

North American Natural Gas Markets in Transition: The Future of Shale Gas



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Is Shale Gas Revolution a “Game Changer”?

- Transforming the Energy Market
- Boosting the US Manufacturing Sector
- Endangering Safety (water, earthquakes)
- Protecting Against Greenhouse Gases
- Shifting Geopolitical Power Balances

Gas Markets as a System

- How high domestic gas prices will rise as US exports expand
- How competitive will US projects be in the world LNG market
- How long will the Asian-North American price “gap” persist
- How long can Russia act strategically in pricing its gas supplies

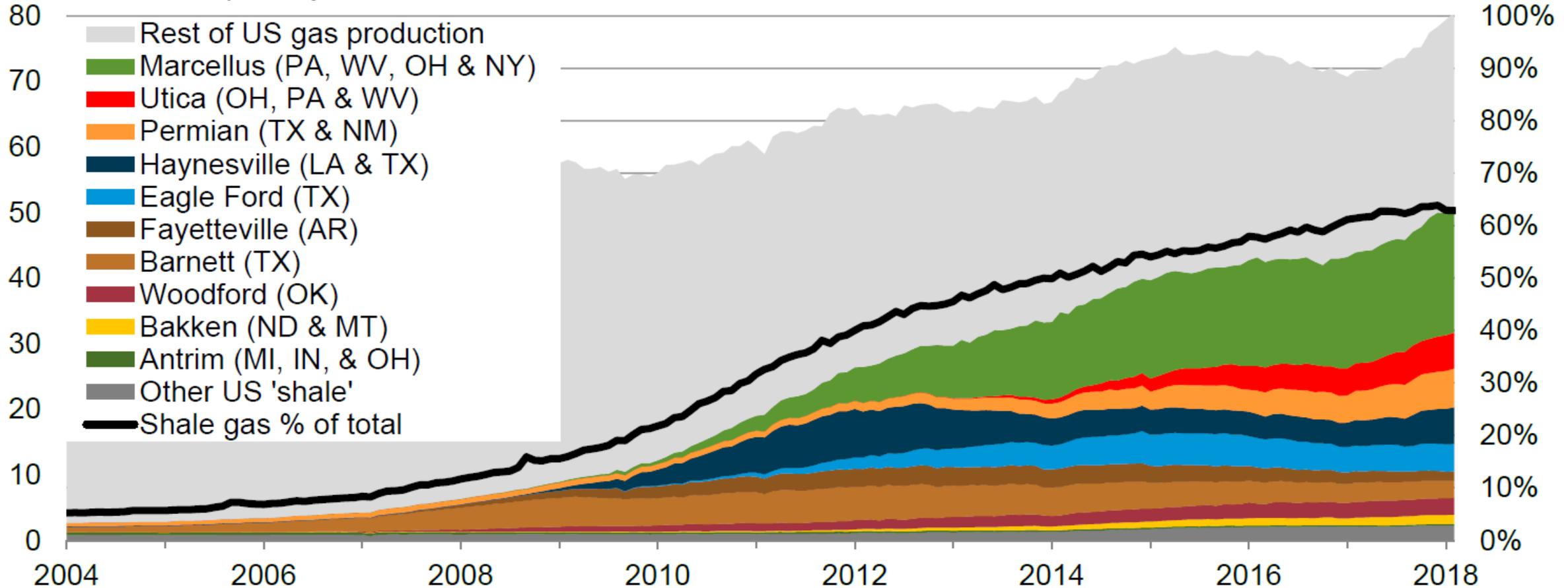
Some Environmental Challenges

- Will not increase greenhouse gases unless methane leakages move above current estimates 1.5-3.0%
- Improved well casings could protect groundwater quality
- Better waste water disposal could reduce earthquake risks (Oklahoma)
- Options for protecting pristine rural areas from industrial congestion

Estimated U.S. shale gas production was 50.6 Bcf/d in February 2018, about 63% of total U.S. dry production (80 Bcf/d)

Natural gas production (dry)

