

Years Not Decades: Proven Reserves and the Shale Revolution

The Apparent End of The Beautiful Story

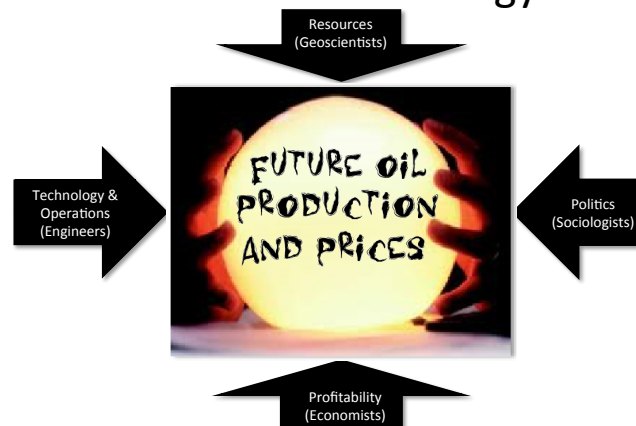
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The Reality of Years, Not Decades, of Shale Gas and Tight Oil

- The current oil price collapse is because the world can't afford tight oil—or ultra-deep water oil and heavy oil.
- Oil and gas from shale is called unconventional, a euphemism for expensive: neither is commercial at current prices.
- Shale plays have added years, not decades, to domestic oil and gas supply.
- The U.S. is not a global oil and gas super-power based on proven reserves.
- There is no revolution: it is a final, desperate effort to squeeze the last remaining petroleum from the worst possible rock.
- 8 years of shale gas proven plus proven-undeveloped reserves in the U.S.
- 3 years of tight oil proven plus proven-undeveloped reserves in the U.S.
- Both will peak in the next 10 years if demand for expensive oil returns.
- Current policy favors export of both oil and gas based on a belief in abundance.
- This will both hasten and accentuate the difficult energy and economic circumstances of the next decade.



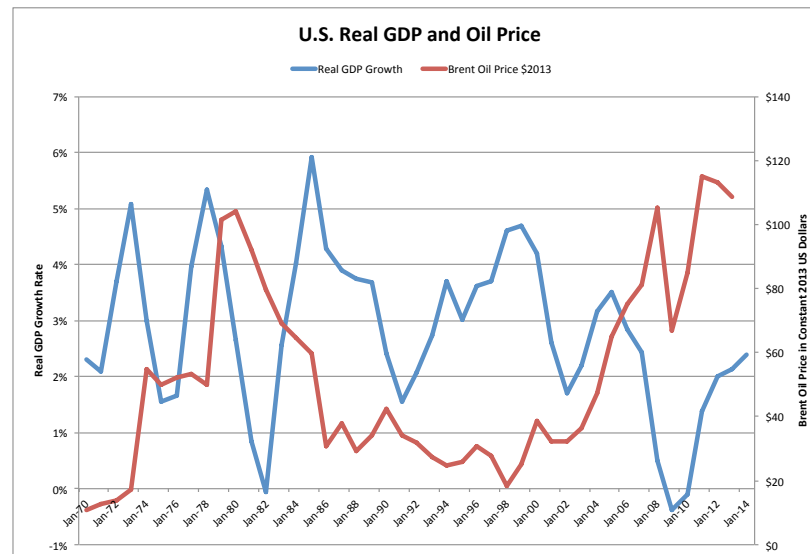
The Beautiful Story: Energy Independence & American Global Dominance

- Production from shale is a revolution that has changed everything.
- The U.S. is now the largest producer of natural gas and petroleum liquids in the world.
- There are at least 100 years of natural gas supply and decades of tight oil supply.
- The U.S. will use its endless oil and gas resources to re-assert dominance in the world.
- It will challenge Russian power and aggression by exporting natural gas to Europe and Ukraine, and export natural gas to Asia.
- U.S. tight oil production has transformed the U.S. economy and makes us less dependent on Saudi Arabia and other Middle Eastern countries.
- Discussions with Iran may alienate other allies in the region but, since we no longer need their oil, it doesn't matter.
- Shale gas has re-invigorated American manufacturing and petrochemical production.
- The problem is that it costs more than the market can bear.



A Framework for U.S. Shale Gas and Tight Oil & The Current Oil Price Crisis

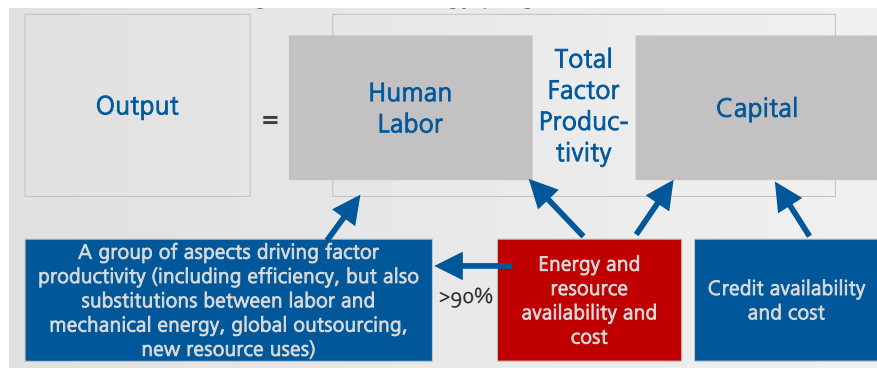
- Energy *is* the economy.
- Currency is a call on work-energy.
- Energy resources are the capital account behind currency.
- The economy can grow as long as there is surplus affordable energy in that account.
- The economy will stop growing when there is only enough surplus affordable energy to meet basic needs.
- The U.S. cannot break out of the Great Recession because there is not enough surplus affordable energy.



Source: EIA, mtpl.com

A Framework for U.S. Shale Gas and Tight Oil & The Current Oil Price Crisis

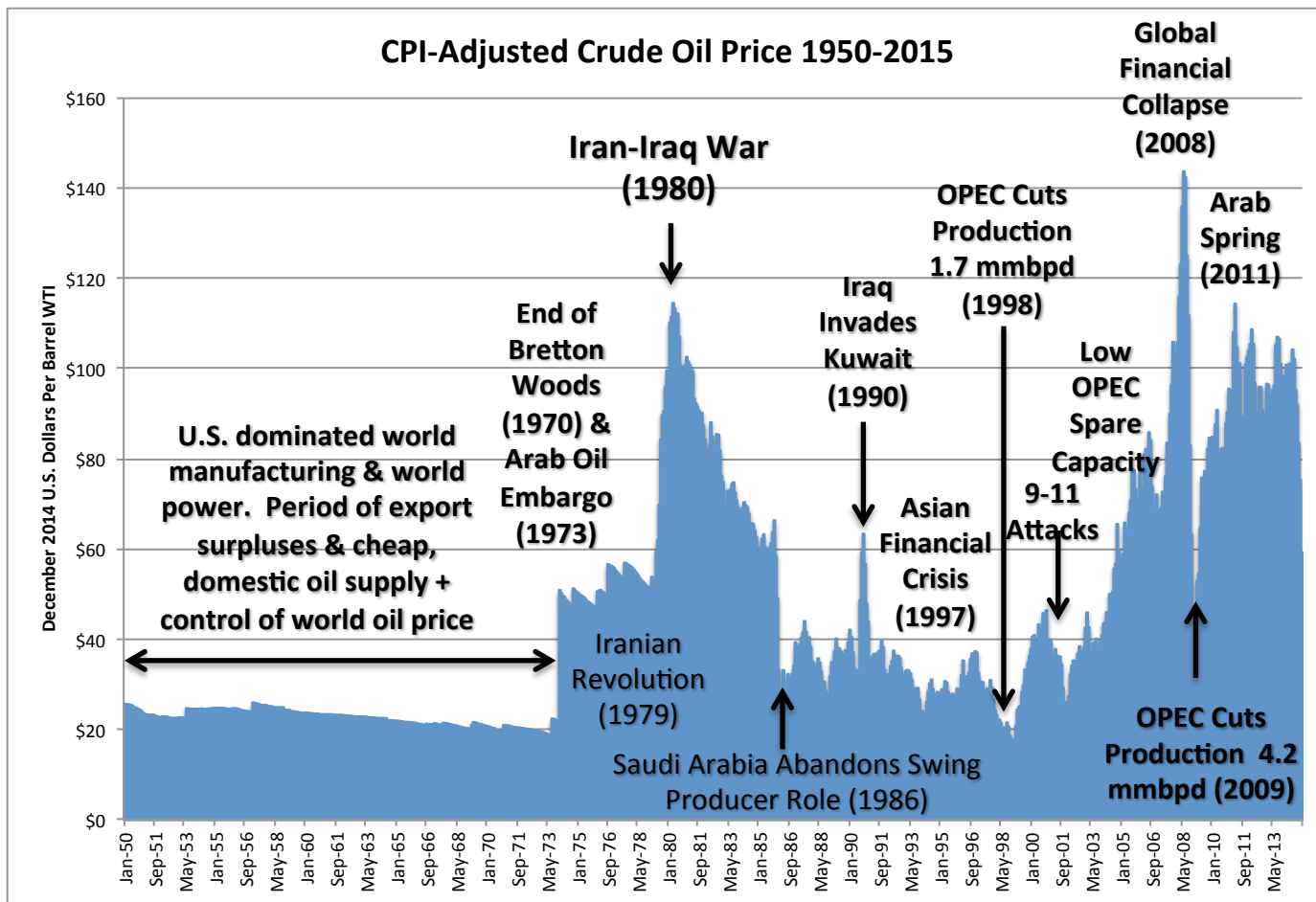
- The American success story is based on a unique period from 1945-1970:
 - After WWII, the U.S. had no rivals for manufacturing and world export,
 - The U.S. dominated world power, naval and air transport,
 - The U.S. was energy self-sufficient with spare production capacity and controlled world oil price through the Texas Railroad Commission's system of allowable production.
- By the mid-1960s, Germany and Japan recovered and challenged U.S. manufacturing.
- U.S. oil production peaked in 1970 and price control was ceded to OPEC.
- In 1971, Nixon took the U.S. off of the gold standard by abrogating the Bretton Woods Accord. The rest of the members of the Accord followed and a massive devaluation of global currency increased oil prices 2.5 x in one year and 5.5 x in 5 years.
- The world and its economy would never be the same.



