

IPEC 2019 Plenary Address “*Innovation and Efficiency Rule*”

Welcome Academics and Regulators

Welcome Service Providers and Operators

Welcome Educators, Scientists, Engineers, Managers, Lawyers

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More 40 year Perspective and Learnings



UPSTREAM



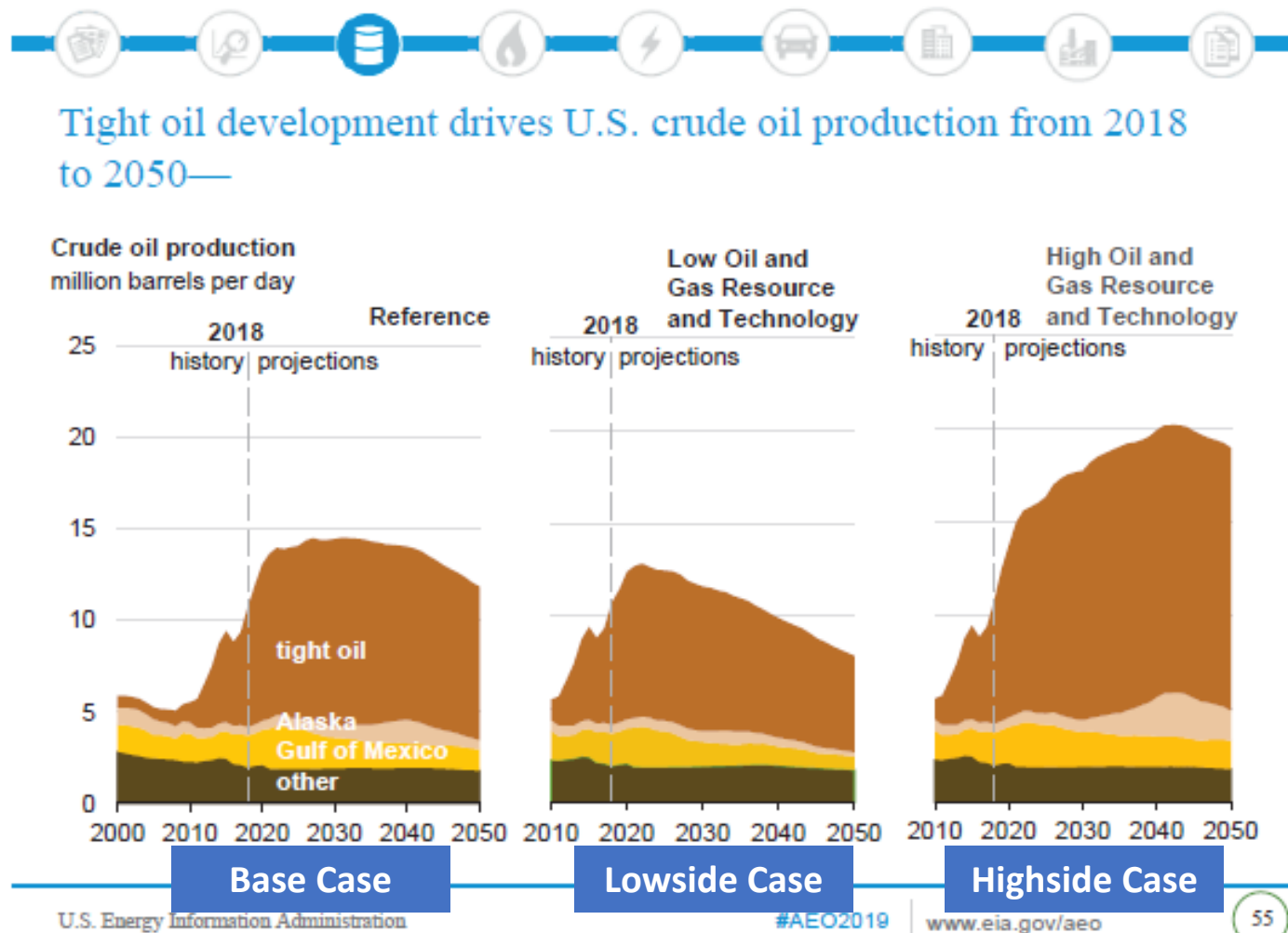
MIDSTREAM



DOWNSTREAM

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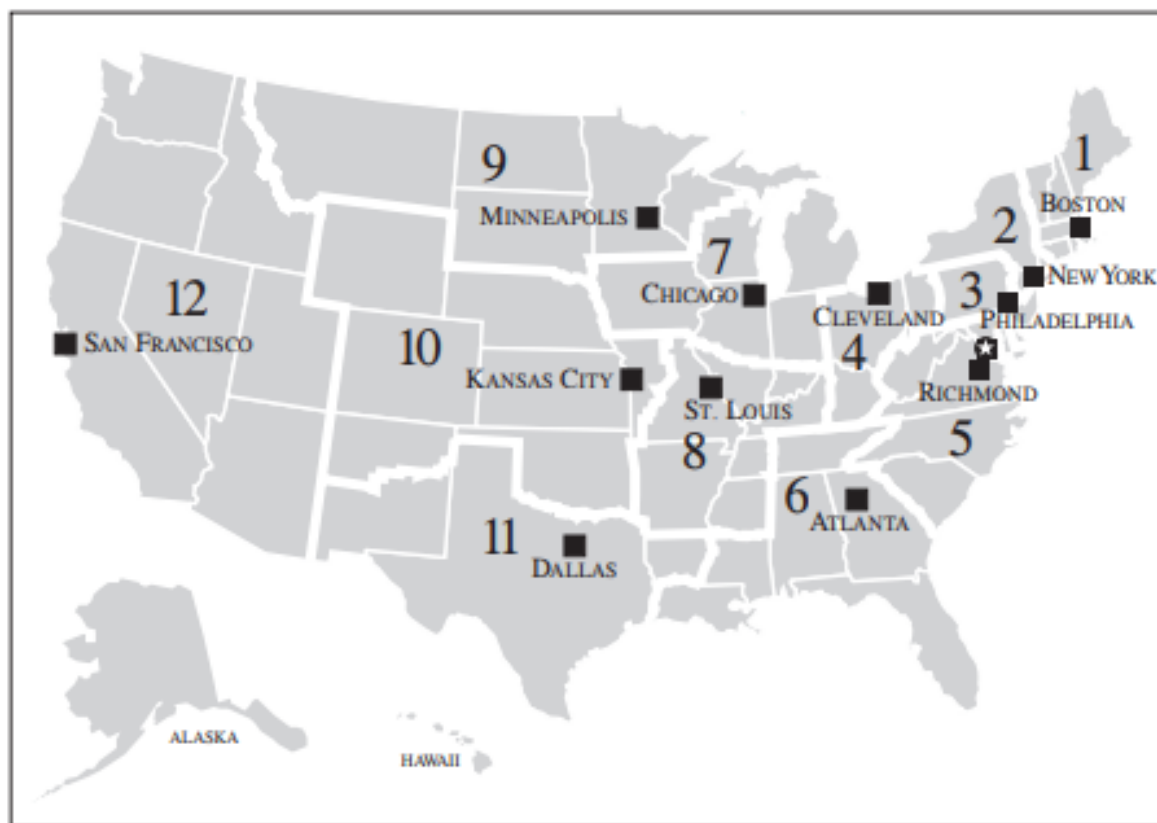
Where has the U.S. upstream sector come from, and predicted to go?



