TRINIDAD DRILLING

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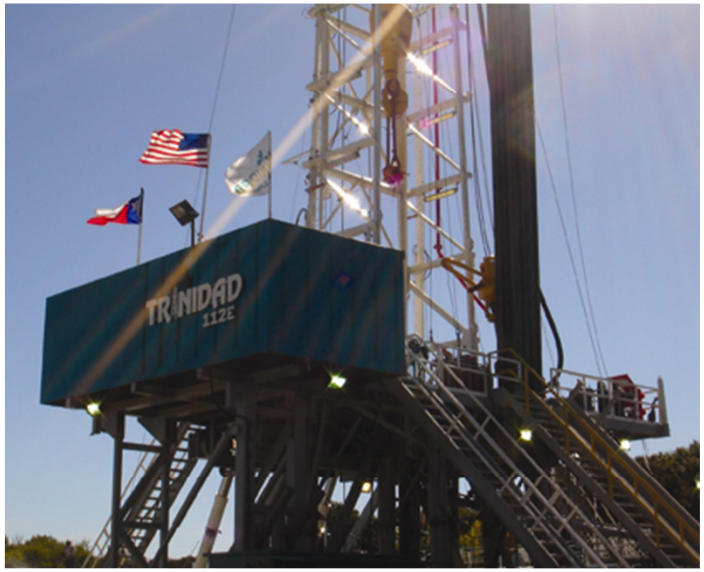




IT'S ABOUT PERFORMANCE

# GPAC/PJVA Annual Joint Conference

## Shale Gas Drilling 101

**November 3, 2010**

# Overview

1. What is Shale?
2. Improving Economics
3. Unconventional is the Future
4. Unconventional Resource Plays
5. US Shale Gas
6. Drilling and Completion Changes
7. Unconventional Drilling Challenges
8. The Rig - New Technology
9. The Future of Unconventional Drilling
10. Questions



# What is Shale?

- Sedimentary rock made up of consolidated clay particles
- Very “tight” rock, with tremendous porosity[1] and very low permeability[2]
- Previously shale was considered the gas source rock and not the reservoir.

Example of shale outcrop – Marcellus
Source – ALL consulting, 2008

1 - the pore spaces available for oil and gas to fill
2 - the measure of the rock’s ability to allow liquid or gas to pass through it.

# Improving Economics

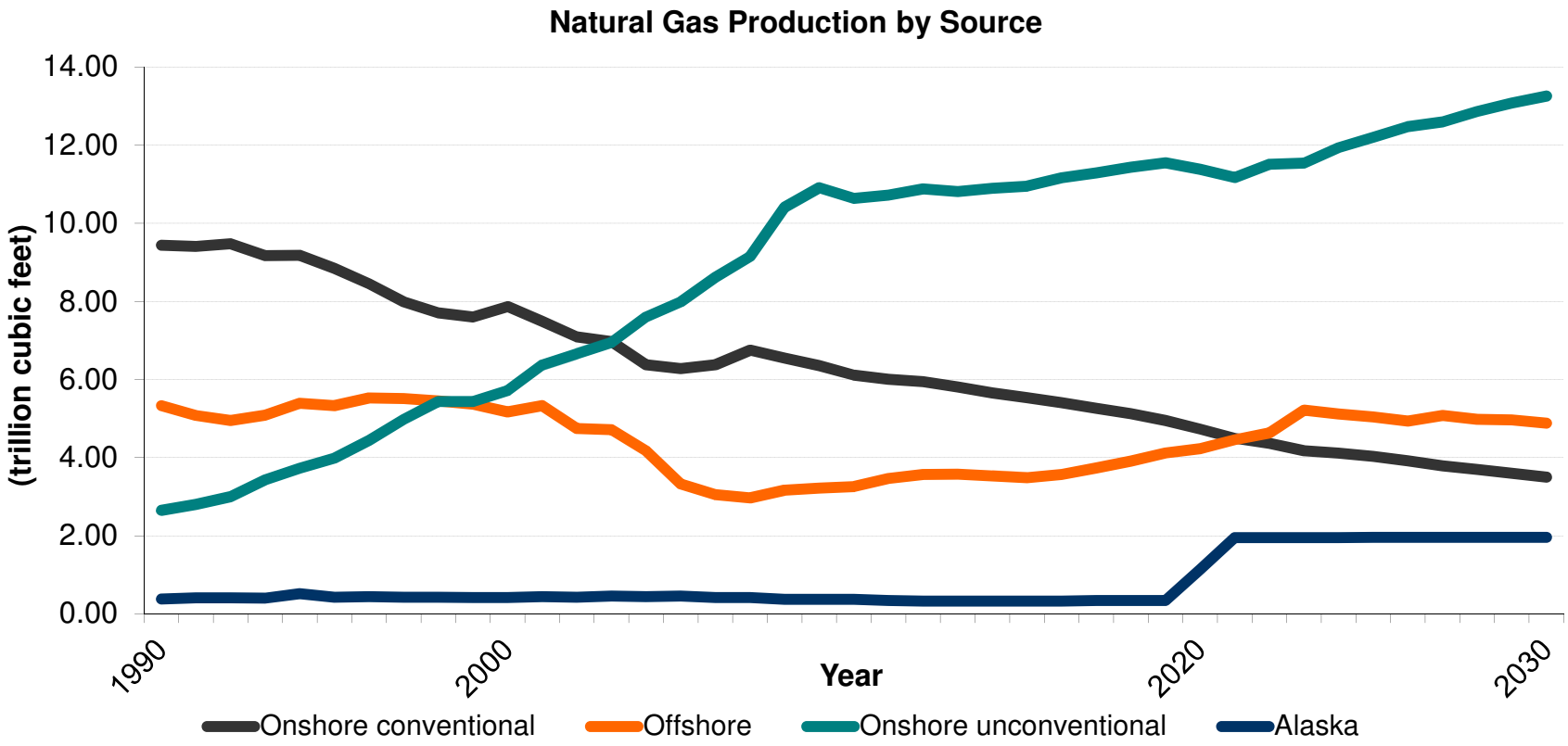
Most unconventional shale targets are not new so why the excitement?

