Saudi America
Mirage or Sustainable Reality?

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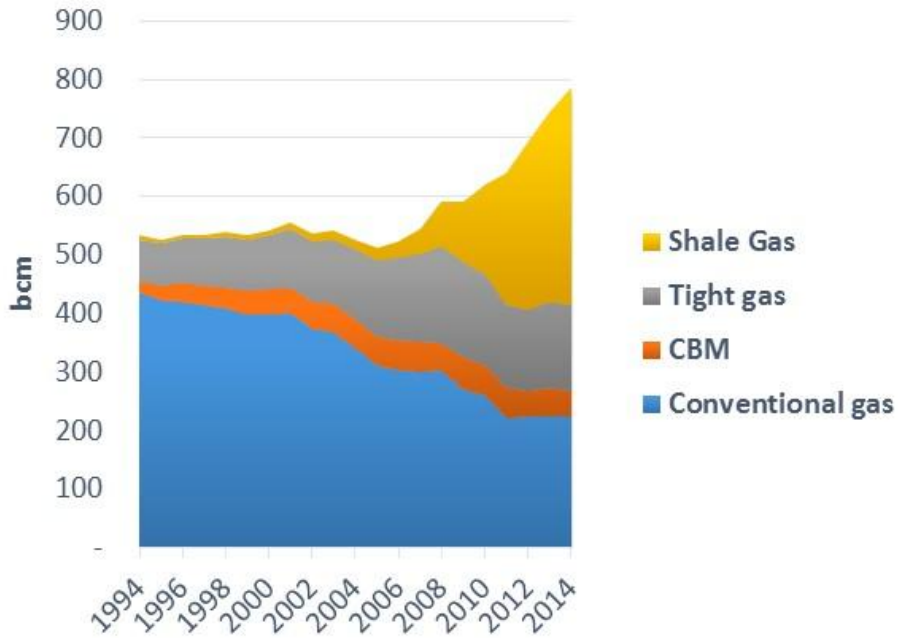
The US shale revolution

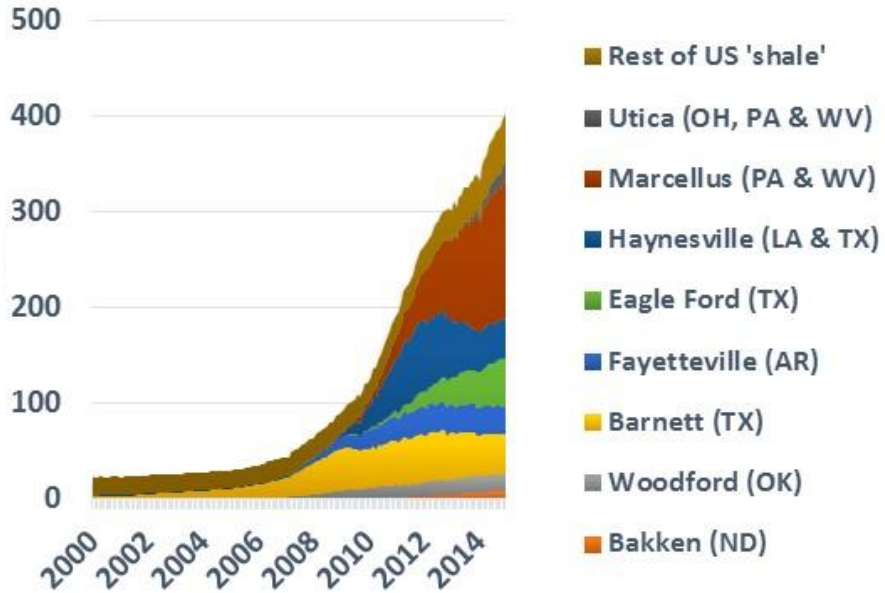
1. Eight years of shale revolution (shale gas, Light Tight Oil and NGLs): the essential and impressive data
2. Will it boost or burst?
   - Shale Business Model
   - Short and Medium/Long term projections and key uncertainties
3. Concluding remarks

