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Clear as Mud(Rocks): A Forward View of Natural Gas

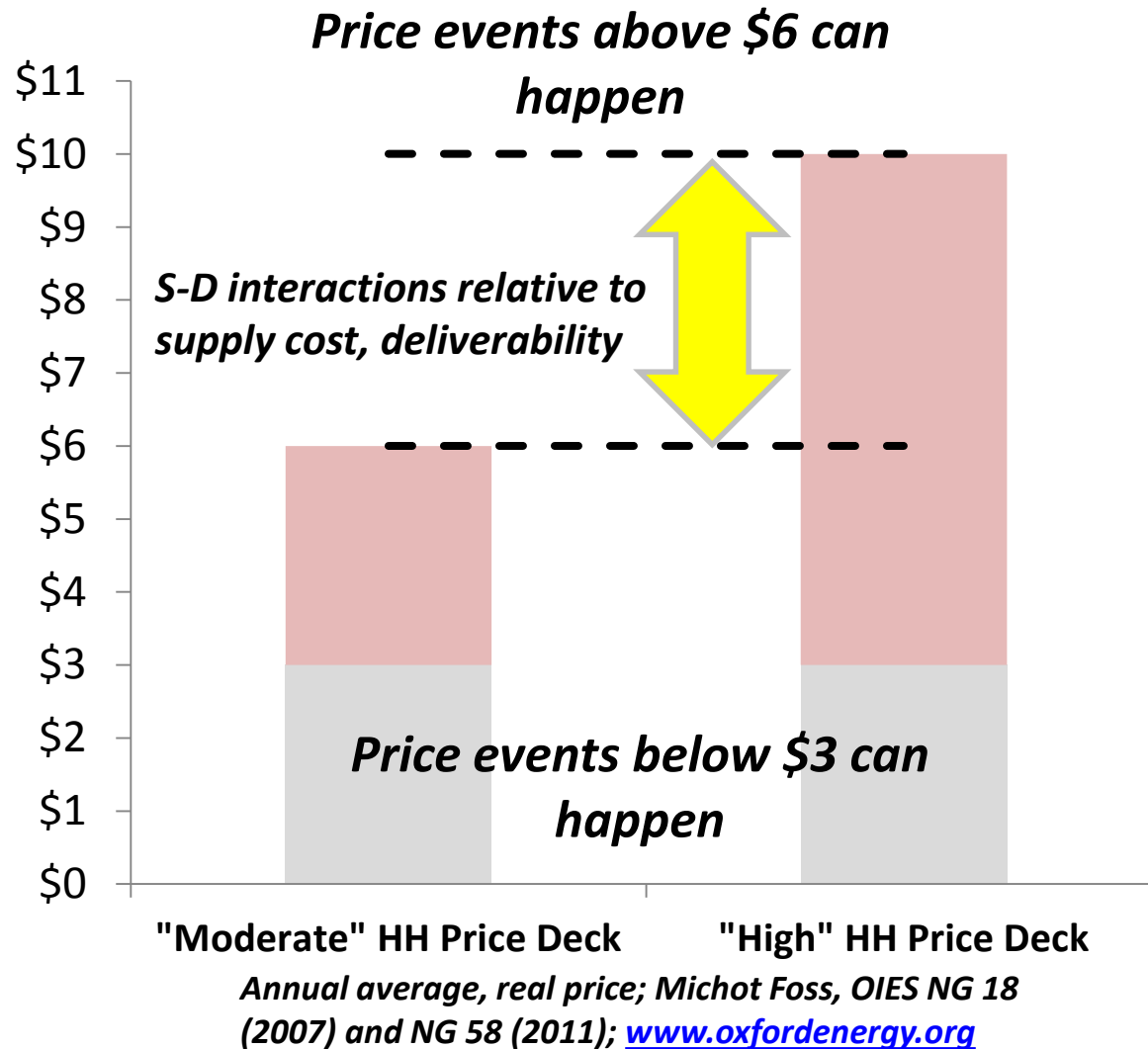
ERCOT BOD April 10, 2018

Michelle Michot Foss, Ph.D., UT BEG/CEE

Overview: U.S. and Texas Natural Gas Supply

- **What a success story! The only considerations are...**
- **...downward pressure on natural gas prices...**
 - *How much? How long? With what consequences (more on that later)?*
- **...because of tight rock dynamics...**
 - *The “bidness” and how to think about it*
- **...and the need to re-plumb the gas system...**
 - *“Primer” on Texas/ERCOT gas infrastructure and flows*
- **...in an extended period of consumer sovereignty.**
 - *Plenty of ideas. Will they all work?*

Gas Price Economics (2030)



Total Methane Supply

***Production (25-30+ TCF):**

Supply Mix

HH price dependent (**70-80%, "NAG", dry; ~60% gas wells)

NGLs, Condensate, "wet" gas (oil linked, S-D, export drivers)

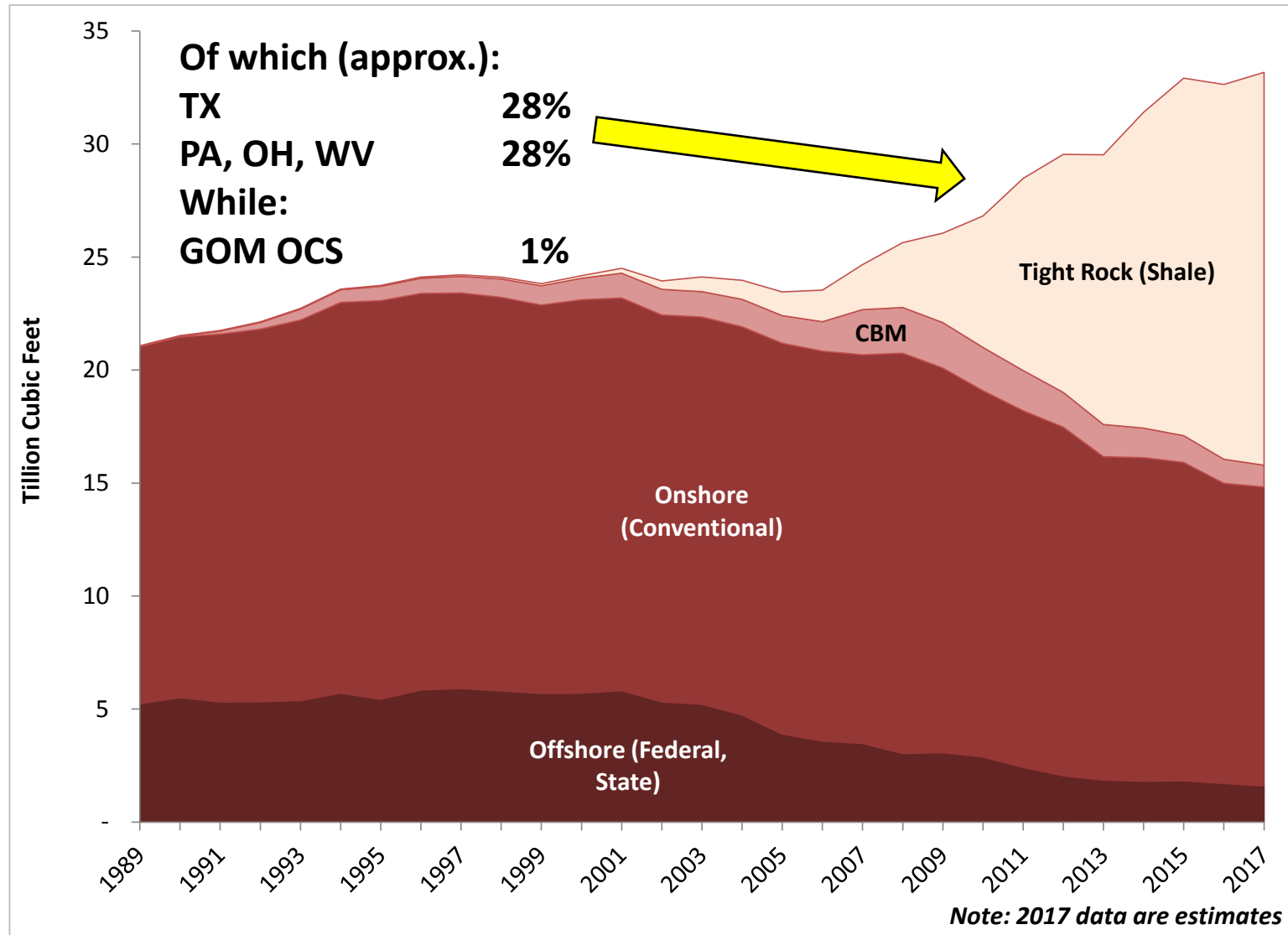
Oil price dependent (**20-30+%, "AG", "wet";

LNG In?

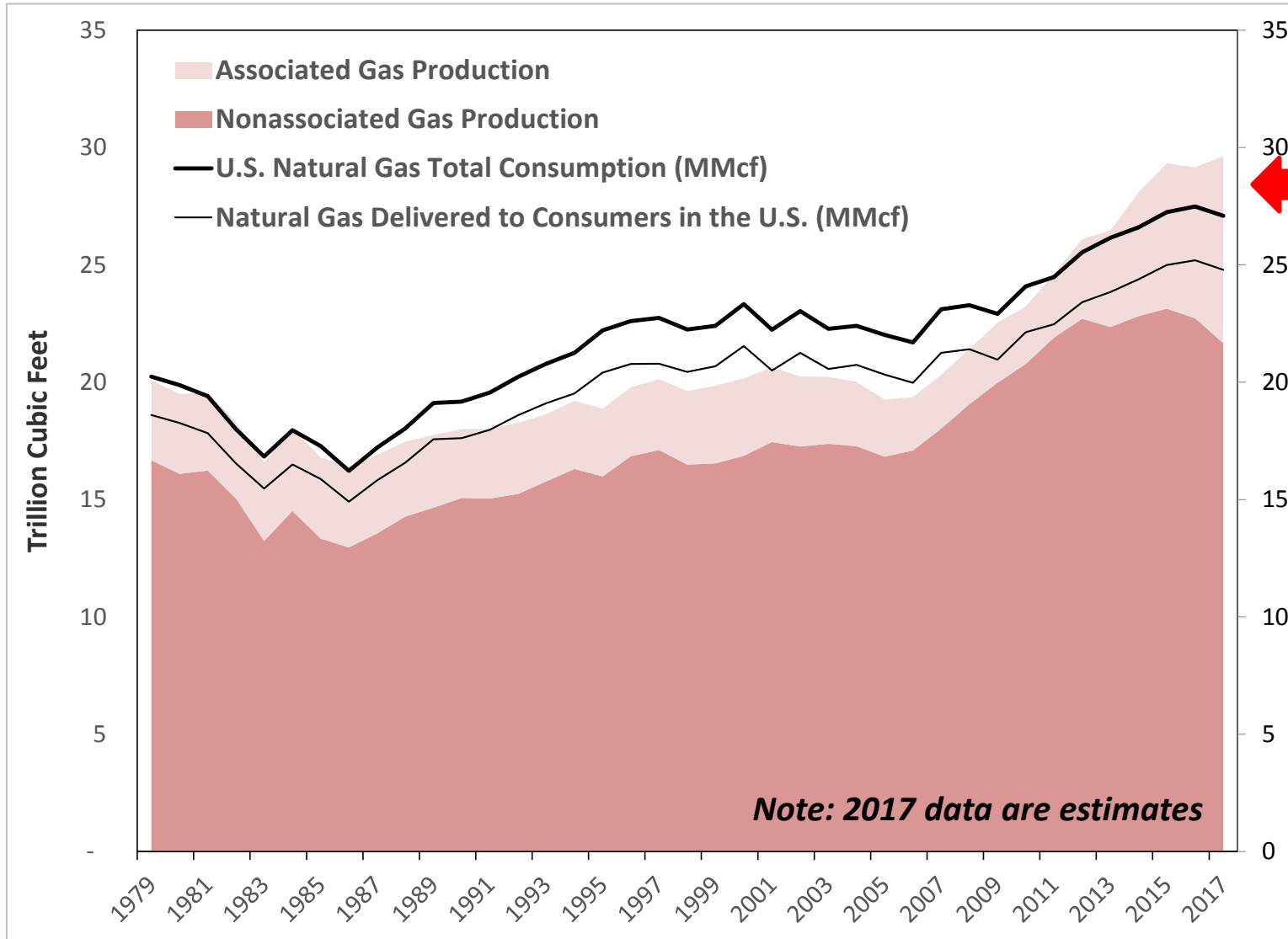
LNG Out?

