

AV Shale Gas and America's Future*

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Summary

- Recent natural gas shale discoveries have changed the energy picture in America.
- Current political leaders have great incentive to support more natural gas usage as a bridge to their carbon-light energy future.
- Increased market share for natural gas vs. coal for electricity consumption and vs. oil for transportation will provide the demand growth needed to absorb the new 1100 tcf of new U.S. gas shale reserves found in past five years in the Big 4 shale plays, while reducing GHG's substantially.
- Natural gas can lead an industrial renaissance in the U.S. by providing cleaner, low cost input prices for decades to come – this is result of the tremendous technological advances realized during the past decade.
- Stable, more predictable demand from the transportation sector through either NGV's or PHEV's will lead to reduced price volatility.
- Likewise, international natural gas discoveries can allow the committed countries to lead the world on clean air and climate change issues for decades to come – first, though, we must dispel the myth of natural gas scarcity.

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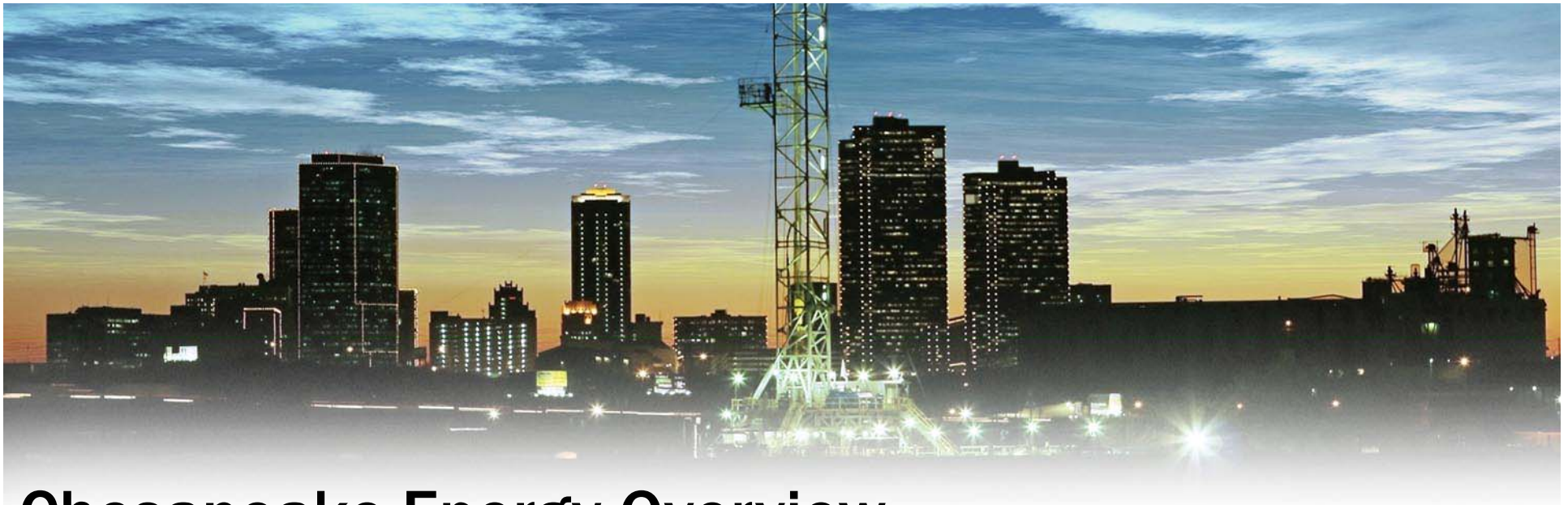
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AAPG Conference

Michael T. Halbouty Lecture
“Shale Gas and America’s Future”
April 12, 2010
New Orleans, LA

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Chesapeake Energy Overview:

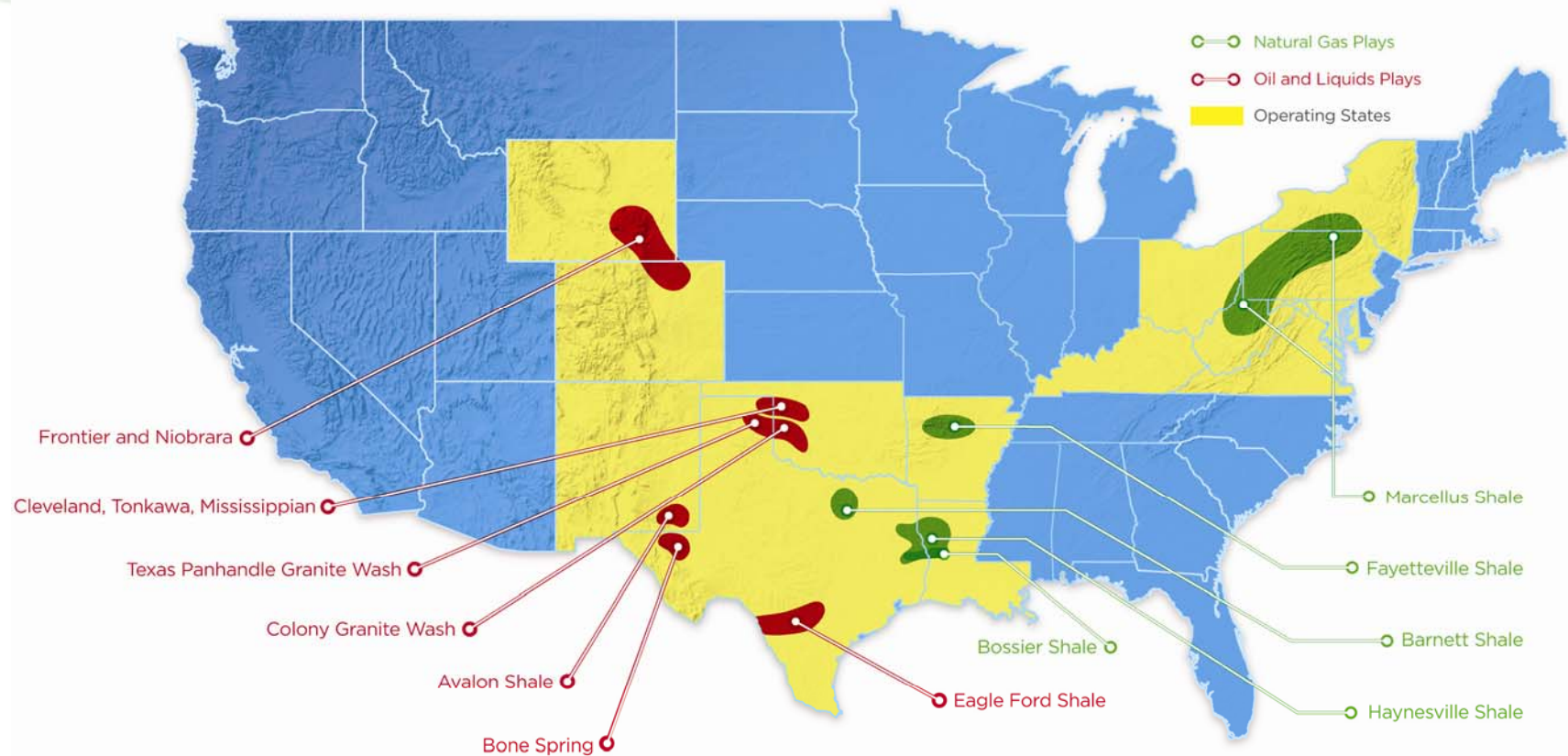
- 2nd largest U.S. natural gas producer (behind only XOM post XTO)
- Most active U.S. natural gas explorer – 116 U.S. drilling rigs (1 of out of 8 in U.S.)
- Employ over 8,200 employees in 16 states
- Applying unconventional thinking and state of the art technologies, CHK has grown from a \$50,000 startup in 1989 to a \$30 billion enterprise today
- CHK is leading the effort to reduce American dependence on unreliable, high-cost foreign oil and on dirty, high-carbon coal through the greater use of natural gas in electrical generation and transportation networks



Just as the 19th and 20th Centuries were the Age of High-Carbon Coal and Oil, the 21st Century will be the Age of Low-Carbon Natural Gas

CHK's Operating Areas

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CHK is transitioning away from 92% natural gas to a greater balance between natural gas and oil



Top 20 U.S. Natural Gas Producers

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[Daily U.S. Natural Gas Production \(a,b\)](#)

Company (c)	Ticker	4Q'09	3Q'09	4Q'08	4Q'09 vs. 3Q'09 % Change	4Q'09 vs. 4Q'08 % Change	2009 Reported U.S. Net Proved Natural Gas Reserves	RP Ratio (d)	Proved U.S. Natural Gas Reserves Ranking	U.S. Gas Rigs Drilling on 3/12/10 (e)	U.S. Gas Rigs Drilling on 8/29/08 (e)	U.S. Gas Rigs % Drilling Change Since 8/29/2008
ExxonMobil (f)	XOM	3,665	3,681	3,382	(0.4%)	8.4%	24,189	18	1	64	78	(18%)
Chesapeake	CHK	2,440	2,286	2,130	6.7%	14.6%	13,510	15	3	117	143	(18%)
BP	BP	2,313	2,278	2,243	1.5%	3.1%	15,216	18	2	12	20	(40%)
Anadarko	APC	2,076	2,144	2,197	(3.2%)	(5.5%)	7,764	10	6	27	36	(25%)
Devon	DVN	1,894	1,999	2,107	(5.3%)	(10.1%)	8,127	12	5	44	66	(33%)
ConocoPhillips	COP	1,831	2,043	2,095	(10.4%)	(12.6%)	10,742	16	4	12	35	(66%)
EnCana	ECA	1,616	1,524	1,677	6.0%	(3.6%)	5,713	10	8	46	53	(13%)
Chevron	CVX	1,405	1,420	1,320	(1.1%)	6.4%	2,698	5	14	2	6	(67%)
Williams	WMB	1,177	1,148	1,156	2.5%	1.8%	4,255	10	9	15	32	(53%)
EOG	EOG	1,075	1,128	1,231	(4.7%)	(12.7%)	6,350	16	7	45	52	(13%)
Shell	RDS	1,064	1,017	1,071	4.6%	(0.7%)	2,258	6	18	13	13	0%
Southwestern	SWN	966	793	624	21.9%	54.9%	3,650	10	11	19	22	(14%)
Apache	APA	689	699	583	(1.5%)	18.1%	2,438	10	17	7	14	(50%)
Occidental	OXY	645	653	596	(1.2%)	8.2%	2,799	12	12	1	4	(75%)
El Paso	EP	585	619	636	(5.5%)	(8.0%)	2,052	10	19	13	11	18%
Petrohawk	HK	577	488	333	18.4%	73.4%	2,700	13	13	20	19	5%
Newfield	NFX	500	462	477	8.2%	4.8%	2,605	14	15	11	23	(52%)
Ultra	UPL	496	477	422	4.0%	17.5%	3,737	21	10	8	15	(47%)
Questar	STR	488	426	445	14.5%	9.6%	2,525	14	16	15	26	(42%)
Noble	NBL	386	397	404	(2.8%)	(4.5%)	1,534	11	20	12	13	(8%)
Totals / Average		25,888	25,682	25,129	0.8%	3.0%	124,862			503	681	(26%)
Other Producers										459	864	(47%)
Total										962	1,545	(38%)

The best of the best only eked out 0.8% sequential production growth in 4Q'09 vs. 3Q'09, private companies in steep decline because of far less drilling



