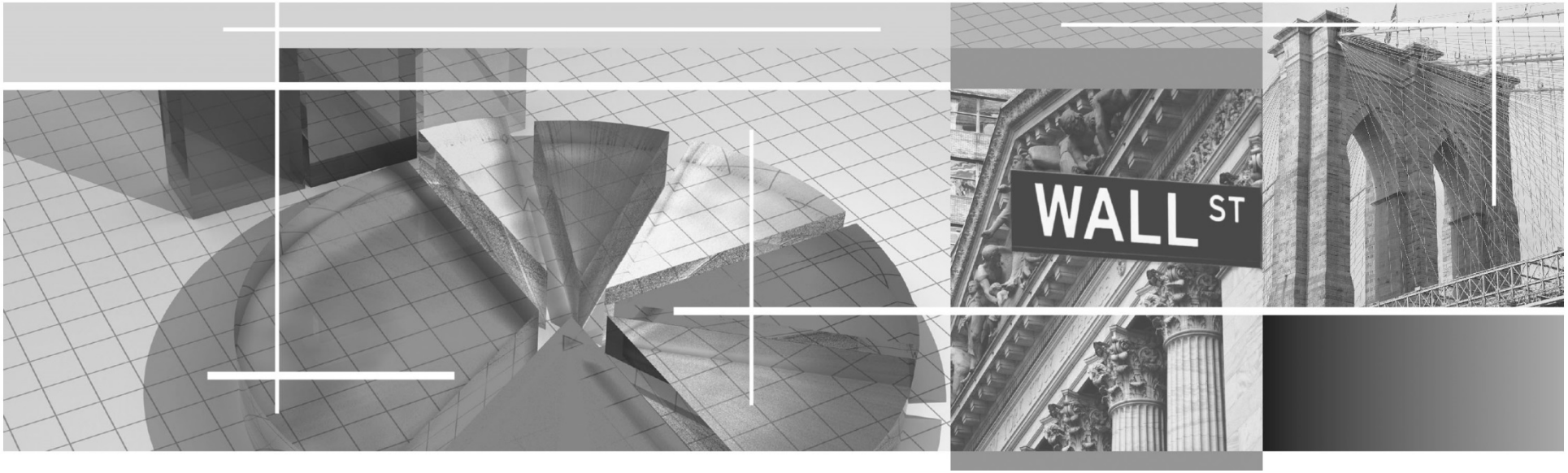

Unconventional Oil & Gas

Demystifying Fracking and Understanding Global Opportunities

September 2014

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Demystifying Fracking & Understanding Global Opportunities

- Unconventional oil and gas extraction from shale via horizontal drilling and fracturing (often referred to as "fracking"), though in existence for some time in some form or another, has only recently been explored in depth in the U.S. and has experienced significant advancements via the evolution of drilling technology
- While unconventional oil has been transformational for the U.S., we believe we are still primarily in the "discovery and delineation" stage of unconventional oil resources
- As the U.S. enters the "exploitation phase", companies may continue to improve and capitalize upon drilling efficiencies, adding value and potentially contributing, perhaps significantly and over longer periods, to global production and reserves
- Unconventional oil reserves are not unique to the U.S.; many other countries have substantial potential
- **When taken to its logical conclusion, unconventional oil and gas production has significant implications with respect to the global energy supply, though challenges still remain**

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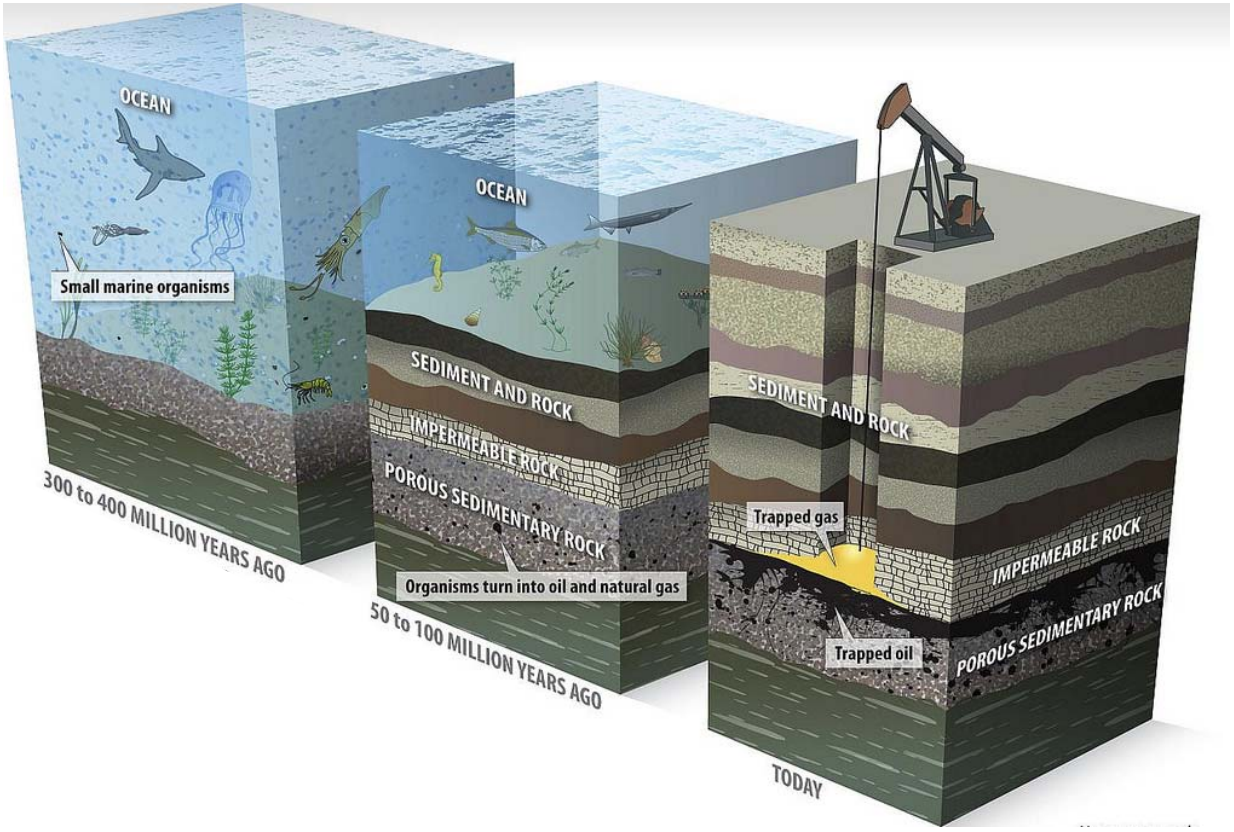
Stepping Back – How is Oil & Gas Formed?