* Canadian gas production, pipe delivery subject to same conditions; **EIA reserves reporting.

Ever More Reliance on “Mud Rocks”



Ever More Reliance on Associated Gas



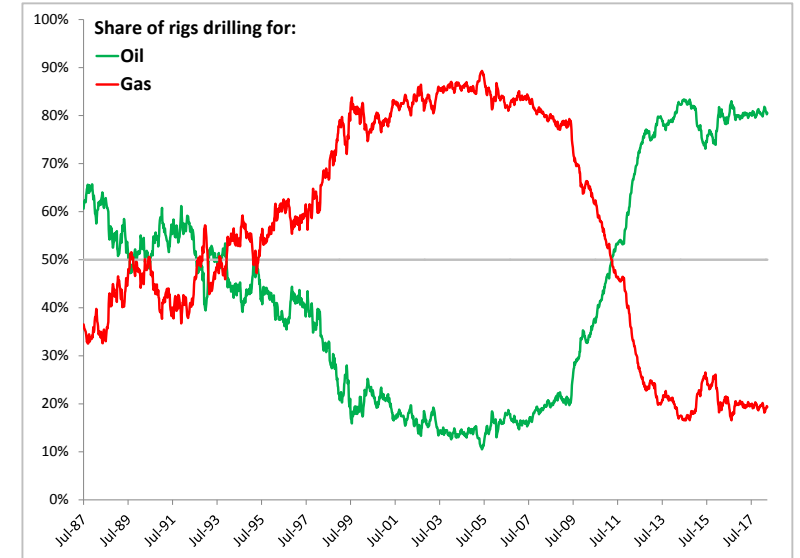
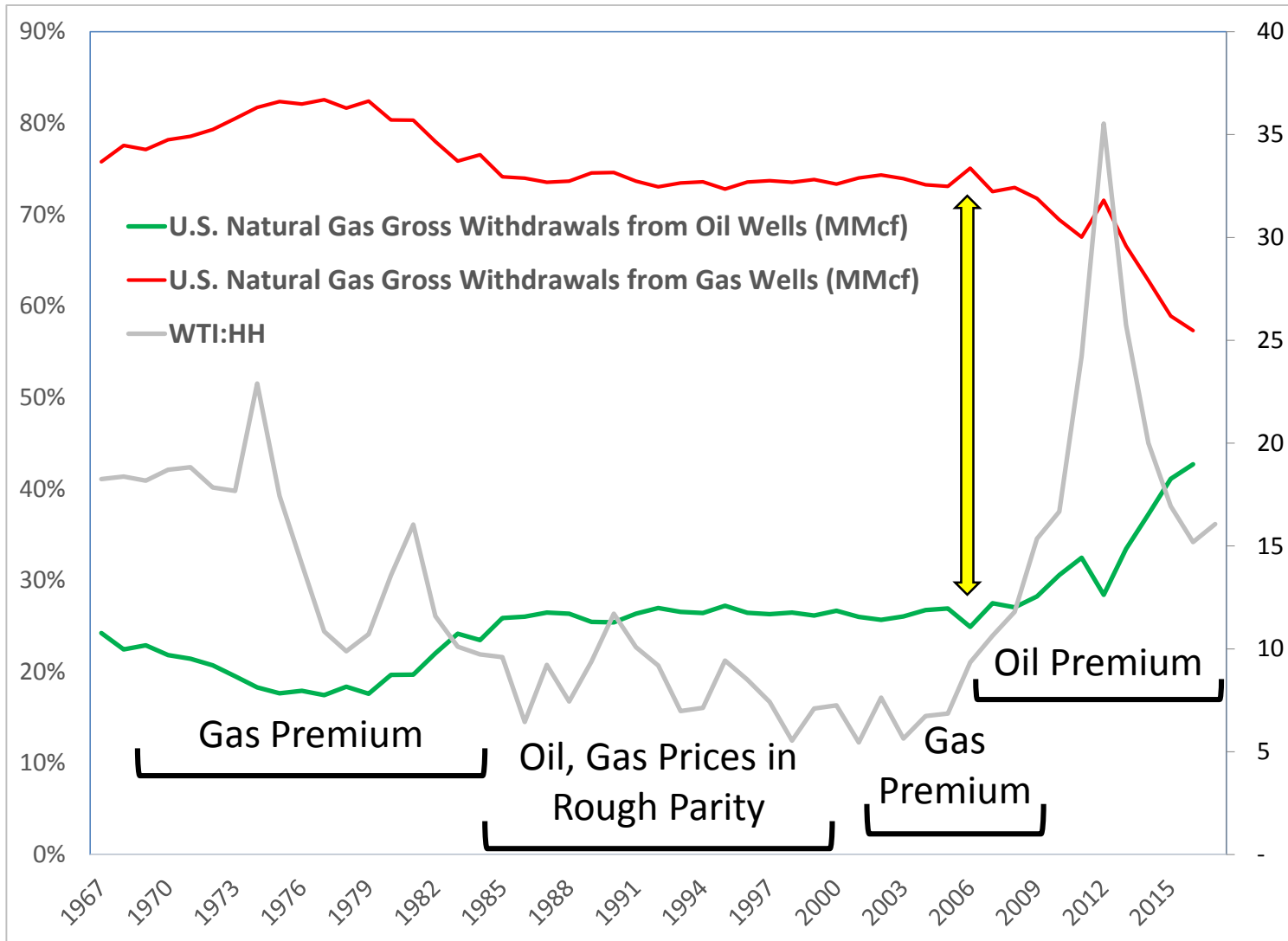
← **“Free” gas. Yay!**

Byproduct of

- **Hunt for liquids, especially Permian black oil;**
- **Over-pressured tight rock;**
- **Enormous gas drive “engines”.**

How much? How long?

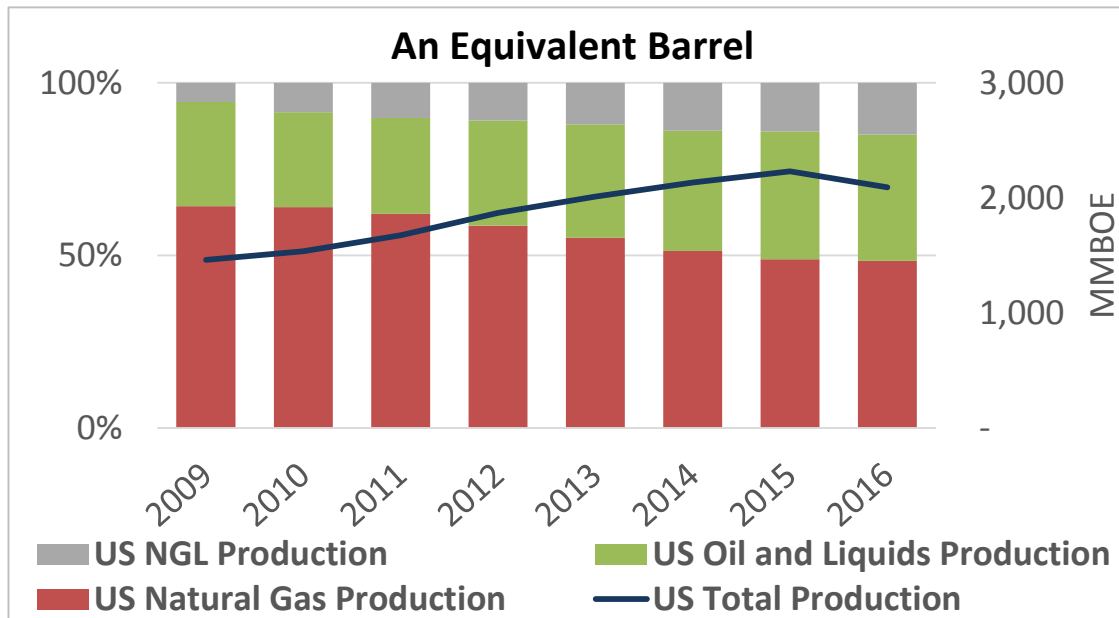
Oil, Liquids Drive Decisions Relative to Opportunities



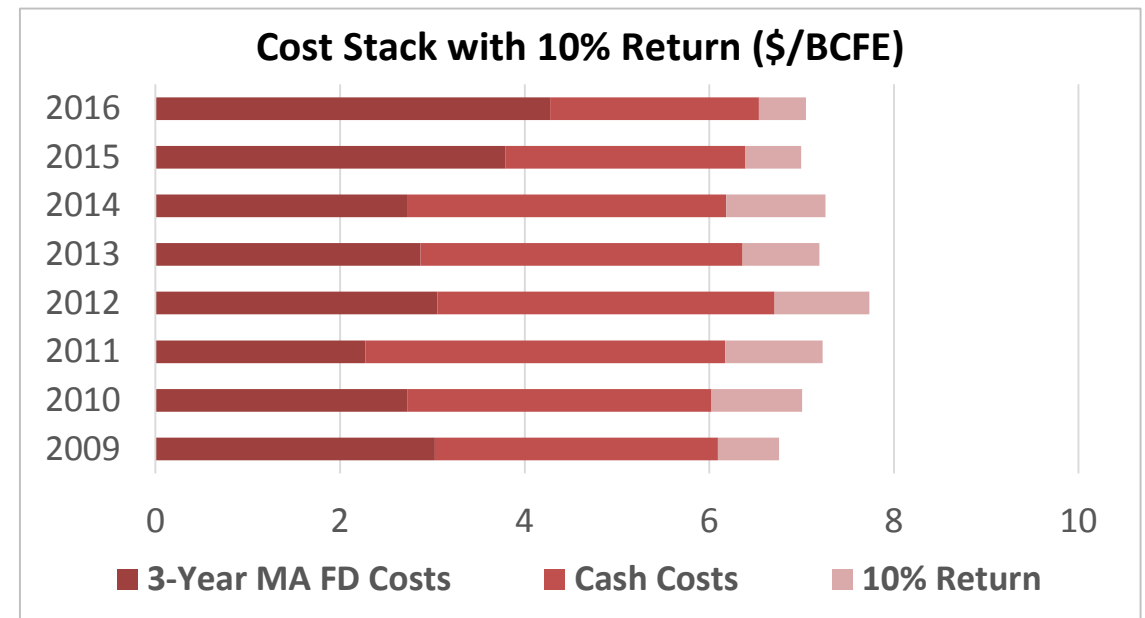
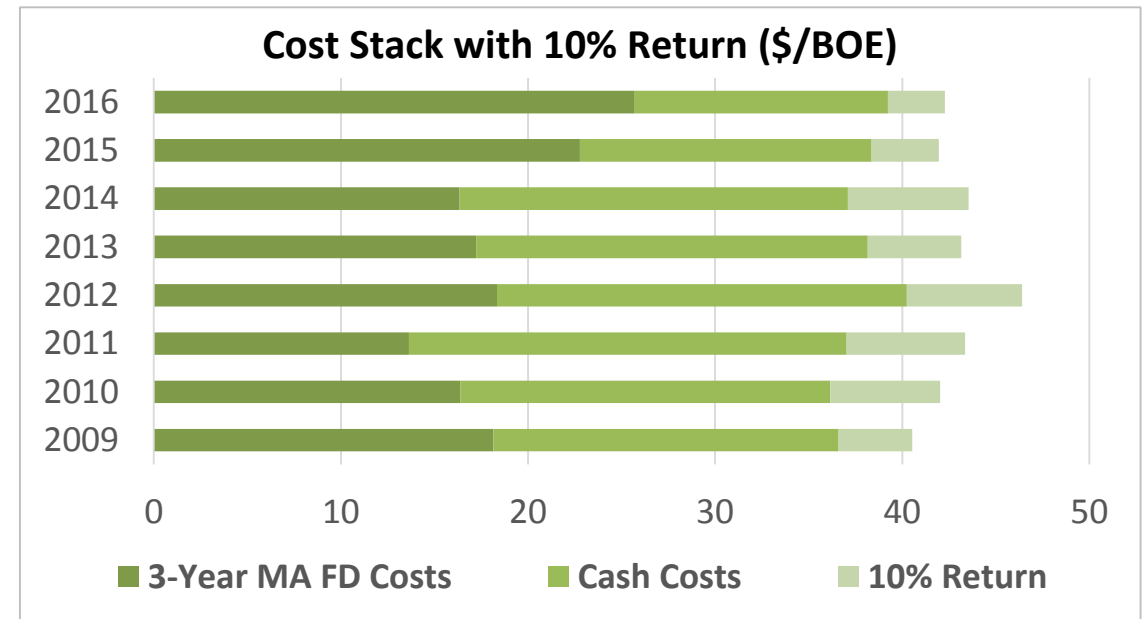
Drilling targets reflect relative premiums and expectations

