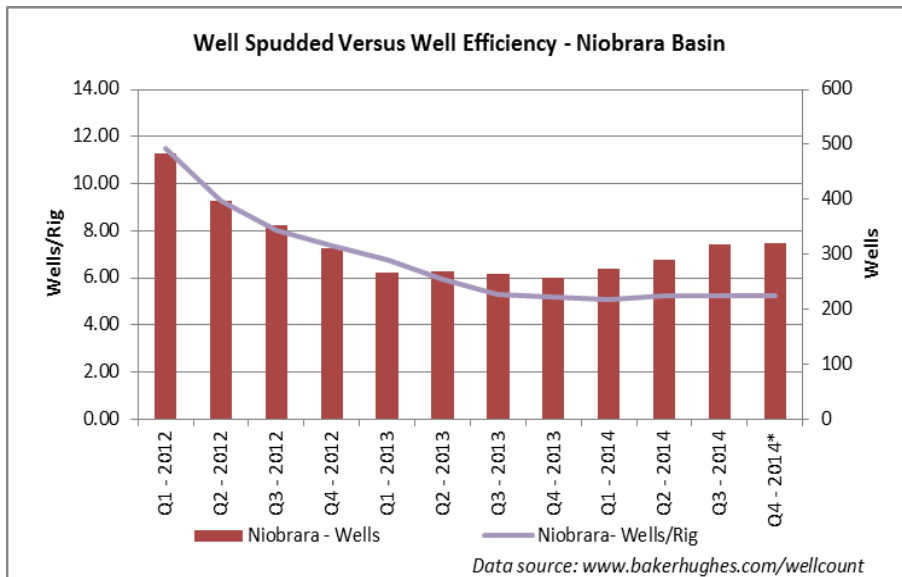
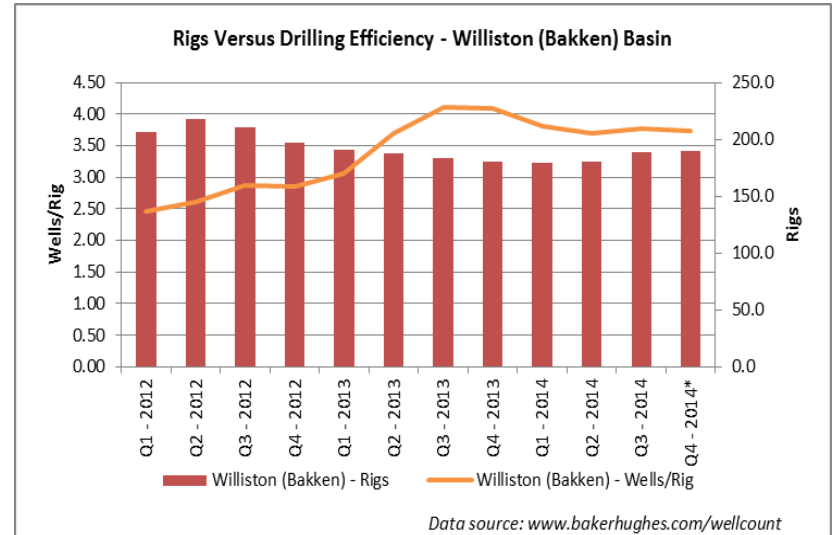
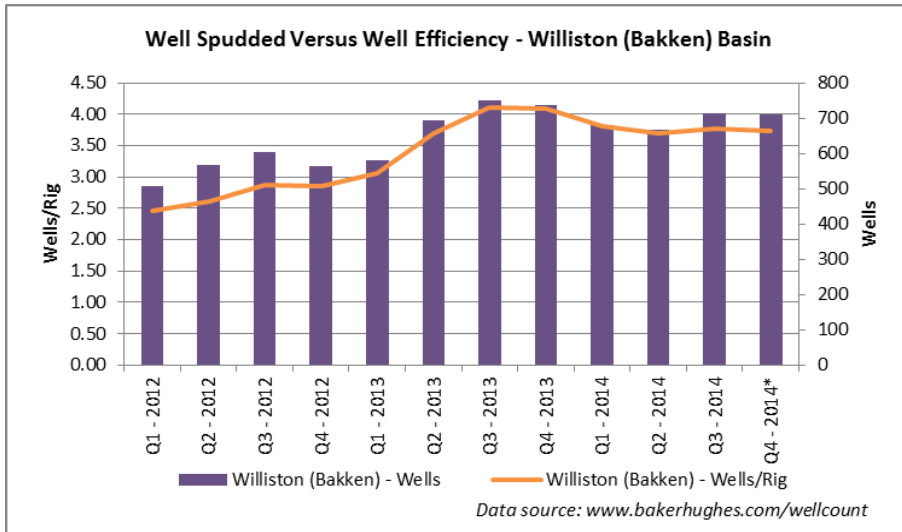
Drilling Efficiency – Select Shale Basins



