Environmental Challenges: The Facts about Water

Washington Energy Policy Conference

The Unconventional Gas Revolution

March 9, 2010

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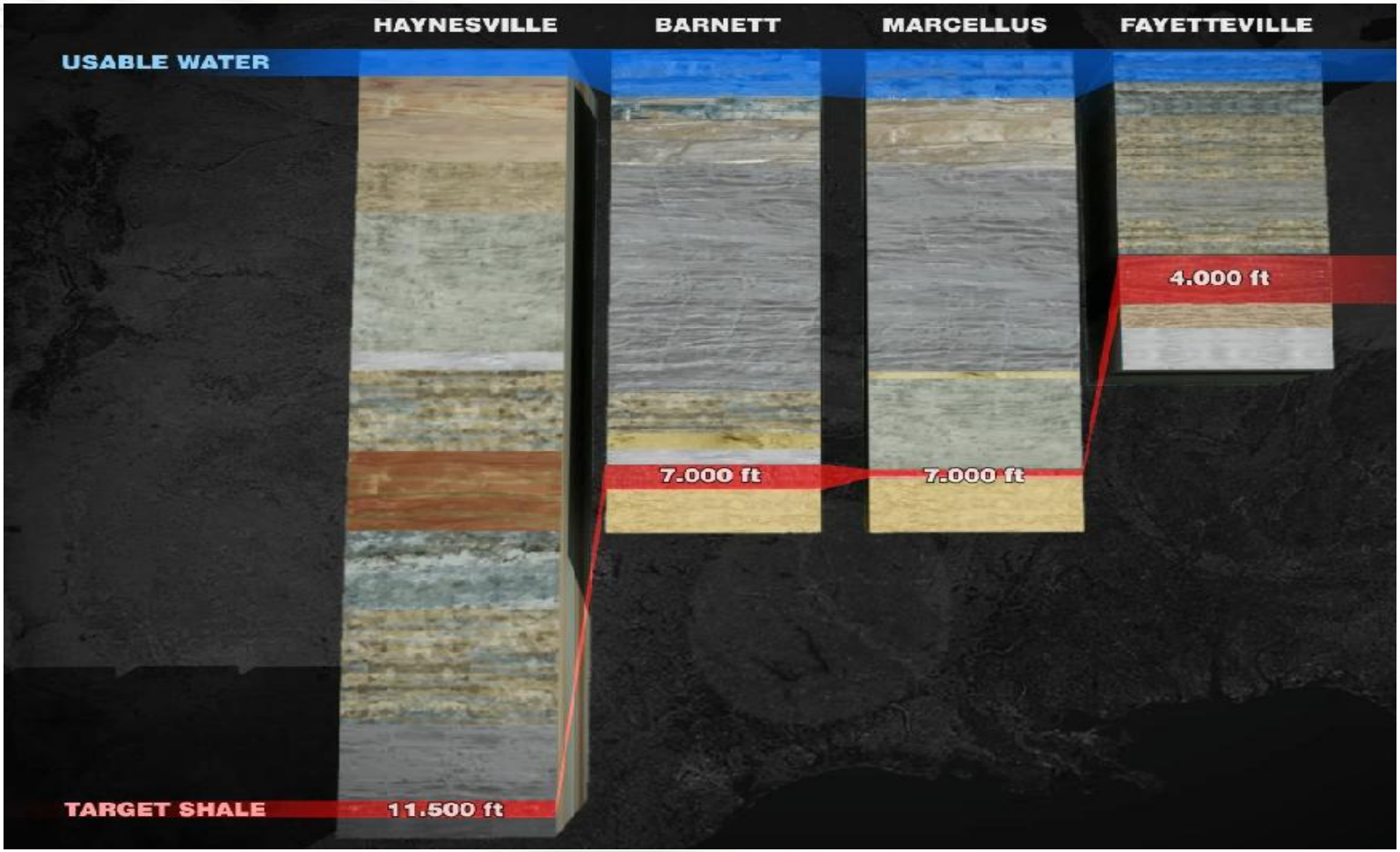
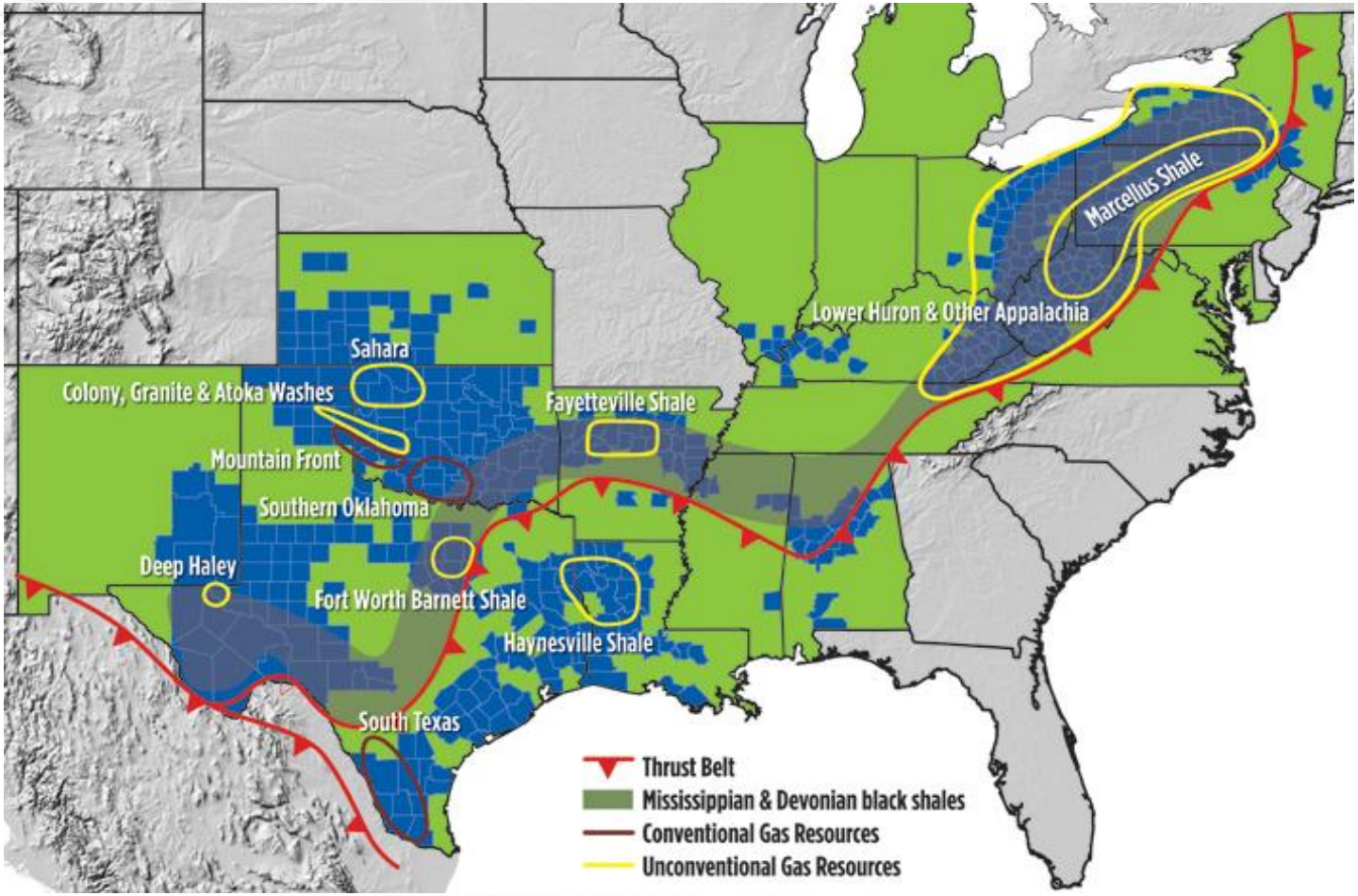
Today's Discussion