Consequences for Producers

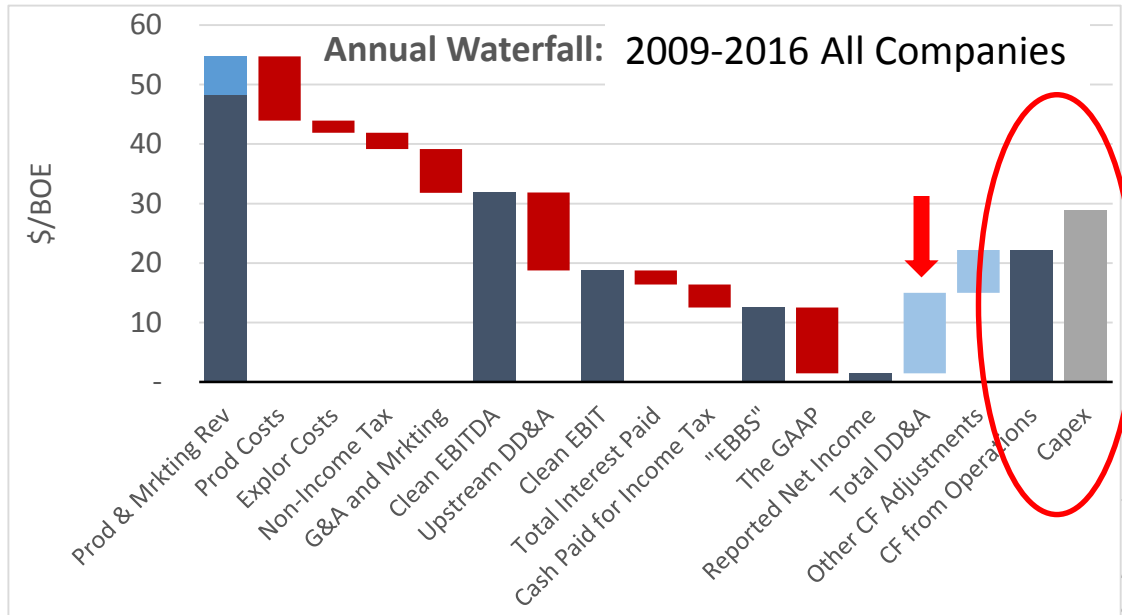
- Extraordinary hunt for liquids rich (black oil) acreage as producers continue to shift portfolios
- Rapid accumulation of debt (now, deleveraging)
- “Gassy” producers are lower cost but...
- ...if all of the cost burden was placed on methane, would need a supporting gas price



Note: CEE 2017 results expected to be broadly equivalent.
 CEE producer benchmarking, 16 companies, annual reports;
 Michot Foss analysis



Consequences for Producers



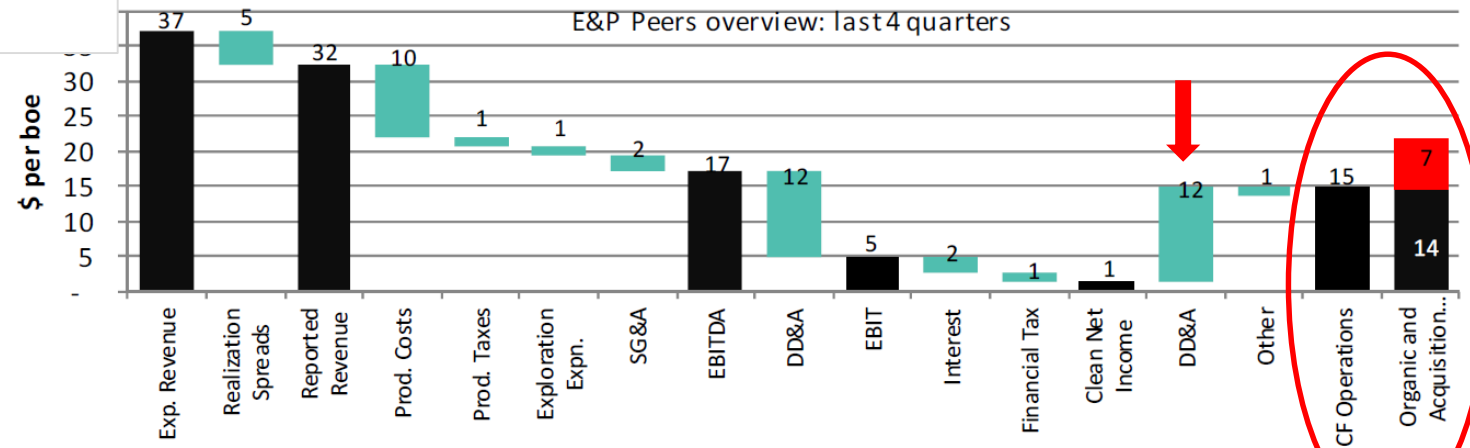
- Challenges keeping spending in line with cash flow (better)
- Large contribution of depreciation to cash flow funded spending (too much)
- Reliance on external capital markets, especially for organic capex (M&A, property dispositions)

Note: CEE 2017 results expected to be broadly equivalent; slight improvement in net income, more capital discipline

CEE producer benchmarking, 16 companies, annual reports; Michot Foss analysis

Bernstein Research (right), used with permission

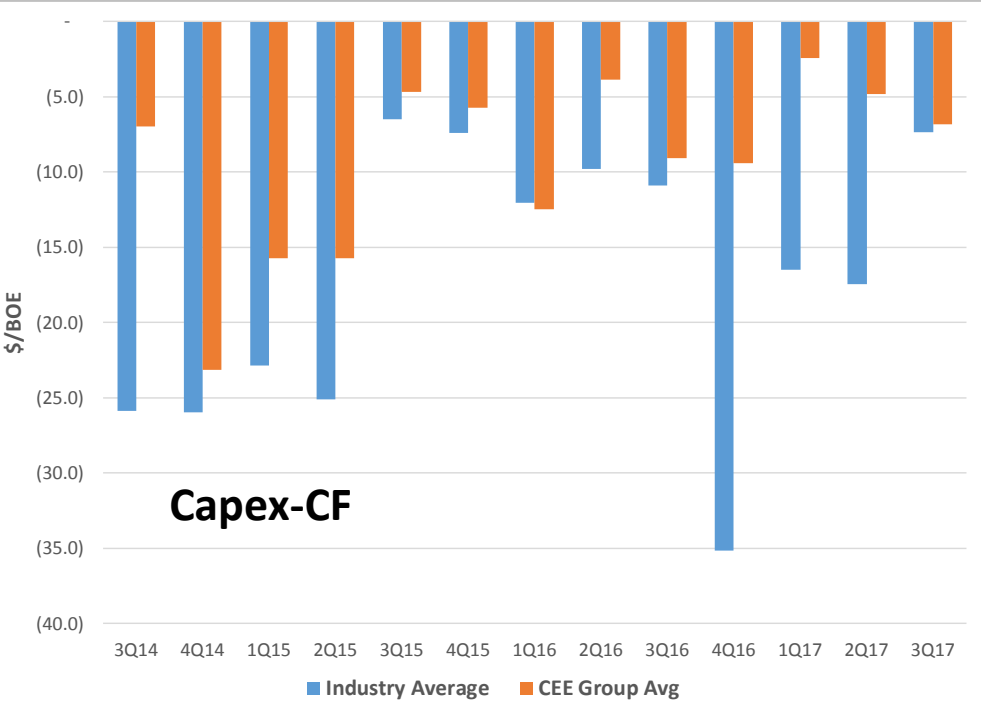
Overview of the last 4 quarters: 1Q 2017 to 4Q 2017. Ratio of Organic Capex to OCF at 97%



Source: FactSet, Company reports, Bernstein analysis (1Q17 - 4Q17 Average WTI \$50.82/bbl, HH \$2.95/mcf)

Note: Acquisition capex is shown in red color in above chart

Long Term Spending and Cash Flow

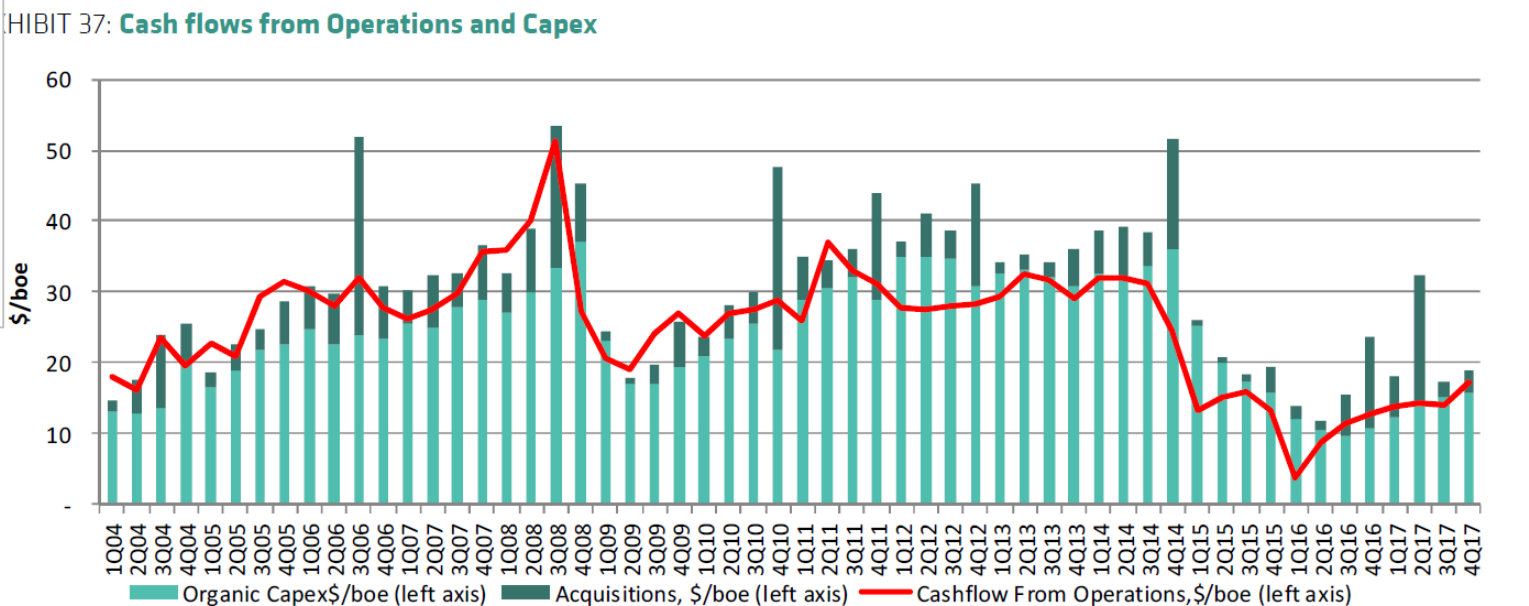


Note: CEE 2017 results expected to be broadly equivalent; slight improvement in net income, more capital discipline

