Range's Path to Discovery and Commercialization of the Marcellus Shale—The Largest Producing Gas Field in the United States*

Jeffrey Ventura[1]

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*Adapted from presentation of Michel T. Halbouty Lecture at AAPG Annual Convention and Exhibition, Pittsburgh, Pennsylvania, May 20, 2013

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Key Points

Role Played by Range Resources

- Pioneered and discovered the Marcellus Shale in 2004, America's largest producing gas field.
- Pioneered and played key roles in several other exciting plays across the country.

Range Resources in 2003

- Company with market capitalization of approximately $400 million
- Strategy was growth through development drilling, traditional exploration (high risk, theoretically high return) and complementary acquisitions; also not repeatable

A New Strategy

- Look for opportunities that, if successful, could become large scale and repeatable.
- Resource plays, including Marcellus shale
- Challenge became test of Marcellus Shale with Barnett style water frac on Renz #1.

Key Lesson #1: Creativity with Strong Scientific Basis Tops Conventional Wisdom

- Renz #1 – The Discovery Well, could we make it work horizontally?
- Decision: The target was large enough; risk was worth taking; Range moved forward, took the "unconventional path."

Key Lesson #2: Focus

- Opened a Pittsburgh office, whose sole purpose was to make the Marcellus work.

- Application of Three Point Correlation with successful completion of Range's first 8 horizontal wells; projection of Marcellus' immense potential.

Key Lesson #3: Do the Right Thing

- Exercised "best engineering practices."
- Pennsylvania has modernized regulations, some of the best in the country. The Marcellus Shale is now the largest producing gas field in the United States.

Significance of this Discovery and the Shale Revolution in General—Includes:

- U.S. gas reserves have increased dramatically; natural gas prices are competitive.
- Potential rebirth of American manufacturing and feedstock for petrochemical industry.
- U.S. is supplying about 84% of its energy needs; oil imports drops to roughly 40%
- Dramatic environmental, health, and financial benefits with use of natural gas in generation of electricity.

Looking Back

- Analogy was to the Barnett; Marcellus is now superior.
- Marcellus transforming how gas moves in the U.S., it is significant source of NGLs.
- Other potential targets are present in the play.
- As of May, 2013, market capitalization is about $12 billion. Assuming 80-acre spacing per well, only 6% of Range's Marcellus acreage has been drilled.

Range's path to discovery and commercialization of the Marcellus Shale – the largest producing gas field in the United States

May 2013

RANGE RESOURCES®

Jeffrey Ventura, Chief Executive Officer

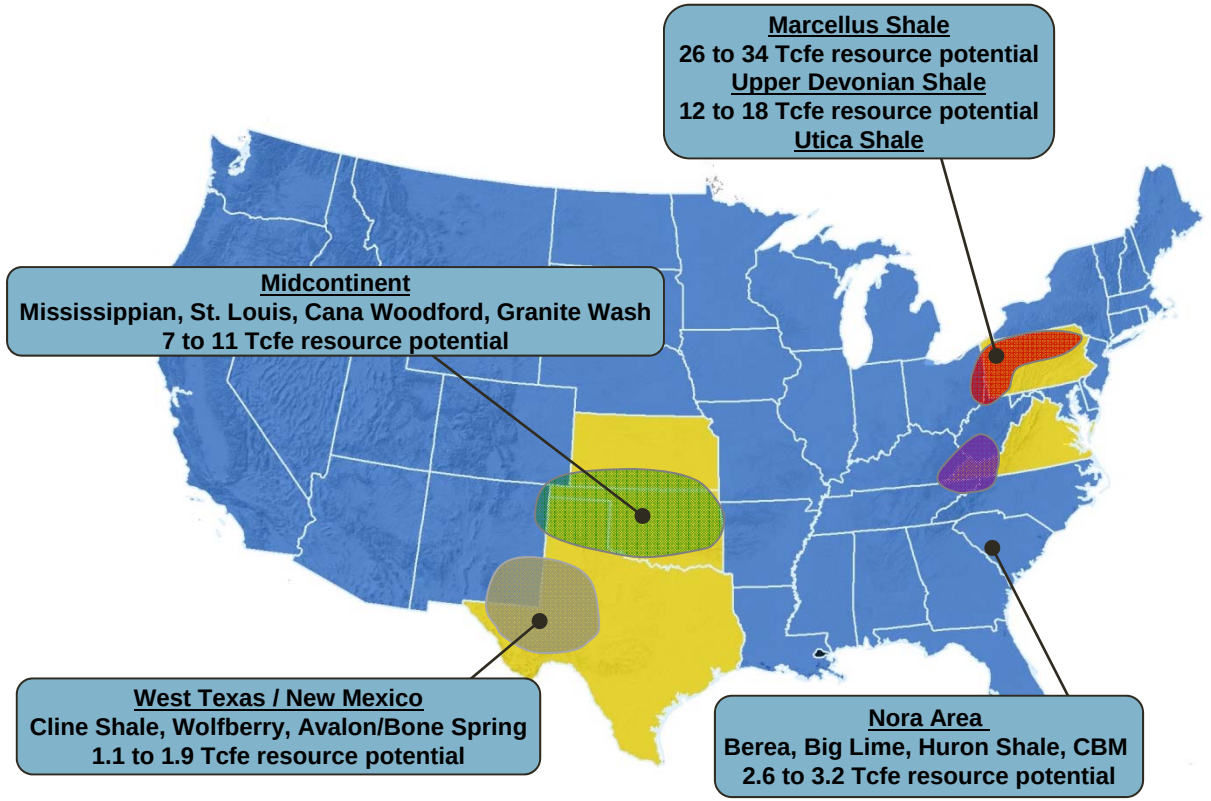
Forward Looking Statements

Statements concerning well drilling and completion costs assume a development mode of operation; additionally, estimates of future capital expenditures, production volumes, reserve volumes, reserve values, resource potential, resource potential including future ethane extraction, number of development and exploration projects, finding costs, operating costs, overhead costs, cash flow, NPV10, EUR and earnings are forward-looking statements. Our forward looking statements, including those listed in the previous sentence are based on our assumptions concerning a number of unknown future factors including commodity prices, recompletion and drilling results, lease operating expenses, administrative expenses, interest expense, financing costs, and other costs and estimates we believe are reasonable based on information currently available to us; however, our assumptions and the Company's future performance are both subject to a wide range of risks including, the volatility of oil and gas prices, the results of our hedging transactions, the costs and results of drilling and operations, the timing of production, mechanical and other inherent risks associated with oil and gas production, weather, the availability of drilling equipment, changes in interest rates, litigation, uncertainties about reserve estimates, environmental risks and regulatory changes, and there is no assurance that our projected results, goals and financial projections can or will be met. This presentation includes certain non-GAAP financial measures. Reconciliation and calculation schedules for the non-GAAP financial measures can be found on our website at www.rangeresources.com.

The SEC permits oil and gas companies, in filings made with the SEC, to disclose proved reserves, which are estimates that geological and engineering data demonstrate with reasonable certainty to be recoverable in future years from known reservoirs under existing economic and operating conditions as well as the option to disclose probable and possible reserves. Range has elected not to disclose the Company's probable and possible reserves in its filings with the SEC. Range uses certain broader terms such as "resource potential," or "unproved resource potential," "upside" and "EURs per well" or other descriptions of volumes of resources potentially recoverable through additional drilling or recovery techniques that may include probable and possible reserves as defined by the SEC's guidelines. Range has not attempted to distinguish probable and possible reserves from these broader classifications. The SEC's rules prohibit us from including in filings with the SEC these broader classifications of reserves. These estimates are by their nature more speculative than estimates of proved, probable and possible reserves and accordingly are subject to substantially greater risk of being actually realized. Unproved resource potential refers to Range's internal estimates of hydrocarbon quantities that may be potentially discovered through exploratory drilling or recovered with additional drilling or recovery techniques and have not been reviewed by independent engineers. Unproved resource potential does not constitute reserves within the meaning of the Society of Petroleum Engineer's Petroleum Resource Management System and does not include proved reserves. Area wide unproven, unrisked resource potential has not been fully risked by Range's management. "EUR," or estimated ultimate recovery, refers to our management's internal estimates of per well hydrocarbon quantities that may be potentially recovered from a hypothetical future well completed as a producer in the area. These quantities do not necessarily constitute or represent reserves within the meaning of the Society of Petroleum Engineer's Petroleum Resource Management System or the SEC's oil and natural gas disclosure rules. Our management estimated these EURs based on our previous operating experience in the given area and publicly available information relating to the operations of producers who are conducting operating in these areas. Actual quantities that may be ultimately recovered from Range's interests will differ substantially. Factors affecting ultimate recovery include the scope of Range's drilling program, which will be directly affected by the availability of capital, drilling and production costs, commodity prices, availability of drilling services and equipment, drilling results, lease expirations, transportation constraints, regulatory approvals, field spacing rules, recoveries of gas in place, length of horizontal laterals, actual drilling results, including geological and mechanical factors affecting recovery rates and other factors. Estimates of resource potential may change significantly as development of our resource plays provides additional data. In addition, our production forecasts and expectations for future periods are dependent upon many assumptions, including estimates of production decline rates from existing wells and the undertaking and outcome of future drilling activity, which may be affected by significant commodity price declines or drilling cost increases. Investors are urged to consider closely the disclosure in our most recent Annual Report on Form 10-K, available from our website at www.rangeresources.com or by written request to 100 Throckmorton Street, Suite 1200, Fort Worth, Texas 76102. You can also obtain this Form 10-K by calling the SEC at 1-800-SEC-0330.