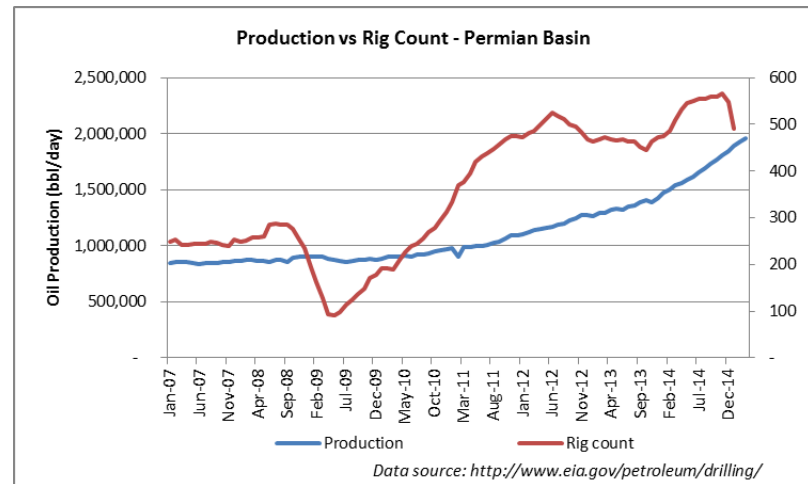
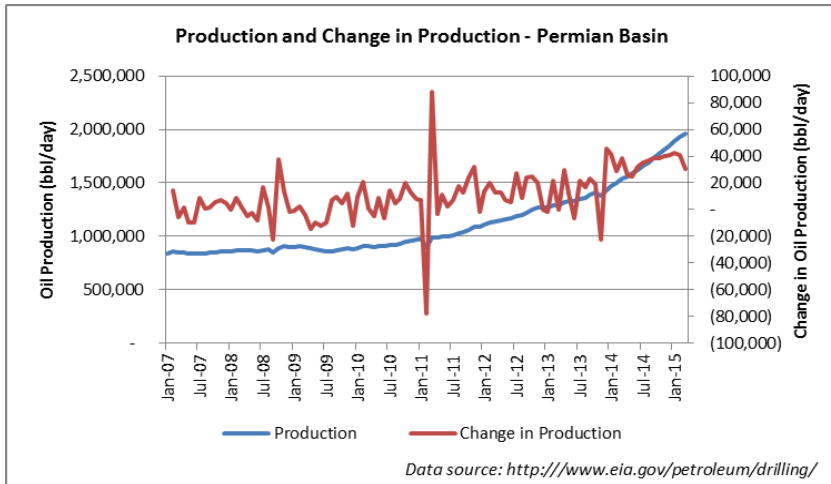
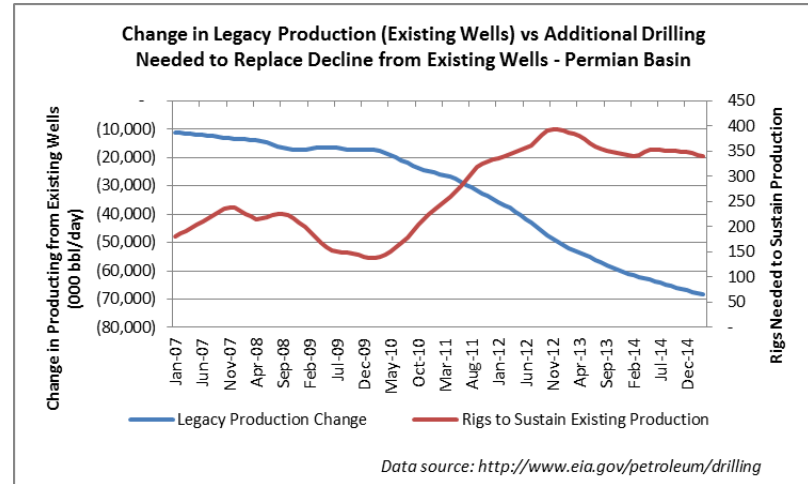
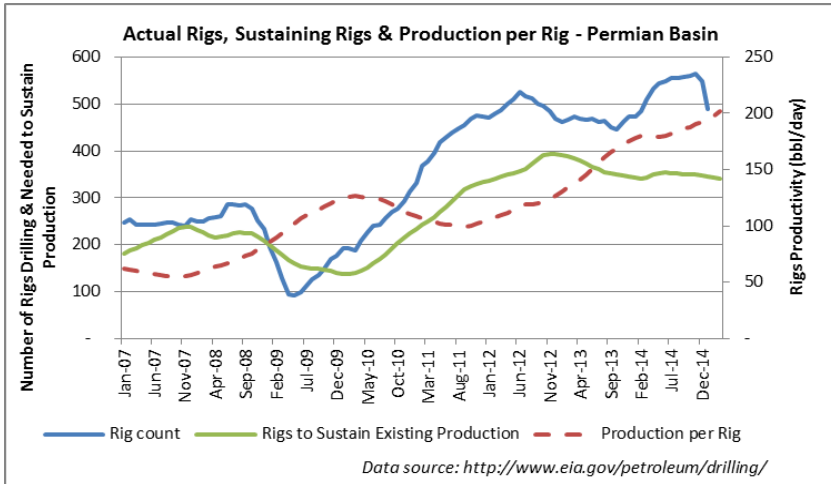
Shale Drilling Efficiency – Permian and Eagle Ford



Shale Drilling Efficiency – Bakken and Niobrara

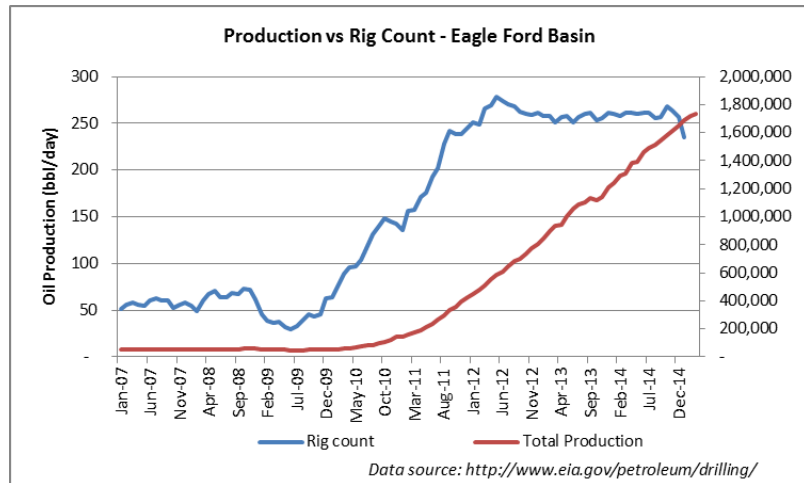
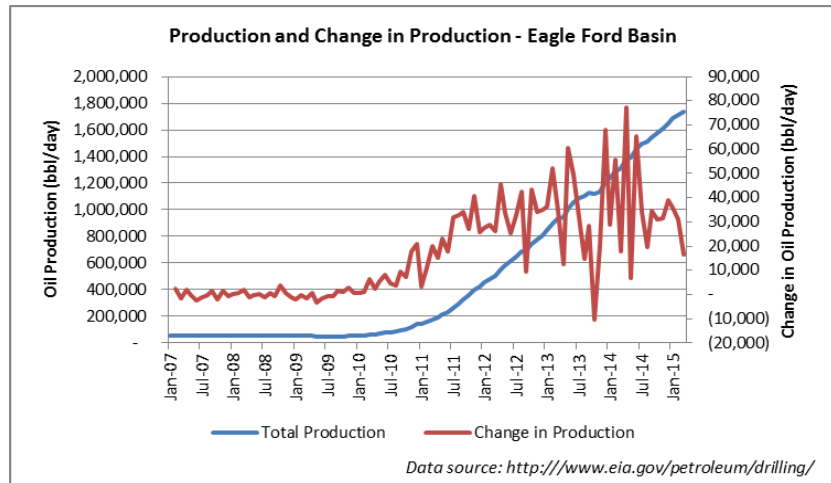
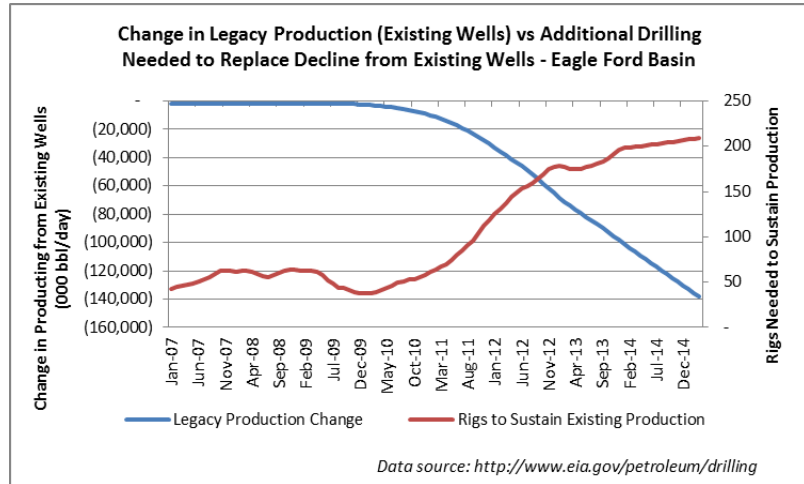
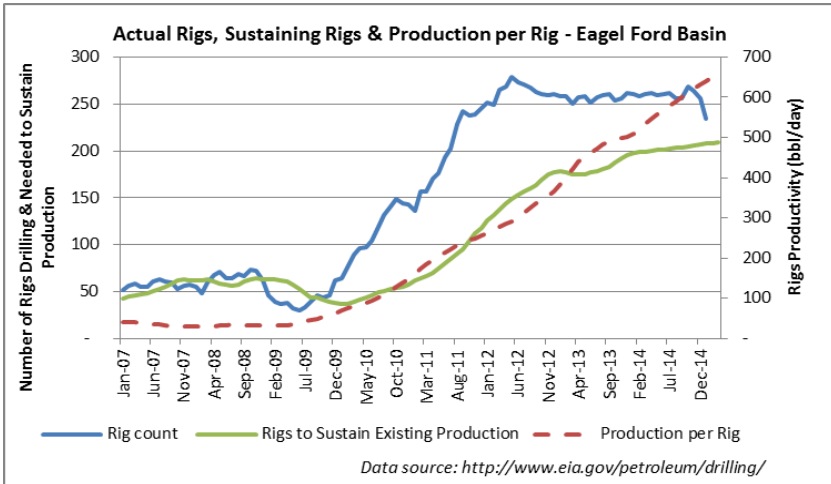


