

**Statement of Dr. William F. Whitsitt  
Executive Vice President  
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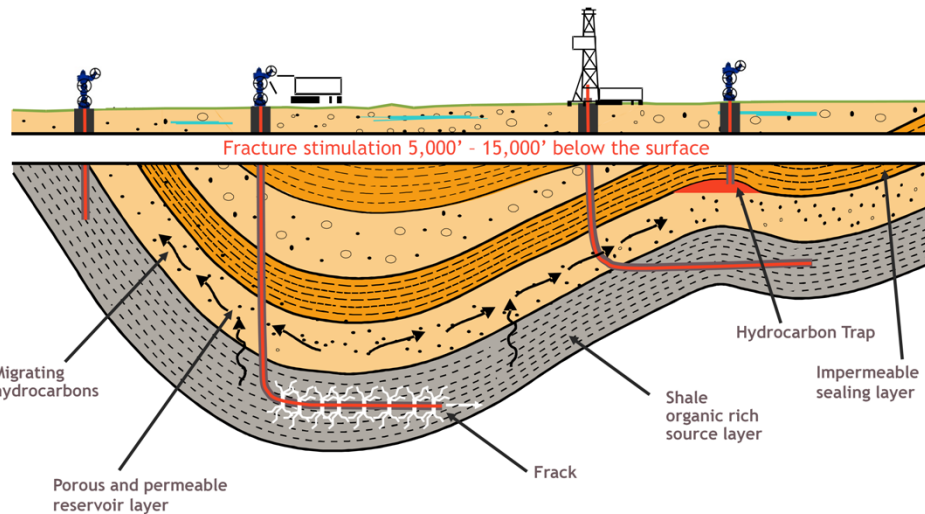
**Committee on Oversight and Government Reform  
U.S. House of Representatives**

**Bakersfield, Calif.  
May 6, 2011**

- Good morning.
- To the members of the House Committee on Oversight and Government Reform, I want to say “thank you” on behalf of Devon Energy Corporation for the opportunity to discuss hydraulic fracturing.
- Probably everyone in this room has heard of hydraulic fracturing by now. This common practice for completing natural gas wells has been around for 60 years, but until the last few years, very few people outside our industry were familiar with it.
- Although you’ve probably heard of fracking, you may not know about the tremendous role it has played in assuring that America has a clean, abundant and domestic source of energy for at least the next 100 years.
- This morning I hope to show you how it works, and the monumental impact it has made.
- But first, a quick geology lesson.

# Technology's role in the revolution

Traps vs. shales



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- With conventional oil and natural gas plays, the gas migrates from the source rock into a reservoir rock formation. From there it flows through pores and up the angle of the reservoir rock into a trap, which is a pocket in a high point of the reservoir layer.
- Our industry has produced from these traps for decades.
- The amount of recoverable natural gas from that well is limited by the size of the trap.
- However, two technological advances have forever changed the natural gas drilling.
- The first was hydraulic fracturing, which has been conducted more than 1 million times since the late 1940s.
  - This process allows us to fracture the source rock (shale). Sand keeps the fractures open while natural gas or oil flows to the wellbore.
  - I will discuss this in more depth in a few minutes.
- The second advancement is horizontal drilling, which allows us to capture gas from a much larger area of the source rock.
  - Horizontal drilling generally results in a far more productive well than a conventional well.
- In 2002, Devon coupled these two processes in the Barnett Shale in North Texas.
- The result has been shale play exploration not only in the U.S., but around the world.
- Now I'll show you where it all started.

# Birthplace of shale natural gas

## The Barnett Shale

Largest natural gas field in the U.S.