The US has become the world's largest gas producer

US natural gas production



US shale gas production



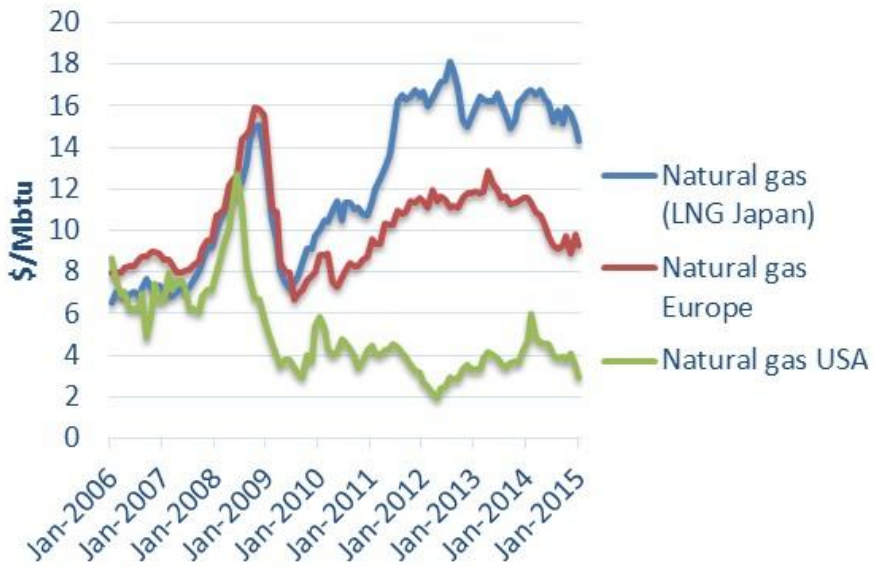
Source: US Energy Information Administration (EIA)

Natural gas production[(a)] reached 800 bcm in 2014
Shale gas accounts for almost half of total production

(a) Marketed production (wet) minus extraction losses

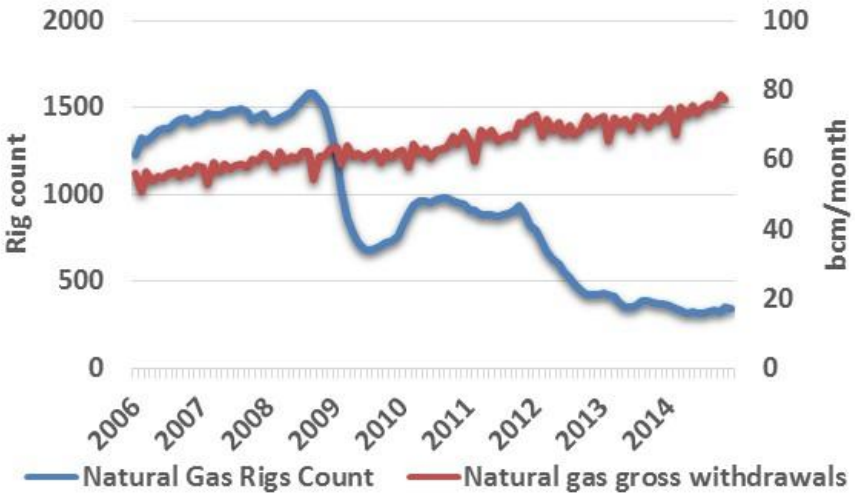
The increase has occurred despite the decline in gas prices and gas drilling activity

Natural gas prices



Source: World Bank, EIA

Natural gas drilling activity



Source: Baker Hughes, EIA

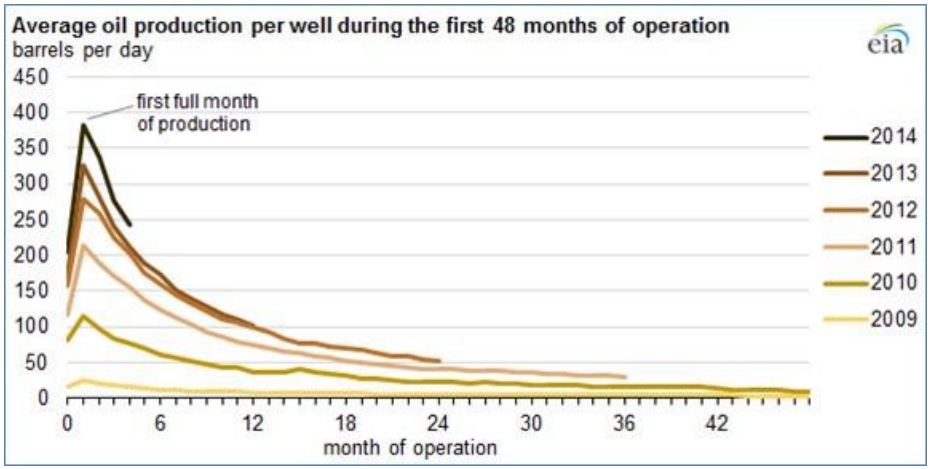
Despite the plunge in gas prices and drilling activity since 2009, production has grown thanks to cost reductions and a focus on core plays and wet gas/NGLs

Innovation and technological progress have been at the heart of the shale revolution

New technologies

- Multi-well pad drilling
- Longer laterals (up to 3 km in length)
- Multi-stage fracturing (up to 50 frac stages)
- Measurement-while-drilling (MWD), and micro-seismic imaging
- Mobile drilling rigs
- Downspacing: Reducing the spacing between new wells

