University of Pittsburgh

Marcellus Shale Development – Challenges and Opportunities

Presentation to the Marcellus Shale Advisory Commission

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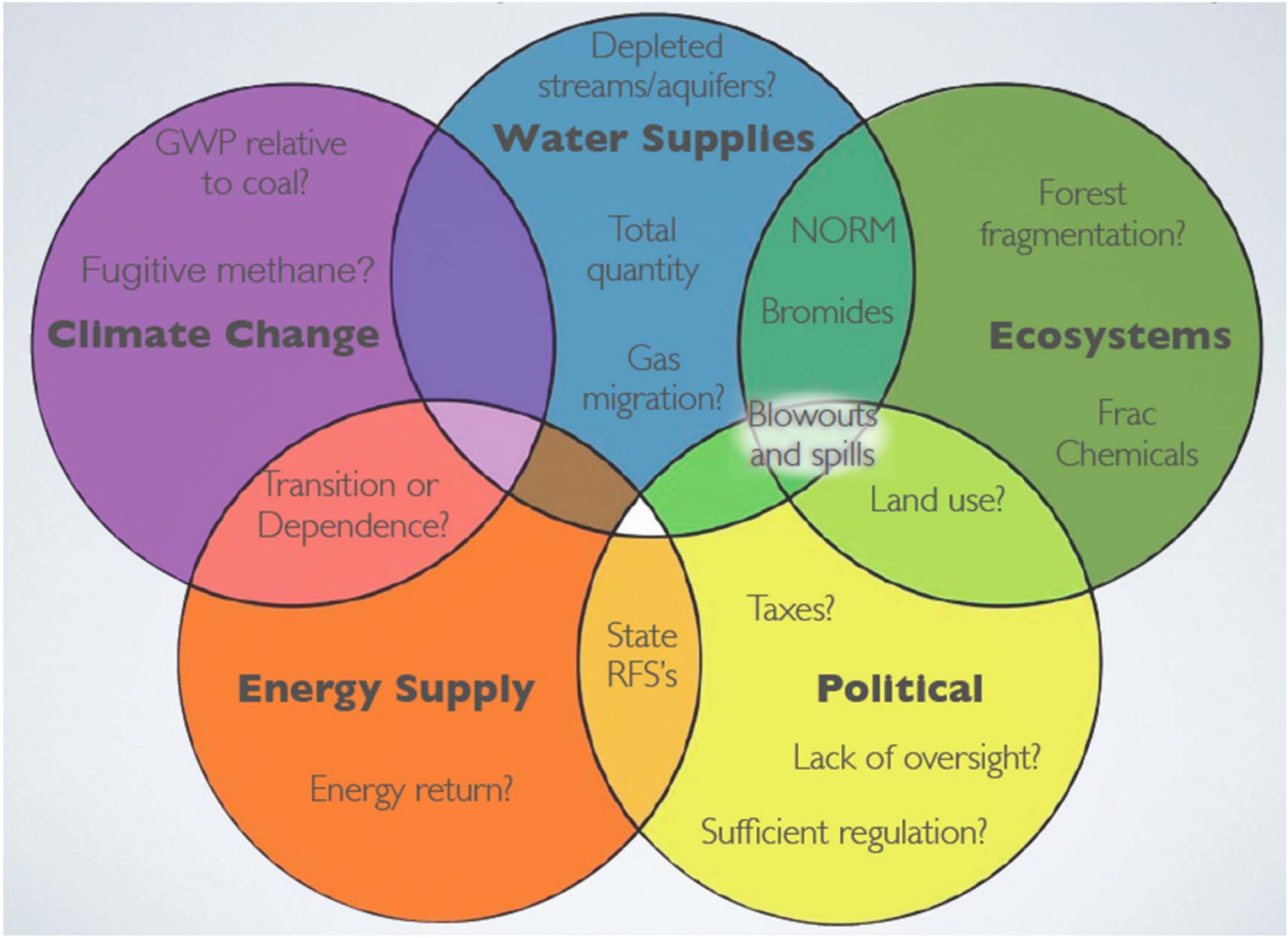
June 7, 2011

Safety and Environmental Protection

- **Life Cycle Assessment**
- **Drilling/fracturing operations**
- **Water management**
- **Air quality issues**
- **Long-term well stability**