Permian Basin



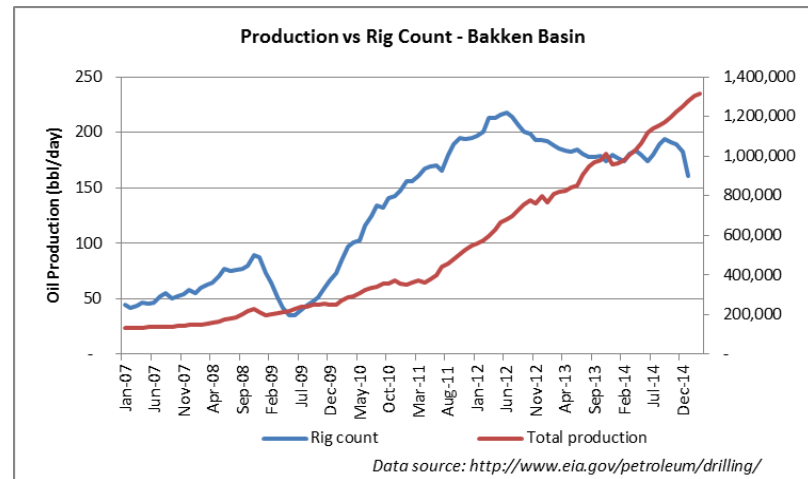
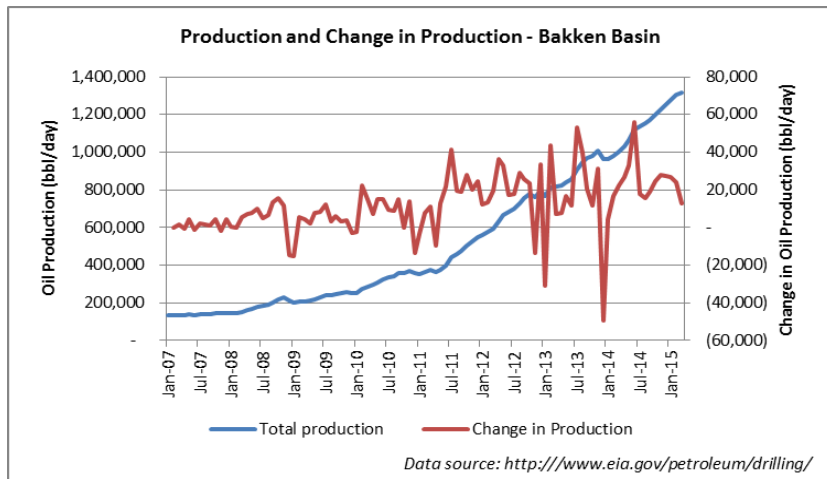
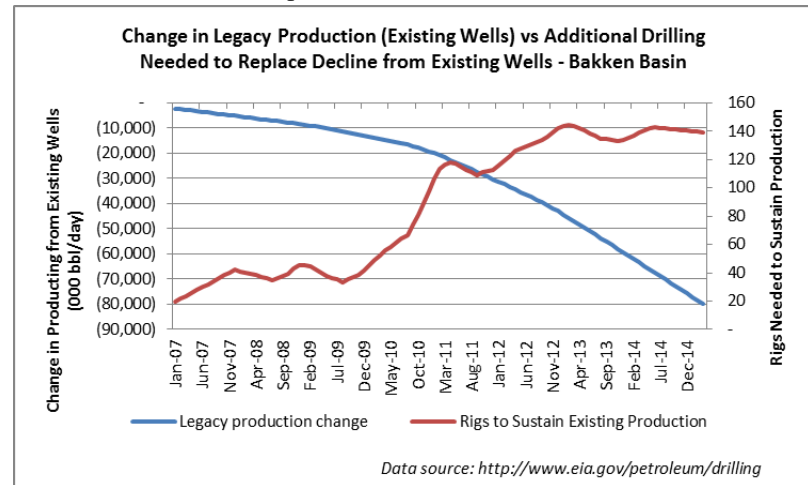
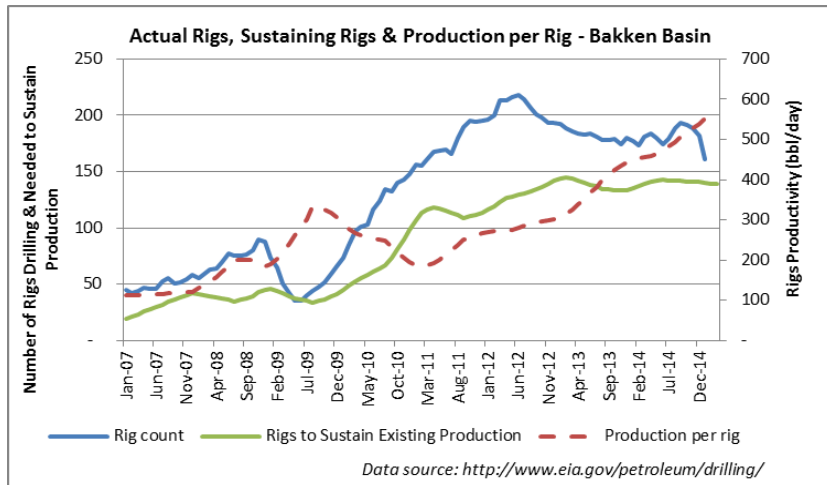
- Productivity increasing, Rig Count Falling, Production increasing but at a slower rate, Rig reduction not yet reflected in reduced production
- Significant drilling effort needed to sustain existing production, requiring cash flow or financing (both of which are reduced with low prices)