Increased production from new wells

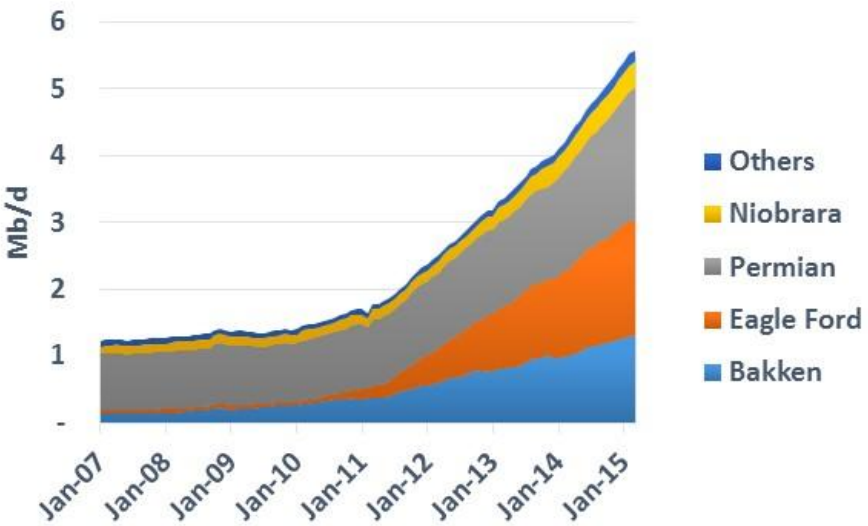


Source: EIA

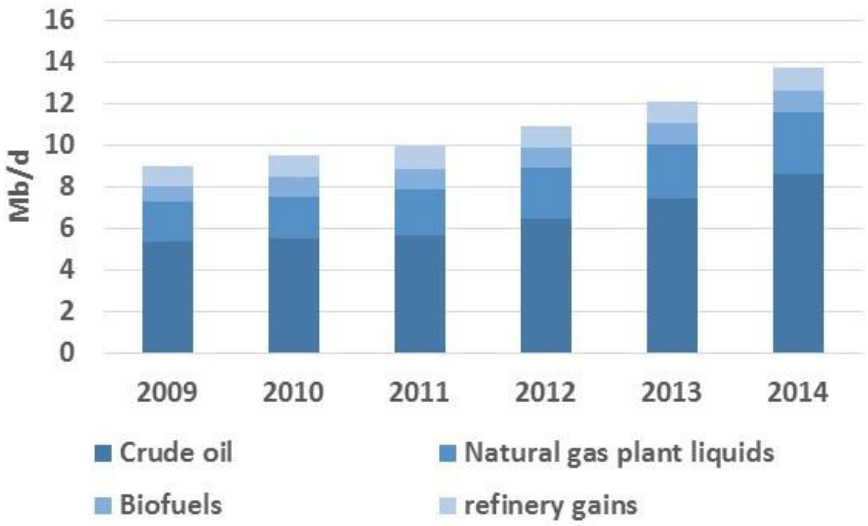
Growth of shale gas and LTO production has been supported by increasing investment and rapid technological innovation leading to higher drilling efficiency and productivity gains

Fracking has also allowed the US shale oil revolution and the US has become the world's largest oil producer

US LTO production



US total liquids production

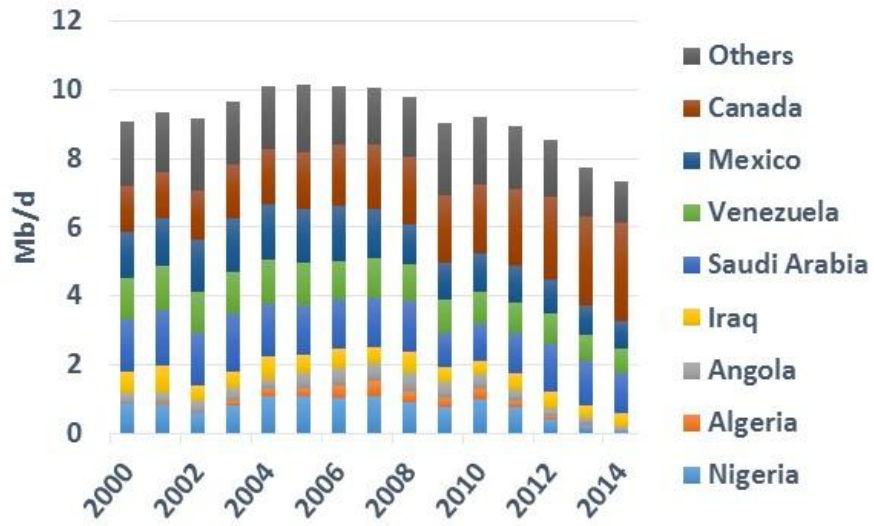


Source: EIA

Crude oil production reached 8.6 Mb/d in 2014
LTO production accounts for more than half of total production (currently: 5.5 Mb/d)
NGLs production also at record high: 3 Mb/d in 2014
US total liquids production reached 14 Mb/d in 2014, an increase close to 4 Mb/d since 2011

