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Best Management Practices (BMPs): What?
How? And Why? (May 26)

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SLIDES: The Costs and Benefits of Best Management Practices: Insights from the Marcellus Shale

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The Costs & Benefits of Best Management Practices



**INSIGHTS & EXAMPLES FROM THE
MARCELLUS SHALE**

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Outline of Presentation

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- Discuss some features of shale energy production
- The incentives for drilling responsibly
- The environmental record in the Marcellus
- Estimating the environmental impacts
- Valuation of environmental impacts
- Defining best management practices
- Evaluating best management practices
 - May not be just a cost-benefit ratio
 - Product liability concerns & risks may be more important
 - What level of risk is acceptable & how much compensation is necessary for people to accept these risks?

Shale Drilling Employs Advanced Technology

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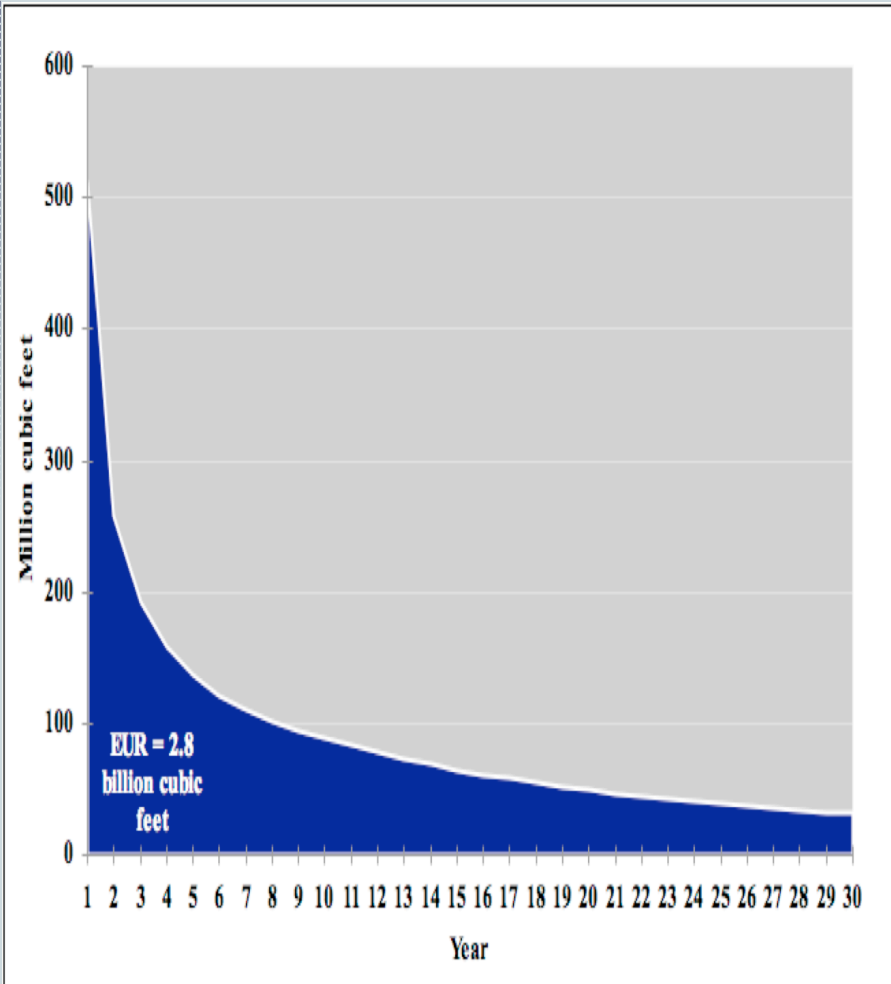
- Seismic Imaging
- Directional Drilling
- Hydraulic fracturing
- Continuous adaptation of techniques to local geology
- These innovations
 - Reduce time to drill,
 - Lower costs, and
 - Raise output
- A very dynamic industry



