



The Economics of North American Oil and Gas

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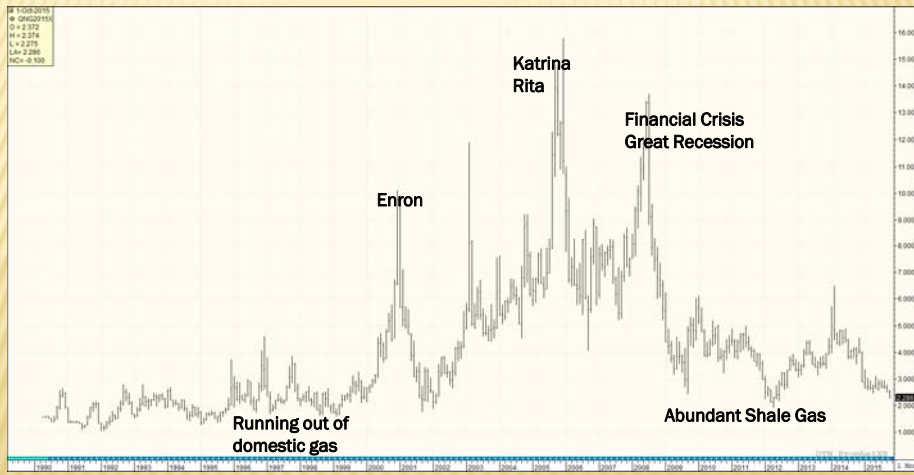
Today's Information

- ✘ Where do you get your information?
- ✘ Who has vested interest in the message?

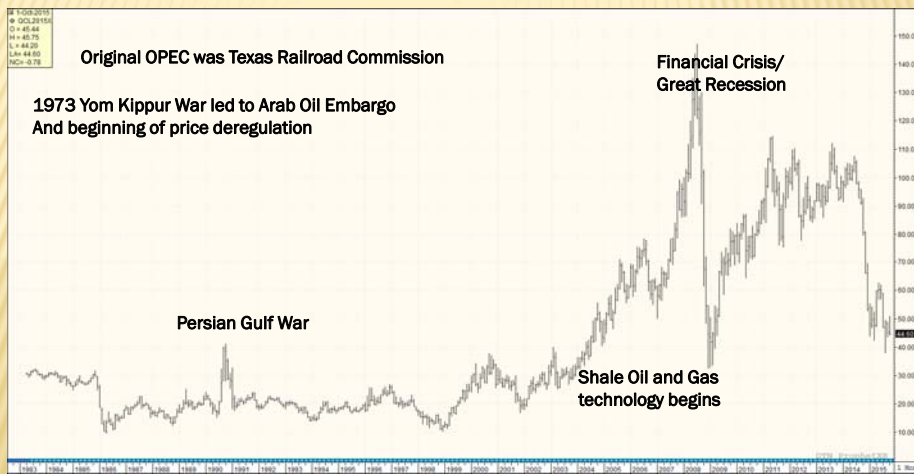
- ✘ Did the “Stone Age” end because we ran out of stones?
 - + Technology's role in our energy future

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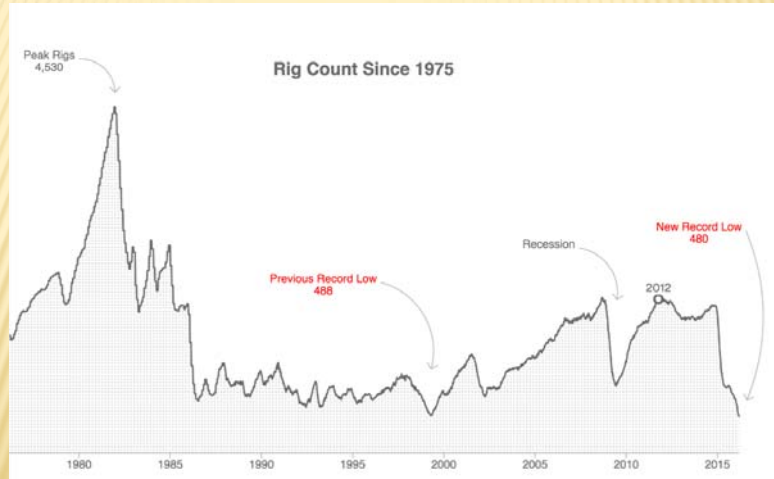
NATURAL GAS PRICE TIMELINE