- (a) Based on 4Q'09 company reports
- (b) In mmcf/d
- (c) Independents in blue, majors in black, pipelines in green
- (d) Based on 2009 production and resources, Shell as of 2008
- (e) Source: Smith International Survey (operated oil and gas rig count)
- (f) Pro forma for XOM's acquisition of XTO

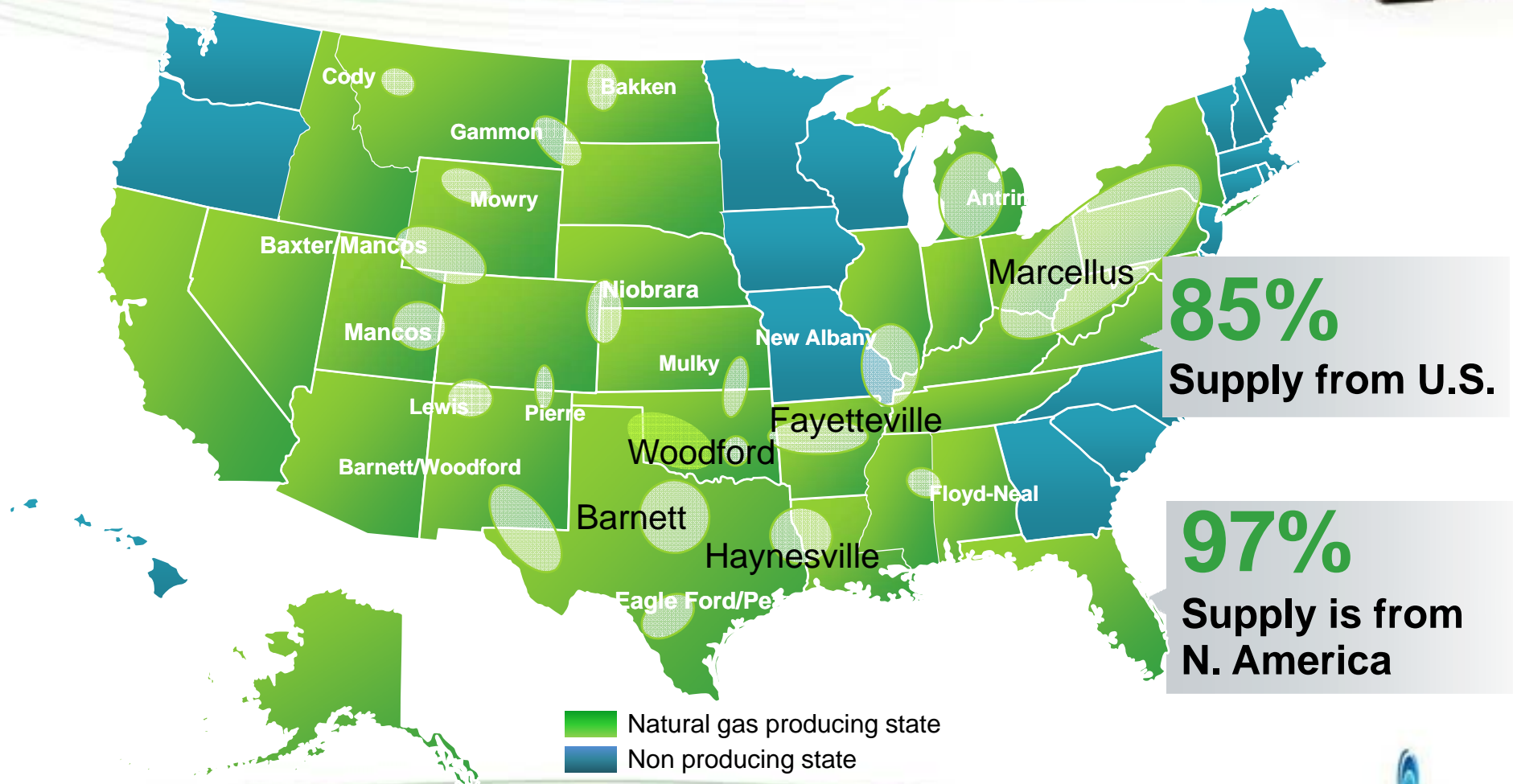


America's Greatest New Opportunity:
Abundant **Natural Gas = Freedom** from Dirty Coal
and Dangerous Foreign Oil



Discoveries Are Spread Across the U.S. – 32 of 50 States Produce Natural Gas

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Source: EIA

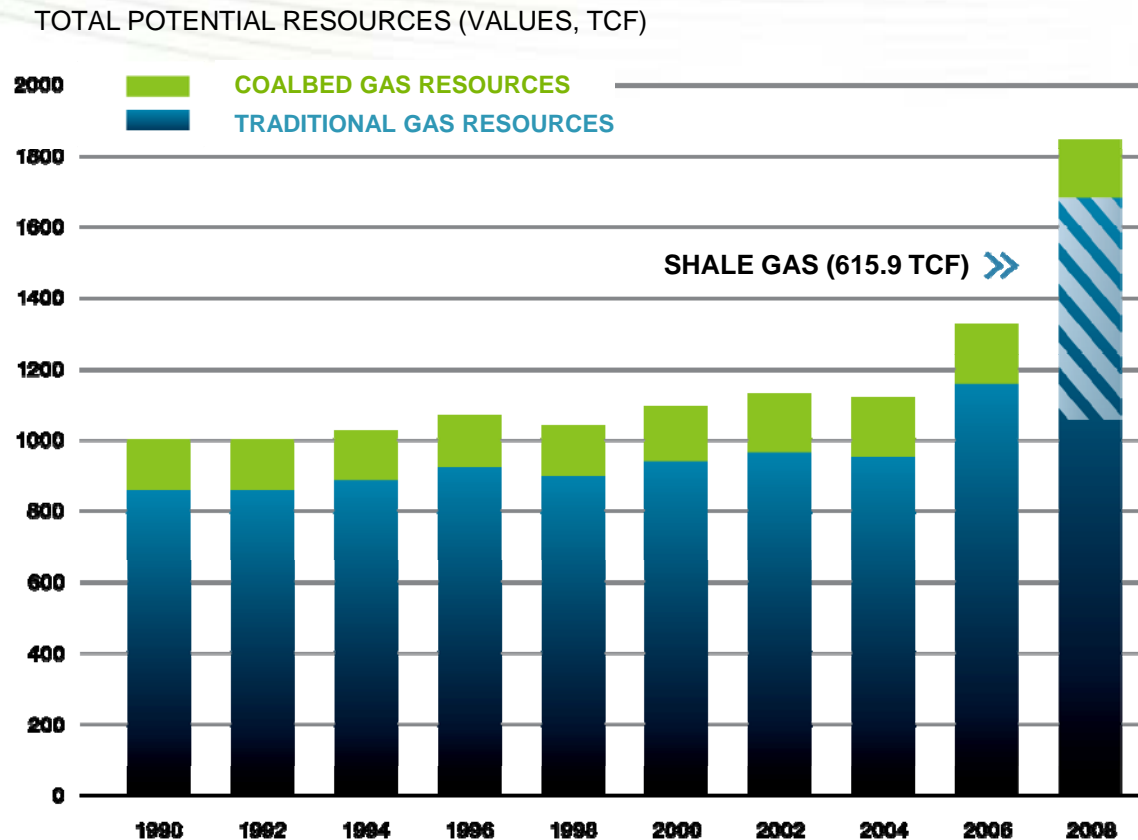
U.S. natural gas deposits are far more widespread and larger than U.S. coal deposits



Natural Gas: A Huge U.S. Resource



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POTENTIAL GAS COMMITTEE REPORT, JUNE 2009

2,074
TCF OF FUTURE
NAT GAS SUPPLY

58%
INCREASE IN
THE PAST 4 YEARS

1,836 Tcf
TOTAL POTENTIAL
RESOURCES

238 Tcf
PROVED RESERVES

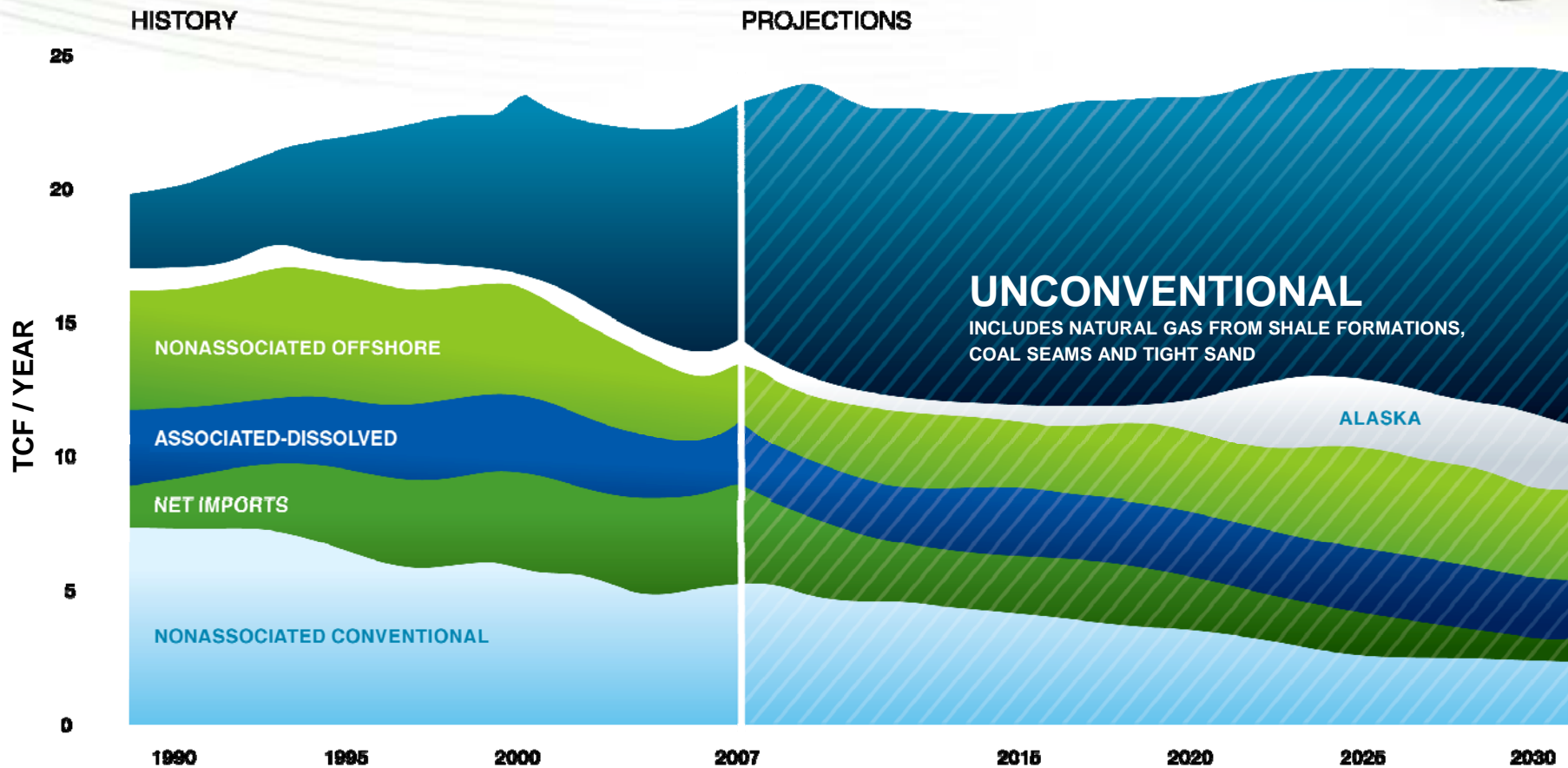
The U.S. uses ~22 TCF of natural gas per year, so we have at least a 100 year supply of natural gas, and it will keep growing – not true with coal 7