The Production Treadmill

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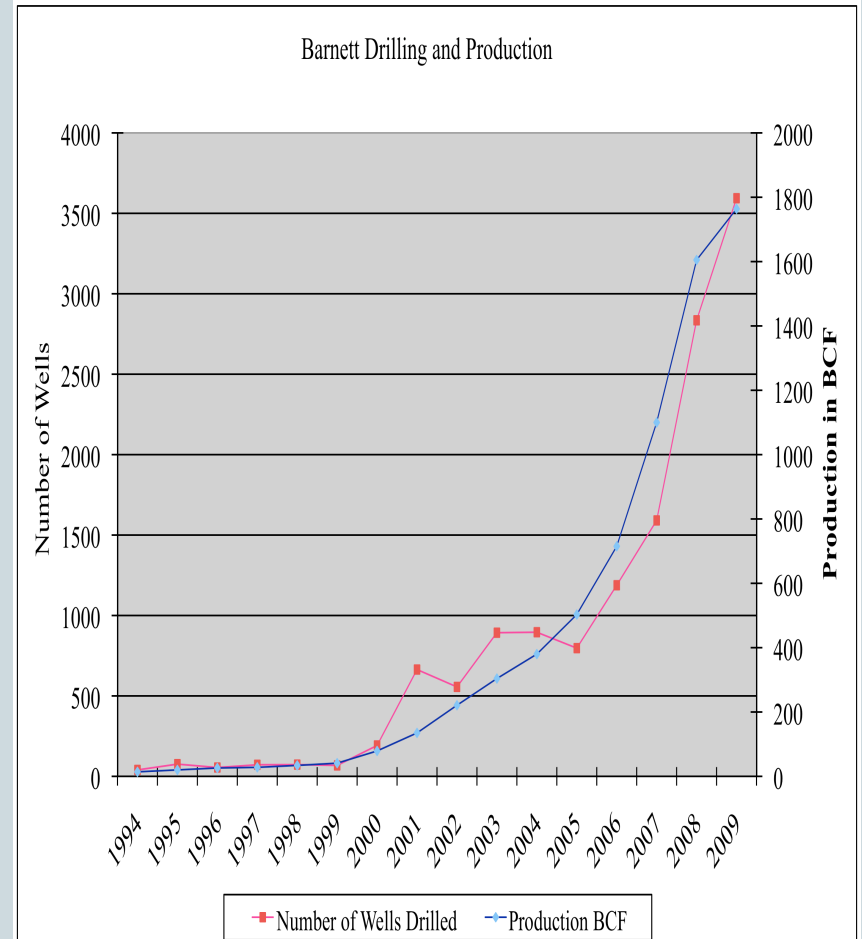
- Why so many wells?
- The steep production decline curve
- Example to right
 - Year 1: 511.9 mmcf
 - Year 2: 257 mmcf
 - Year 10: 88 mmcf
 - Year 30: 32 mmcf
- To keep increasing output, need to keep drilling!