BOOM AND BUST HISTORY OF CRUDE OIL

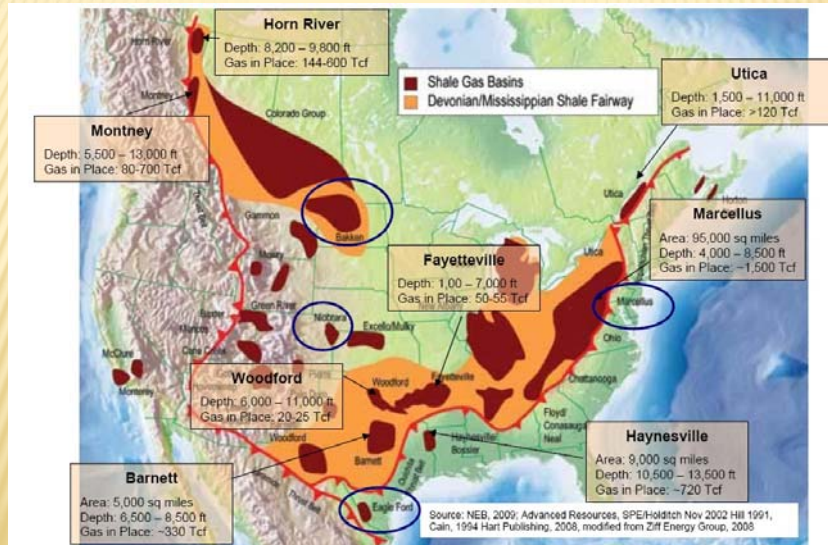


CRUDE OIL US RIG COUNT



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WE'VE GOT PLENTY GAS IT'S JUST A MATTER OF PRICE



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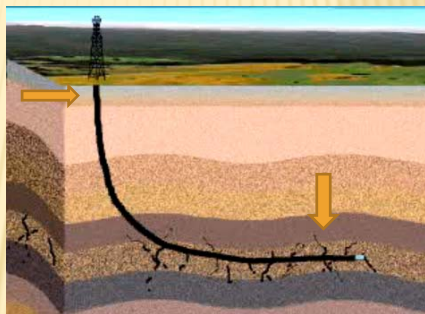
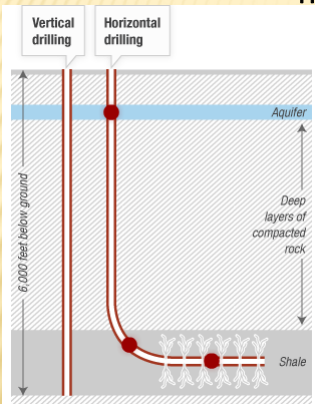


The porosity of sandstone is so much greater than shale that for comparison purposes, if you could fit the Statue of Liberty inside the matrix of sandstone, then the matrix of shale would only have enough space to fit a man.



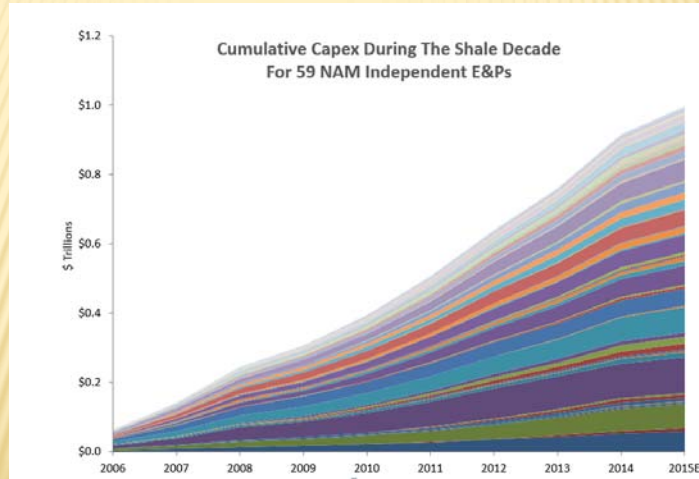
Horizontal Drilling and Hydro Fracing

How did it develop?



