What is This Stuff Really Worth?

A Wood Mackenzie Presentation for
The Center for Energy Economics
Bureau of Economic Geology
2010 Annual Meeting and Natural Gas Forum

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The New Big Picture—The Resource is There, But…

Gas is Available in Any Feasible Quantity at a Moderate Price …But It's *Not* $4.00.

› **Short-Term: Through early 2012**

- Weighted by sluggish economic recovery and supply strength; coal displacement continues to influence the gas market

› **Mid-Term: Late 2012 - 2016**

- With an increasing call on production as demand growth resumes, there is potential for growing pains as the market transitions from retrenchment to expansion; prices rise to the $5.75 - $7 range.

› **Long-Term: 2016 and Beyond**

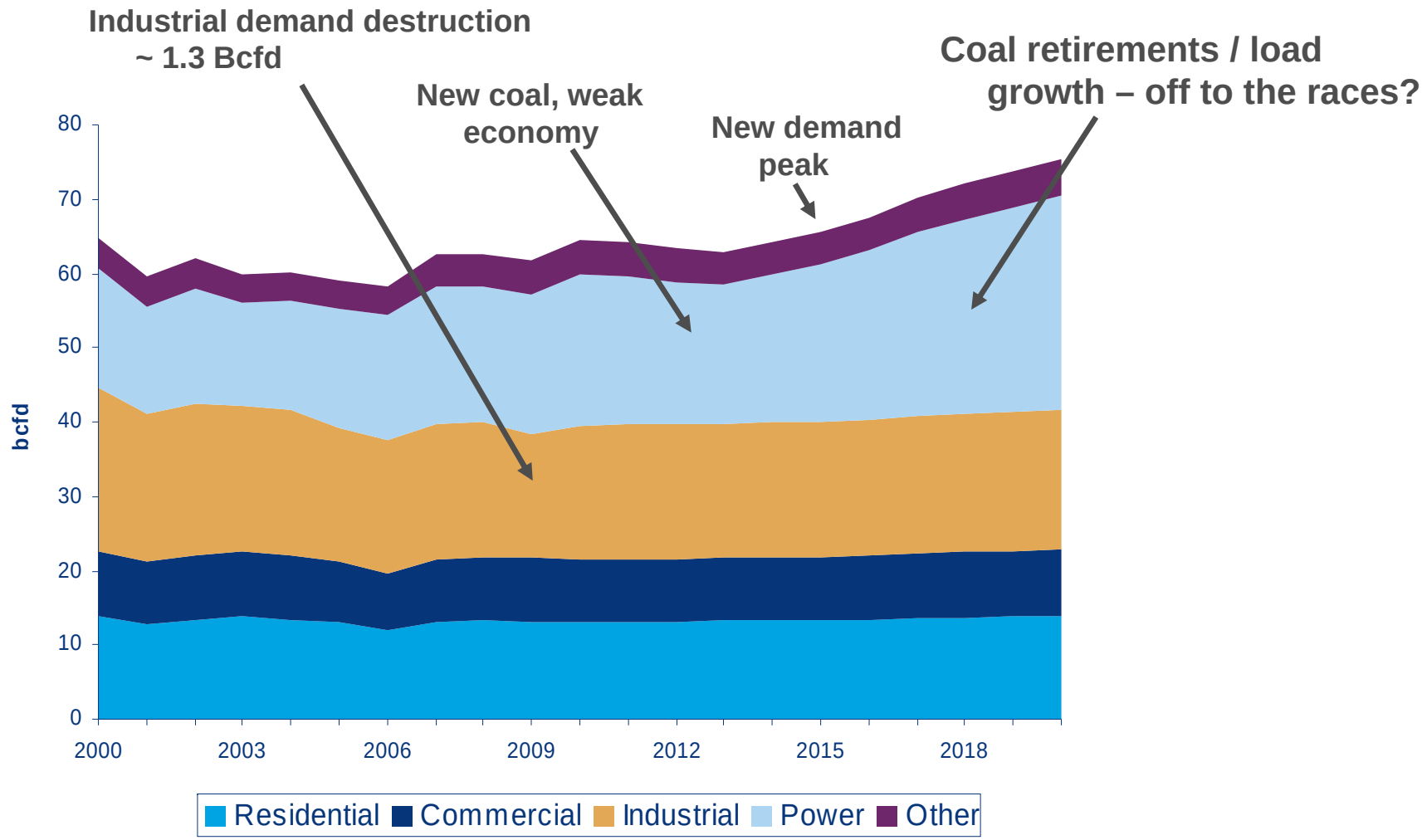
- Consistent demand growth appears likely, with the pace of growth shaped by coal retirements, potential carbon legislation and long-term US domestic resource strength.
- With the rebuilding of the upstream, pricing remains moderate: $6.50 - $7.50

Within this Base Case view of the North American market, policy and politics will become increasingly influential, and can shift the fundamentals

What has it Taken to Get Prices Even Where they Are? A Coincidence of Strong Factors:

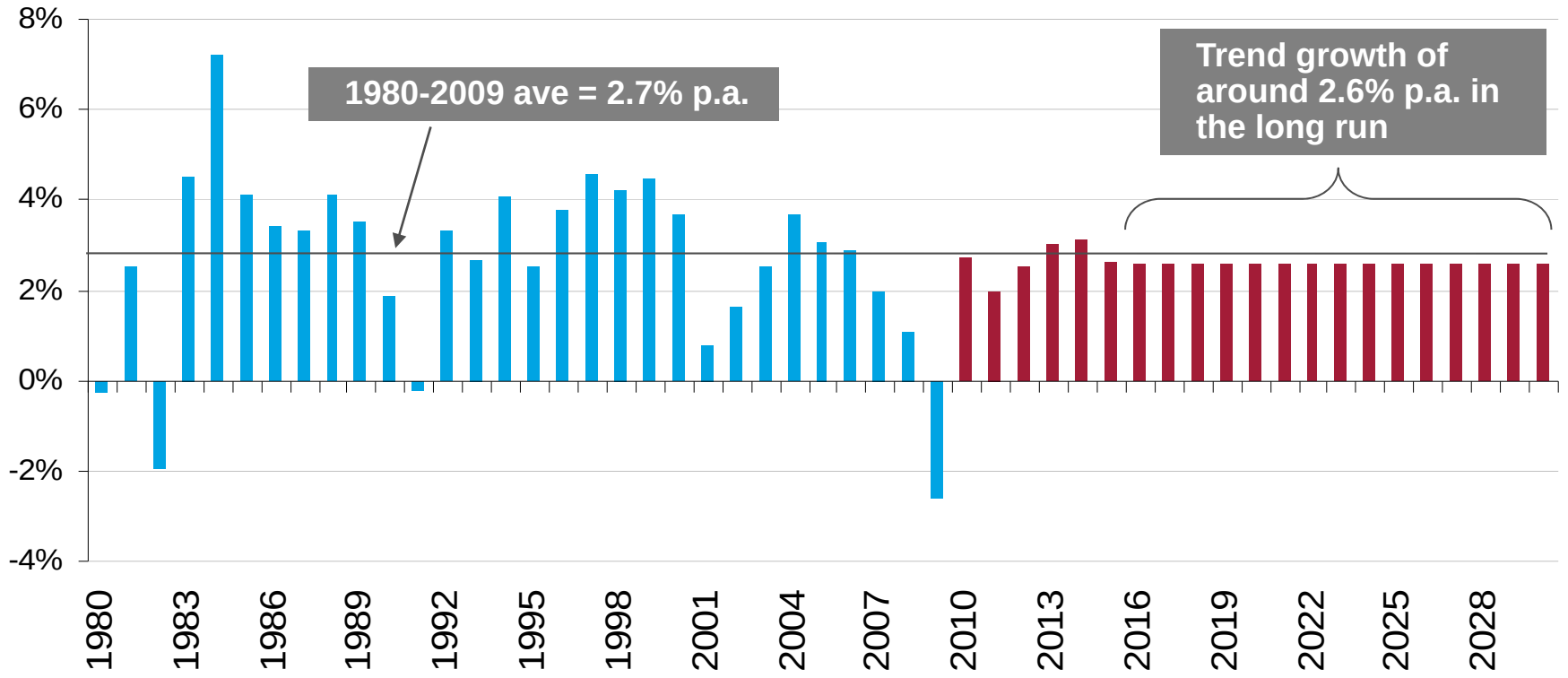
- **1) Economic Cataclysm**
  - Steepest economic downturn since Great Depression …
  - *And* a slower than average rebound
- **2) Demand Destruction**
  - Approximately 1.3 Bcfd in the industrial sector in 2009, partially offset by coal displacement and weather
- **3) A Production Peak**
  - Highest rate since 1973
  - Likely to see declines starting early-mid 2011
- **4) All-time High Storage**
  - 1800 + Bcf, all-time high, for the spring inventory minimum

