

What's the big deal with natural gas and unconventional oil?

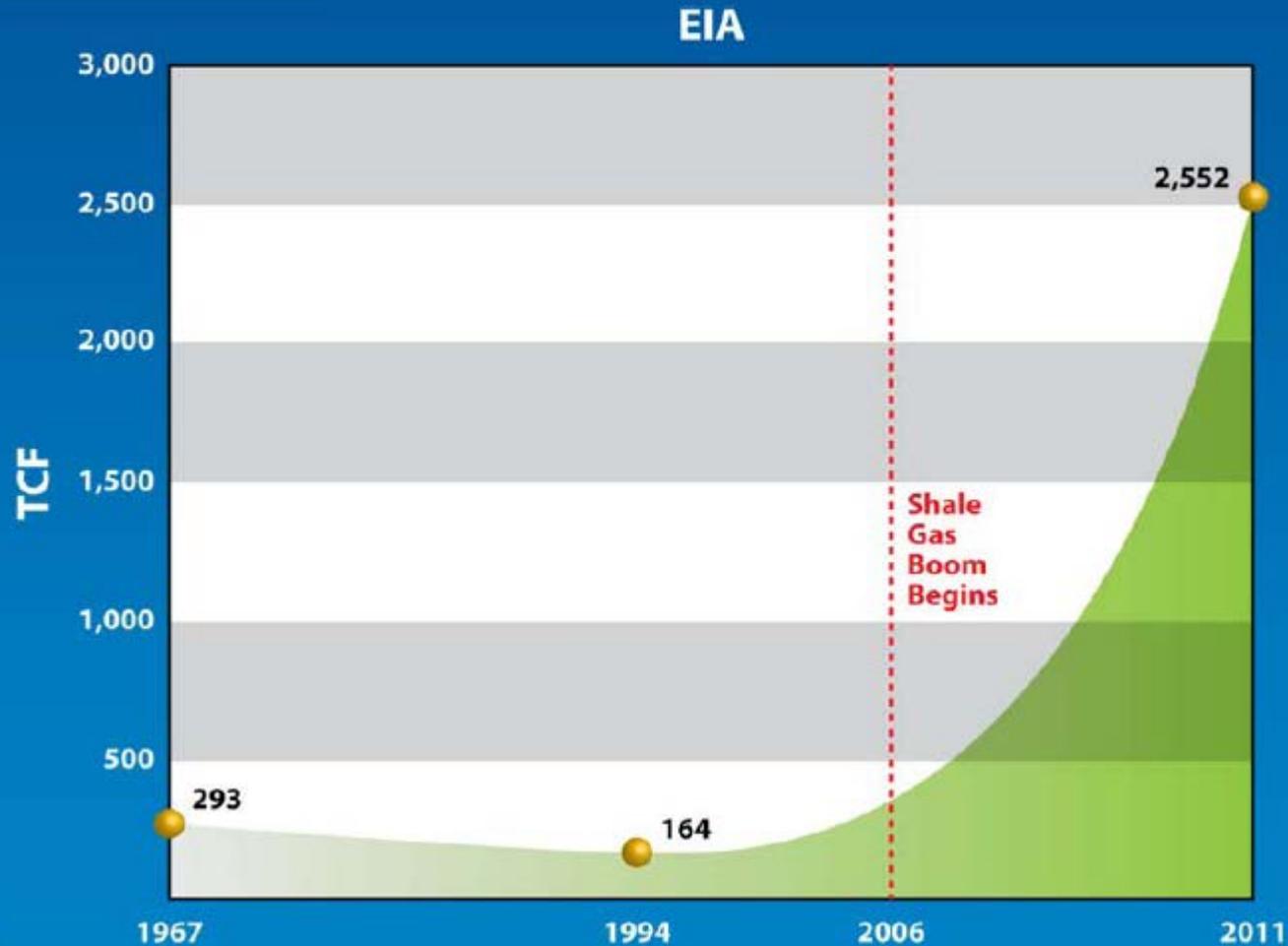
What is hydraulic fracturing?

How much proppant is needed?