Covers more than 20 counties

Play-wide production: > 5 BCFD

15,000 producing wells

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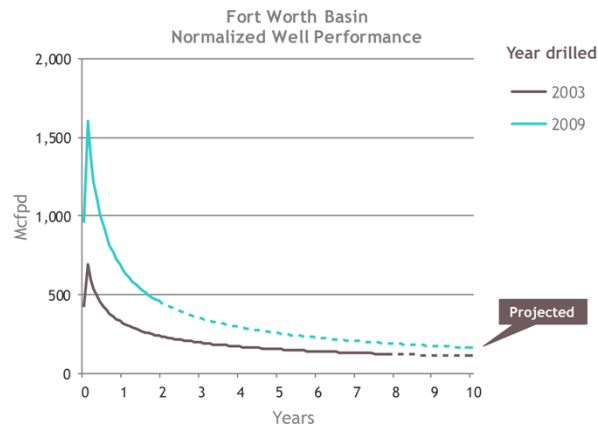


- The origin of shale gas production can be found in the Barnett Shale of North Texas.
- Devon acquired its initial position with the acquisition of Mitchell Energy Group in 2002.
- Mitchell had been using vertical wells in a relatively confined geographic area.
- Devon acquired Mitchell with the idea of using horizontal drilling to greatly expand the geographic area over which the Barnett could be developed.
- By drilling horizontally through the Barnett Shale, Devon was able to contain the fracture better, which increased access to more shale and more gas. This dramatically expanded the number of viable drilling locations within the play.
- We also learned that by drilling horizontally, we were able to create a well that was about three times more productive than a vertical well.
- Horizontal drilling combined with light sand fracking was the key to unlocking the shale gas potential.
- Other producers moved in, and now this is the largest onshore gas field in the U.S.

## Fort Worth Basin performance

### Industry well performance over time

- 2003-88% of wells drilled in Barnett Play were vertical
- 2009-91% of wells drilled in Barnett Play were horizontal



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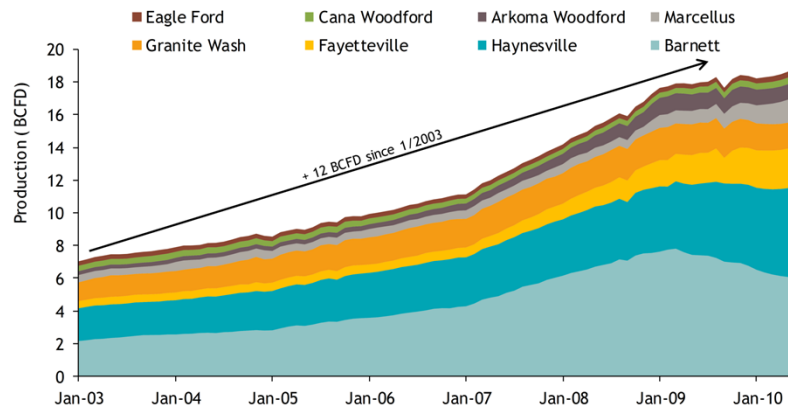
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- How dramatic is this development?
- Consider that just eight years ago, virtually every well drilled in the Barnett was a vertical well.
- Today, virtually every well drilled there is horizontal.
- One aspect of horizontal wells is that the initial production is dramatically higher than with vertical wells.
- And, production remains higher than with vertical wells for years thereafter.
- Both Devon and the industry have made technological improvements in the Barnett over the past few years.
- As a result, well performance has increased.
- Similar improvements have taken place in the other shale plays, as well.

## Industry growth - select plays

Existing plays have upside - additional plays to be developed?



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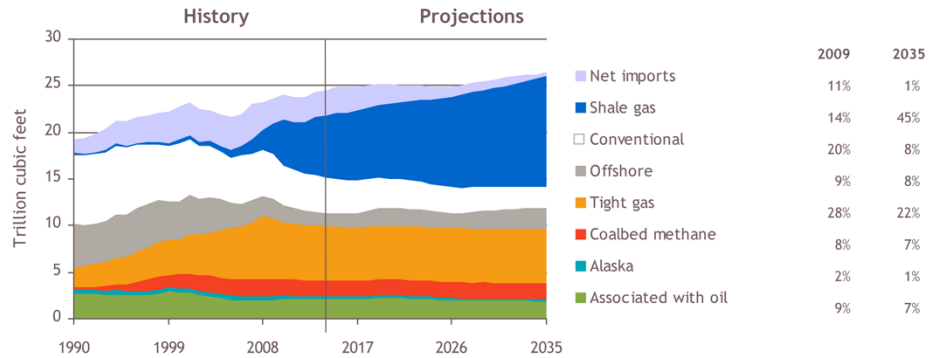