US Demand – Still weak, but consistent pressure 2013 and beyond



Economic Crisis – the Steepest GDP Decline in Recent Decades, and a Weak Rebound

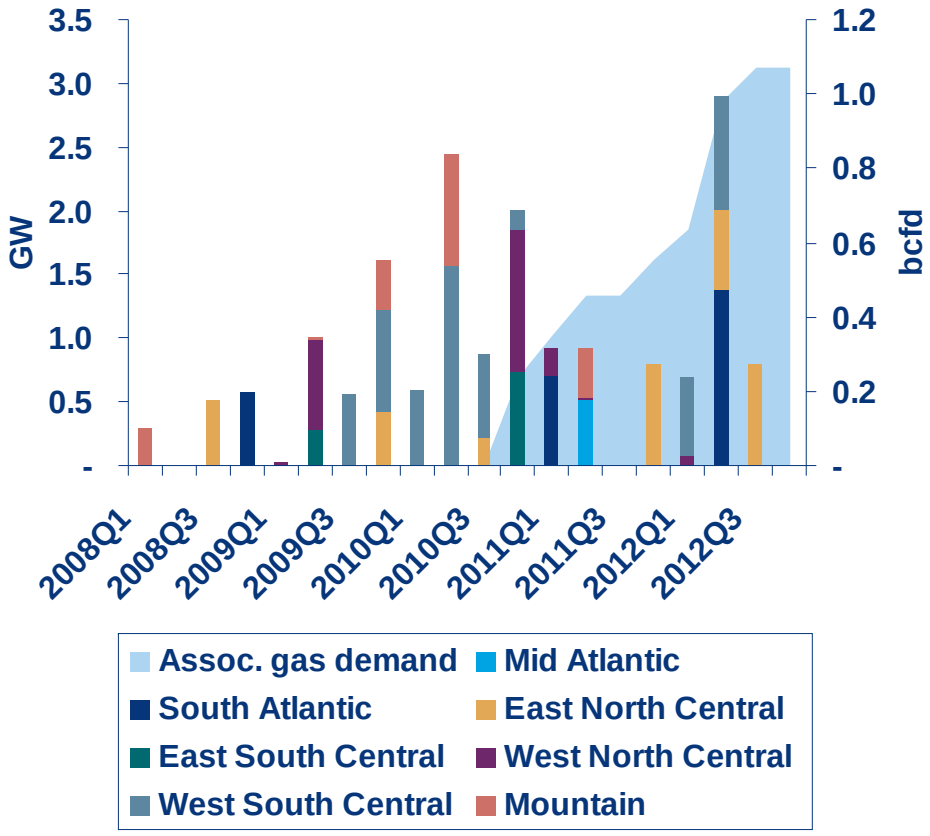
US annual real GDP growth



Source: US BEA, Wood Mackenzie projections

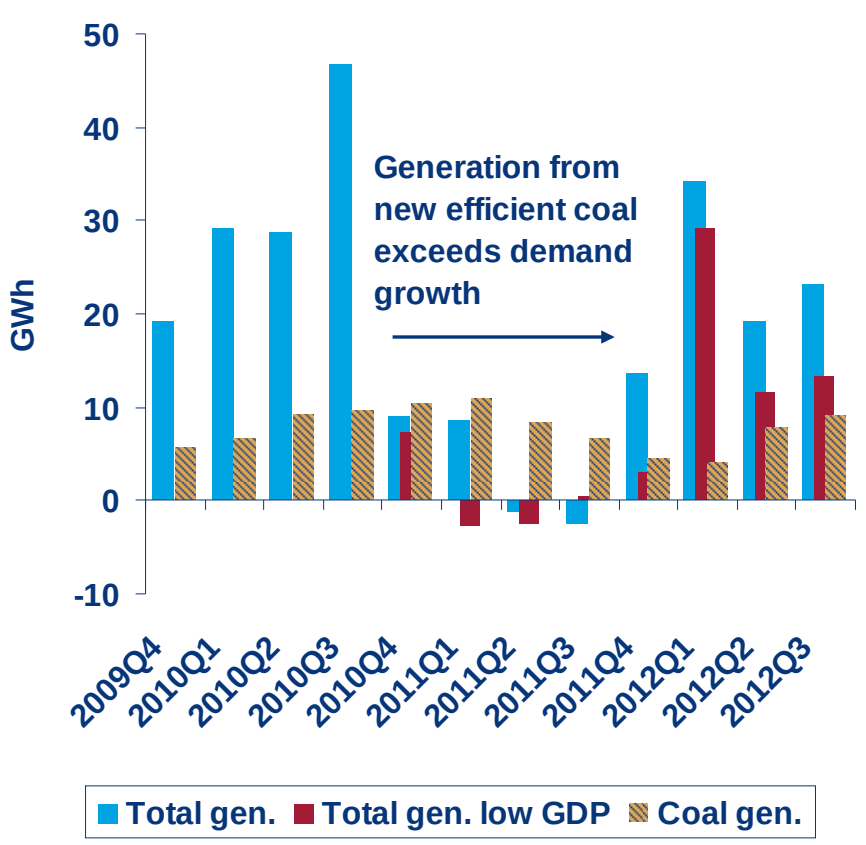
Slowing generation growth doesn't help either…especially with new coal coming online

New coal capacity



Source: Wood Mackenzie North America Power Service

Year-over-year generation growth

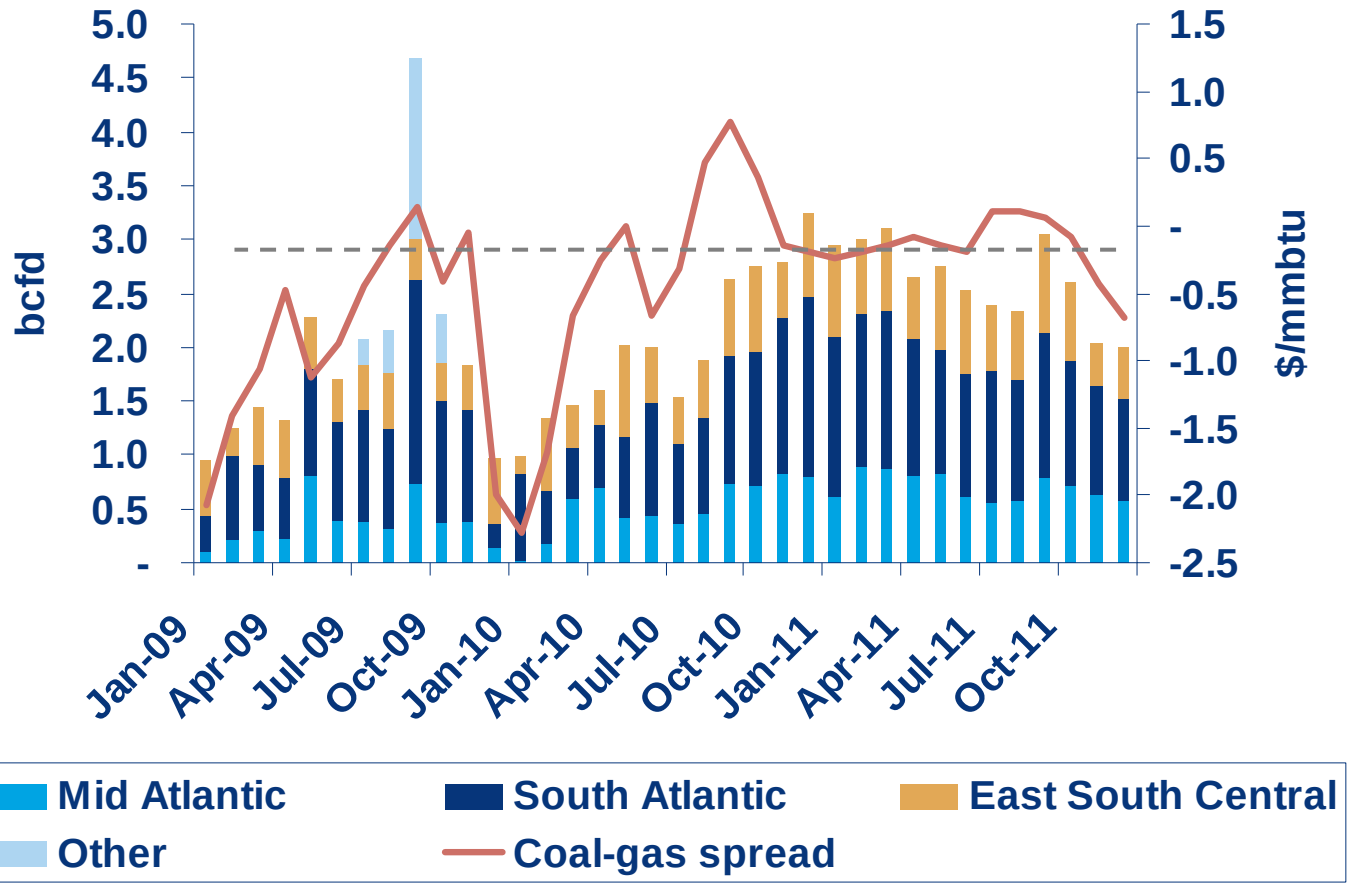


Source: Wood Mackenzie North America Power Service

Displacement supported gas demand in 2010 and looks likely to increase for 2011

- Higher gas prices resulted in lower displacement levels YTD in 2010 versus 2009
- High spot coal prices during Q3 2010 did not translate into much displacement, since exposure to those prices is limited