What are the

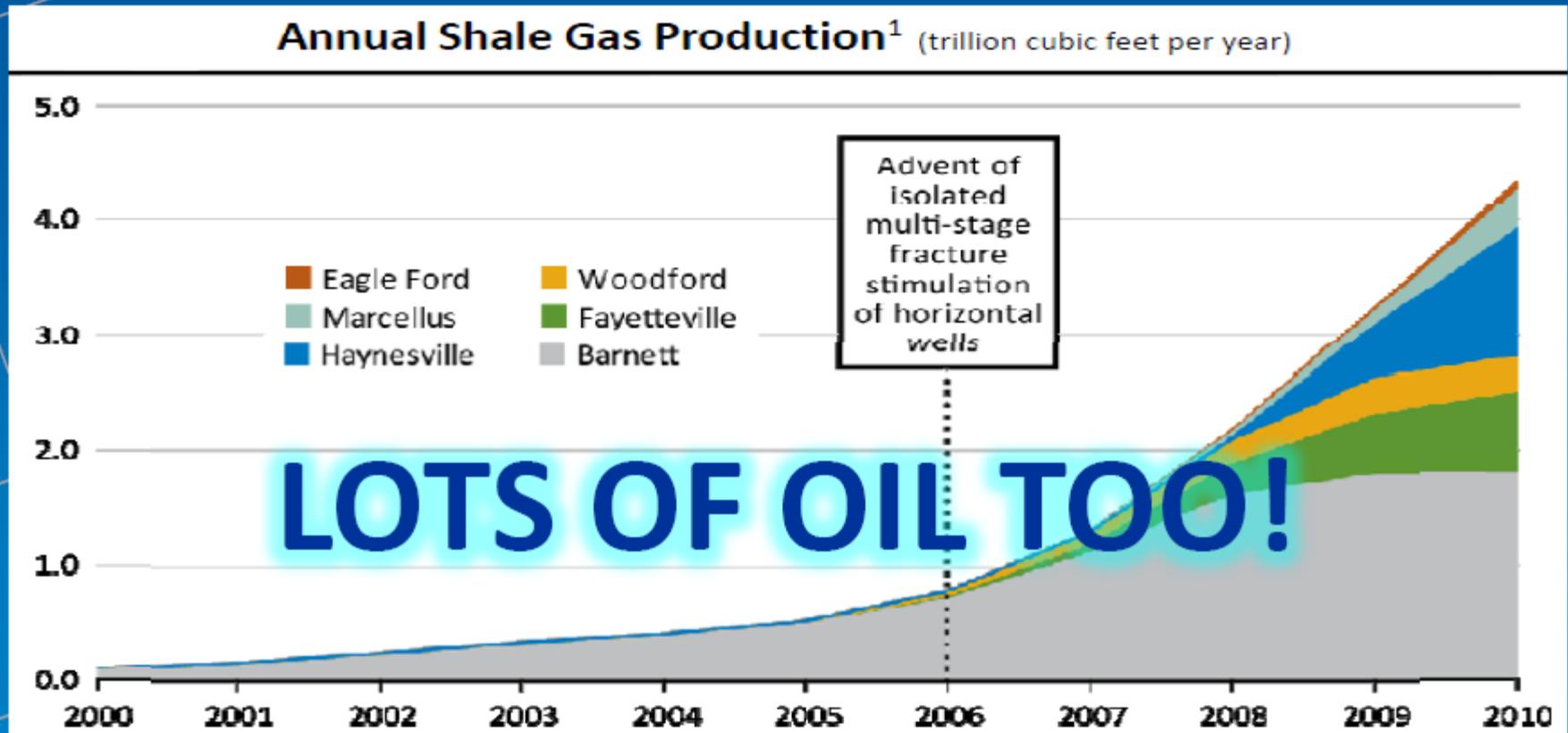
environmental considerations for hydraulic fracturing for unconventional oil

Natural Gas U.S. Reserves Estimates



Shale Revolution Timeline

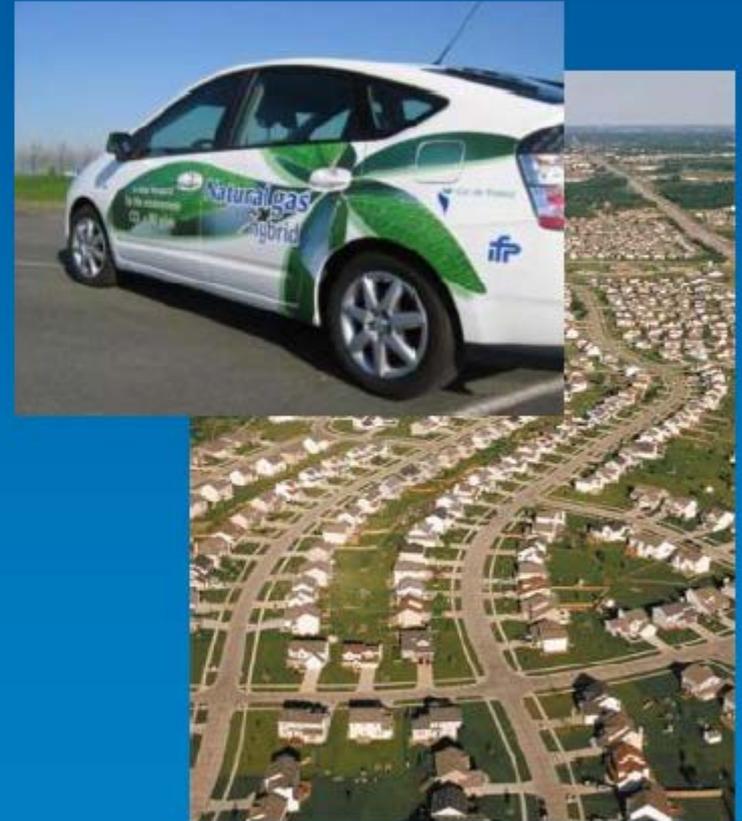
U.S. Shale Gas Production Has Increased Six-Fold Since 2006



Shale gas has grown to over 15% of U.S. gas production² and is expected to grow to 45% by 2035.

Magnitude of Supply

- A trillion cubic feet is enough gas to:
 - Heat 15 million homes for 1 year
 - Generate 100 billion kilowatt-hours of electricity
 - Fuel 12 million natural gas vehicles for one year
 - Marcellus alone \approx 50 – 500 tcf
- 120 year supply in U.S.
- Lots of oil too (Utica, Eagle Ford, Bakken, etc.)



Natural Gas Characteristics

- We have **lots of it**.
- **Cleanest combustion fuel available (half the CO₂ of coal).**
But fugitive loss of CH₄ is **25xCO₂ potency for GHG.**
- **“Bridge” fuel** for transition to renewables,
and **“leveling” fuel** for wind and solar.
- **Extensive transmission / distribution network** already in place.
- Underutilized gas power generation capacity can achieve **20 percent CO₂ emissions reduction** rapidly.
- Current **supply far exceeds demand.**



Supply > Demand so Natural Gas is Affordable

- 1 barrel of oil = **\$97.23** (May 10, 2012)
- 1 MMBtu of gas = \$2.56 (May 10, 2012)
- 1 barrel of oil equivalent (BOE) = 5.8 MMBTU
- Price of 1 BOE of natural gas = **\$14.85**



Premier Webinar Series



Dedicated to excellence in the practice of environmental engineering to ensure the public health, safety, and welfare to enable humankind to co-exist in harmony with nature.