Unconventional Natural Gas: A Game Changer



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Source: EIA, Outlook 2009



The Many Advantages of Natural Gas



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● Abundant

New Discoveries:

- Barnett Shale: 44 Tcf*
- Fayetteville Shale: 42 Tcf*
- Haynesville Shale: 250 Tcf*
- Marcellus Shale: 490 Tcf**



● Affordable

- Natural gas price of \$5 per MMBtu equivalent to \$30 Bbl oil
- Current oil price around \$85 Bbl, so gas is 70% cheaper than oil

● Clean

- 50% less CO₂ than coal
- 30% less CO₂ than gasoline
- No mercury or particulate emissions

● Versatile

- Clean-burning power plants
- Residential use
- Industrial and manufacturing
- Commercial space heating
- Transportation fuel (CNG/LNG)



*US Department of Energy (April 2009): *Modern Shale Gas Development in the United States*, p. 17)

**Dr. Terry Engelder, Penn State University

Tcf = trillion cubic feet

“Clean coal” is an expensive dream, while clean-burning natural gas is an inexpensive reality today

Want Climate Change Risk Reduction and Cheap Electricity? The Answer is Natural Gas

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- Coal-fired plants emit ~2.0 billion tons of CO₂ annually – **82%** of total power plant emissions
- The most immediate and efficient way to reduce GHG emissions and improve our environment is by increasing natural gas power generation in existing plants and shutting down old, dirty “clunker” coal power plants
- Most critical step is to rapidly increase currently underutilized combined cycle natural gas units
 - 1/3rd of total U.S. generating capacity
 - Ultra-efficient and far lower GHG emitting than coal
 - Currently operate at an average capacity factor of less than 35 %*
 - Increased capacity utilization could result in billions of cost savings over new plant construction & carbon sequestration
 - Gas fired plants run ~23% of time, coal-fired power plants run 69% – by doubling gas plant utilization to 50%, could reduce coal plants to 55% utilization, greatly benefiting the environment

Best way to reduce emissions??

Utilize low carbon natural gas instead of high carbon coal

*FTI Consulting, Inc – Washington, DC



Natural Gas Is the Fuel of Choice for a Cleaner Environment



Fossil Fuel Emission Levels

Pounds per Billion Btu of Energy Input

Pollutant	Natural Gas	Oil	Coal	The Natural Gas Advantage
Carbon Dioxide	117,000	164,000	208,000	44%
Carbon Monoxide	40	33	208	81%
Nitrogen Oxides	92	448	457	80%
Sulfur Dioxide	1	1,122	2,591	99.9%
Particulate Matter	7	84	2,744	99.7%
Mercury	0.000	0.007	0.016	100%



If serious about environmental pollution, why do we continue burning so much coal when natural gas is so much cleaner?

Natural Gas is **Cleaner**, But Also Cheap and Scalable Immediately



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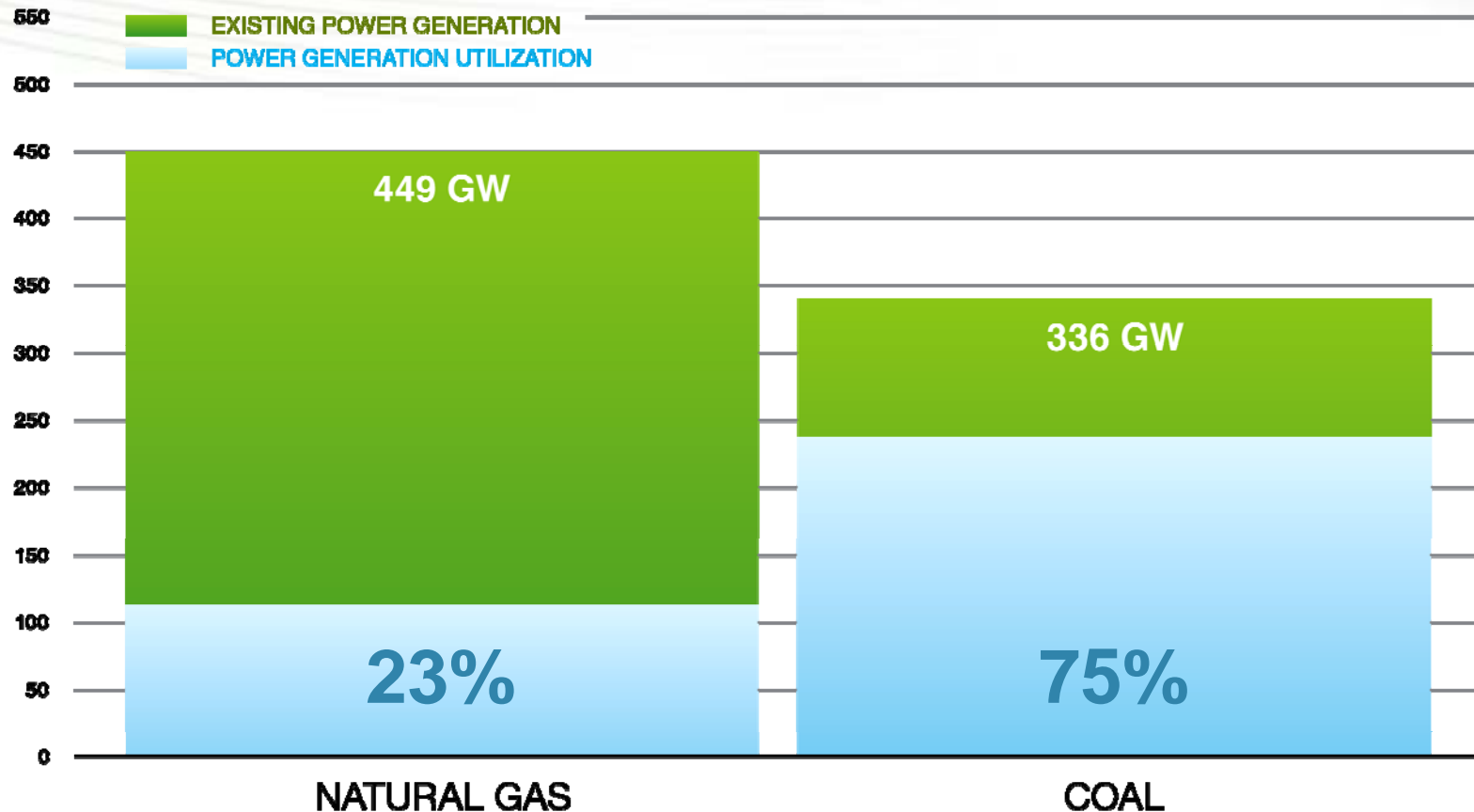
Renewables simply don't work without natural gas as the “quick-fire” baseload fuel



We Can Switch Today to Cleaner Natural Gas



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U.S. ENERGY INFORMATION ADMINISTRATION 2007



Coal plants run 3x more than natural gas plants run – this must change to reduce CO₂ and other pollutants

Environmental Advocacy for Natural Gas

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Robert Kennedy Jr. – *U.S Environmental Lawyer, 10/2009*
Financial Times

“Converting rapidly from coal generation to gas....is the most obvious step to saving our planet and jump starting our economy”

Congressman Ed Markey

Chairman - Energy and Environment Subcommittee, 11/2009

New York Times

“I largely subscribe to the view about the role which natural gas can and should play in the long-term in our country. Natural gas actually emits half the pollutants as coal, so that could help in our dealings with greenhouse gas emissions and compliance, when combined especially with solar and wind.

Dan Yergin – *Author and Chairman of IHS CERA, 8/2009*

Wall Street Journal

“The biggest energy innovation of the decade is natural gas—more specifically what is called "unconventional" natural gas. Some call it a revolution.”



Natural Gas Is Today's Clean Energy Answer for America's Economy



- **RELIABILITY** - America has an abundance of natural gas and will continue to increase supplies with the increased development of shales
- **DELIVERABILITY** - Natural gas power generation will provide lower per unit costs for American consumers
- **STABILITY** - Price stability through domestically abundant and hurricane-proof deep shale gas will provide consistent pricing
- **SENSIBILITY** - A low carbon fuel, natural gas as a energy resource can enable American companies to avoid climate change costs and credits
- **VIABILITY** - Using a clean, economical, domestic energy source will help keep jobs in America





Natural Gas and the Environment: Regulation and Hydraulic Fracturing

Are Oil and Gas Operations Regulated?

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Myth: “..... the U.S. oil and gas production industry..... has enjoyed loopholes in federal laws that allow it to pollute the land, air and water, and release toxic substances into the environment.” NRDC Press Release, October 31, 2007

Fact: Development of natural gas is regulated under a system of interrelated, interdependent, and overlapping federal, state and local laws that address exploration and operation.



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Issues Regulated



- Air Quality
- Groundwater Protection (Surface Casing Programs)
- Surface Water Protection
- Water Use
- Chemical Handling & Transportation
- Cultural Resources
- Employee Safety
- Erosion/Sediment Control
- Floodplains
- Fluid Handling/Disposal
- Incident Reporting
- Noise
- Placement/construction of Wellbores
- Public Safety
- Road Use
- Spill Response & Remedial Measures
- Stream Crossings
- Threatened & Endangered Species
- Waste Handling & Disposal
- Well Density/Spacing
- Well Testing
- Well Production
- Wetlands

Fracture Stimulation – The Facts

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U.S EPA Confirms Freshwater is Protected and Regulated



"State regulators are doing a good job overseeing a key natural gas production technique called hydrofracing and there's no evidence the process causes water contamination"

Steve Heare, director of EPA's Drinking Water Protection Division
(Source: Dow Jones, 2.15.10 from the NARUC Winter Meeting)