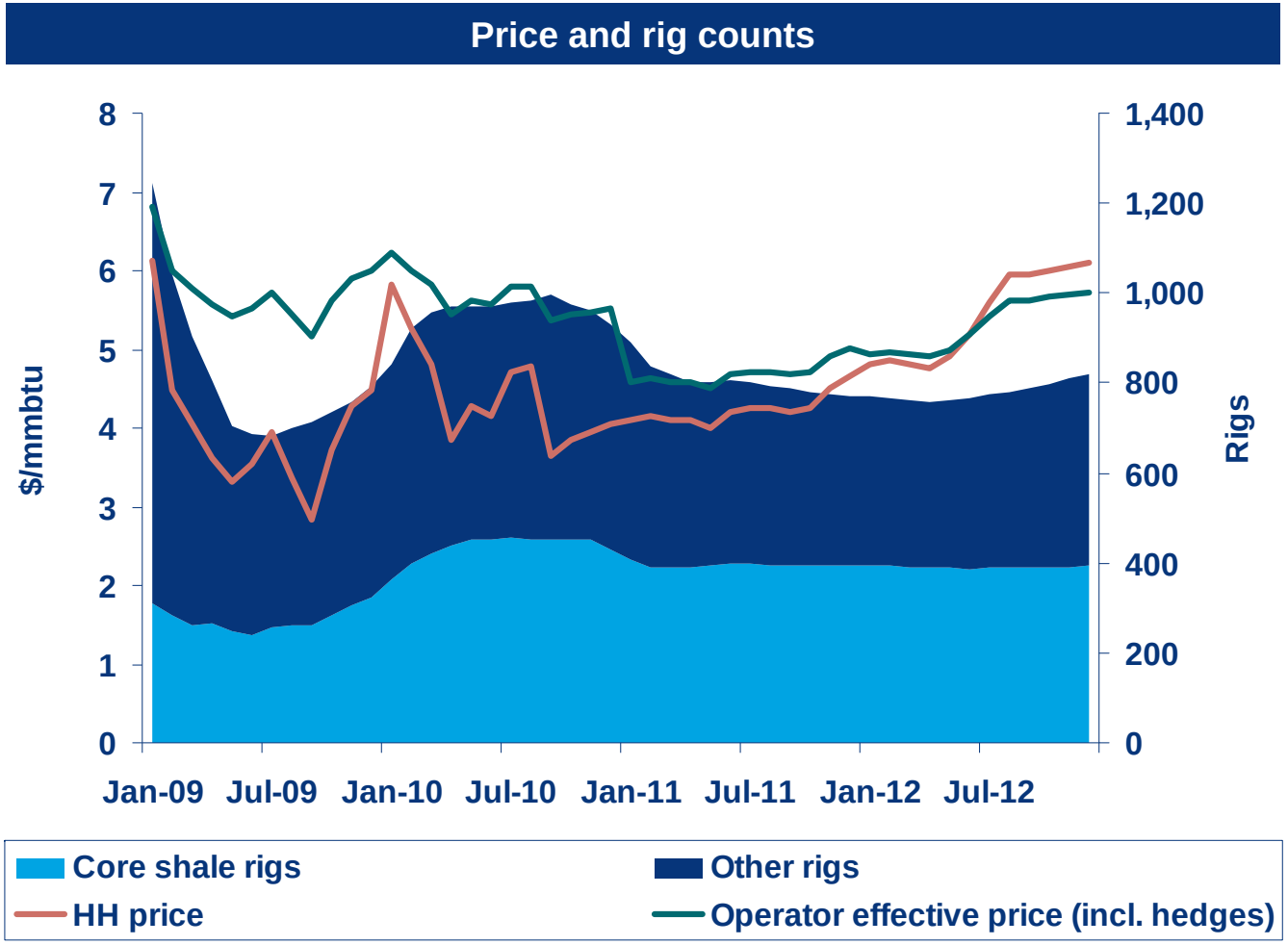
Coal-gas displacement and price spread



Source: Wood Mackenzie

Price—settling for added coal displacement in 2011, supply realignment for 2012

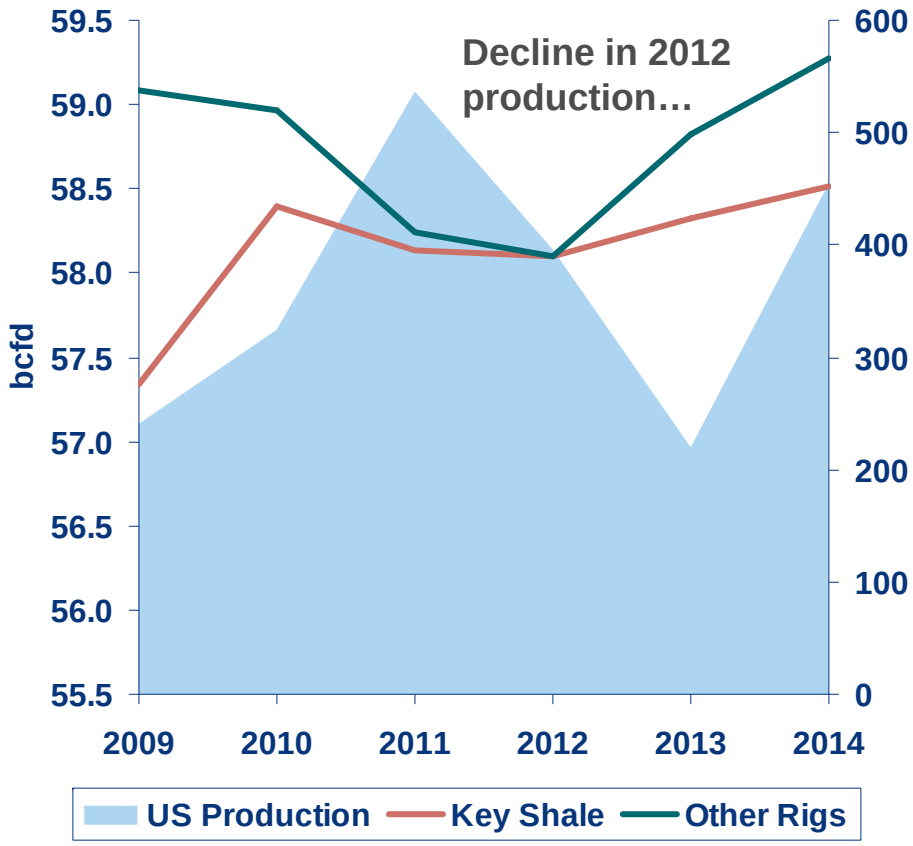
- **2011 average price of $4.25/mmbtu cuts drilling**
  - Down ~$0.20/mmbtu from 2010
- **Realized price for hedgers falls further**
  - Down ~$1.00/mmbtu from 2010
  - Lower cash flows cuts counts outside the shales
- **HBP rigs cut in Haynesville**
  - Move to oil and liquids
- **Could 2012 hedges weigh down cash flow?**



Sources: Wood Mackenzie, Smith Bits

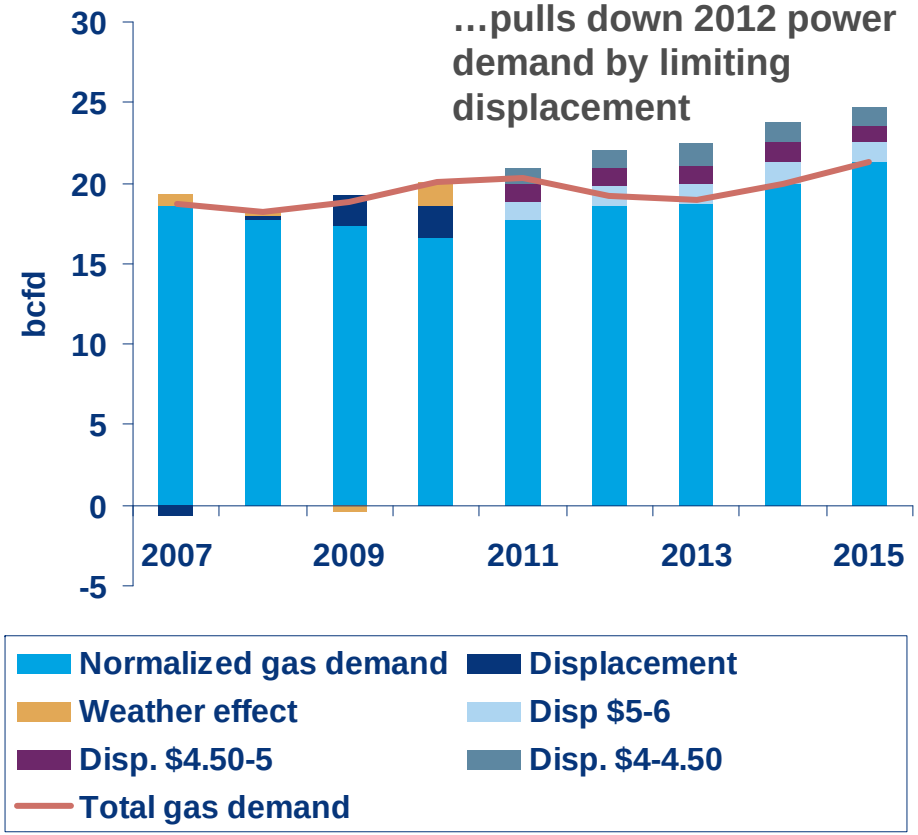
2012: Declining rig counts cut into supply and gas demand

Drilling and supply



Sources: Wood Mackenzie, Smith Bits

Power sector summary



Source: Wood Mackenzie

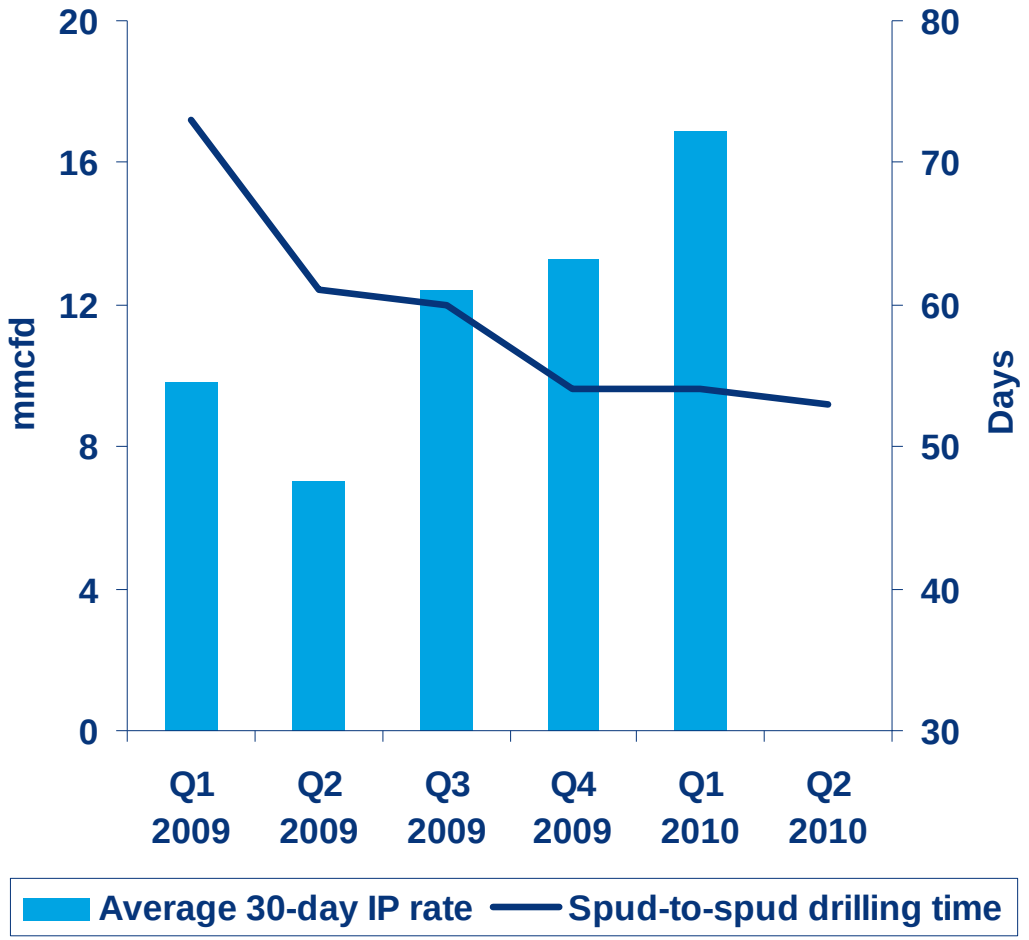
Drilling down the price: short-term market messages

- **Market soft again in 2011**
  - Demand weakened by decelerating GDP, new coal
  - Supply growth continues, but rig counts decline as HBPs, favorable hedges fade
  - Added displacement balances the market
  - Firming coal markets limit the price declines—Henry Hub price of $4.25/mmbtu
  - Downside risk into upper $3/mmbtu from La Nina, coal market downshift, potential double-dip
- **2012-'13 markets transition to higher price levels**
  - Demand potential increases, realized demand declines
  - Supply drops off, competition with oil and liquids mutes rig increase as prices recover
  - Henry Hub prices in the $5/mmbtu range, aligned drilling-price incentives reduce downside risk
- **Risks to outlook**
  - Haynesville is key, higher-than-expected drilling levels or improved well performance would hold price down
  - How does oil play out?