U.S. Clean Energy Challenges Focus on Hydraulic Fracturing



*Moderator--
Hunter Nolen, P.E.,
BCEE, President,
Industrial Services,
CDM Smith*



*Colorado Governor (ret)
William Ritter, Director,
Center for the New Energy
Economy, Colorado State
University*

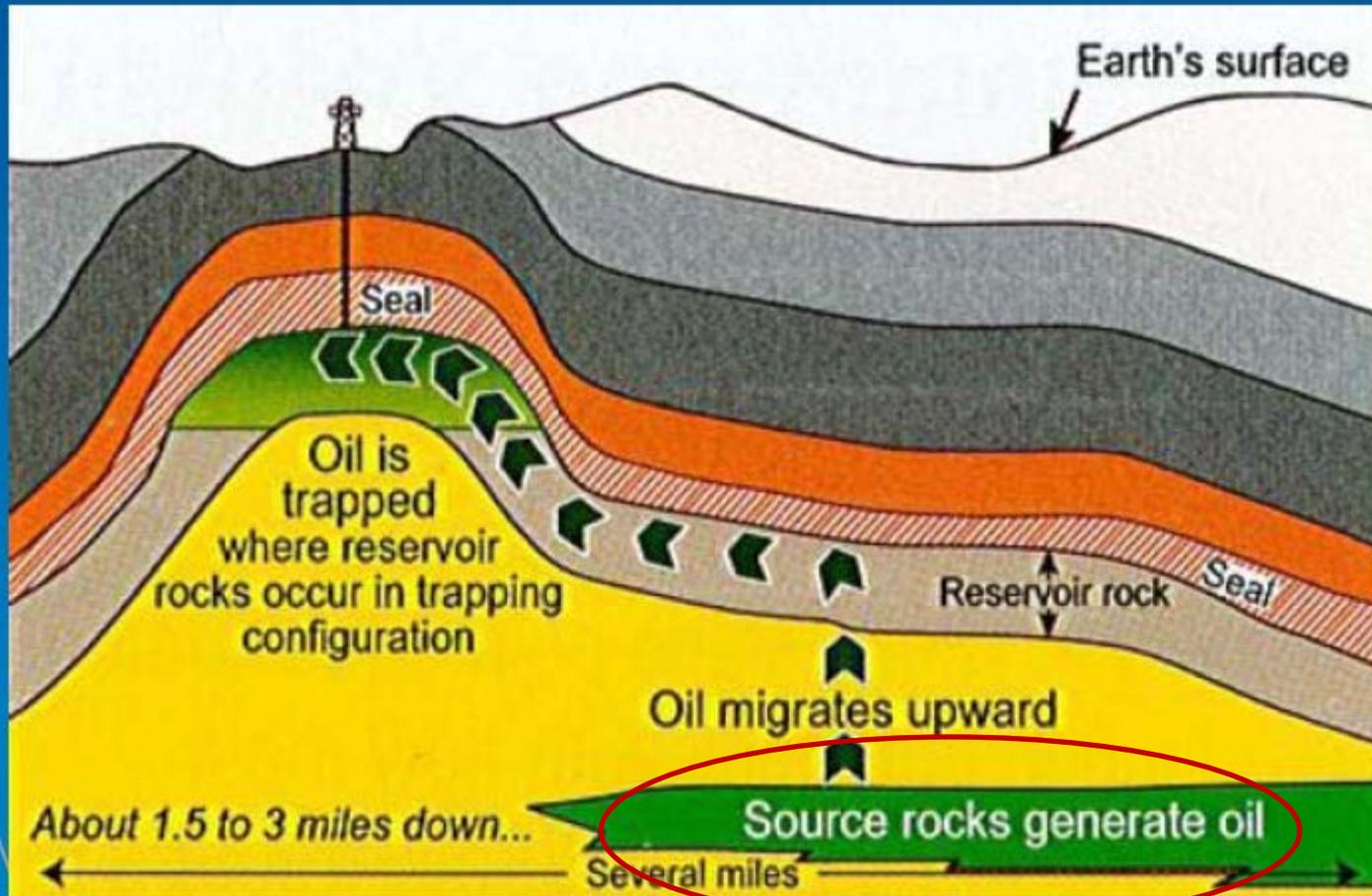