CEE producer benchmarking, 16 companies, annual reports; Michot Foss analysis

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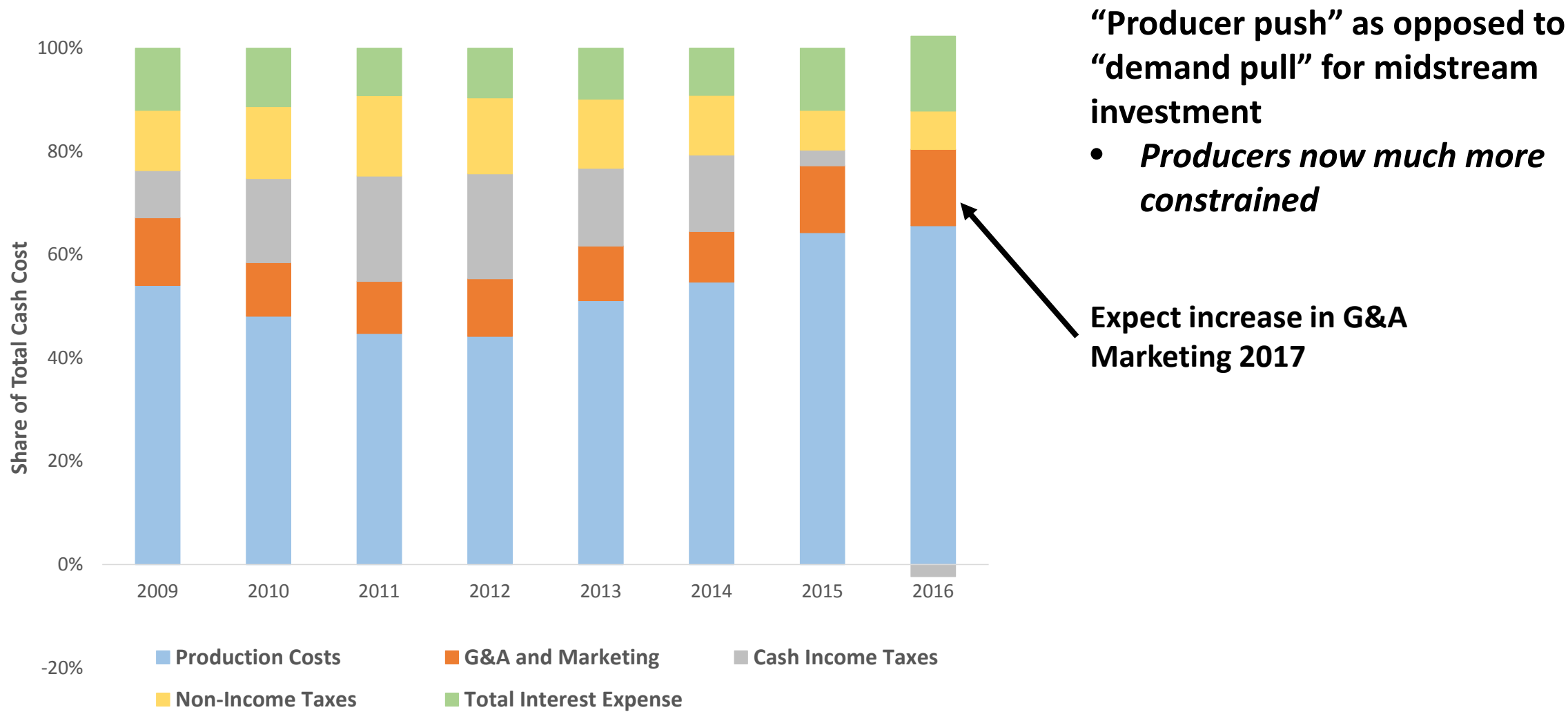
The “treadmill” shows up in the need for continuous outlays of capex, largely funded by accumulated depreciation and external capital



Source: FactSet, Company reports, Bernstein analysis, Bloomberg
Note: The production volume is an absolute measure and differs from quarter to quarter based on number of companies included in the calculations

Revised to indicate percentages on vertical axis of chart.

For Producers, Midstream Costs have Grown

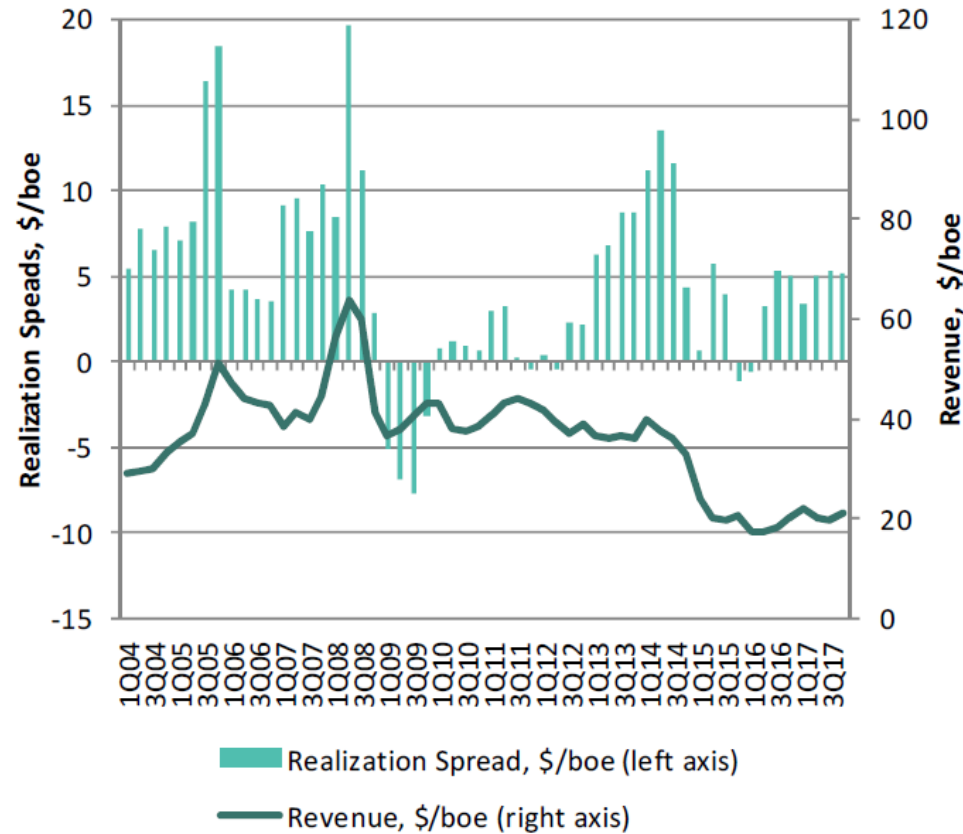


Realizations: Expected vs Reported Revenue

Positive = Realized < Expected

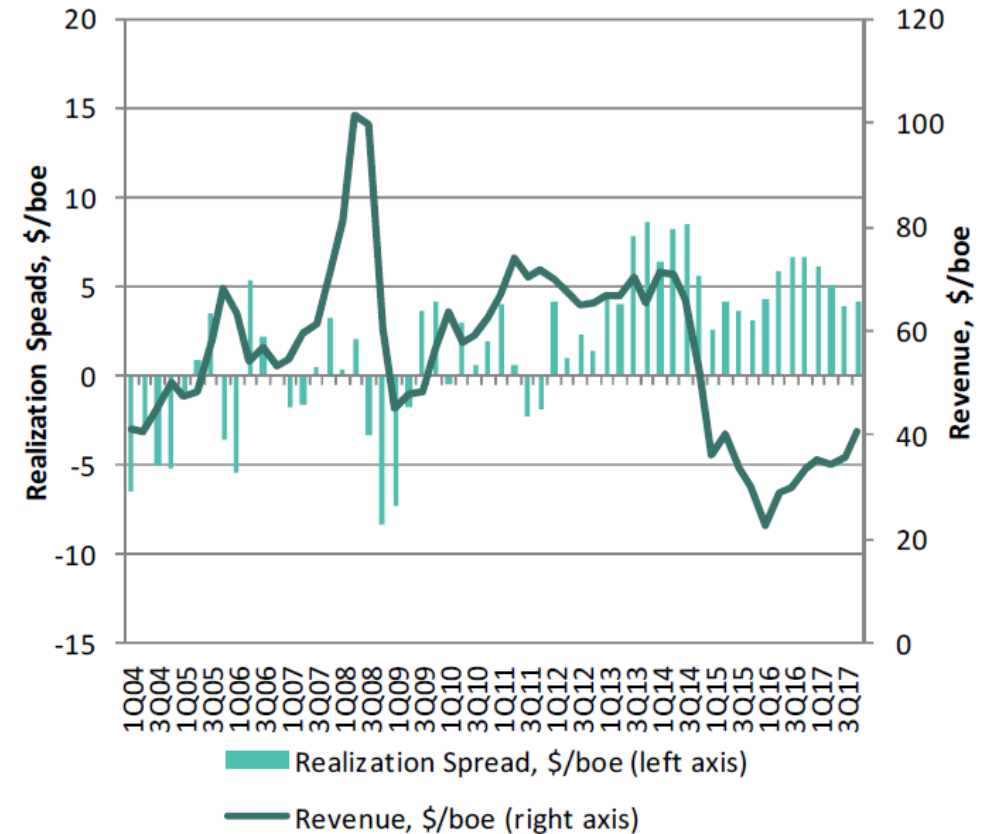
Gassy companies have greater difficulty meeting realized revenue targets

EXHIBIT 13: Realization Spreads - Gassy companies



Source: FactSet, Company reports, Bernstein analysis, Bloomberg

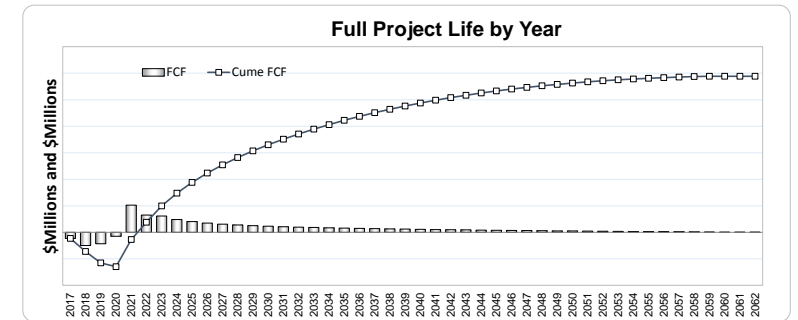
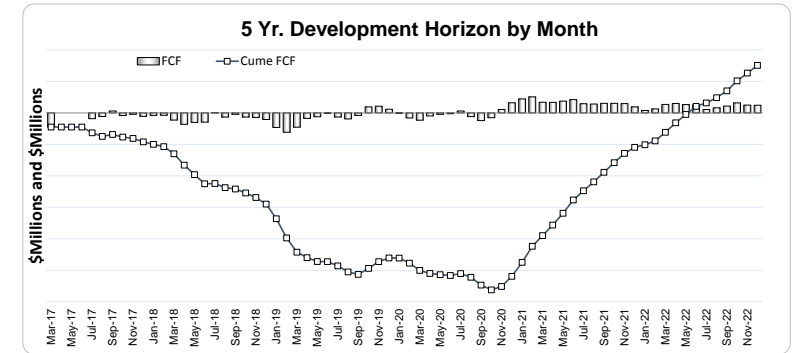
EXHIBIT 14: Realization Spreads - Oily companies