Source: IIER



The End of Normal: James Kenneth Galbraith



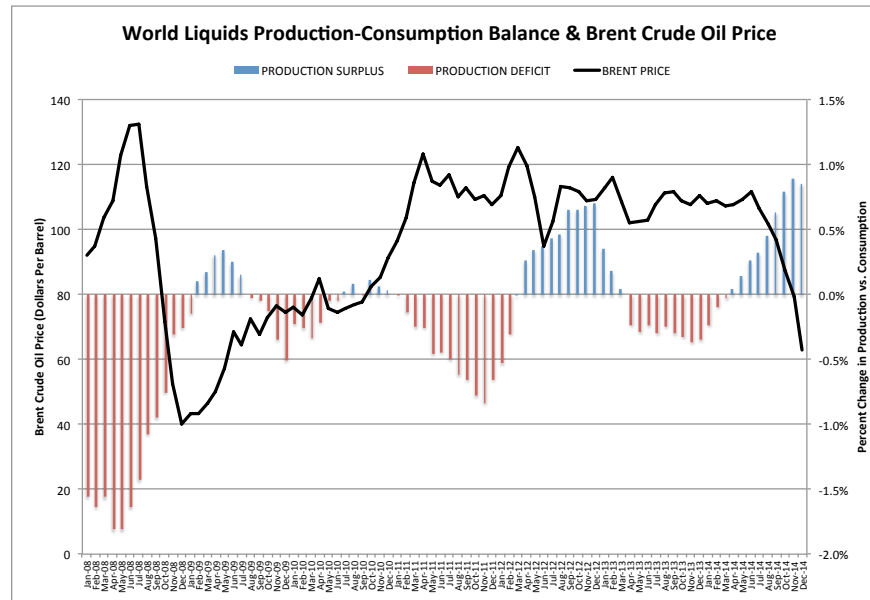
Source: EIA, Dow Jones, Inflationdata.com

1974: Credit Alert.

1979-1980: Credit Downgrade.

2008: Bankruptcy Proceedings Began.

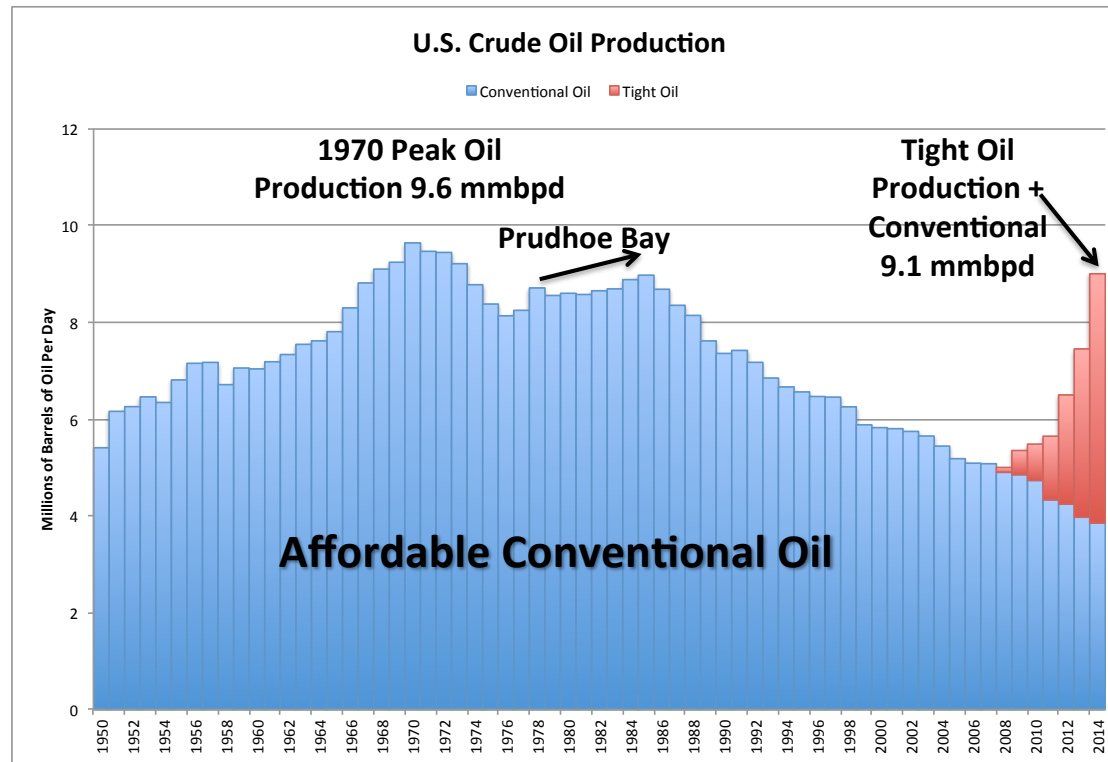
The Choke-Chain: Net Energy Scarcity Characterized by ~ 12-Month Cycling



Source: EIA

- Supply Deficit → Price increase to demand limit → Incentive to over-produce → Demand destruction → Production surplus → Price drop → Producers cut back → Supply deficit → Price Increase.
- Chronic scarcity of affordable energy, 2007-Present:
 - resource costs become significant and doubts about price cycling limit investment spending,
 - Net scarcity persists once established because of uncertainty.
- Service costs increase faster than product price during high-price cycles.
- The choke chain is why neither price or technology is a solution to more energy: high price and the cost of technology trigger the choke chain.

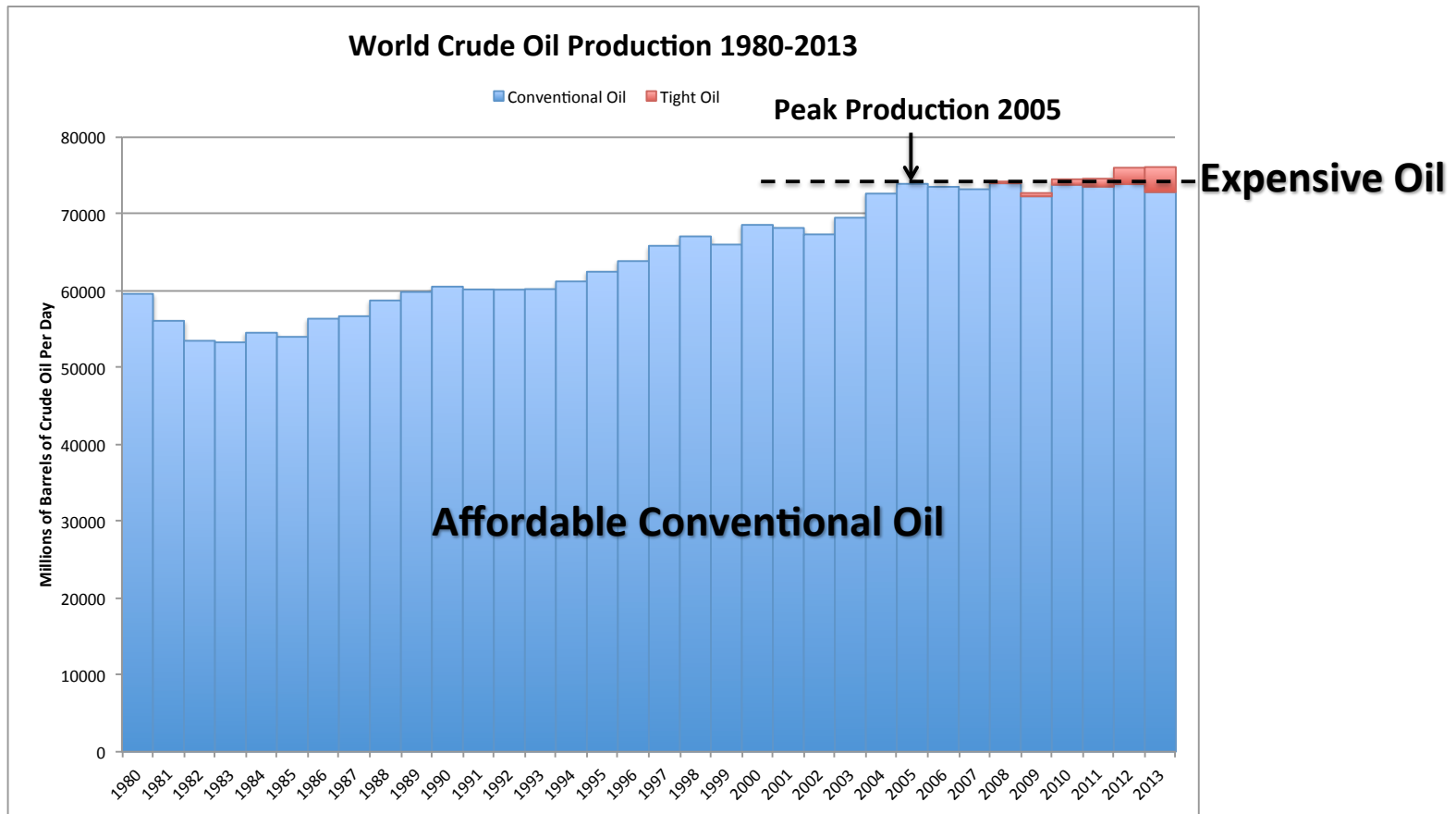
The End of Peak Oil?