15,000 psi 6 MM gallons water 100K lb. sand

TRILLION DOLLAR SHALE GAME



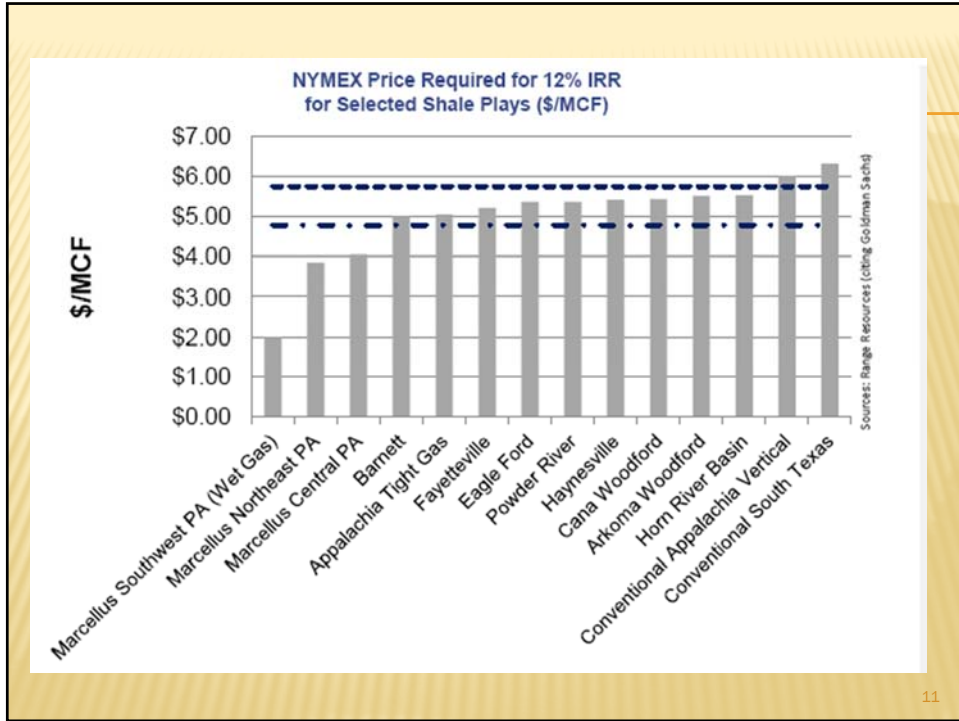
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Estimates of Breakeven Costs for US Shale Plays

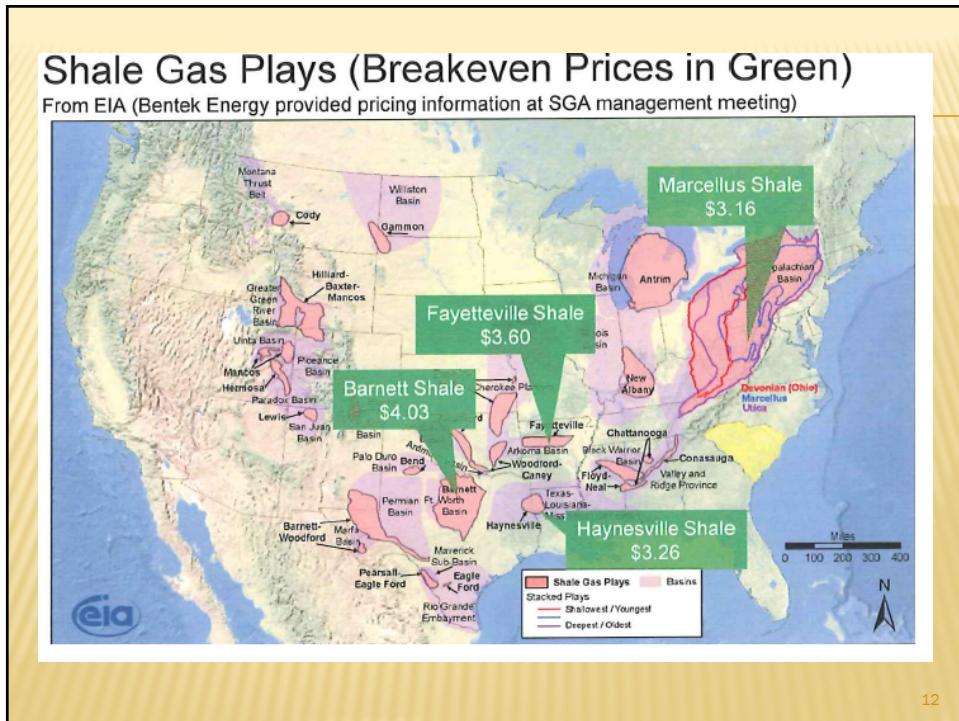
Field	Harvard (2013)	Center for Energy Studies	MIT (2011)
Marcellus	3.32	4.00	4.00
Eagle Ford	3.51	4.00	-
Utica	3.97	6.25	-
Barnett	4.47	4.25	5.84
Fayetteville	5.05	4.25	5.25
Haynesville	6.11	4.00	5.04
Woodford	6.24	4.50	5.96
Average	4.06	4.20	4.50