About Range Resources

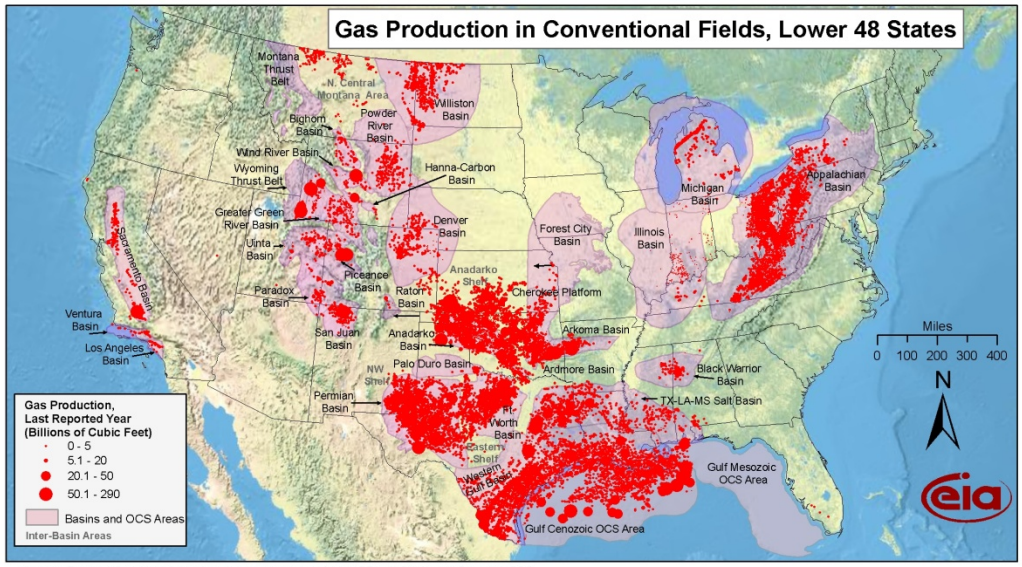
- Corporate Headquarters in Ft. Worth
- 800 employees and growing
- Pioneered and discovered the Marcellus Shale in 2004, America's largest producing gas field
- Pioneered and played key roles in several other exciting plays across the country



Total Resource Potential
48 to 68 Tcfe without Utica Shale

Range Resources in 2003

- Stock price ~ $4.00/share
- Market cap ~ $400/million
- Areas of operations:
  - Offshore Gulf of Mexico
  - Gulf Coast
  - Appalachia
  - Permian Basin
  - Midcontinent



Source: Energy Information Administration based on data from HPDI, IN Geological Survey, USGS
Updated: April 8, 2009

- Strategy – growth through development drilling, traditional exploration and complementary acquisitions

Range's Exploration Strategy in 2003

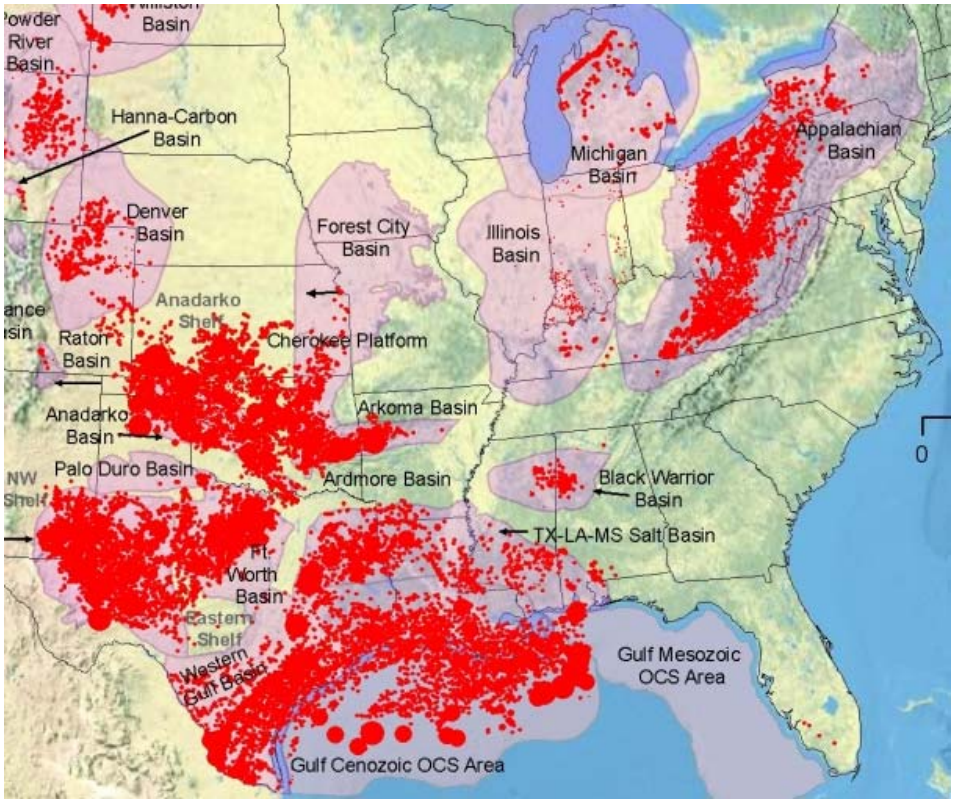
- **Traditional exploration – high risk, theoretically high return**

- **Range's portfolio:**
  - **Deep Woodbine East Texas**
  - **Norphlet onshore Mississippi**
  - **Offshore shelf GOM**
  - **Trenton Black River – PA + NY**

- **Probability of Success of Range's prospects 10% – 20%**

- **Industry exploration history**
  - **– if probability of success 50% - close**
  - **– less than 20% ended up 5% or less**

- **In addition to being high risk, not repeatable – tough way to build Range**



A New Strategy

- Look for opportunities that if successful, could become large scale and repeatable
- Resource plays – shale, tight oil or gas, CBM
- The challenge is once identified, could the economics be improved to bring the project to commerciality
- Challenge was made to Range exploration teams – great response. One of the ideas was the Marcellus Shale

First Horizontal "walking" rig in Appalachia

Bill Zagorski' s Idea

- 2003 drive to find the next Barnett Shale
- By early 2004 Bill was presented with a Neal Shale deal
- Eureka moment – the Marcellus compares favorably to Barnett, much larger, but it was in Appalachia

To Test or Not to Test – That is The Question?

Had an available wellbore, the Renz #1

- Failed Lockport, Salina, Oriskany tests
- Marcellus was uphole
- Well was being plugged and abandoned
- A lot of the surface reclamation was complete

Engineering/Operations Point-of-View

- Tired of the Renz #1; had spent a lot of money unsuccessfully
- Common knowledge for decades; Marcellus was water-sensitive
- Large Barnett style water frac would “lock it up”

Bill Zagorski

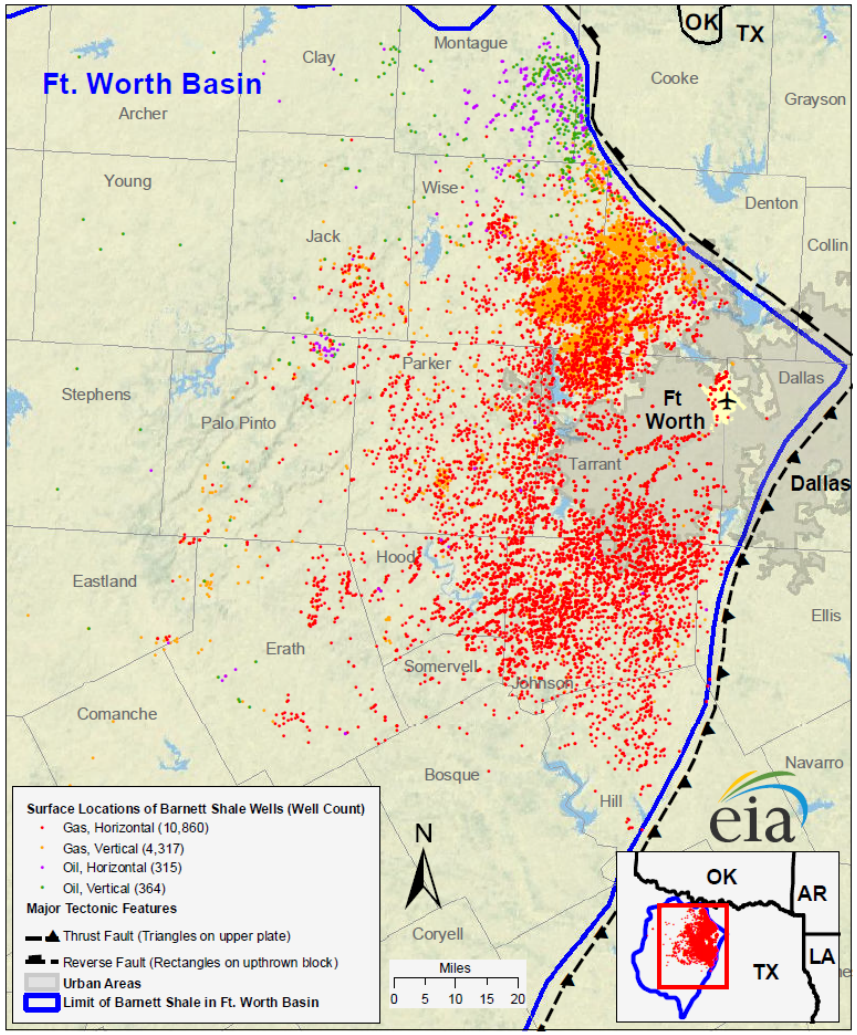
- The Marcellus compared very favorably to the Barnett in many ways
- The Marcellus had much more upside than the Barnett; covered a much larger area
- The Renz #1 had great gas shows in the Marcellus
- Other wells in the area had great shows in the Marcellus

To Test or Not to Test – That is The Question?

Continued…

- Conventional wisdom
  - Do not test; it won't work
  - It's been tried before, albeit with smaller jobs
  - Decades of drilling through it shows it's water-sensitive
- Bill Zagorski
  - Compares well with Barnett; lots of great gas shows
- Decision
  - Put a big Barnett style water frac on it

Barnett Shale Play, Fort Worth Basin, Texas



Source: US Energy Information Administration based on data from HPDI, USGS, Pollastro et al (2007)
Updated: May 31, 2011

Reflecting Back…It was one of the best decisions of my life!