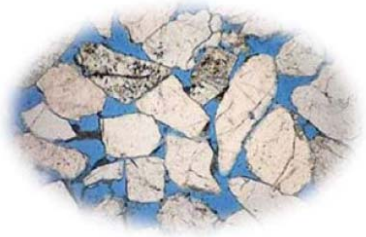
- Over millions of years, heat and pressure formed by the layering of sediment and rock have turned the remains of ancient marine organisms into oil and gas which are now "trapped" in these layers miles below the earth's surface



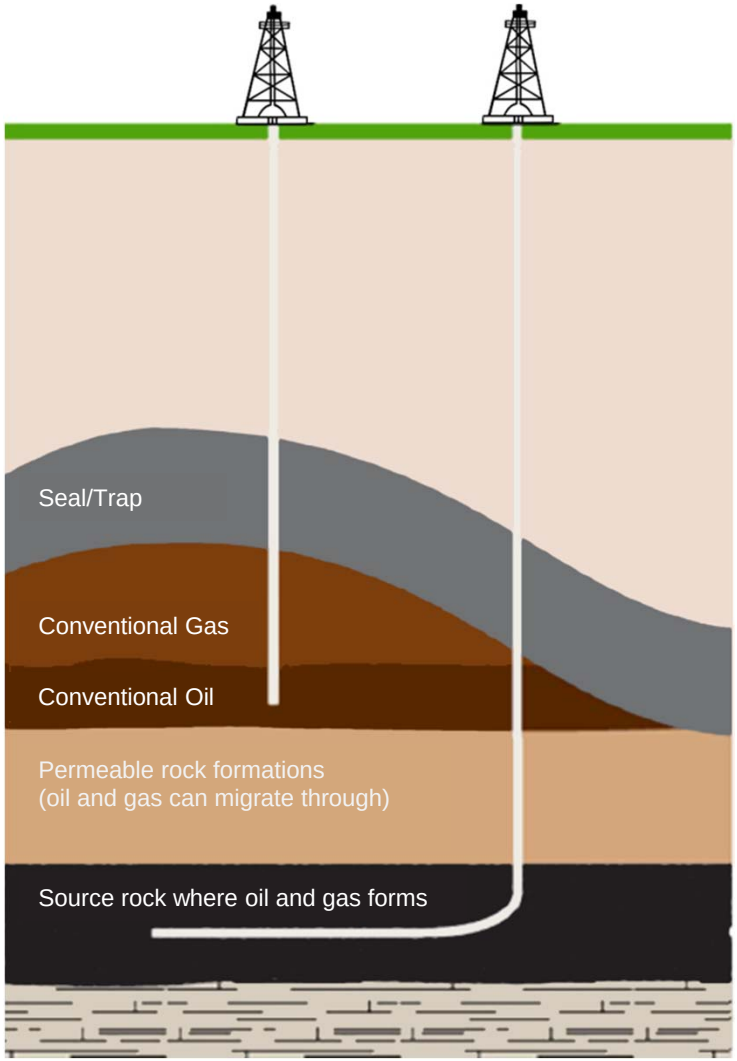
Source: www.need-media.smugmug.com; Data as of September 2014.

Conventional vs. Unconventional Oil: A Primer

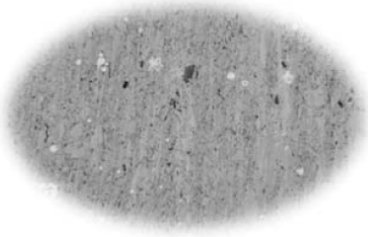
CONVENTIONAL



- High permeability
- Fracking: minimal
- Principal evaluations:
  - Trap
  - Seal
  - Source
  - Reservoir
  - Migration
  - Timing
- Primary risk: geologic
- Access: vertical wells



UNCONVENTIONAL



- Ultra tight rock
- Fracking: large, hydraulic
- Principal evaluations:
  - Kerogen content
  - Maturity
  - Clay content
  - Pressure
  - Bulk volume Hydrocarbon
- Primary risk: economic
- Access: horizontal wells