*Kevin Rice, Senior
Business Development
Manager, Baker
Hughes*

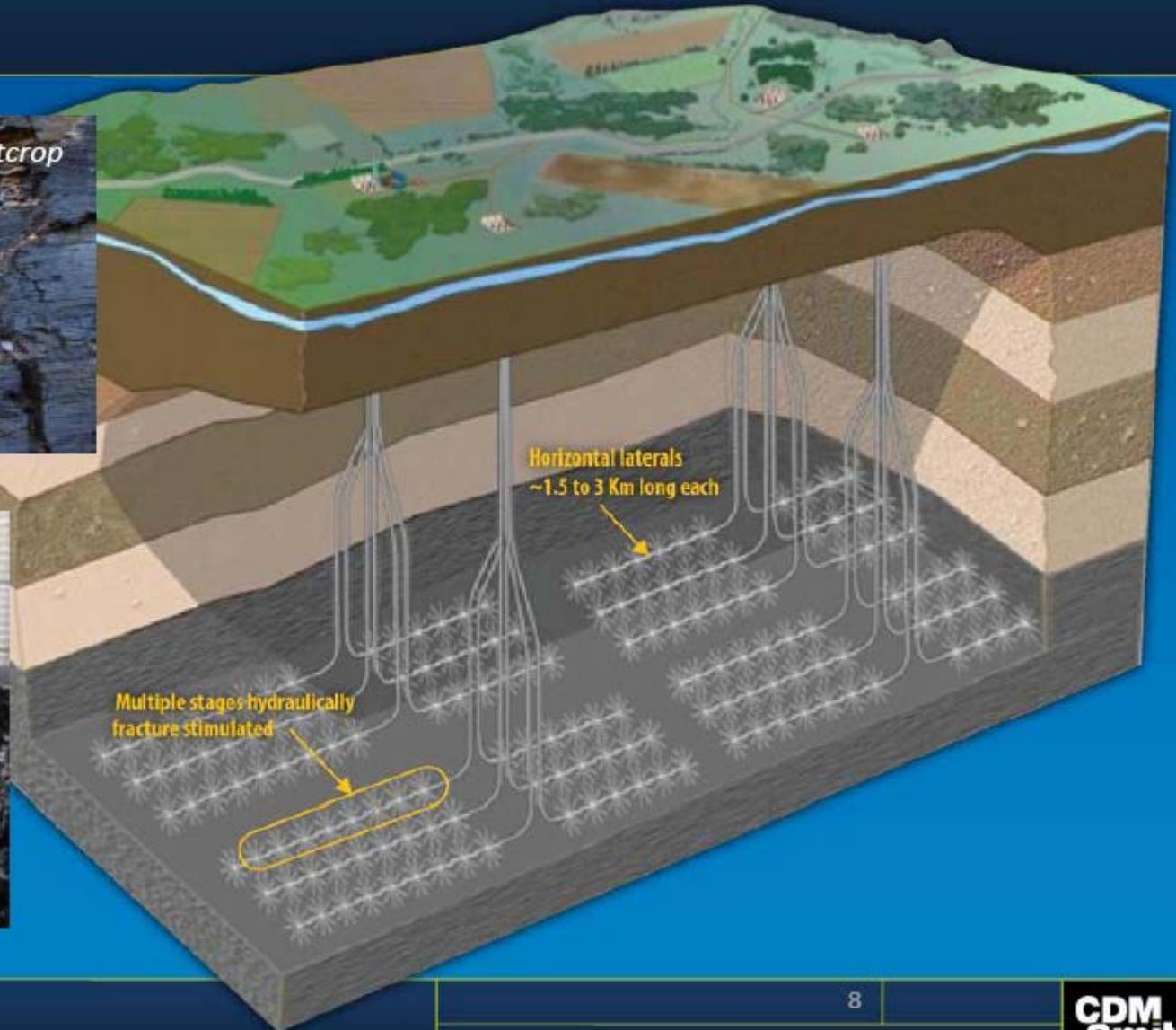
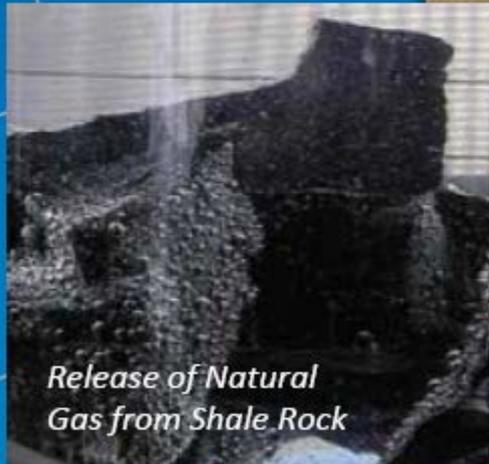
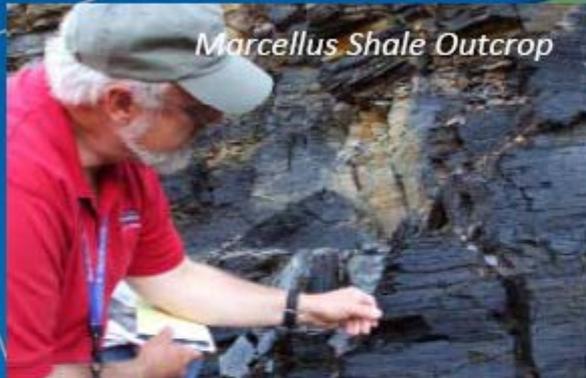


*Tom Tomastik, Geologist,
Ohio DNR, Division of Oil
and Gas Resources
Management*