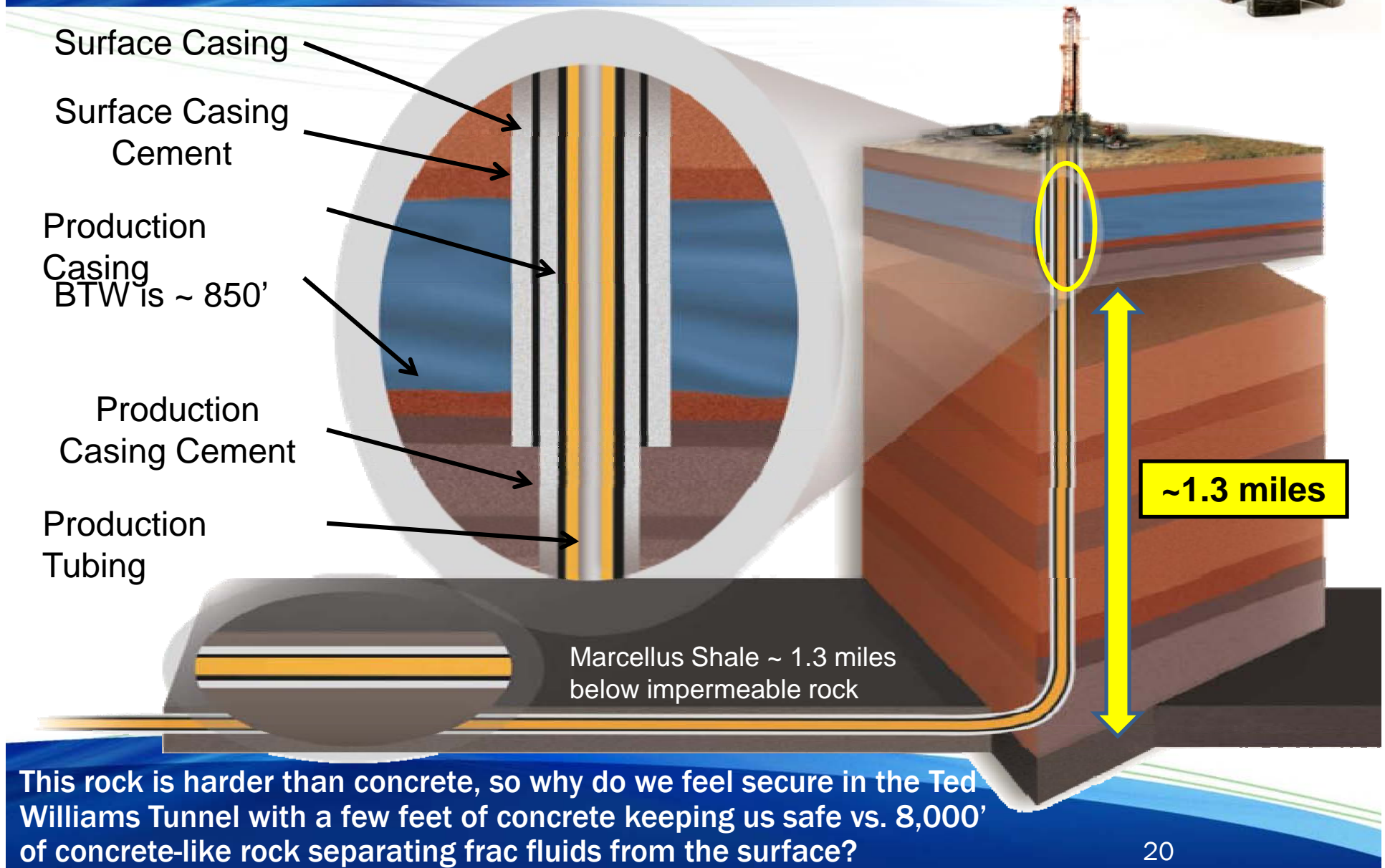
"I think it [fracing] can be done responsibly, and the [Eñvironmental Protection Agency] and other agencies will be looking to ensure it's done safely and responsibly," Chu said. "If [natural gas] can be extracted in an environmentally safe way, then why would you want to ban it?"

Steven Chu, U.S. Secretary of Energy,
(WSJ, January 15, 2009)



Fracture Stimulation and Gas Production Are Completely Isolated From Fresh Water

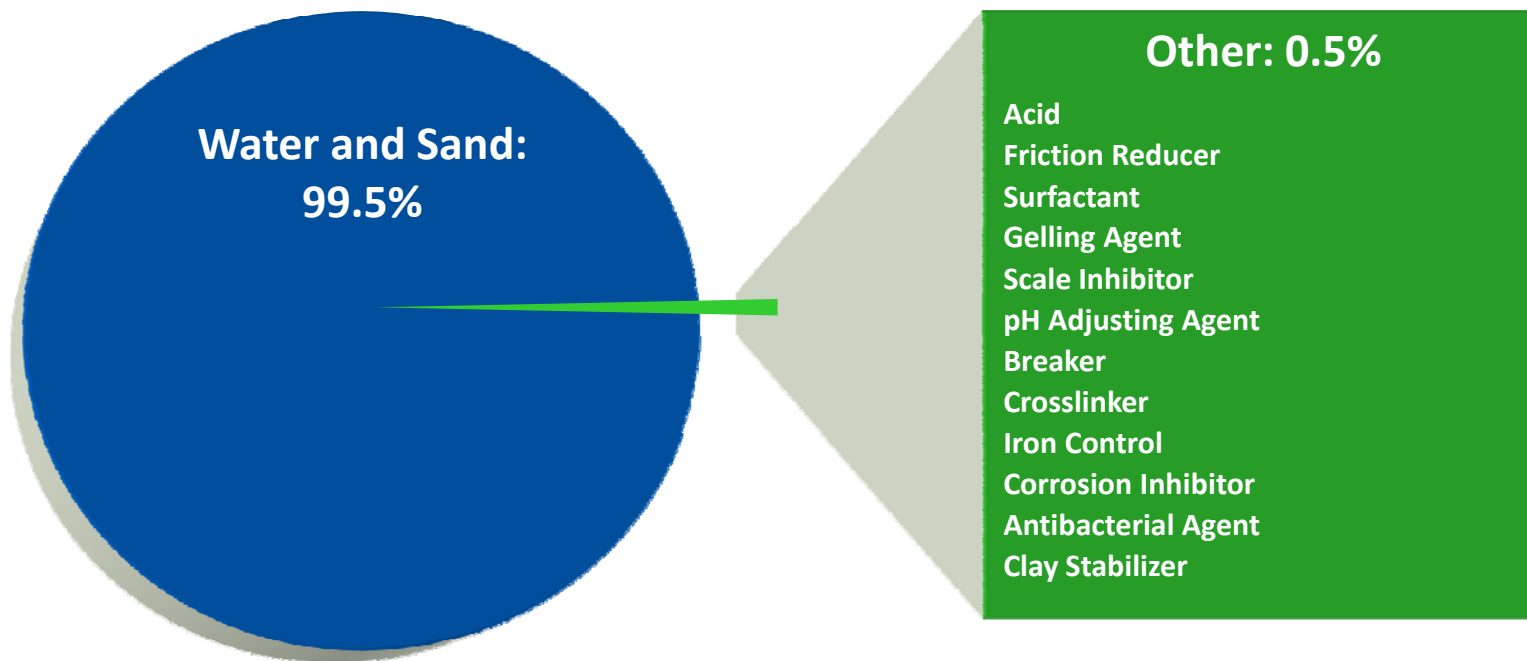
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Composition of the Fracture Stimulation Mix – Dispelling the Myths, Presenting the Facts



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For all the facts, please visit www.hydraulicfracturing.com



Components of Frac Fluid – The Facts



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Product Category	Main Ingredient	Purpose	Other Common Uses
Water	99.5% Water & Sand	Expand fracture and deliver sand	Landscaping, manufacturing
Sand (Proppant)		Allows the fractures to remain open so the gas can escape	Drinking water filtration, play sand, concrete and brick mortar
Other	~ 0.5%		
Gel	Guar gum or Hydroxyethyl cellulose	Thickens the water in order to suspend the sand	Cosmetics, baked goods, ice cream, toothpaste, sauces, and salad dressings
Friction Reducer	Petroleum distillate	“Slicks” the water to minimize friction	Used in cosmetics including hair, make-up, nail and skin products
Acid	Hydrochloric acid or muriatic acid	Helps dissolve minerals and initiate cracks in the rock	Swimming pool chemical and cleaner
Anti-Bacterial Agents	Glutaraldehyde	Eliminates bacteria in the water that produces corrosive by-products	Disinfectant; sterilizer for medical and dental equipment
Scale inhibitor	Ethylene glycol	Prevents scale deposits in the pipe	Used in household cleansers, de-icer, paints, and caulk
Breaker	Ammonium Persulfate	Allows a delayed break down the gel	Used in hair coloring, as a disinfectant, and in the manufacture of common household plastics
Corrosion inhibitor	n,n-dimethyl formamide	Prevents the corrosion of the pipe	Used in pharmaceuticals, acrylic fibers and plastics
Crosslinker	Borate Salts	Maintains fluid viscosity as temperature increases	Used in laundry detergents, hand soaps and cosmetics
Iron Control	Citric Acid	Prevents precipitation of metal oxides	Food additive; food and beverages; lemon juice ~7% citric acid
Clay Stabilizer	Potassium Chloride	Creates a brine carrier fluid	Used in low-sodium table salt substitute, medicines, and IV fluids
pH adjusting agent	Sodium or potassium carbonate	Maintains the effectiveness of other components, such as crosslinkers	Used in laundry detergents, soap, water softener and dish washer detergents
Surfactant	Isopropanol	Used to increase the viscosity of the fracture fluid	Used in glass cleaner, multi-surface cleansers, antiperspirant, deodorants and hair-color

Is the Fracture Stimulation Process Safe? Listen to the Experts...



*“The fact that there has been **no documented case of contamination from these operations, to include hydraulic fracturing**, is a testament to the proactive regulation of the industry by the Board. “*

– David E. Bolin, Deputy Director, State Oil and Gas Board of Alabama, 10/2007

*“...we have found **no example of contamination of usable water where the cause was claimed to be hydraulic fracturing**. “*

- Mark E. Fesmire, PE, Director, New Mexico Oil and Gas Conservation, 5/2009

*“.....the Ohio Department of Natural Resources....has become aware of **websites and media releases reporting** that the State of Ohio has documented **cases of ground water contamination caused by the standard industry practice of hydraulic fracturing**. **Such reports are not accurate.**”*

– Scott R. Kell, Deputy Chief, Ohio Department of Natural Resources, Division of Mineral Resources Management, 6/2009

*“Though hydraulic fracturing has been used for over 50 years in Texas, **our records do not indicate a single documented contamination case associated with hydraulic fracturing**.”*

– Victor G. Carrillo, Chairman, Railroad Commission of Texas, TIPRO 7/2009



Why the hysteria now over an industrial process found safe
over 1,000,000 times since 1949?



Natural Gas and the Environment: Air and Water Issues

Regulation of Air Emissions



- All sources of air emissions in the natural gas and oil industry are subject to the Clean Air Act (CAA). EPA or delegated states regulate emissions from:
 - Mobile engines (drilling and fracturing equipment)
 - Stationary engines (compressor engines / pump jacks)
 - Tanks (flash and working/breathing losses)
 - Dehydration
 - Flaring
 - Venting
- Often, states place additional restrictions on air emissions related to natural gas and oil production activities
- In nonattainment areas (e.g., Dallas/Fort Worth), even more stringent requirements are implemented to help improve the region's ambient air quality



Air Emissions Misconceptions

- The deep shale gas industry is primarily responsible for:
 - **Misconception #1: Elevated ground-level ozone concentrations in urban areas**
 - Actually, emissions from cars / trucks, like in most parts of the country, are the primary source of ozone forming pollutants. Moving toward natural gas as a transportation fuel would decrease ozone precursor emissions from these sources.