Radical change in trade flows

US crude oil imports



US net petroleum products exports

Source: EIA

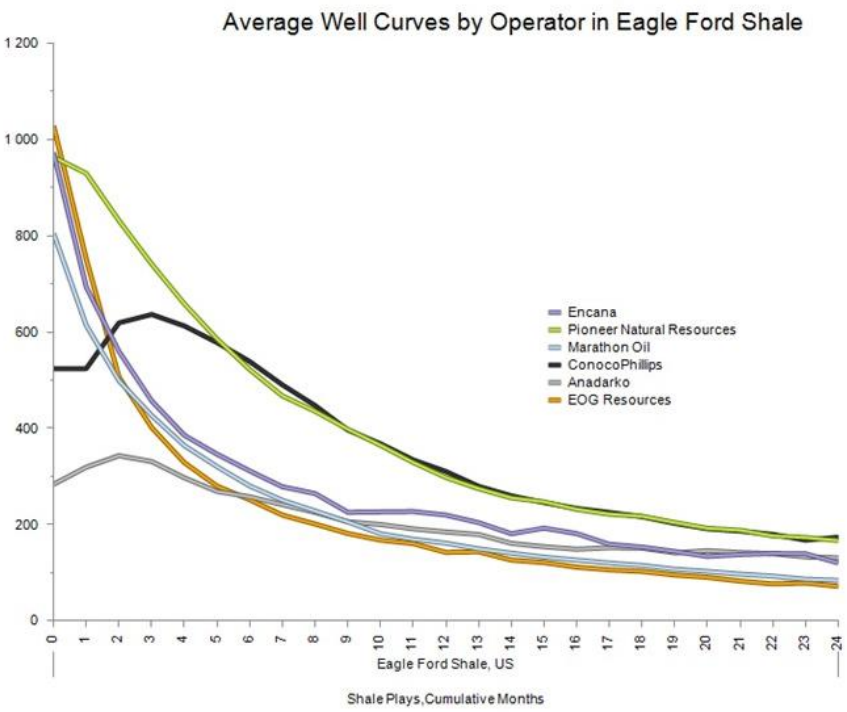
US oil import dependence has decreased dramatically. The share of US oil and petroleum products consumption covered by imports fell from 60% in 2005 to 27% in 2014.

LNG exports to start by the end of 2015 (to Asia, South America and Europe)

MIRAGE OR SUSTAINABLE REALITY?

The Shale Business Model widely differs from E&P of conventional resources

Production profile for shale oil wells



Source: Rystad

LTO Business Model

- **High initial production rate (IP) and rapid decline after the first year**
- **Mixed production**: oil, natural gas and NGLs
- **Low recovery rates** (only 5%) compared with conventional oil
- **EURs (Estimated Ultimate Resources):** 0.1 to 0.5 Million boe (based on 30 years)
- **Widely diverse geological conditions (and costs) among plays and within a play**
- The "**80/20 rule**": 20% of the wells produce 80% of the total output of a play

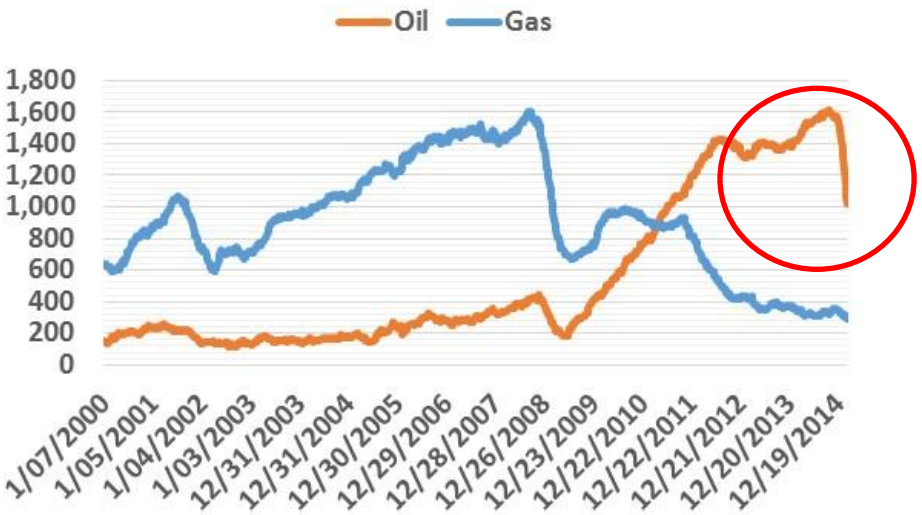
Rapid decline in production requires continuous drilling programs to support production