- Chesapeake overview
- Shale gas history
- Keys to deep shale natural gas development
- Water use and protection

The “Big 4” Shale Plays: Usable Water vs. Target Depth



Chesapeake's Operating Areas



Chesapeake Energy Overview

- Second largest U.S. natural gas producer
- Most active explorer for natural gas with 117 active US drilling rigs
- Employ over 8,200 employees throughout 10 states
- Chesapeake has generated 19 consecutive years of U.S. gas supply increases due to its consistent investment of 100% of operating cash flow

Leading the American effort to provide reduced dependence on unreliable, high cost foreign oil and other high carbon energy sources

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Independents Leading the Effort to Produce America's Clean Energy

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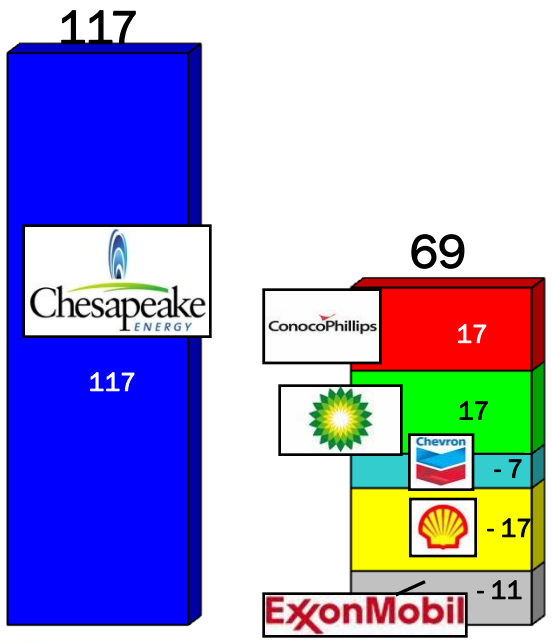
Top Operators – U.S.

Rank	Company	Rig Count
1.	Chesapeake	117
2.	XTO	79
3.	EOG	70
4.	Devon	68
5.	EnCana	47
6.	Anadarko	47
7.	Newfield	46
8.	SandRidge	45
9.	Petrohawk	32
10.	Questar	32
	Subtotal: Top 10	421
	Total U.S.	1,278

Chesapeake vs. 5 Majors

Active U.S. Onshore Rigs



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Source: Smith Tool, 1.29.10

Unconventional Natural Gas

Unconventional resource plays are a growing source of natural gas in the U.S.

- **First known Shale Gas Well**
  - Fredonia, New York
- **First Known Coal Bed Methane Well**
  - Big Run Field in West Virginia
- **First Known Tight Sands Gas Well**
  - Disputed information, claims date back to 1880s

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Shale Gas

- Found in organic-rich sedimentary rock (shale) that was originally deposited as mud within tidal flats and deep water basins
- Low permeability with restricted ability for gas to flow freely
- Requires a combination of horizontal drilling and hydraulic fracturing for the gas to be released in economic quantities
- Deep shale gas wells can produce at steady rates for decades