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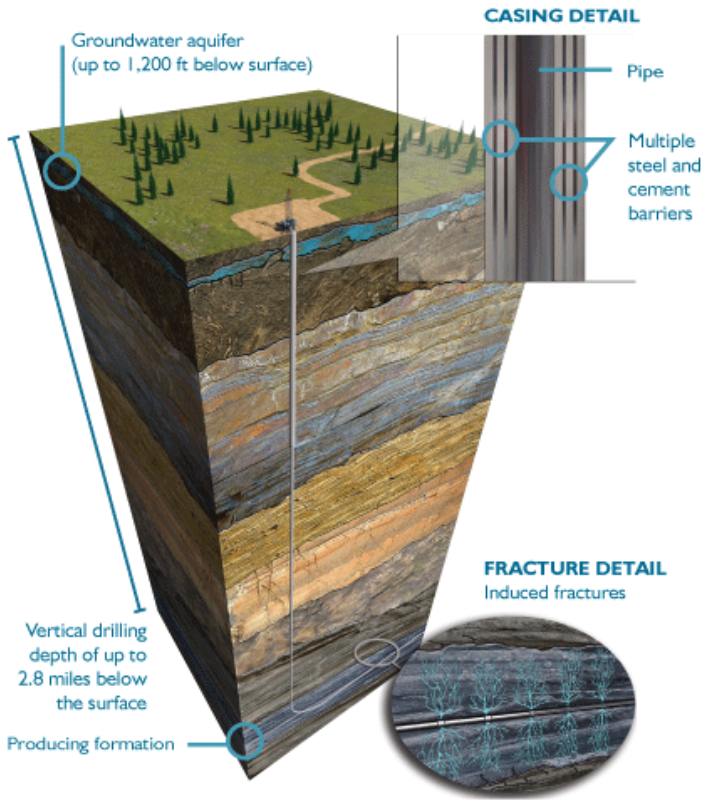
Source: Pioneer Natural Resources; Data as of September 2014.

Three Factors that Sparked the U.S. Shale Revolution

Horizontal Well With Multi-Stage Fracturing



I. **Horizontal drilling technology** (began 1930's):

- allowed access to significantly greater volume of reservoir rock

II. **Horizontal hydraulic fracture stimulation technology** (began 1950s):

- created porosity and permeability – created "channels" that allowed oil and gas to flow

III. **Historically strong commodity prices**

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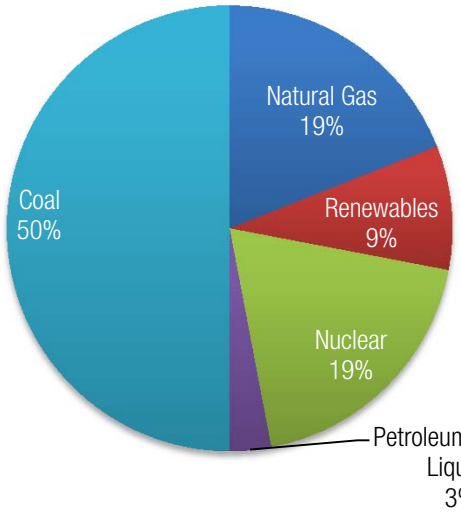
Source: EnCana, Pioneer Natural Resources; Data as of September 2014.