Oil Migration & Entrapment, Conventional Model



Horizontal Drilling and Hydraulic Fracturing





Frac Tanks/ Fluid Storage

Chem Truck

Blender

Sand Storage Units

Wellhead

Data Van

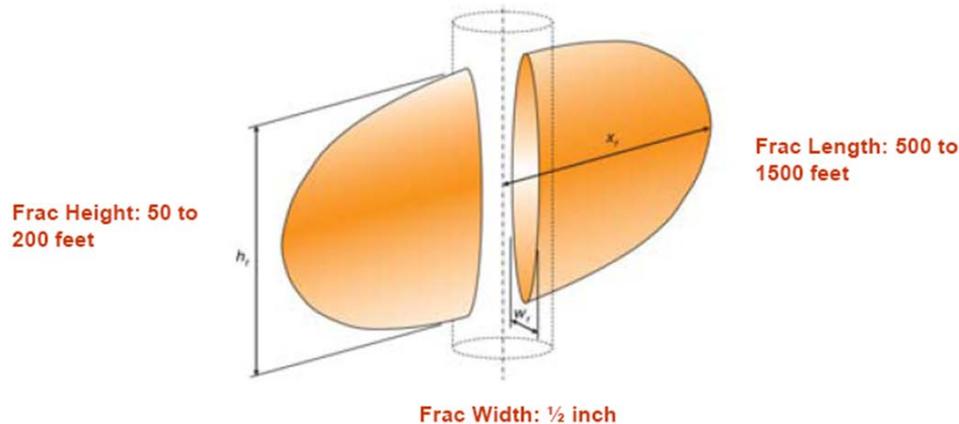
Pump Trucks



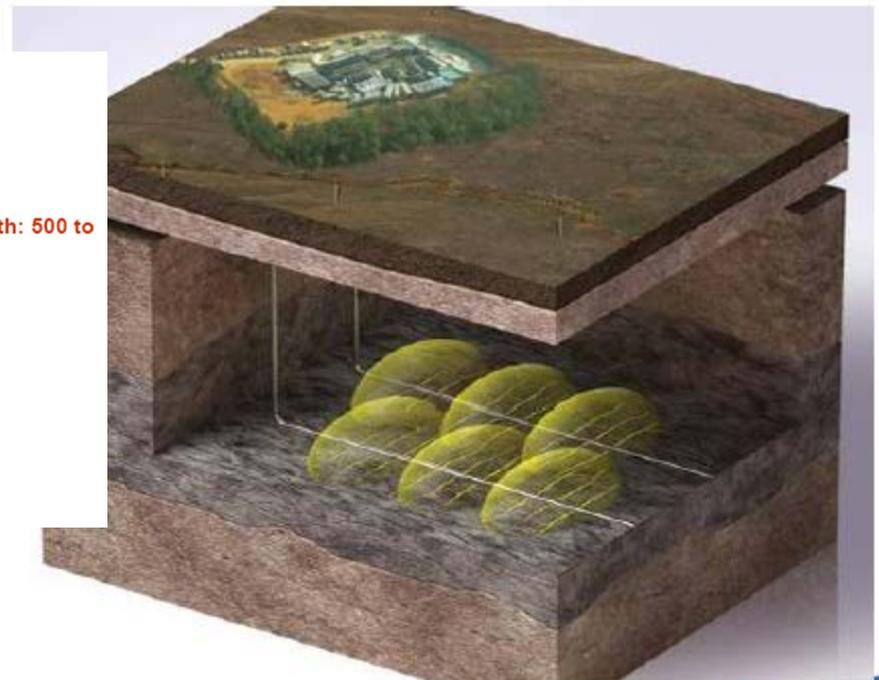
Fracturing Network

- Currently developing and evaluating different techniques to alter the near wellbore stress field and promote more secondary fractures
- The average number of stages per well in 2011 was 16+

Clustering method



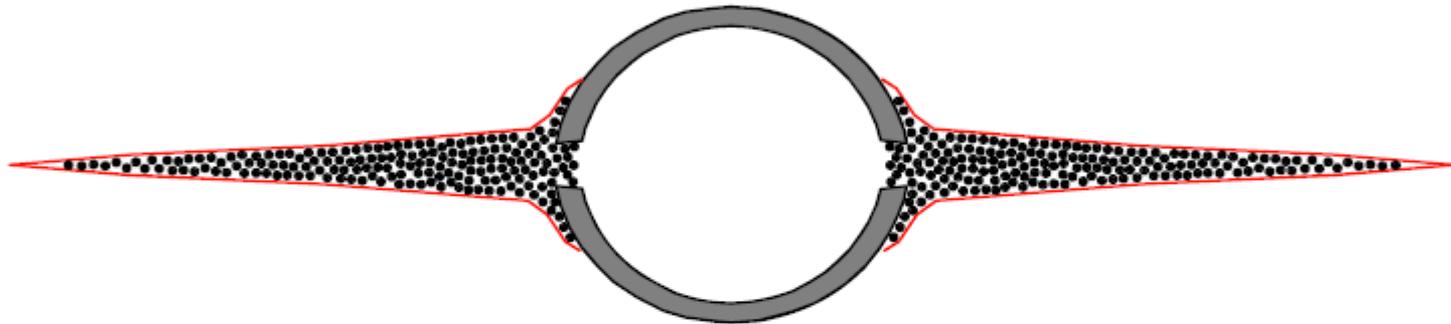
Alternating clusters in adjacent wells



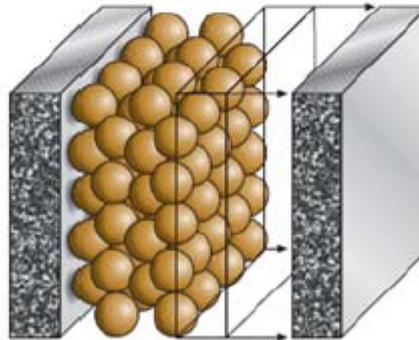
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Fracturing Proppants

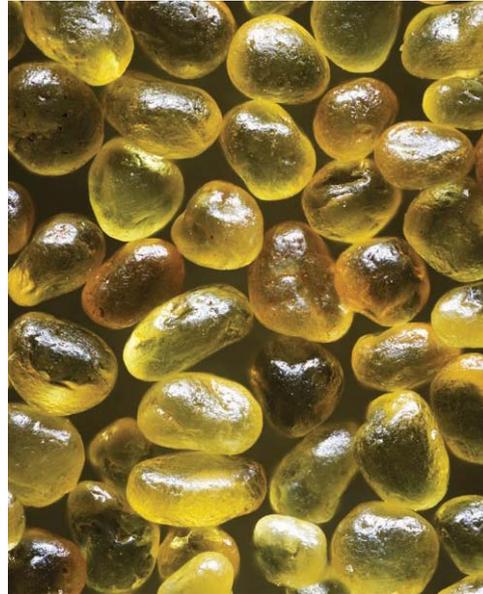
Fractures are created, then held open with a proppant, creating a conductive path



Sand



Ceramic



Sand SiO_2
w & w/out resin coating

Bauxite

20/40 Mesh (per in) Proppant

Proppant Shortage JPT April 2011

Pricing and Production

Current Data from Wisconsin

Current capacity ~ 14 mmt

Proposed ~ 11 mmt

Cost to mine ~\$20-\$30/ton

Current cost ~\$100/ton

Projected cost ~\$ 50/ton

The Coming Tsunami Of Frac Sand Supply; Seeking Alpha, Aug 2012

St Peter Sandstone in Wisconsin

Proppant Shortage JPT April 2011

Transport Volume

(How accurate is this estimate?)