Marcellus Shale Outcrop in Pennsylvania

Photograph - ALL Consulting, 2008

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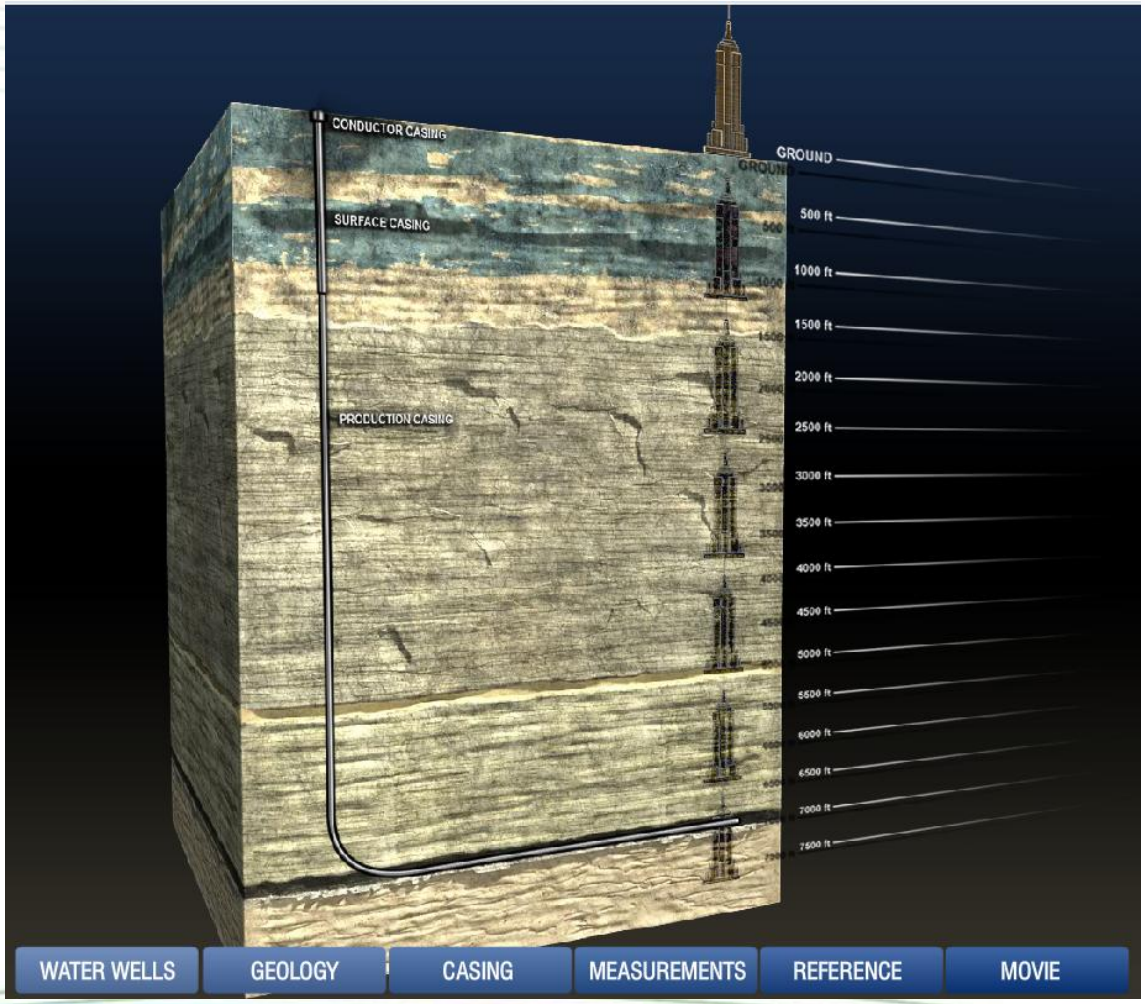
Horizontal Wells: Bore Hole and Casing Structure



Advantages of Deep Shale Natural Gas

- Abundant in U.S.
  - Barnett Shale: 44 Tcf*
  - Fayetteville Shale: 42 Tcf*
  - Haynesville Shale: 251 Tcf*
  - Marcellus Shale: 262-500 Tcf*

- Affordable
  - Natural gas price of $5 per Mcf equivalent to $30 per Bbl oil
  - Current oil price around $80 per Bbl
- Emission friendly
  - 50% the carbon dioxide of coal
  - 30% the carbon dioxide of gasoline
  - No mercury or PM emissions
- Most widely used fuel source
  - Clean burning power plants
  - Residential use
  - Industrial and manufacturing
  - Commercial space heating
  - Transportation fuel (CNG)

*US Department of Energy (April 2009): *Modern Shale Gas Development in the United states: a Primer, (p. 17)*
Tcf = trillion cubic feet

Natural Gas Production Projections Can Have A Dramatic Impact of Enhanced U.S. Consumption

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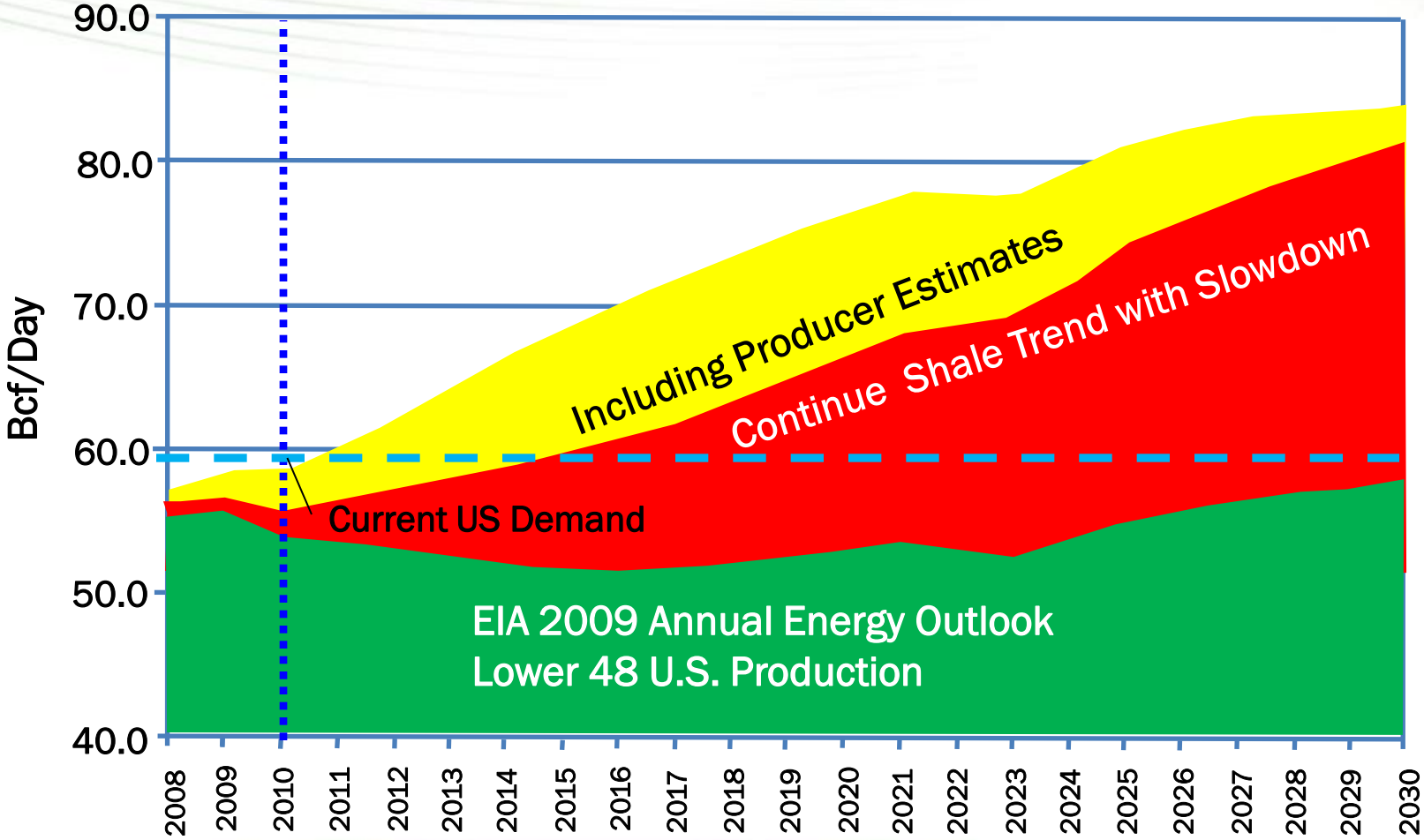