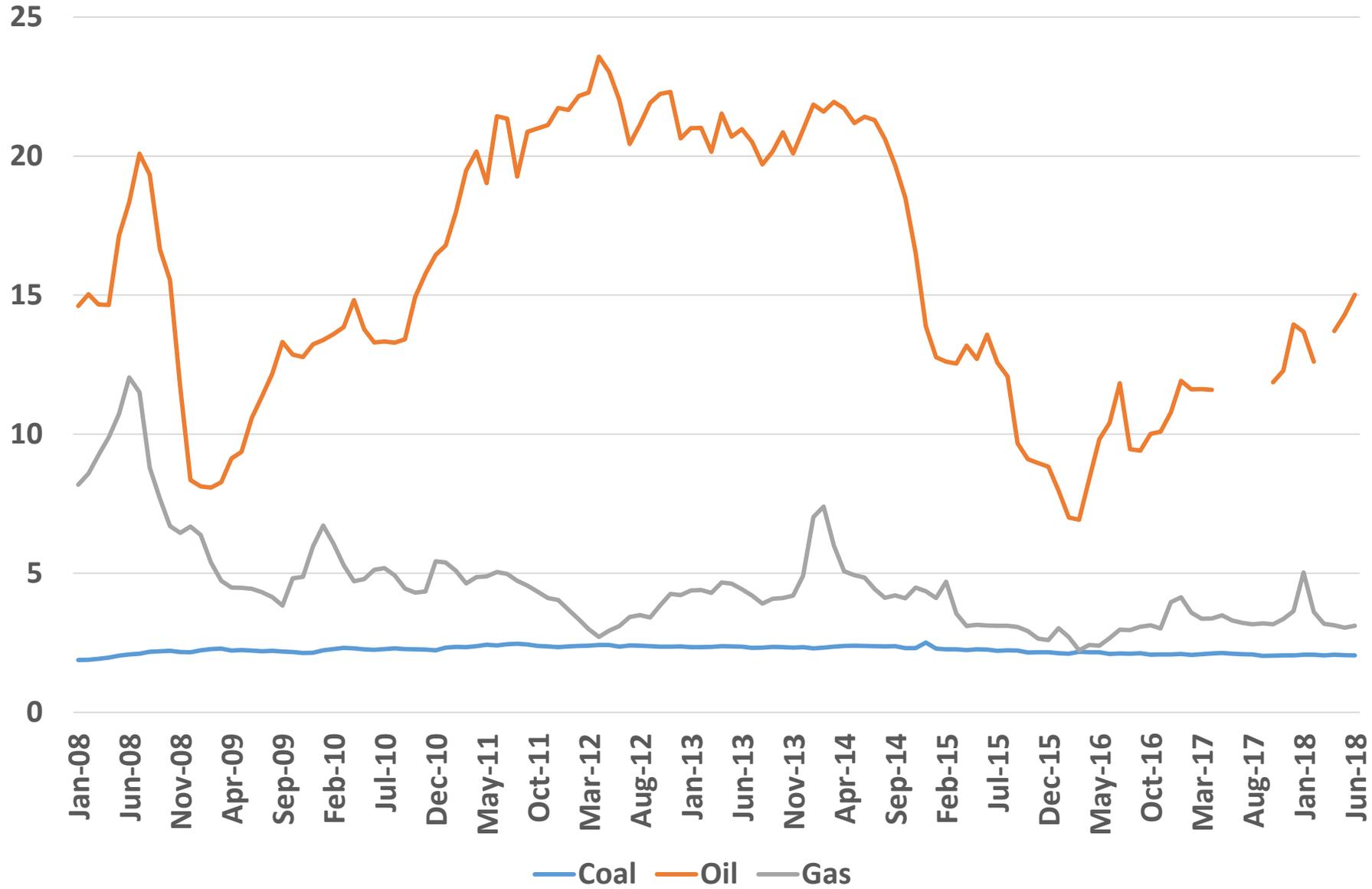
billion cubic feet per day



Sources: EIA Natural Gas Monthly, STEO through February 2018 and DrillingInfo.