History of Barnett Drilling & Production

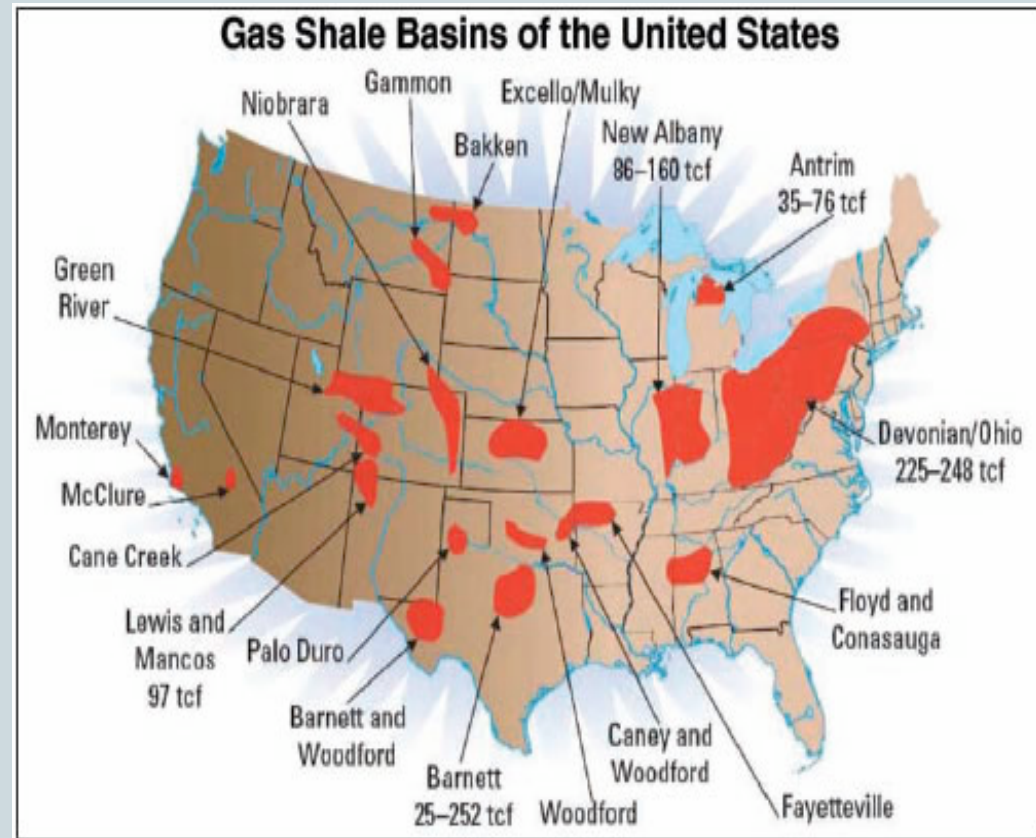
5

- Intensive drilling
 - Increase from 556 wells in 2002
 - To 3,594 wells in 2009
- Production increased
 - 221 bcf in 2002 (0.61 bcf / day)
 - 1,764 bcf in 2009 (4.83 bcf / day)
- Occurred in urban area over past 10 years