How the U.S. Shale Revolution Has Shaped U.S. Energy Production

- Natural gas has encouraged coal-to-gas switching among electricity producers

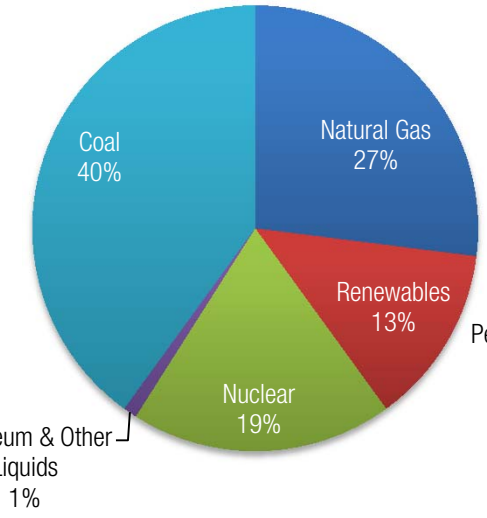
Previous Power Generation Mix 2005

2005 Capacity = 4.1 Trillion Kilowatthours



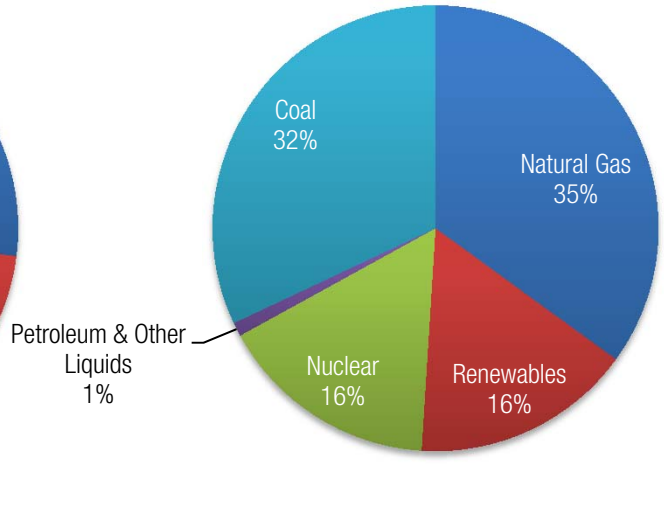
Current Power Generation Mix 2013

2013 Capacity = 4.1 Trillion Kilowatthours



Projected Power Generation Mix 2040

2040 Capacity = 5.2 Trillion Kilowatthours

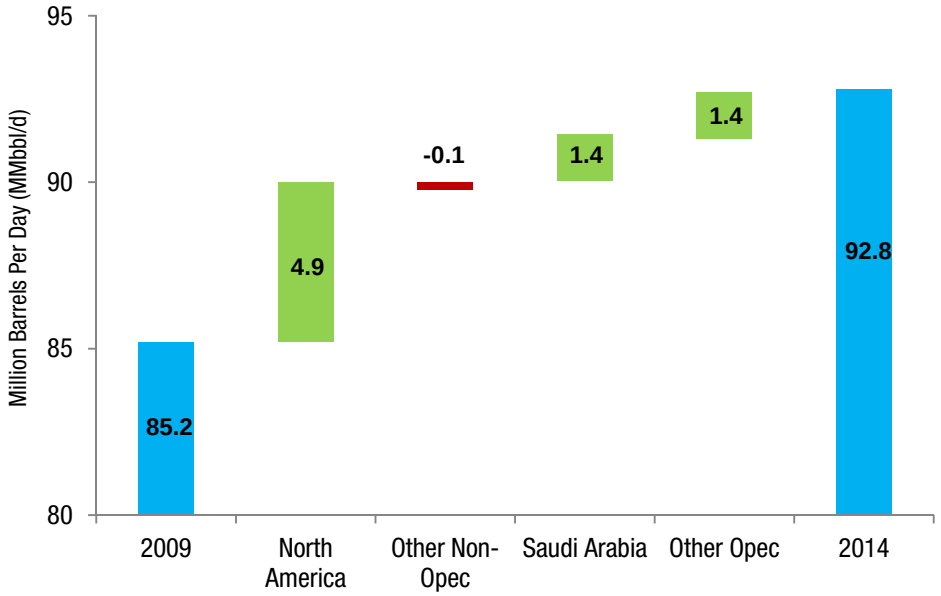


Source: Pioneer Natural Resources; Data as of September 2014.

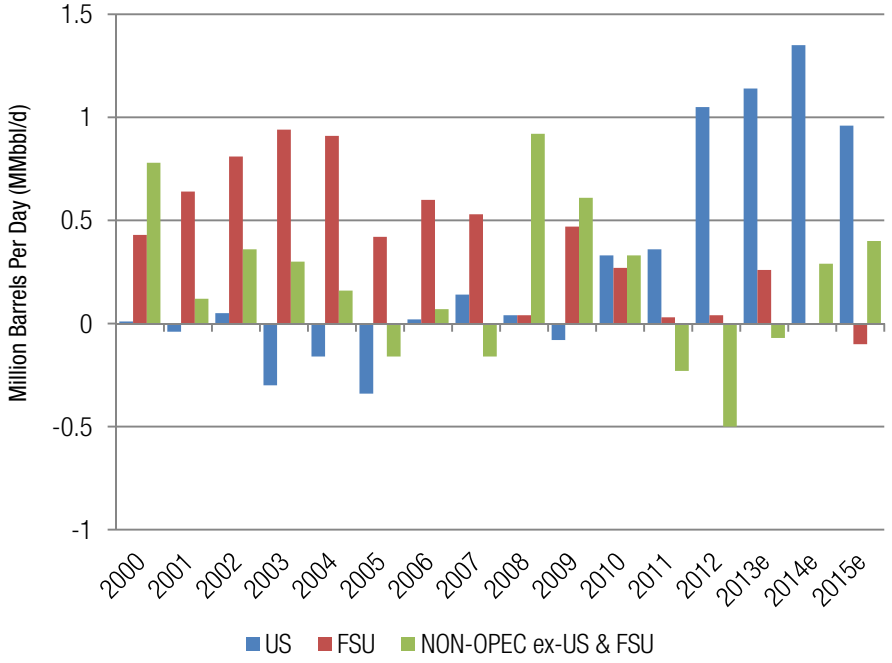
How the U.S. Shale Revolution Has Shaped Global Supply

- U.S. and Canada have been the only recent source of non-OPEC (Organization of the Petroleum Exporting Countries) supply growth

Oil Supply Growth During 2009 – 2014
(with Brent Crude Oil at $105 / bbl)



Year-over-Year Growth in Supply
U.S., Former Soviet Union (FSU), Non-OPEC ex-U.S. & FSU



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Source: U.S. Energy Information Administration (EIA); Data as of July 31, 2014.

How Can the Value of Unconventional Resources be Increased?

Access More Rock

- Acquire more land
- More stratigraphic layers
- Tighter well spacing
- Longer, more accurate laterals
- More frac stages
- Bigger frac stages

Improve Well Economics

- Faster drilling
- Reduce drilling costs
- Optimize production
- Stack laterals
- Integrate frac distribution

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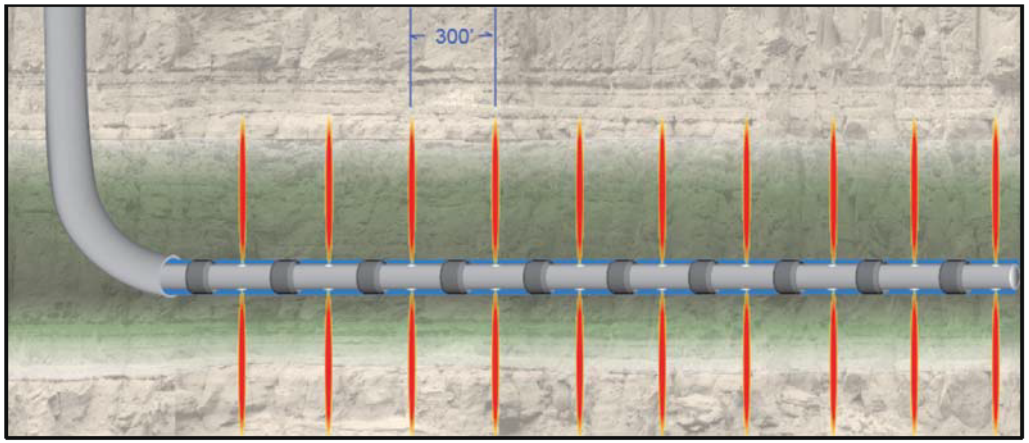
Case Study: Whiting Petroleum – More and Bigger Frac Stages