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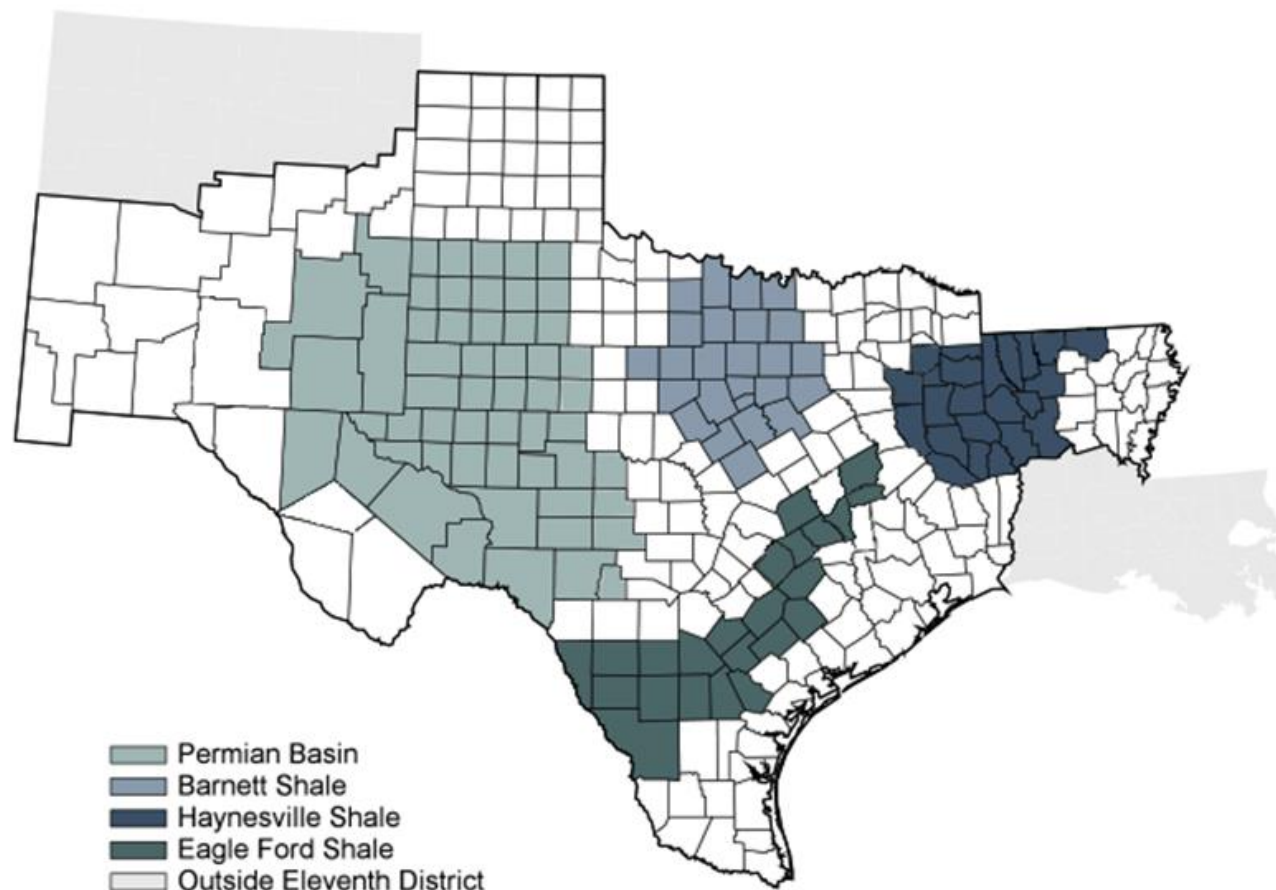
Let's hear from the folks that know about money

The Federal Reserve System



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Let's hear from the folks that know oil and gas