- Which explains this graphic. As you can see, since 2003 the production of shale gas has soared.
- Today, shale gas production is approaching 20 Bcf a day.
- Production from shale is starting to make up a meaningful portion of the United States' natural gas supply.
- Even during the recession of 2009, when natural gas rig counts were down dramatically, year-over-year production increased by about 17 percent.
- What I hope you sense from this slide is the optimism we feel about production continuing to increase well into the future.

## Projecting natural gas sources

### Shale to provide growing share of U.S. supply

- Shale gas offsets declines in other U.S. supplies to meet consumption growth and lower import need



Source: EIA, Annual Energy Outlook 2011

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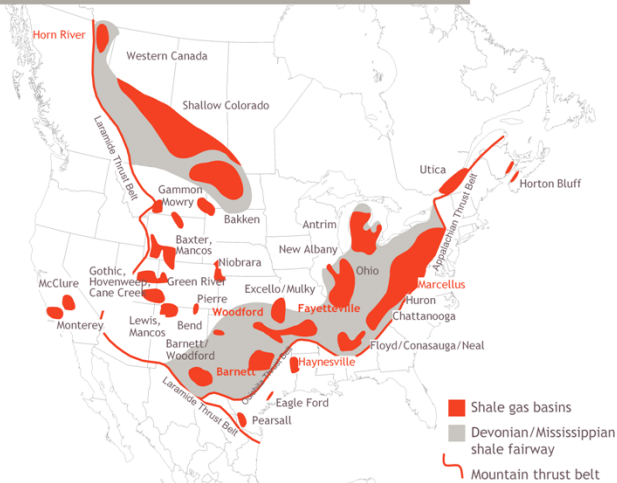
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- Here you see more evidence of that optimism.
- In 2009, shale natural gas comprised 14% of the total U.S. natural gas supply.
- The federal government projects that share will continue to grow — to an amazing 45% by 2035.
- Why is that?

## North American shale gas Basins and plays

Just since 2006, resource base rose from 1,321 to 1,898 Tcf (44% increase), and it continues to rise.



Sources: EIA, Potential Gas Committee, Ziff Energy

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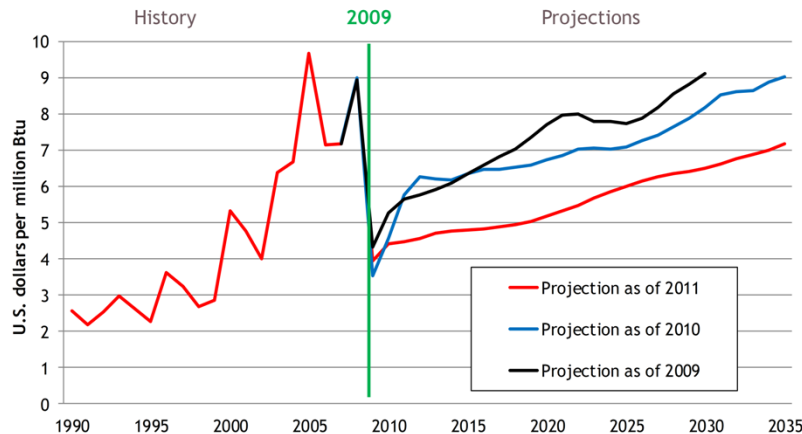


- The EIA's projection is based on this reality: Shale is abundant in North America.
- Many of these shale basins are now being tested or developed for natural gas production.
- You've probably heard of some of the shale plays found within these basins:
  - The Marcellus, which covers parts of Ohio, New York and Pennsylvania;
  - The Haynesville in east Texas and west Louisiana;
  - We even have a couple in Devon's home state of Oklahoma: the Arkoma-Woodford and the Cana-Woodford.
  - In the Cana-Woodford alone, Devon has determined an estimated resource of 11 Tcf, which equates to a nearly 2 billion barrel oilfield. That figure includes only Devon's position in that shale play.