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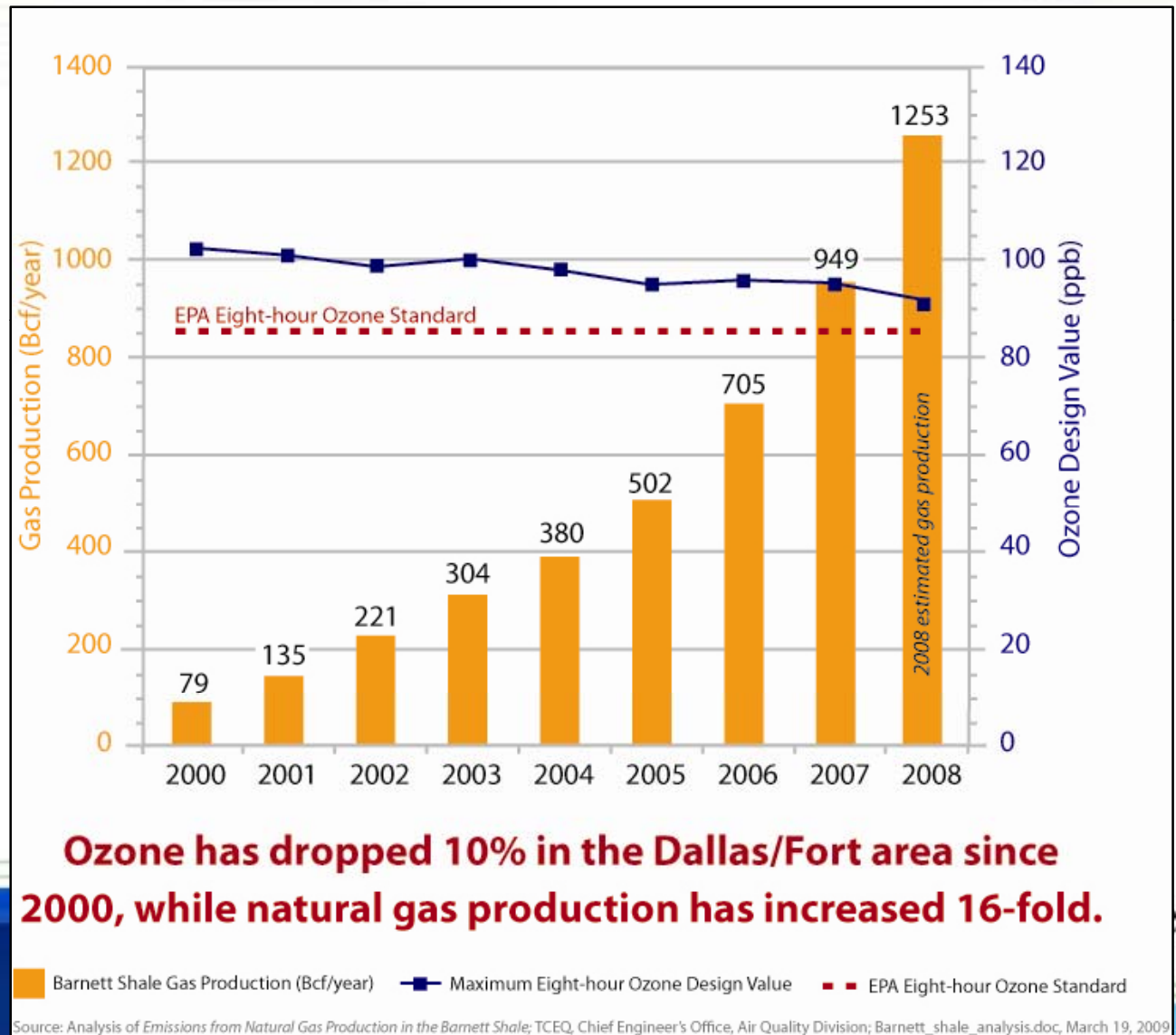


Ozone Decreased as Drilling Increased



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Contrasting relationship between increased drilling activity and reduction of ozone emissions in the D/FW Metroplex



Air Emissions Misconceptions

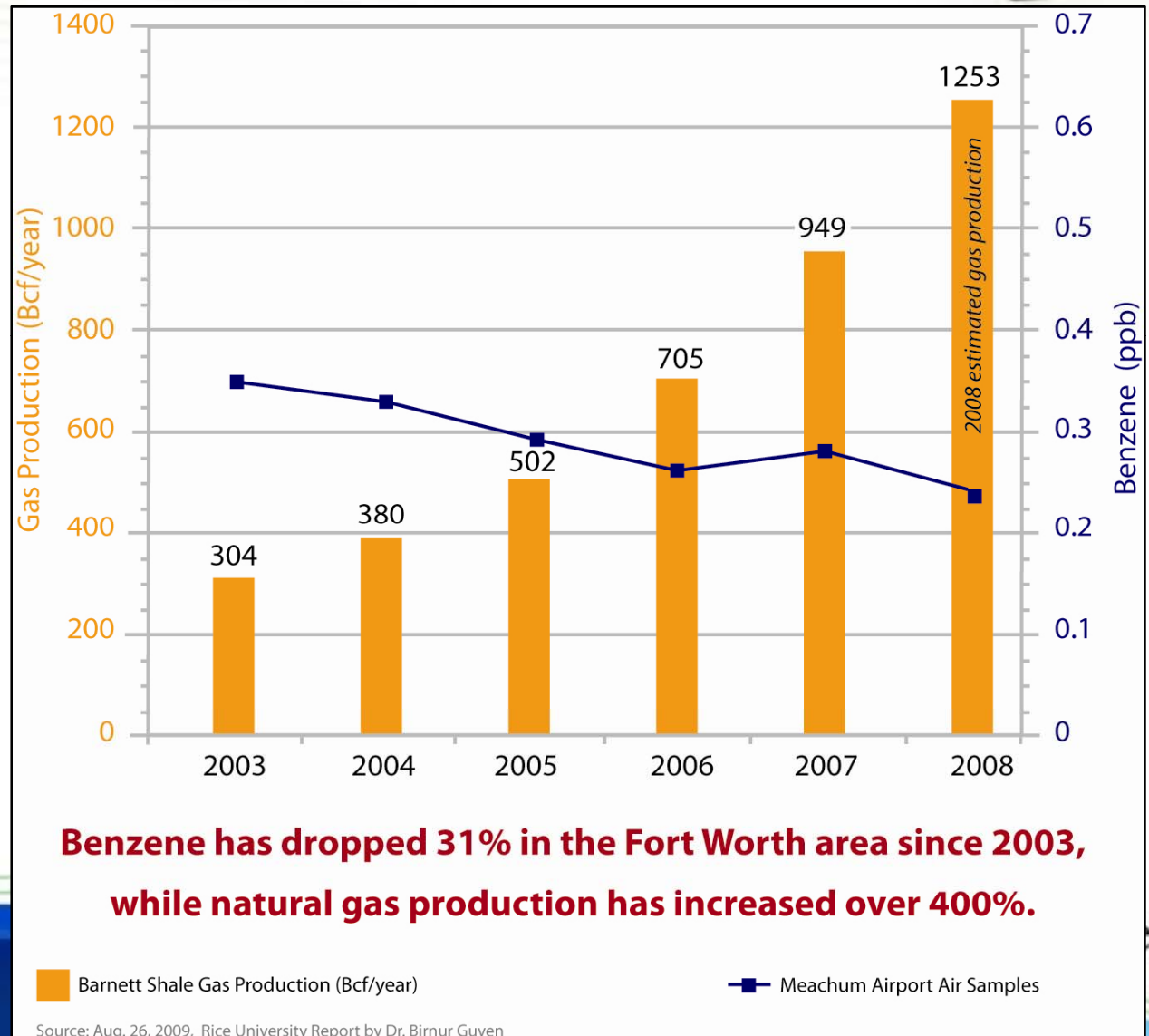


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 - Actually, emissions from cars / trucks, like in most parts of the country, are the primary source of ozone forming pollutants. Moving towards natural gas as a transportation fuel would decrease ozone precursor emissions from these sources.
 - **Misconception #2: Widespread VOC and benzene emissions in Fort Worth**
 - VOC are associated with wet/rich gas and condensate production. Most of the deep shale gas in the Greater Fort Worth area is dry. Regardless of VOC content, proactive monitoring and maintenance ensures compliance with air regulations. As above, gasoline is the primary source of benzene in urban areas. Moving to natural gas as the primary fuel source would virtually eliminate benzene emissions from these sources.

Benzene Decreased as Natural Gas Production Increased



Contrasting relationship between increased production volume and reduction of benzene emissions in the D/FW Metroplex



Air Emissions Misconceptions



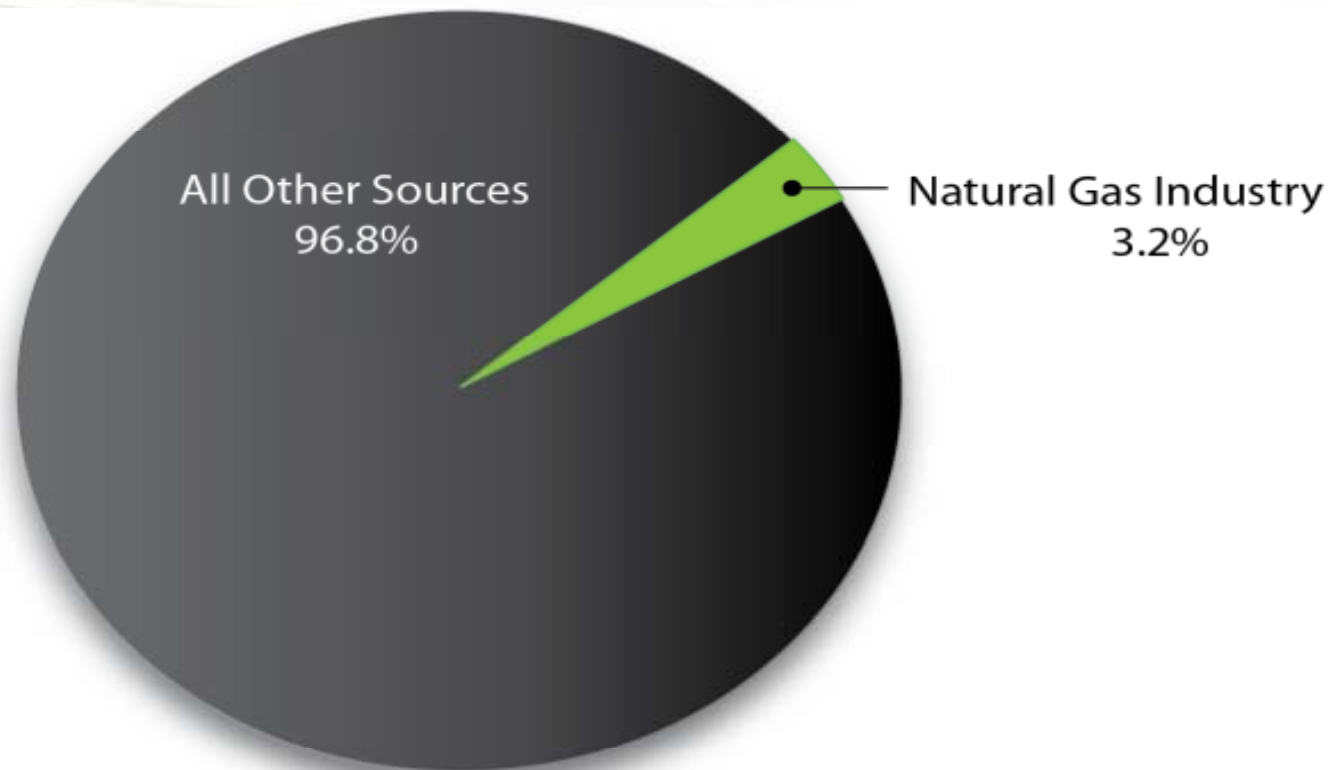
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 - **Misconception #3: Massive contributions to greenhouse gas (GHG) emissions**
 - Actually, the natural gas industry is a minor contributor to GHG emissions. In fact, as equipment and operations improve, the fugitive emissions relative to our operations will continue to decrease – a dual function of good business practices (more product to sell) and environmental stewardship (less emissions).