Shales have supported 2010 production growth, as higher productivity has meant improved well performance

- **Production growth mainly supported by key emerging shales**
- **Drilling expected to decline in 2011 and 2012**
  - Majority of the productive core acreage in Haynesville likely to be held by mid-year
  - Some JV cost carries begin to run out
- **New cost carries in Eagle Ford**
- **Drilling to be more in line with play economics?**
  - Operators unlikely to find hedge support
- **Increased focus on liquids-rich plays could adversely affect gas drilling**
  - Competition for capital — operators increasing spending on liquids plays

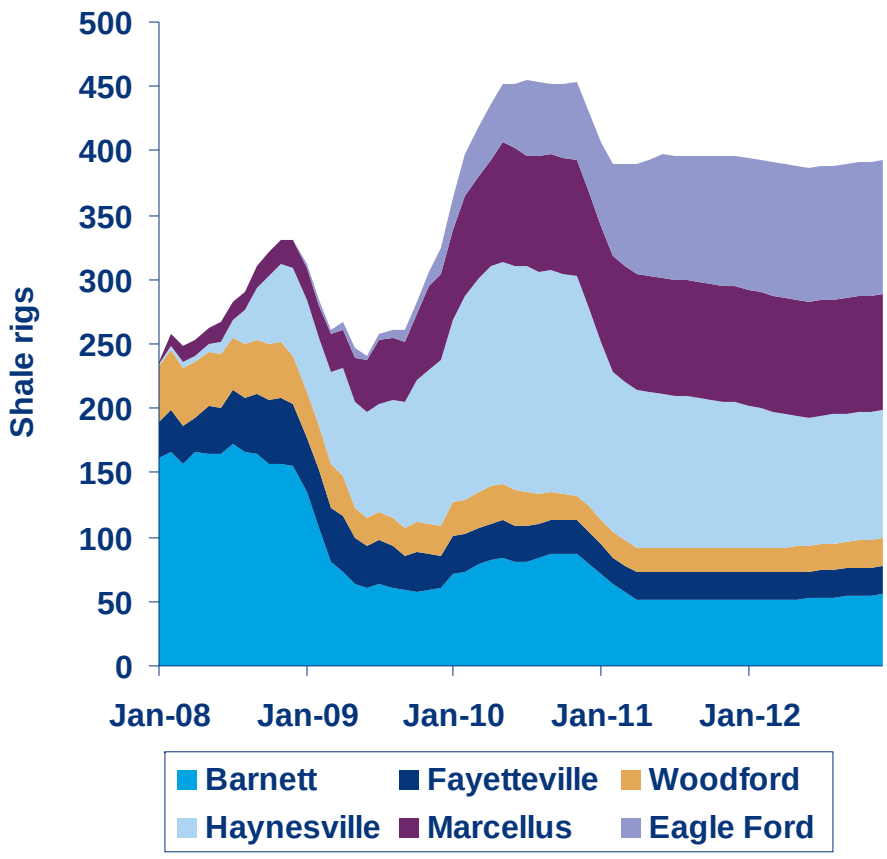
Increased Haynesville rig and well productivity



Source: Haynesville operators

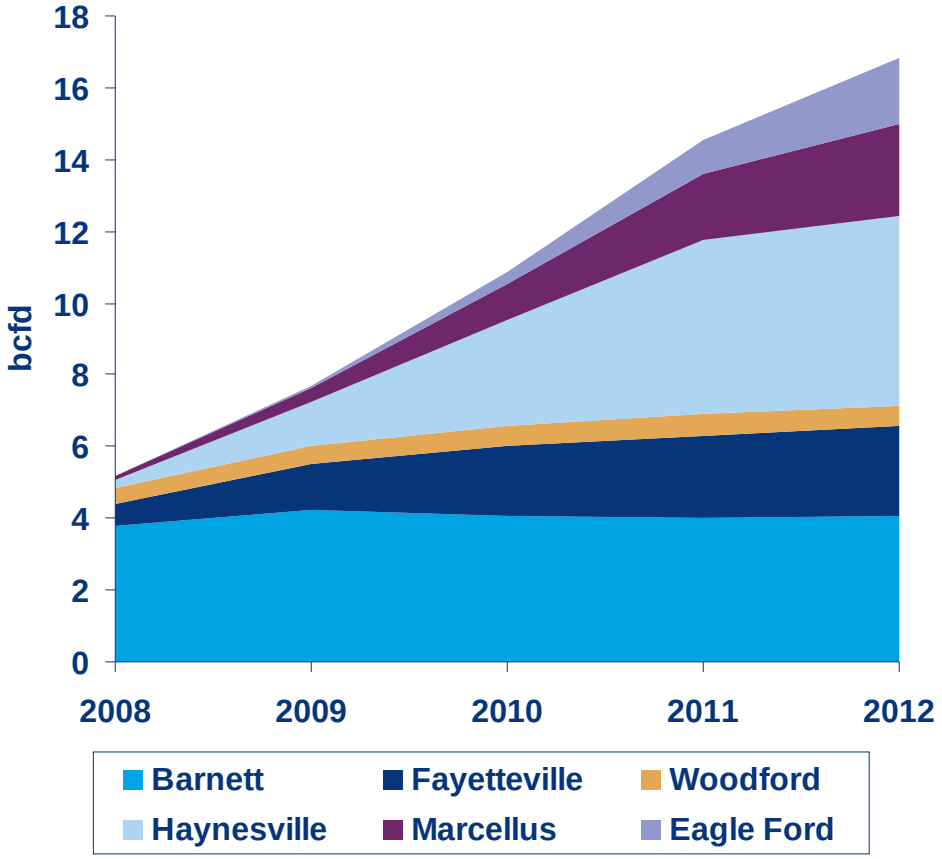
At 170 rigs, Haynesville drilling—and production—have ramped up quickly, and other shales also have been targeted aggressively

Shale rig counts



Source: Smith Bits

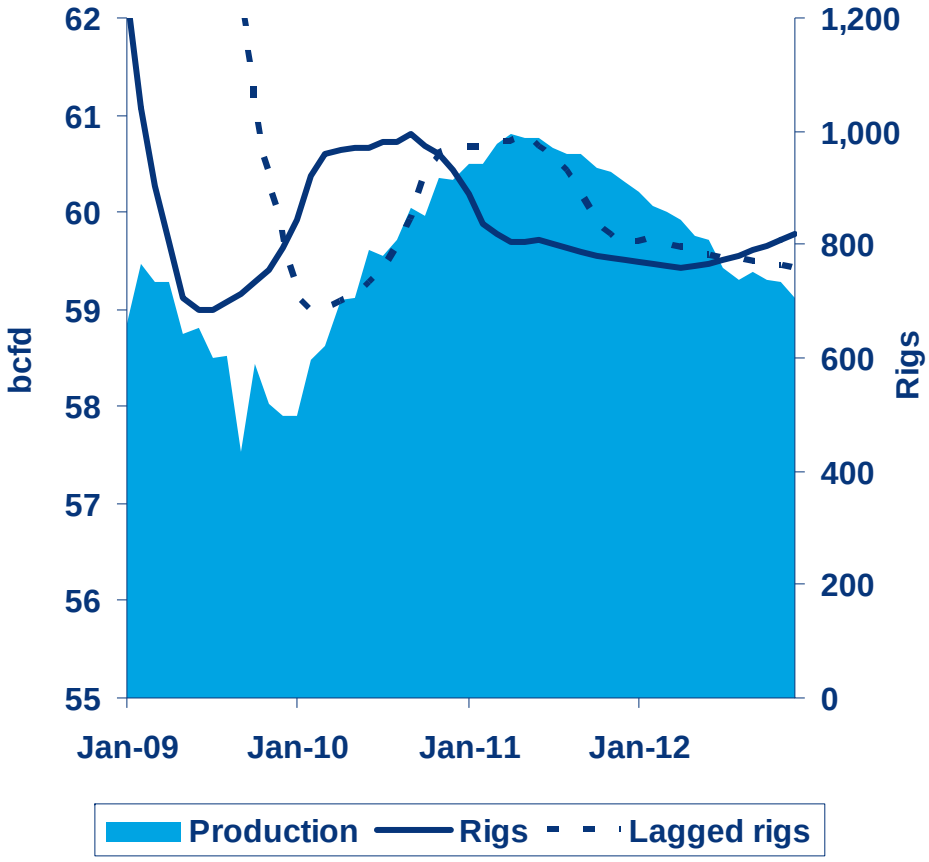
Shale production



Source: Wood Mackenzie

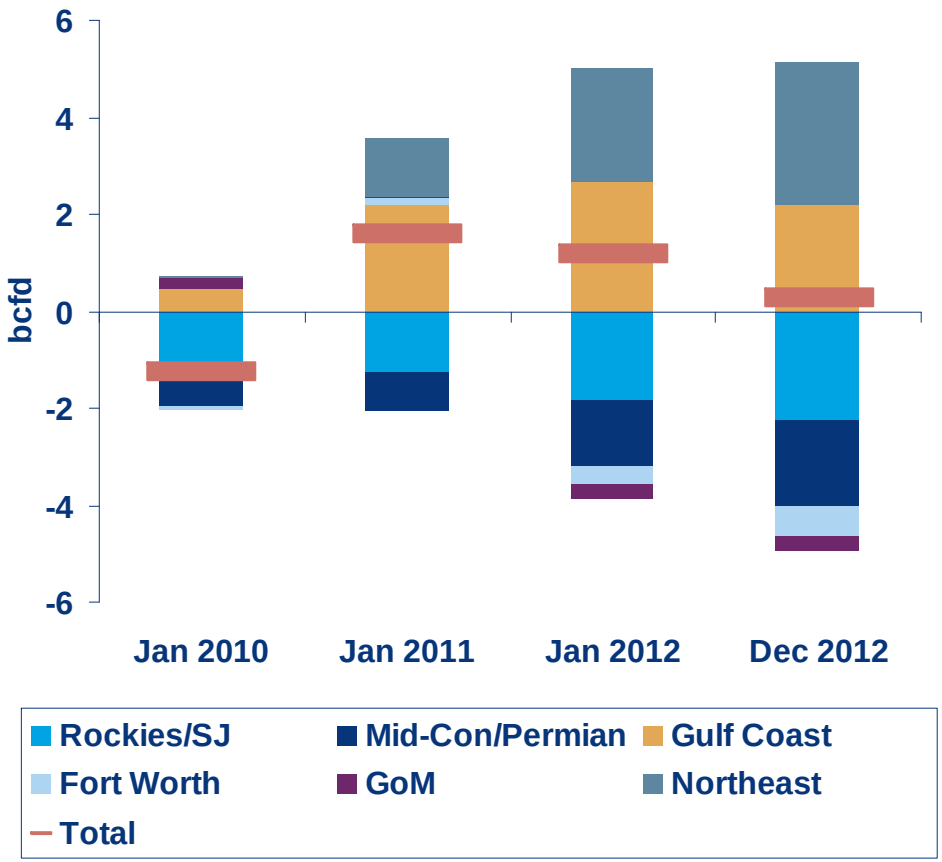
Production declines expected to start in mid-2011, following rig layoffs