## EIA projections for natural gas

### Newfound abundance leads to lower prices

Natural gas price projections are significantly lower than past years due to an expanded shale gas resource base



Source: EIA, Annual Energy Outlook 2011

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- Shale gas is beginning to have a meaningful impact on natural gas supplies.
- That newfound supply is reflected in the commodity prices we have seen since the end of 2008.
- Natural gas prices generally have remained between \$4 and \$6 per Btu since the beginning of 2009.
- Not only that, the EIA's price projections for the next 25 years are considerably lower than they were just two years ago.
- The black line illustrates the EIA's future projections as of 2009.
- The blue line shows price projections the EIA made last year.
- The red line shows what the EIA now thinks prices will look like through 2035.
- In its latest report, the agency credited the abundance of shale gas for its new projections.



## America's "new" natural gas: Choice, reliability, competition, price stability

- 100+ years of natural gas supply - and growing with technology
- New shale gas resources:
  - Near-term supply impact
    - Short well drilling times
    - Very high initial production rates
  - Long-term supply stability
    - Wells produce for 40-50 years or more
- New resources onshore are easier and less expensive to develop and less affected by weather
- More pipeline miles - gas where it's needed
- Additional LNG and storage capacity available if needed

**Bottom line:**  
Greater energy and economic security; more stable, predictable prices

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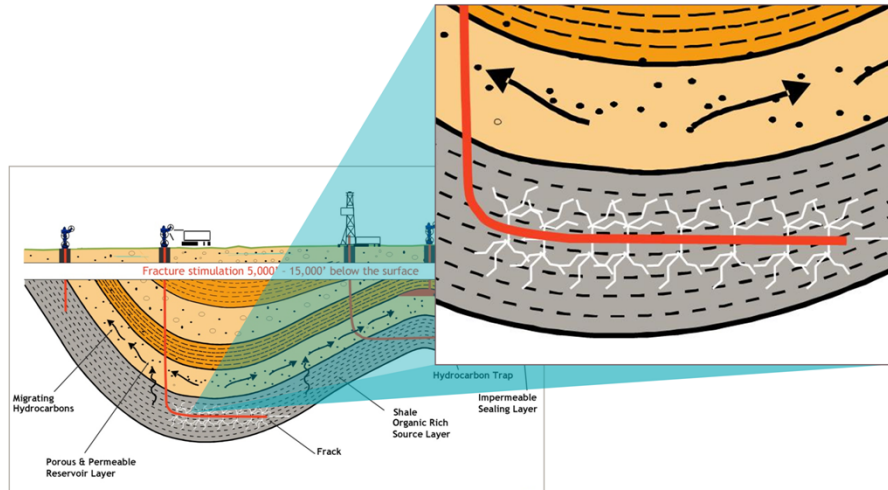
- Natural gas now provides near-term and long-term supply stability.
- The development of shale natural gas prompted the Potential Gas Committee to report just last week that the U.S. now has more than a 100-year supply of natural gas.
- It is cheaper to produce and less susceptible to weather issues.
- And finally, recent pipeline upgrades means gas flows quickly to where it is needed.
  - Consider this: In the last two years, more than 8,000 miles of pipeline has been added in the U.S., primarily to take gas from shale plays to major markets.
- Now I'd like to tell you more about drilling shale gas wells, and specifically the 60-year-old process we use called hydraulic fracturing.