Source: MIT "The Future of Natural Gas" (2011), Baker Institute (2011), A.K. Cohen (2013)

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NYMEX PRICES

Strip	May 16		
1 Month	1.995	31 Month	2.874
2 Month	2.070	32 Month	2.884
3 Month	2.145	33 Month	2.896
4 Month	2.205	34 Month	2.906
5 Month	2.248	35 Month	2.914
6 Month	2.290	36 Month	2.914
7 Month	2.349	37 Month	2.913
8 Month	2.434	38 Month	2.913
9 Month	2.515	39 Month	2.914
10 Month	2.578	40 Month	2.915
11 Month	2.626	41 Month	2.916
12 Month	2.647	42 Month	2.918
13 Month	2.663	43 Month	2.921
14 Month	2.680	44 Month	2.928
15 Month	2.696	45 Month	2.937
16 Month	2.711	46 Month	2.945
17 Month	2.725	47 Month	2.951
18 Month	2.739	48 Month	2.952
19 Month	2.755	49 Month	2.952
20 Month	2.775	50 Month	2.953
21 Month	2.799	51 Month	2.955
22 Month	2.835	52 Month	2.957
23 Month	2.852	53 Month	2.959
24 Month	2.852	54 Month	2.961
25 Month	2.853	55 Month	2.965
26 Month	2.855	56 Month	2.971
27 Month	2.858	57 Month	2.980
28 Month	2.862	58 Month	2.988
29 Month	2.864	59 Month	2.994
30 Month	2.868	60 Month	2.996

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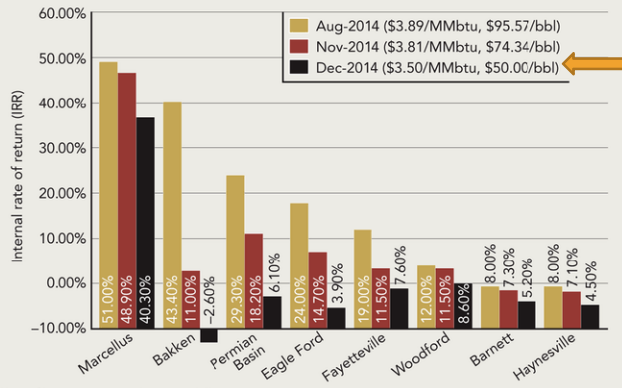
DRILLERS NEED HIGHER PRICES

- ✘ Simmons & Company indicates that gas basins in the US need \$3.50 to \$4.50 for producers with medium to higher finding cost to be able to make enough money to warrant drilling
- ✘ Only the Marcellus and Utica basins offer economic drilling opportunities below those prices.
- ✘ That's why the northeast gas production has grown from 4 to 21 Bcfd while Texas production is off 500,000 Dts a day year over year and still declining.
- ✘ Meanwhile, futures prices for gas deliveries 5 years out are below the finding cost of every basin in America except the sweet spots of the Marcellus and Utica.