US production and gas rig count



Sources: Wood Mackenzie, Smith Bits

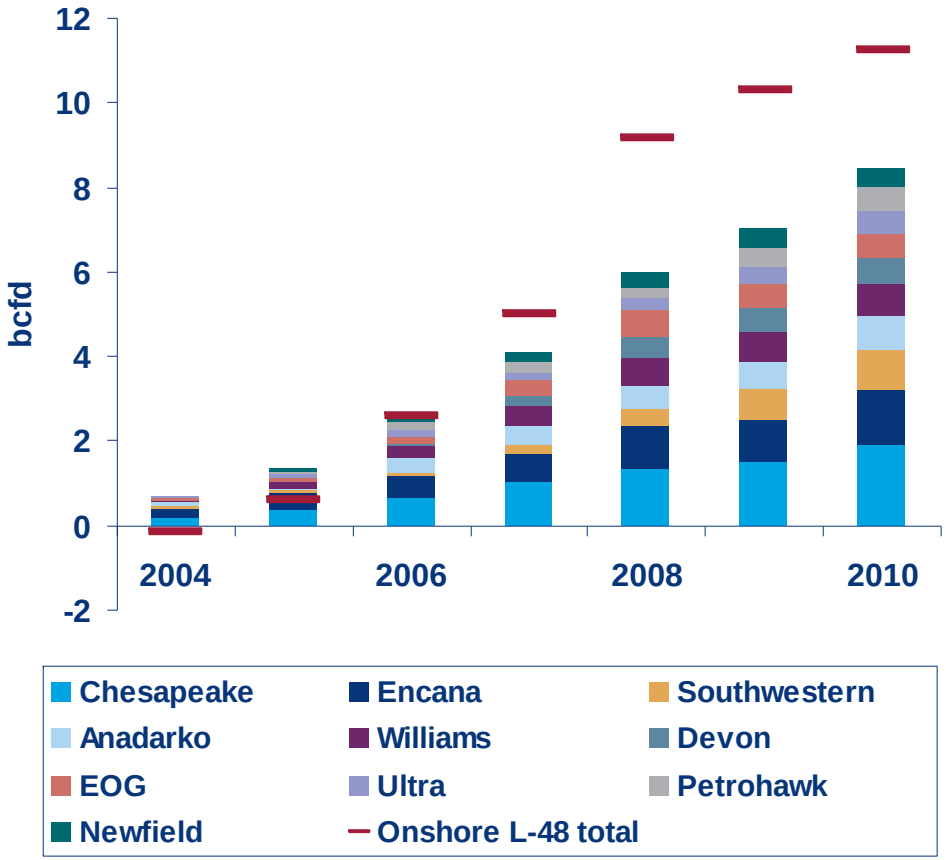
Production relative to Jan. 2009



Source: Wood Mackenzie

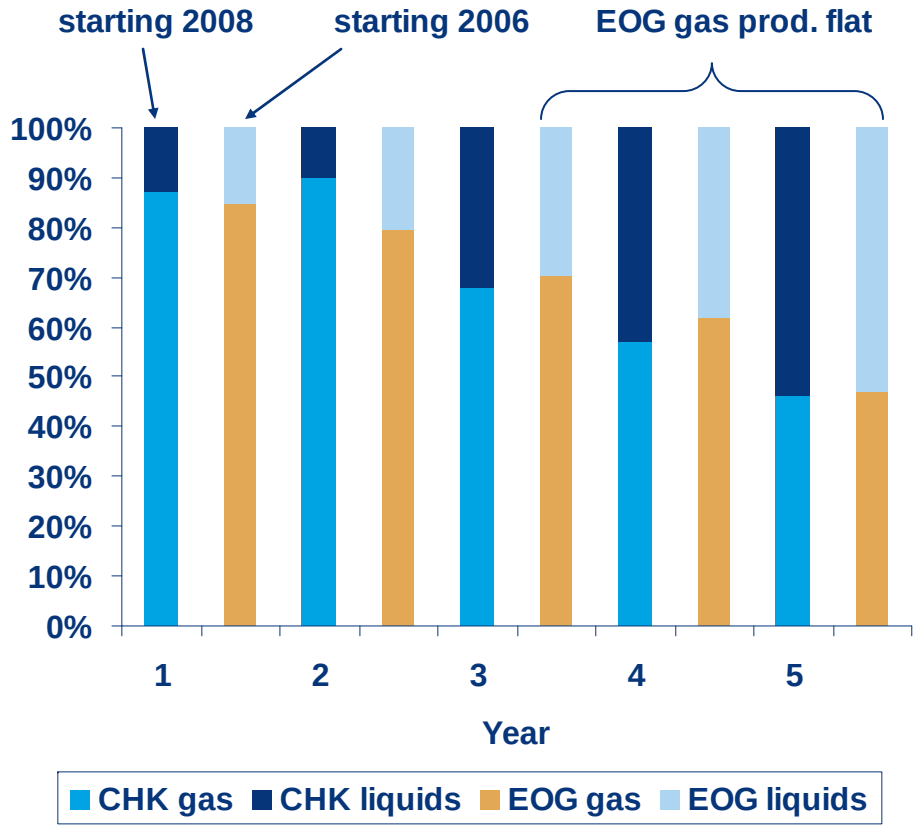
Operators are increasing capital commitment to oil and liquids-rich plays. Short-term trend, or long-term constraint?

Onshore Lower-48 production growth (vs. 2003)



Source: Wood Mackenzie Corporate Analysis Tool

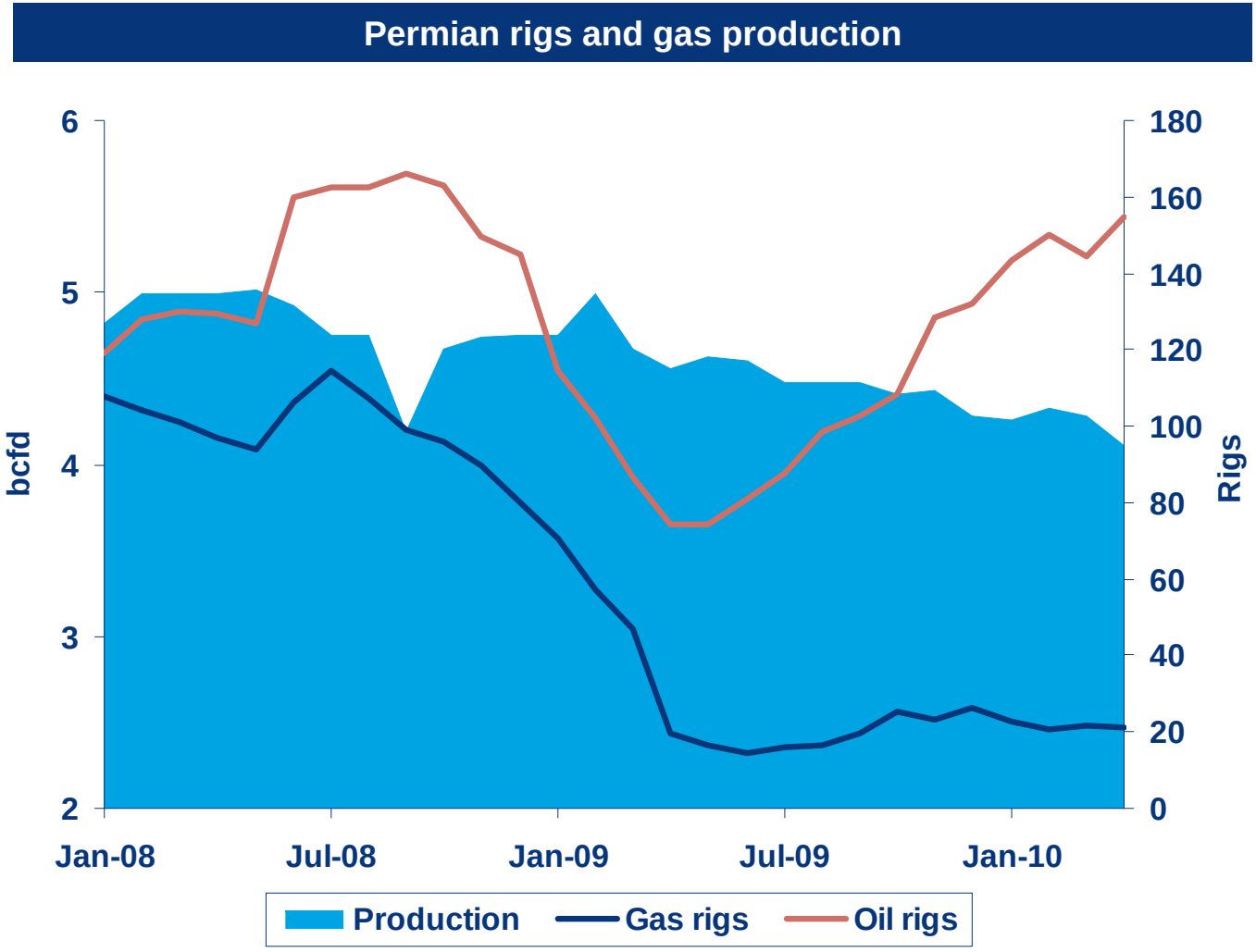
Chesapeake and EOG capex



Sources: Chesapeake filings, Wood Mackenzie Corporate Analysis Tool

Wouldn't associated gas support production? Sort of.