Eagle Ford Basin



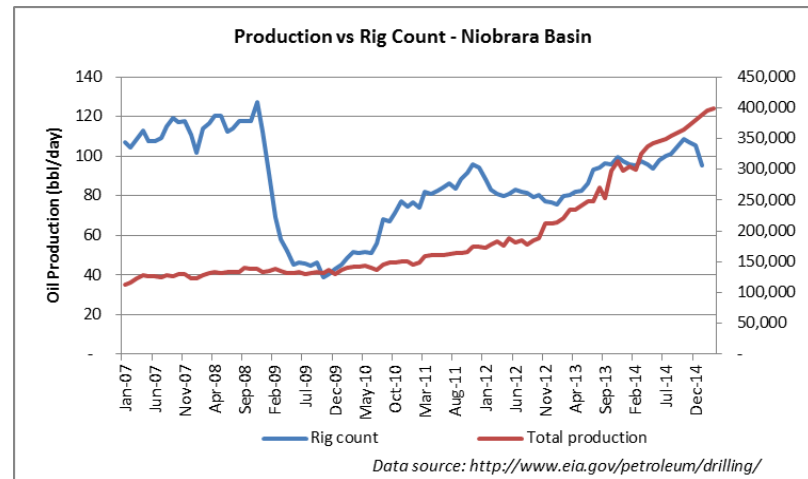
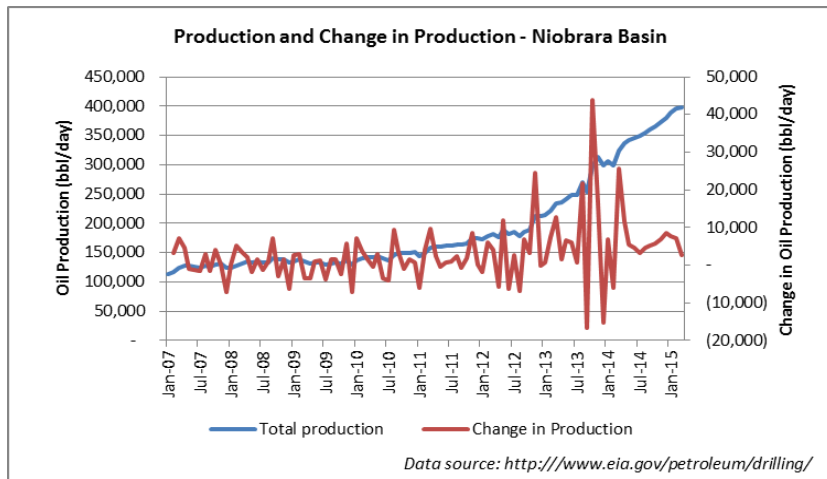
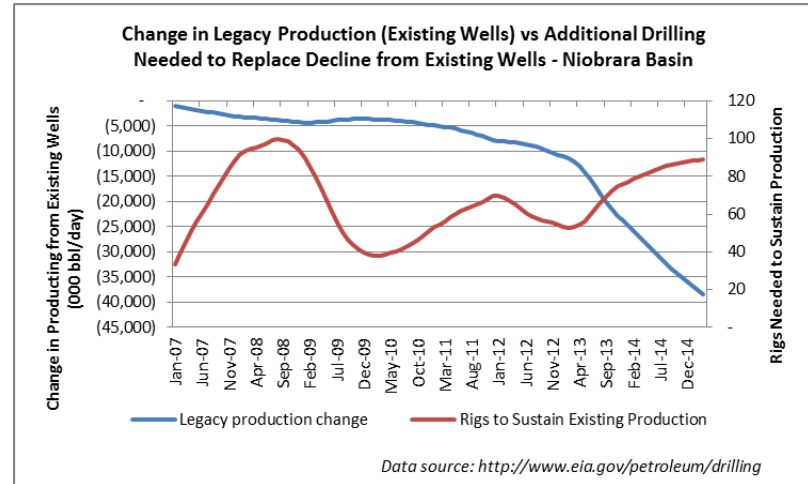
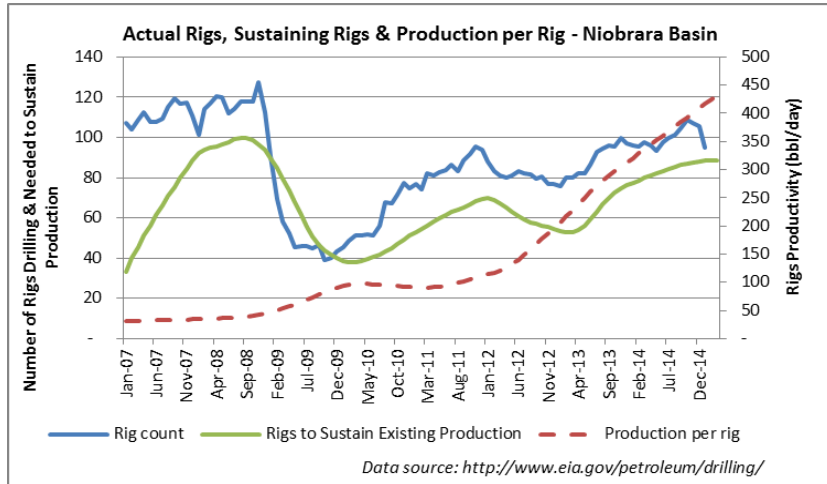
- Productivity increasing, Rig Count Falling, Production increasing but at a slower rate, Rig reduction not yet reflected in reduced production
- Significant drilling effort needed to sustain existing production, requiring cash flow or financing (both of which are reduced with low prices) – within 3 years nearly 50% of EUR already produced