Renz #1, discovery well completion, October 2004

Key Lesson #1

- **Creativity with strong scientific basis tops conventional wisdom**

Renz #1 – The Discovery Well, October 2004

- Initial test
  - Acceptable
  - High Btu gas
  - Lacked infrastructure
- After shut-in for one year, it began producing to sales
  - Discovered the aging process
  - We were in the wet window; better economics
  - Established high pressure gradient/over-pressure
- Drilled two offset wells to the Renz #1; the Deiseroth #1 and the Renz #2

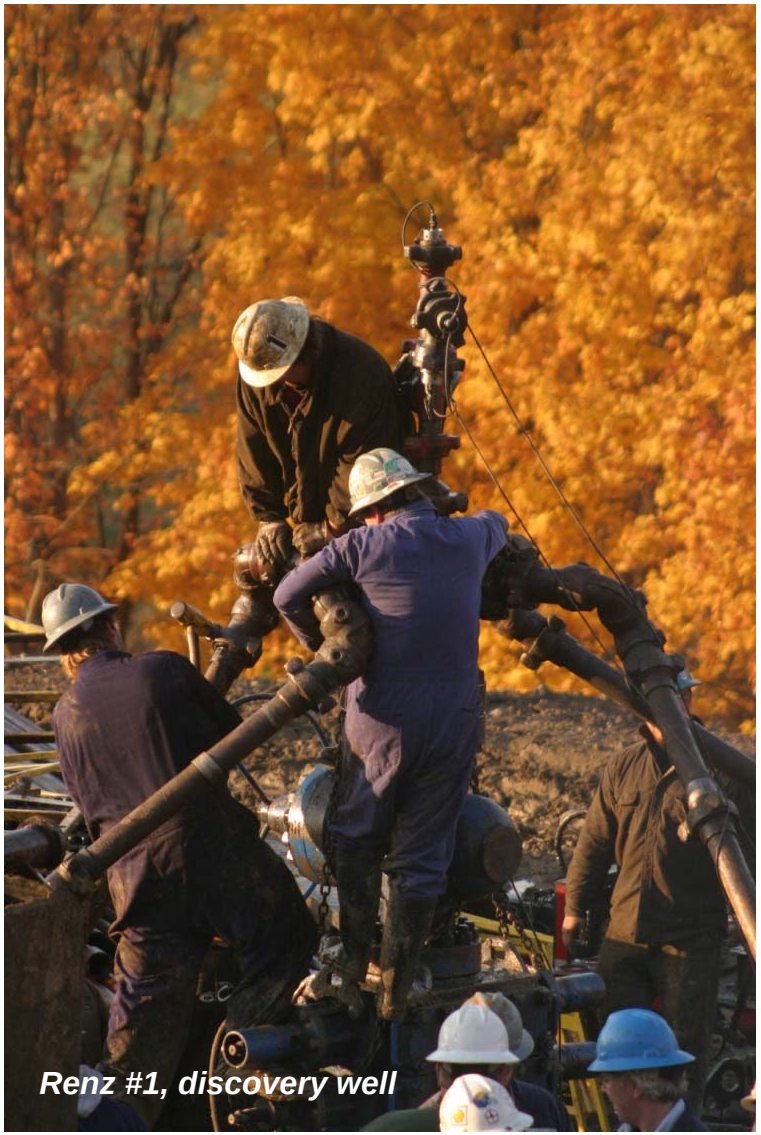
Renz #1, discovery well drilling, October 2004

Bigger is Better

- Decided to pump Barnett style water frac

- Didn't "Over Science it;" didn't design specifically for Renz #1
  - Ask Barnett service company for a "typical job"
  - Designing most likely would have resulted in a much smaller job – Marcellus in the Renz #1 is about one third the thickness of the Barnett

- Range at this point was a small Appalachia operator
  - Common practice – pump small job, keep costs down
  - New idea with risk – reduce financial risk with small job



Renz #1, discovery well

Bigger is Better
Continued…

- Decided to pump a large Barnett style water frac
- Large jobs were successful on the Renz #1, #2 and Deiseroth #1
  - Encouraged and moved forward to drill more wells
- Small jobs may have been one-third the size; may have resulted in a much lower rate and reserves
  - Poorer results may have discouraged us
- Early success, beneficial for small company, which Range was in 2004

Renz #1, discovery well completion, October 2004

"Why Make Billions When You Can Make Millions?"

- Range's history in Appalachia; drilled a lot of Clinton and Medina wells, which typically made ~150 mcf/d initially
- Drilling the Marcellus on air, we encountered flows of 1,000 to 10,000 mcf/d in shallower formations
- Team wanted to stop and complete each one
- "Don't give up; what will drive our company is the Marcellus"

Renz #1, discovery well

Could We Make It Work Horizontally?

- Vertical wells worked, but key to growing and building Range was for the play to be horizontal
- Conventional wisdom pops up again
  - Got lucky with the vertical wells, but horizontal would never work
  - Marcellus is water-sensitive, you'll never be able to drill it successfully
- Decision - the target was large enough and the risk was worth taking - we moved forward and took the "unconventional path"

Gulla #9, horizontal well breakthrough

Key Lesson #2 – FOCUS!

- First three Marcellus horizontal wells cost a lot and were not very good
- Vertical Marcellus wells worked, especially relative to the Clinton and Medina wells
- Our office at that point in time was in Hartville, Ohio
- Local pressure
  - Discontinue horizontal drilling
  - Make Marcellus a vertical program
  - Continue to drill Clinton and Medina
- Answer – FOCUS – Open a Pittsburgh office whose sole purpose was to make the Marcellus work

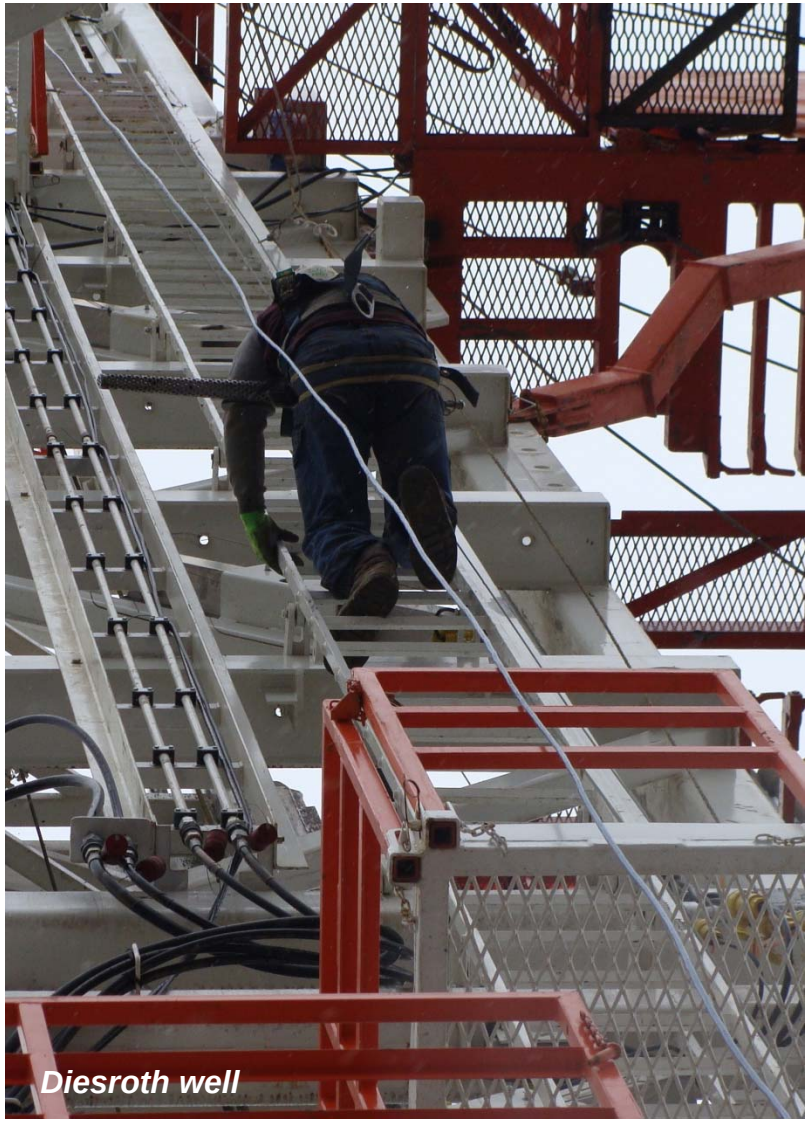
Ray Walker, circa 2007

Ray Walker Opens Range's Pittsburgh Office

- Early 2007
  - 1 person Pittsburgh staff
  - Basin lacked equipment, technology and expertise
  - Marcellus ~ 0.001 Bcf/d
- Spring 2013
  - 350 employees and growing
  - PA is a leader in equipment, technology and expertise
  - Marcellus is ~9 Bcf/d

Size Matters and We Didn't Have It

- From 2004 to the spring of 2007 - Range had invested ~$150 million
- First 3 horizontal wells - not commercial
- Range in July 2003 - maximum risk investment ~$3.0 million in a project
- Deadline/Budget
  - We had decided that we would invest up to $200 million max and set a deadline of year-end 2007
  - In the spring of 2007, we had $50 million and eight months left to figure it out