From presentation by Faouzi Aloulou

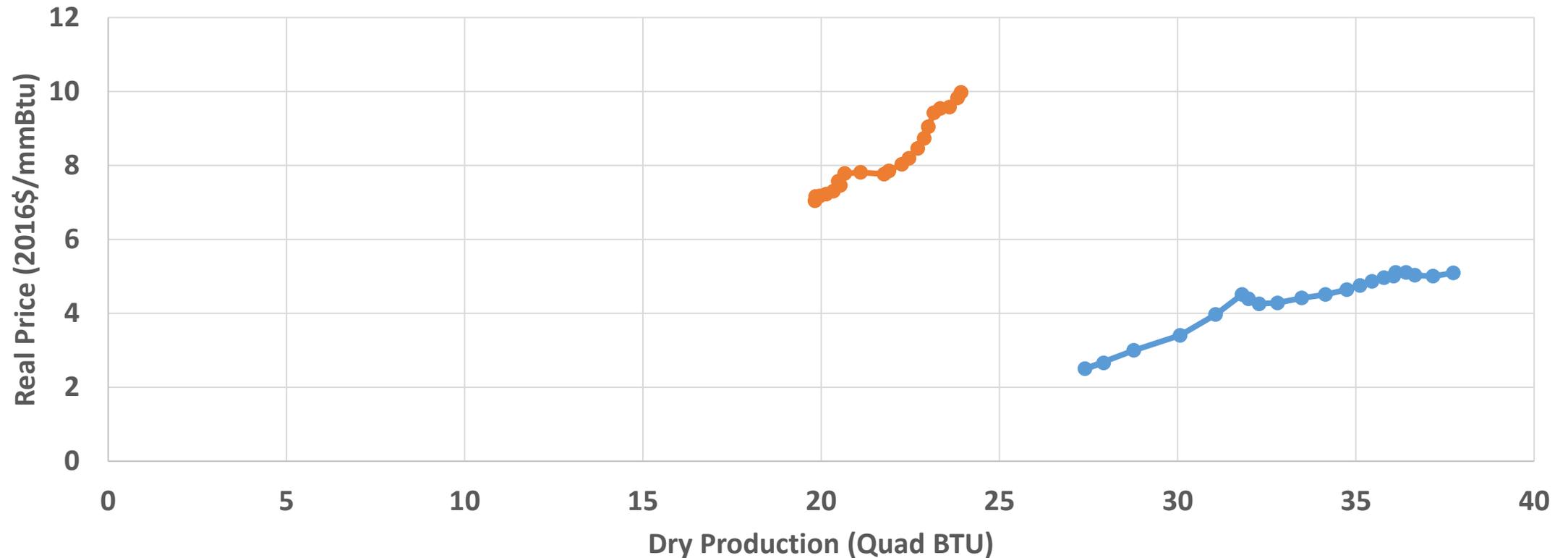
Fossil-Fuel Prices for Electric Generation (\$/mmBtu)



Response: US Energy Markets

- Relatively permanent reduction in natural gas prices
- Gas principally displaces coal for power
- Broader fuel competition includes
 - Nuclear: earlier retirement, less construction
 - Renewables: greater pressure on costs
 - May have retarded some energy efficiency options
- Modeling teams consider natural gas prices as one of the largest uncertainties with the strongest future impact