- Eagle Ford condensate window apart, most of rig increases expected in oil/liquids plays
- Associated gas only provides minor support
- Replacing a gas well with an oil well contributes only 10% of the production
- Strong gas production declines in the Permian Basin despite strong oil rig increases



Sources: Wood Mackenzie, Smith Bits

How many rigs does it take to hold production flat? Depends on where those rigs are

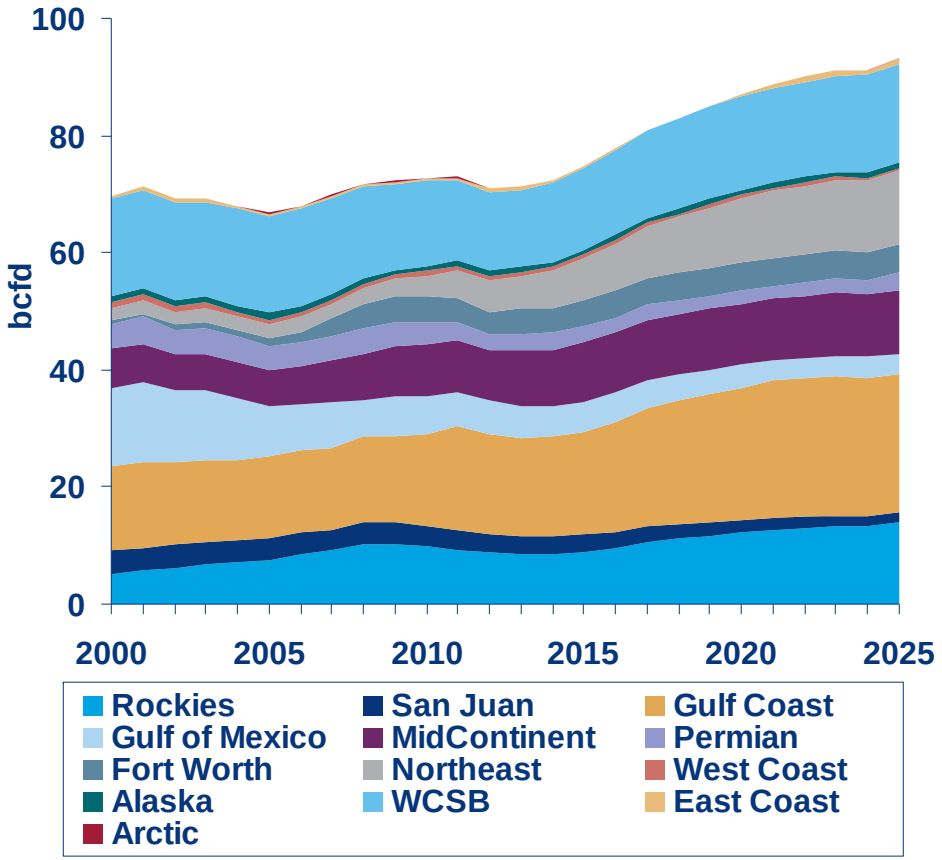
- **With horizontal rigs at record highs and increased rig productivity, rig counts required to maintain production have dropped significantly**
- **Rig counts to maintain production at 2010 year-end levels depend strongly on activity levels in key growth shales**
  - The rig count to sustain production could be even lower once a majority of shale drilling switches to pad rigs, after acreage constraints ease

Rig counts required to maintain production at 2010 year-end levels

	Total Rigs	Haynesville	Eagle Ford	Fort Worth	Marcellus	Fayetteville & Woodford	Non-shale horizontal
Low emerging shale	1,050	75	70-85	110	90	40	190
Base case	900	100	90-105	90	90	40	160
High emerging shale	780	125	115-135	50	90	40	120
Current	974	172	58	88	90	45	205

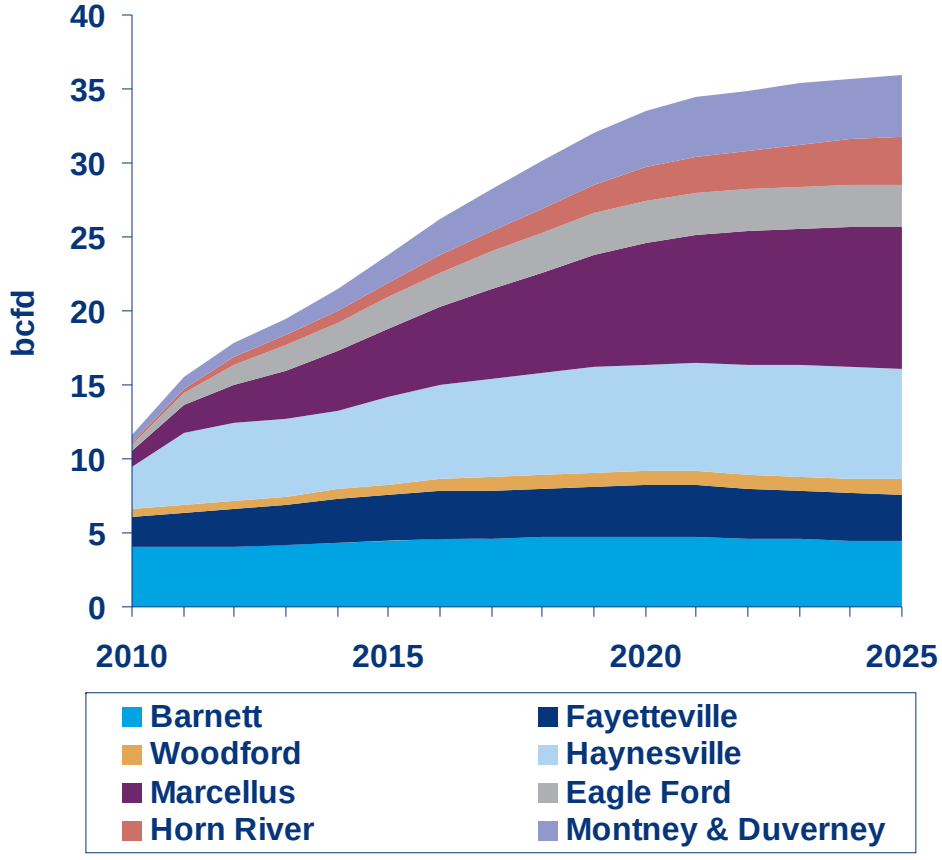
Strong growth in domestic supply

US and Canadian production



Source: Wood Mackenzie

Major shales

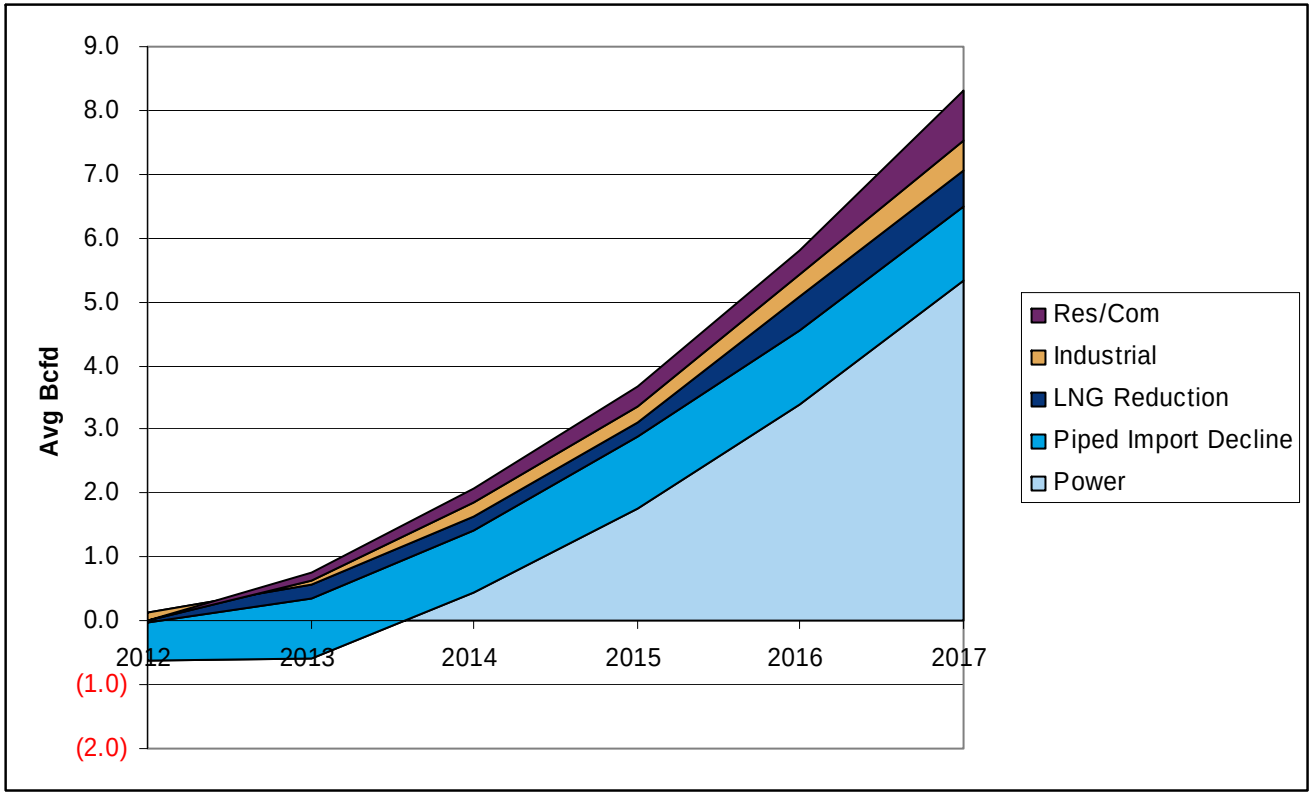


Source: Wood Mackenzie

But it Will be Needed: Strength in Power Demand and Declining Piped Imports Increase the Call on US Domestic Supply: 2012-17 compared to 2011

- Power demand uplift is 2/3 of overall growth
- Pipes imports decline, including an increase in exports to Mexico.
- Canadian supply declines continue
- This higher pace of development and competition with oil for resources increases costs