Life Cycle Assessment



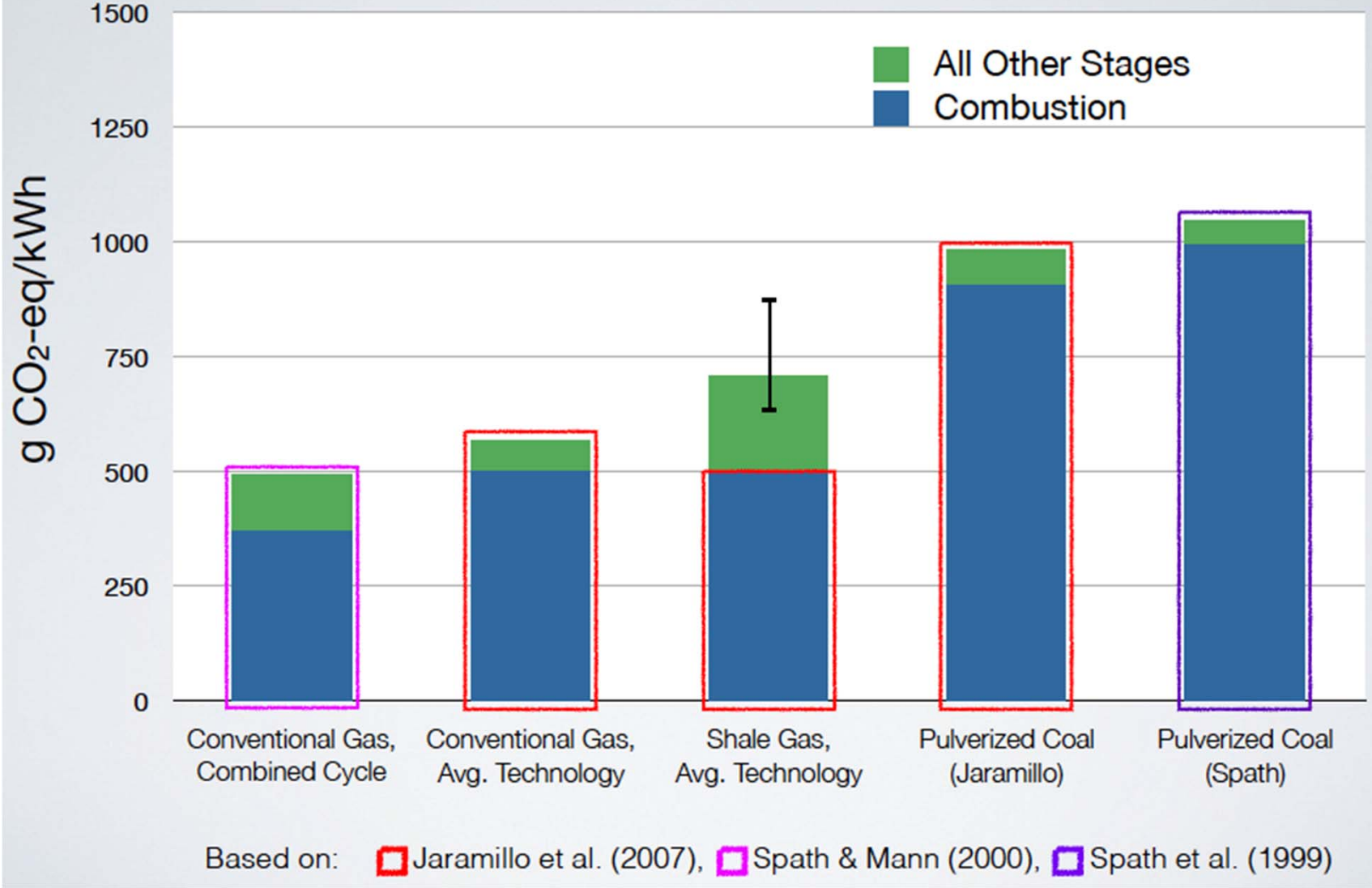
Life Cycle Assessment

- **Energy return on energy invested**
- **Water use**
- **Global warming potential**

Needs to be:

- **Based on actual data**
- **Expressed per unit of energy produced**

PRELIMINARY RESULTS



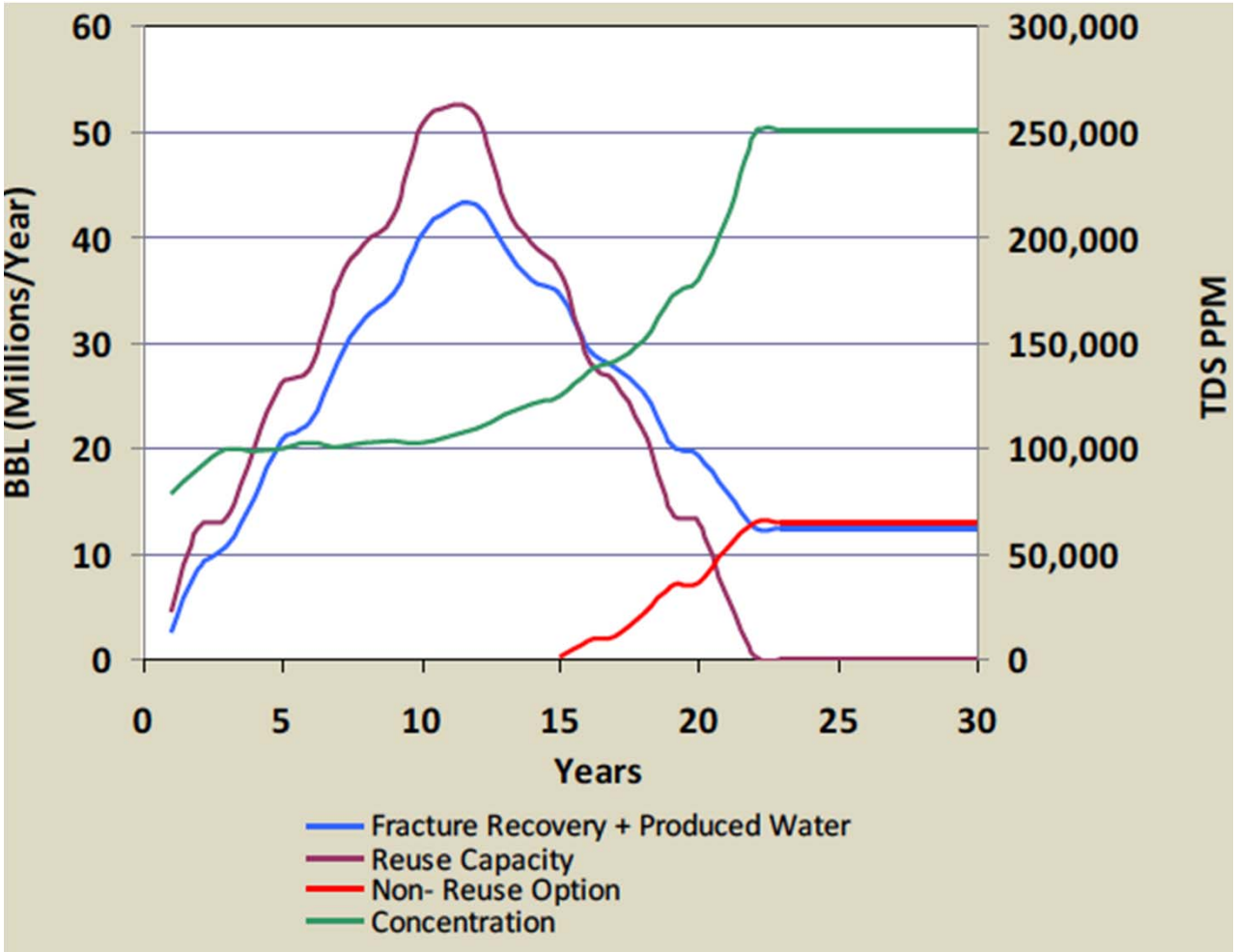
Drilling/fracturing operations

- Identify hazards
- Risk assessment/management
  - Major hazards
  - Emergency response scenarios
- Best management practices
- Technology Transfer
- Spill prevention/containment
- Environmentally-friendly drilling fluids

Water Management

- **Recycling/Reuse**
- **Water Bank Concept**
- **Water Treatment**
- **Acid Mine Drainage as a Resource**
- **Impoundment management**