Source: EIA

- The observation of Peak Oil: once affordable conventional production peaks, supply will become increasingly dependent on more expensive, lower quality sources of oil.
- ...Like shale, deep-water, and tar sands.
- It looks like Peak Oil is batting 1000!

The End of Peak Oil?



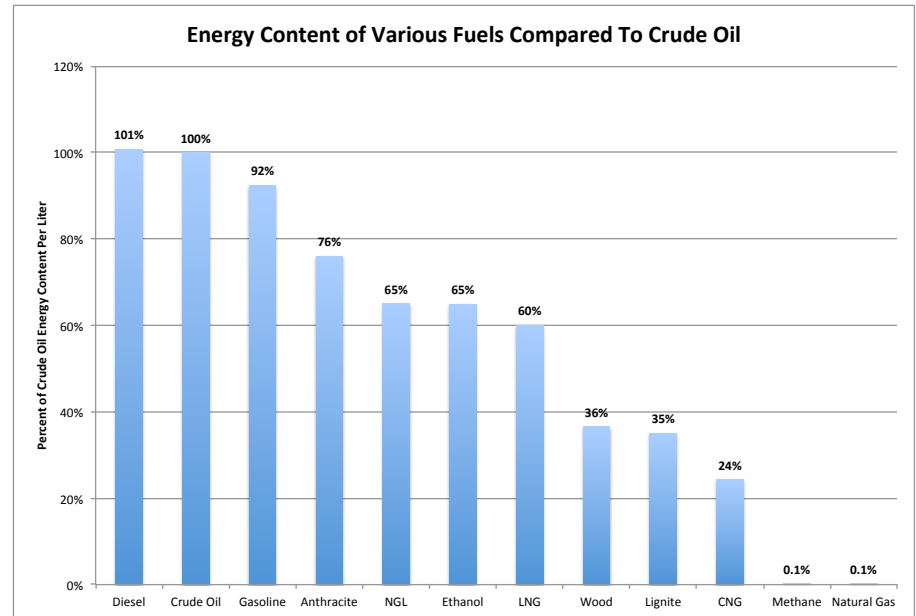
Source: EIA

- World conventional production probably peaked in 2005.
- Tight oil and deep-water production will continue for another decade.

Not All Energy Is Equal

| | Net Energy |
|-----------------------|------------|
| Oil (Saudi Arabia) | 100:1 |
| Coal | 50:1 |
| Hydroelectric | 30:1 |
| Oil (Global Average) | 30:1 |
| Wind | 18:1 |
| Wave | 15:1 |
| Natural Gas | 10:1 |
| Nuclear | 10:1 |
| Shale Gas & Tight Oil | 9:1 |
| Geothermal | 8:1 |
| Solar PV | 7:1 |
| Oil Sands | 6:1 |
| Biofuels | 3:1 |
| Solar Thermal | 2:1 |

Source: Heinberg and Barnatt



Source: EIA

- Net energy from shale gas and tight oil is less than from wind and only slightly more than from solar PV.
- BTU content of natural gas liquids is <65% of crude oil or gasoline.
- BTU content of natural gas is <1% of crude oil or gasoline on a volume basis and only 24% as CNG and 60% as LNG.

Shale Gas and Tight Oil Proven Reserves

| SHALE GAS | | | | | | |
|------------------------|--------------|------------|--------------|------------|---------------|---------------|
| TCF GAS | PDP | PDP YRS | PUD | PUD YRS | PDP + PUD | PDP + PUD YRS |
| TOTAL SHALE GAS | 164 | 6.3 | 69 | 2.7 | 234 | 9.0 |
| MARCELLUS | 65 | 2.5 | 29 | 1.1 | 94 | 3.6 |
| BARNETT | 26 | 1.0 | 6 | 0.2 | 32 | 1.2 |
| EAGLE FORD | 17 | 0.7 | 9 | 0.3 | 26 | 1.0 |
| HAYNESVILLE | 16 | 0.6 | 7 | 0.3 | 24 | 0.9 |
| WOODFORD | 13 | 0.5 | 10 | 0.4 | 22 | 0.9 |
| FAYETTEVILLE | 12 | 0.5 | 5 | 0.2 | 17 | 0.7 |
| BAKKEN | 5 | 0.2 | 4 | 0.1 | 9 | 0.3 |
| OTHER | 10 | 0.4 | ? | ? | 10 | 0.4 |
| | | | | | | |
| TIGHT OIL | | | | | | |
| MMBO & CONDENSATE | PDP | PDP YRS | PUD | PUD YRS | PDP + PUD | PDP + PUD YRS |
| TOTAL TIGHT OIL | 9,560 | 1.7 | 7,976 | 1.4 | 18,019 | 3.3 |
| BAKKEN | 4,844 | 0.9 | 3,382 | 0.6 | 8,226 | 1.5 |
| EAGLE FORD | 4,177 | 0.8 | 2,680 | 0.5 | 6,857 | 1.2 |
| PERMIAN | 335 | 0.1 | 1,819 | 0.3 | 2,154 | 0.4 |
| MARCELLUS | 129 | 0.0 | 51 | 0.0 | 180 | 0.0 |
| BARNETT | 58 | 0.0 | 44 | 0.0 | 102 | 0.0 |
| NIOBRARA | 17 | 0.0 | ? | ? | 17 | 0.0 |
| OTHER | 483 | | ? | ? | 483 | 0.1 |

Source: EIA

- How can these volumes and years of supply be reconciled with the expectations promoted by the oil and gas industry, politicians and press?
- Reserves are volumes at a certain price—oil reserves will fall in 2015.

New Reserve Additions For Shale Gas & Tight Oil Were Insignificant in 2013

| 2013 SHALE GAS PROVEN RESERVES | BCF |
|--|-------------|
| New Field Discoveries | 16 |
| Marcellus-Utica (KY-TN-OH) | 16 |
| New Reservoir Discoveries in Old Fields | 1113 |
| Woodford | 424 |
| Marcellus-Utica | 312 |
| Permian | 4 |
| Barnett | 338 |
| Eagle Ford | 29 |
| Bakken | 3 |
| Niobrara | 3 |

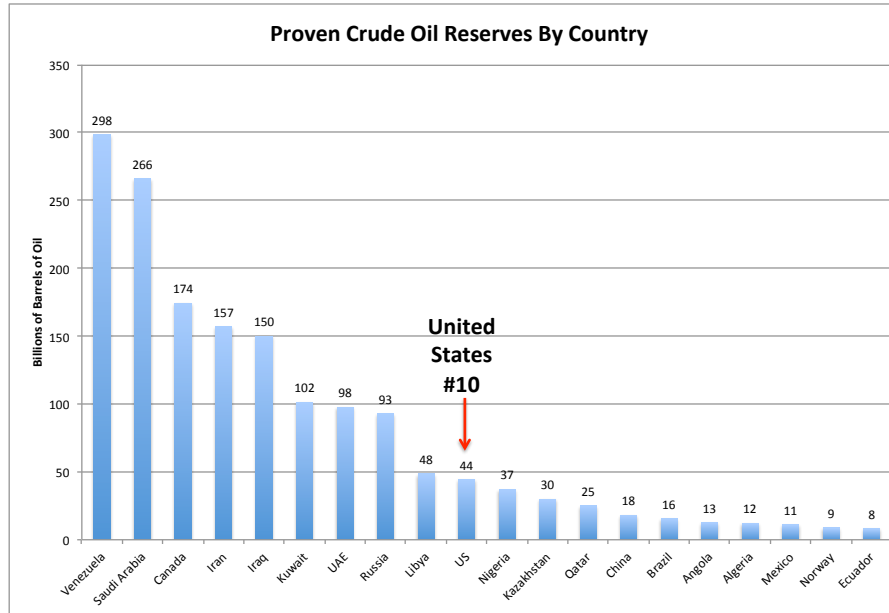
Source: EIA

| 2013 TIGHT OIL PROVEN RESERVES | Mmbo |
|--|------------|
| New Field Discoveries | 9 |
| Bakken | 4 |
| Eagle Ford | 3 |
| Niobrara-Mancos | 1 |
| Woodford | 1 |
| New Reservoir Discoveries in Old Fields | 170 |
| Permian | 75 |
| Woodford | 34 |
| Eagle Ford | 26 |
| Niobrara-Mancos | 18 |
| Bakken | 13 |
| Marcellus-Utica | 3 |
| Barnett | 1 |