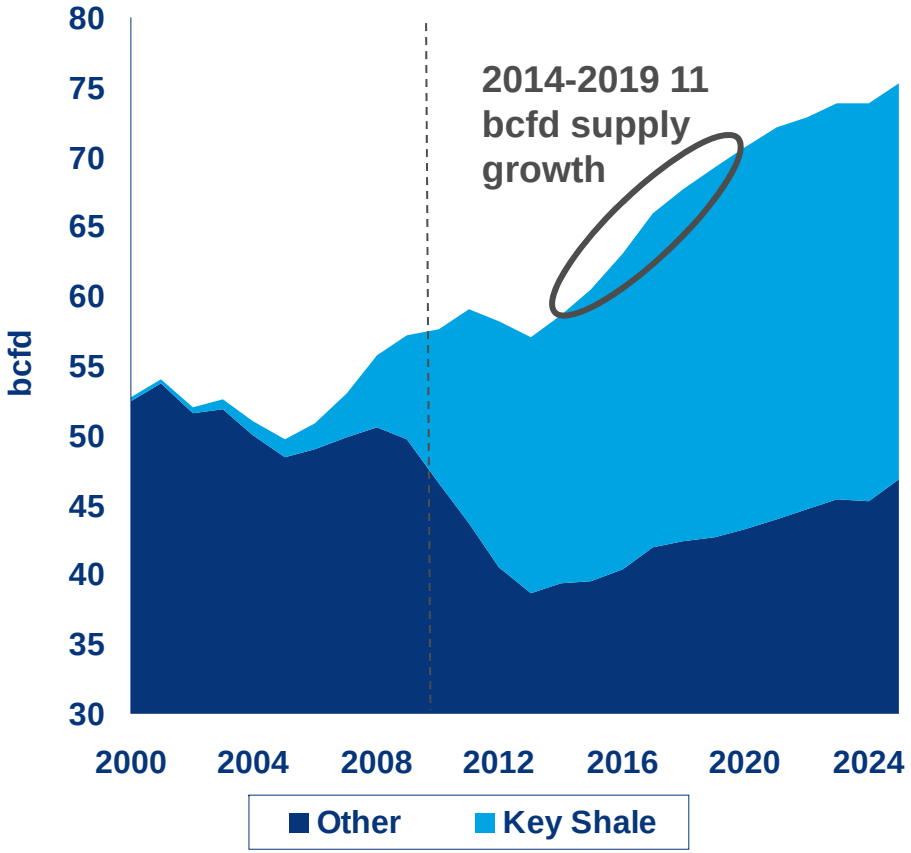
Increasing Call on US Production



Source: Wood Mackenzie

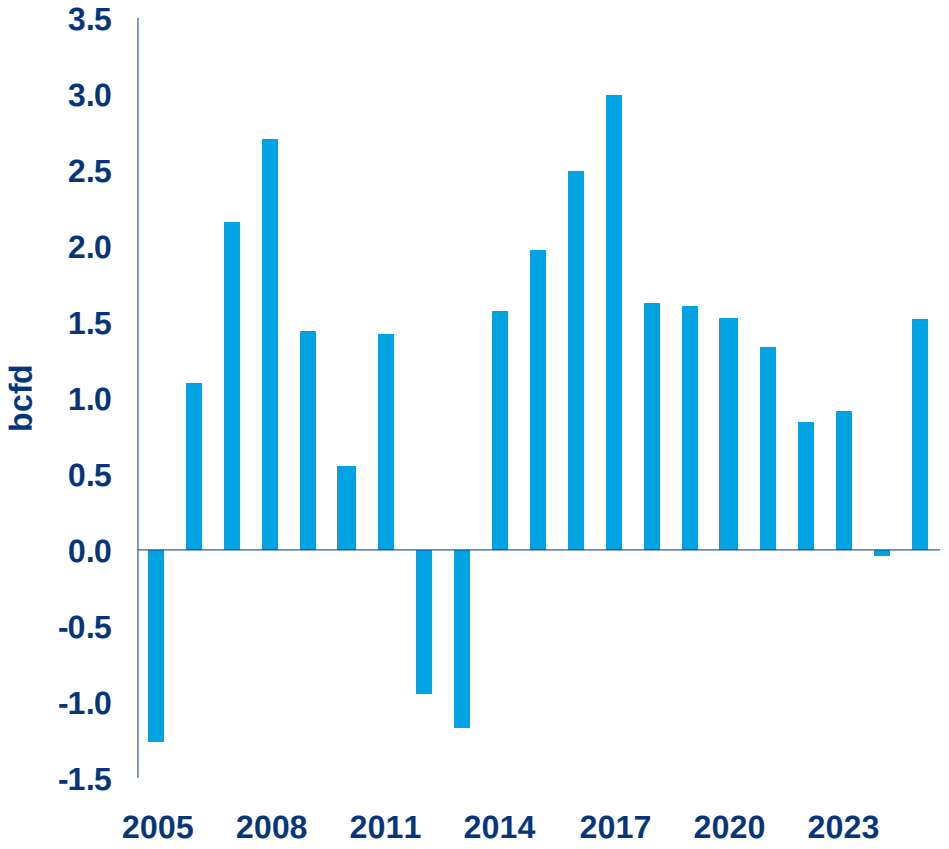
And domestic supply growth feeds the new demand

US production by source



Source: Wood Mackenzie

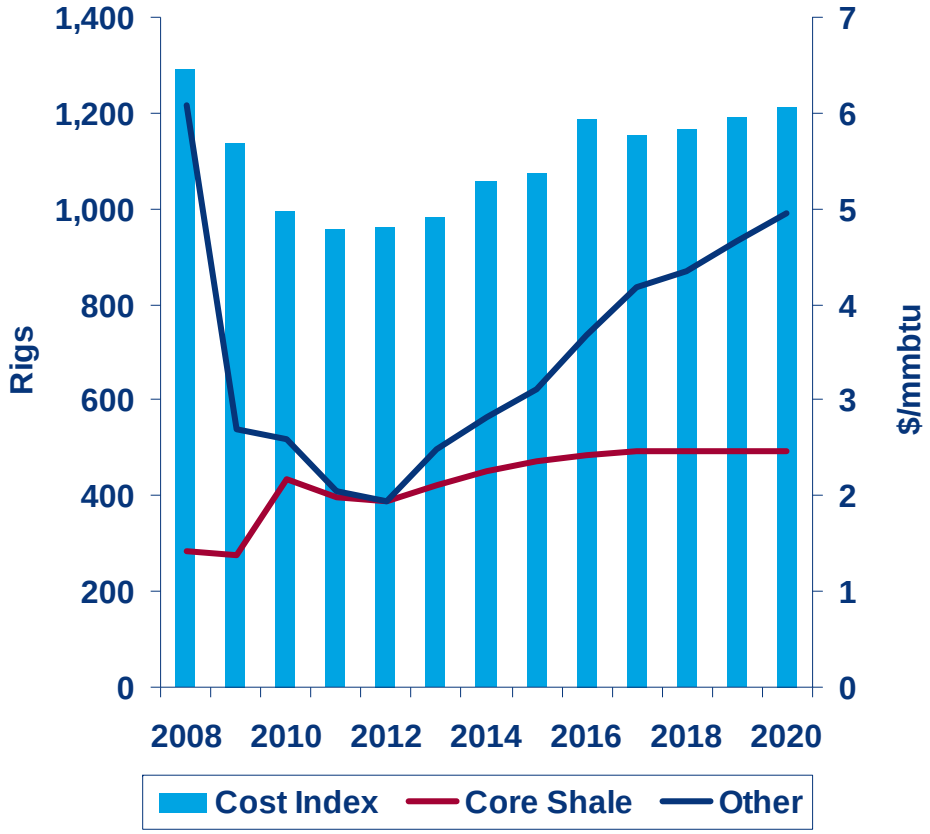
Annual change in US production



Source: Wood Mackenzie

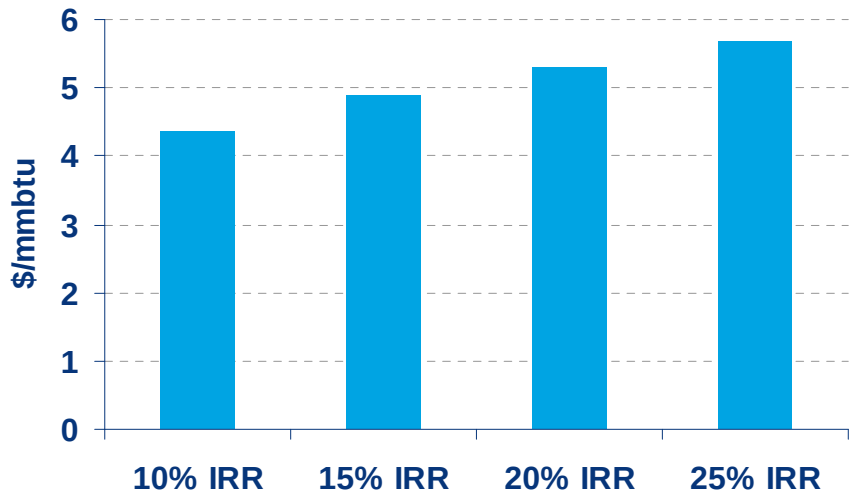
But what prices are necessary to fuel this growth?