Back of the envelope estimate

Capacity per car = 250,000lbs = 125tons

Wisconsin production capacity = 14 to 25 mmt/yr
(St Peter sandstone)

Number of cars = $25,000,000/125 =$

200,000 cars = 2000 unit trains

OSHA Studies Frac Sand
Puts Breaks on Silica Rules
ENR 10/23/12



Proppant Fines

SiO_2

Natural materials are not uniformly graded.

To contain only 20 to 40 mesh size grains proppants need to be sieved

Wash sieve before shipping??

Hydraulic Fracturing

The Shale Development Solution & Environmental Controversy

- Frac Water Volume: 2 to 6 million gallons per well
- Additional components include biocides, corrosion inhibitors, O₂ scavengers, proppant, etc.
- 20-40% frac “flowback” water recovery requires collection, handling, and disposal / treatment / reuse



Source: ALL Consulting. Handbook on Coal Bed Methane Produced Water: Management and Beneficial Use Alternatives, July 2003.

History of Fracturing



Late 1800's Explosive fracturing

1940's First hydraulic fractures

1988 Common practice
(1 million performed to date)

2006 Advent of multistage fracturing of horizontal well

2011 60% - 80% of all O&G wells are hydraulically fractured
(35,000 per year and 2.5 million to date)

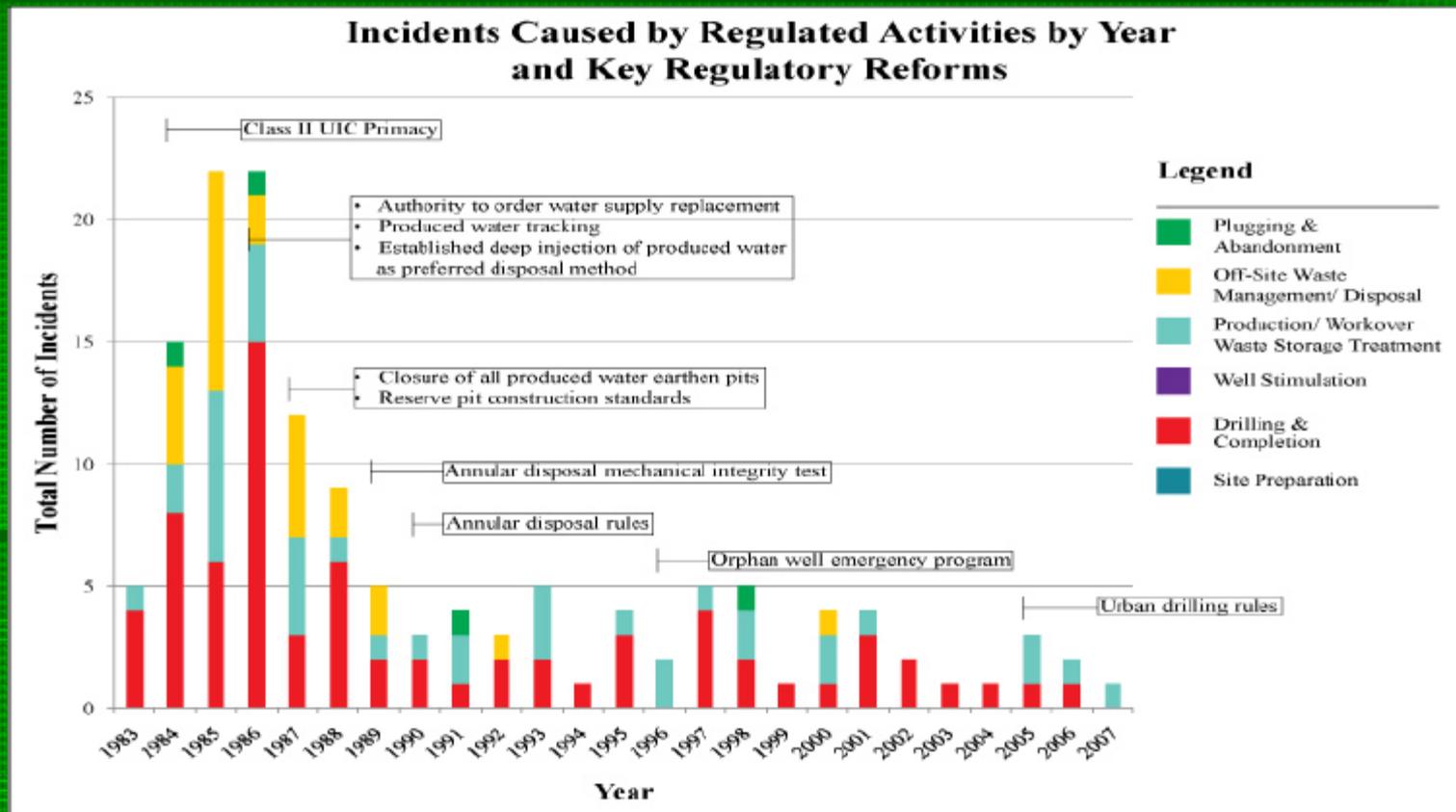


HYDRAULIC FRACTURING IN OHIO

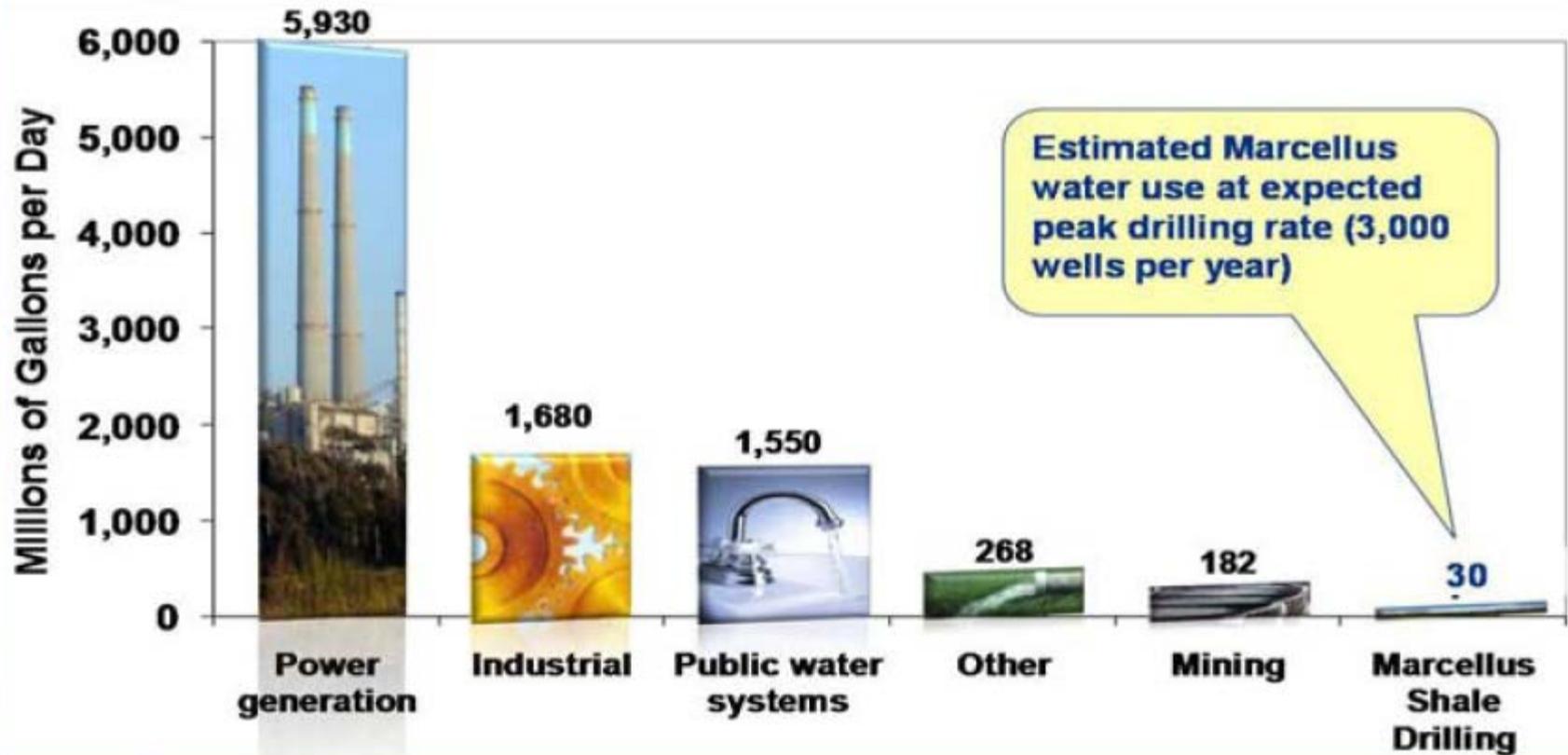
- Hydraulic fracturing was first used in Ohio in 1951 and met with considerable success – particularly in the tight, Clinton sandstone
- Hydraulic fracturing dramatically reduced the number of dry holes drilled in Ohio
- Tens of thousands of oil and gas wells have been successfully hydraulic fractured in Ohio since 1951