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RETURN ON CAPITAL IS UNACCEPTABLE

F6: IRR FOR DRILLING AT THREE PRICE DECKS



Appalachia	
Dominion, North Point	1.075
Dominion, South Point	1.100
Leidy Hub	—
Columbia Gas, App.	2.425
Columbia Gas, App. non-IPP	1.055
Lebanon Hub	2.415
REX, Clarington Ohio	—
Tennessee, zone 4-Ohio	—
Tennessee, zone 4-200 leg	1.130
Tennessee, zone 4-300 leg	0.650
Texas Eastern, M2 receipts	1.050
Millennium, East receipts	1.020
Transco, Leidy Line receipts	0.950

Note: Chart assumes no change in drilling costs

Industry Standard Is 12% Minimum IRR

VAST MAJORITY OF PRODUCERS CAN'T MAKE MONEY

- ✗ Cabot Oil and Gas has arguably the best position in the Marcellus
 - + dropping down to 3 rigs “until more favorable pricing returns”
- ✗ US E&P funded “boom” with \$206 billion in bonds and \$574 billion in syndicate loans
- ✗ Fitch Ratings has over 70% of independent producer debt listed as “junk”

Weak prices to halt Marcellus growth: EIA

PRODUCTION Though many industry observers are expecting production from the prolific Marcellus Shale to continue growing at a rapid clip through the end of the decade, the US Energy Information Administration is forecasting little to no production growth through 2018 and a slight decline thereafter, EIA data showed.

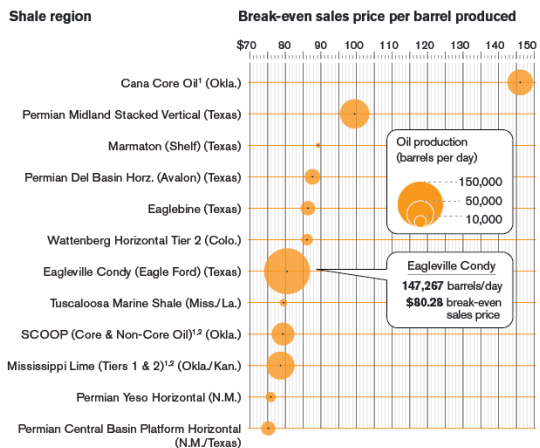
SHALE OIL FACTS

- ✘ Reporting on the state of the US shale oil and gas industry, Arthur Berman, of Labyrinth Consulting Services, reported “The reality is, if you actually balance your cost and the price, almost everybody was losing money at \$90/b, and everybody is losing money at \$30/b, and 1 out of 3 firms is at risk of bankruptcy.” analysts estimate as many as 150 E&P companies are going bankrupt over the near term. Deloitte estimated that “about 175 companies are in the high-risk quadrant” for bankruptcy.

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Testing the Shale Boom

The recent surge in U.S. oil production may slow with oil prices near \$75 a barrel, according to Investment Technology Group Inc. At least 413,000 barrels a day comes from regions that are estimated to lose money at that price.



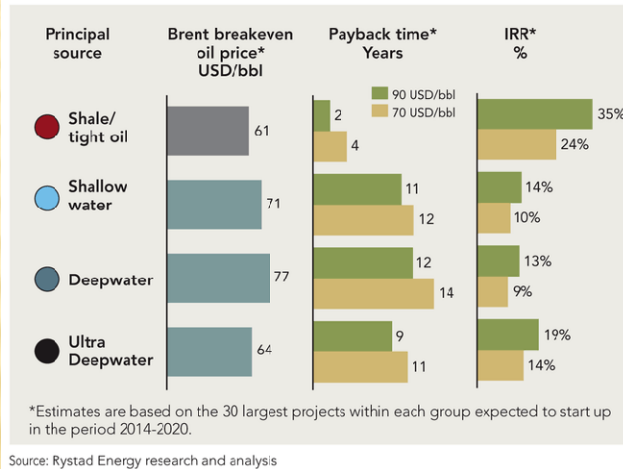
Note: Production estimates were unavailable in four of 19 regions where break-even prices are above \$75.
 1 - Well data were unavailable from Drillinginfo. Production estimates shown are based on company data.
 2 - Break-even estimate shown for core areas. Marginal areas have higher costs.
 Sources: Drillinginfo, company data, Bloomberg New Energy Finance.