New technology allows improved efficiency

- Horizontal drilling
- Rigs - drilling can be done more quickly and with improved results
- New completion techniques vastly increase the amount of production

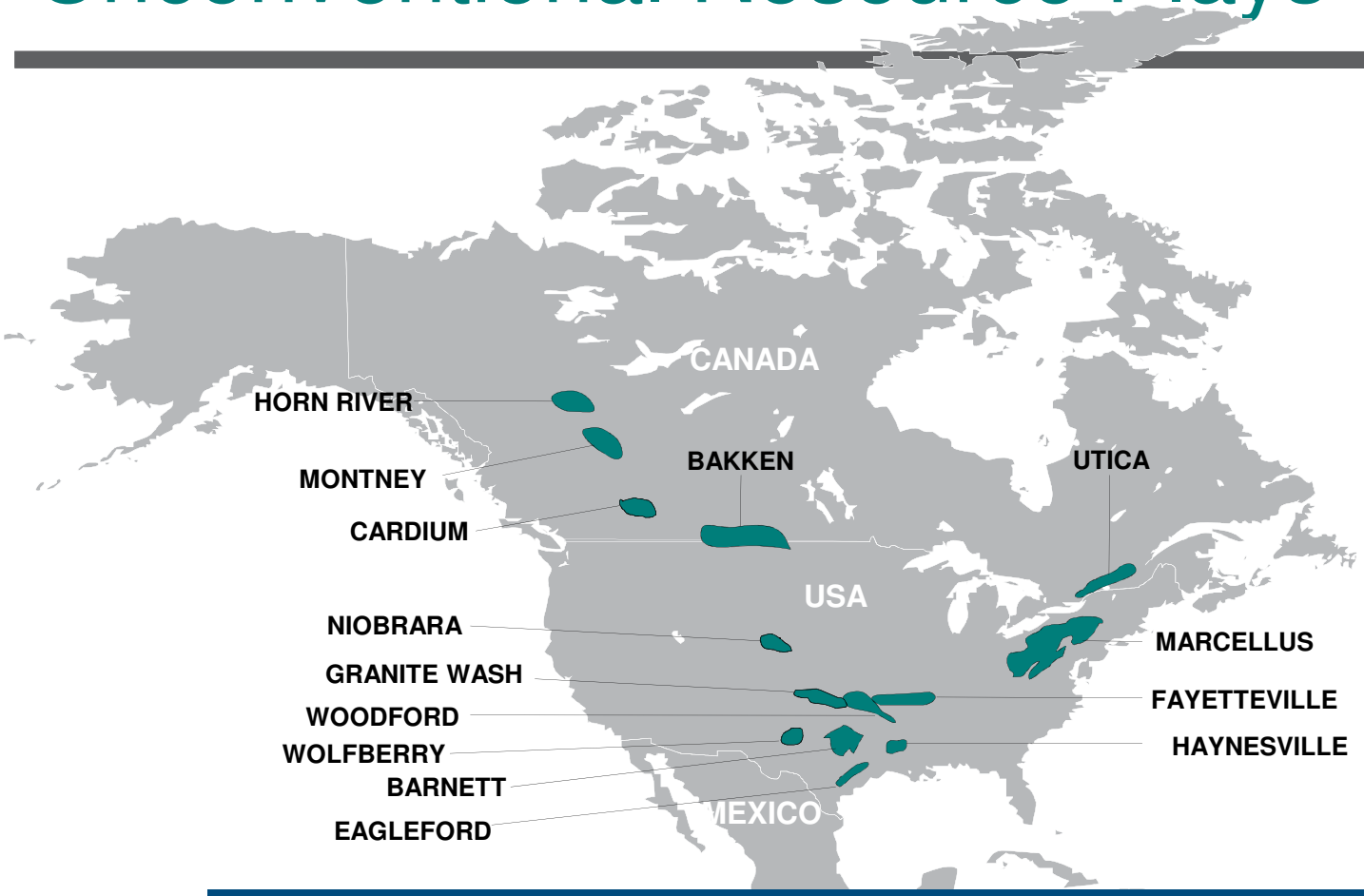


# Unconventional is the Future




*Source – EIA*

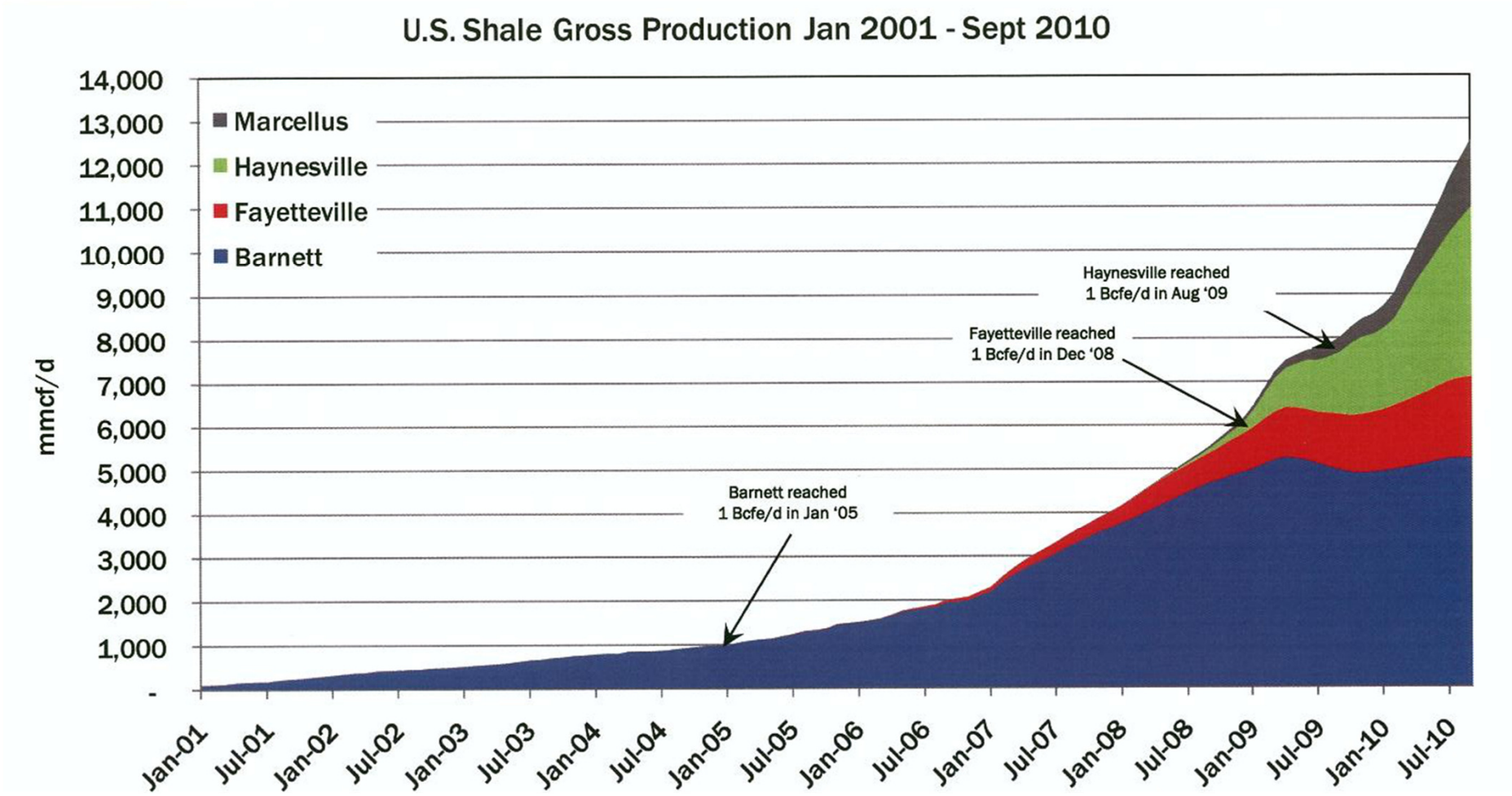
# Unconventional Resource Plays




Trinidad has 55% of its fleet operating in unconventional resource plays



# Growth in Gas Shale Production




*Source – Chesapeake Energy*

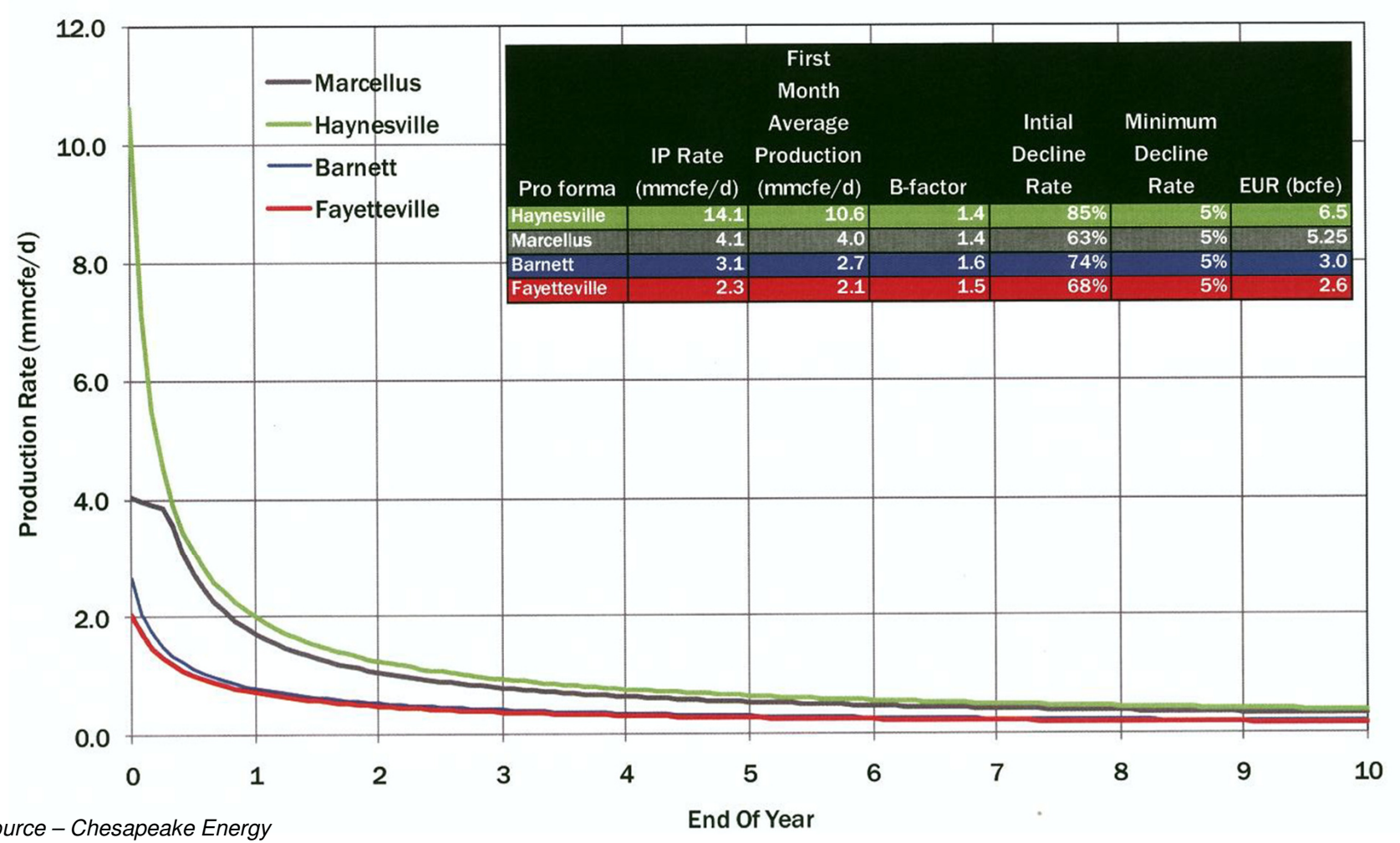


# Comparison of US Gas Shales

| | Barnett | Haynesville | Fayetteville | Marcellus |