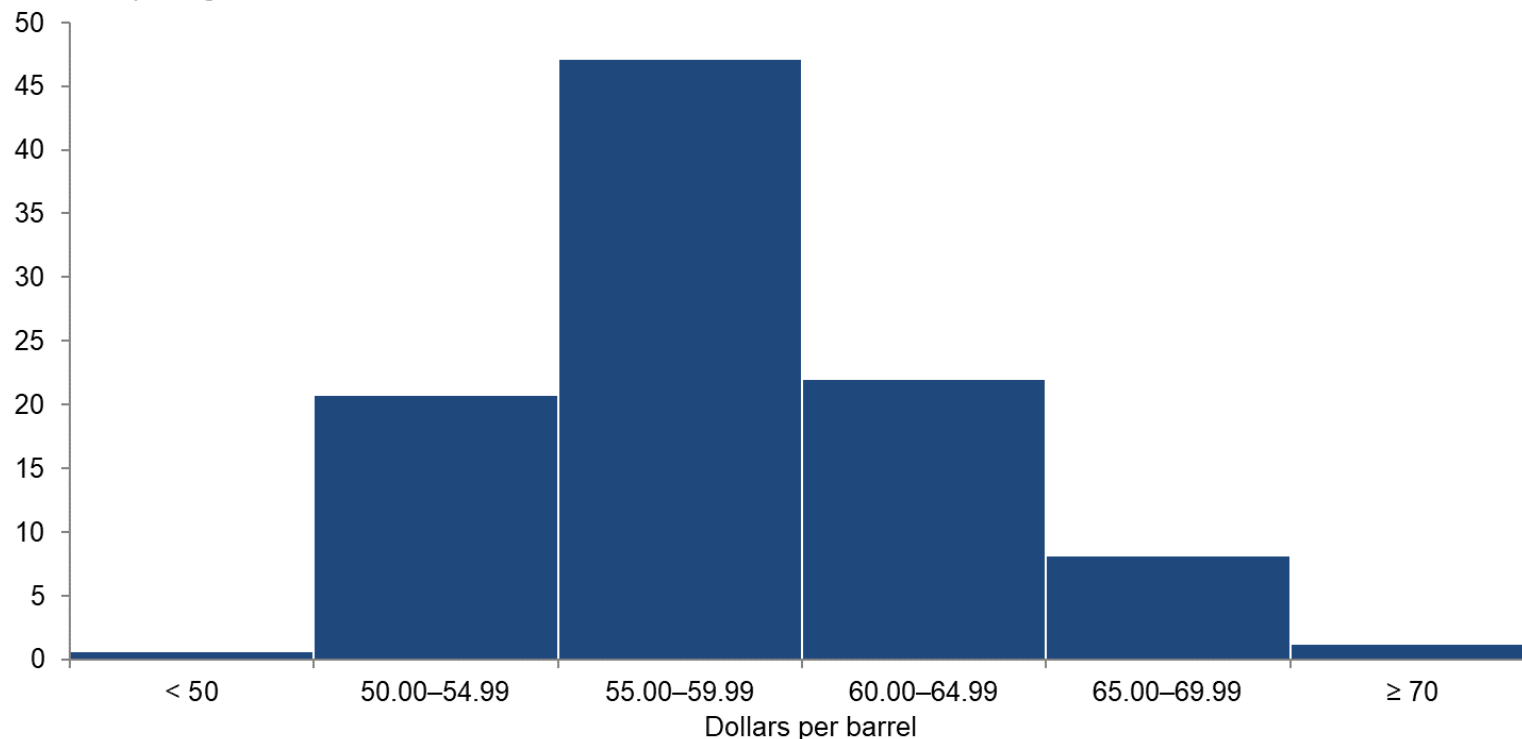
**163 CEOs
responded from
108 Operating
Companies and 55
Service Companies
operating in the
Permian,
Eagleford, Barnett,
and Haynesville**

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CEO responses for oil pricing:

What do you expect the WTI crude oil price to be at the end of 2019?