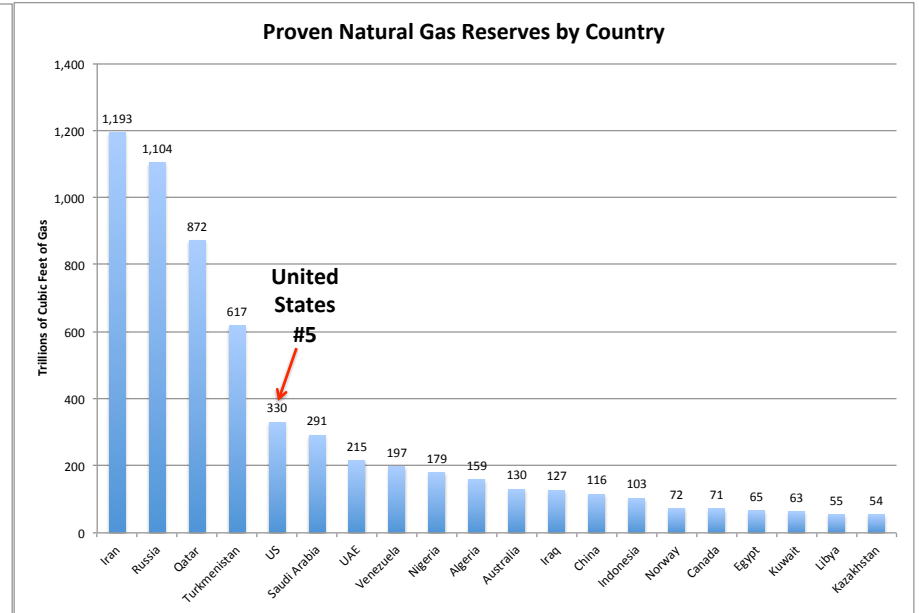
Source: EIA

- All changes for natural gas reserves were because of higher price only.

The United States is Not an Oil or Gas Super Power



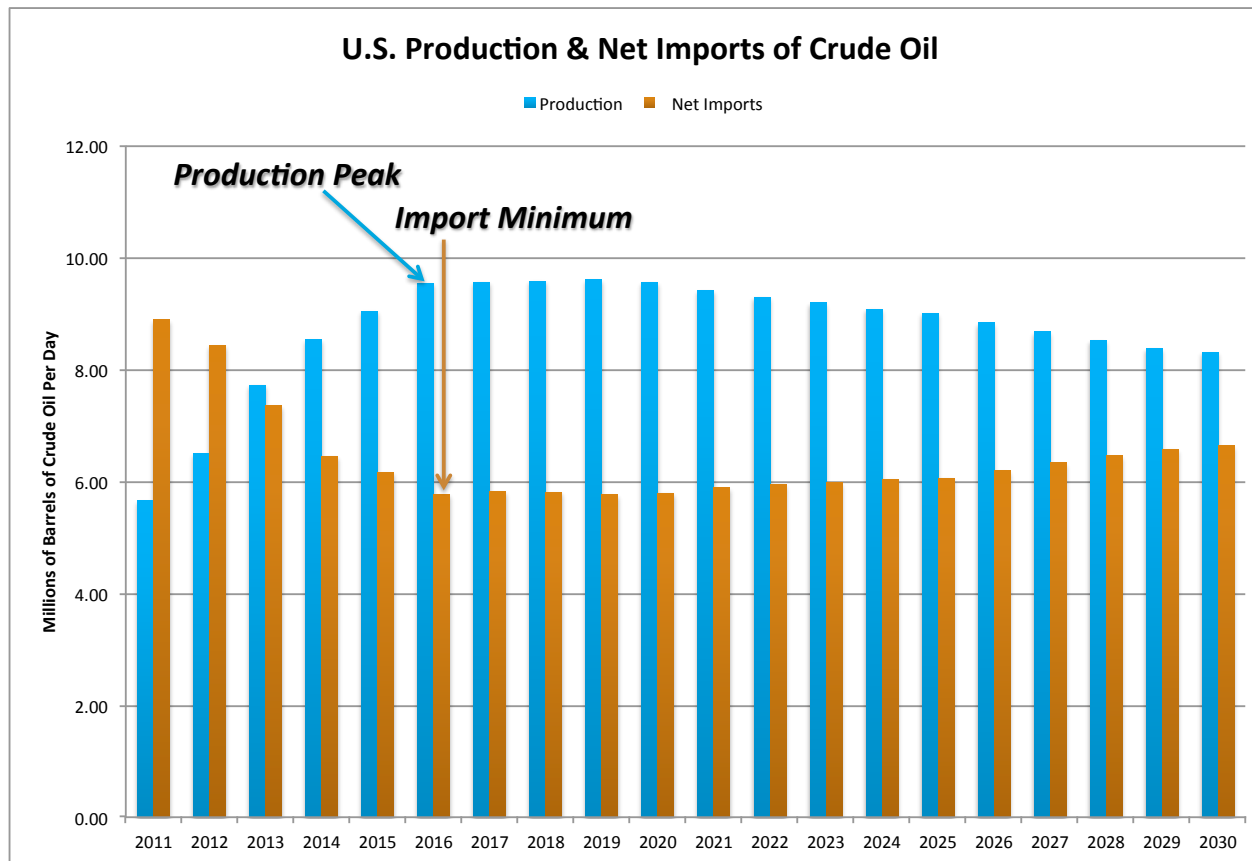
Source: BP



Source: BP

- The U.S. is 10th in oil reserves including tight oil.
- It may produce more oil than Saudi Arabia for awhile but reserves are only 17%.
- It is a long 5th in natural gas.
- U.S. gas reserves are 53% of #4 Turkmenistan & 38% of #3 Qatar.

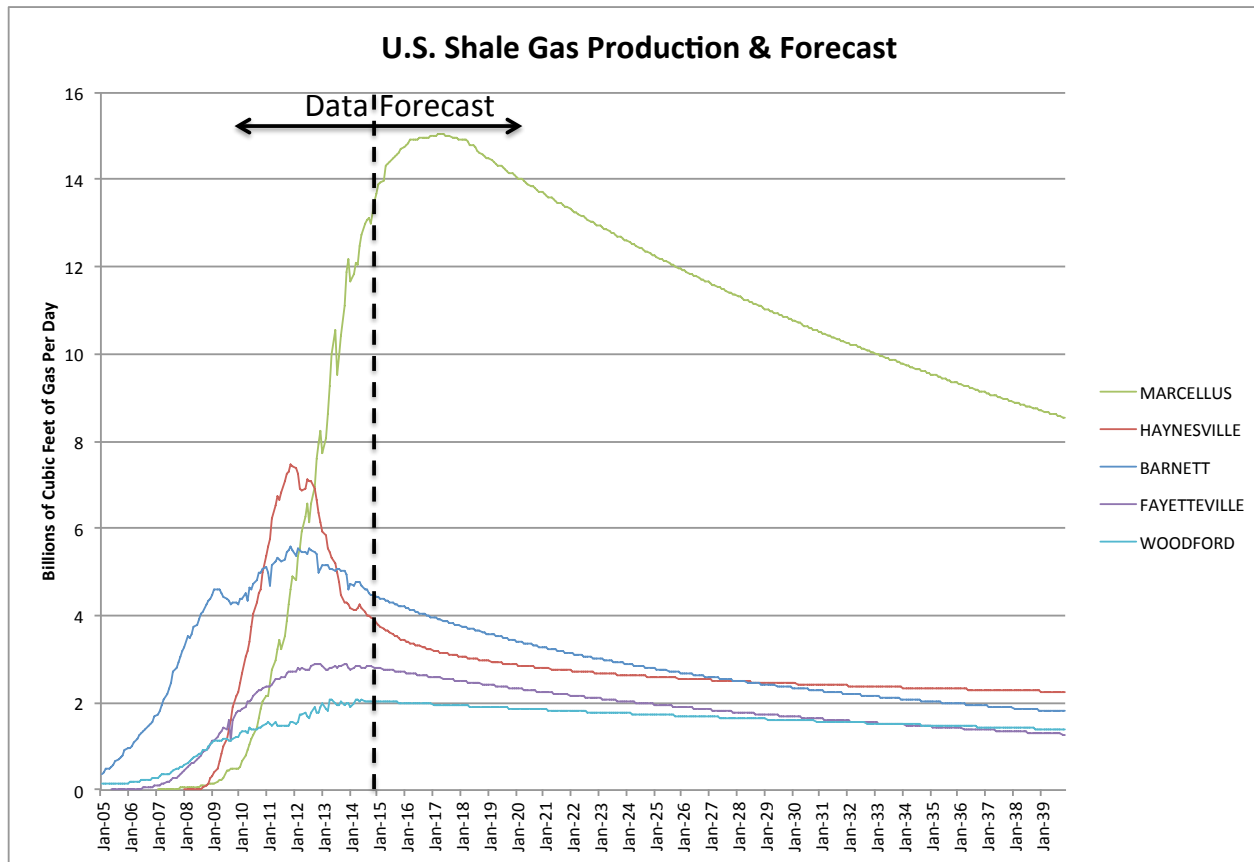
U.S. Oil Production Will Peak Soon and Imports Will Increase.