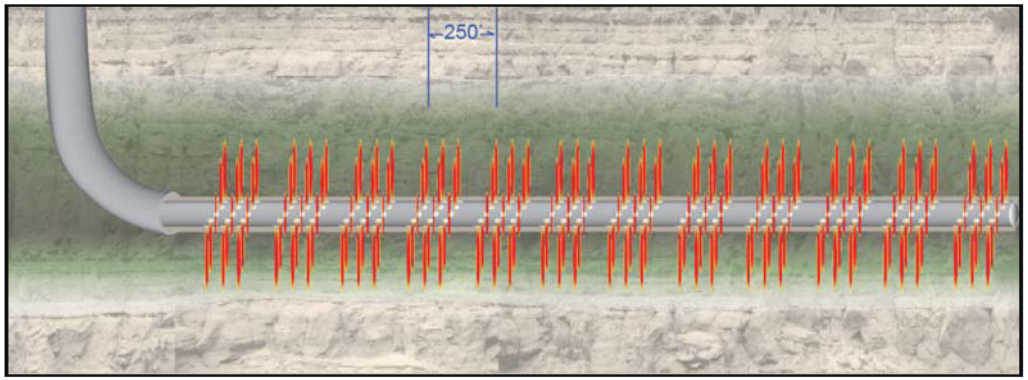
Older Style Completion

Annulus (Gaps)	Stages	Frac Ports / Stage	Potential Entry Points
Free fluid between packers	30	1	30



New Style Completion

Annulus (Gaps)	Stages	Perforation Clusters / Stage	Potential Entry Points
Cemented	40	3	120



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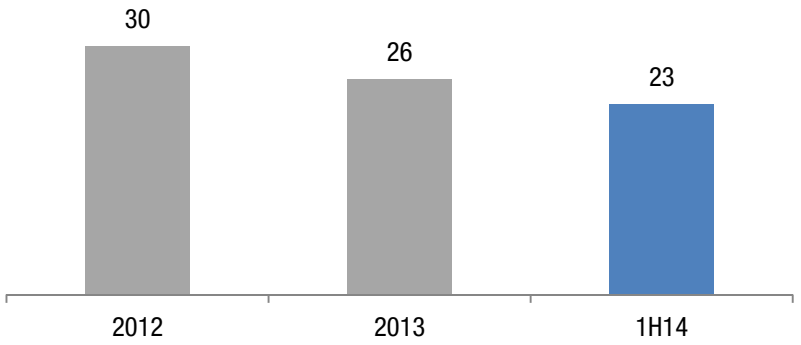
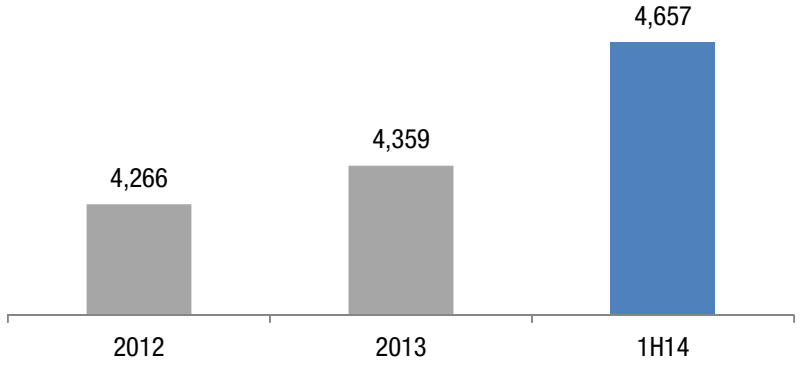
Source: Whiting Petroleum; Data as of June 30, 2014.

Case Study: Concho – Faster Drilling, Longer Laterals and More Frac Stages

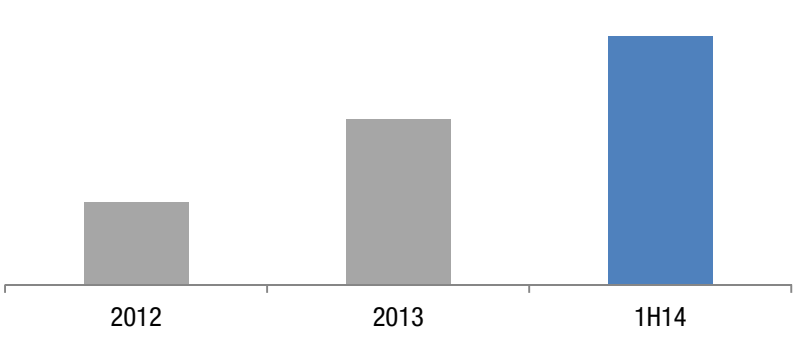
Average Drilling Days – 23% Decrease



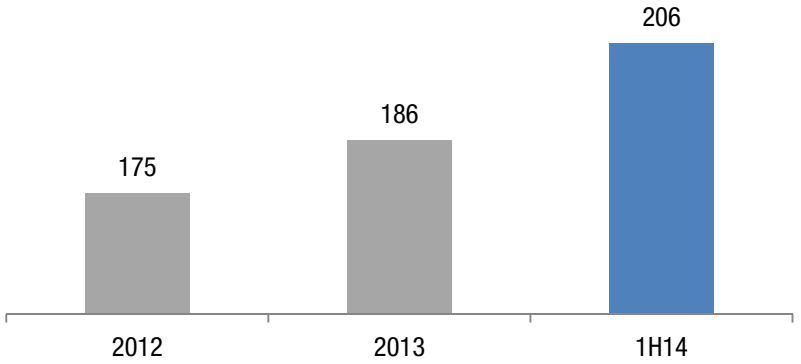
Average Lateral Length (Feet) – 9% Increase



Average Stages Per Well – 27% Increase
(note: figures intentionally hidden)



Average 30-Day Initial Production (Boepd* per 1,000 Wells) – 18% Increase



**Boepd = Barrels of Oil Equivalent per Day*

Source: Concho Resources; Data as of June 30, 2014.