|---|---|---|---|---|
| Vertical Depth (ft) | 7,300 | 11,900 | 5,700 | 6,200 |
| Thickness (ft) | 350 | 260 | 135 | 150 |
| Gas in place (Tcf) | 355 | 670 | 105 | 1,900 |
| Recovery factor | 40% | 28% | 38% | 30% |
| Porosity (avg.) | 5.1% | 8.3% | 5.9% | 6.2% |
| Pressure (psi/foot) | 0.46 | 0.84 | 0.42 | 0.61 |
| EUR/horizontal well | 3.0 Bcfe | 6.5 Bcfe | 2.6 Bcfe | 5.3 Bcfe |
| Dominant lithology | Siliceous Mudstone | Argillaceous Calcareous Mudstone | Siliceous Mudstone | Argillaceous Mudstone |
| Age (millions of years) | Mississippian 320-345 | Jurassic 152-156 | Mississippian 320-345 | Devonian 385-390 |
| Initial production (MMcfe/d) | 3.1 | 14.1 | 2.3 | 4.1 |
| First-year decline | 74% | 85% | 68% | 63% |

*Source: Chesapeake Energy Corp*

# US Shale Play Comparison




| Pro forma | IP Rate (mmcfe/d) | First Month Average Production (mmcfe/d) | B-factor | Intial Decline Rate | Minimum Decline Rate | EUR (bcfe) |
|---|---|---|---|---|---|---|
| Haynesville | 14.1 | 10.6 | 1.4 | 85% | 5% | 6.5 |
| Marcellus | 4.1 | 4.0 | 1.4 | 63% | 5% | 5.25 |
| Barnett | 3.1 | 2.7 | 1.6 | 74% | 5% | 3.0 |
| Fayetteville | 2.3 | 2.1 | 1.5 | 68% | 5% | 2.6 |