Source: EIA

- According to EIA, U.S. oil production will peak in 2016 and decline thereafter.
- 2016 will also be the lowest point for U.S. imports that will increase in later years.

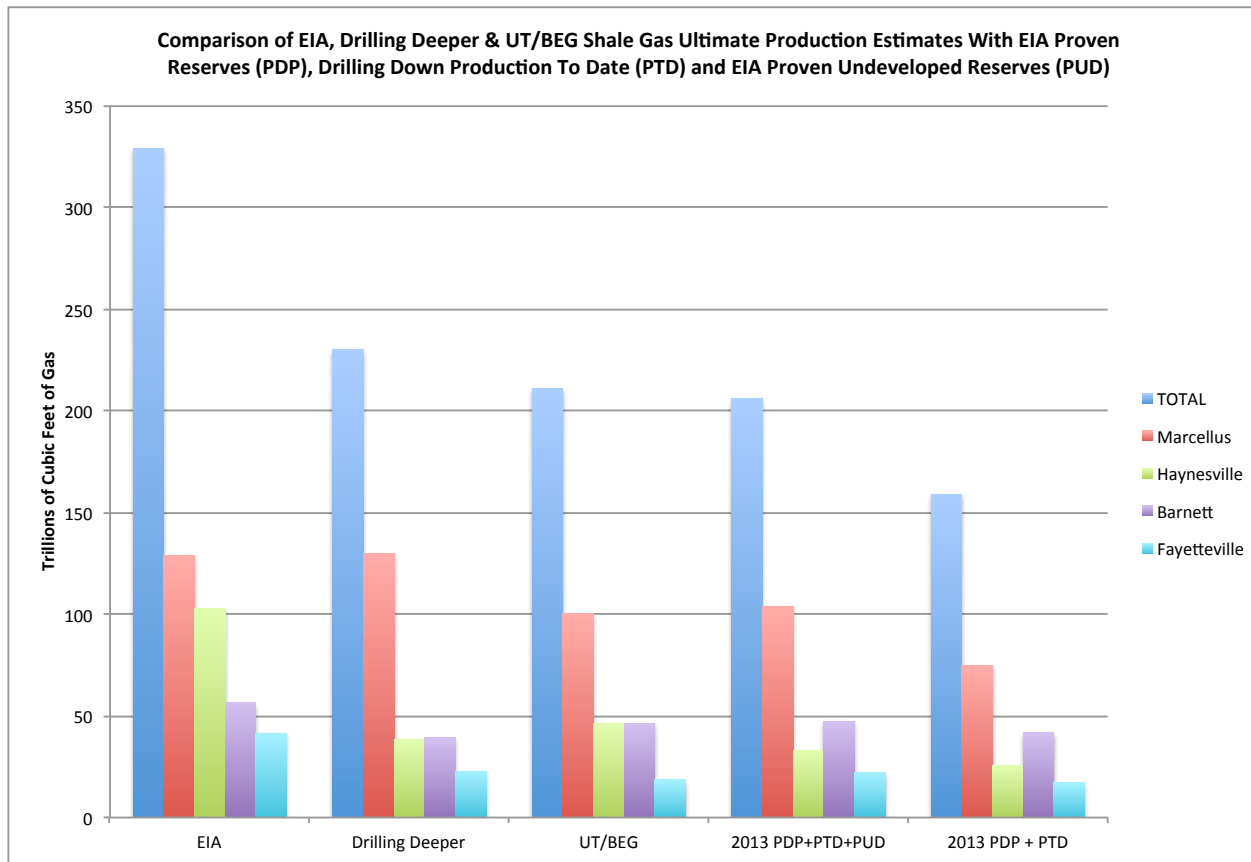
Most Shale Gas in Decline



Source: Labyrinth Consulting Services, Inc.

- All shale gas plays except the Marcellus are in decline already.
- The future of U.S. gas supply is a single bet on the Marcellus Shale.
- Credible 3rd party forecasts predict a Marcellus peak around 2020.

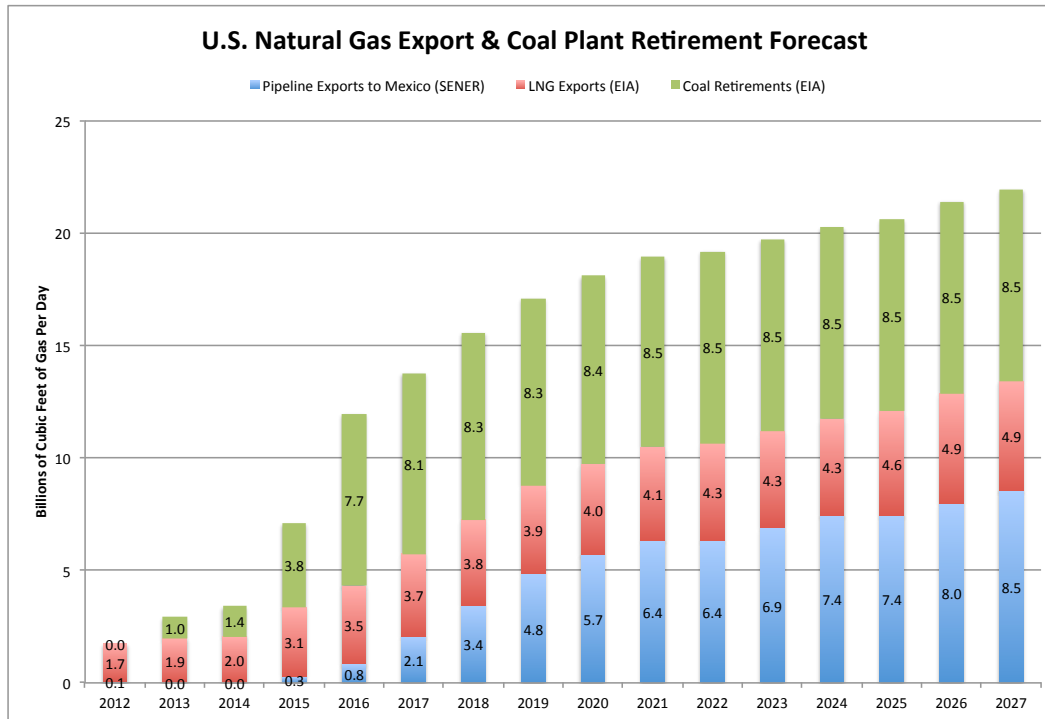
The Fracking Fallacy Debate Casts Doubt on the EIA Natural Gas Forecast



Source: EIA, Drilling Deeper & BEG

- Bureau of Economic Geology and David Hughes (Drilling Deeper) forecast total U.S. natural gas peaking in the early 2020s.