Williston (Bakken) Basin



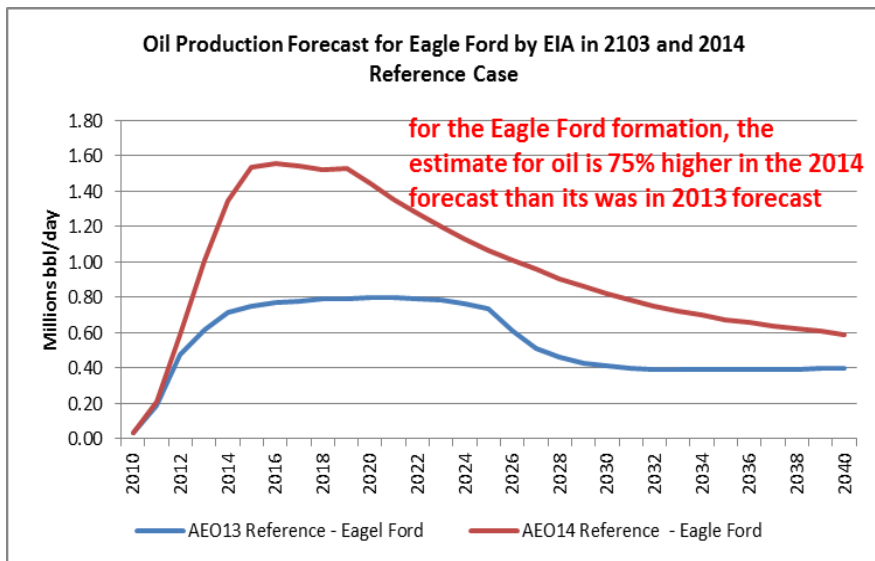
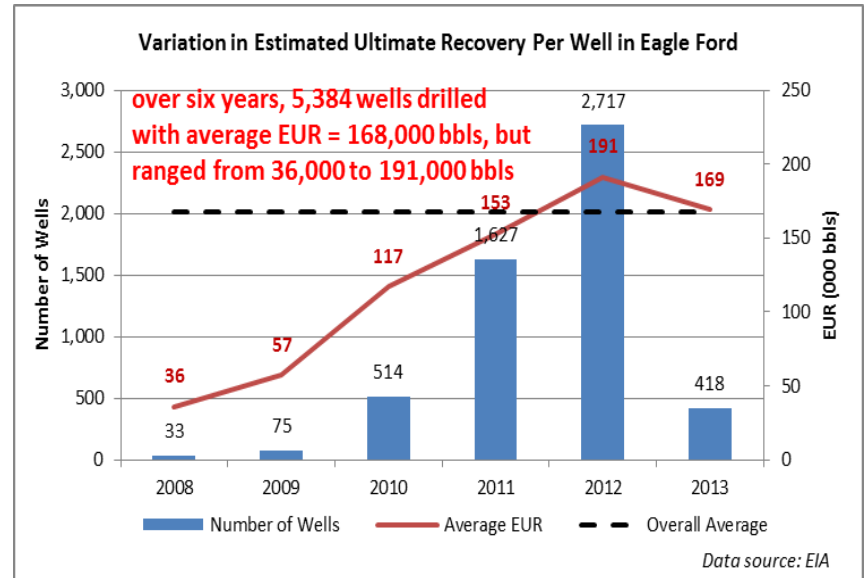
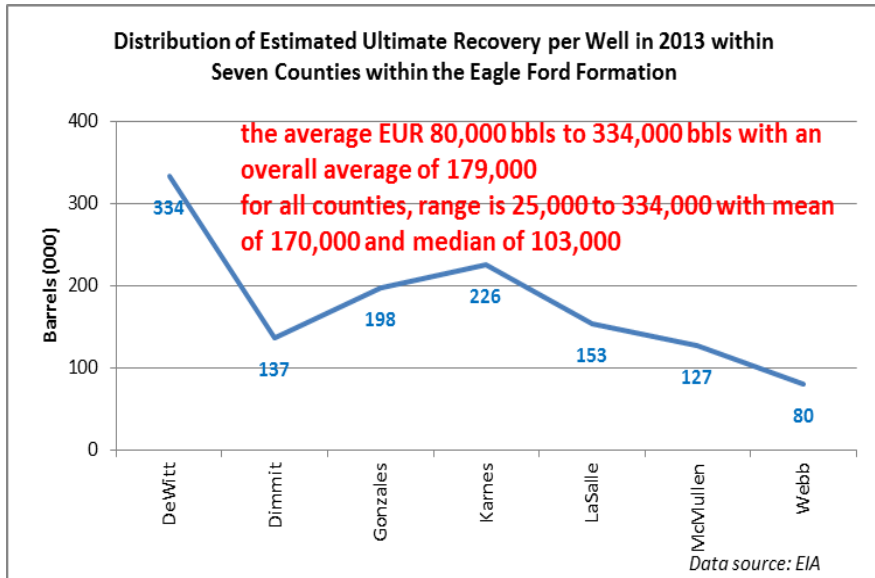
- Productivity increasing, Rig Count Falling, Production increasing but at a slower rate, Rig reduction not yet reflected in reduced production
- Significant drilling effort needed to sustain existing production, requiring cash flow or financing (both of which are reduced with low prices)

Niobrara Basin



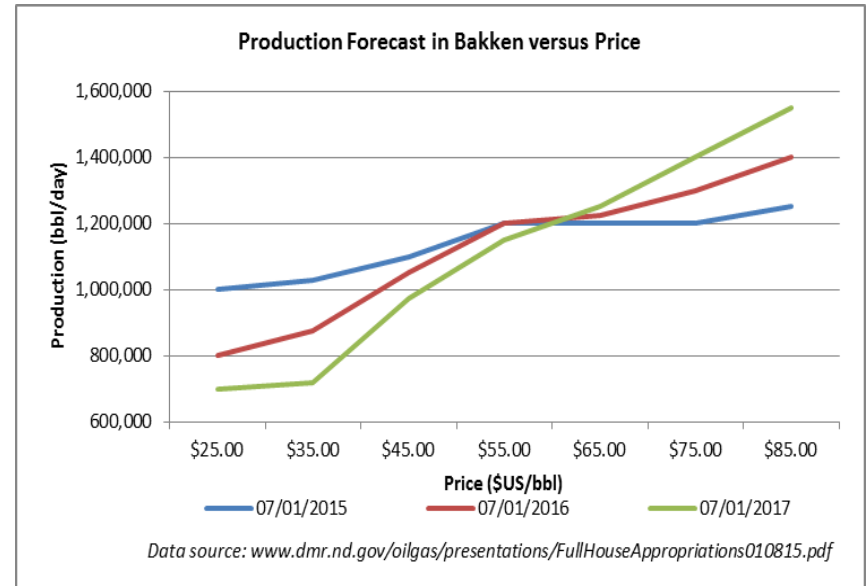
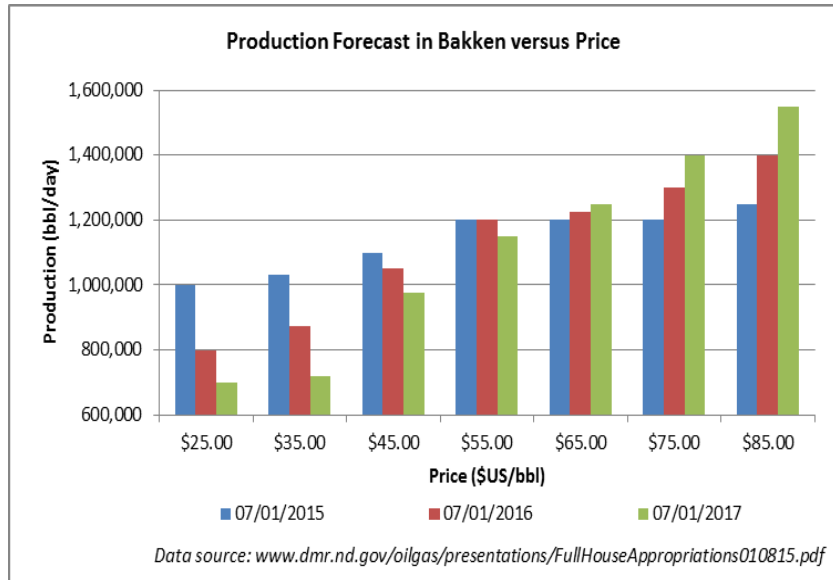
- Productivity increasing, Rig Count Falling, Production increasing but at a slower rate, Rig reduction not yet reflected in reduced production
- Significant drilling effort needed to sustain existing production, requiring cash flow or financing (both of which are reduced with low prices)

Substantial Variability in the Estimates



- EIA noted that for one well in Eagle Ford, they estimated EUR = 574,000 bbls with one year of data and when four years of data was available for the same well, the estimate dropped to 189,000 bbls
- Another well went from 105,000 to 224,000 bbls in going from one year to four years of data
- Because most well producing less than 3 years, EIA warns that EUR likely to change⁴⁰

Production Forecast in Bakken Influenced by Price



- Price changes have more dramatic impact with more time to react
- According to a presentation given by the Director of North Dakota Department of Mineral Resource to the state's House Appropriation Committee, \$55/bbl required to maintain production at 1.2 million bbls/day