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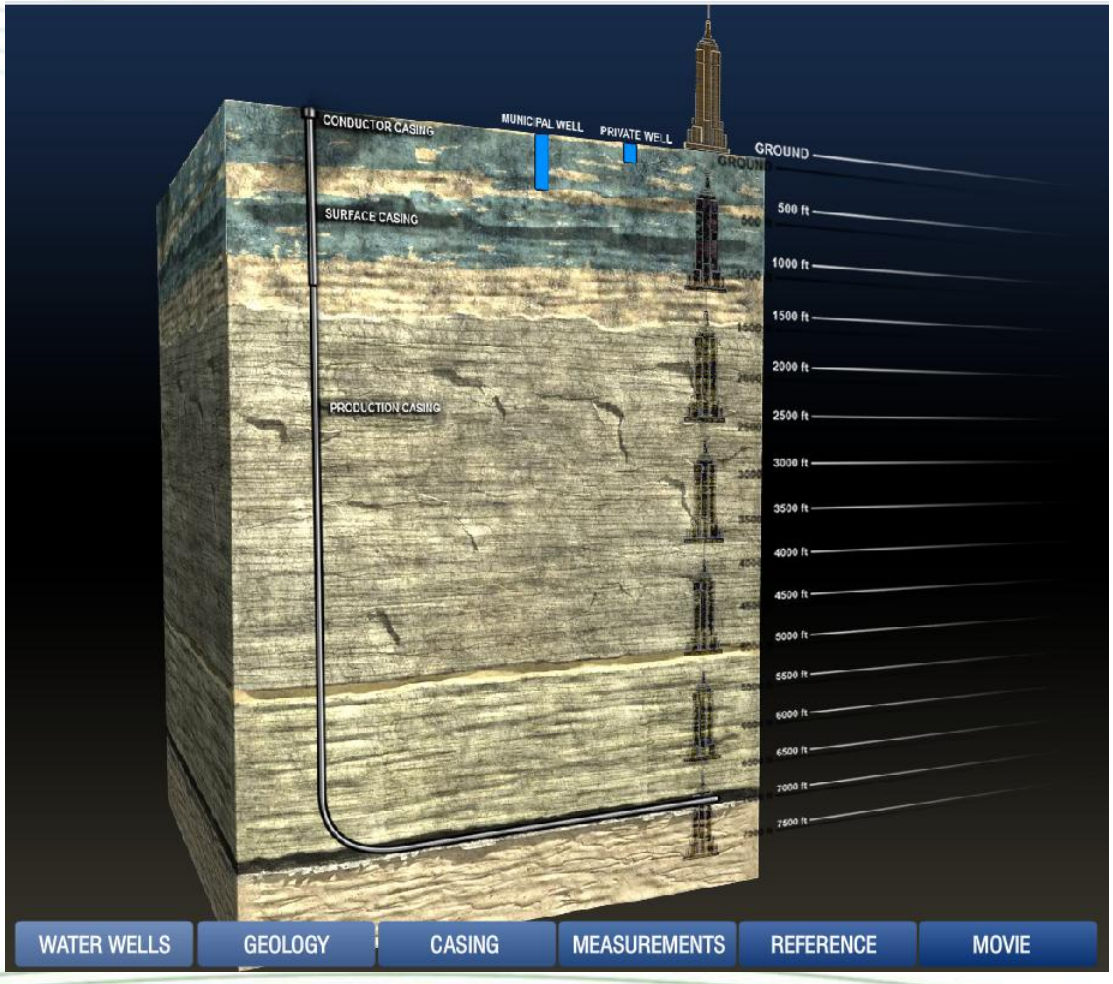
Source: Navigant 2009

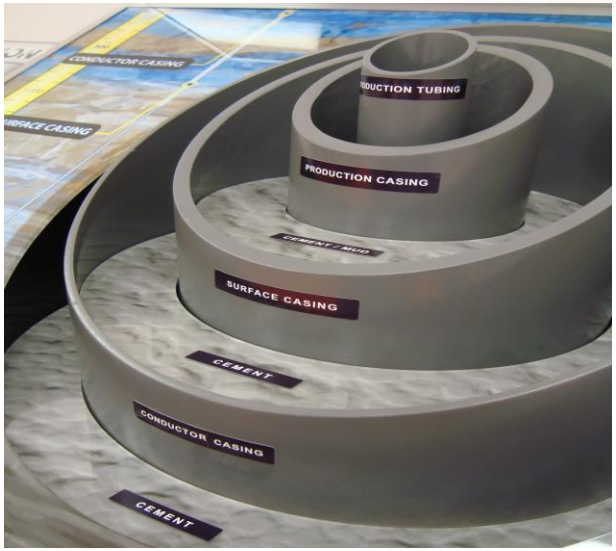
Fresh Water Protection: Casing and Depth



Keys to Deep Shale Natural Gas Development

Knowing where fresh water is located

- Established by state water protection agencies



Protective well design

- Multiple Layers of Protection
  1. Conductor casing is set and cemented in place
  2. Surface casing is run inside the cemented conductor casing below the deepest aquifer
  3. Surface casing cemented back to surface
  4. Production casing inside surface casing cement to deep shale formation
  5. Production casing sealed with combination of bentonite clay and additives cemented back to the surface in three stages
  6. Steel production tubing through which gas and fluids move
  7. Internal plastic coating on tubing to prevent corrosion

Keys to Deep Shale Natural Gas Development

Horizontal drilling

- Consists of a vertical wellbore that curves to a 90-degree angle as it reaches the gas-bearing deep shale formation
- Results in a need for fewer overall well pads to be constructed and fewer wells drilled

Hydraulic fracturing of shale formations

- A pressurized mixture of 99.5% water and sand with a small amount of special purpose additives
- The process creates cracks/fractures in the targeted deep shale formation allowing gas to flow into the pipe

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Typical Deep Shale Gas Fracturing Mixture