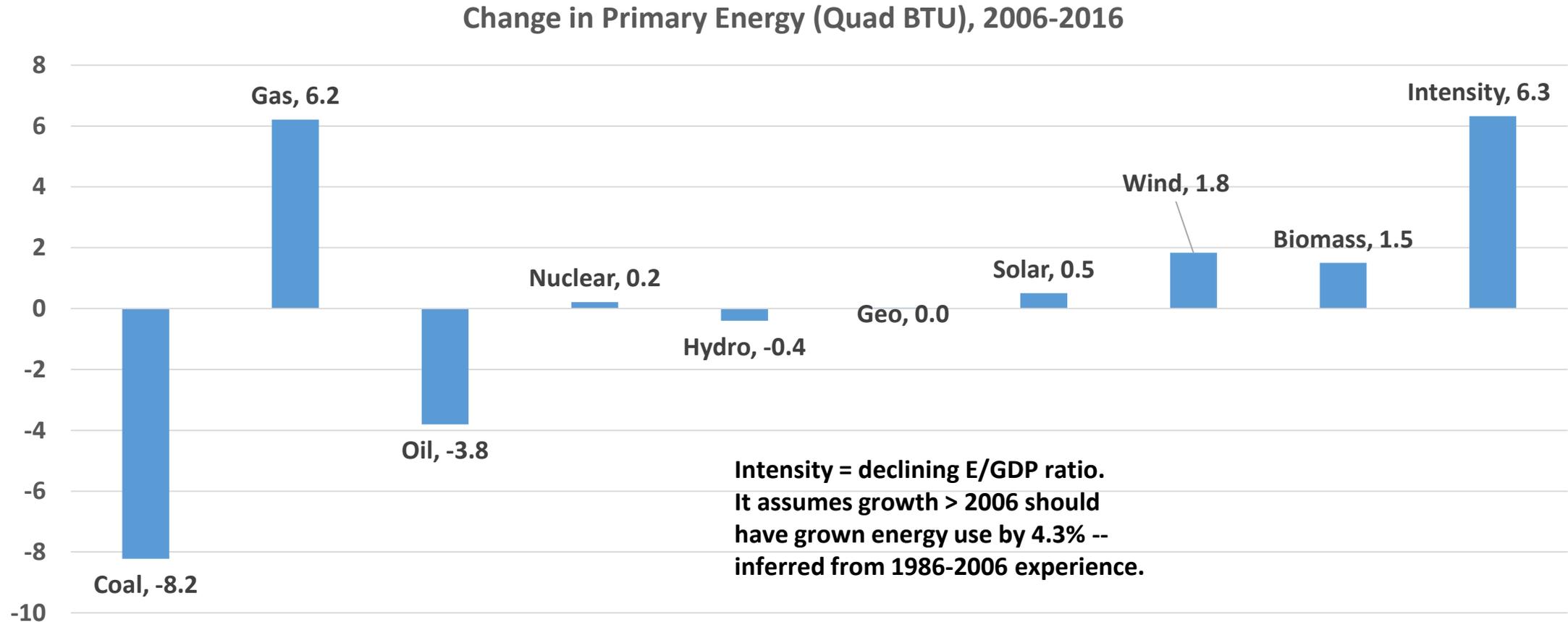
US Natural Gas Conditions in 2010 and 2017 AEOs