Source: FactSet, Company reports, Bernstein analysis, Bloomberg

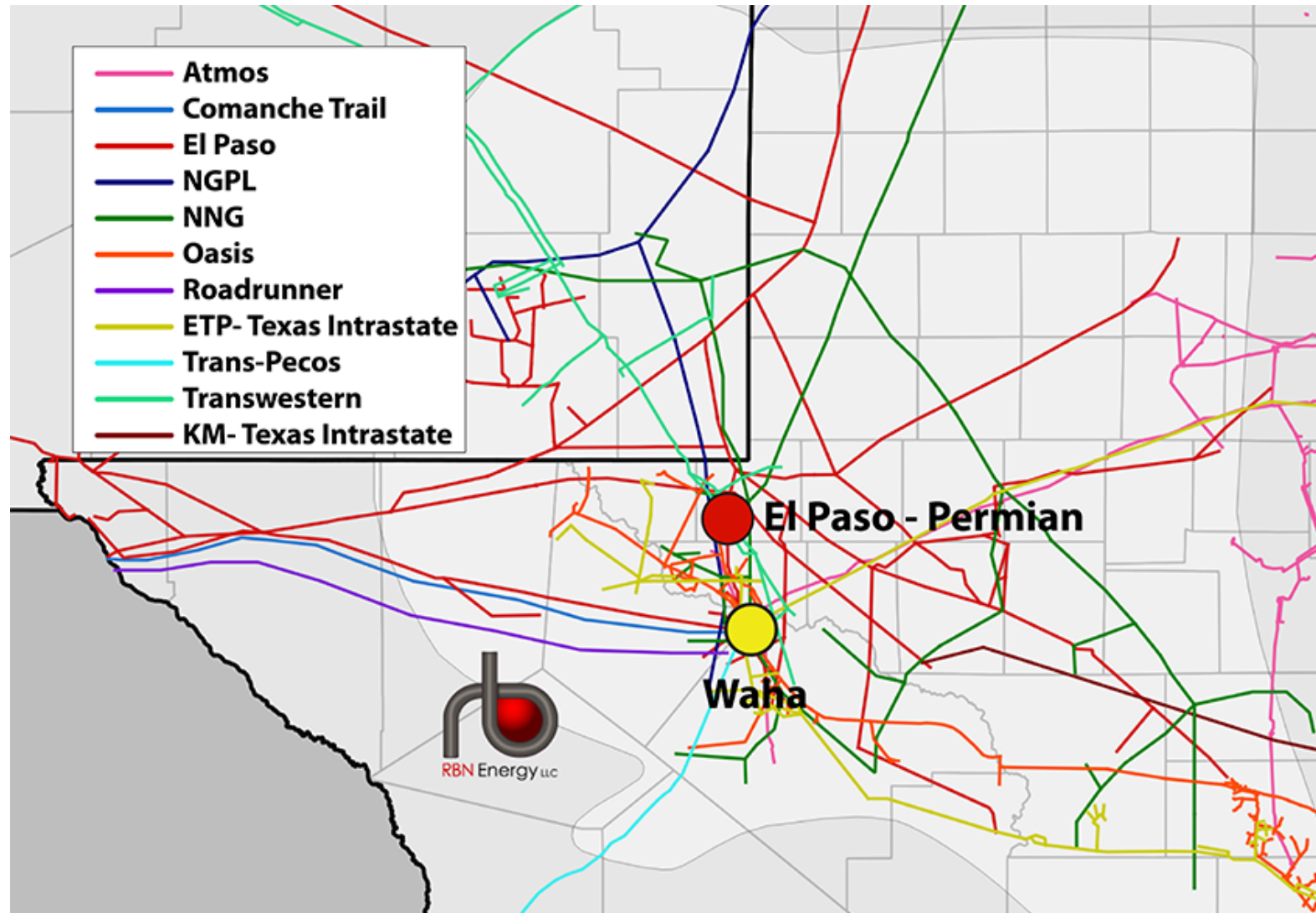
In Sum: State of the Industry

- Improvements in cost management, so far, but
 - Midstream continues to burden producers
 - Capex will grow again as companies try to reposition
 - Acreage consolidation to pursue drilling patterns
 - *The “cube” strategy of “wine rack” near simultaneous completions as companies work to manage “parent-child” well interference (charts on right, proprietary project)*
- The need to drill to sustain upstream businesses is quite real
 - “Prove up” to retain, attract new capital
 - Volumes to produce sufficient funding for operations
- Given these realities + predominant “gas drive” reservoirs + midstream bottlenecks + offtake = impact on prices and spreads



Assumptions: Avg realized crude price \$55; Avg realized gas price \$3.20

Waha and EP-P



Weekly

El Paso Permian

West Texas/SE New Mexico Natural Gas Prices



NGI naturalgasintel.com

Deterioration of spreads

Waha

West Texas/SE New Mexico Natural Gas Prices



NGI naturalgasintel.com

Houston Ship Channel

East Texas Natural Gas Prices



NGI naturalgasintel.com

Henry Hub

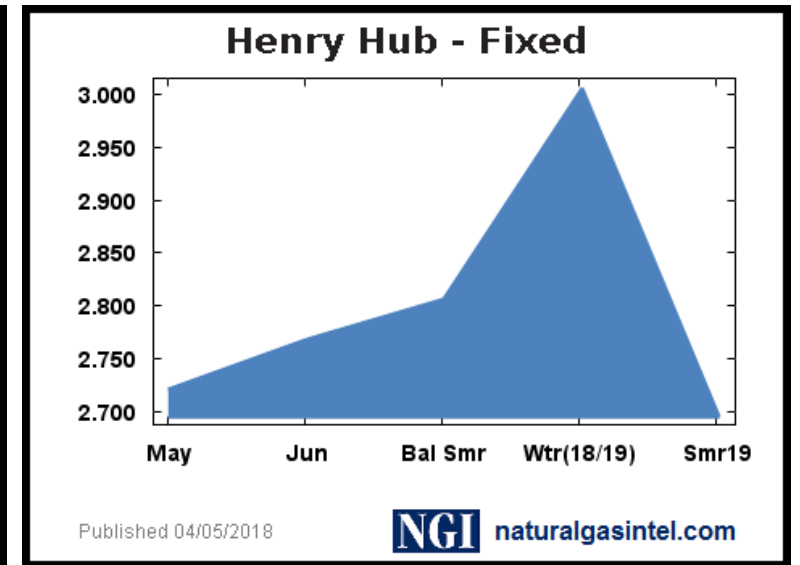
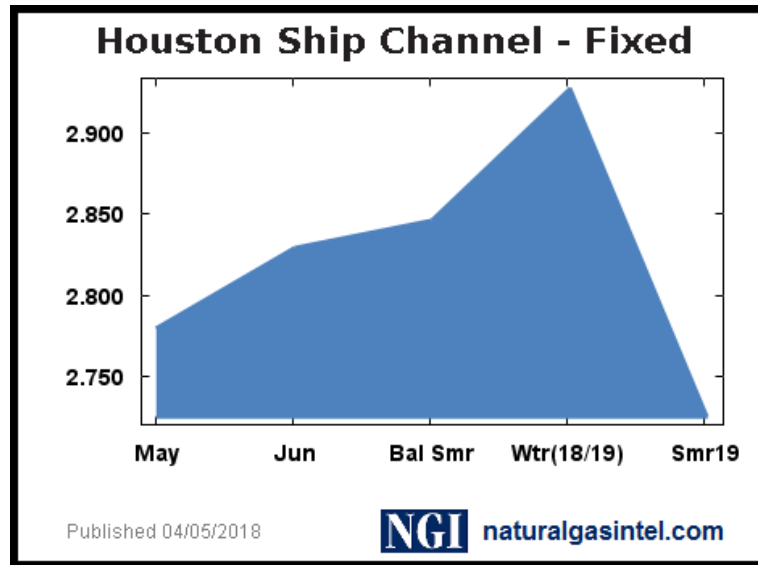
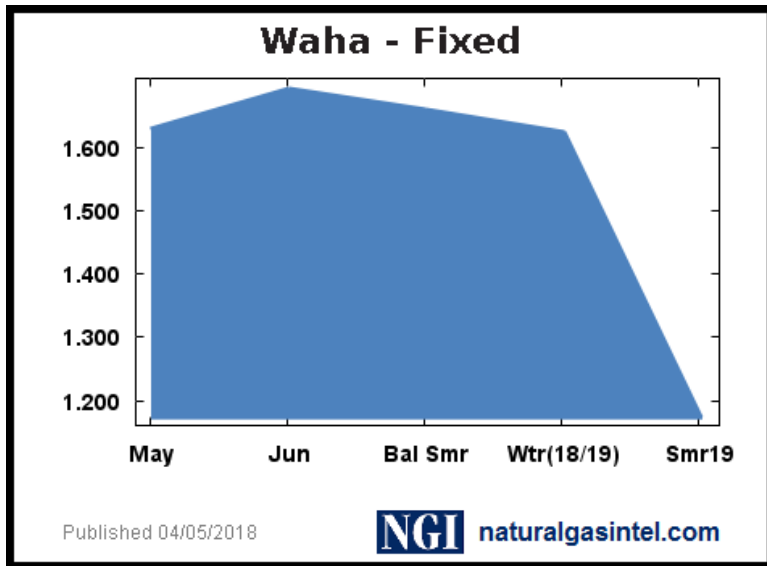
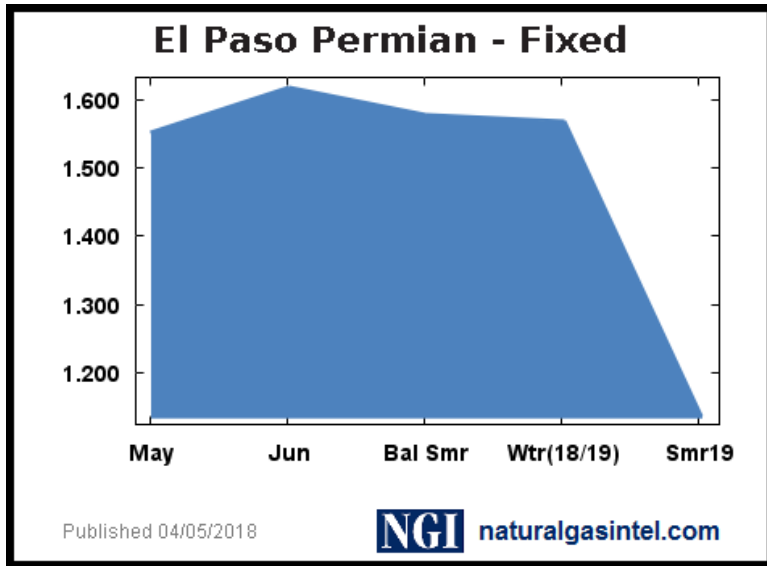
South Louisiana Natural Gas Prices



NGI naturalgasintel.com

http://www.naturalgasintel.com/data/data_products/weekly?location_id=SLAHH®ion_id=south-louisiana

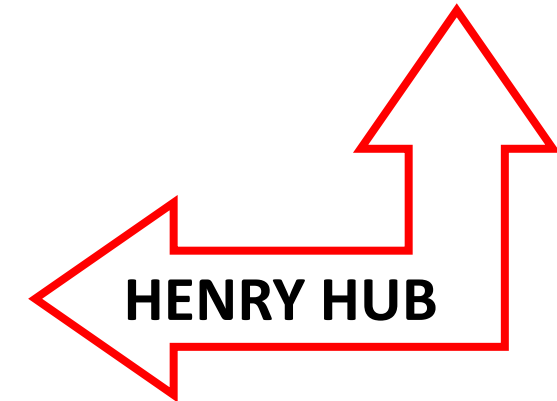
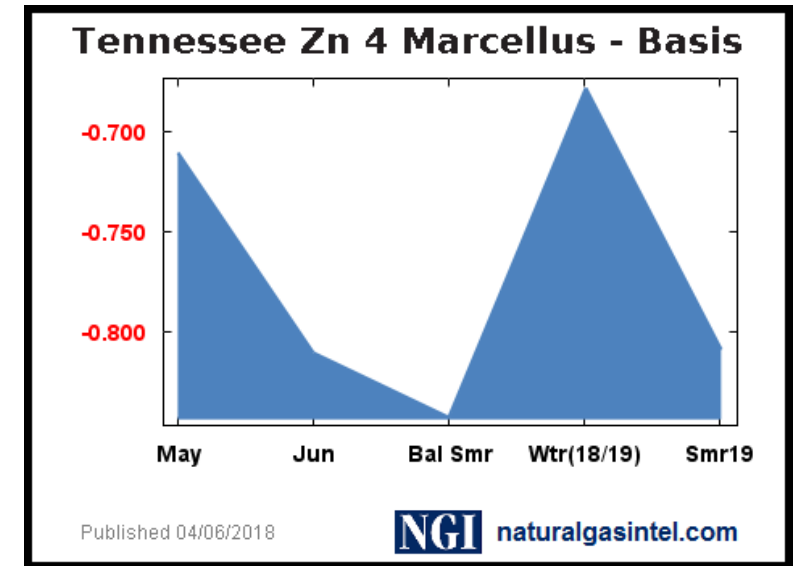
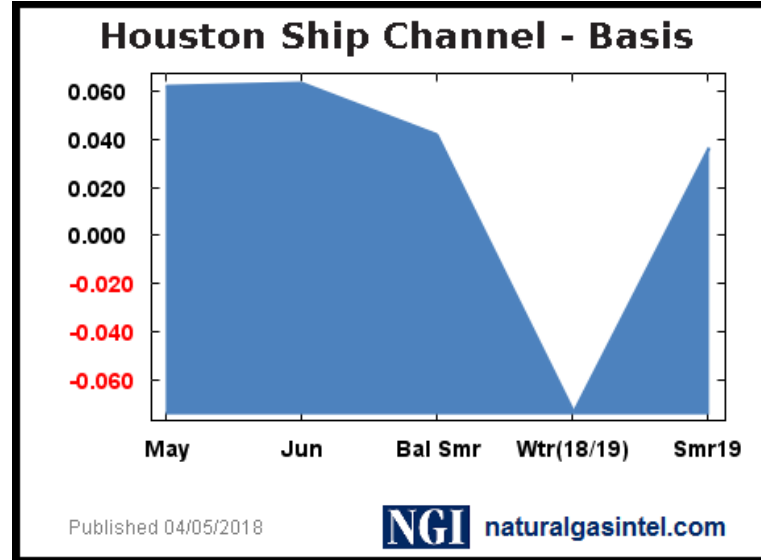
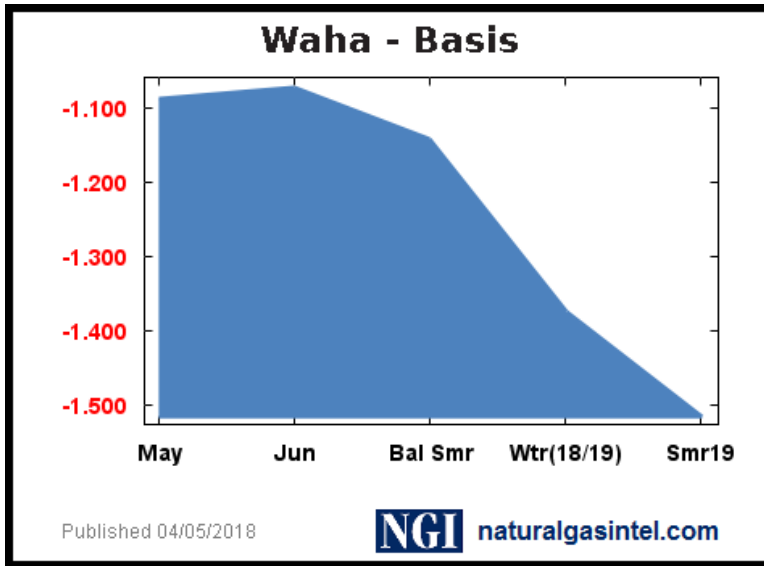
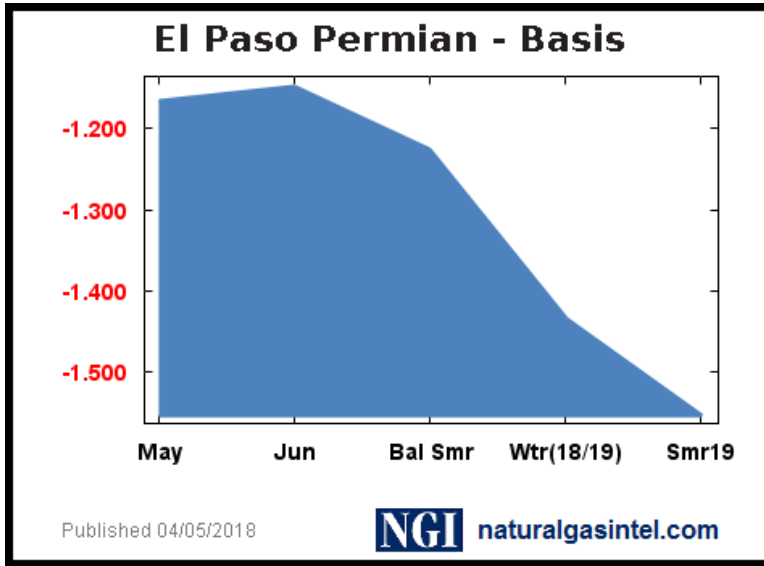
Forward - Fixed