Percent reporting



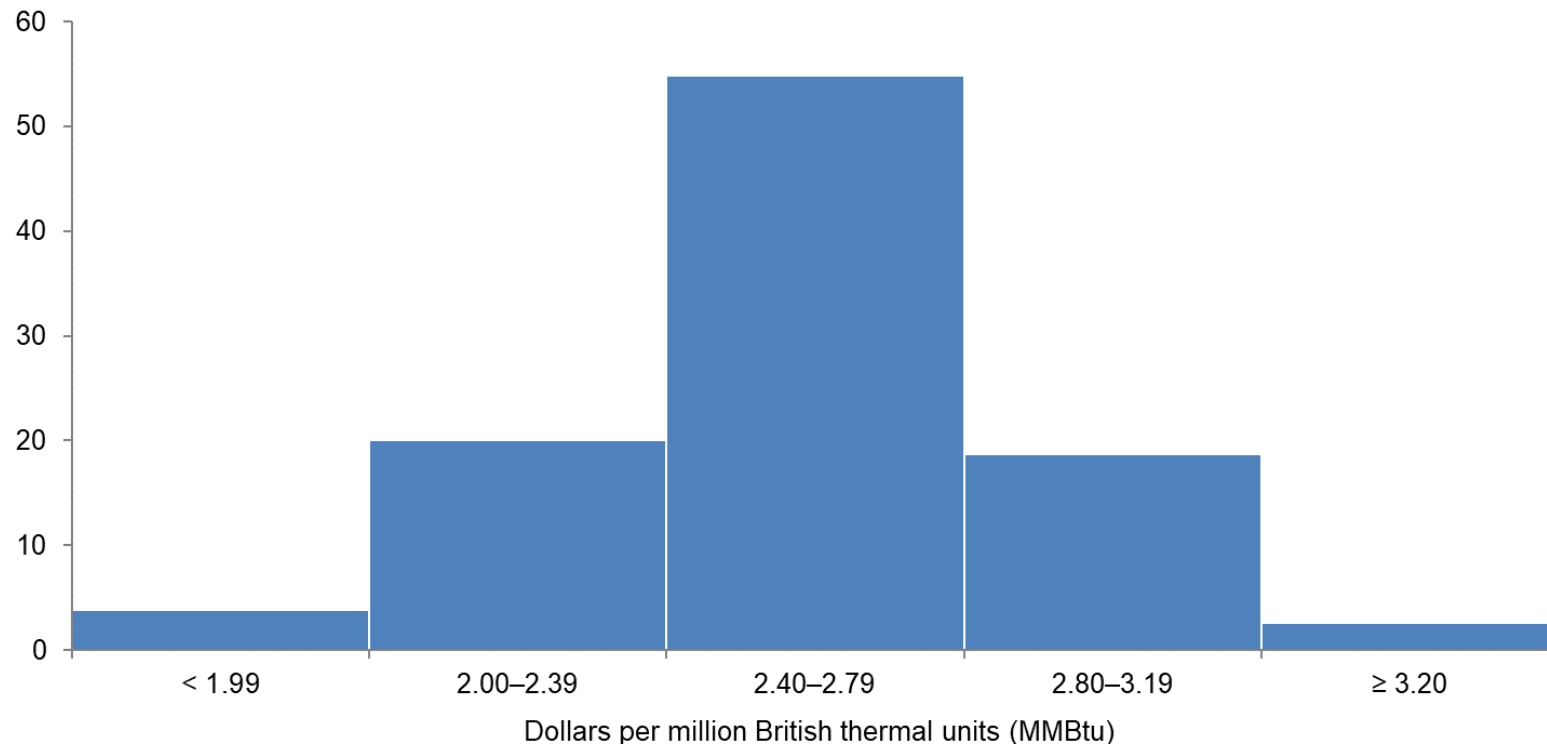
NOTES: Executives from 159 oil and gas firms answered this question during the survey collection period, Sept. 11–19, 2019. For reference, WTI (West Texas Intermediate) spot prices averaged \$57.76 per barrel during the period.
SOURCES: Federal Reserve Bank of Dallas; Energy Information Administration (reference price).

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CEO responses for natural gas pricing:

What do you expect the Henry Hub natural gas price to be at the end of 2019?