Total U.S. Manmade Greenhouse Gas Emissions



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Source: Coverage of Natural Gas Emissions and Flows under a Greenhouse Gas Cap-and-Trade Program; ICF International, for the Pew Center on Global Climate Change



Regulation & Protection of Water Resources



- All freshwater aquifers are protected by state water management oil and gas agencies. Protection of drinking water and surface water quality are undertaken by the EPA through regulations derived from the Safe Drinking Water Act (SDWA) and the Clean Water Act (CWA)
 - Use of water, protection of water resources, disposal of produced water, use of Underground Injection Control (UIC) wells
- Like air issues, states are often delegated authority to implement EPA's programs and, in many cases, place additional restrictions on natural gas production activities.
- Three issues have traditionally been delegated to the states
 - Protection of groundwater aquifers
 - Protection of surface water
 - Allocation of water

Water Resources Misconceptions

The deep shale gas industry is primarily responsible for:

- **Misconception #1: Groundwater aquifers are not protected**
 - Surface casing is required and the depth the casing extends is mandated by each state's regulatory agency. Surface casing is set well below the base of the freshwater aquifer.

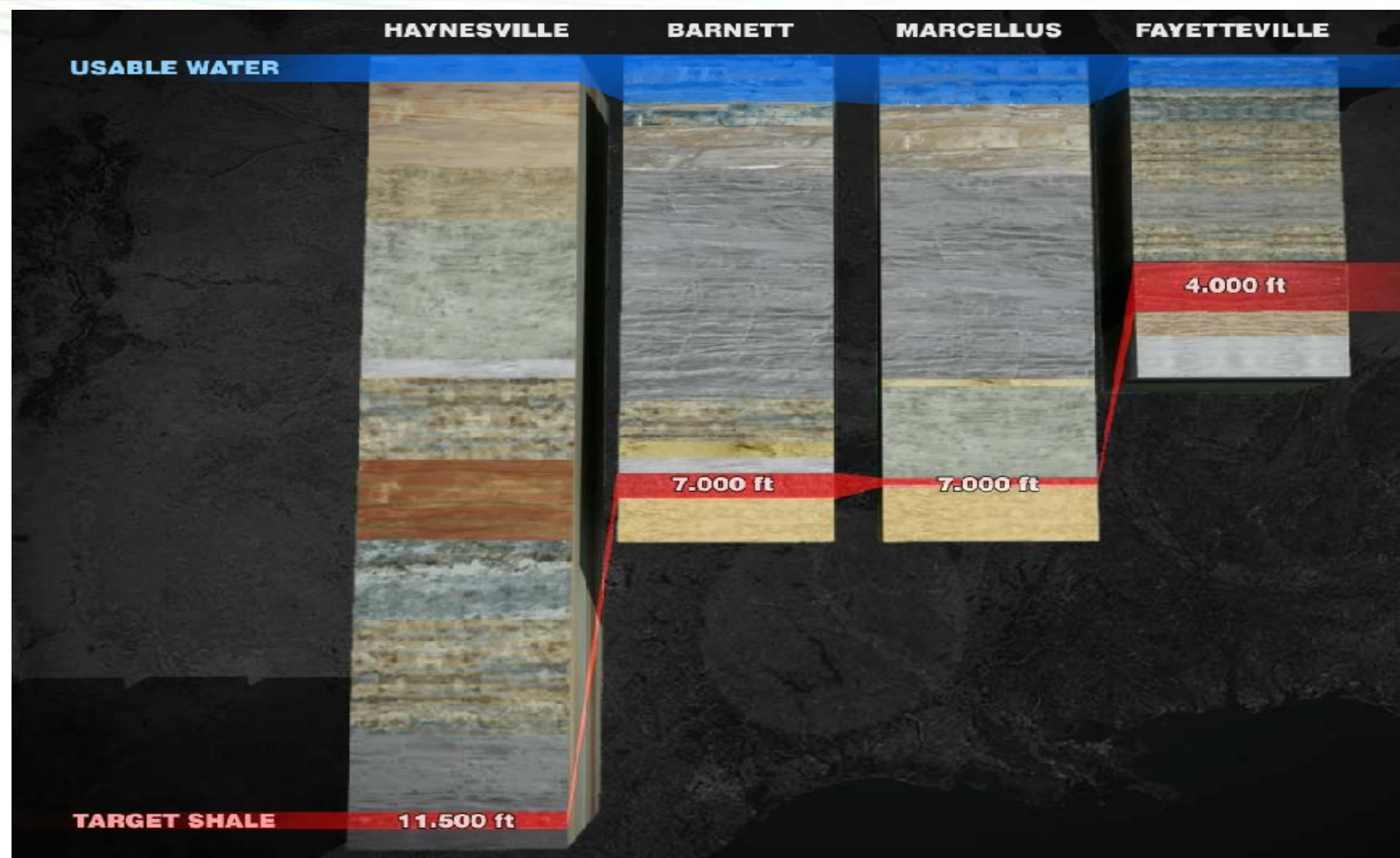
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The “Big 4” Shale Plays: Usable Water vs. Target Depth



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State water agencies determine the usable water levels that drives the surface casing programs.



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
 2. Conductor casing is cemented in place
 3. Surface casing is run inside the cemented conductor casing below the deepest aquifer
 4. Surface casing is cemented back to surface
 5. Production casing is run inside surface casing to deep shale formation
 6. Production casing sealed with combination of cement, bentonite clay and drilling fluid back to the surface
 7. Steel production tubing, where the gas and liquids flow to surface, is run inside production casing



*Marcellus / Barnett



Water Resource Misconceptions



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- **Misconception #2: Chemicals are not managed at the surface**
 - Chemicals are managed in several ways: sites are constructed to minimize storm water run-off, DOT approved chemical containers are maintained inside lined secondary containment areas, secondary containment and diversion systems are used at hose and pipe connections.

Surface Protection & 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



Water Resource Misconceptions



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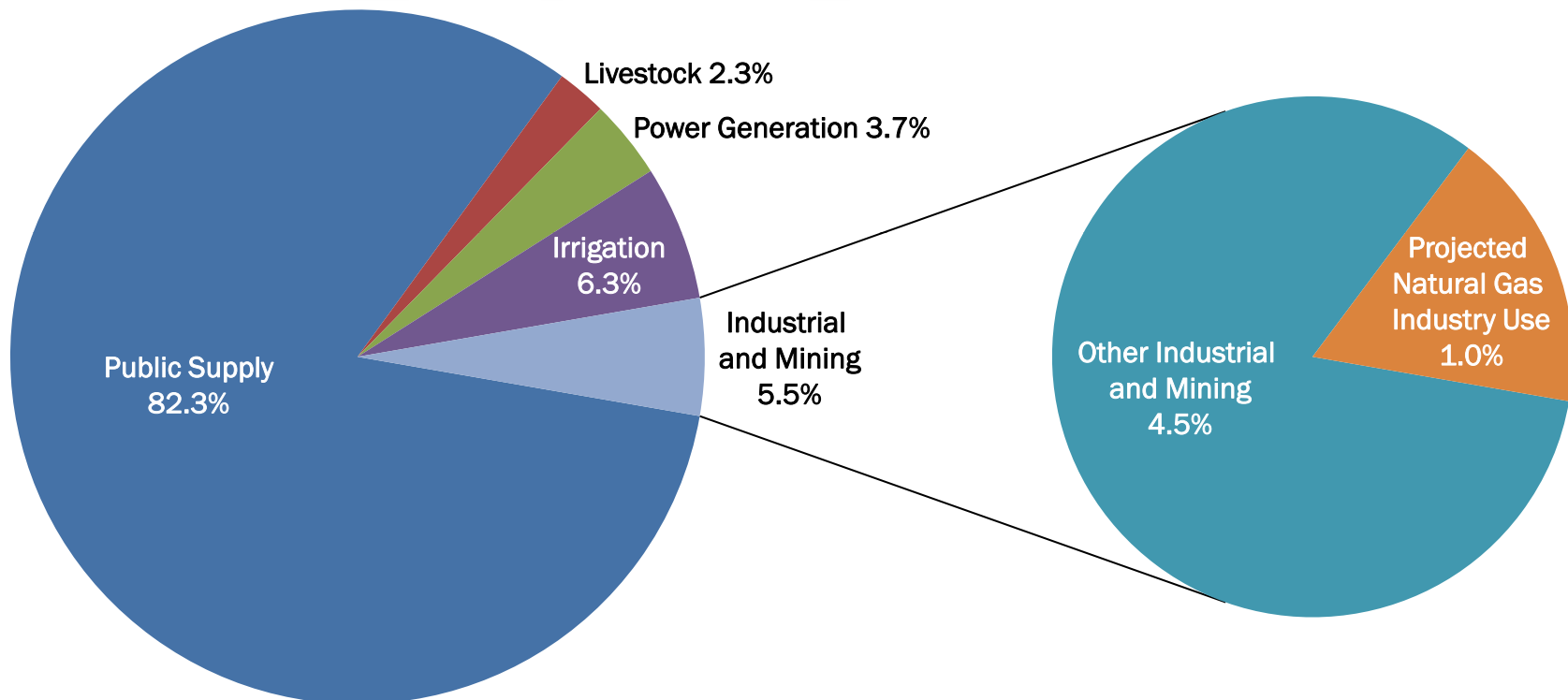
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- **Misconception #3: Unsustainable and irresponsible use of water**
 - Deep shale natural gas is one of the most water efficient, easily and quickly scalable energy sources available today.



Water Use in Barnett Shale Area



Total water use (surface water and groundwater)
in North Central Texas (20-county area) by sector