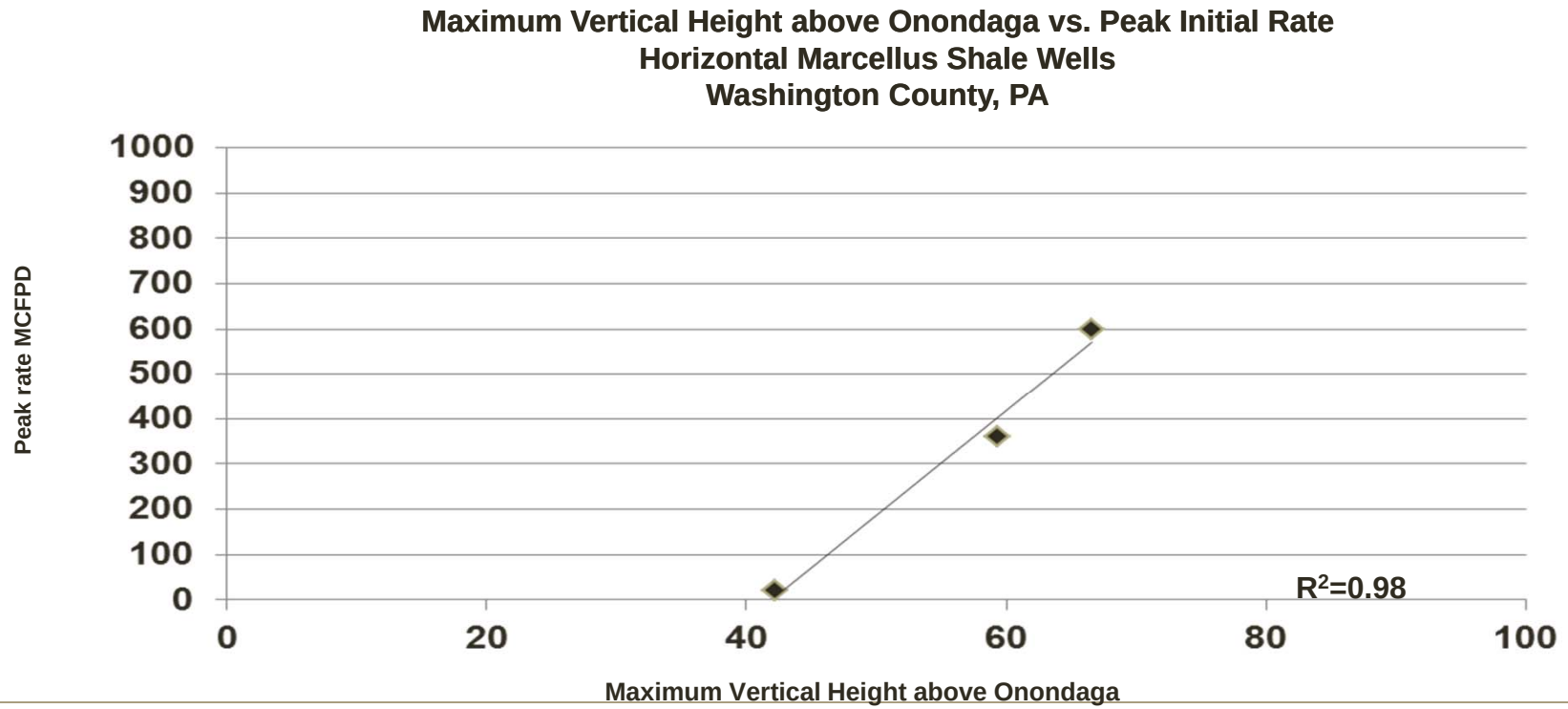
Diesroth well

Zagorski Scores Again!

- First three horizontal wells
  - 20 mcfp/d
  - 250 mcfp/d
  - 600 mcfp/d
- Engineering - longer laterals, more stages, more sand, different perforating charges and methodology, etc?
- Bill Zagorski - famous three point correlation

"The Famous Three Point Correlation"

- Well #4
  - Breakthrough well - 3.2 Mmcf/d
  - Equivalent of a good Barnett well
- Lesson from Bill
  - Don't wait for more data to at least look for correlations



Successful Follow Up and Press Release

- After "cracking the code," drilled 3 more successful wells in a row: 3.7, 4.3 and 4.7 Mmcfepd
- Press release on December 10, 2007, with results of these wells
- Early 2008, Terry Engelder gave estimate of Marcellus reserves, showing immense potential
- Shortly after, Range completes its 8th horizontal well for 14 Mmcfpd!

The New York Times

TUESDAY, APRIL 08, 2008

There's Gas in Those Hills

Clifford Krauss

HUGHESVILLE, Pa. — At first, Raymond Gregoire did not want to listen to the raspy voice on his answering machine offering him money for rights to drill on his land. They want to ruin my land, he thought. But he called back anyway a week later to hear more.

By the end of February, he had a contract in hand for $62,000, and he pulled together a group of 75 neighbors who signed $3 million in deals.

"It's a modern-day gold rush in our own backyard," Mr. Gregoire said.

Not just his backyard either — a frenzy unlike any seen in decades is unfolding here in rural Pennsylvania, and it eventually could encompass a huge chunk of the East, stretching from upstate New York to eastern Ohio and as far south as West Virginia. Companies are risking big money on a bet that this area could produce billions of dollars worth of natural gas.

A layer of rock here called the Marcellus Shale has been known for more than a century to contain gas, but it was generally not seen as economical to extract. Now, improved recovery technology, sharply higher natural gas prices and strong drilling results in a similar shale formation in north Texas are changing the calculus. A result is that a part of the country where energy supplies here long thought to be largely tapped out is suddenly ripe for gas prospecting.

Pennsylvania, where the Marcellus Shale appears to be thickest, is the heart of the action so far. Leasing agents from Texas and Oklahoma are knocking on doors, leaving voice mail messages and playing host at catered buffets to woo dairy farmers and retirees. They are rifling through stacks of dusty deeds in courthouse basements to see who has underground mineral rights to the deepest gas formations.

Thomas B. Murphy, a Pennsylvania State University educator who runs a program to instruct landowners on their rights, estimated that more than 20 oil and gas companies will invest $700 million this year developing the Marcellus Shale. Up to one half of that will be invested in Pennsylvania, he estimated.

The cost to companies for leasing mineral rights jumped from $300 an acre in mid-February to $2,100 now. "It shows you the pace this is going," Mr. Murphy said. "I would call it breakneck."

Dale A. Tice, a lawyer representing landowners in lease negotiations, said companies were on a "feeding frenzy."

Industry experts say in the last three years companies like Anadarko Petroleum, Chesapeake Energy and Cabot Oil and Gas have leased up to two million acres for drilling in the region, half of that in the last nine months.

Whether their bets will pay off is by no means a sure thing.

Researchers at Penn State and the State University of New York at Fredonia estimate that the Marcellus has 50 trillion cubic feet of recoverable natural gas, roughly twice the amount of natural gas consumed in the United States last year. But government estimates of the amount of gas recoverable from the Marcellus are relatively modest.

Early test results have encouraged companies to keep drilling, but most are holding details of their test wells close to the vest.

The company that has done the most work is Range Resources of Fort Worth, which says it plans to invest at least $426 million in the Appalachia region this year.

The company has reported promising results from the first 12 wells that it has drilled horizontally, the technique considered by most experts to be the most effective in the Marcellus. The most recent six have each produced more than three million cubic feet of production a day in recent months, and company executives say that is better than the average for wells recovering natural gas in the Barnett Shale in north Texas.

"The Marcellus is important to Range and it could be important to the country but it really is still early," said Rodney L. Waller, a senior vice president at Range. "I can build you a scenario where it can be significantly better than the Barnett but it's a function of economics."

Energy experts say the Marcellus, along with other smaller shale formations being developed around the country, is coming under scrutiny at an opportune moment, just when conventional domestic natural gas production and imports from Canada are diminishing. With easy-to-find gas fields in decline, the country will need to explore in deeper waters in the Gulf of Mexico and penetrate deeper under the surface on land.

If all goes well, the Marcellus could help moderate the steep climb in natural gas prices and reduce possible future dependence on natural gas from the Middle East, which is beginning to arrive at coastal terminals in liquefied form.

Natural gas in the Marcellus and other shale formations is sometimes found as deep as 9,000 feet below the ground, a geological and engineering challenge not to be underestimated. The shales are sedimentary rock deposits formed from the mud of shallow seas several hundred million years ago. Gas can be found trapped within shale deposits, although it is too early to know exactly how much gas will be retrievable.

The gas from all the shales combined "is a game changer," said Robert W. Esser, an oil and gas expert at Cambridge Energy Research Associates. He estimated that shale produced four billion cubic feet of gas a day on average last year, or about 7 percent of national production, and that shale gas production would increase to nine billion cubic feet a day by 2012, or about 15 percent of expected national production.

The New York State Energy Research and Development Authority estimates that developing New York's portion of the Marcellus could roughly double the amount of natural gas now produced in New York. Currently that is about 55 billion cubic feet a year, providing for 5 percent of the state's needs.

The Marcellus has suddenly become attractive in large part because natural gas prices have spiked in the last several years and the geologically similar Barnett Shale has been an industry sensation.

By using horizontal drilling techniques, oil and gas companies have been able to draw natural gas from underneath the city of Fort Worth, even from below schools, churches and airports. The companies have perfected hydraulic fracturing techniques, pumping water and sand into well bores to fracture shale and release gas from its pores.

Production in the Barnett has exploded from a trickle five years ago to over three billion cubic feet a day, and energy experts say that number could more than double by 2015. Shale gas development in other parts of Texas, Louisiana and Arkansas has also shown promise.

But no formation compares in size to the Marcellus. It is deeply entrenched in wooded and mountainous countryside and expensive to reach. But the reserve is also within short pipeline distance from some of the nation's most energy-hungry cities.

Still, not everyone here is happy about all the leasing and drilling. At meetings with the companies, landowners have asked questions about potential hazards to water and woodlands.

Keith Eckel, 61, a grain farmer with 700 acres in northeastern Pennsylvania, said he had not decided whether to let the companies drill on his property. "Farmers have taken care of this land all their lives and don't want to see it destroyed," he said.

But many farmers and retirees in rural Pennsylvania appear excited that their lives are about to change.

"Now I can retire," said Robert Deiseroth, a 63-year-old farmer and auctioneer from the town of Hickory, who recently received a $16,000 royalty check from Range Resources that he hopes will be repeated month after month. "This was a godsend for me. If it weren't for this I would have to sell off some of my land to get some money for retirement."

Mr. Deiseroth has put new windows in his house, bought a new fishing boat and plans to build a new garage. His 89-year-old father and 90-year-old mother, who live nearby, just got a $20,000 monthly check. His father has replaced the golf cart he drove around his farm with a Kubota utility vehicle, while his mother has bought a flat-screen television.