Significant cuts in CAPEX and a steep decline in oil drilling activity

LTO Business Model

- **Short lead-time, short payback time and low upfront capital costs**
- **CAPEX higher than OPEX**
- Economies of scale and standardization **(Industrial manufacturing of oil)**
- **Very flexible and modular**
- **Highly responsive to oil prices**
- US oil independents offer contrasted financial situations **(debt, hedging strategies)**
- **Significant cuts in CAPEX/drilling activity for all of them**

Decline in oil drilling activity

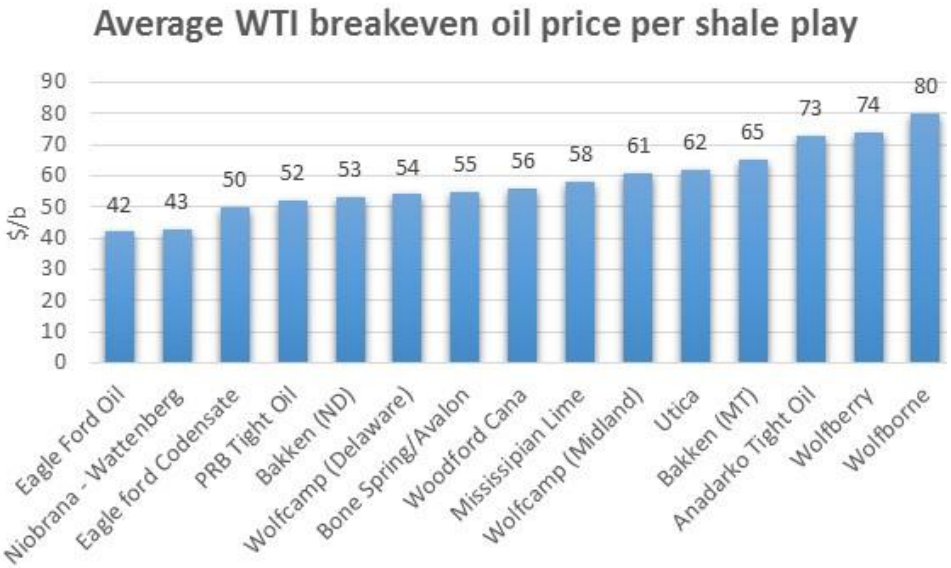


Source: Baker Hughes, 20 February 2015

Significant cuts in CAPEX translate into a steep decline in oil drilling activity
The oil rig count is down 37% from its October peak.
But most companies still forecast an increase in oil production in 2015 (but less than in 2014)

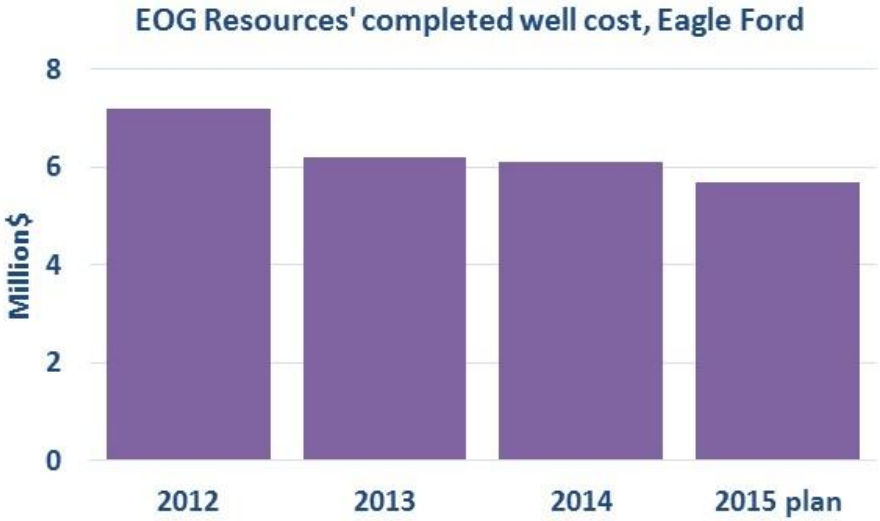
Breakeven prices: no single answer as they vary from area to area and well to well