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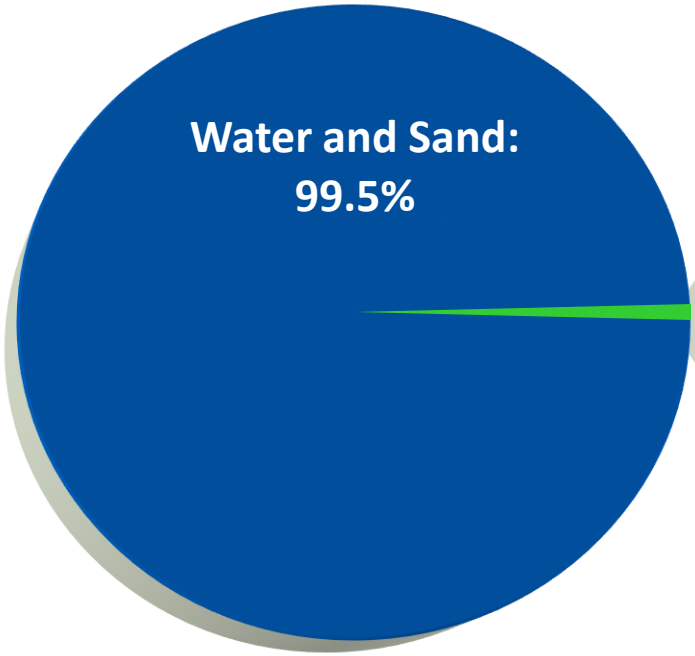

Other: 0.5%

- Acid
- Friction Reducer
- Surfactant
- Gelling Agent
- Scale Inhibitor
- pH Adjusting Agent
- Breaker
- Crosslinker
- Iron Control
- Corrosion Inhibitor
- Antibacterial Agent
- Clay Stabilizer

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For more information, see the Hydraulic Fracturing Fact Sheet on http://www.hydraulicfracturing.com

Vertical Separation of Deep Shale Gas & Fresh Water

Gas Shale Basin	Barnett	Marcellus	Fayetteville	Haynesville
Est. Arial Extent (sq. mi.)	5,000	95,000	9,000	9,000
Depth (feet)	6,500-8,500	4,000-8,500	1,000-7,000	10,500-13,500
Net Thickness (feet)	100-600	50-200	20-200	200-300
Depth of Base of Treatable Water (feet)	~1,200	~850	~500	~400
Total Organic Carbon , %	4.5	3-12	4.0-9.8	0.5-4.0
Total Porosity, %	4-5	10	2-8	8-9
Gas Content, scf/ton	300-350	60-100	60-220	100-330
Well spacing (Acres)	60-160	40-160	80-160	40-560
Gas-In-Place (tcf)	327	1,500	52	717
Reserves (tcf)	44	262-500	41.6	251

scf = standard cubic feet of gas
tcf = trillions of cubic feet of gas
Mcf = thousands of cubic feet of gas

Source: US DOE Publication - Modern Shale Gas; A Primer

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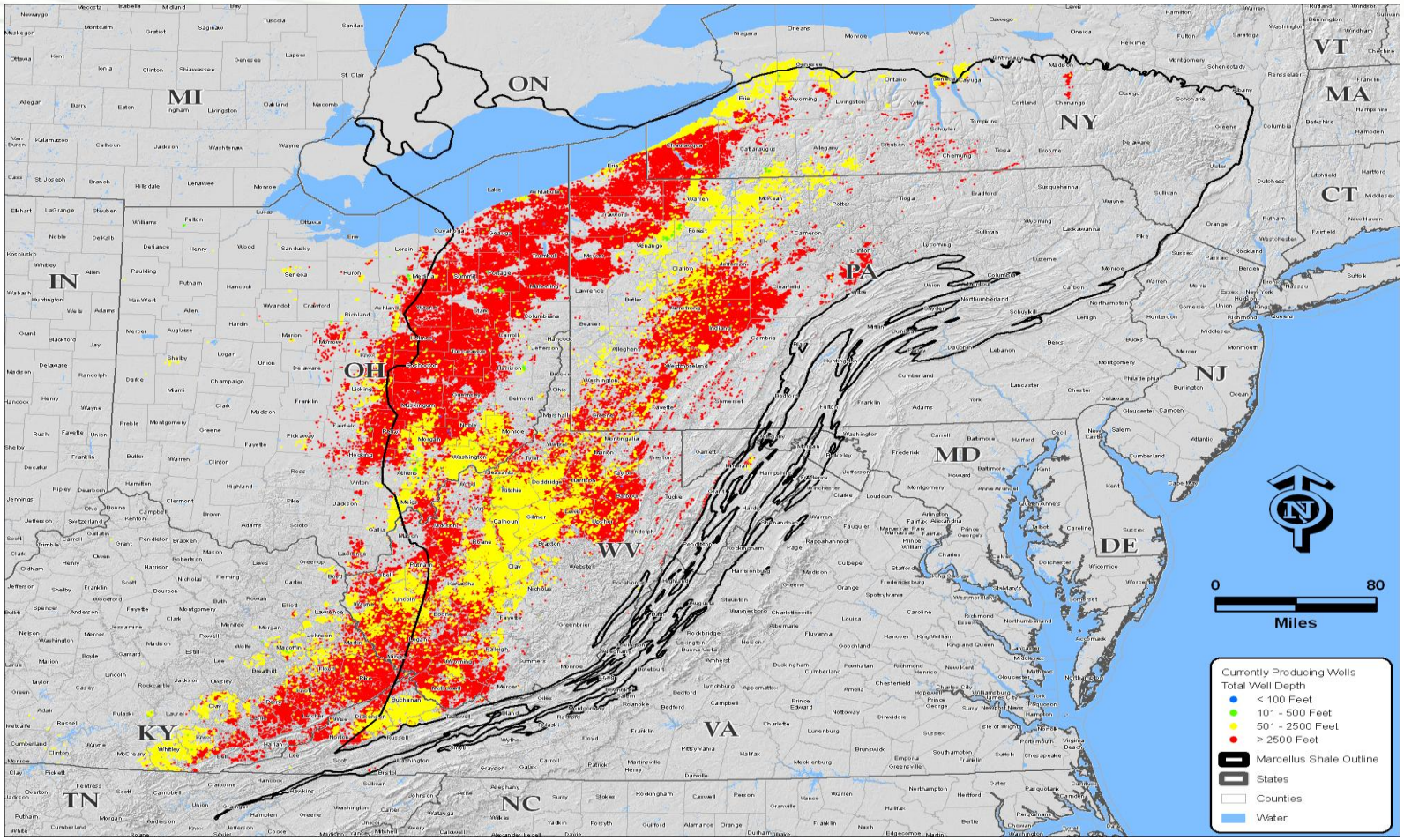
Surface Protection and Management