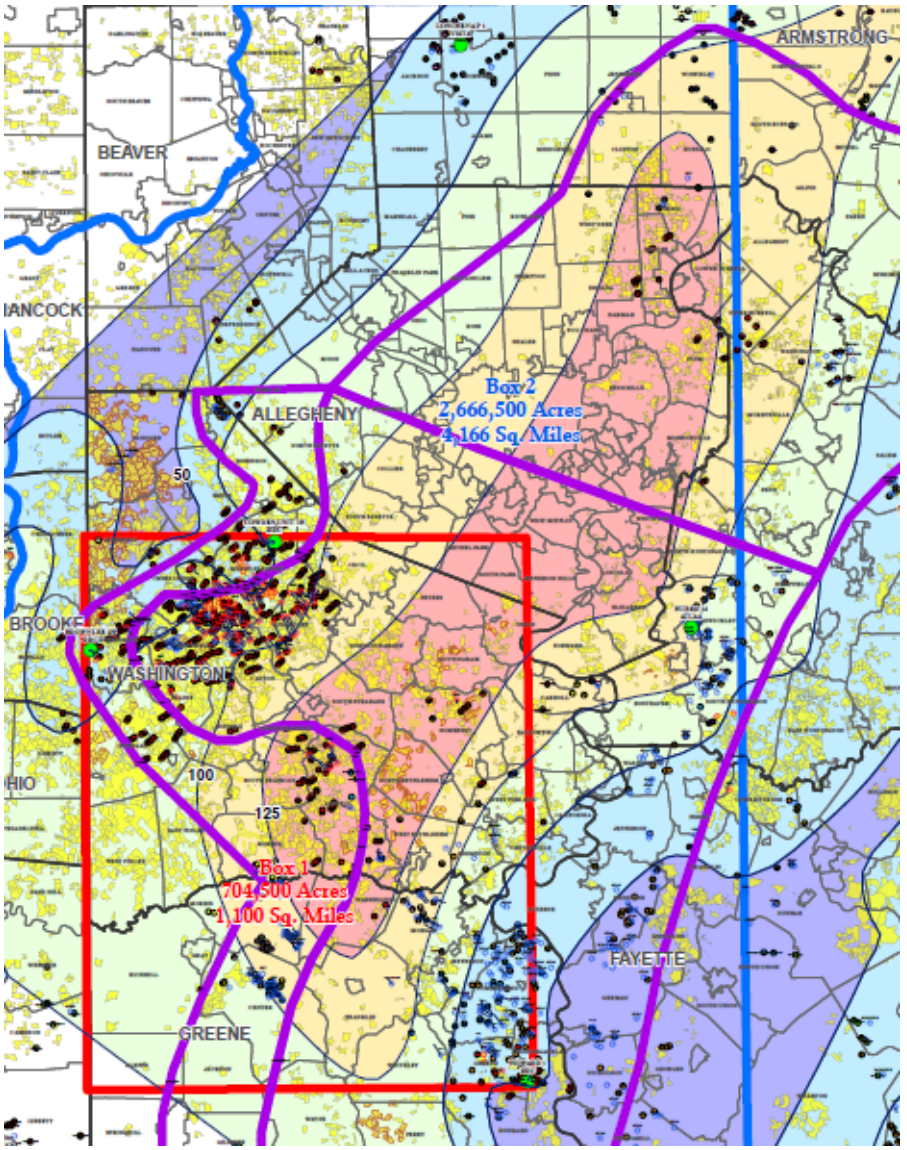
"When Range came in a lot of people didn't like it," Mr. Deiseroth said. "But things changed when they started getting their checks."

The Entire Team is Important Including the Financial Guys and the Board

- $150 million invested in the project by spring of 2007 was huge for Range
- One of Range's key strategic elements – operating strategy driven company rather than a financial strategy driven company
- Financial strategy driven could have interfered with the creative process by imposing strict risk allocation components
- Operating strategy driven allowed capital to follow operating success and disciplined R&D
- Range stayed focused long enough to get the breakthrough we were looking for

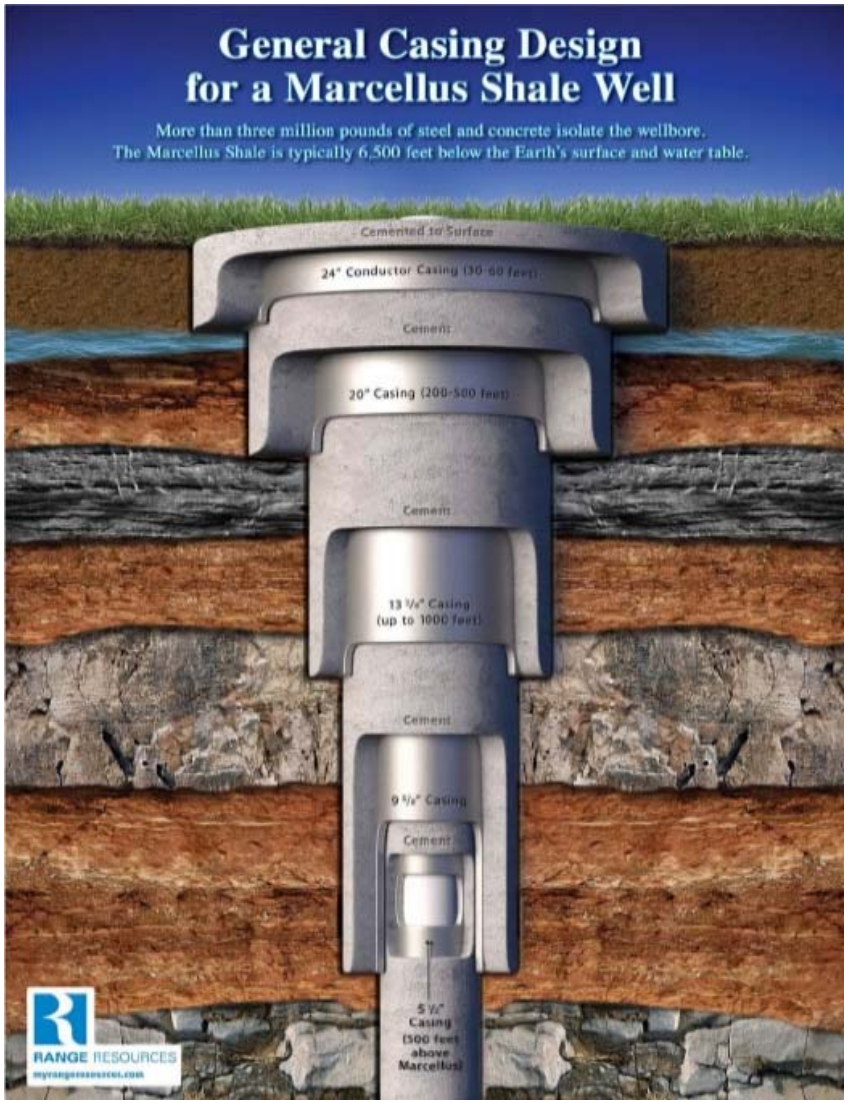
You Have to Have a Good Land Position

- We proved the concept and realized the play covered a large area
- Needed to focus leasing
  - Bill creates the "Rosetta Stone" with core area called the "tenderloin"
- We had an elephant by the tail



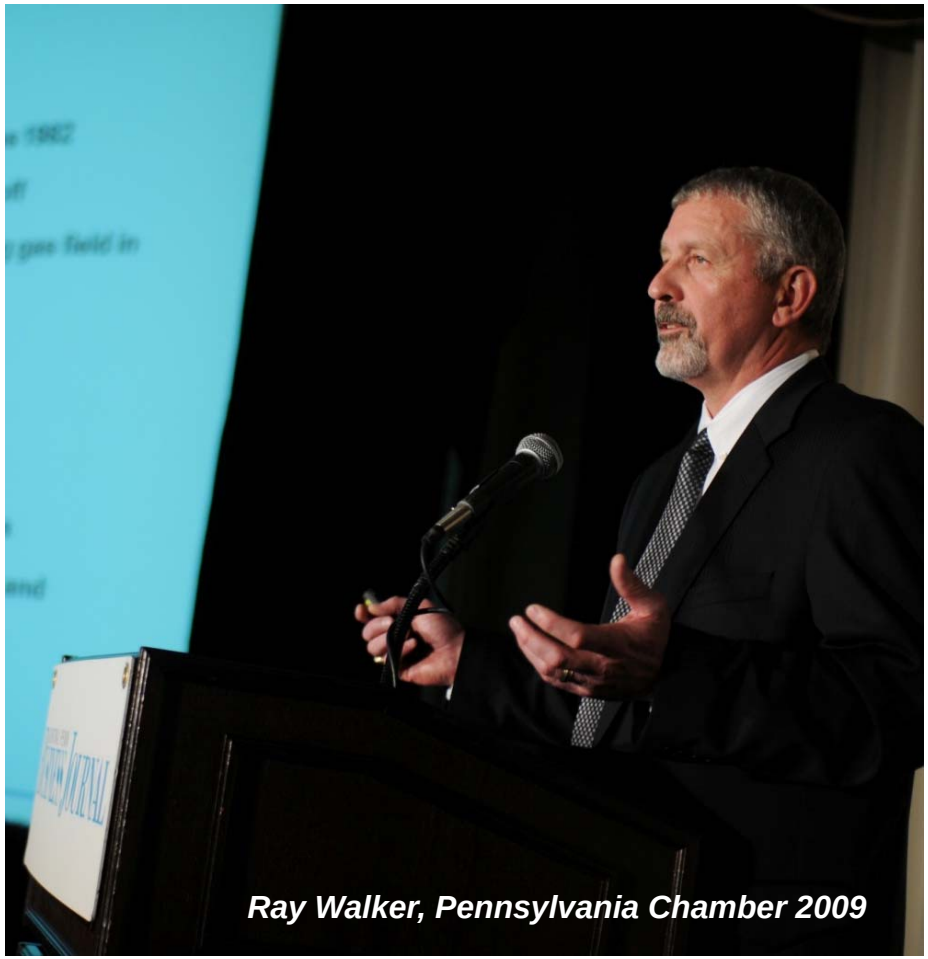
Key Lesson #3 – DO THE RIGHT THING

- Early on, “best engineering practices” exceeded existing state regulations and added $200,000 per well
- Local experts - state regulations are adequate
- Range decision
  - Do the right thing
  - Move to “best engineering practices”
  - Inform state and other operators
- Pennsylvania today has modernized all regulations and has some of the best in the country



The Risks were Not Just Technical

- Spring 2008, play was taking off
- Needed to recognize the Environmental and Social Concerns
- Range worked on getting best practices adopted by Pennsylvania
- Ray Walker initiates Marcellus Shale Coalition



Ray Walker, Pennsylvania Chamber 2009

Recycling Frac Water – That Will Never Work

- Historical wells produced very little water and no disposal capacity
- Range Engineers; let's recycle
- Conventional wisdom
  - It won't work
  - Additives won't work in saline water
  - Risk of formation damage and a poorer well

Worstell Impoundment, 2010 best practice test site water recycling

Recycling Frac Water – That Will Never Work
Continued...