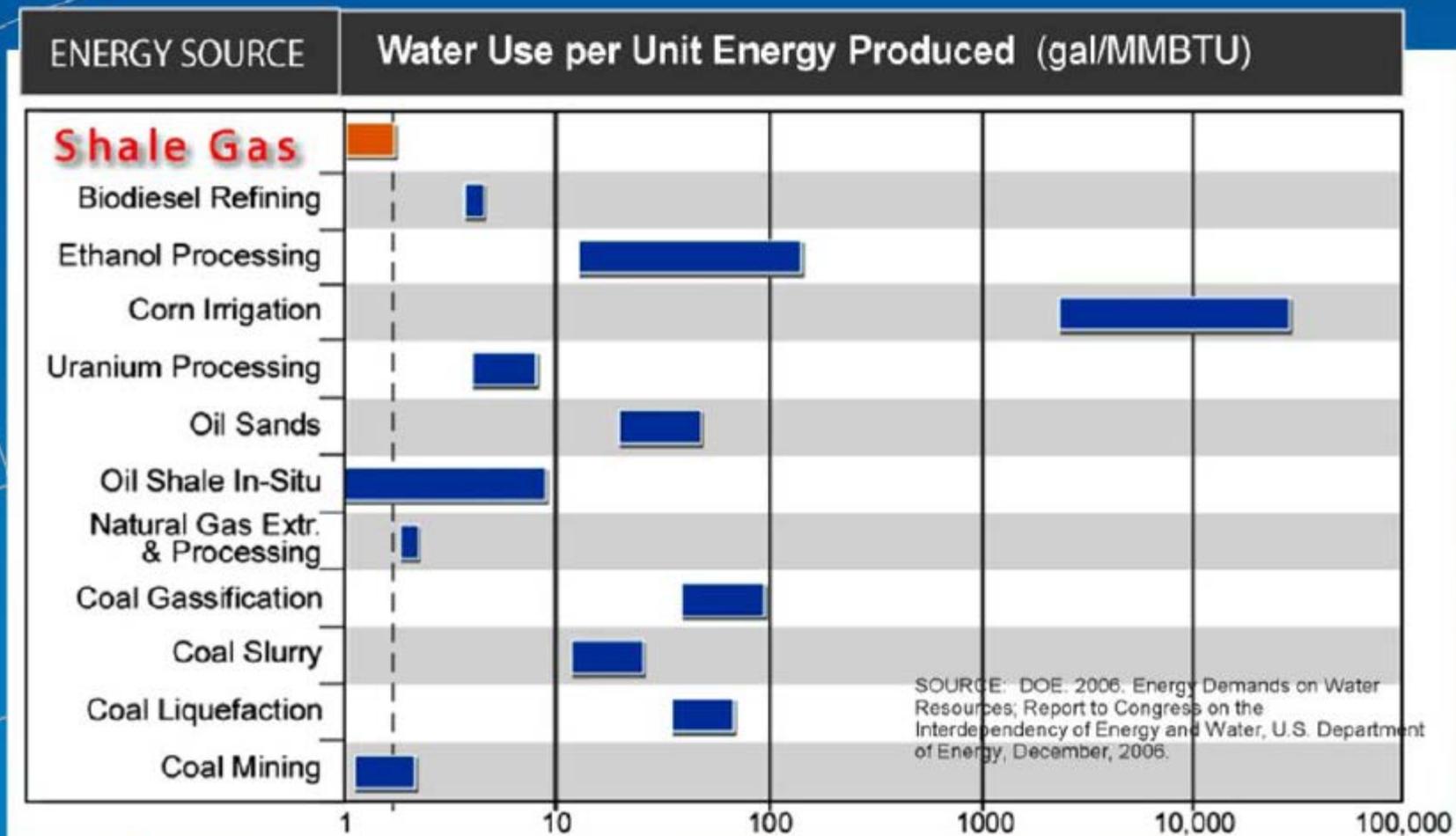
REGULATORY REFORM HAS HELPED!



Shale Gas Water Use Requirements



Shale Gas: Water Use Efficiency vs. Other Energy Sources

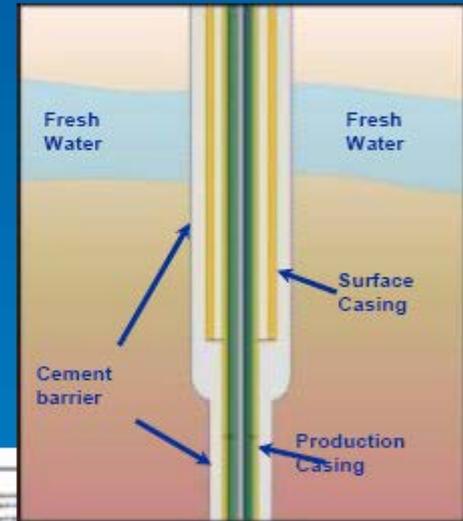


Groundwater & Surface Water Concerns

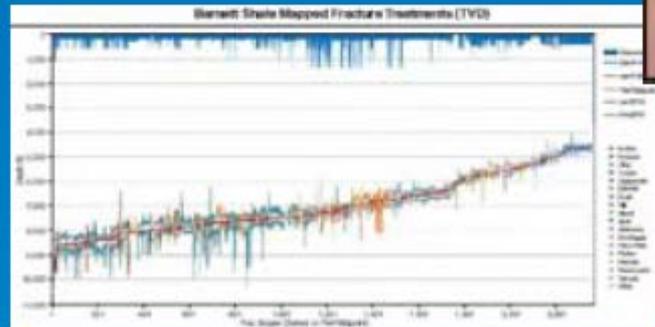
Surface Activities



Well Completion



Fracturing?





[most competitive price of fracturing proppant](#)

Min. Order: 50 Tons

FOB Price: US \$360-600 / Ton

fracturing proppant

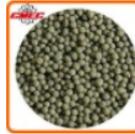
- 1)high strength & conductivity
 - 2)increase 30%-50% oil & gas output
 - 3)bauxite material
- 20/40,30/50,40/70...

Proppant Type: Bauxite Ceramic Proppant

Category: [Energy](#) | [Other Petrochemical Related Products](#)

RelatedKeywords: [Fracturing Proppant](#) | [Fracturing Proppant](#) | [Ceramic Fracturing Proppant](#)

Compare



[proppant sand 40 70](#)

Min. Order: 100 Tons

FOB Price: US \$350-399 / Ton

- 1.proppant sand 40 70
- 2.high fracture conductivity
- 3.high crush resistance
- 4.16/30, 20/40, 30/50, 40/70 mesh
- 5.API & SPE...

Proppant type: ceramic proppant

Category: [Energy](#) | [Other Petrochemical Related Products](#)

RelatedKeywords: [Proppant Sand 40 70](#) | [Proppant Sand 40 70](#) | [Proppant Sand 40 70](#)

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