Cost index and rig counts



Source: Wood Mackenzie

2010 Haynesville development breakeven cost



Source: Wood Mackenzie Upstream GEM

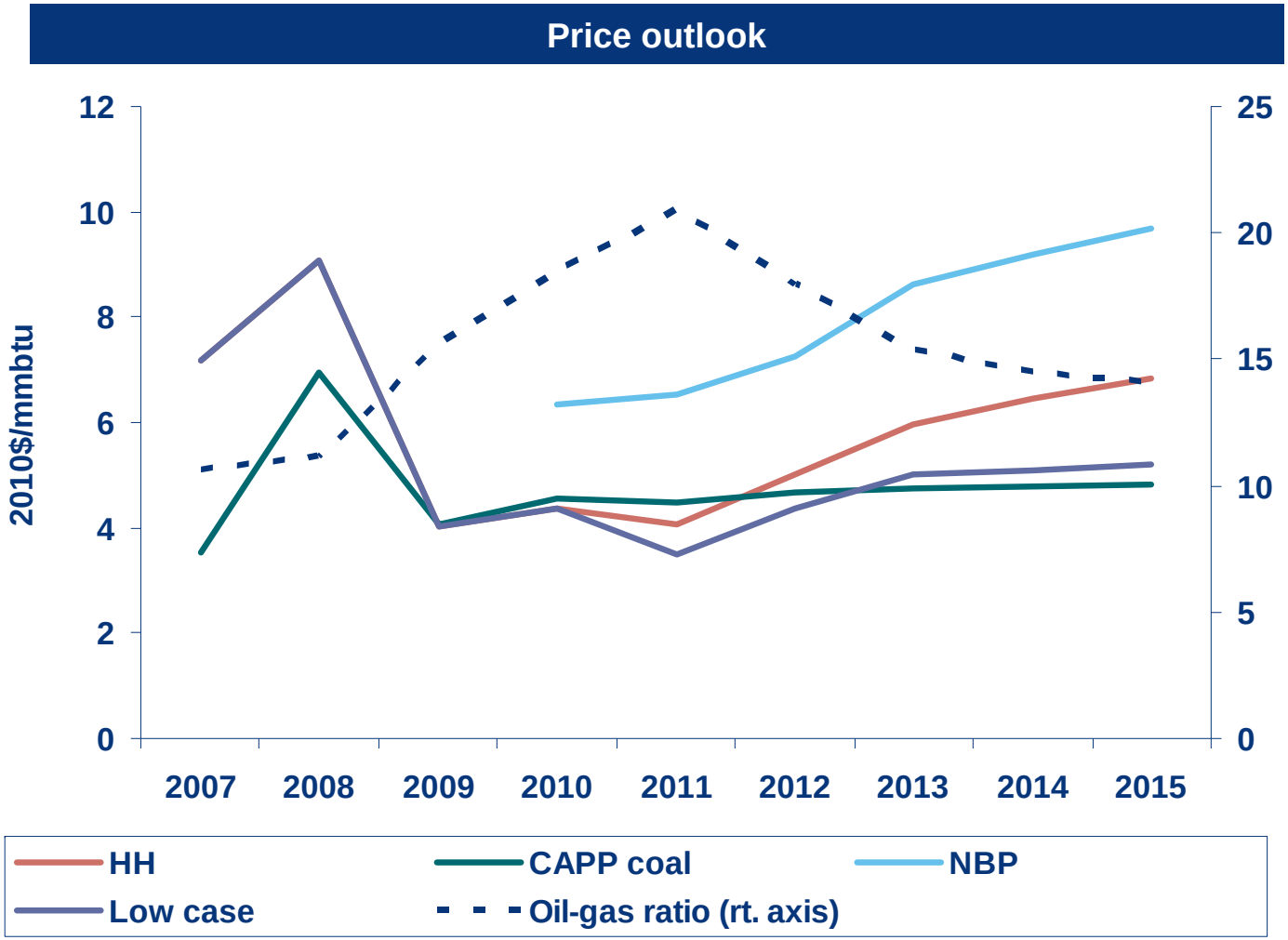
- Breakeven costs will shift
- Environmental risk
- Full-cycle cost components
- Competition for capital

Slide 20

JS2 Jen Snyder, 10/12/2010

With higher required drilling levels, price expectations rise through 2015

- **Mid-term uncertainties**
  - Coal retirements
  - Global market?
  - Demand risks
    - La Nina
    - GDP
  - Drill baby drill
    - Pace of tech. change
    - Haynesville



Source: Wood Mackenzie Coal Markets Service, NAGS, EGAPS, and Macro Oils

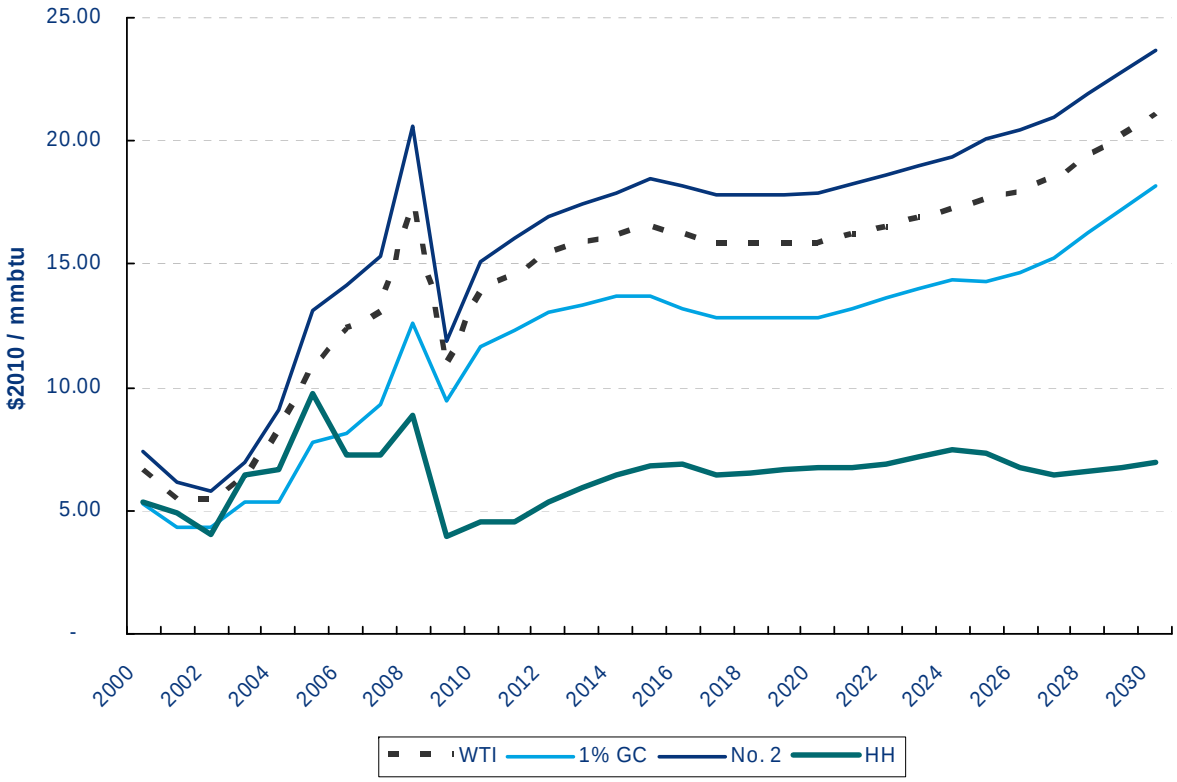
Even with Higher Prices, in Relative Terms Gas Remains Cheap

- **Average price WTI:**
  - 2010-15: *$89.46*
  - 2016-20*: $92.21*
- **2021-30*: $105.26***
- ***Plentiful exploration risk, and reservoir performance risk in this oil outlook, in contrast to US gas.***
- ***Average price Henry Hub:***
  - *2010: $4.35*
  - *2011-15: $5.67*
  - *2016-20: $6.65*
  - *2021-30: $6.91*

Average WTI to Henry Hub Differential

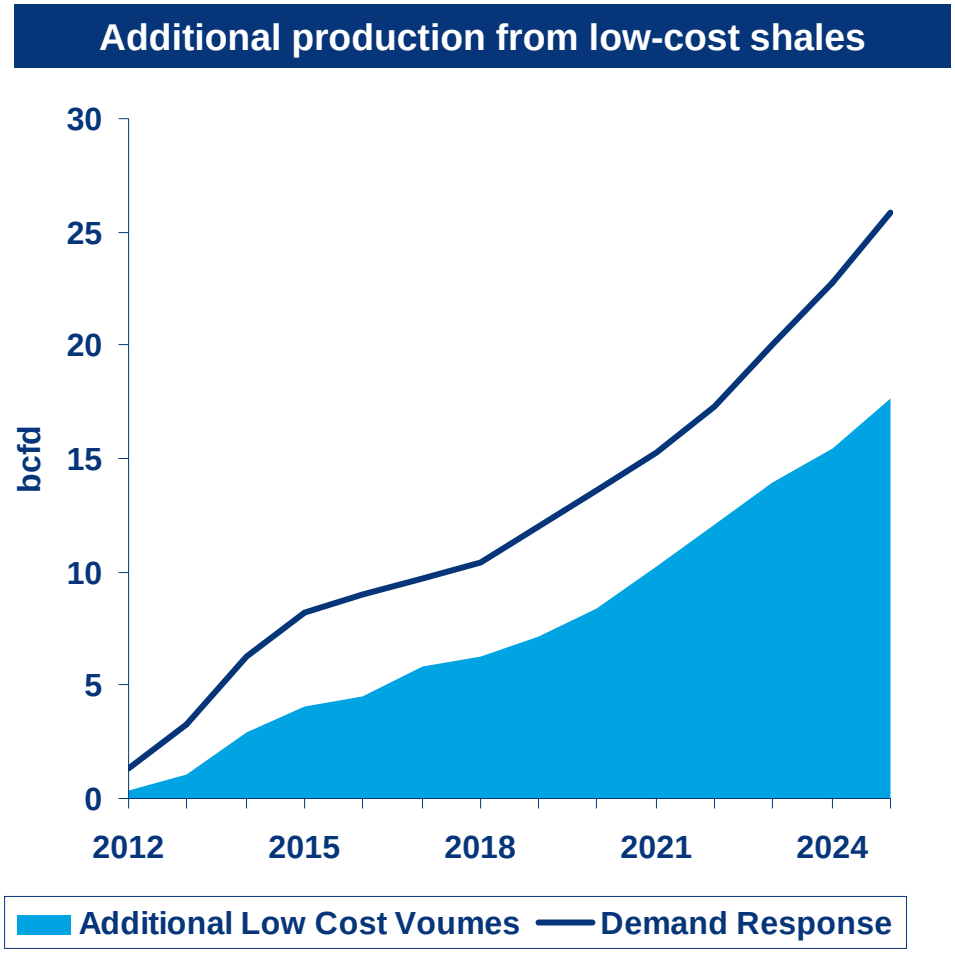
	$2010/mmbtu
2000-2008	2.83
2009	6.88
2010-2020	9.55
2021-2030	11.24

Oil and Gas Commodity Price Forecasts



Could shale success support a $5.00 world? Not likely.

- Significant additional volumes from low-cost shales required
- Many wells required in key shales to support production levels required
- Can we rule out another Haynesville?
- Strong demand response from power sector



Source: Wood Mackenzie

The Bottom Line

The Natural Gas Resource Base is There, *But* …

It's Not a $4.00 - $5.00 Fuel

(Possibly $6-$7 though)

Source: Wood Mackenzie

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