Bloomberg Graphics

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CRUDE MARKET

F3: KEY ECONOMIC METRICS FOR SHALE AND OFFSHORE



US shale producers say at \$65/bbl they are drilling again

US SHALE ROLE IN WORLD OIL PLAY

- ✘ US shale oil production has increased about 4 million barrels a day since 2010.
- ✘ Saudis were able to bring on as much oil in one month as the US shale industry developed over 5 years of drilling
- ✘ But shale oil accounts for less than 10% of the global oil market.
- ✘ Since oil price decline \$200 billion in deals delayed
- ✘ Big oil projects require 3 to 7 years to bring oil to market
- ✘ Shale producers can create cash flow in 90 days
- ✘ In the longer term, the draconian cuts in expenditures on the major drilling projects will lead to prolonged tightness in crude markets.
- ✘ US shale producers will have another window of opportunity to make significant profits again then

OPEC ON THE HORNS OF A DILEMMA

- ✘ Saudi Arabia need \$106 per barrel to balance their national budget
 - + Ending subsidies and installing tax codes for wealthy to make ends meet
- ✘ New Sovereign Wealth Fund includes selling part of Aramco in an IPO and getting two trillions dollar buildup to get Saudi weaned off of oil revenue

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RUSSIA

- ✘ Russia and its Putin lead regime is in serious economic trouble so the Russian people have much pain to bear.
- ✘ Oil, gas and coal account for 25% of total GDP, down from 33% last year.
- ✘ Energy exports account for about 68% of Russian trade. Oil and gas revenues provide half the Russian government's official budget.
- ✘ As a result of the fall in oil prices, the Russian economy is predicted to decline by 3.5% this year, with oil export revenue down by \$95bn, after suffering a fall of \$174bn in 2013.
- ✘ One of the major reasons for the fall of the Soviet Union at the end of the 1980s was the collapse in energy prices.

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SHALE GAS FACTS

- ✘ Current production and demand: 72 Bcfd
- ✘ Future LNG Exports: 10 Bcfd
- ✘ Mexico exports: 8 Bcfd
- ✘ Additional Power Generation demand: 15-30 Bcfd
- ✘ Decline rates on shale gas wells
 - + 50%-70% year one
 - + 25% to 35% year two
 - + Can become uneconomic in years 3 or 4

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SHALE GAS FACTS

- ✘ Financial markets not extending more financing
- ✘ Futures market are selling gas below replacement cost for next 5 years
- ✘ EPA creating more demand
- ✘ Overhang of wells drilled but not yet online
 - + Estimated to be 4 Bcfd
- ✘ Weather plays a major role in gas pricing
- ✘ Natural gas storage dictates short term pricing

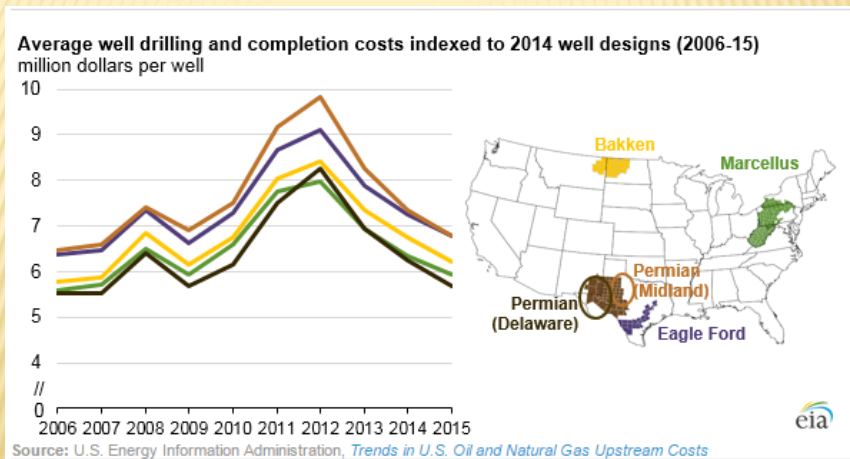
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SHALE GAS FACTS

- ✘ Natural gas liquids have created glut in propane and ethane markets thru 2020-22
 - + Total ethane exports are expected to average 150,000 b/d in 2016 and 283,000 b/d in 2017.
- ✘ Gas pipeline infrastructure projects exceed 200 billion dollars
- ✘ Ethane crackers trying to be approved in Marcellus
- ✘ Northeast becoming “hub” for natural gas supply and pricing

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LOWER DRILLING COSTS



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NATURAL GAS SHORTAGES IN THE MIDST OF A GLUT

- ✘ The fastest growing sector for natural gas demand growth is power generation
- ✘ The build out of pipeline capacity is trailing power demand (over \$100 billion of projects)
- ✘ This result is periods of pipeline capacity shortages during high power demand called Operational Flow Orders of OFO's
 - + Gas travels at 20 MPH but power demand is immediate)
- ✘ The law of supply and demand dictates high delivered gas prices during OFO's

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Why do we have more curtailments and new types of curtailment such as Operational Flow Orders (OFO)?