Examples include:

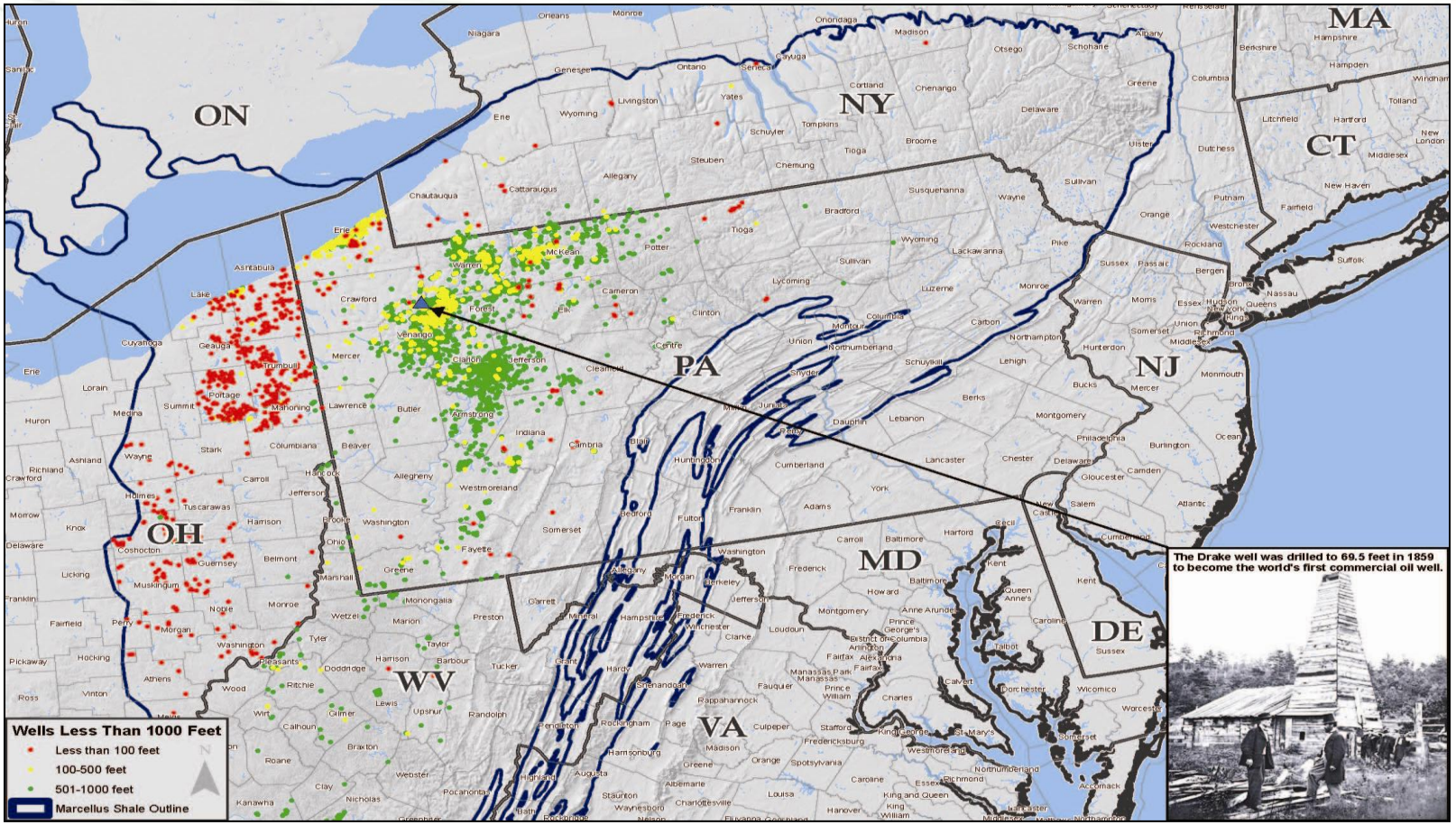
- Chemical trailers, containers and raw chemical transfer equipment is placed in lined secondary containment
- Construct sites in a manner to contain fluids

Wells Producing in Marcellus Area



Historical O&G Wells in Marcellus Area

Depths Less than 1,000 ft



After 150 Years…

- Chemicals have been used daily throughout the history of our industry
- Chesapeake is not aware of any significant spills/releases **from our industry** that have impaired watersheds in Marcellus area
- Chemical use and reporting structure applies to our industry like all industries in the U.S.
- To date, there is not 1 example of undiluted frac fluid being released to a watershed
- Unsubstantiated and inflammatory assumptions about chemical exposure(s) is irresponsible; need to focus on the data and the facts