Total water use in Barnett area:
470 billion gallons per year

Source: Galusky, 2007

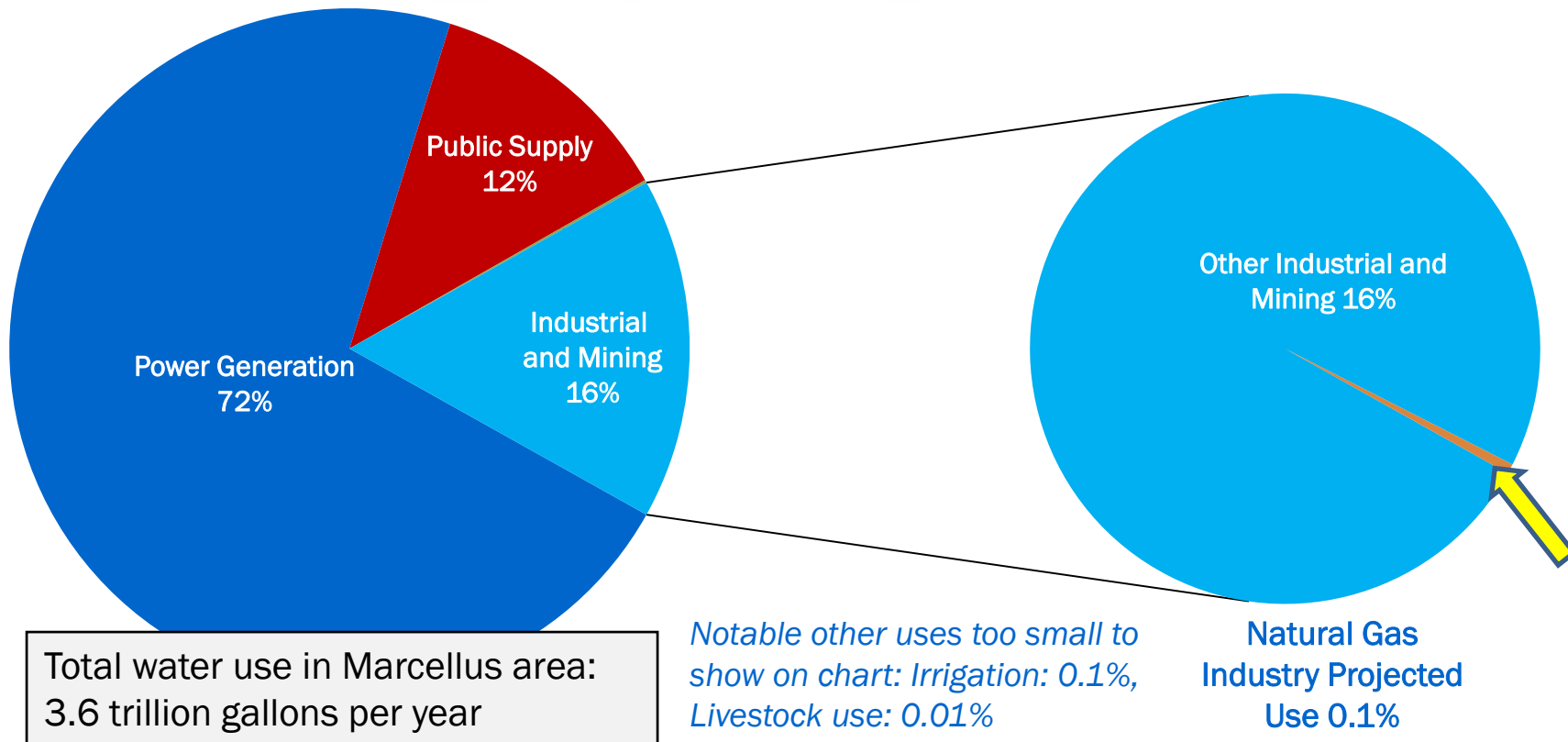


State, regional and/or local agencies allocate water resources.

Water Use in Marcellus Shale Area



Marcellus Shale water usage pales in comparison to other industries



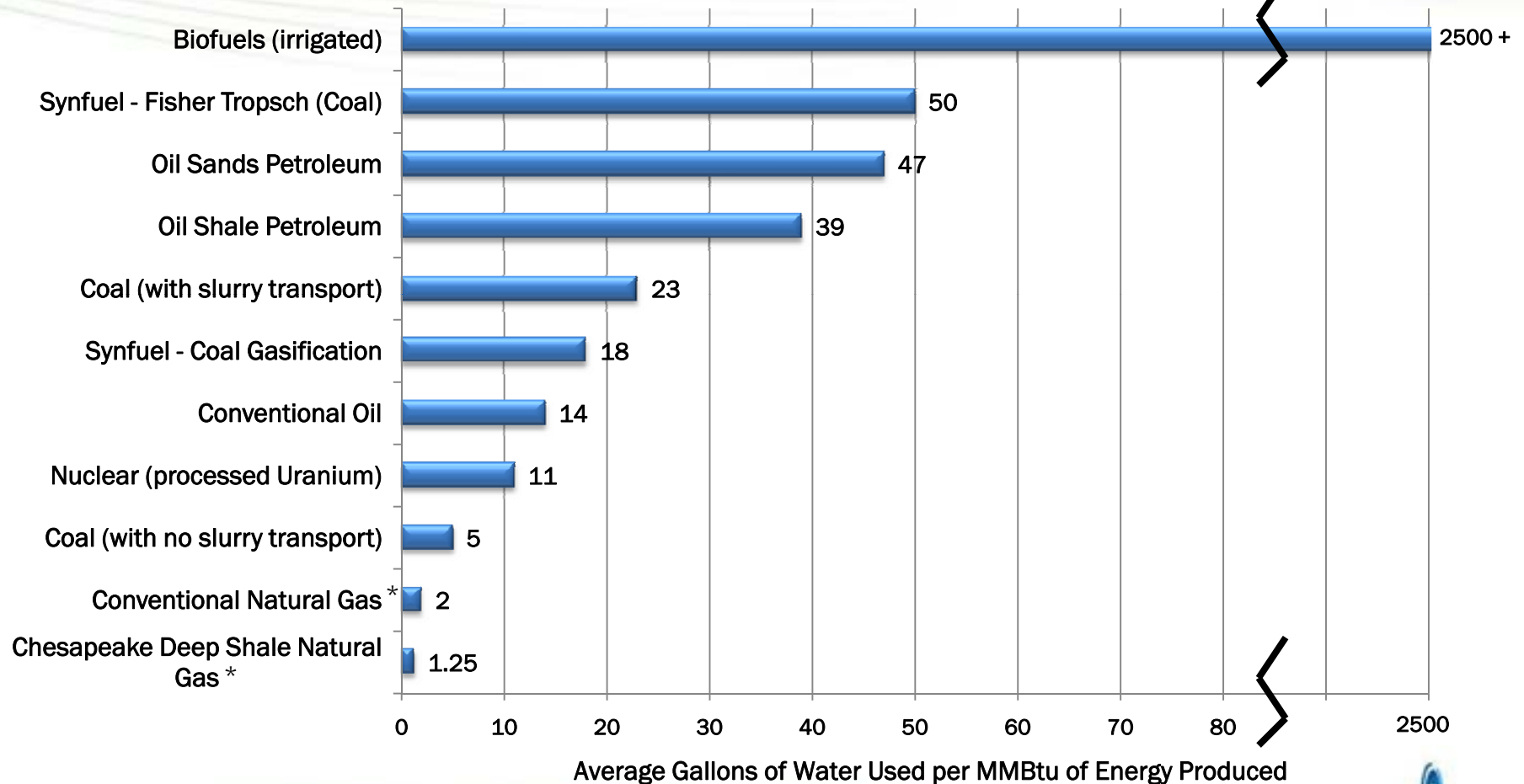
Source: USGS Estimated Use of Water in US, County Level Data for 2000

Total water use (surface water and groundwater) 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

Water Used to Produce Energy



Empowering Energy



Source: USDOE 2006 (other than CHK data)

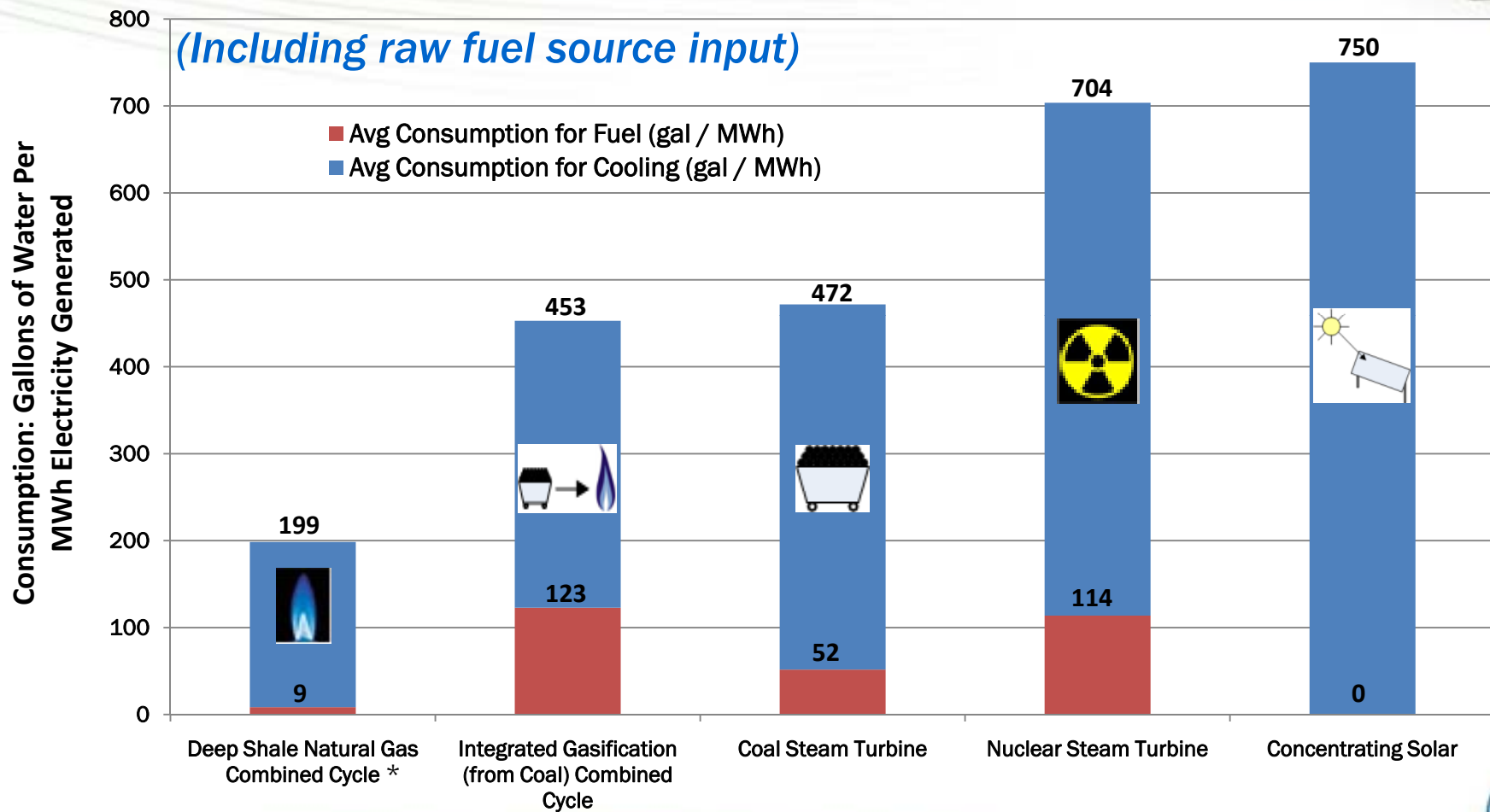
*Does not include processing which can add from 0 - 2 gallons per MMBtu

Solar and wind not included in table (require virtually no water for processing)

Values in table are location independent (domestically produced fuels are more water efficient than imported fuels)