“The Disruptive Role of Gas-Fired Generation and Related Curtailment Challenges.”

Carolina
Utility
Customers
Association,
Inc.

5/7/2014
Presented by
Aubrey Hilliard

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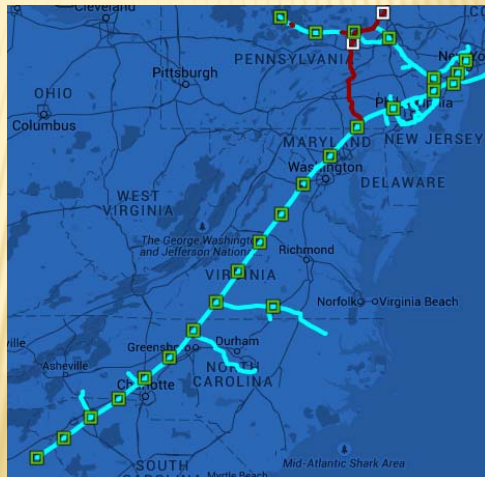
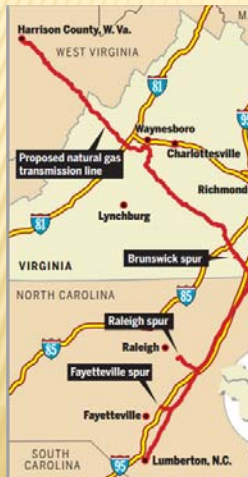
EXAMPLE OF OFO GAS PRICING

Month	FOM Price
Jan-14	\$4.90
	TRANSCO
DATE	Zone 5 del.
01/07/14	\$ 70.430
01/08/14	\$ 26.290
01/22/14	\$ 118.095
01/23/14	\$ 81.510
01/24/14	\$ 38.435
01/25/14	\$ 43.545
01/26/14	\$ 43.545
01/27/14	\$ 43.545
01/28/14	\$ 89.495
01/29/14	\$ 29.415

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PIPES ARE CATCHING UP 3 BCFD ADDITIONS IN DEC 2018

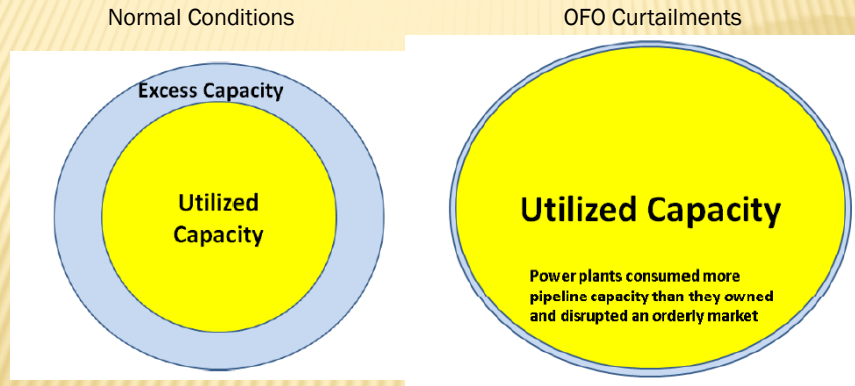
Atlantic Coast Pipeline, Dalton Express, Atlantic Sunrise and more bring +3 bcf/d



ACP will Be a pipe Designed To serve Power Plants, but Will have NO STORAGE It will stay In OFO mode

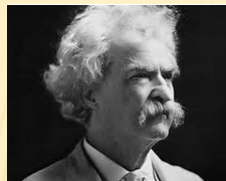
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THE DIFFERENCE DUKE ENERGY GAS PLANTS HAVE MADE



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WATER



**“Whiskey is for drinking.
Water is for fighting over.”**

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WATER

- ✘ Four billion people, or two-thirds of the world's population, face severe water shortages during at least one month every year.
- ✘ Groundwater levels are falling, lakes are drying up, less water is flowing in rivers, and water supplies for industry and farmers are threatened worldwide.
- ✘ Half of the four billion people who experience conditions of severe water scarcity year live in China or India.
- ✘ Mexico and the western and southern parts of the United States, such as California, Texas and Florida face scarcity.
- ✘ Freshwater scarcity is a major future risk to the global economy.