# Hydraulic Fracturing

## An Overview



# Hydraulic fracturing



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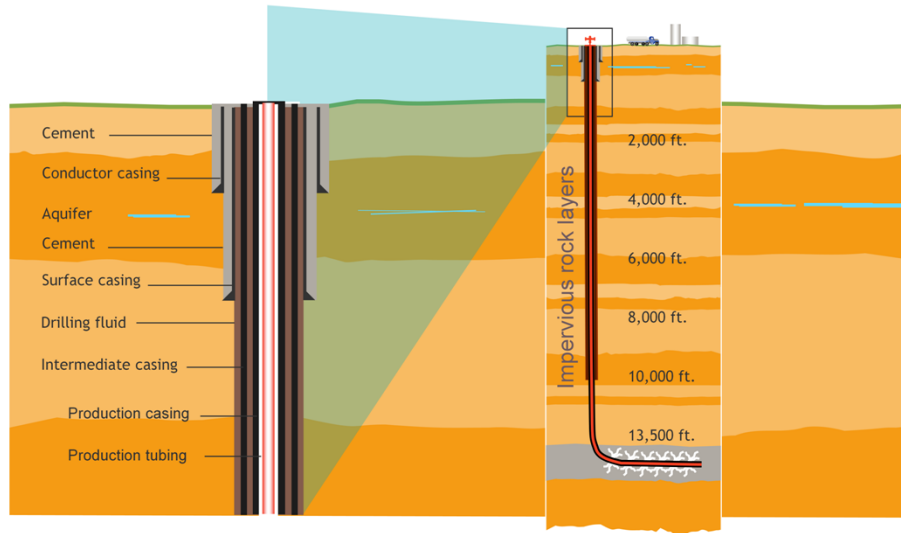


- As we saw earlier, the purpose of hydraulic fracturing is to capture natural gas directly from the source rock.
- Hydraulic fracturing is done in multiple stages, typically one to two miles below the earth's surface.
- The process allows for a greater amount of natural gas to flow into the wellbore.
- The process is rigorously regulated by state regulators.



- This cut-away demonstrates how horizontal drilling and hydraulic fracturing works.
- First the drill goes down vertically, and then it is taken horizontally through the source rock (shale).
- Once drilling is completed to the desired depth and the desired length of the well, the drilling rig is removed and replaced on site by frack job trucks.
- A perforation gun is inserted to the end of the well to make perforations in the shale.
- At that point, the frack fluid is pushed down the well at extremely high pressure to create fractures within the shale.
- It is important to note that these fractures extend no more than 200 feet from the wellbore.
- The fluid is extracted, and a plug is put into place.
- If further fracking stages are necessary, the same process is conducted, with a plug put in place after each stage.
- When we are ready to capture the gas, the plugs are removed.

# Well construction



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- Fracking generally takes place several thousand feet deep.
- Often it is conducted as deep as 15,000 feet.
- Aquifers, on the other hand, typically are a few hundred feet deep.
- Between the aquifer and the source rock are layer after layer of impenetrable rock.
- Well construction is a key to the success of hydraulic fracturing.
- As you can see, the wellbore is surrounded by surface casing and then a layer of cement, then by conductor casing and another layer of cement.
- These sealing layers and steel casing are a primary reason that in the 60 years that hydraulic fracturing has been conducted, regulators have not found a single instance of groundwater contamination caused by fracking.

## Hydraulic fracturing

### 3-7 day process

- Each horizontal well is initially fractured in 6-8 stages
- Represents 90% of total water requirement for a Barnett Shale well
- Approximately 4 million gallons of fresh water are required per well, which equals the amount used:
  - By a golf course every two weeks
  - By New York City every six minutes
  - Through irrigation to produce 5,100 gallons of ethanol



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- In the Barnett Shale, each well requires about 4 million gallons of water for hydraulic fracturing.
- That's roughly the same as the amount required every two weeks to water a Texas golf course, based on annual water use totals.
- It's also the same amount needed to fill six Olympic-size swimming pools.
- New York City uses roughly the same amount every six minutes.
- And finally, according to the USDA, it takes about the same amount of irrigated water to produce 5,100 gallons of ethanol as it takes to complete a natural gas well capable of producing 3 billion cubic feet or more of natural gas.

## Frack fluid components

### And their purposes

Ingredient	Percentage	Purpose
Water	95%	Creates necessary force to create tiny fractures within the formation
Sand	4.5%	Keeps fractures open, allowing natural gas to be collected in the well
Additives	0.5%	Gelling agents carry the sand through water. Others break down gel when natural gas is ready to be collected. Proppants keep fractures open so gas can flow to the wellbore. Ingredient lists for specific wells available at <a href="http://www.fracfocus.com">www.fracfocus.com</a> .