Forward prices of natural gas delivered for each reference period at the various locations/hubs.

http://www.naturalgasintel.com/data/data_products/forward-contracts?location_id=SLAHH®ion_id=south-louisiana

Forward - Basis

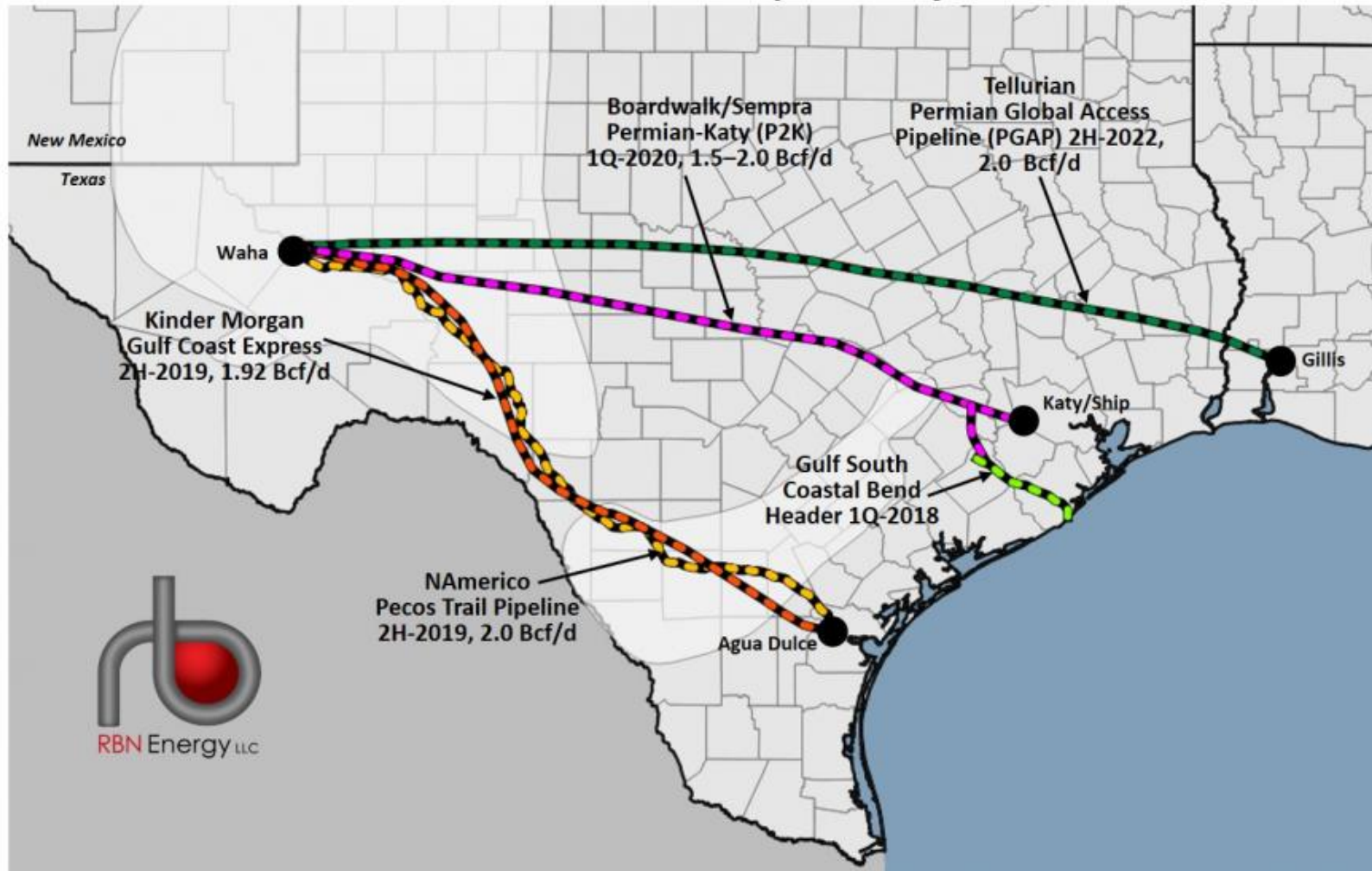


"Basis price" represent the differential, for each reference period, between the Henry Hub and various locations/hubs.

http://www.naturalgasintel.com/data/data_products/forward-contracts?location_id=SLAHH®ion_id=south-louisiana

A fix?

Permian Natural Gas Pipeline Projects

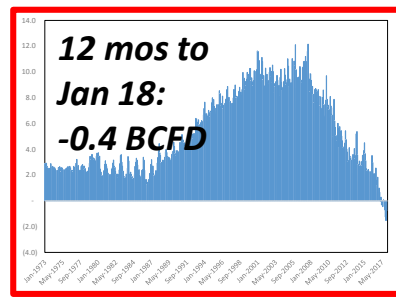


Usefulness of Spreads

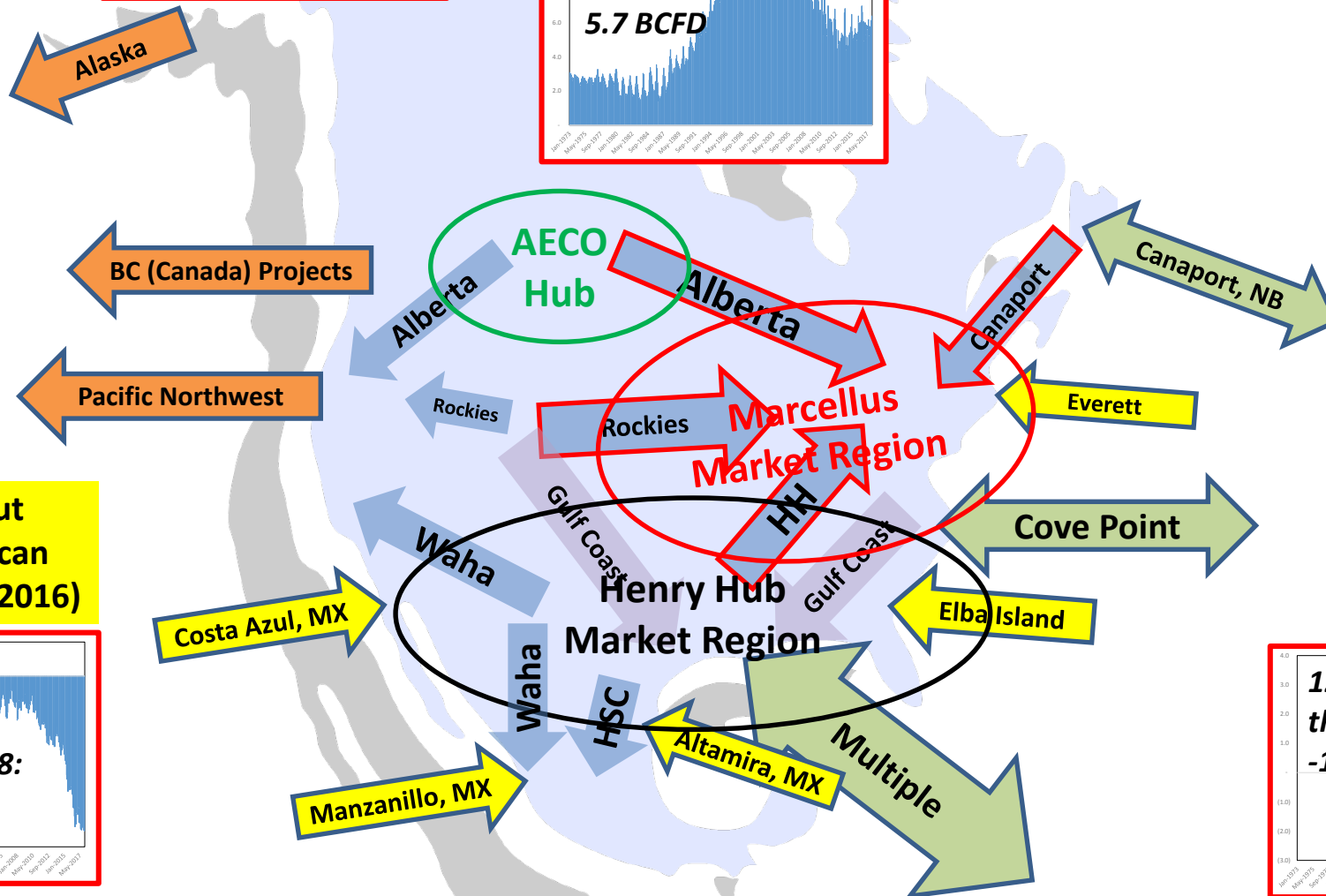
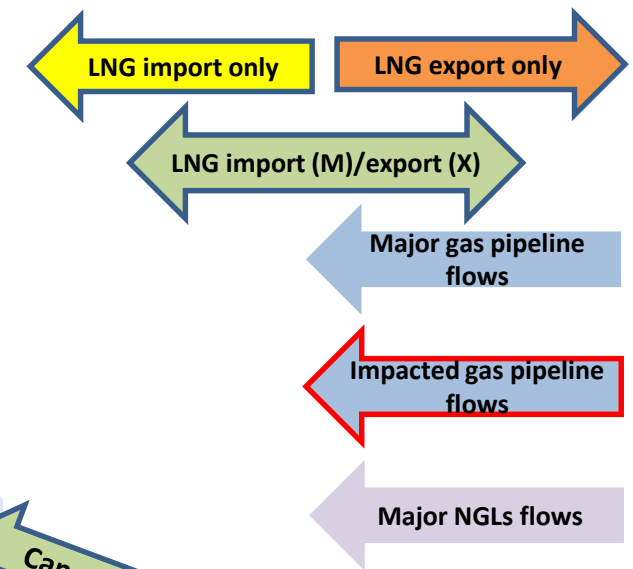
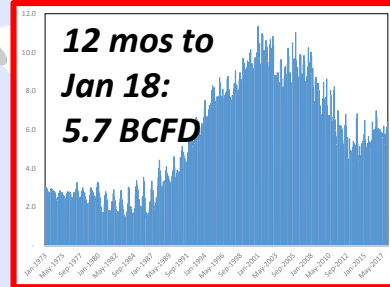
- Lure investment to bottlenecks and...
- ...attract monetization options...
 - *Gains from trade*
 - *End users*
- ...so long as business conditions support “optionality”.
 - *And it can be paid for.* 😊