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OILFIELD WATER CONCERNS

- ✘ Two to six million gallon of water per well for fracing
- ✘ One to two million gallons returned in first year of operation
- ✘ The USGS reported that about 7 million people live in areas of the central and eastern US where "induced seismicity" is linked to the injection of wastewater from oil and gas wells.
- ✘ Oklahoma has cut 40% with a very positive response already.
- ✘ It's easy to cut disposal of frac water when drilling has nearly come to a halt but this will become problematic when we start drilling again

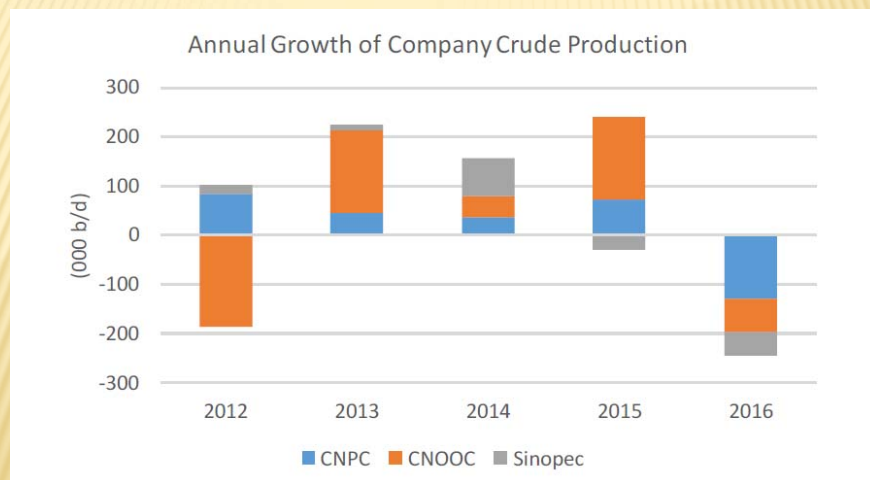
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CHINA'S GAS INDUSTRY

- ✘ Natural gas - production: 117.1 Billion cubic meters (2013)
 - + Ranked 4th in the world
- ✘ Shale wells in China remain expensive, taking some three and a half months to drill, in comparison with the US, where factory production methods have reduced drilling time to less than a month.

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CHINA LAGS BEHIND



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CHINA

- ✘ Over the last decade, growth in Chinese gas consumption has outstripped increases in domestic production. The former rose by 17.3% on average each year between 2002-2013, while the latter increased by 12.8%.
- ✘ By 2020, the gap between domestic supply and demand is expected by the IEA to have reached 129 Bcm, rising to 204 Bcm in 2030.

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CHINA

- ✘ At present, China is constructing the second West-East Pipeline from the west end to the eastern and southern parts of China. Simultaneously, China is investing in the Central Asia Pipeline to transport natural gas from Turkmenistan, via Uzbekistan and Kazakhstan.
- ✘ The total length of the main trunk line of both pipelines will be over 6 800 km.
- ✘ \$30 Billion USD equivalent and far from self sufficient

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CHINA OIL

- ✘ As a result of persistent low crude prices, crude producers in China either suffered a loss or saw shrinking profits in 2015.
- ✘ This year, all three major Chinese crude producers have announced plans to cut crude production. Including over-seas crude production, the three companies are expected to cut a total of 250,000 b/d in 2016, in contrast to a production increase of 210,000 b/d in 2015.

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PREDICTING NATURAL GAS

- ✘ Continued low gas prices in 2016, especially if El Nino winter is mild in northeastern US which will cause overhang of low prices into 2017
- ✘ Afterwards, lack of drilling while demand grows leads to “pinch point”
- ✘ \$3 to \$5 trading range with spikes to \$7-\$8

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PREDICTING CRUDE

- ✘ Arab States hold control
- ✘ Prices below \$50 through 2018-2020 until world demand meets supply
 - + Supply outside Arab States declines due to low drill rates
 - + Arab states drilling at record rate
- ✘ Price spike and several years of higher prices until “elephant” projects are drilled and online

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