Recycling/Reuse



- 4800 wells on 625 mi^2
- 3 refractures/well
- 33% water reuse

- Works for 12-15 yrs

- Eventually we are a net producer of water

Water Bank Concept

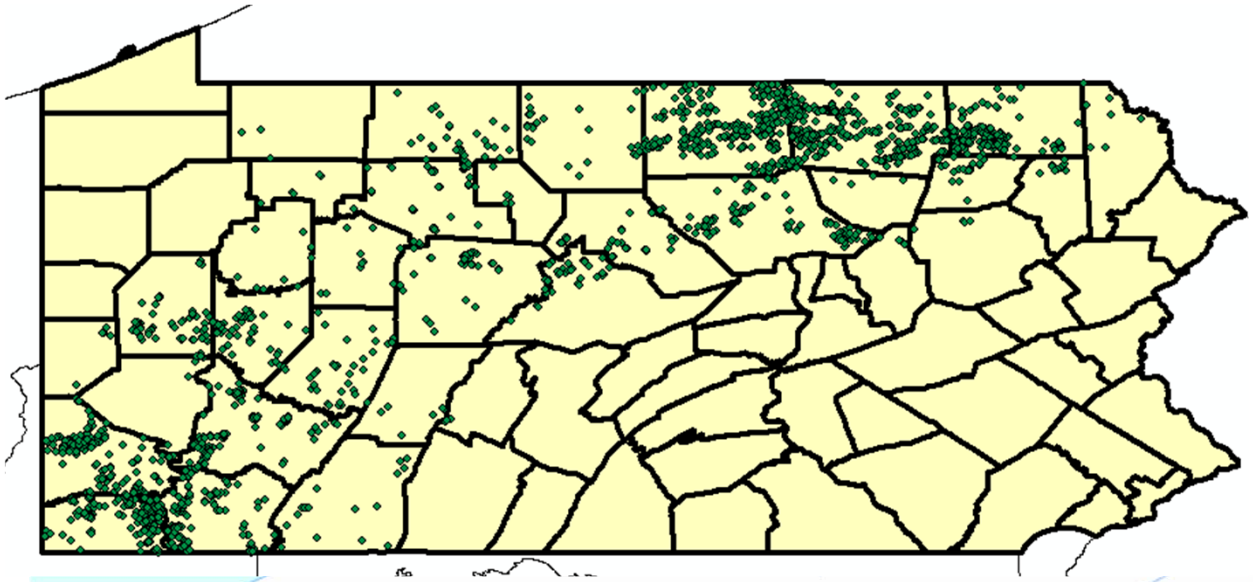
- **Reuse difficult for smaller operators**
  - **Insufficient well count**
  - **Insufficient capital**
- **Develop rules for water banking**
  - **Smaller operator dispose of their wastewater in regional impoundments**
  - **Larger operators get credit for water reuse and pollution elimination**

Water Treatment

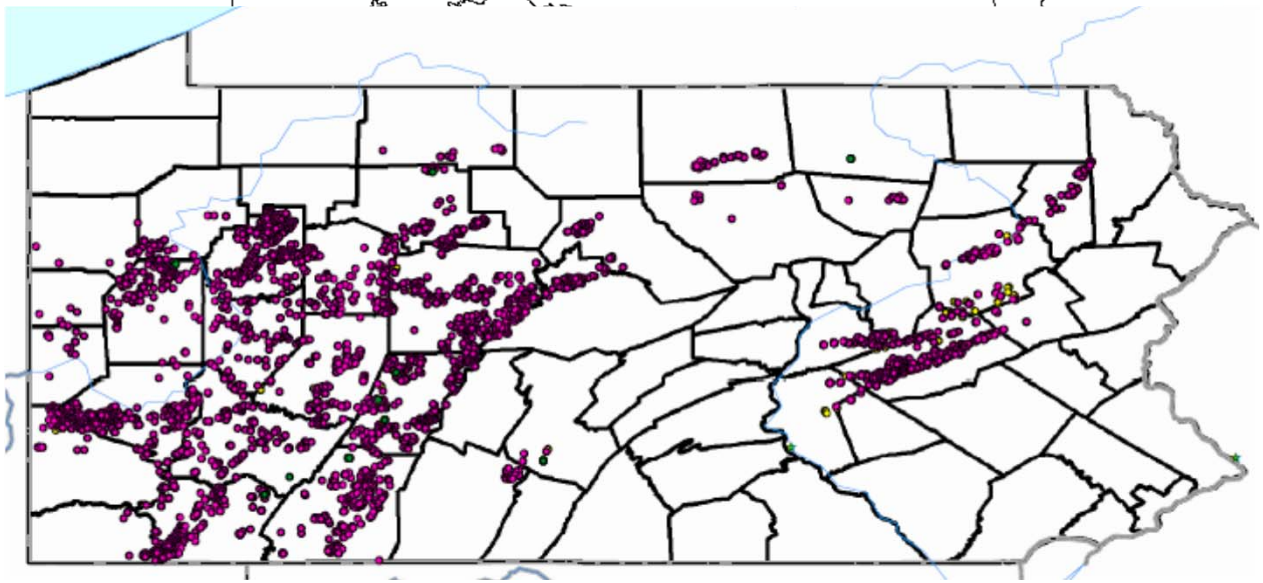
- **New technologies**
  - **Mechanical vapor recompression**
  - **Membrane distillation**
  - **Gas hydrates**
  - **Crystallization**
- **Export knowledge and technology development**
- **Salt Management/Utilization Plan**

Acid Mine Drainage as a Resource

Marcellus well sites



AMD sites



Acid Mine Drainage as a Resource

- **Policy Issues**
  - **"You touch it, you own it"**
  - **Involvement and clarification from the Commonwealth is needed now**
- **Technical issues**
  - **Quantity**
  - **Access**
  - **Sulfate**