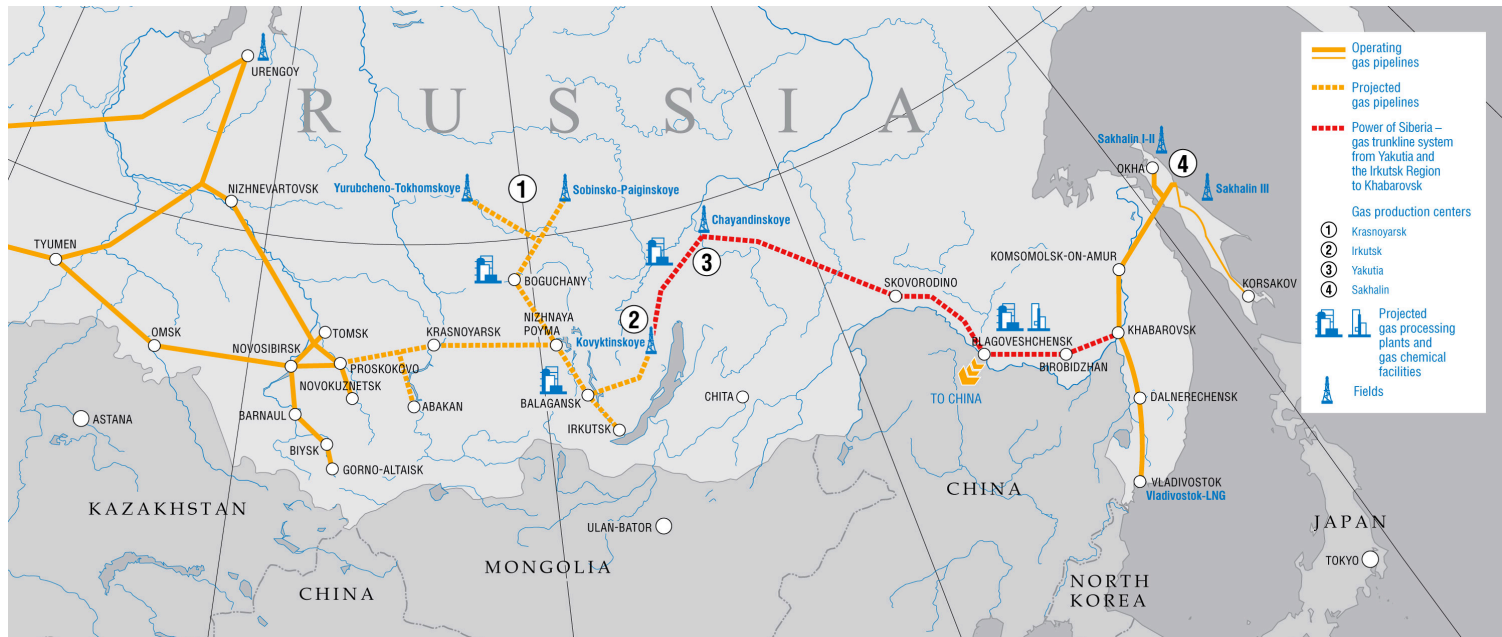
Natural Gas Exports and Increased Demand From Coal Plant Retirements



Source: EIA & SENER

- Almost 10 Bcf/d of pipeline and LNG exports are sanctioned by 2020.
- More than 8 Bcfe/d of coal retirements for electric power generation by 2020 beginning this year.

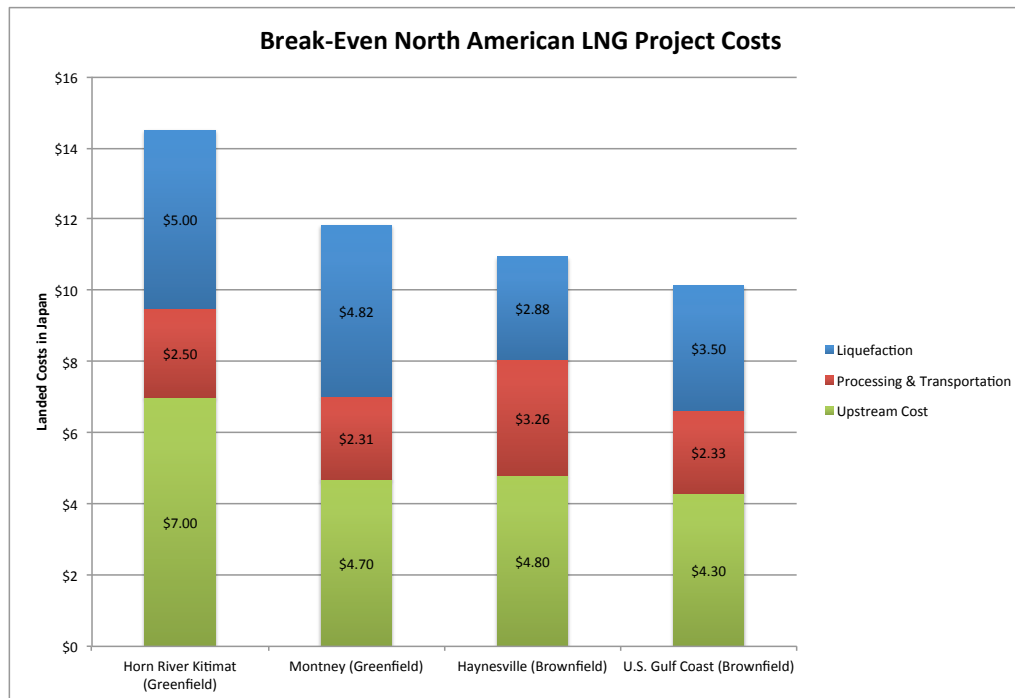
The Power Of Siberia Pipeline Changes Everything



Source: Gazprom

- Russia's gas deal with China : 1.4 Tcf/year for 30 years for \$10/mmBtu.
- Sets a new benchmark price for Asia without oil linkage.
- Gas agreement has far-reaching implications for global LNG markets.
- Russia plans to be the leading supplier to Asian gas markets.
- Russia's East Siberia proven reserves: 196 Tcf & 7 billion barrels of oil , 3-times Canadian reserves and more than U.S. shale gas resources.
- This is only the beginning: pipelines to Korea & Japan are planned.

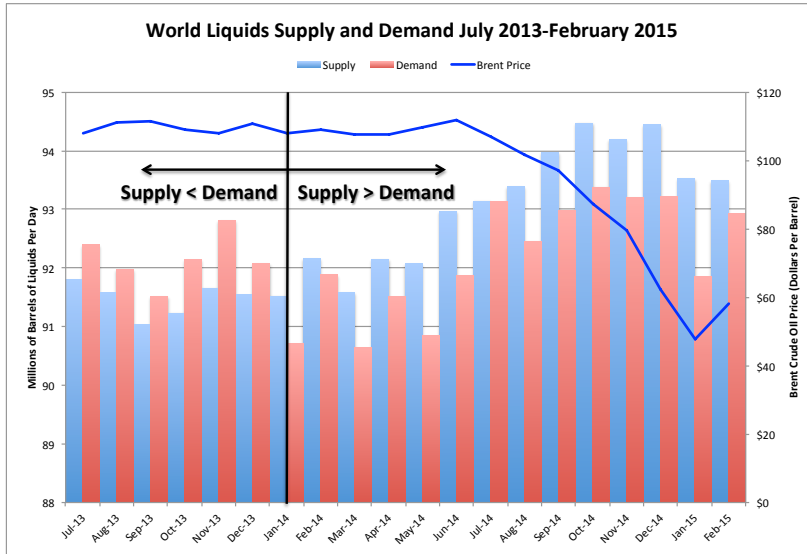
LNG Exports Will Follow the Ill-Conceived History of LNG Import in the U.S.



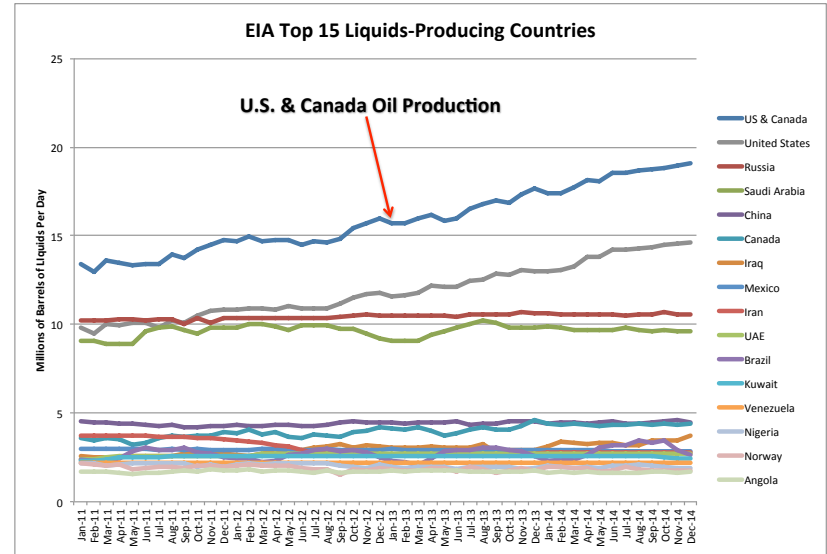
Source: RBC

- Lowest break-even price for Gulf Coast brownfield projects will struggle to compete with Russian price threshold.
- When natural gas prices increase as production peaks in the next 5 years, LNG export will seem like a bad idea because of higher margin from domestic sales.
- Ironically, LNG import beginning in the 2020s is likely.