Wide range of breakeven prices



Source: Rystad, January 2015

Breakeven prices are falling



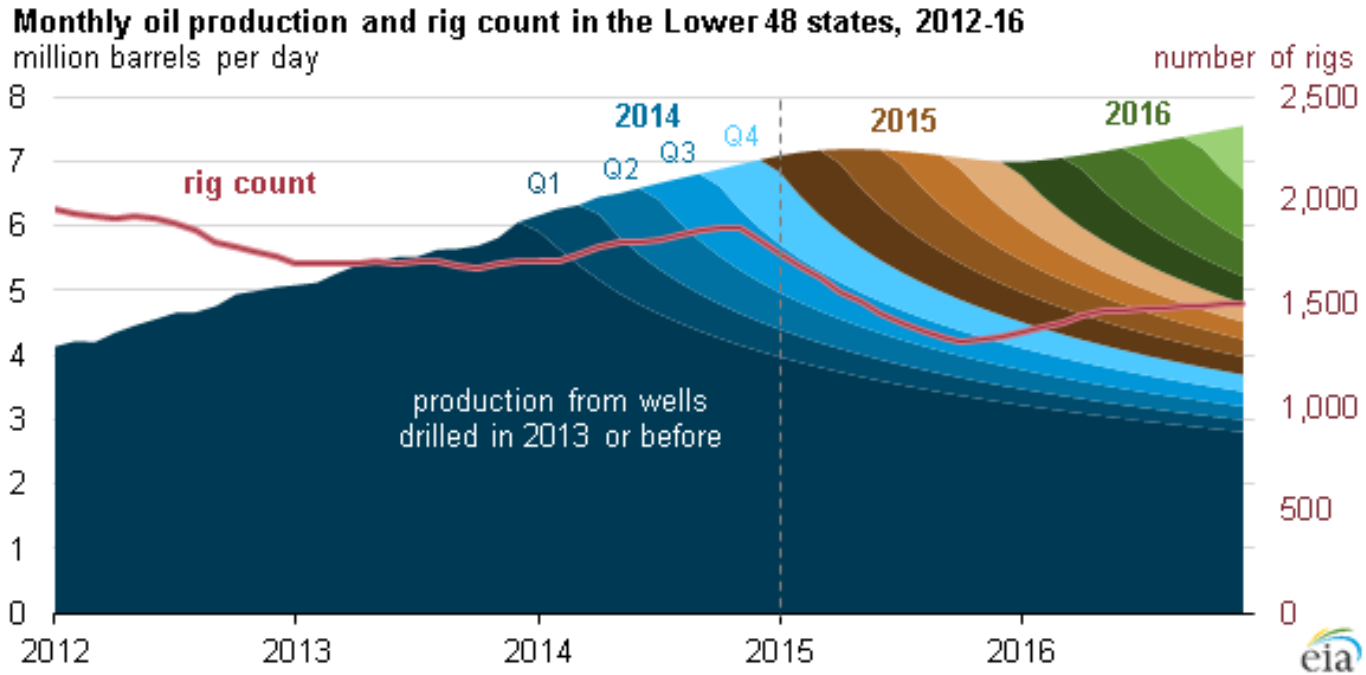
Source: EOG Resources

Wide variation in breakeven prices, even within a play (Eagle Ford from less than $50 to $100)

They also differ from one operator to another (first movers have lower costs)

They have fallen and are expected to fall further

US oil production reflects more than just the rig count



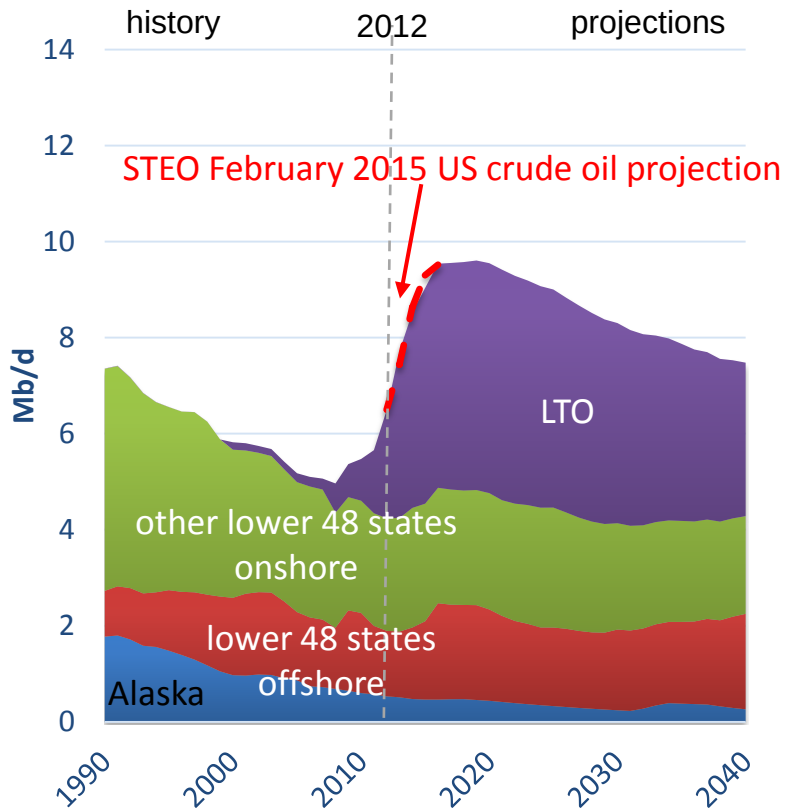
Source: EIA, Today in Energy, 26 January 2015