*Source – Chesapeake Energy*



# Drilling Changes

Drilling has become more complex and deeper

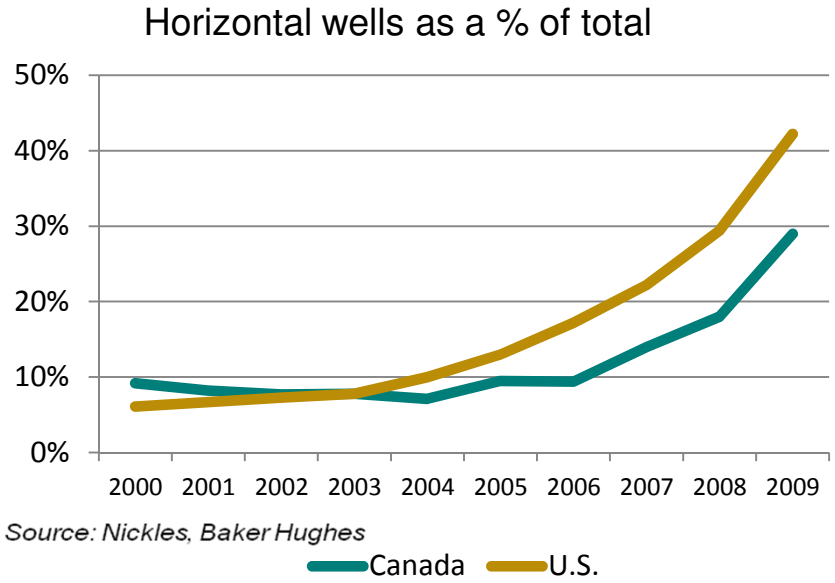
- Increased use of horizontal drilling
- Ability to drill deeper targets
- Automation increases speed and efficiency
  - Pad drilling
  - Pipe handling
  - More precision while drilling
  - Use of top drives
  - Integrated controls