The Simple Explanation for the Current Oil Price Collapse: Supply Surplus



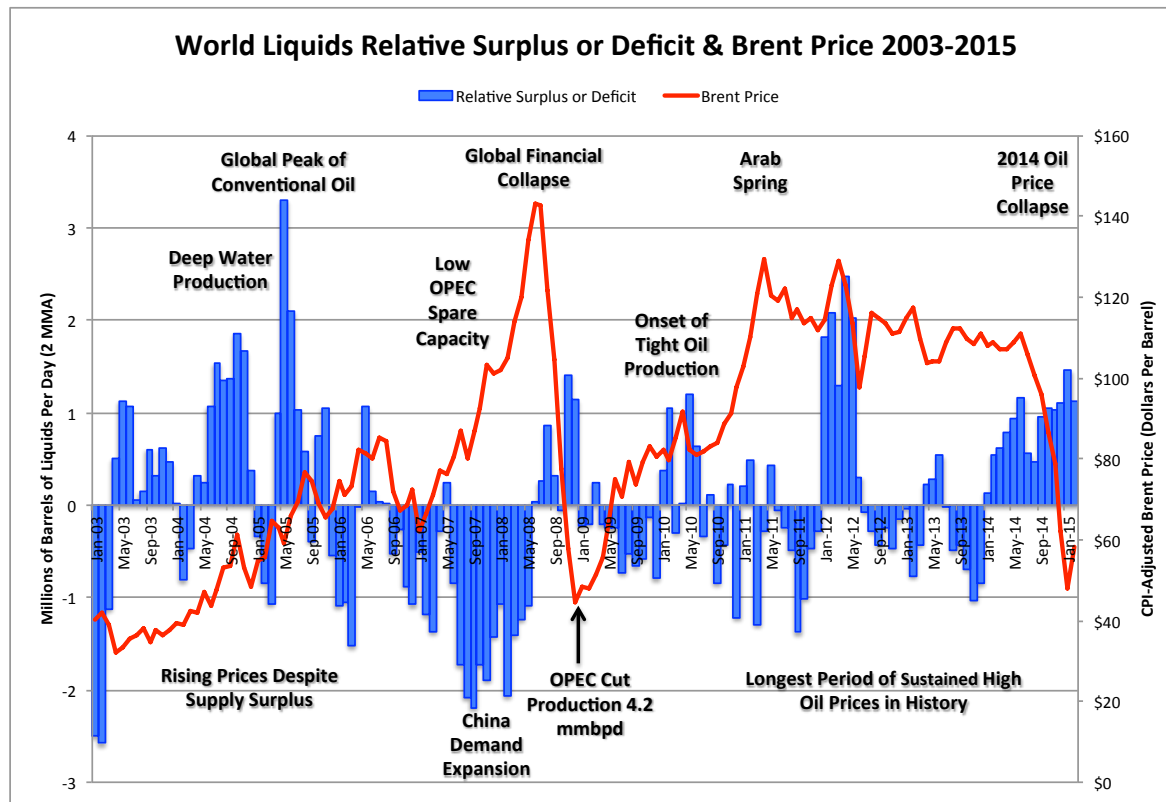
Source: EIA



Source: EIA

- In the 2nd half of 2013, world liquids demand exceeded supply.
- Beginning in 2014, supply exceeded demand because of surging North American tight oil production and weakening demand.
- The market lagged the signal by about 6 months and prices began to fall in June 2014.

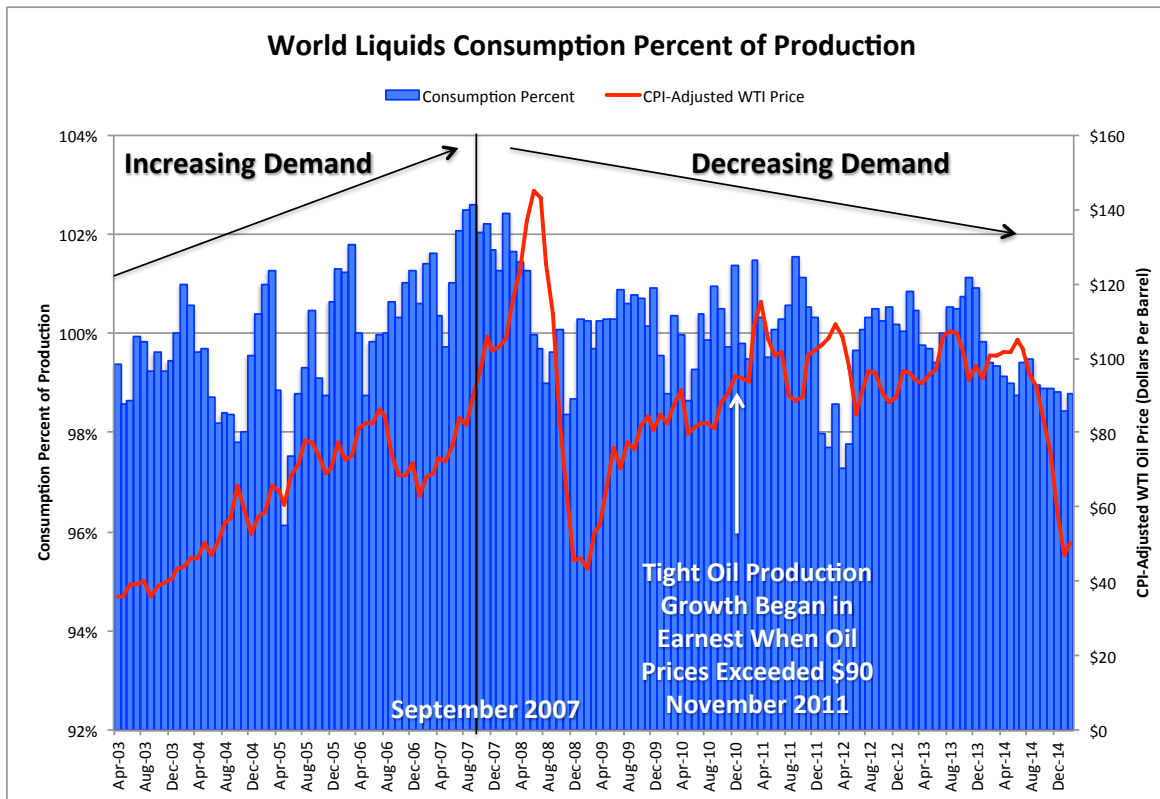
The Context For The Current Oil Price Crisis: Supply-Demand Fundamentals



Source: EIA

- Oil prices relatively insensitive to supply-demand fundamentals below ~\$90/barrel.
- In 2004, the relative supply surplus reached 1.94 mmbpd & in 2005, it reached 4.1 mmbpd but oil prices continued to rise: oil was less than \$75/barrel.
- Greatest relative surplus in the current episode was 1.7 mmbpd but average price from Nov 2010 – Oct 2014 was \$91 and was more than \$100 for 18 months.

The Context For The Current Oil Price Crisis: Demand Destruction



Source: EIA

- Demand generally increased until September 2007 and decreased after 2007.
- Tight oil production began in earnest in 2011.
- CPI-adjusted WTI oil price passed \$90/barrel in November 2011.

Tight Oil & Shale Gas Plays Funded by Debt, Bonds, Stock Offerings & Asset Sales

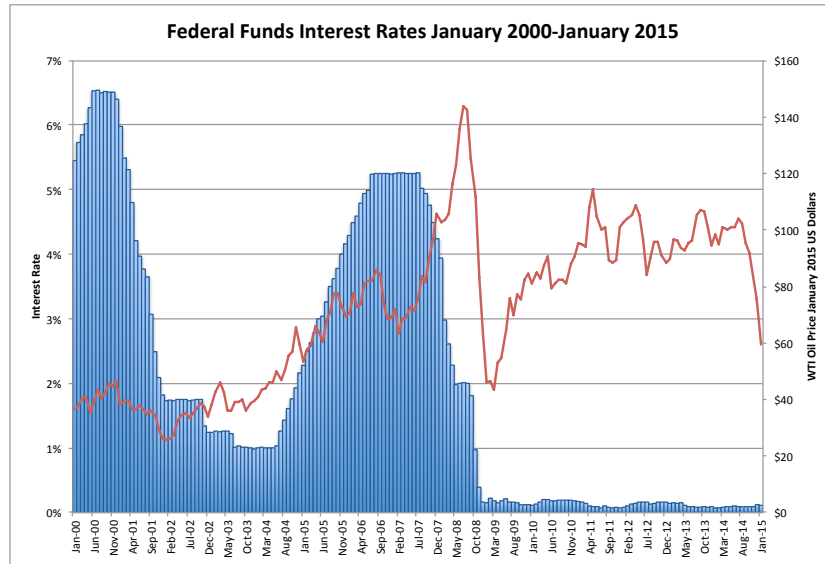
| Oil-Weighted | 2014 FCF | 2013 FCF | FCF Change | CF/CE | Debt/Equity | 2014 DEBT | 2013 DEBT | Debt Change |
|---------------|------------------|-----------------|-----------------|-------------|-------------|-----------------|-----------------|----------------|
| OXY | \$451 | \$3,247 | -\$2,796 | 1.04 | 0.20 | \$6,838 | \$6,939 | -\$101 |
| EOG | \$402 | \$269 | \$134 | 1.05 | 0.33 | \$5,910 | \$5,913 | -\$3 |
| MRO | \$327 | \$504 | -\$177 | 1.03 | 0.30 | \$6,391 | \$6,597 | -\$206 |
| WTI | -\$46 | \$8 | -\$54 | 0.92 | 2.67 | \$1,360 | \$1,205 | \$155 |
| SFY | -\$80 | -\$229 | \$149 | 1.53 | 1.35 | \$1,075 | \$1,142 | -\$68 |
| COP | -\$350 | \$550 | -\$900 | 0.98 | 0.43 | \$22,565 | \$21,662 | \$903 |
| CRZO | -\$360 | -\$421 | \$61 | 0.58 | 1.22 | \$1,351 | \$900 | \$451 |
| PDCE | -\$392 | -\$236 | -\$156 | 0.38 | 0.58 | \$665 | \$605 | \$60 |
| PVA | -\$491 | -\$243 | -\$249 | 0.37 | 1.64 | \$1,110 | \$1,281 | -\$171 |
| OAS | -\$528 | -\$1,756 | \$1,228 | 0.62 | 1.44 | \$2,700 | \$2,536 | \$164 |
| MUR | -\$570 | \$48 | -\$618 | 0.85 | 0.35 | \$3,002 | \$2,963 | \$39 |
| ROSE | -\$570 | -\$1,237 | \$667 | 0.53 | 1.20 | \$2,000 | \$1,500 | \$500 |
| MHR | -\$581 | -\$520 | -\$61 | 0.03 | 1.78 | \$949 | \$880 | \$69 |
| NFX | -\$741 | -\$650 | -\$91 | 0.65 | 0.74 | \$2,892 | \$3,694 | -\$802 |
| HES | -\$810 | -\$970 | \$160 | 0.85 | 0.27 | \$5,987 | \$5,798 | \$189 |
| WLL | -\$1,153 | -\$650 | -\$503 | 0.61 | 0.99 | \$5,629 | \$2,654 | \$2,975 |
| PXD | -\$1,210 | -\$731 | -\$479 | 0.66 | 0.31 | \$2,665 | \$2,653 | \$12 |
| CLR | -\$1,361 | -\$1,176 | -\$185 | 0.71 | 1.21 | \$5,998 | \$4,716 | \$1,282 |
| APA | -\$2,419 | -\$1,385 | -\$1,034 | 0.78 | 0.43 | \$11,245 | \$9,725 | \$1,520 |
| TOTALS | -\$10,482 | -\$5,577 | -\$4,904 | 0.75 | 0.92 | \$90,331 | \$83,363 | \$6,968 |