Marginal impact in the short-term <u>provided that oil prices rebound later this year</u>
US crude oil production growth is decelerating (production starts to decline in H2 2015)
Annual growth: +8% (+ 0.6 Mb/d) in 2015 and +2% (+ 0.2 Mb/d) in 2016 compared with +16% (+1.2 Mb/d) in 2014 (EIA STEO, February 2015)
NB: The fall in drilling activity is steeper than expected

Resource and technology assumptions, and the level of oil prices, have major implications in the mid/long term

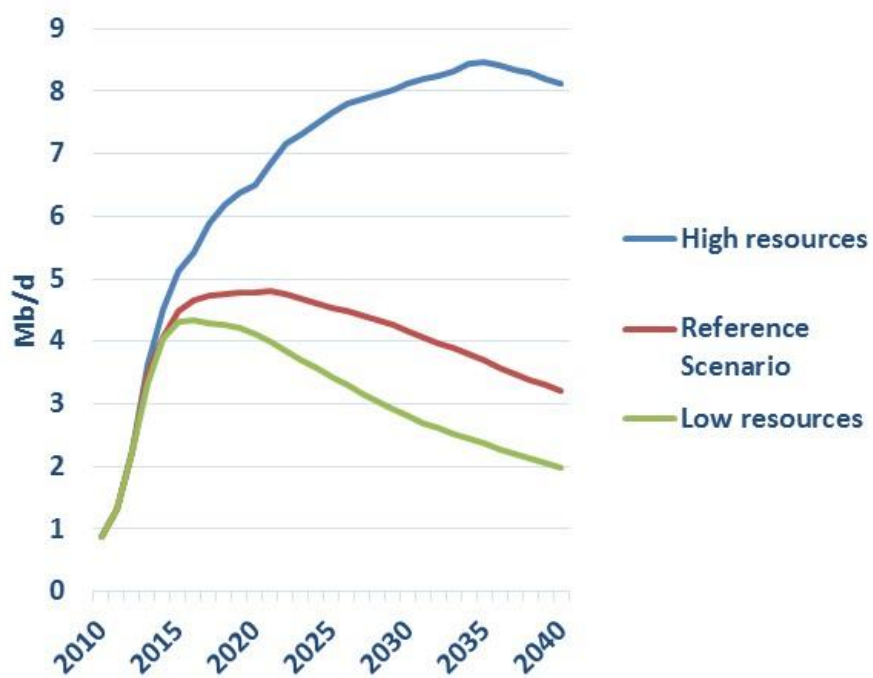
Crude oil production

EIA Reference case



LTO production

EIA High and Low Oil and Gas Resource cases



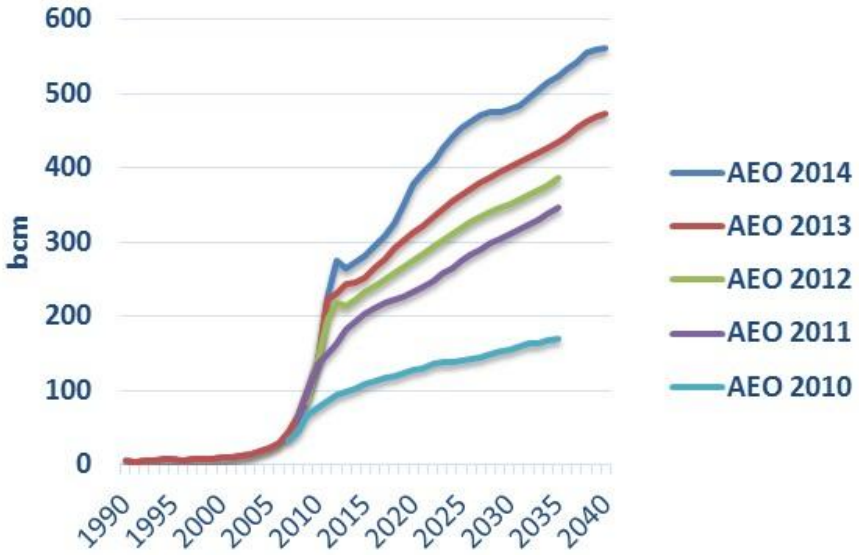
Source: EIA, Annual Energy Outlook, 2014