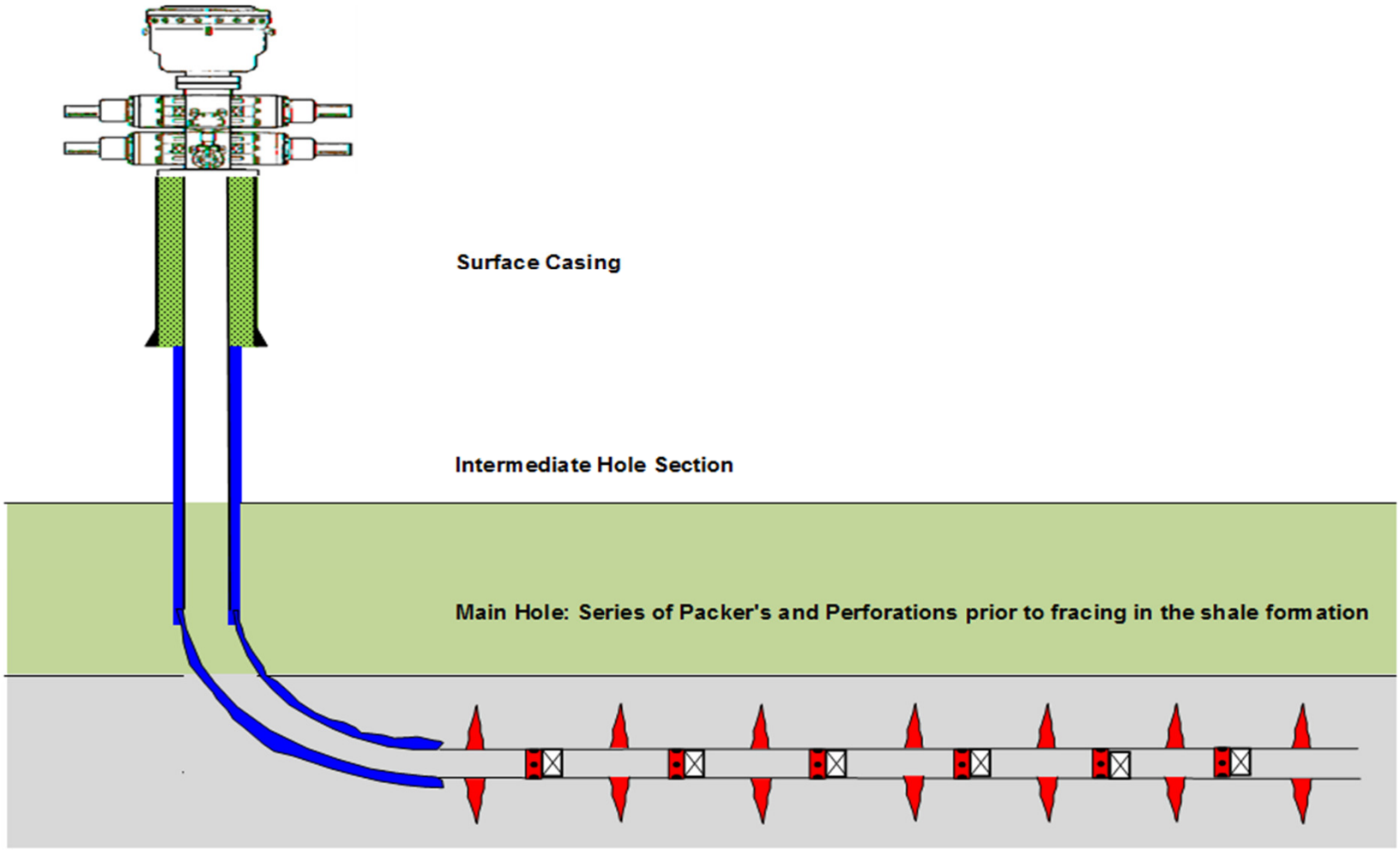
# Horizontal Drilling

Horizontal Drilling is becoming the new “norm”

- Growing need for deep, technologically-advanced rigs
- Horizontal wells now in 2010 account for:
  - > 50% of all wells drilled in the US
  - > 40% of all wells drilled in Canada