| Stock Ticker | 2014 FCF | 2013 FCF | FCF Change | CF/CE | Debt/Equity | 2014 DEBT | 2013 DEBT | Debt Change |
|---------------|------------------|-----------------|-----------------|-------------|--------------|-----------------|-----------------|----------------|
| ECA | \$141 | -\$423 | \$564 | 1.06 | 0.98 | \$7,813 | \$7,668 | \$145 |
| UPL | \$100 | \$96 | \$4 | 1.16 | -19.73 | \$3,378 | \$2,470 | \$908 |
| PQ | \$3 | -\$241 | \$243 | 1.02 | 3.53 | \$425 | \$425 | \$0 |
| XCO | -\$30 | \$30 | -\$60 | 0.92 | 3.81 | \$1,447 | \$1,891 | -\$444 |
| KWK | -\$116 | -\$153 | \$37 | 0.04 | -1.85 | \$2,038 | \$1,989 | \$49 |
| GDP | -\$201 | -\$180 | -\$21 | 0.38 | 1.79 | \$569 | \$486 | \$83 |
| CRK | -\$234 | -\$262 | \$28 | 0.63 | 1.03 | \$1,070 | \$799 | \$272 |
| TLM | -\$242 | -\$696 | \$454 | 0.89 | 0.71 | \$5,274 | \$5,540 | -\$266 |
| COG | -\$243 | -\$170 | -\$73 | 0.84 | 0.50 | \$1,752 | \$1,147 | \$605 |
| BBG | -\$323 | -\$182 | -\$140 | 0.45 | 1.15 | \$829 | \$984 | -\$155 |
| RRC | -\$470 | -\$554 | \$84 | 0.67 | 0.94 | \$3,073 | \$3,141 | -\$68 |
| XEC | -\$489 | -\$248 | -\$241 | 0.77 | 0.35 | \$1,500 | \$924 | \$576 |
| SGY | -\$536 | -\$76 | -\$460 | 0.43 | 0.85 | \$1,041 | \$1,027 | \$14 |
| AR | -\$611 | -\$521 | -\$90 | 0.62 | 0.96 | \$4,363 | \$2,079 | \$2,284 |
| CHK | -\$673 | -\$1,962 | \$1,289 | 0.87 | 0.71 | \$11,555 | \$12,904 | -\$1,349 |
| SD | -\$951 | -\$645 | -\$305 | 0.40 | 1.95 | \$3,195 | \$3,195 | \$1 |
| DVN | -\$1,007 | -\$1,322 | \$315 | 0.86 | 0.58 | \$11,262 | \$12,022 | -\$760 |
| APC | -\$1,042 | \$1,167 | -\$2,209 | 0.89 | 0.69 | \$15,092 | \$13,565 | \$1,527 |
| SM | -\$1,063 | -\$277 | -\$786 | 0.58 | 0.92 | \$2,366 | \$1,600 | \$766 |
| QEP | -\$1,184 | -\$411 | -\$773 | 0.57 | 1.18 | \$2,273 | \$3,107 | -\$834 |
| NBL | -\$1,365 | -\$1,010 | -\$355 | 0.72 | 0.55 | \$6,241 | \$4,887 | \$1,354 |
| SWN | -\$5,006 | -\$344 | -\$4,662 | 0.32 | 0.45 | \$6,967 | \$1,950 | \$5,017 |
| TOTALS | -\$15,541 | -\$8,383 | -\$7,159 | 0.68 | -0.01 | \$93,522 | \$83,798 | \$9,724 |

Source: Company 2014 10-K Filings and Labyrinth Consulting Services, Inc.

- Companies are chronically cash-flow negative: outspend cash flow by 25% (tight oil) and 32% (shale gas).
- Unmanageable debt that can never be paid from cash flow.
- Debt must be continually re-financed on increasingly poorer terms.
- Diminishing returns on investment.
- The E&P business has become financialized—the only measure is production-reserve growth.
- The appeal is the relatively short-term basis compared with deep-water, etc.

The Financialization of the Exploration & Production Business

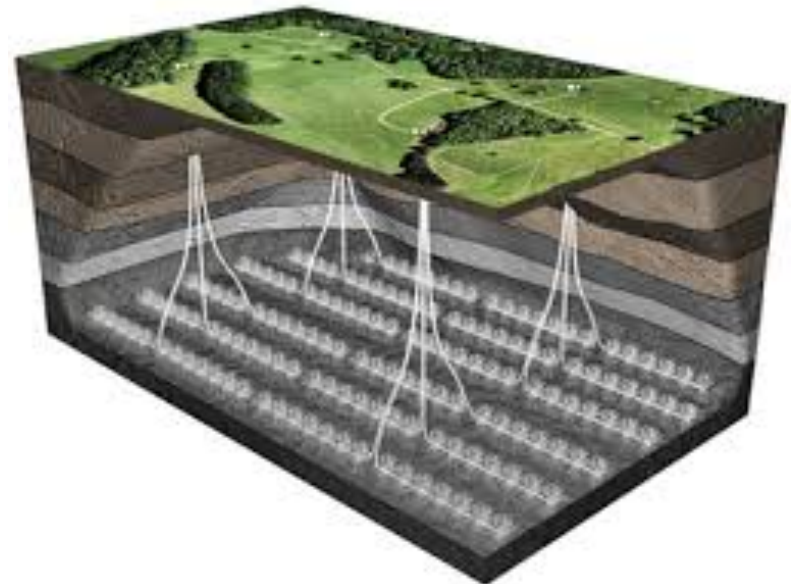


Source: EIA and Federal Reserve Board

- In a zero-interest world, where could reasonably secure yields be found?
- Investment banks identified the U.S. E&P business as the solution.
- Yields for corporate junk bonds, preferred stock and other capital instruments in the range of 6-10% interest.
- In the United States and “backed” by a hard asset in the ground.
- E&P companies became the sub-prime derivative of the post-Financial Crisis period.
- Shale gas and later, tight oil companies had access to almost infinite capital with no performance requirement other than to avoid debt covenants.

The Problem With The Shale Plays

- The story stresses success based on resource estimates but not reserves.
- Production volumes but not the cost of that production.
- The benefits of technology but not its price.
- Claims of profit that exclude important expenses.
- The government and press accept this story because it paints a picture that fulfills so many aspirations of energy independence, U.S. re-emerging political strength, dominance in energy affairs and economic growth.
- Warning signs of potential risk have so far been ignored.



Concluding Observations

- The current oil-price collapse is because of expensive unconventional oil and the market's inability to support its cost.
- \$90 per barrel appears to be threshold for demand destruction.
- Only the core of the core areas of the best tight oil plays are profitable at these prices.
- Only small areas of the core areas break even at present oil prices.
- Shale gas plays have never been commercial since prices collapsed in 2008 but have been propped up by easy money based on zero-interest rates.
- Easy money has also funded zombie tight oil plays and companies.
- The present oil-price collapse is severe because of the accumulated, long-term price fatigue since late 2007.
- The key to recovery is demand—low price will cure demand.
- The effect of reduced E&P spending on the U.S. economy is unclear and could reduce demand.
- Continued non-commercial over-production will subside faster than most imagine especially after 1st Quarter 2015 earnings reports.
- Crude oil export will keep oil prices lower for longer which is good for demand but bad for the oil industry.
- Natural gas export never made sense but will occur. The U.S. will become a net importer of gas by 2030.