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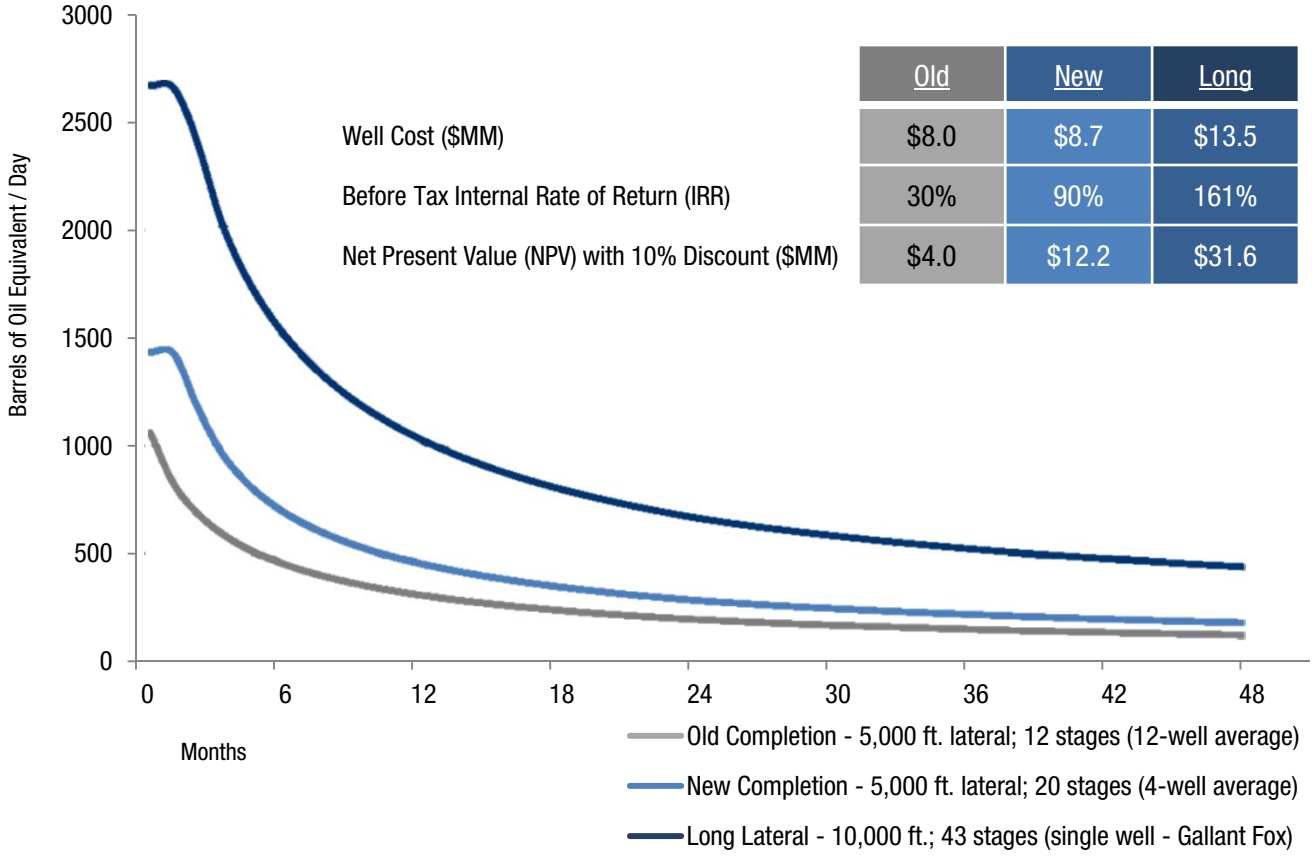
Case Study: Cimarex – Longer Laterals and More Frac Stages

Well Cost Estimates – Culberson County Wolfcamp D Wells

	Old	New	Long
Well Cost ($MM)	$8.0	$8.7	$13.5
Before Tax Internal Rate of Return (IRR)	30%	90%	161%
Net Present Value (NPV) with 10% Discount ($MM)	$4.0	$12.2	$31.6



**Assumptions: Oil = $90 / barrel ; Gas = $4 / thousand of cubic feet; Natural Gas Liquid = $30 / barrel (full recovery)*

Source: Cimarex; Data as of June 30, 2014.