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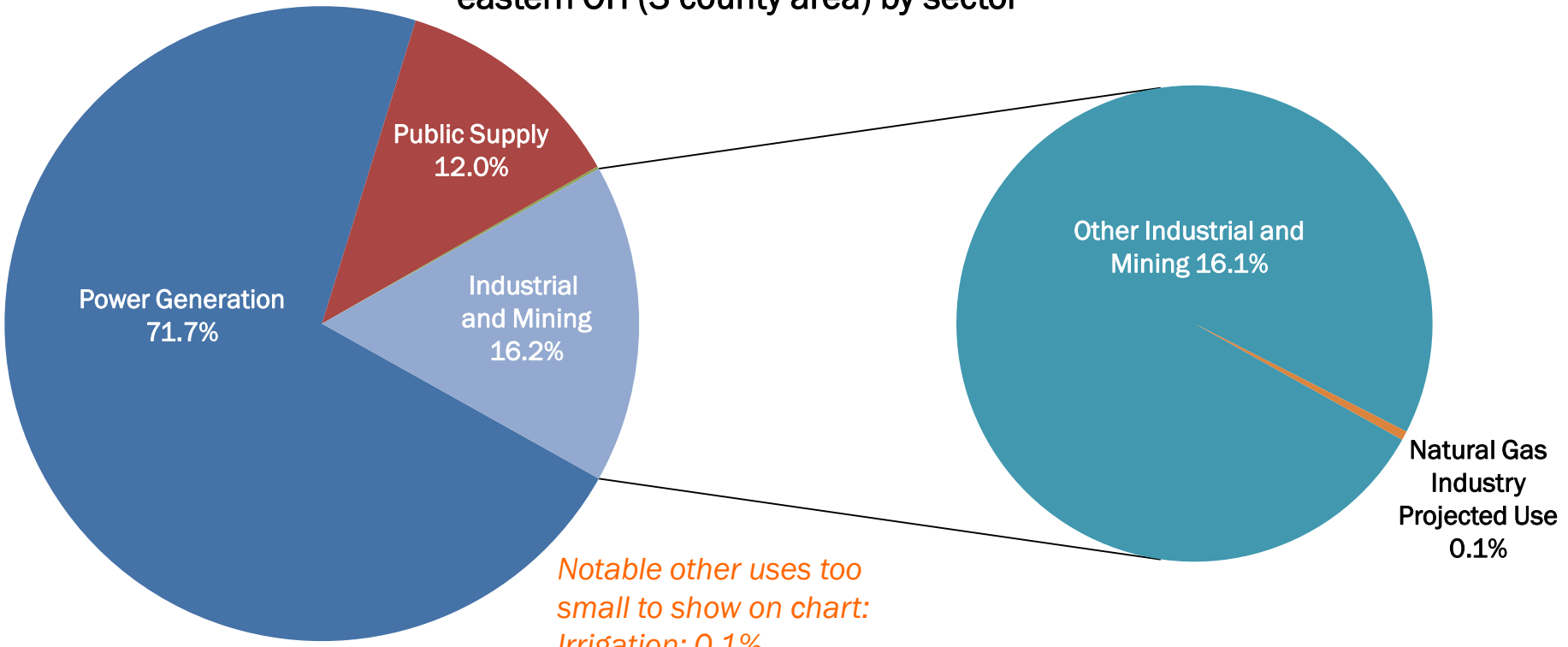
Water Use in Marcellus Shale Area

Total water use (Surface Water and Ground Water) in central PA (32 county area), southern NY (10 County Area), northern WV (29 county area), western VA and MD (5 county area) and eastern OH (3 county area) by sector



Notable other uses too small to show on chart:
Irrigation: 0.1%
Livestock use: 0.01%

Total water use in Marcellus area:
3.6 trillion gallons per year

Source: USGS Estimated Use of Water in US, County Level Data for 2000

Water Use Comparison

- Approximately 5 million gallons of water is needed to drill and fracture a Marcellus deep shale gas well
  - Equivalent to water consumed by:
    - New York City in 8 minutes
    - A 1,000 megawatt coal-fired power plant in 13 hours
    - A golf course in 28 days
    - Nine acres of corn in a season

Water Resource Regulatory Community

- States have established water management systems
  - Evaluation of total state water resources (state water plans)
  - Established process to allocate water for use by the state
  - Systems in place to ensure that the industry stays within the allocated water plan
    - CHK proactively involved in state water plan processes / updates
- Individual local and multi-state watershed management groups
  - Ensure that water from watersheds is used and allocated appropriately
- These states and groups ensure both water use and water quality
  - Cannot be duplicated at the federal level
  - Based on specific knowledge of local and state conditions

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Water Use and Deep Shale Natural Gas

- Considering the lifecycle water footprint of all energy resources, deep shale natural gas is among the most water-efficient fuel sources available
- Natural gas (including deep shale natural gas), wind and solar are the most water efficient fuel sources available
- Natural gas-fired power plants, utilizing shale gas as fuel, are among the most water efficient power plants available*
- Natural gas-based transportation fuels (CNG) are the most water efficient transportation fuels available