Source: US Energy Information

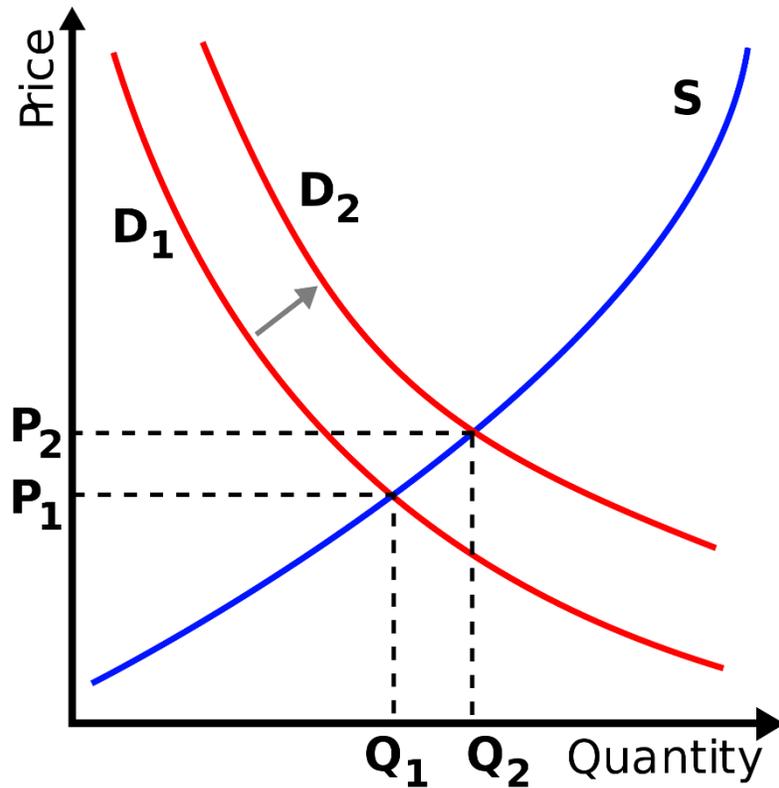
—●— 2010 AEO —●— AEO 2017

Gas + Intensity Shifted US Energy Mix after 2006

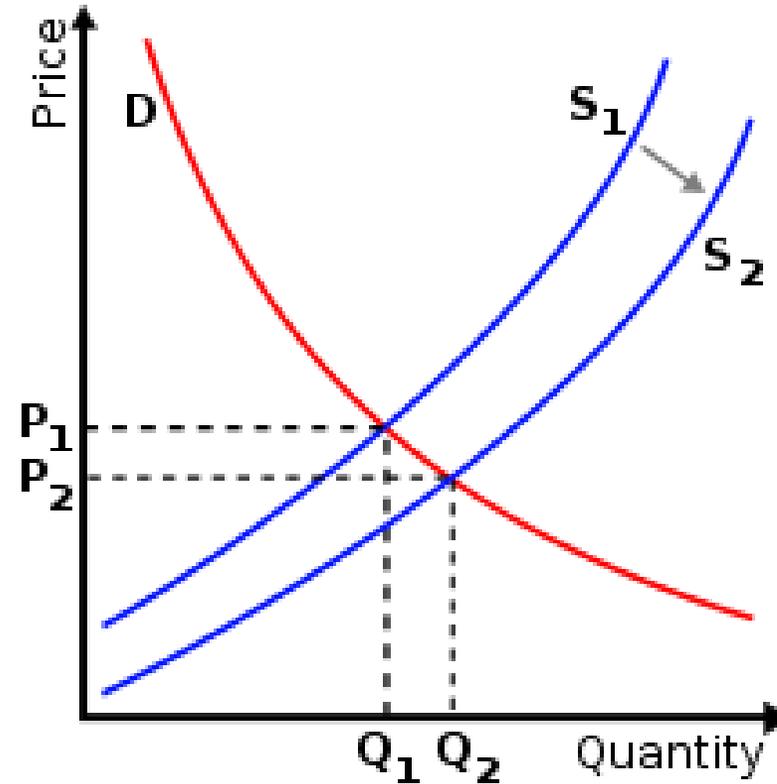


Estimates from Combining EMF Scenarios

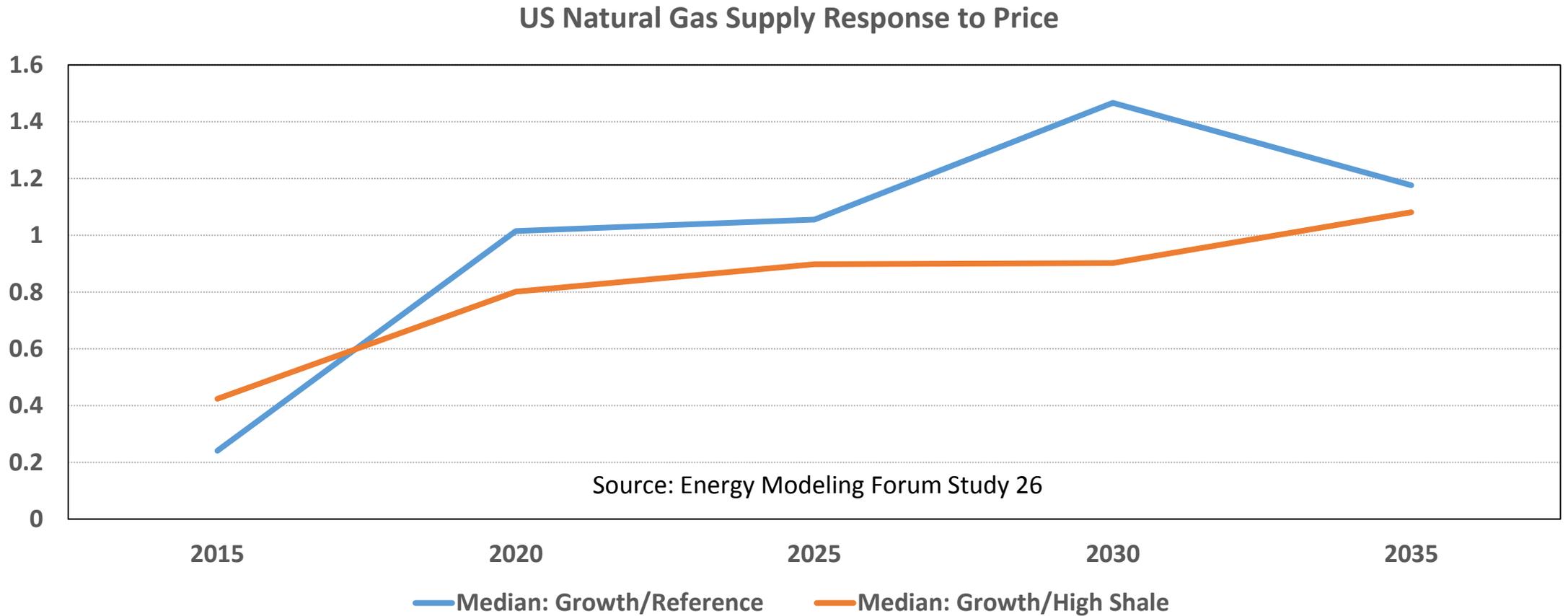
Supply Response to Price



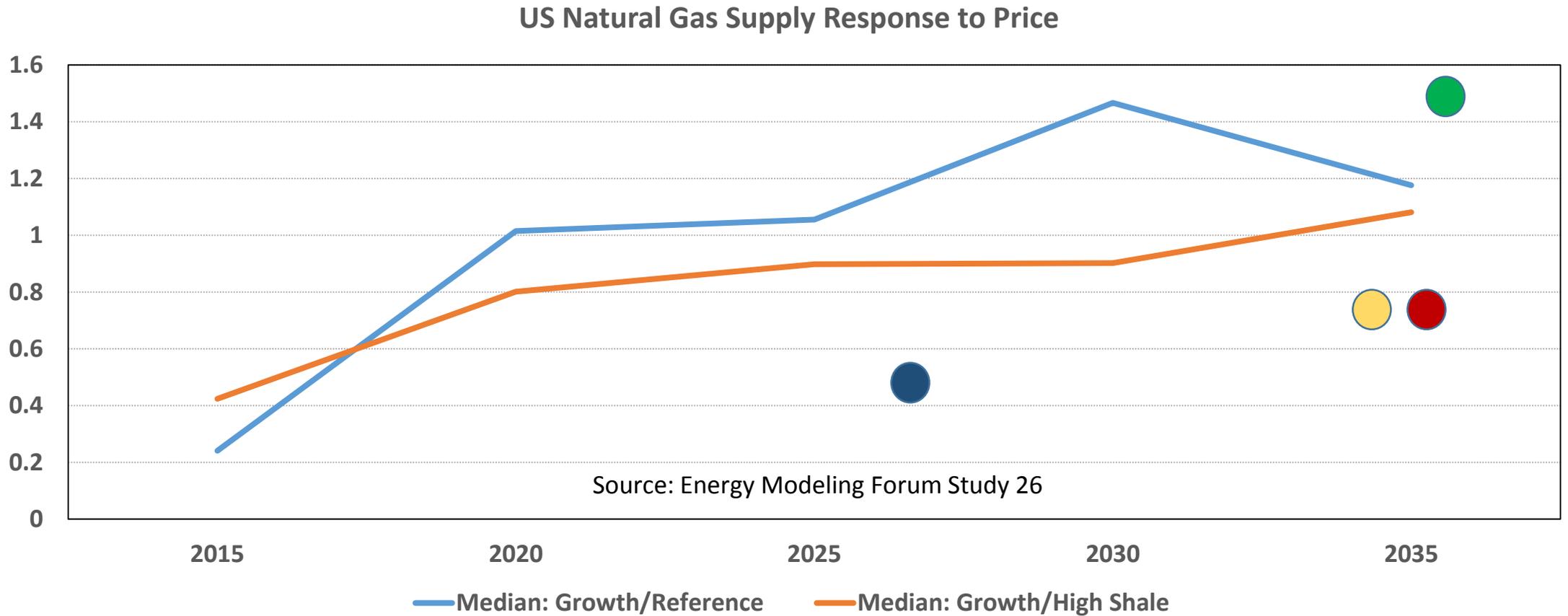