Breakeven Price

Breakeven Prices - Conceptually

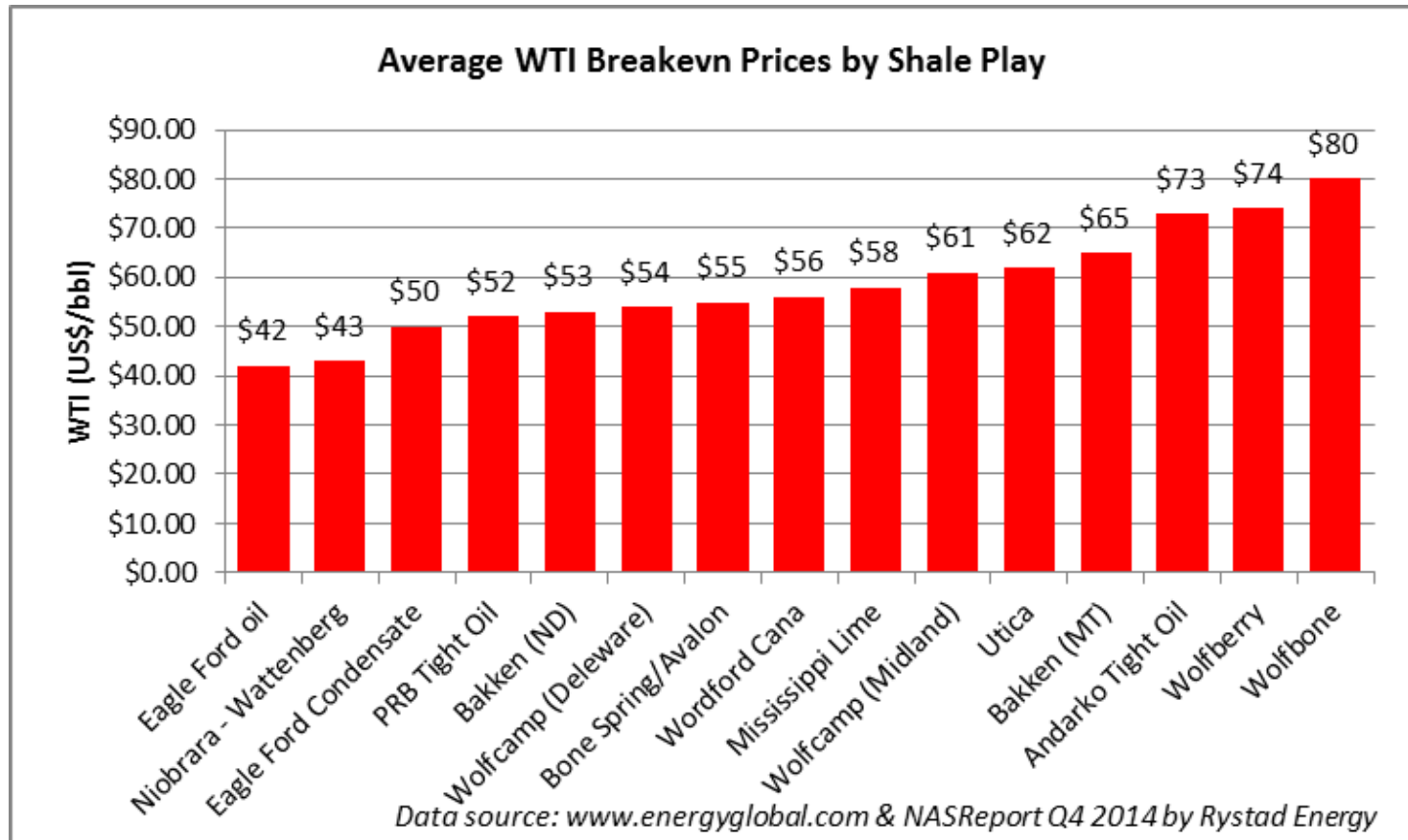
$$\frac{\sum_{t=0}^T P_B * (1 + \varepsilon) * Q_t - CAPEX_t - OPEX_t - Lease_t - Taxes_t}{(1 + r)^t}$$

$$P_B = \frac{\sum_{t=0}^T \frac{CAPEX_t + OPEX_t + Lease_t + Taxes_t}{(1 + r)^t}}{\sum_{t=0}^T \frac{(1 + \varepsilon) * Q_t}{(1 + r)^t}}$$

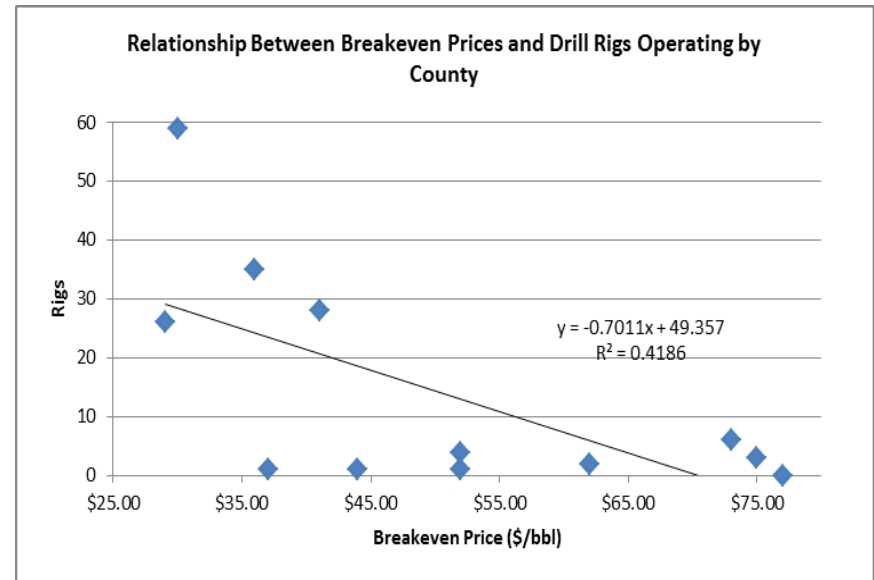
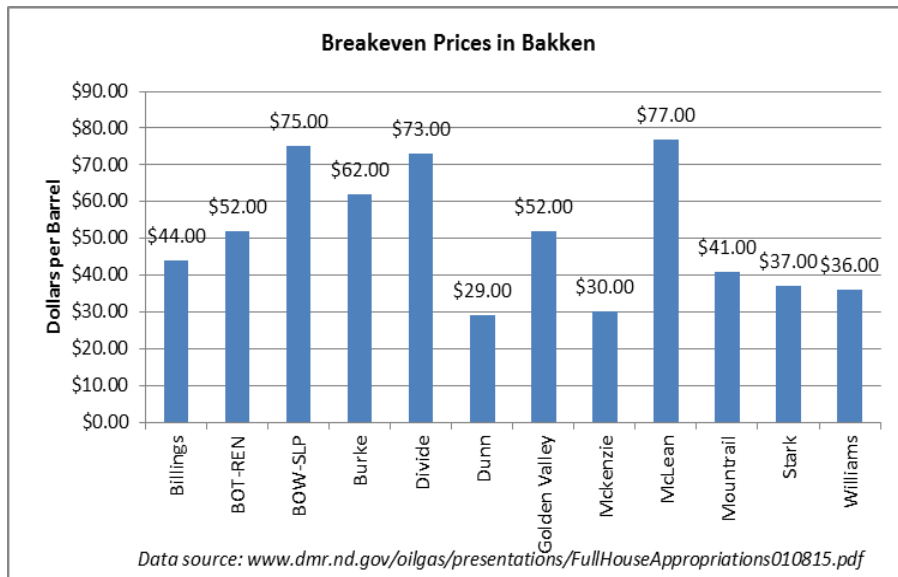
Given all the parameters that feed into a NPV calculation, what is the price that would have to prevail to ensure that the NPV just equals zero