Percent reporting



NOTES: Executives from 155 oil and gas firms answered this question during the survey collection period, Sept.11–19, 2019. For reference, Henry Hub spot prices averaged \$2.67 per MMBtu during the period.
SOURCES: Federal Reserve Bank of Dallas; *Wall Street Journal* (reference price).

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CEO responses for activity:

Dallas Fed Energy Survey's Level of Business Activity Index



SOURCE: Federal Reserve Bank of Dallas.

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CEO Added Comments:

- Each day is a new day and the market is heavily driven by events of the moment, which makes strategic planning more like strategic speculation.
- The capital markets remain problematic. Access to capital will crimp the industry. It feels like employment in the sector will be decently lower in the next 12 months.
- Outspending cash flow, limited access to capital markets, and higher industry bankruptcies suggest lower activity [and] flat to lower production.
- The capital market has dried up for small E&P companies.
- We are seeing increased costs in supplies, and vendors are attributing the increases to tariffs.

Q: Given this climate, what is the path to success right now?

A: The same as it has been during every* down cycle in our industry:

Innovation and efficiency, successfully identified and properly applied, will make our business safer, better, more economic

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Innovation is all around us in everyday life

- Artificial Intelligence “AI” or Big Data or Data Analytics in sports: baseball’s “Stat-cast”; also SportsDataIO for major professional and college sports
- AI in devices: Alexa, Siri, Hey Google personal assistants, smart phones, smart watches, autonomous driving and flying vehicles

Innovation is also in the upstream business

- AI is used routinely during property evaluations, for well targeting, for selecting completion fluids, proppants, placement recipes and more
- “Better iron” for drilling: bits, mud motors, steering systems
- “Better iron” for completions: longer laterals; electric frac fleets replacing diesel; evolution towards full bore sleeves over traditional plug and perf or ball and sleeve designs
- “Better iron” for produced water – continuously see new treatment and handling technologies, plus better adaptations of existing ones

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Efficiency and Safety are all around us in everyday life

- Garbage trucks now have one person as both driver and operator
- Toll booths are now unmanned, people are out of harm’s way
- Robots and mechanical systems move warehouse inventory greatly reducing lifting related injuries

Efficiency and Safety are also in the upstream business

- Automation on the drill rig – pipe handling systems
- Automation on the completions spread – frac manifolds with remotely actuated valves keeping personnel out of the “red zone”; frac sand handling systems that minimize dust and waste
- Automation in production, midstream and downstream ops – real time data collection and notification for operational levels, pressures and temperatures; actuators for remotely controlling critical valves; remote sensing for reporting air emissions

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Innovation will be showcased at IPEC

- Hear case studies for use of new in situ bioreactors (ISBRs) built on bead technology to enhance biodegradation .
- New applications for Electric Leak Location (ELL) as a non-invasive technology
- UAVs equipped with a cesium vapor magnetometer to locate legacy wells in highly vegetated areas
- UAV Photogrammetry to determine proppant stockpile volumes
- The potential of using laser induced break down spectroscopy (LIBS) as a sensor for continuous measurements of subsurface fluid chemistry
- Characterization of suspended solids down to micro and nano particulate sizes in water and oil emulsions

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Efficiency and Safety will be showcased at IPEC

- Using otherwise flared gas and waste heat at the wellhead for water treatment and electrical generation
- Use and reuse of produced water (versus freshwater) for hydraulic fracturing and other applications within the oil and gas industry
- Use of produced water for beneficial use applications outside the industry
- Seismic monitoring arrays during hydraulic fracturing to allow for real time mitigations to begin at micro seismic levels
- Managing wells over their full life cycle, aka well integrity
- Best Practices to reduce venting and flaring with economic benefit
- Hear about a technology to recovers base oil from drilling waste while reducing carbon dioxide emissions

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Questions?

Contact Information

Lloyd H. Hetrick, P.E., C.S.P
Operations Engineering Advisor
East Shore Investments, LLC
The Woodlands, TX
lloyd.h.hetrick@gmail.com
lloyd.hetrick@eastshoreinv.com
Cell 281-630-6571



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