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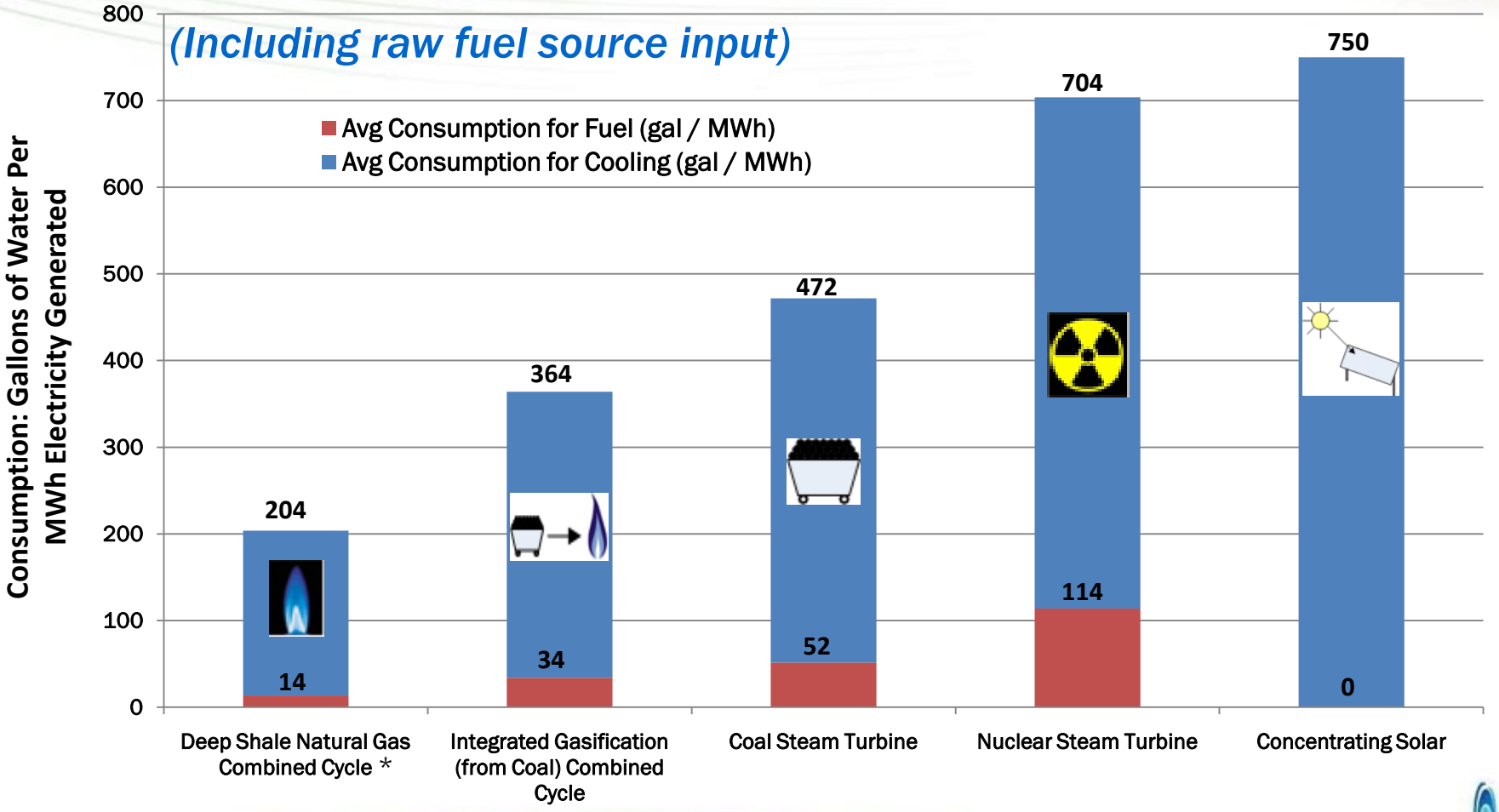
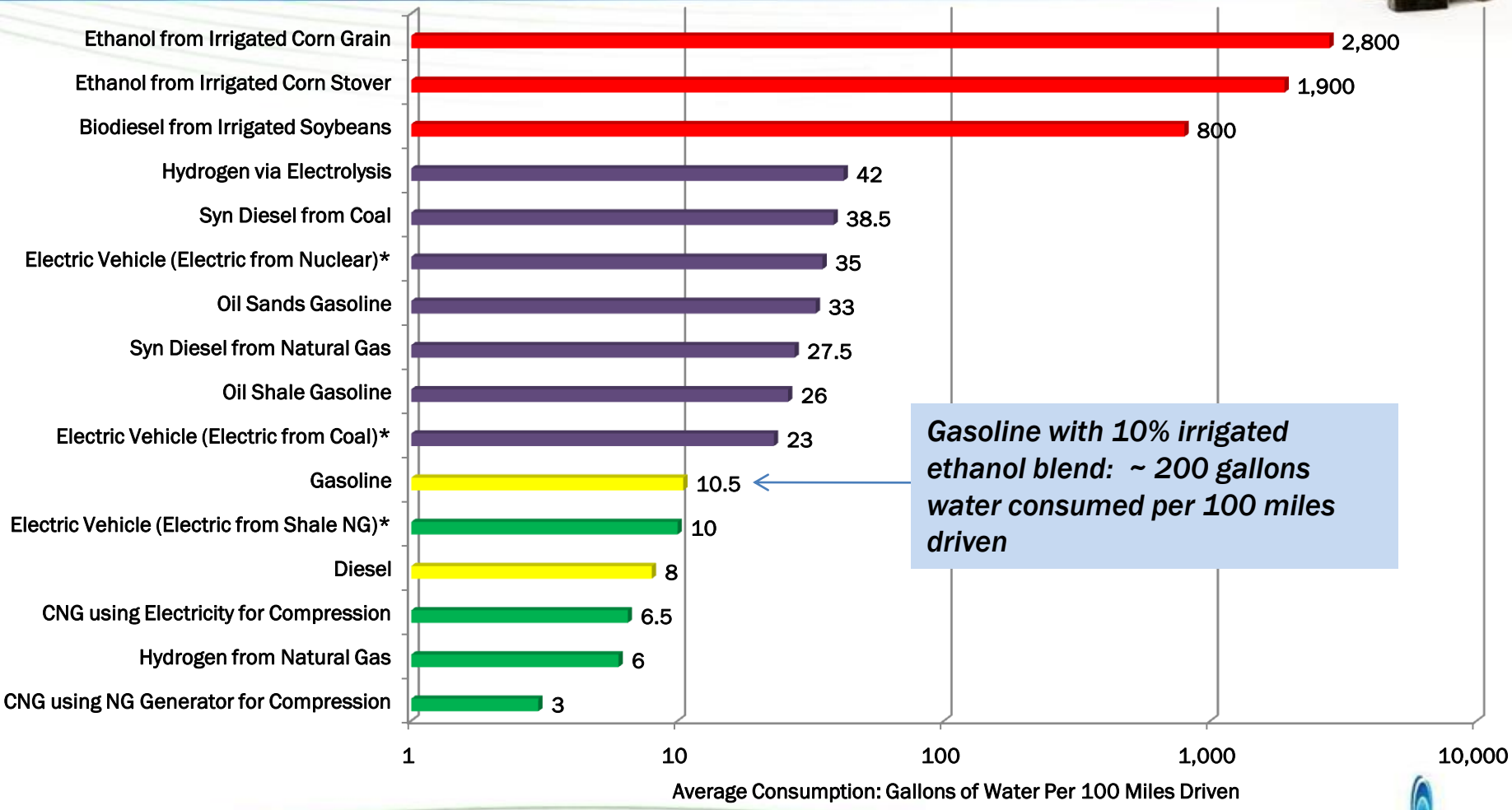
* Wind turbines and photovoltaic solar cells are the most water efficient (utilize virtually no water) but are not considered "base-load worthy" sources of electricity

Power Generation Water Use Efficiency



Source: USDOE 2006 (other than CHK data)
*Average consumption for fuels; Chesapeake data
MWh = megawatt-hour

Water Intensity of Transportation Fuels



Gasoline with 10% irrigated ethanol blend: ~ 200 gallons water consumed per 100 miles driven

Compressed Natural Gas (CNG)
Source: Adapted from King and Webber 2008a;
*Adapted from King and Webber 2008b, combined with data from USDOE 2006

Summary

- The majority of natural gas supply in the future will come from deep gas projects like deep shale gas
- Deep shale production is separated from the base of fresh water by thousands of feet of impermeable rock
- Hydraulic fracturing and chemical use is not new; just technologically advancing
- The process of hydraulic fracturing is safe
- Water consumed for natural gas exploration and production is regulated by state agencies
- Natural gas is one of, if not the single, most water efficient energy/transportation fuel sources

The strategic advantages – economic, environmental and energy security – of the responsible development of America's abundant natural gas reserves are too important.

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