Any price above that corresponds to profits and if prices are below that number and with sufficient adjustment time, operations would cease

Huge Variation in Breakeven Prices for Shale



Variation in Bakken for Breakeven Prices



According to a presentation given by the Director of North Dakota Department of Mineral Resource to the state's House Appropriation Committee, there is a large variation in breakeven prices in the Bakken – range from \$29/bbl to \$77/bbl

The shut down price for existing wells is estimated to be \$15/bbl

Inverse relationship between breakeven prices and drilling activity, most activity in lower cost counties

www.rystadenergy.com

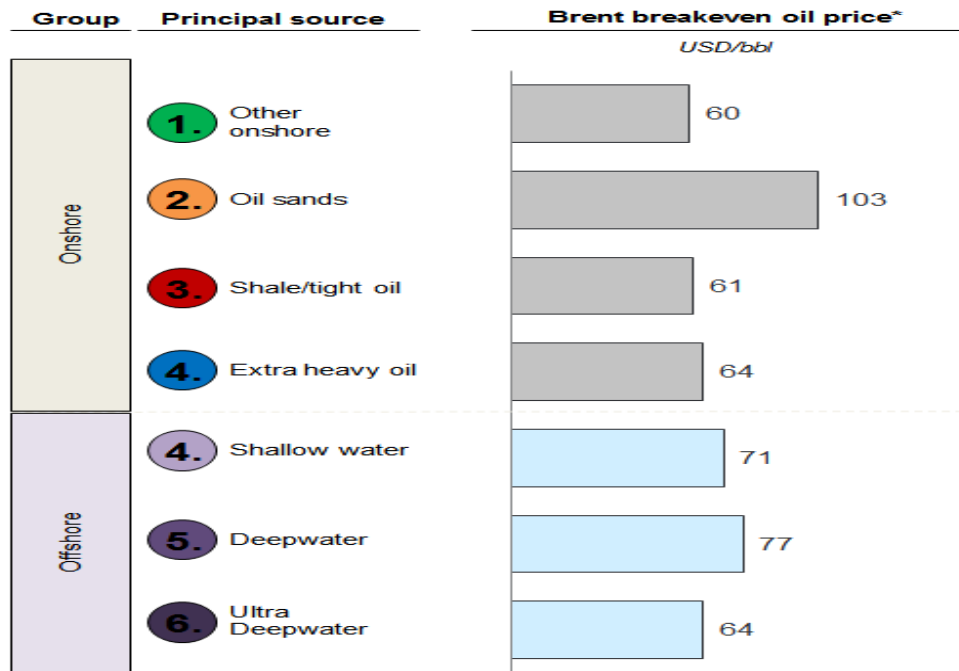


Figure 3: Breakeven prices for different sources of new production *Estimated are based on the 30 largest projects within each group expected to start up in the period 2014-2020 (Source: Rystad Energy UCube)

Rystad Energy believes that the long term oil price has to stay above 100 USD/bbl, if supply and demand should balance in 2020 (Feb 18, 2015)

Offshore will be the most important source of new production by 2020-25

Shale Efficiency

EOG Resources : Deferred Completions



oil price until completion, then \$65 thereafter. Note: Based on Eagle Ford West Type Well.

With high decline rates (50% depleted within 3 years) and about 33% drilling share costs and a 67% completion costs, it makes sense to drill , but delay completions in an environment where oil prices are expected to rise

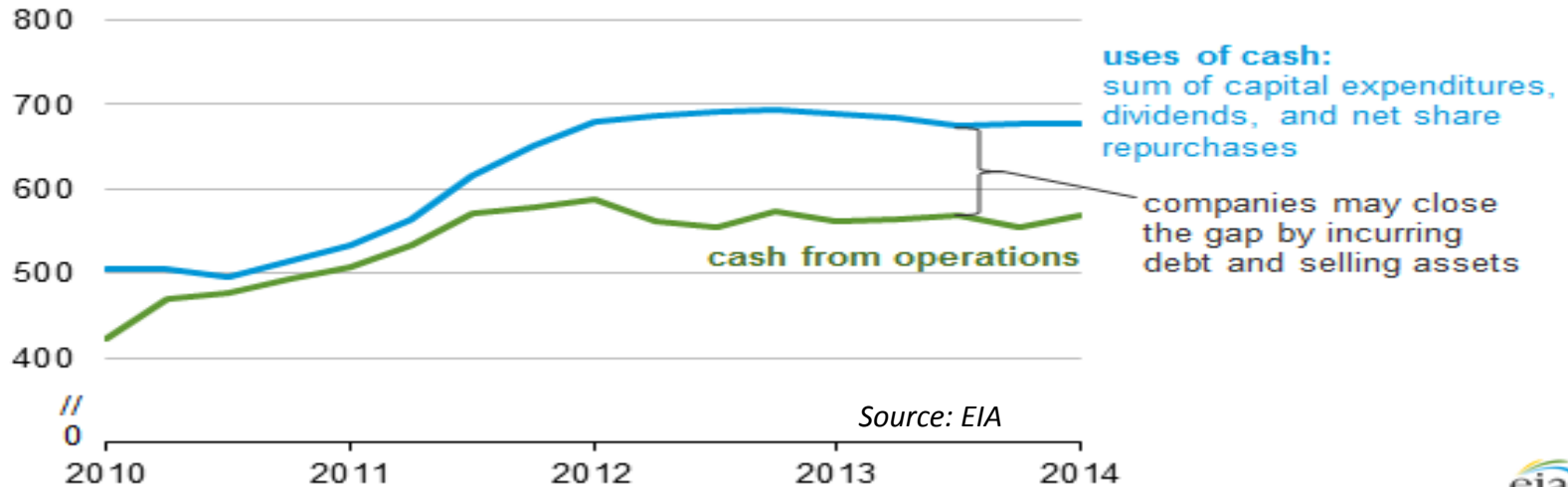
How is Efficiency Achieved

- Horizontal drilling – increase length of the horizontal lateral (in Bakken, typically 10,000 ft with 30 fracturing stages)
- Multiple-well pad drilling
- Walking drill rigs
- Utilizing adjacent leases
- Drilling in “sweet spots” which according to the EIA can be 10 times more productive than drilling in other parts of the play
- **EIA noted that ‘The easy improvements in tight oil well drilling and completion efficiency (e.g., longer laterals, pad drilling) have apparently been achieved; therefore, future improvement to existing technology are likely to occur at a more measured pace.’**
- **EIA noted that “as the high-productivity portions of the tight oil formations (i.e., sweet spots) are depleted, drilling activity will have to focus on the less-productive portions of the tight formations, requiring more well completions just to maintain oil production.”**

Shale Debt

Energy Debt Increasing

Major energy companies' cash from operations and uses of cash
billion 2014 dollars, annualized values from quarterly reports