US/NAM Gas Trade Net Imports

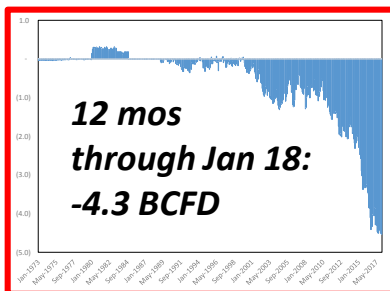
2013: ~2x current
NA exports by 2020
to ~9+ BCFD?
As of Jan 18
~9 BCFD



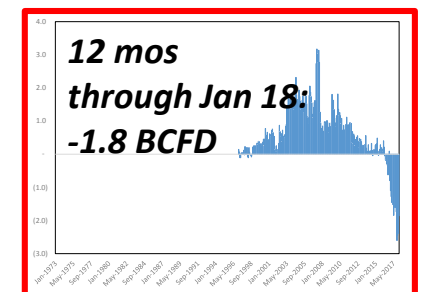
U.S. is about
24% of Canadian
consumption (2016)



U.S. is about
47% of Mexican
consumption (2016)

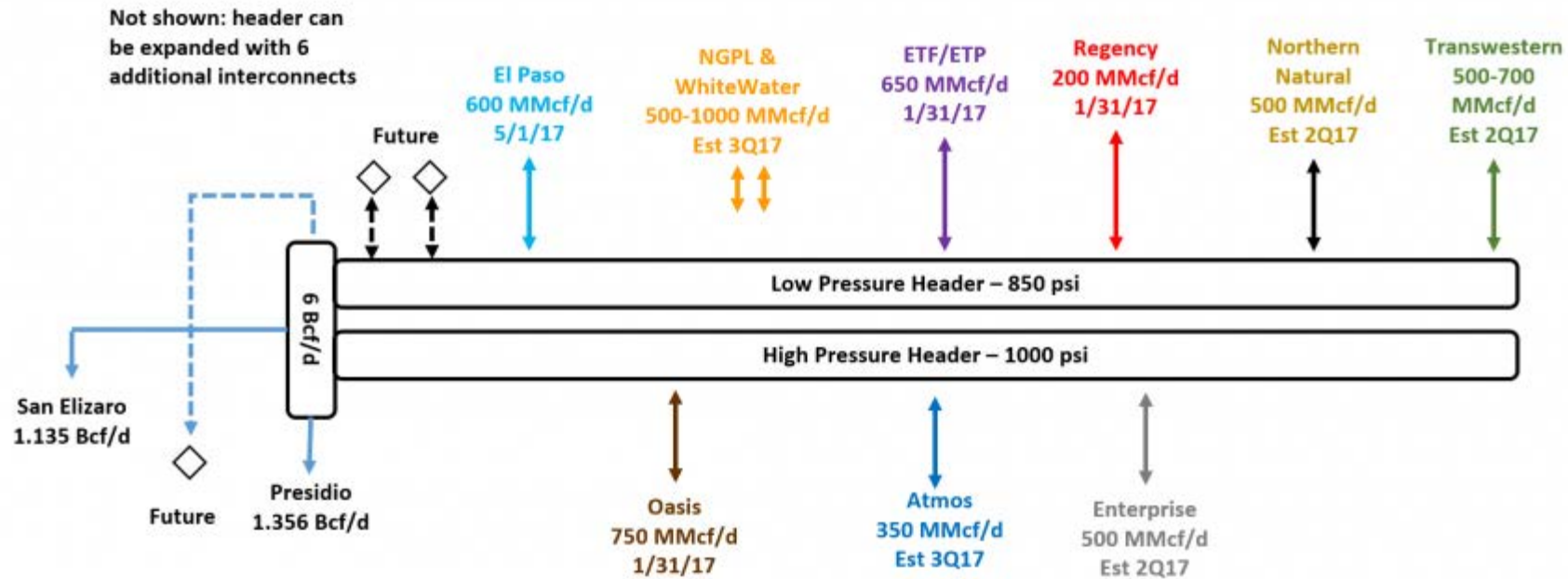


U.S. LNG

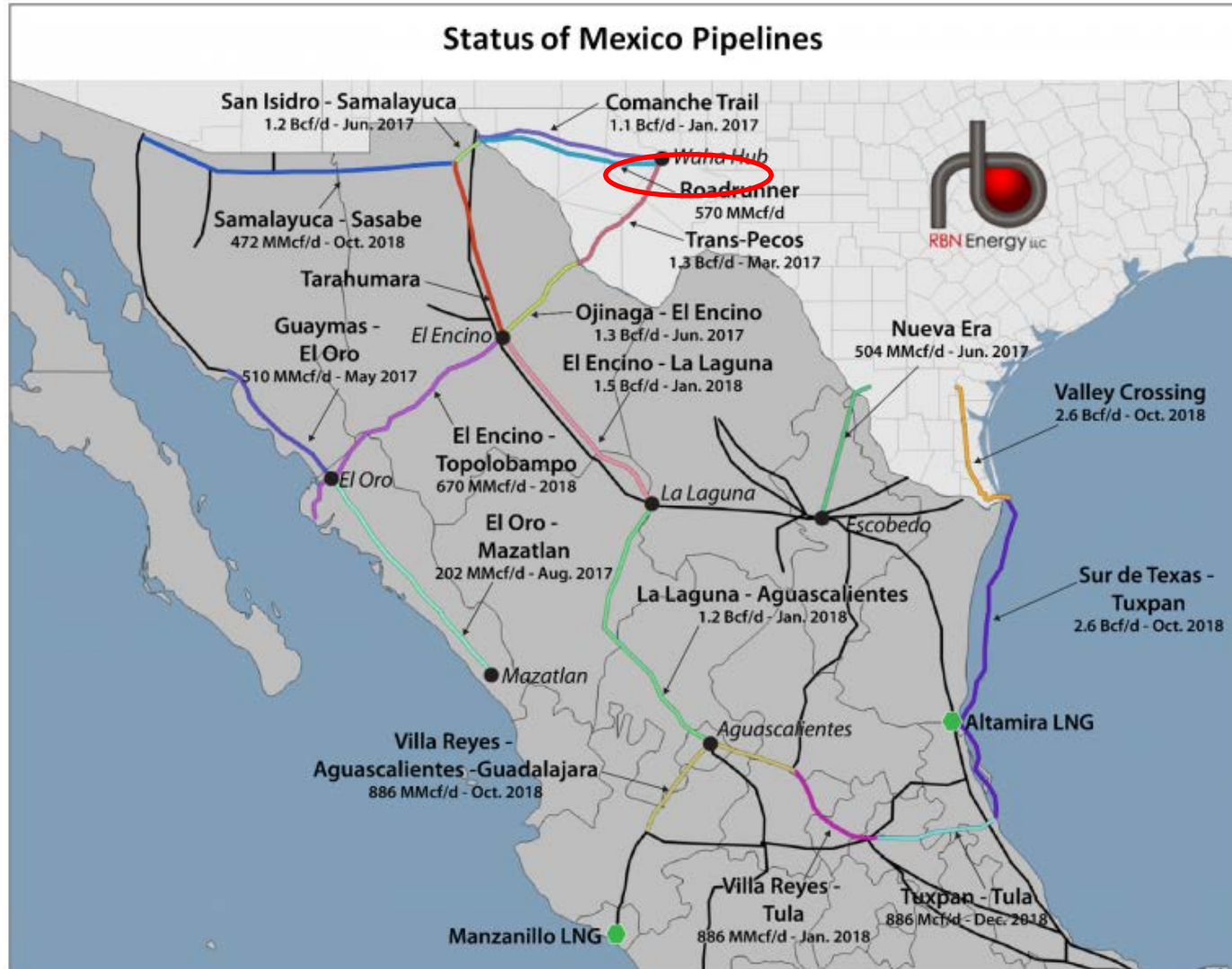


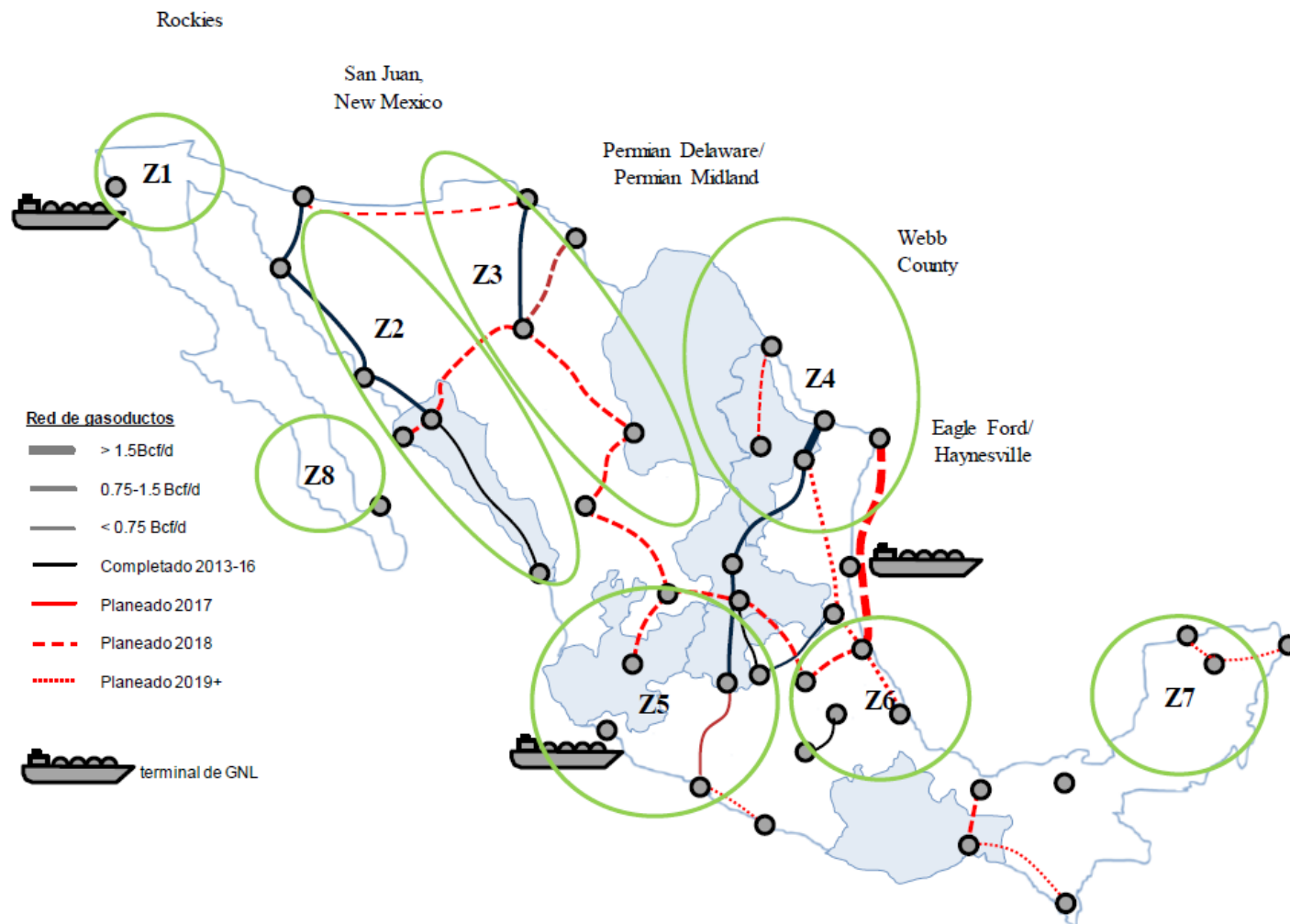
Waha Infrastructure

Waha Header & Interconnections



Big Bets



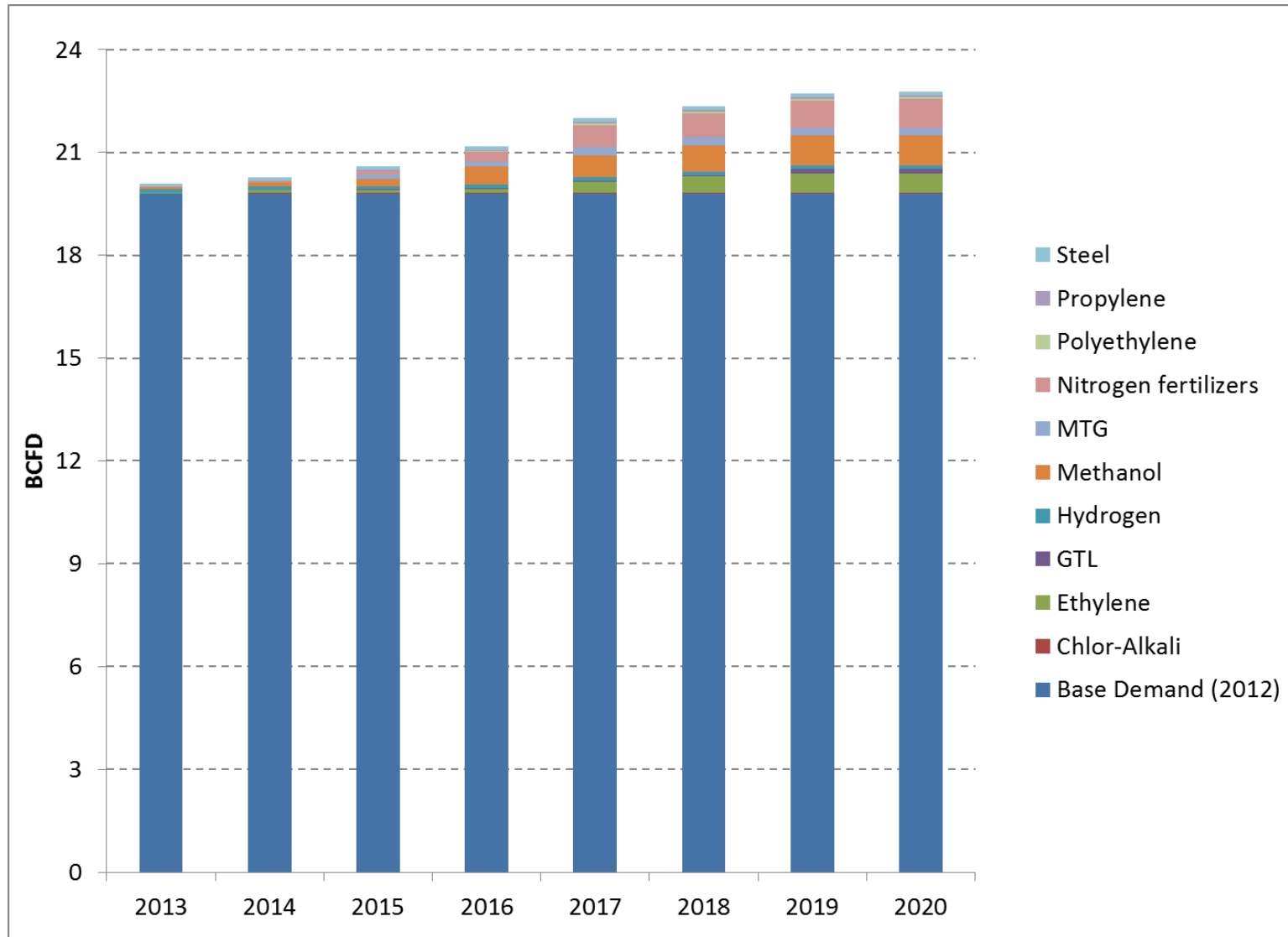


CFE's zonal pricing strategy intended to:

- Improve signaling for internal de-bottlenecking and expansions
- Improve price signals for imports
- *Provide price signals for domestic production*

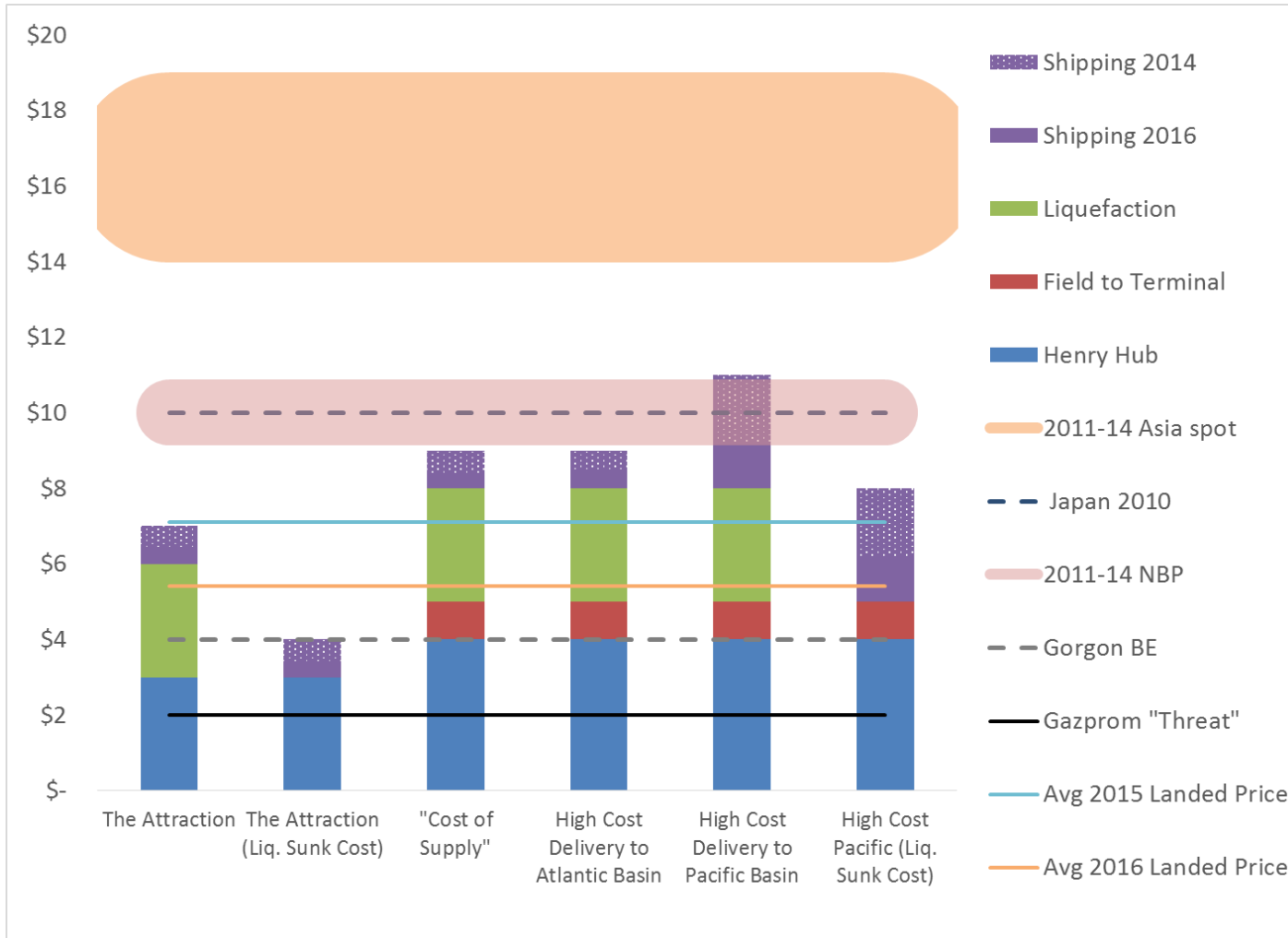


Our Renaissance



- ***About 100 Projects***
- ***About \$90 billion***
- ***Incremental NG demand of ~3 BCFD***

Global LNG complexities...



- **“Low” demand growth (China, India, Japan, and others):**
 - Coal, nuclear, renewables have priority - energy security
 - Not enough gas infrastructure (especially storage)
 - Low gas market readiness
 - Sluggish economic growth
 - Japanese energy policy: nuclear, renewables, efficiency
- **“Surging” global LNG supply → excess supply until the mid 2020s**