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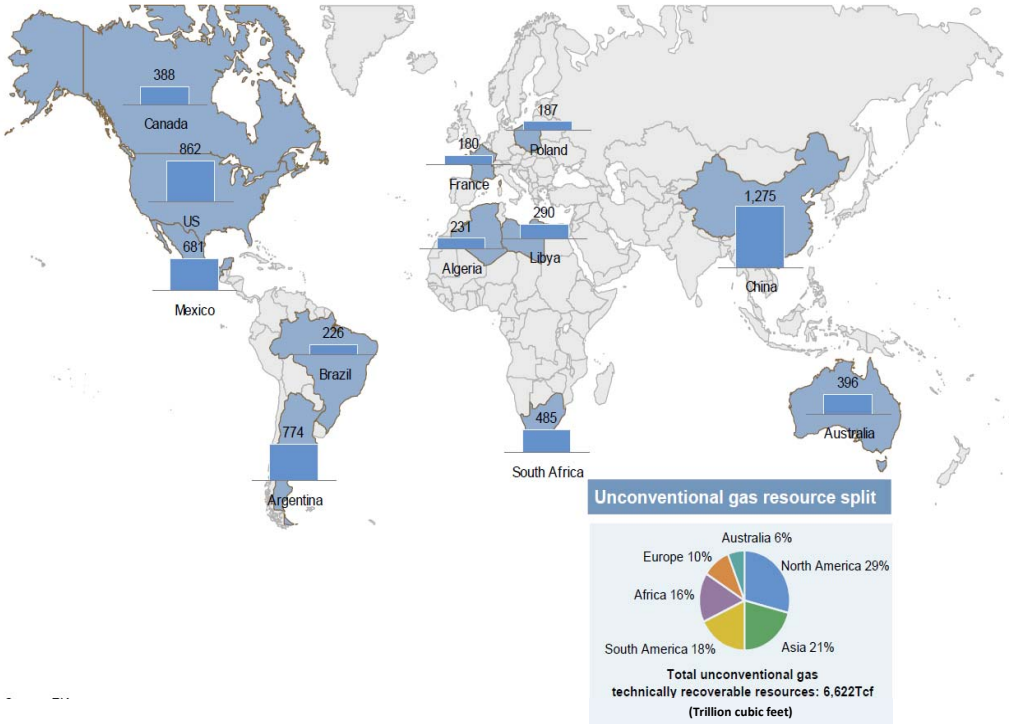
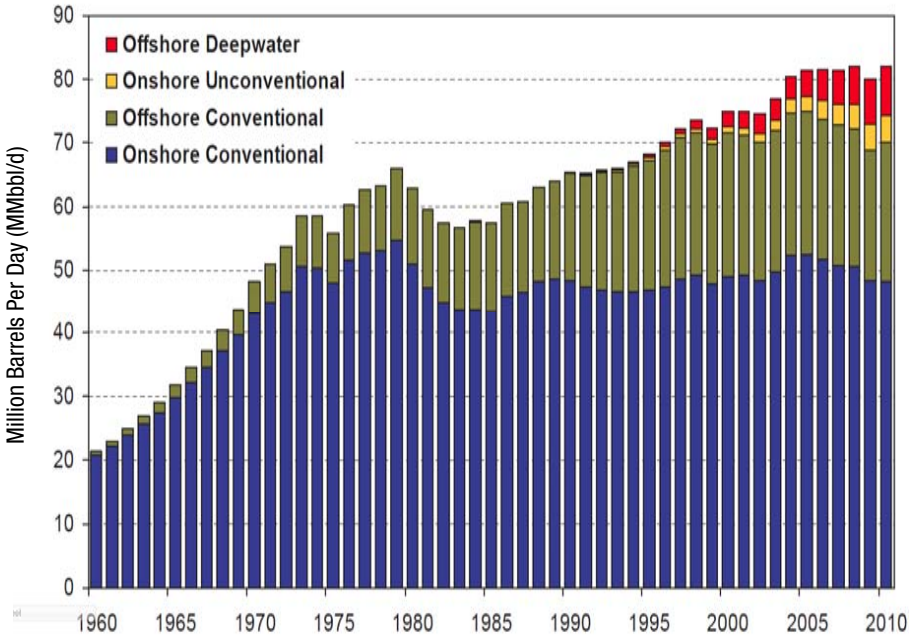
Game Hasn't Even Started Yet Globally

- The potential U.S. unconventional resource opportunity remains vast; yet represents a fraction of global unconventional gas reserves and overall global oil production

Countries with Major Unconventional Gas Resources
(# of Technically Recoverable Resources)



Global Oil Production

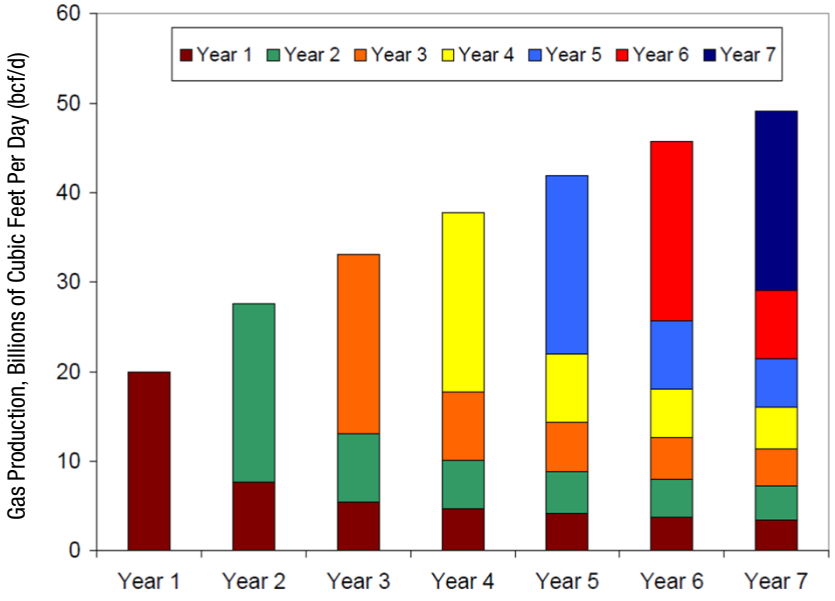


Source: U.S. Energy Information Administration (EIA), Bloomberg; Data as of July 31, 2014.