- Range Engineers
  - Began to reduce and/or change additives
  - Greener fluid
  - 99.9% water and sand
- Reduced water required for fracing
- Reduced the need for disposal wells
- Less expense and better economics
- Pennsylvania now recycles a very high percentage of its frac water

PITTSBURGH TRIBUNE-REVIEW

Recycling of waste water to be norm for Marcellus Shale gas wells

Tuesday, October 20, 2009

"We are recycling 100 percent of the flowback water, which is between 15 percent and 30 percent of the water used during Marcellus Shale well drilling," said Ventura. A typical well drilled in the Marcellus Shale formation uses new horizontal drilling technology that uses millions of gallons of water to fracture gas-containing shale thousands of feet underground and may return 600,000 gallons of water to be recycled.

We've Got a Good Product and Process – Let's Talk about It!

- In 2010, Range became the first company in the industry to disclose what's in its frac fluid
- 99.9% water and sand
- 0.1% chemicals which are found in everyday household use
- The vast majority of industry has now followed

THE WALL STREET JOURNAL.

WEDNESDAY, JULY 14, 2010 - VOL. CCLVI NO. 11

Natural-Gas Driller to Disclose Chemical Use

By Russell Gold

Range Resources Corp. says it plans to disclose the chemicals used to hydraulically fracture natural-gas wells in Pennsylvania, confronting rising pressure from environmental groups worried that drilling could contaminate drinking water.

The decision, which Range said was voluntary, reflects the mounting distrust that energy companies face, especially in the wake of the ongoing oil spill in the Gulf of Mexico. Even before the offshore spill, the industry was facing increasing scrutiny as gas drilling in the Marcellus Shale spreads across Pennsylvania and neighboring states.

In a significant break from past practice, Range says it will begin submitting a detailed list of all chemicals and additives, and the volumes, used to fracture each of its gas wells to the state.

"There has been so much misinformation about the Marcellus, we think it's prudent" to begin making this information public, says John Pinkerton, chairman and chief executive of the Fort Worth, Texas, company. Range holds leases for 1.3 million acres in the Marcellus and its ability to develop the gas is central to future growth. "It's the right thing to do morally and ethically, but it's also right for our shareholders," he says.

Range plans to make the disclosures with state Department of Environmental Protection within 30 days of "frac" jobs, and post the information online.

The decision was praised by environmental groups and some members of Congress who have proposed a law to require similar levels of disclosure.

The industry has resisted disclosing the chemicals it uses, although that has been softening recently. Exxon Mobil Corp. Chairman and Chief Executive Rex Tillerson told Congress earlier this year he "wouldn't object to any disclosure."

Loosening gas molecules from dense shale rock requires drilling a well, then pumping in thousands of gallons of fluid under high pressure to crack the rock open. Range used 4.5 million gallons in a simple fracture of a recent well—the overwhelming majority being water, according to a sample of the disclosure provided by the company. It also used smaller amounts of chemicals such as sodium hydroxide, ethylene glycol, hydrochloric acid and benzalkonium chloride.

Range says the purpose of disclosure was to dispel concerns that chemicals added to fracture fluids are a risk. The fluid is being pumped a mile beneath the groundwater and is 99.8% water and sand, the company says. And the chemicals are "comparable to household chemicals in a very diluted form," says Ray Walker, a Range executive.

Some politicians and environmental groups that support increased use of natural gas as a cleaner alternative to coal have expressed frustration with the industry's disclosures. Tim Wirth, a former Democratic senator from Colorado who has been a prominent advocate for natural gas, says the industry's penchant for secrecy is making it harder to win over skeptics.

"If there's no problem, then disclose," Mr. Wirth said. "That's the price of admission in this day and age."

Amy Mall, senior policy analyst with the Natural Resources Defense Council, says the industry has used hundreds of different chemicals in fracture fluids in the past. She said the disclosure will help homeowners who have had difficulty figuring out what chemicals to test for when they grew suspicious that their water well had been contaminated.

Also, John Hanger, secretary of the Pennsylvania Department of Environmental Protection, said he was pleased with Range's new policy. "If one company can do it, everyone can do it—and should do it. The holding back of information in this area has fueled public suspicion."

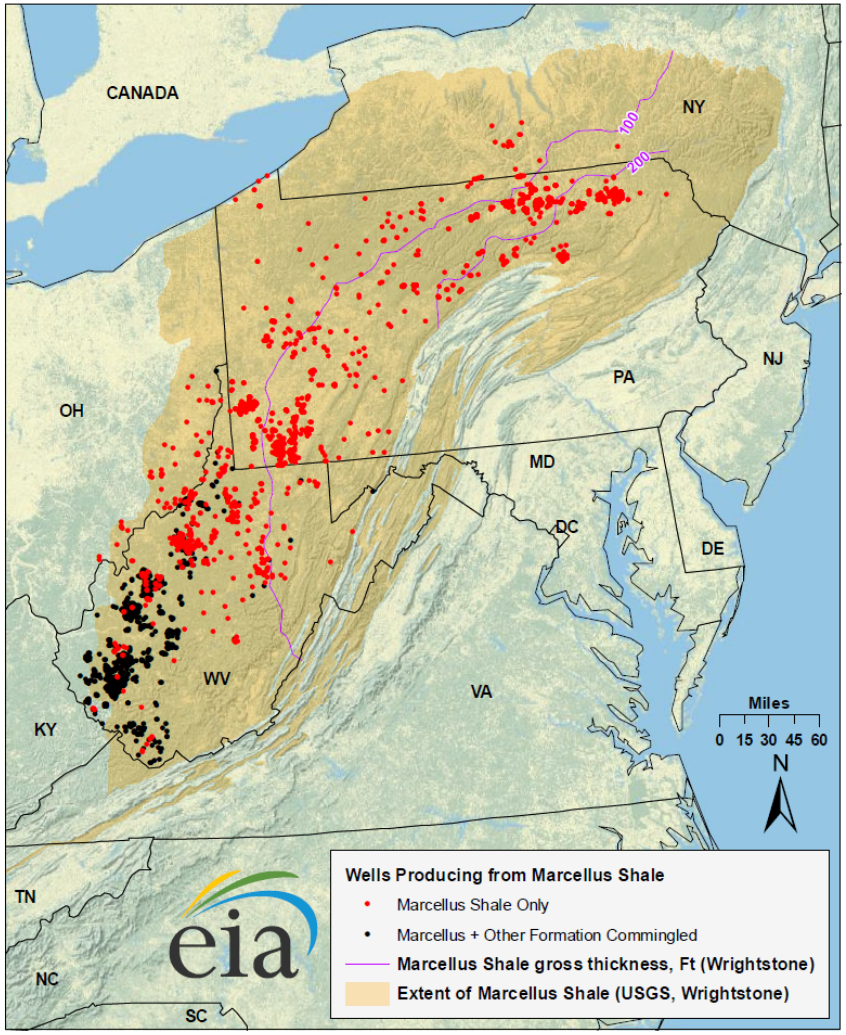
Jan Jarrett, president of Citizens for Pennsylvania's Future, an environmental advocacy group, applauded Range's disclosure program as a "step in the right direction."

Extracting natural gas from shale requires forcing in water and some chemicals to crack the rock open, worrying residents about pollution.

The Marcellus Shale is Now The Largest Producing Gas Field in the United States

- Range discovered the Marcellus back in 2004
- Renz #1 came online in 2005
- First cryogenic plant came online late 2008, industry production less than 0.1 Bcfpd
- Now, four and half years later, the Marcellus is producing about 9 Bcfpd
- A field typically includes all horizons. Adding in the potential of future Marcellus, Upper Devonian and Utica, Marcellus may become the largest field in the world

Marcellus Shale Gas Play, Appalachian Basin



Source: US Energy Information Administration based on data from WVGES, PA DCNR, OH DGS, NY DEC, VA DMME, USGS, Wrightstone (2009). Only wells completed after 1-1-2003 are shown. Updated June 1, 2011

The Marcellus Shale is Now The Largest Producing Gas Field in the United States

- **Marcellus Play Potential – 84 TCF/3.5 Billion Bbls liquids (USGS 2011) to 489 TCF (Engelder PSU 2009)**
- **Consider the resource potential of the Genesee Group and Utica/Point Pleasant intervals**
- **Shale is truly a global game changer**

World's Largest Non Associated Gas Fields (Tcf)

No.	Field Name		Country	Recoverable Reserve Tcf
1	South Pars/North Dome		Iran & Qatar	1235
2	Urengoy		Russia	222
3	Yamburg		Russia	138
4	Hassi R'Mel		Algeria	123
5	Shtokman		Russia	110
6	South Iolotan-Osman		Turkmenistan	98
7	Zapolyarnoye		Russia	95
8	Hugoton		USA (TX-OK-KS)	81
9	Groningen		Netherlands	73
10	Bonavenko		Russia	70
11	Medvezhye		Russia	68
12	North Pars		Iran	48
13	Dauletabad-Donmez		Turkmenistan	47
14	Karachaganak		Kazakhstan	46
15	Kish		Iran	45

Table Sources: Global Natural Gas Reserves - A Heuristic Viewpoint
Raphael Sandrea, 2006