With current technology, growth in US LTO is expected to flatten out in coming years, reflecting high well decline, low recovery rates and less extensive resources than gas. With breakthrough in technology, LTO production continues rising

Better prospects for shale gas production based on higher resources and recovery rates

Shale gas production

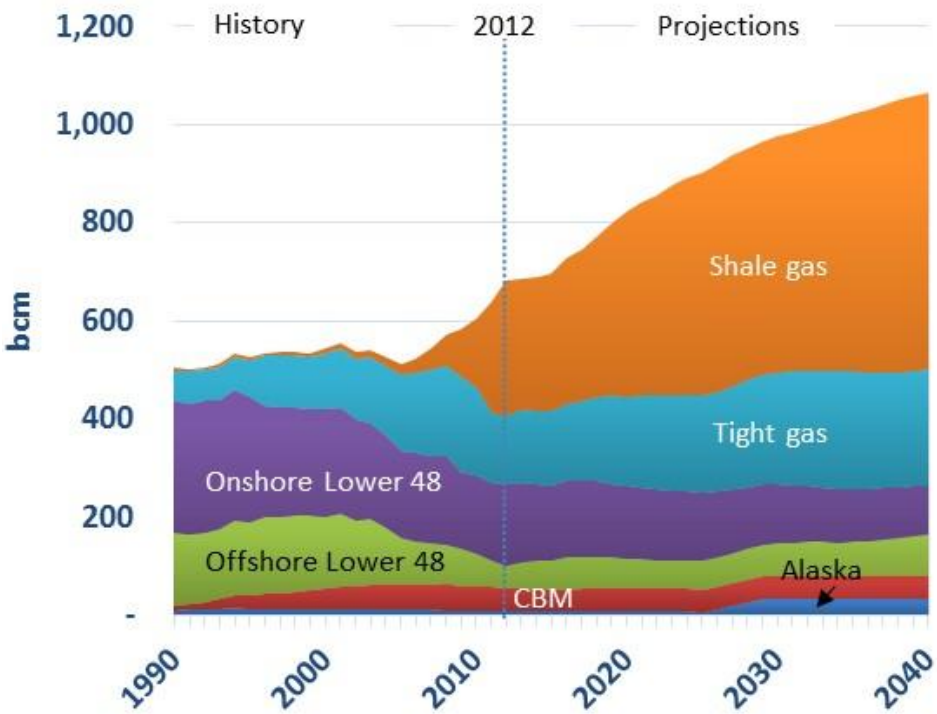
EIA Reference case, AEO 2010 to AEO 2014



Source: EIA, Annual Energy Outlook, 2010 to 2014

Natural gas production

EIA Reference case



Shale gas production is expected to grow rapidly thanks to continued productivity gains

Environmental impact is being addressed

- **Methane emissions** from hydraulically fractured natural gas wells have been reduced by 73% since 2011 (EPA report, January 2015)
  - New EPA rules by summer 2015: The EPA's goal is to reduce methane emissions from the oil and gas sector by 40-45% from 2012 levels by 2025.
- **Two global initiatives launched in September 2014**
- **Oil & Gas Methane Partnership**
  - Multinational oil and gas companies with governments and international environmental organizations
  - Main goal: To reduce short-lived climate pollutants (methane, HFC and black carbon)
- **Oil and Gas Initiative** announced by Saudi Aramco on behalf of others engaged in the initiative, including BG Group, Eni, PEMEX and TOTAL.
  - The Initiative serves as a platform to address climate change concerns, to share industry best practices, advance technological solutions
  - Initial work focusses on energy access, energy efficiency, reduction of gas flaring and methane emissions, carbon capture and storage, the expanded role of natural gas and renewable energy.

Conclusion: Mirage or Sustainable Reality?

- **Contrasted projections between shale gas and LTO**
- **Oil production**
- **Short term: Impact of lower prices**
  - Thanks to its short lead-time and low upfront capital costs, LTO may prove quicker to ramp up production than conventional supply as soon as oil prices recover
- **Mid/Long term: Dependent on resources and technological progress**
  - Under current technology, LTO production is expected to peak by 2020 and start declining
- **Natural gas production**
  - **In contrast, growth in shale gas is expected to continue, thanks to higher resources, recovery rates and productivity gains**

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Thank you for your attention

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