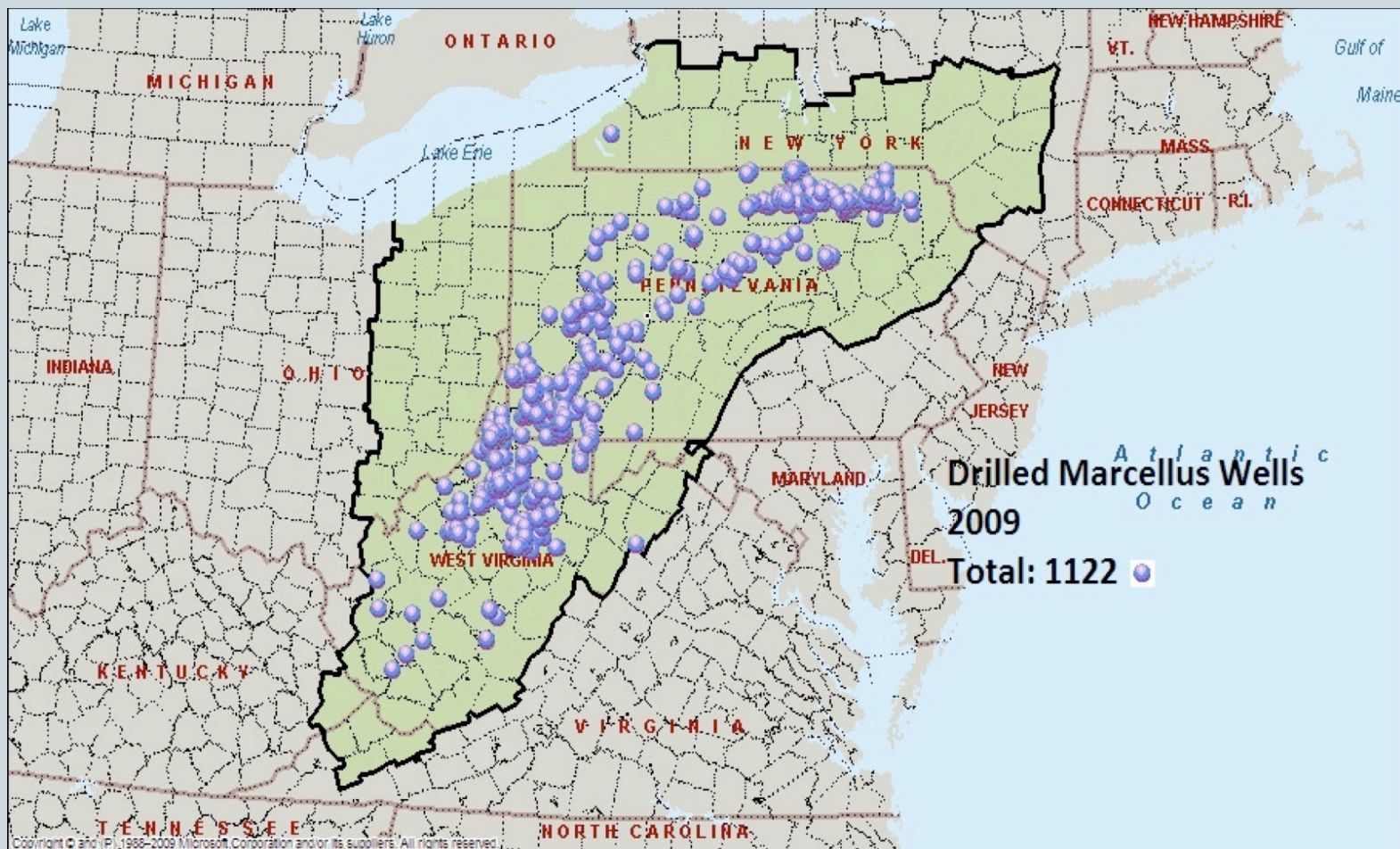
The Shale Plays Multiply

- After the great economic success of the Barnett shale many more shale plays began to pop up across the country
- Today there are about 20 large scale shale plays in the United States



Marcellus Drilling in 2009

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Marcellus Spending in millions of current dollars

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	Pennsylvania		West Virginia	
	<u>2008</u>	<u>2009</u>	<u>2008</u>	<u>2009</u>
Total Spending	3,224.6	4,535.3	889.8	1,313.3
Lease & Bonus	1,837.7	1,728.8	475.2	657.6
Exploration	121.9	243.8	35.4	55.8
Drilling & Completion	857.8	1,700.4	249.2	392.7
Pipeline & Processing	329.4	695.8	95.7	150.8
Royalties	22.2	54.7	18.2	30.9
Other	55.5	111.8	16.1	25.4
Severance Taxes	0	0	10.8	14.2

Source: Estimates & based upon industry surveys.

Economic Impacts

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Millions of 2010 dollars			
State &			
Year	Value Added	Local Taxes	Jobs
2008	2,556	265	30,137
2009	3,877	389	44,098
<i>Planned</i>			
2010	8,039	785	88,588
2011	10,129	987	111,413
<i>Forecast</i>			
2015	14,415	1,417	160,205
2020	18,853	1,872	211,909