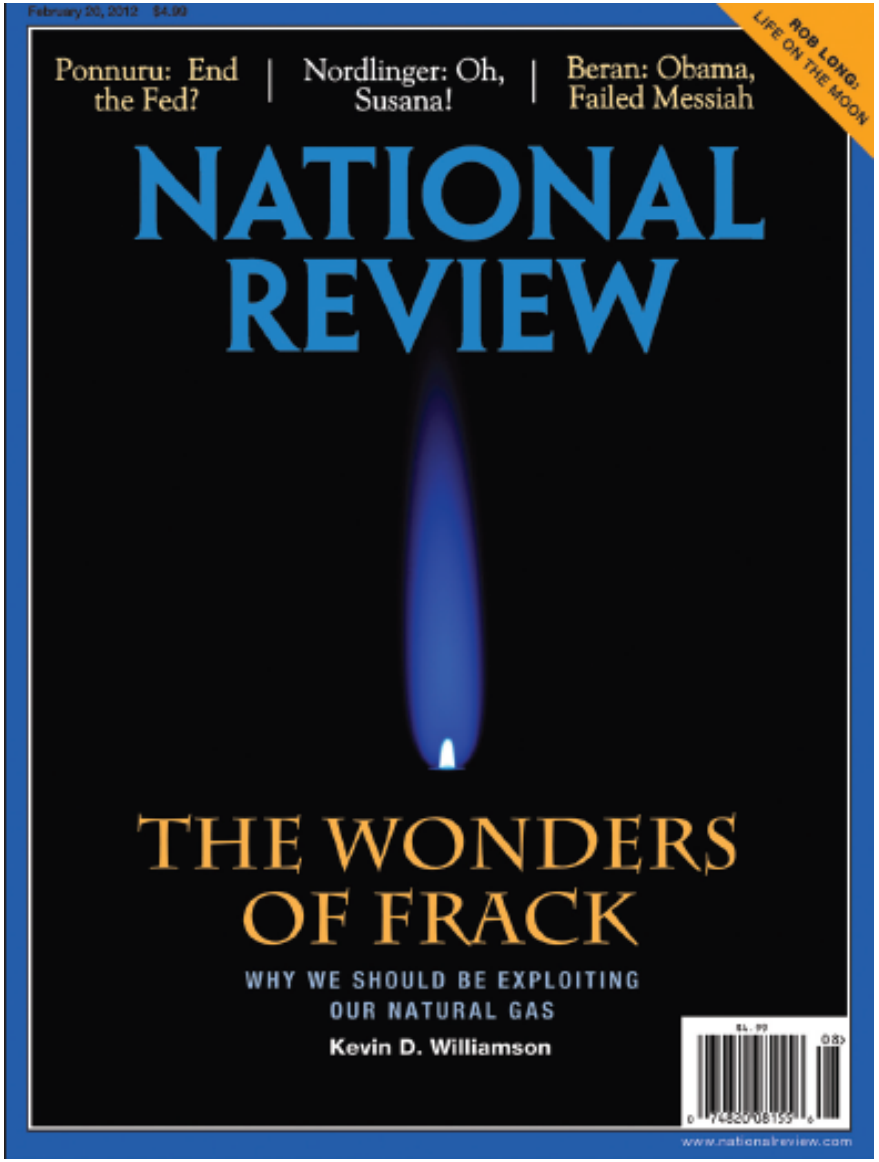
Size refers to ultimate recoverable reserves expressed in trillion cubic feet

What's the Significance of this Discovery and the Shale Revolution in General?

1. US reserve life index has increased dramatically

What's the Significance of this Discovery and the Shale Revolution in General?

2. US natural gas prices competitive



What's the Significance of this Discovery and the Shale Revolution in General?

3. Potential rebirth of American manufacturing

SPORTS SCORES INSIDE | THE NATION'S NEWSPAPER | $1.00

FINALLY, A COLLEGE PLAYOFF

Format, to start in 2014, will create two semifinal games, 1C

USA TODAY

A GANNETT COMPANY

Nora Ephron | 1941 - 2012

Movie matchmaker

Her films, including *Sleepless in Seattle*, made us laugh, cry, fall in love, 1D

Newsline

WEDNESDAY, JUNE 27, 2012

Report finds best, worst beach waters

Mid-Atlantic's Delmarva had lowest violation rate of water standards; Great Lakes region had highest, 3A

Zimmerman passed lie test day after shooting teen

Florida prosecutors release report with results of lie detector test; experts say it makes it harder to get impartial jury in Trayvon Martin case. 3A.

Mardy Fish, Serena Williams advance at Wimbledon

Both players overcome recent struggles to move to second round. Other top seeds advancing: Rafael Nadal, Andy Murray, Petra Kvitova. 7C.

Serena Williams

Low-carb dieters burn more calories than low-fat dieters

Participants burned 300 more calories a day following low-carb diet, such as Atkins diet. 4D.

Google set to unveil tablet

Devices to run Android operating system. 1B.

See news photos of the day on your smartphone

Scan with a QR reader; AT&T code scanner available at scan.mobi. Get codes for your business at att.com/mxode.

COVER STORY

NATURAL GAS GOLD RUSH

Is your state next?

Out-of-the-way towns across the USA have been swept up in the 'fracking' phenomenon, ushering in jobs, cash and conflict.

Natural gas drilling: A rig operates in Moshannon State Forest in Clearfield County, Pa.

By Dan Vergano
USA TODAY

The script might not play out exactly the same in each new community touched by the nationwide boom in natural gas and oil drilling, but the changes have a familiar echo:

Trucks. Noise. Cash. Conflict.

Since the late 1990s, American landscapes have become dotted with a small forest of shale gas wells — 13,000 new ones a year, or about 35 a day, according to the American Petroleum Institute. In the past decade, this steady stream of development has become a gusher as nearly half the country has staked claim to these energy riches. In 2000, the USA had 342,000 natural gas wells. By 2010, more than 510,000 were in place — a 49% jump — according to the U.S. Energy Information Administration.

Twenty states have shale gas wells, so-named because they tap rock layers that harbor the gas in shale formations (with names such as Marcellus, Utica, Barnett.) The bulk of the drilling has come since 2005, according to the EIA.

Wherever drilling happens, life changes.

First, the "landmen," or agents from drilling companies, show up offering three- to six-year drilling leases to property owners. The payoff can be as little as $15 an acre or up to $6,000 an acre, producing a new class of wealthy landowners, though some have used the windfall to simply pay off old farm debts.

Then the trucks arrive and the drilling starts, using a process called hydraulic fracturing, or "fracking," to retrieve the natural gas. The process pumps millions of gallons of water, sand and chemicals underground to fracture shale layers and release its natural gas.

That's what happens below the Earth's surface. Above ground, rents increase and hotel rooms begin to fill up. In the process, out-of-the-way towns that had been moseying along for

Please see COVER STORY next page ▸

Afghan IEDs kill fewer troops

Trend reflects shift in U.S. combat plan

By Tom Vanden Brook
USA TODAY

WASHINGTON — U.S.-led troop deaths from makeshift bombs in Afghanistan are dropping sharply even though the number of improvised explosive devices (IEDs), planted by insurgents are near record levels, Pentagon data show.

Now, less than half of troop deaths come from the bombs, although there has been a 5% spike in homemade bomb incidents since March, according to the Pentagon. The high number of incidents highlights continuing problems choking off the supply of bomb parts from Pakistan and a resilient Taliban, according to a senator and military analyst.

Part of the decline in deaths can be traced to the changing nature of combat. Attacks have shifted from southern to eastern Afghanistan where allied forces are focusing on insurgents in mountainous terrain. Troops in the east tend to travel in armored vehicles, which have experienced a 17% rise in attacks over the past three months, the Pentagon's Joint IED Defeat Organization says. In the south, troops tend to touch off bombs on foot.

From June 1, 2011, to May 31 this year, there were 16,221 incidents in which bombs exploded or were found before they detonated. The record for a calendar year was in 2011, when

IED fatalities in Afghanistan

IED fatalities
Total fatalities

600
500
400
300
200
100
0
'10
'12

IEDs 76
Total 145

1 — As of June 20

Source: Department of Defense

By Julie Snider, USA TODAY

What's the Significance of this Discovery and the Shale Revolution in General?

4. Natural gas feedstock potential for US petrochemical industry

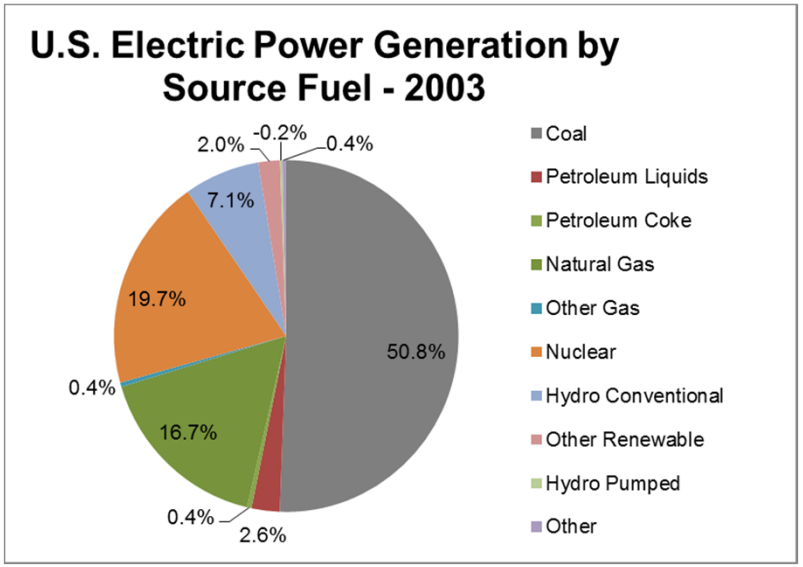
5. Shale revolution extends to oil

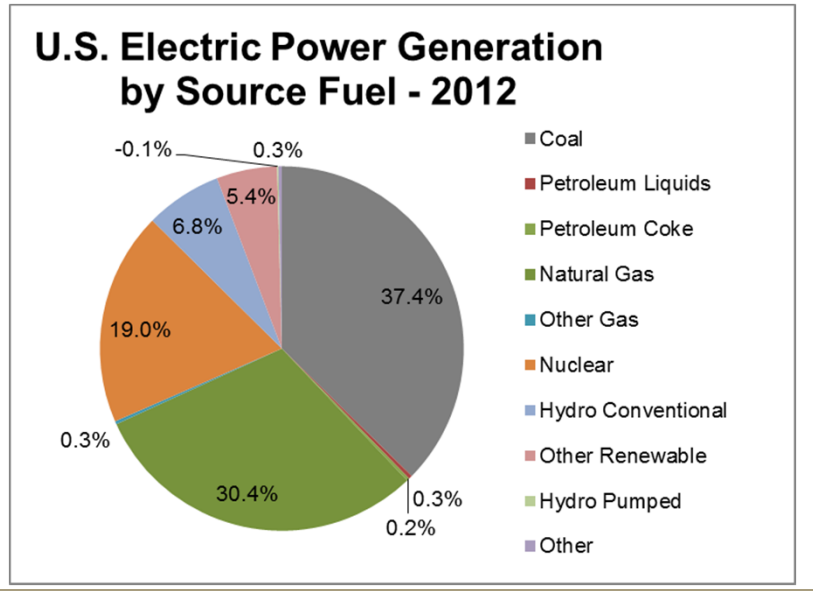
6. EIA – US supplying about 84% of its energy needs, oil imports drops to roughly 40%

First Range CNG fleet truck

What's the Significance of this Discovery and the Shale Revolution in General?