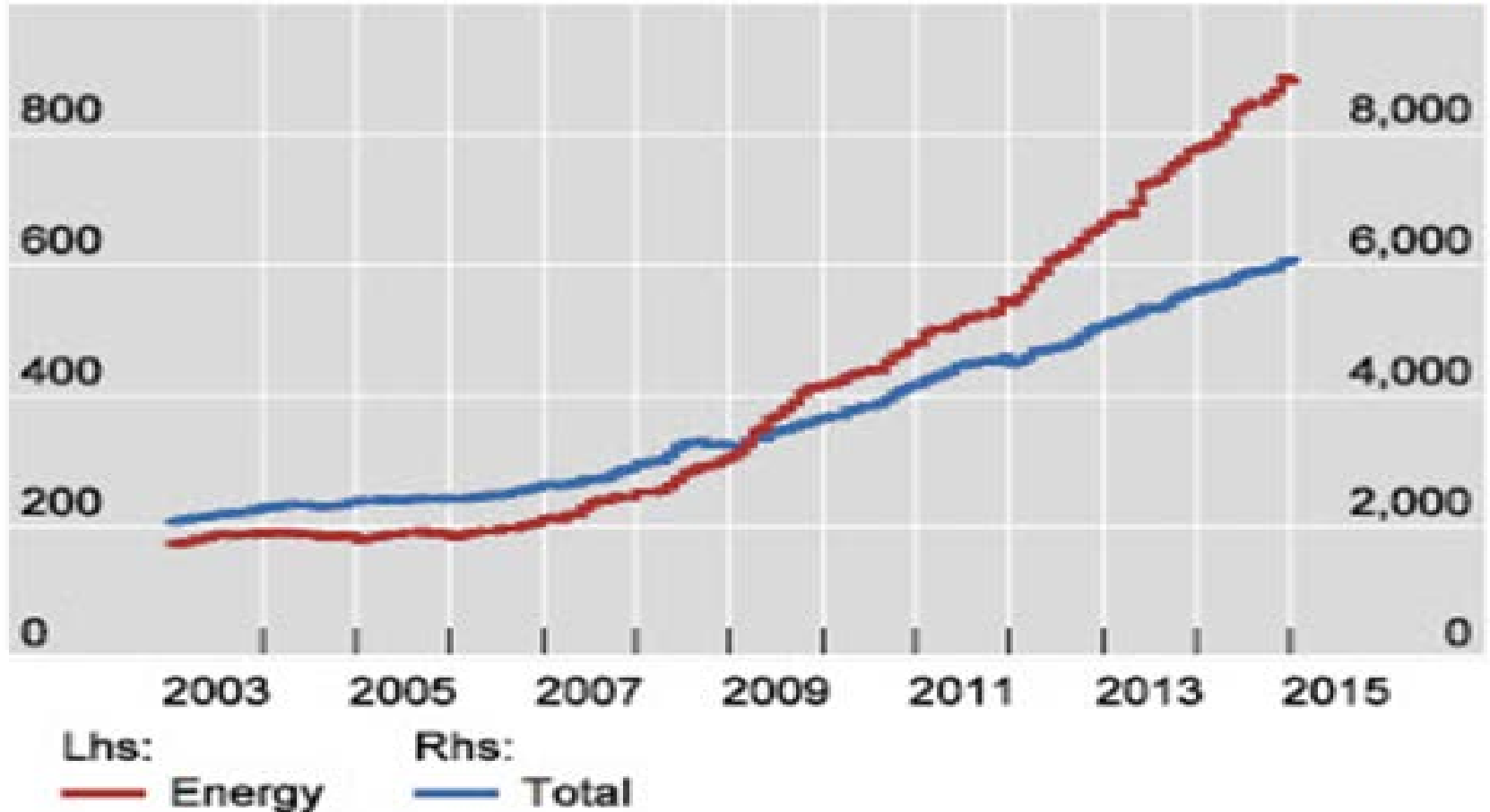
for the year ending March 31, 2014, the EIA reported on July 29, 2014 that cash from operations for 127 major oil and natural gas companies totaled \$568 billion, but their major uses of cash totaled \$677 billion, a difference of almost \$110 billion. This shortfall was filled through a \$106 billion net increase in debt and \$73 billion from sales of assets, which increased the overall cash balance.

The gap between cash from operations and major uses of cash has widened in recent years from a low of \$18 billion in 2010 to \$120 billion during the past three years.

Debt of Energy Companies is Growing

US dollar-denominated debt securities outstanding

USD bn



Source: Bank of International Settlements

Shale Debt (1)

- Deutsche Bank Dec 5, 2014: US Credit Strategy – Year ahead Outlook 2015 noted that the
- **presence of hedges** (future production sold forward) should allow some to maintain existing cash flow balance for some time even in this price environment.
- A **sustained drop in price beyond \$60/bbl** could put substantial pressure on viability of many US shale producers, although it **will take time to materialize**, as in the short run many producers could continue to maintain production levels taking only marginal costs into account.
- hedged near-term production and survival at marginal cost –
 - it is going to take low oil prices for longer before its negative impact fully filters through the system

Shale Debt (2)

- As reported on Bloomberg (Dec 10, 2014)
- “It’s been **super cheap**” for energy companies to obtain financing over the **past five years**, said Brian Gibbons, a senior analyst for oil and gas at CreditSights in New York. **Now**, companies with ratings of B or below are “**virtually shut out of the market**” and will have to “rely on a combination of asset sales” and their credit lines, he said.
- Deutsche Bank analysts predicted in a Dec. 8 report that about a third of companies rated B or CCC may be unable to meet their obligations should oil prices drop to \$55 a barrel.

Shale Debt (3)

- Wall Street Journal Jan 6, 2015 reported that
- American oil and gas companies have gone **heavily into debt** during the energy boom, increasing their borrowings by 55% since 2010, to almost \$200 billion. Their **need to service that debt** helps explain why U.S. producers plan to **continue pumping oil** even as crude trades for less than \$50 a barrel, down 55% since last June.
- But **signs of strain** are building in the oil patch, where **revenue growth hasn't kept pace with borrowing.**

HIS (Feb 3, 2005) press release

- HIS (Feb 3, 2005) forecast that by latter half of 2015, oil production will flatten
- Hedging programs, finishing work on uncompleted well, contractual obligations and further drilling of the most economic tight oil plays mean that many new wells will still be drilled in 2015. But adverse economics and lower spending will lead to fewer wells drilled than in 2014
- About 25% of wells drilled in 2014 had a WTI breakeven price of \$40 or less, just less than 50% of new wells in 2014 had a breakeven price of \$60 or less and nearly 30% of new wells had a breakeven price of \$81 or higher

Conclusion (1)

- Price drop driven by shale production
- Adjustment delayed by licencing, sweet spots, hedging, and efficiency gains
- Price will recover as demand recovers and that has started (China, Europe and Japan)
- As demand recovers, higher marginal cost of production sources will have to be used
 - The full cycle cost of new oil sands will be in the range of \$100 US/bbl and other marginal sources are in that range
- The slowdown in Alberta will have a dramatic and substantial impact on NL through reduced demand for labour

Conclusion (2)

- It may take two years for prices to recover, but we should start to see noticeable changes by the middle of 2015
- Things are getting better and we should not let short-term problems dictate long-term actions
- I would expect prices to be back in the \$100/bbl within the next three years
- **While we should be concerned, we should not be overly paranoid. The world is not falling apart and the future looks bright for NL**

Thank you