Flowback/Produced water

Abandoned mine drainage (AMD)

Cleaner product

Quality sufficient for reuse

Constituent	K_{sp}
$BaSO_4$	1.08×10^{-10}
$SrSO_4$	3.44×10^{-7}

Impoundment Management

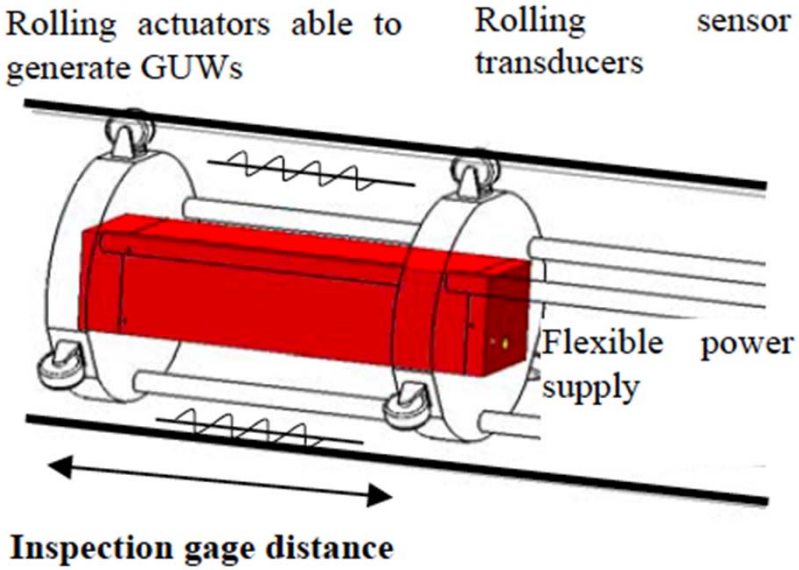
- **Leak detection/prevention**
  - **Optimal design**
  - **Containment guidelines**
- **Biological control**
  - **Aeration?**
  - **Disinfection?**
  - **Alternatives**

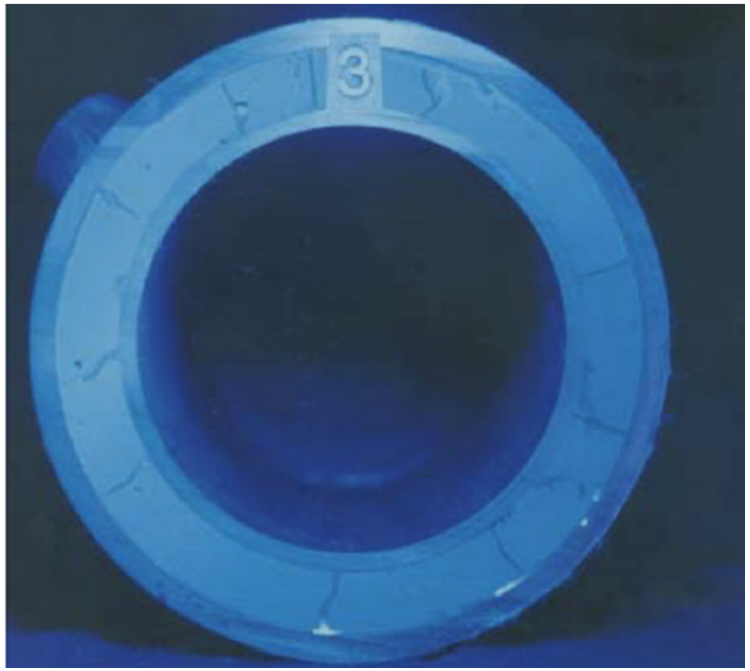
Air Quality

- **Emissions during drilling and fracturing**
- **Fugitive emissions (flaring)**
- **Emissions from impoundments**
- **Fugitive emissions during transport and processing**

Long-Term Well Stability

- **Monitoring**
- **Non-Destructive Evaluation (NDE)**
- **Casing/Construction Techniques**





The Time to Act is Now

- **What is needed**
  - **Data-driven, unbiased, peer-reviewed research on these problems**
  - **Universities can play role of *honest broker***
- **Problem is larger than any one municipality – i.e. Impact Fee not designed to solve Commonwealth-wide problems**

Center for Gas Resource Development

- **Health, Safety & Environmental Protection at Drilling Sites**
- **Holistic Water Management**
- **Life Cycle Assessment**
- **Transportation Issues**
- **Workforce Development**
- **Public Outreach & Economic Development**

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