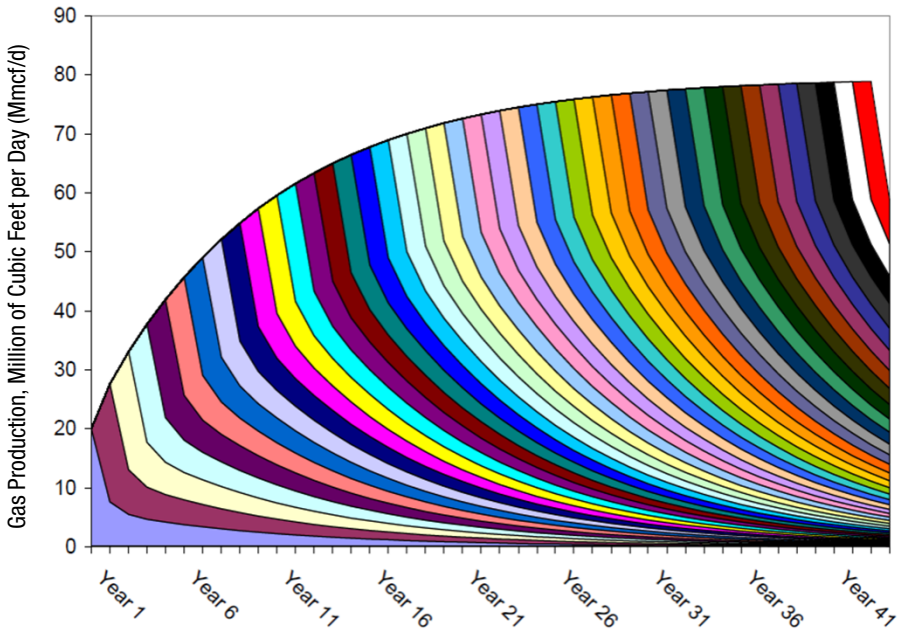
Some Issues to Consider: Capital Intensity (Production Profiles)

- High initial rates deliver a growing production profile
- Production growth typically moderates but this happens, generally, after many years

Production Profile – Constant Well Quality



Production Profile by Year – Constant Well Quality



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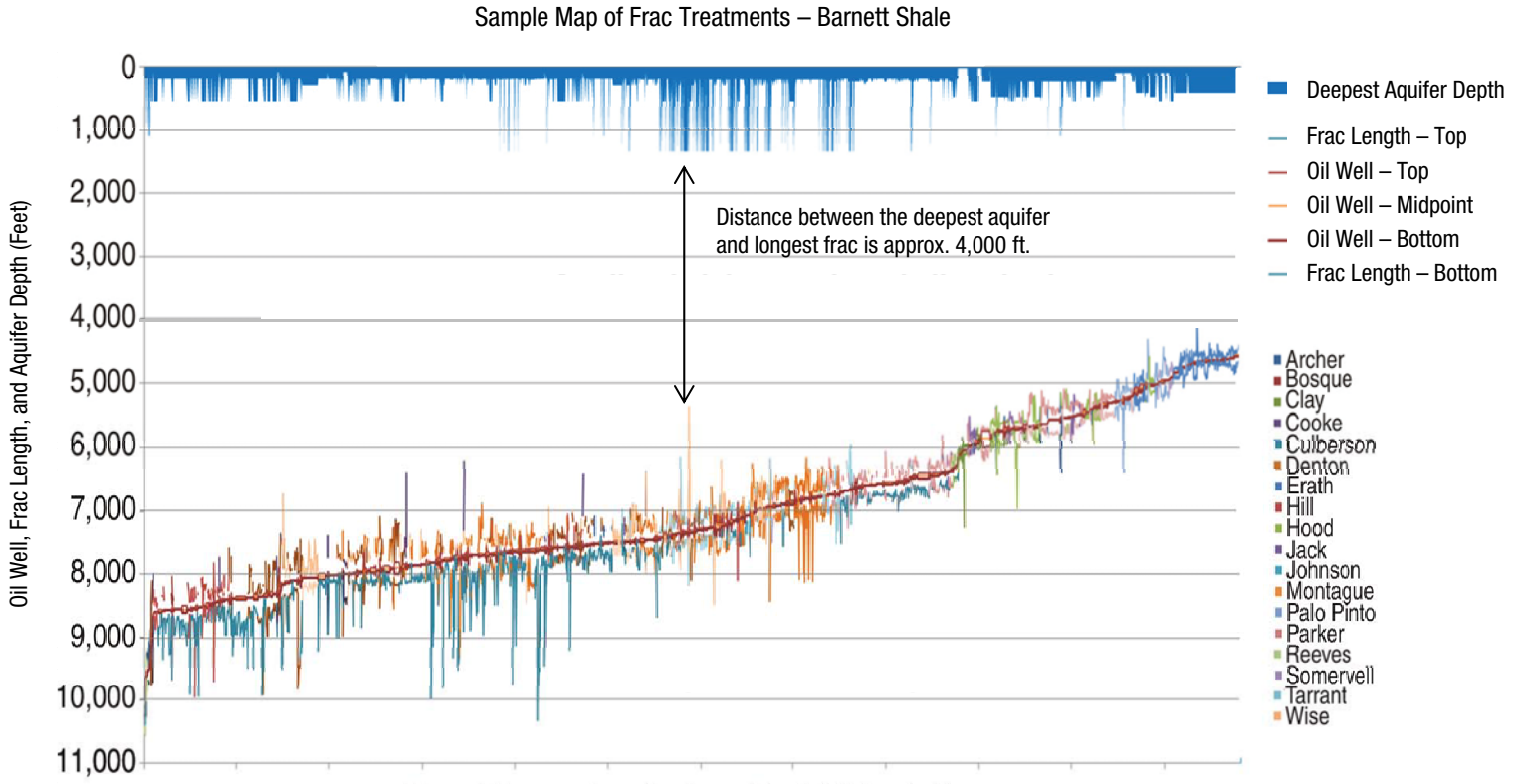
Source: Pickering Energy Partners; Data as of July 31, 2014.

Some (Additional) Issues to Consider: Environmental Impacts

- Groundwater contamination risk should be less of a concern as tests on well depth, frac length and corresponding distance from water aquifers generally exhibit large separations



Source: The American Oil & Gas Reporter; Data as of September 2014.