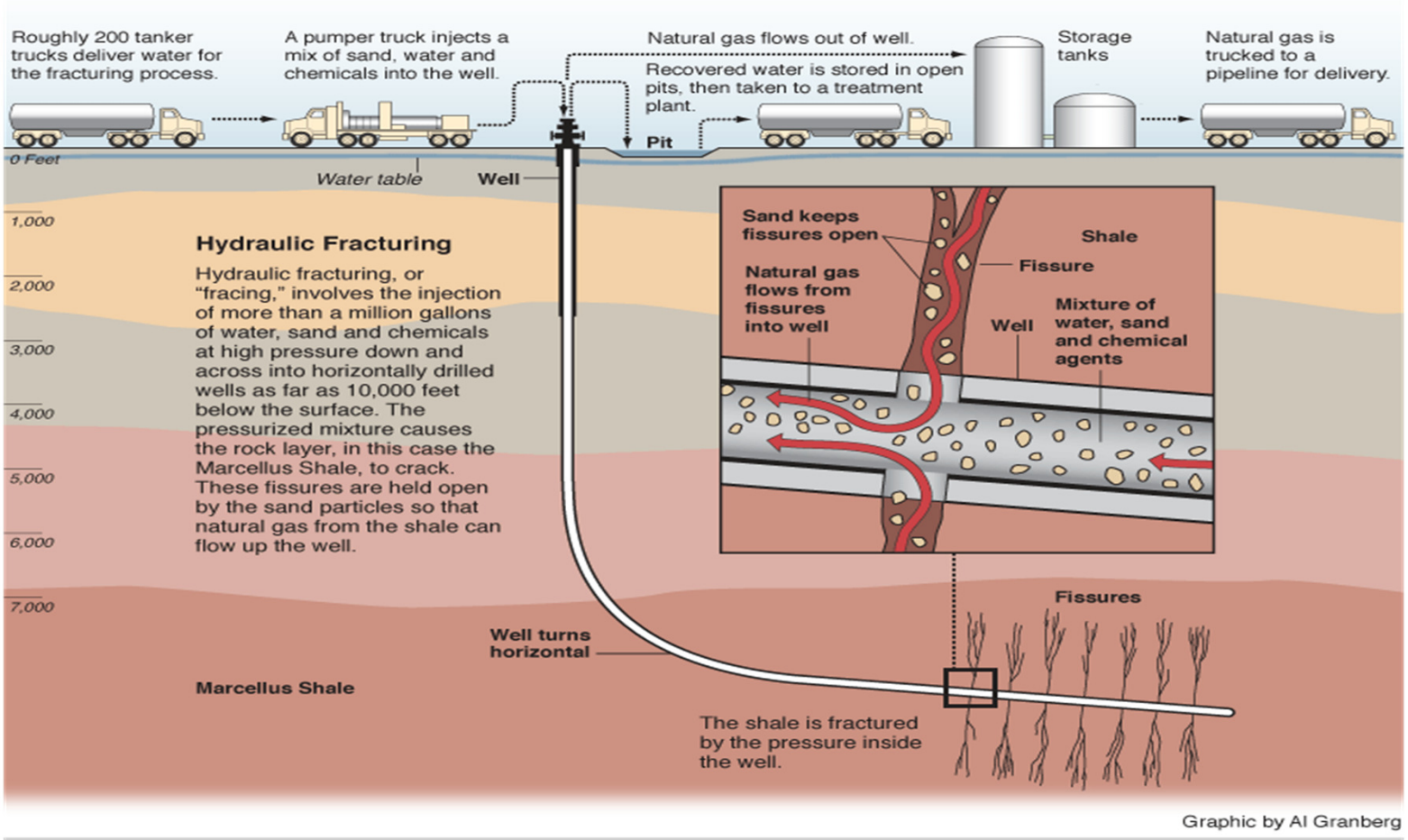



# Horizontal Well Stick Diagram





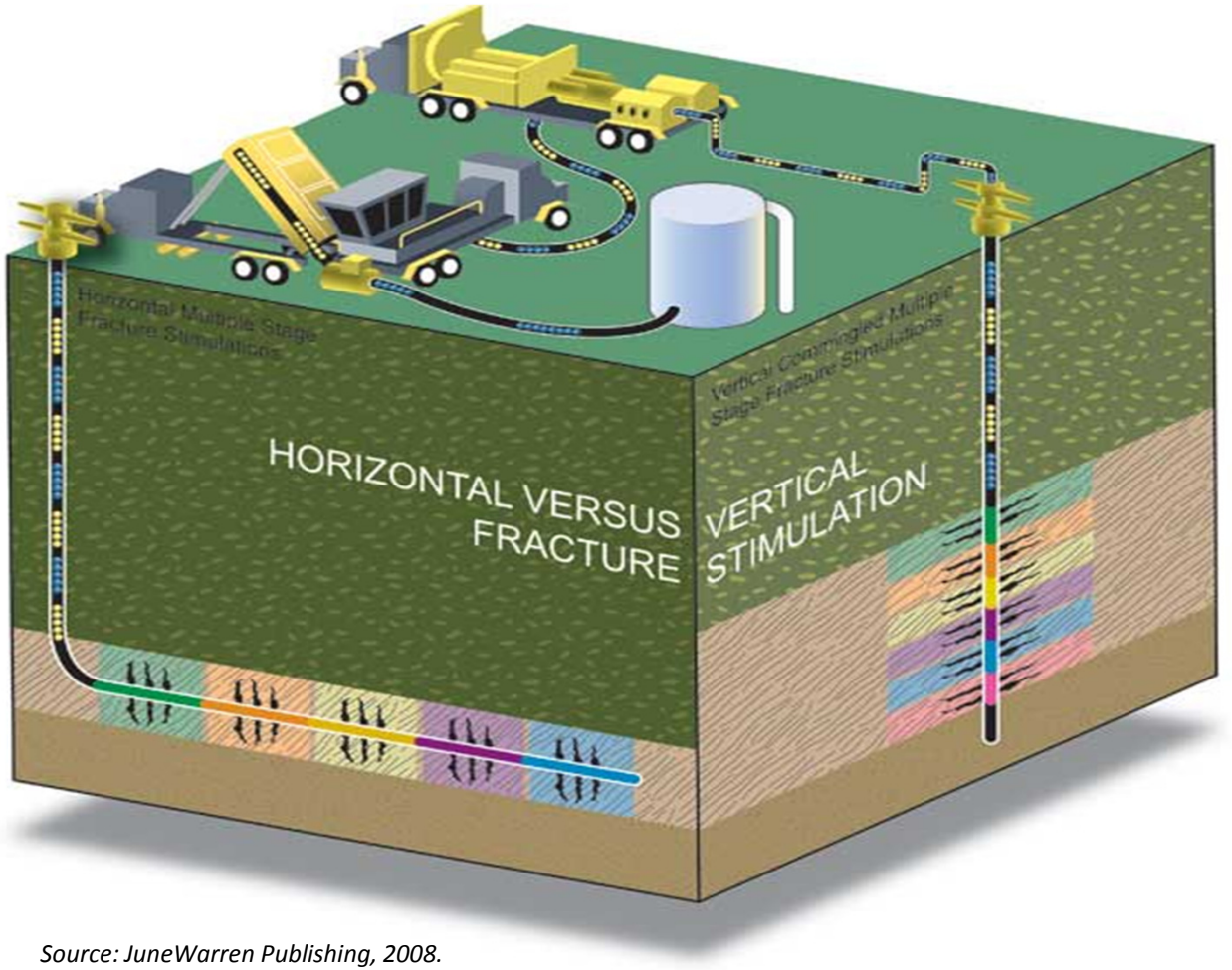

# Hydraulic Fracturing




*Source: ProPublica*



# Horizontal vs Vertical




*Source: JuneWarren Publishing, 2008.*



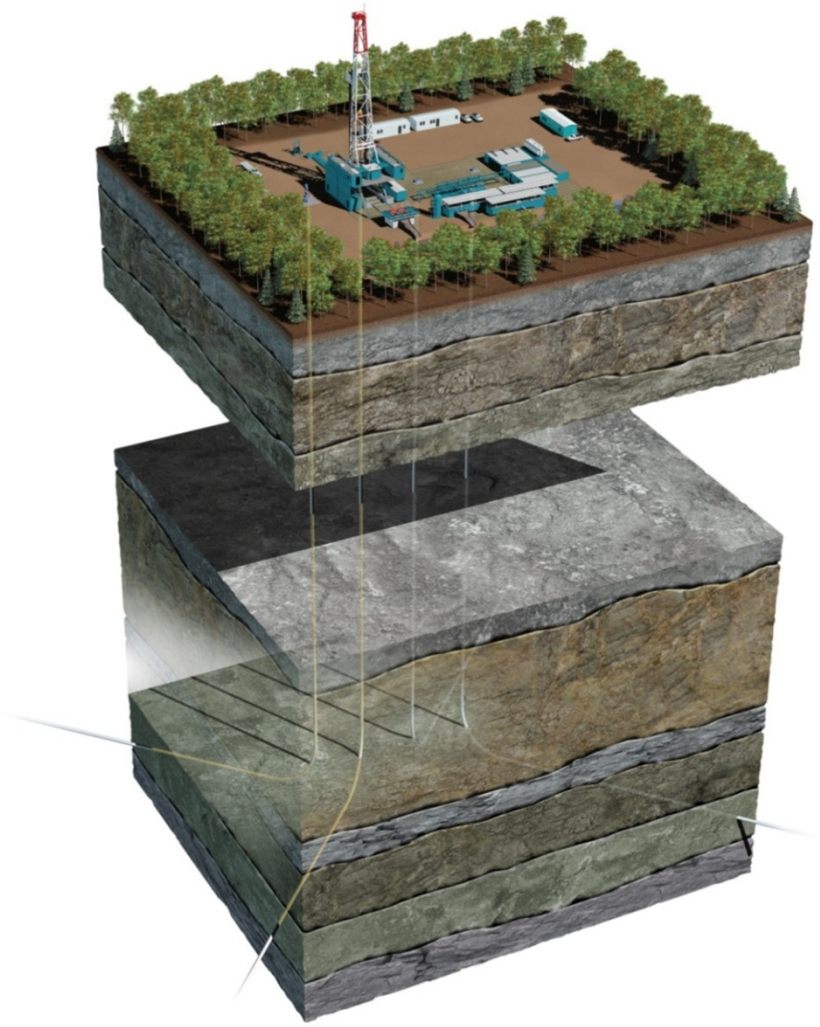
# Unconventional Drilling Challenges

- Deep horizontal wells require high hook load capacity
- High pressure, high temperature conditions require precision and good well control
- High capital costs need improved efficiencies

## Solutions:

- Integrated control system
- Auto driller
- AC drawworks
- Increasing automation
- Pad moving systems

# Why New Technology Matters…



- Improved performance
  - AC drawworks gives enhanced drilling precision
  - Integrated control system allows better up-hole and down-hole control
  - More consistent and accurate weight on bit
  - Less damage to formation
  - Faster moving from well to well
- Improved safety
- Less environmental impact



# Making Pipe Connections

Manual Conventional Style

Automated Iron Roughneck



# Moving Drill Pipe

Manual Conventional Style