 - Unsubscribed U.S. liquefaction capacity
 - Parts of contracted volumes not tied to specific destinations

http://www.beg.utexas.edu/energyecon/template/IAEE%20Energy%20Forum_062116.pdf

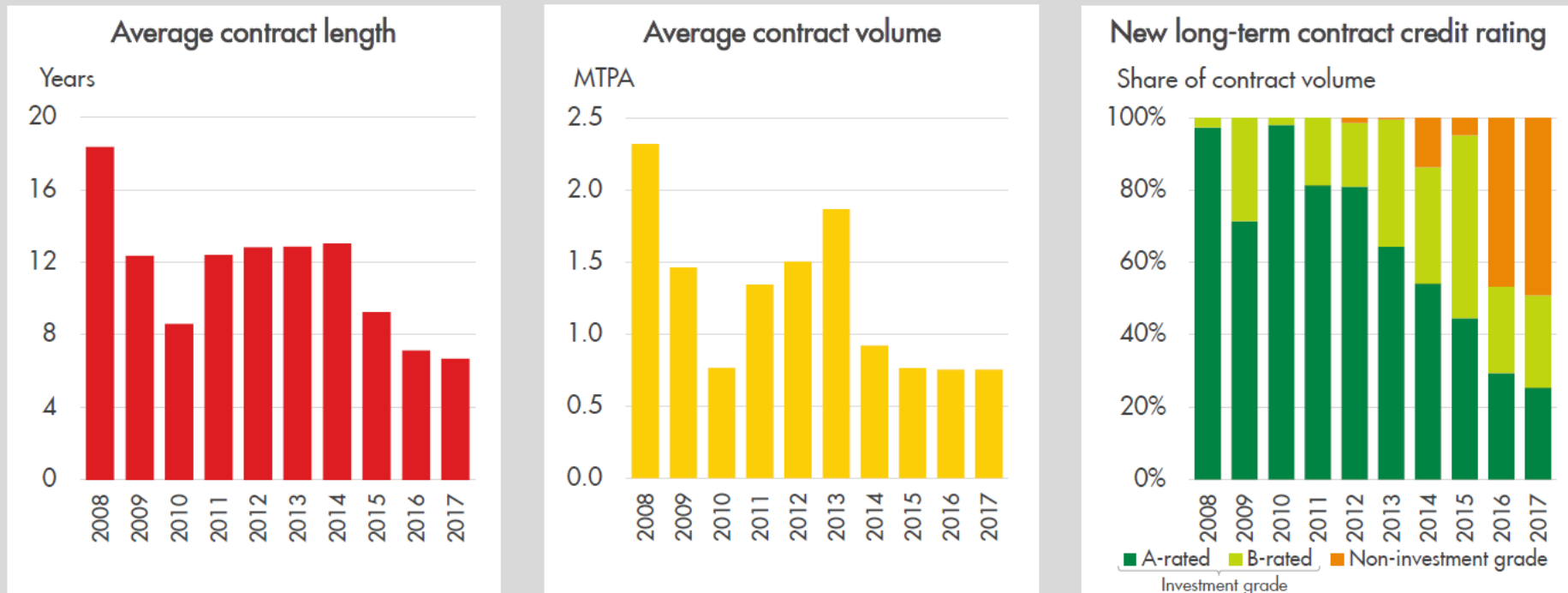
http://www.beg.utexas.edu/energyecon/thinkcorner/CEE_Advisor_Research_Note-Andy_Flower_LNG_Supply_Outlook-Aug16.pdf

http://www.beg.utexas.edu/energyecon/thinkcorner/CEE_Research_Paper-China_and_India_Current_Future_Natural_Gas_Demand-Apr17.pdf

http://www.beg.utexas.edu/energyecon/thinkcorner/CEE_Research_Paper-China_and_India_Current_Future_Natural_Gas_Demand-Apr17.pdf

...and rapidly shifting terrain.

LNG BUYERS SIGNING SHORTER AND SMALLER CONTRACTS



Source: Shell interpretation of IHS Markit Q4 2017, Moody's and Fitch data

Creditworthiness of buyers is a substantial risk to global LNG trade growth.

Closing Thoughts

- How to keep the success story going
 - *First, do no harm*
- Ultimately, market will set pathway...
 - Cost of capital
 - Attraction of oil and gas for investment portfolios
 - Ability of producers to consolidate acreage positions in order to sustain, improve efficiencies and get off the treadmill (???)
 - Trade, petrochemicals do not provide enough “oompf”
 - Gas competitiveness for electric power is key
- **...perceptions will dictate**