Power Generation Water Use Efficiency



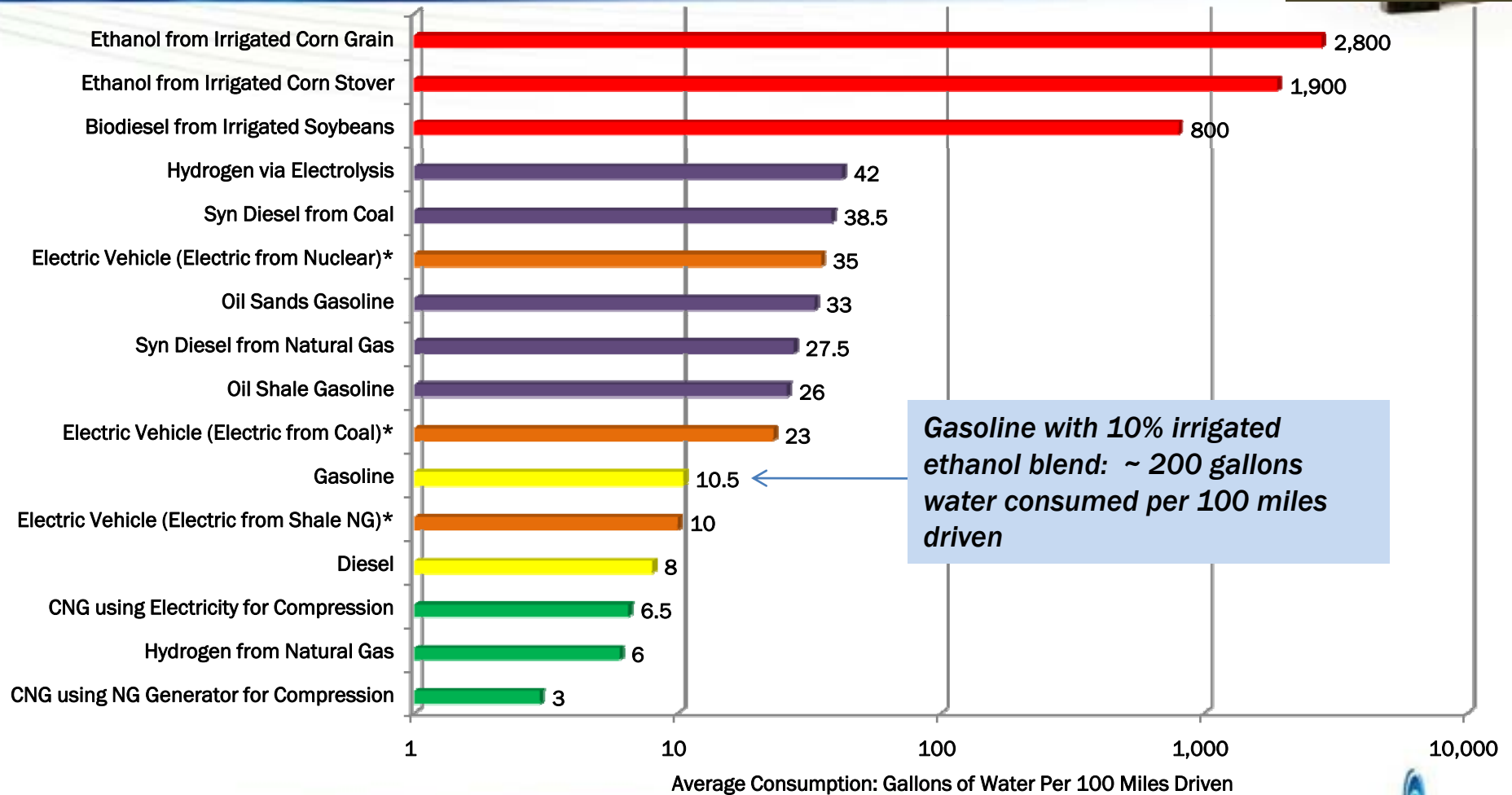
Source: USDOE 2006 (other than CHK data)
*Average consumption for fuels; Chesapeake data
MWh = megawatt-hour



Water Used for Transportation Fuels



Empowering Energy



Compressed Natural Gas (CNG)

Source: Adapted from King and Webber 2008a;

*Adapted from King and Webber 2008b, combined with data from USDOE 2006



Water Conservation & Protection



Water Conservation

- Divert water to storage impoundments during high flow periods and limit water diversions during periods of high demand and drought
- Water reuse / recycling
- Pursue advances in engineering and technology to reduce the amount of water needed in core processes

Groundwater Protection

- Where appropriate, exceed protection standards for residential groundwater wells by running deeper conductor and surface casing
- Adhere to strict quality control on well materials including cement installation and testing
- Follow strict surface BMPs for surface containment of chemicals and fluids
- Continue to pursue use of more environmentally benign additives in operations



Natural Gas Production: Temporary Operations and Minimal Footprint



Empowering Energy



Utilizing modern technology, natural gas production requires an intensive 30-50 days of operations to drill 1-2 miles below the earth's surface under millions of tons of rock



The remaining footprint and environmental impact is small, providing clean natural gas to our country for decades



Coal Production: Dangerous Long-Term Effects

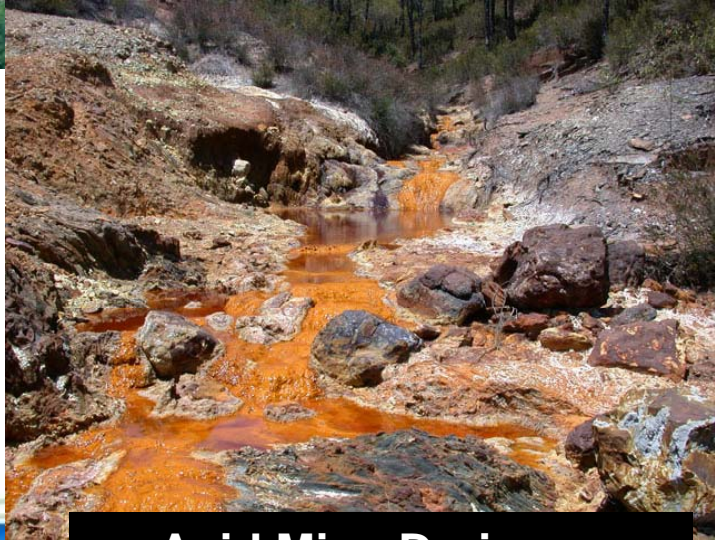


Empowering Energy

Mountaintop Removal



Fly Ash Pit Break



Acid Mine Drainage

Where is the outrage over these extremely harmful coal industry practices ?



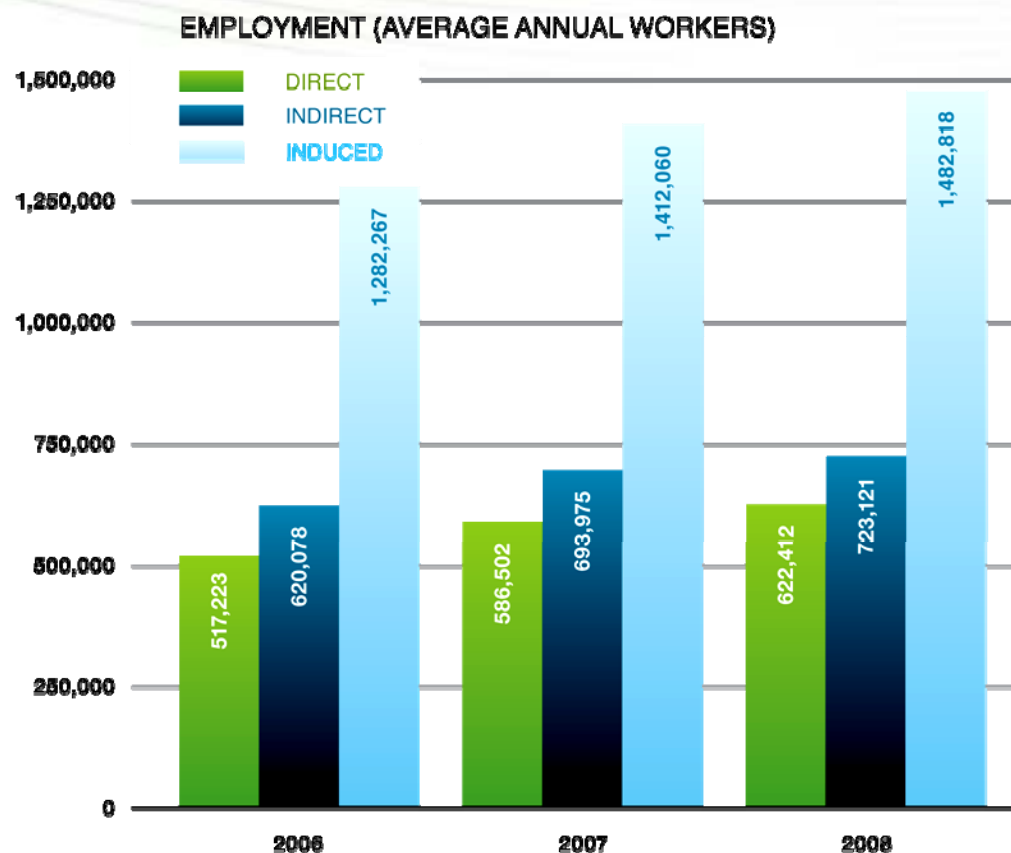


The Economic Case for Natural Gas

Natural Gas Strengthens the U.S. Economy



Empowering Energy



2.8 MILLION
2008 TOTAL
EMPLOYMENT

2.6 MILLION
2007 TOTAL
EMPLOYMENT

2.4 MILLION
2006 TOTAL
EMPLOYMENT

The natural gas industry provides far more green jobs than wind and solar could ever hope to provide



The NGV Opportunity



- The transportation sector accounts for 30% of U.S. CO₂ emissions
- Converting one heavy-duty truck from diesel to natural gas is the pollution-reduction equivalent of removing 325 cars from the road.
- There are more than 10 million NGVs worldwide, with only about 120,000 in the U.S. – ranking the U.S. 12th in the world



If you think this recession was bad, wait until you see the one caused by \$150 - \$200 oil in the years ahead



Natural Gas Vehicles Are a Clean Transportation Solution and the Most Efficiently Scalable Answer



- Natural gas vehicles, combined with Plug-In Hybrid Electric (PHEV) sedans, will support America's economy, environment, and energy security
 - Natural gas is an ideal replacement for high-fuel consumers and polluting vehicles such as:
 - Transit buses
 - Refuse trucks
 - Commercial fleets
 - Semi-trucks
 - School buses
 - Delivery vans
- PHEVS are only clean if powered by clean electricity – what's the point of replacing imported gasoline with electricity from dirty coal



All Current Natural Gas Vehicles

Using NGVs in the Heavy Duty Class Will Enable Stable Supply and Demand Growth While Reducing Emissions and Keeping Billions Of Dollars in the US



Conclusions

Imagine If...



Empowering Energy

We replace the eight coal-fired power plants located near the Dallas-Fort Worth Metroplex with natural gas powered plants...

	Coal Fired Emission (tons per year)	Natural Gas Fired Emissions (tons per year)	Percentage Change with Natural Gas
Nitrogen Oxide	72,000	4,000	↓95%
Sulfur Dioxide	293,000	3,000	↓99%
Particulate Matter	12,000	2,400	↓80%
Carbon Dioxide	120,000,000	39,000,000	↓70%
Mercury	11,000*	0	↓100%

Source: Model Used



All measurements in tons per year unless otherwise noted

* Pounds per year

Imagine If...



We converted our cars, trucks, buses, vans, and SUVs from gasoline and diesel to compressed natural gas, known as CNG.

We could reduce vehicle:

- Nitrogen oxide emissions by at least 25%***
- Benzene emissions by 99%***
- Carbon dioxide emissions by 25%***
- Imported oil by 3 million bbls per day***



Source: Model Used



Let's change "Imagine If" to "Imagine When"!

Summary

Empowering Energy

- Recent natural gas shale discoveries have changed the energy picture in America
- Current political leaders have great incentive to support more natural gas usage as a bridge to their carbon-light energy future
- Increased market share for natural gas vs. coal for electricity consumption and vs. oil for transportation will provide the demand growth needed to absorb the new 1,100 tcf of new U.S. gas shale reserves found in past five years in the Big 4 shale plays, while reducing GHG's substantially
- Natural gas can lead an industrial renaissance in the U.S. by providing cleaner, low cost input prices for decades to come – this is result of the tremendous technological advances realized during the past decade
- Stable, more predictable demand from the transportation sector through either NGV's or PHEV's will lead to reduced price volatility
- Likewise, international natural gas discoveries can allow the committed countries to lead the world on clean air and climate change issues for decades to come – first, though, we must dispel the myth of natural gas scarcity

2010 – 2050: Let's guarantee it's the Age of Natural Gas and the Age of Fewer CO₂ Emissions



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