7. Changing how we generate electricity, dramatic environmental and health benefits





What's the Significance of this Discovery and the Shale Revolution in General?

8. **EPA: 14% decrease in toxic air emissions from last reporting period in Mid-Atlantic, double the 20-year CO2 reductions of the rest of the Kyoto agreement in one year**

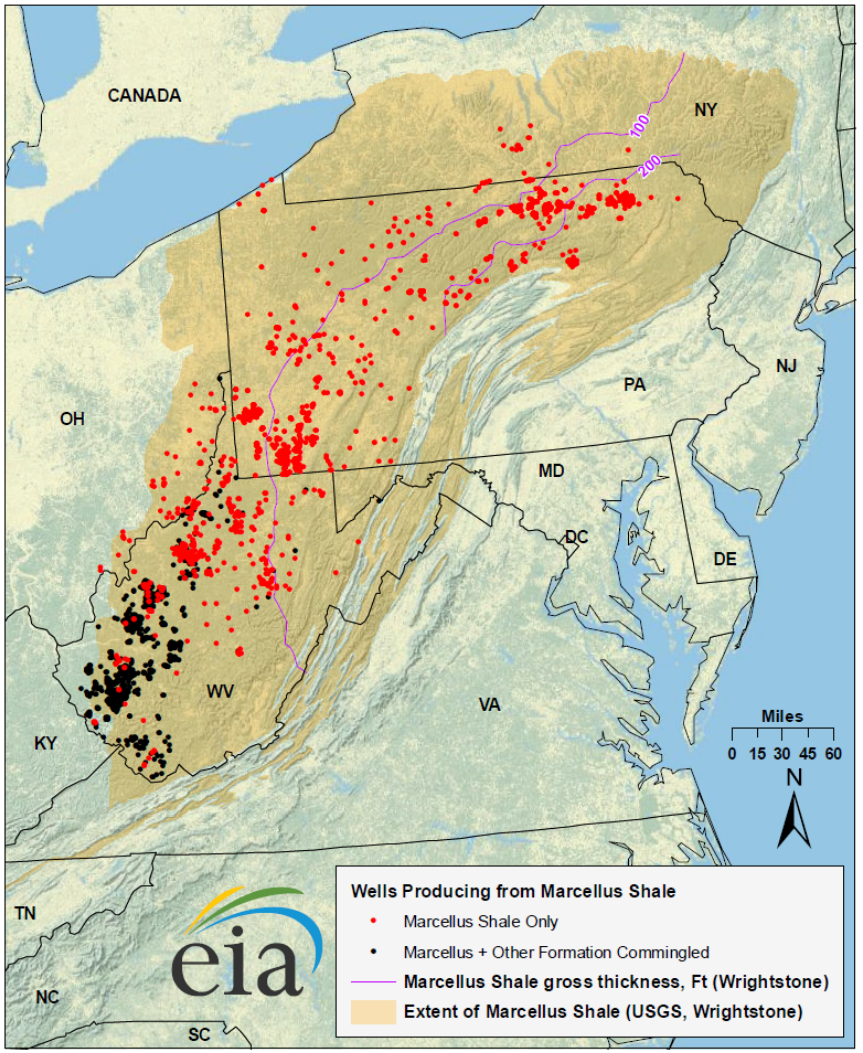
What's the Significance of this Discovery and the Shale Revolution in General?

9. $113 billion annual utility savings for total US consumers; in PA alone public health savings due to lower emissions $14-$37 billion annually

Looking Back

1. Analogy was to the Barnett, Marcellus is now superior with better wells and a much larger field

Marcellus Shale Gas Play, Appalachian Basin



Source: US Energy Information Administration based on data from WVGES, PA DCNR, OH DGS, NY DEC, VA DMME, USGS, Wrightstone (2009). Only wells completed after 1-1-2003 are shown. Updated June 1, 2011

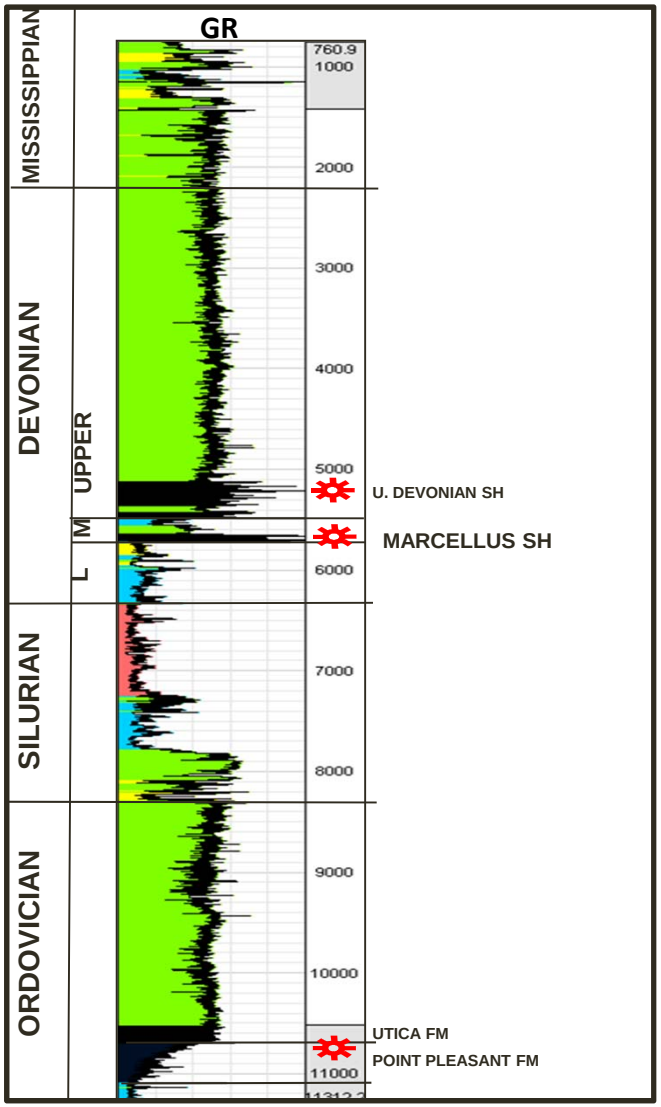
2. Marcellus wells continue to improve and impress

3. Marcellus transforming how gas moves in the US

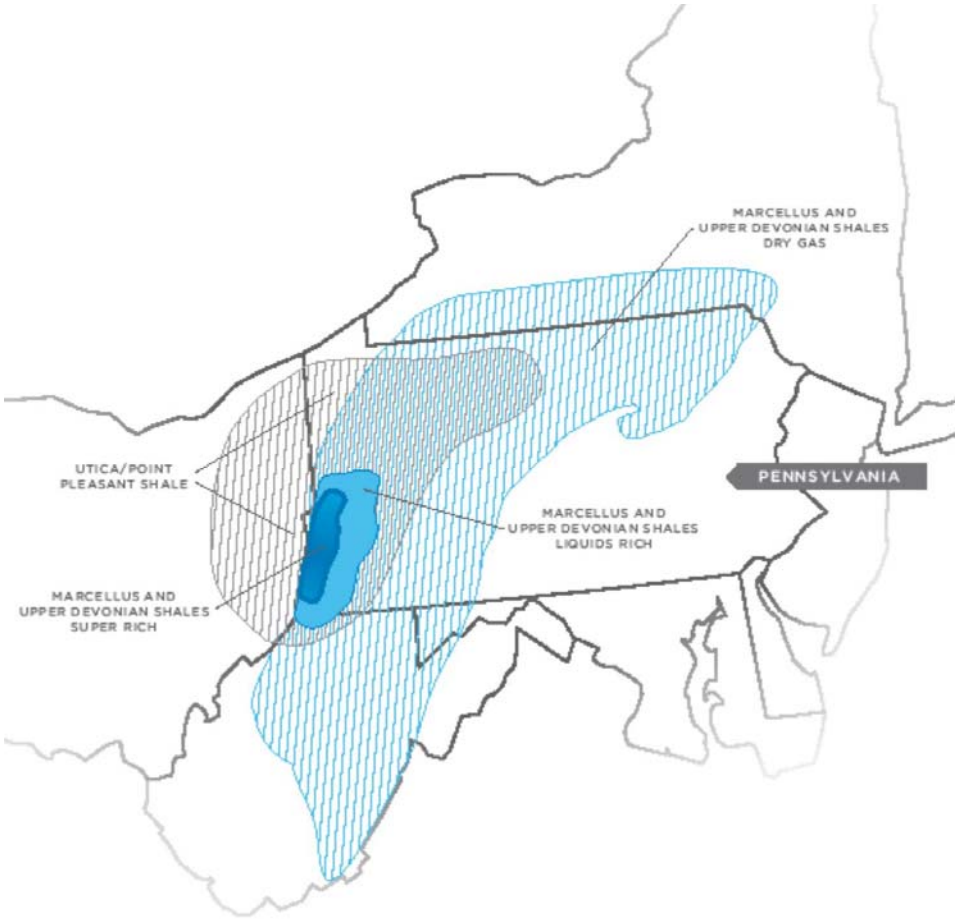
4. Marcellus significant source of NGLs, USGS: estimates 3.5 billion barrels recoverable in the play

5. Range of potential outcomes from failure to success (P99-P1)

6. In addition to Marcellus, triple pay potential with Upper Devonian and the Utica/Point Pleasant



7. In 2003 $4 stock with a $400 million market cap. Today about $74 stock with about $12 billion market cap. Assuming 80-acre spacing per well, only drilled 6% of our Marcellus acreage



Who's Responsible?

- Bill Zagorski
- Ray Walker
- John Applegath
- Greg Davis
- Matt Pitzarella
- Scott Roy
- Doug Bowman
- Andrew Tullis
- Curt Tipton
- Martin Emery
- Roger Manny
- John Pinkerton
- Mike Forrest
- Alan Farquharson
- Shawn Hodges
- Dave Styles
- Jim Funk
- Mark Whitley
- Jim Morris
- And many, many others…

Thank You