Automated Catwalk



# Top Drive



# Integrated control system




# Moving Systems – The Way Of The Future

- Allows rig to move between wells with drill pipe still in derrick
- 4,500m rig can move 5m in one hour (versus 4 days without a moving system)
- Gas factory application



# The Right People

The right equipment is nothing without the right crew

- Experienced crews
- Ongoing training, mentoring and coaching
- Focus on safety; modern equipment, training, attitude



# Future of Unconventional Drilling

Unconventional resource plays will continue to be the plays of choice

- Better economics than conventional drilling
- Ability to transfer technology to oil and liquids plays
- International shale plays at early stage of development e.g. Central Europe, Russia, India
- Improving technology and expertise exposing additional opportunities



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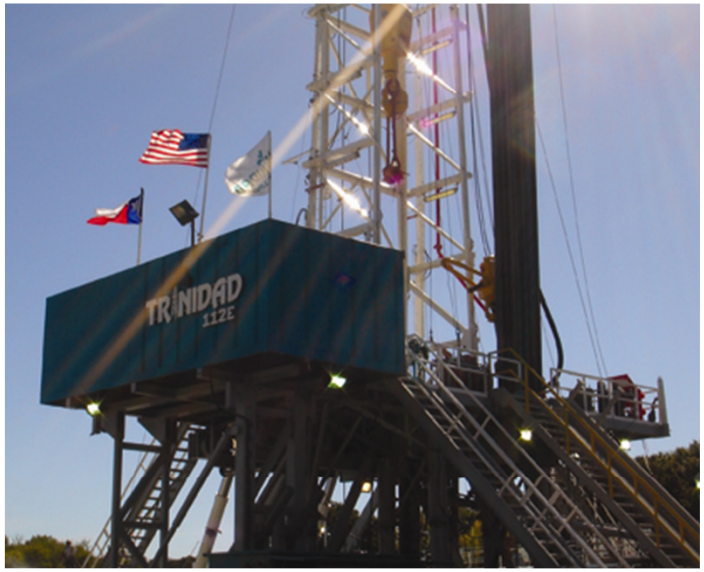



**www.trinidaddrilling.com**
2500, 700 – 9 Avenue S.W. | Calgary, Alberta, Canada | T2P 3V4
T 403.265.6525 | F 403.265.4168 | E info@trinidaddrilling.com