Demand Response to Price



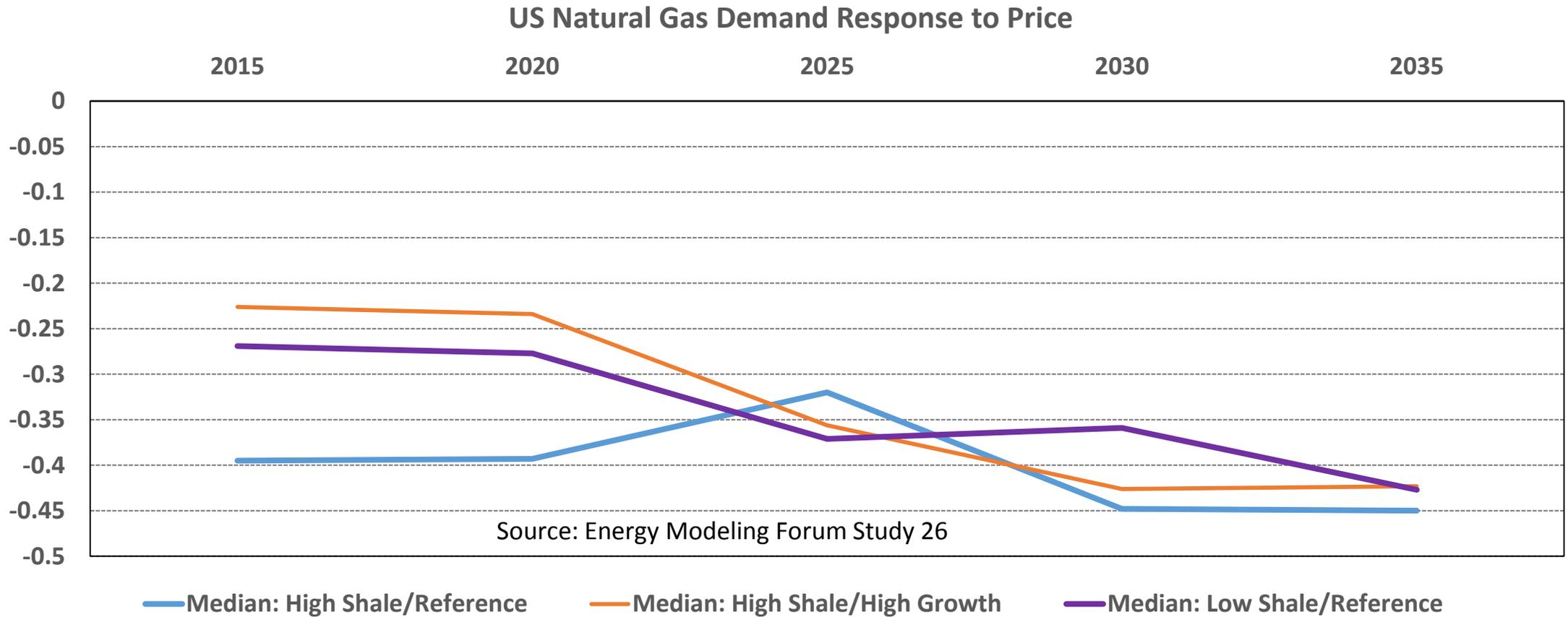
US Natural Gas Supply Response to Price



US Natural Gas Supply Response to Price



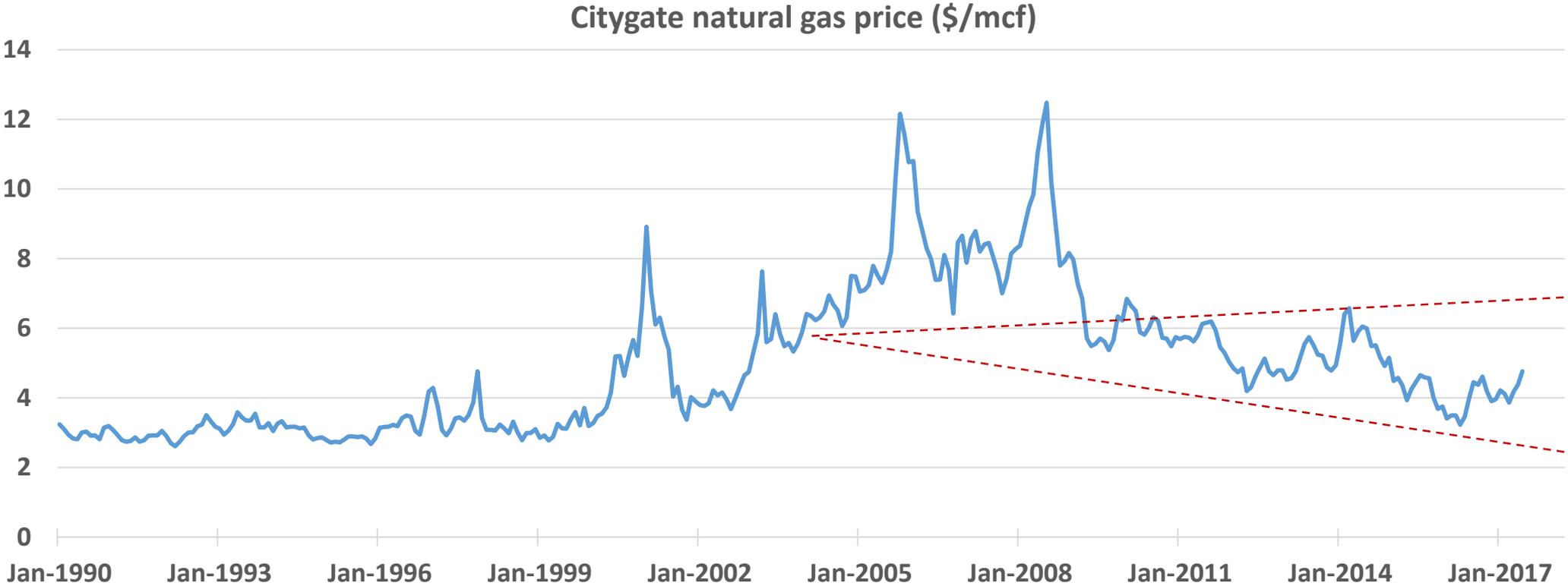
US Natural Gas Demand Response to Price



Natural Gas, Fuel Diversity and North American Energy Markets

- Working group first met in January 2002.
- 2020 prices could range between 58% and 118% of June 2003 level.
- Investments in resources/technologies play a critical role.
- Fuel-substitution opportunities provide a more stable long-run price path.

The New 'Normal' for Natural Gas Prices



Concluding Remarks

- Shale gas likely to dominate future US energy markets
- Lower prices help economy but no manufacturing rebirth
- Environmental challenges remain but are surmountable
- Long-run domestic supplies and demands respond to price
 - Estimates from EMF studies suggest an export expansion increasing total demand by 10% would increase prices by less than 7% in the long run
- Models sometimes provide insights, especially when conditions are changing

Thank you