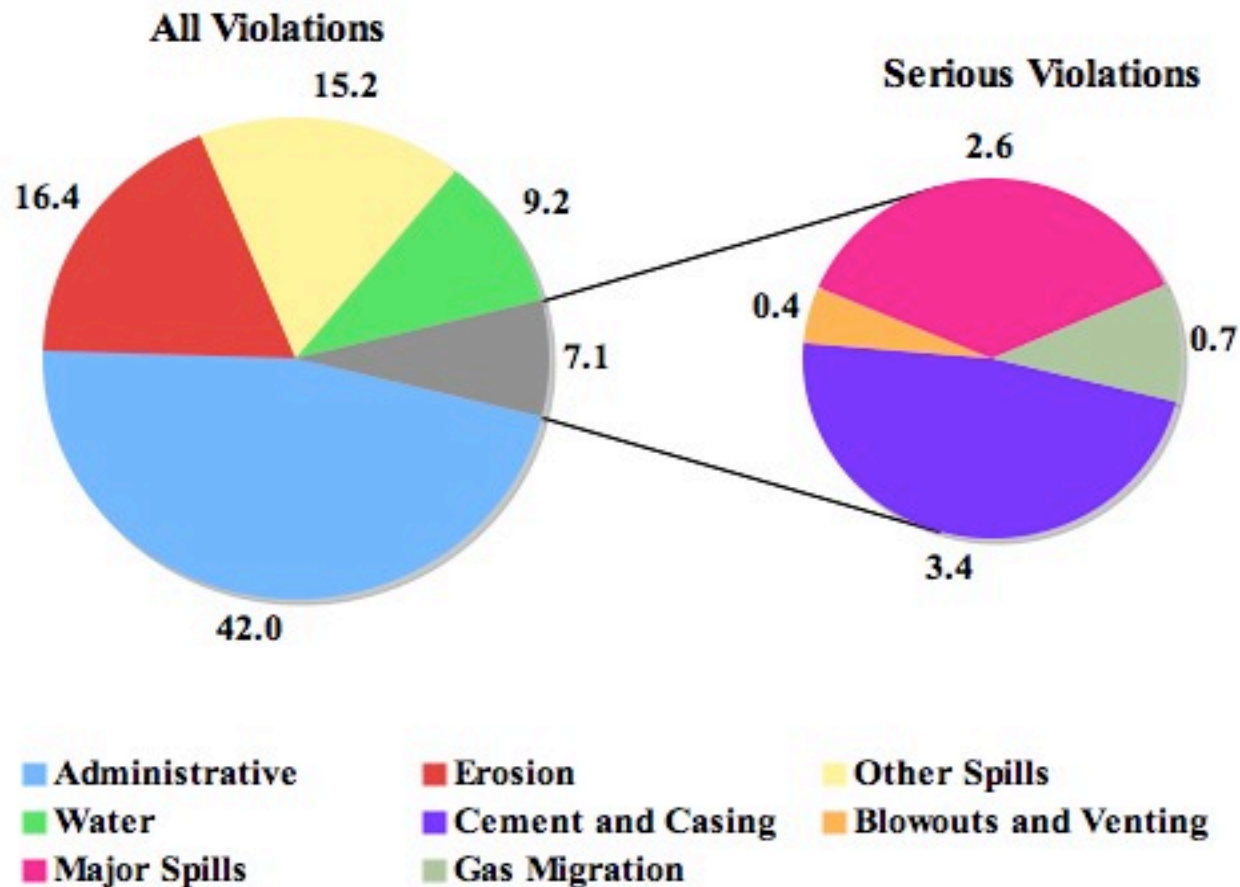
Environmental Impacts

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- **Unavoidable impacts**
 - Clearing of land for well pads and pipelines
 - Local congestion, noise, dust in rural communities
 - Emissions during drilling
- **Environmental hazards**
 - Stray gas – failures in casing & contamination of water
 - Containment pond breaches
 - Condensate handling
 - Well blow-outs, spills
- **Environmental risk – perceptions**
 - There have been isolated, serious problems
 - From a societal perspective, what is there proper context?

Environmental Violations

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Economic Benefits & Environmental Costs

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- **Benefits**
 - Gains in real output, jobs, and tax revenues
 - Environmental – avoided emissions from coal
- **Costs**
 - Air emissions from shale energy production
 - Water pollution
 - Forest disruption
 - Noise, traffic externalities, etc.
- **Are the costs really more than \$14.3 billion in cumulative value added from 2008 to 2010?**
- **What level of benefits are necessary to accept environmental risks?**

Best Management Practices: Goals & Methods

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- **Protecting water supplies**
 - American Petroleum Institute standards for cement
 - Use of intermediate casing strings
 - Using tarpaulins at well sites
 - Testing before & after drilling
 - Pipelines to move fresh & produced water
- **Ensuring safety – blowout preventers & crisis crews**
- **Reducing traffic – pipelines & air drilling**
- **Minimizing erosion & sedimentation – Closed system drilling & use of steel pits**

Evaluating Best Management Practices

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- Need for a baseline – breakout of “Allowance for Expenditure” forms in the industry
- What is currently being spent and for what?
- What are the incremental costs of BMPs?
- What are the benefits?
 - Reducing probability of accident or incident
 - Avoiding fines, law suits, and damages
- **Benefit-cost framework assumes risk neutrality**
 - Aversion to risky outcomes appears paramount
 - What is the local population’s willingness to accept risks?

Concluding Thoughts

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- Rapid technological change
- Intensive shale energy production underway
- Economic benefits are significant
- Environmental impacts – few & localized
- There are techniques to minimize these impacts
- Evaluation on a cost-benefit basis should be done
- Risk is critical
 - What is societal risk aversion?
 - What are acceptable risks & what level of compensation is necessary to accept these risks?