Source: EIA, Annual Energy Outlook 2011

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- News accounts typically state that hydraulic fracturing is conducted using water, sand and additives.
- What often is omitted from those stories is that water and sand make up 99.5 percent of the mixture.
- The remainder consists of additives needed for specific purposes depending on each individual well.
- There has been some mystery regarding the hydraulic fracturing mixture.
- That mystery has led to public concerns and a desire for more information.
- Devon shares the desire for more transparency, and that is why we have worked with two groups of regulators to provide an internet database where the public can see what additives are used in each well – and in what quantities.

## Fracfocus.org

### Hydraulic fracturing fluid composition

Trade Name	Supplier	Purpose	Ingredients	Chemical Abstract Service Number (CAS #)	Maximum Ingredient Concentration in Additive (% by mass)**	Maximum Ingredient Concentration in HF Fluid (% by mass)**
Water	Operator	Carrier	Water	7732-18-5	100.00%	94.46100%
Frac Sand (All Meshes) [CWT]	BHI	Proppant	Crystalline Silica (Quartz)	14808-60-7	100.00%	5.11899%
Hydrochloric Acid, 10.1-15%	BHI	Acidizing	Hydrochloric Acid	7647-01-0	15.00%	0.05582%
			Water	7732-18-5	85.00%	0.31633%
FRW-15A	BHI	Friction Reducer	Copolymer of Acrylamide and Sodium Acrylate	25987-30-8	40.00%	0.01879%
			Hydrotreated Light Distillate	64742-47-8	30.00%	0.01409%
			Nonyl Phenol Ethoxylate	127087-87-0	5.00%	0.00235%
			Sorbitan Monooleate	1338-43-8	5.00%	0.00235%
Ferrotrol 300L	BHI	Iron Control	Citric Acid	77-92-9	70.00%	0.00283%
NE-940	BHI	Non-emulsifier	Methanol	67-56-1	60.00%	0.00017%
			Isopropanol	67-63-0	10.00%	0.00003%
			2-Ethyl Hexanol	104-76-7	10.00%	0.00003%
			Polyoxyethylene Glycols	25322-68-3	5.00%	0.00001%
			Solvent naphtha (Petroleum)* Heavy Arom.	64742-94-5	5.00%	0.00001%
			Ethoxylated Alcohol* Branched	78330-19-5	5.00%	0.00001%
			Ethoxylated Alcohol* Branched	78330-20-8	5.00%	0.00001%
			Naphthalene	91-20-3	1.00%	0.00000%
			1*2*4-Trimethyl Benzene	95-63-6	1.00%	0.00000%

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- This is snapshot of one such well that you can see at that website, [www.fracfocus.org](http://www.fracfocus.org).
- The website was developed by the Ground Water Protection Council – which is composed of state environmental and oil and gas regulators – and the Interstate Oil and Gas Compact Commission.
- This example is a Devon well in Denton County, Texas, which was fracked on March 22, 2011, at a depth of about 8,200 feet.
- Water and sand make up a little more than 99.5 percent of the total volume.
- This database went live about a month ago.
- To date, about 450 wells are available for the public to inspect.
- That number will continue to expand.
- This database should remove any mystery about these additives and their purpose in the hydraulic fracturing process.



## Hydraulic fracturing

### Key to the revolution

- Excellent environmental record over decades
- Regulated by states
- Fracfocus.com offers public database
- Continually improving well construction
- Steel and cement protection of aquifers
- Incident control, containment and clean-up plans

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- Hydraulic fracturing has been conducted safely and without a singled documented case of water contamination since the late 1940s.
- The states are rigorous in their regulatory duties regarding the process.
- Internet database of individual frack fluid compositions now available to the public.
- Well construction is continuously improving.
- Aquifers are protected not only by steel and cement casing, but also the sheer distance and the layers of impermeable rock that separate fresh water supplies and the depth where fracking occurs.
- And finally, our industry is required to have provide a detailed plan of action in the event of any incident.

Thank you

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- I realize that this has provided just a brief overview of hydraulic fracturing.
- I'll be happy to take any questions.