

Broadening the Marcellus Discussion – *Overview of the Play*



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August 2009

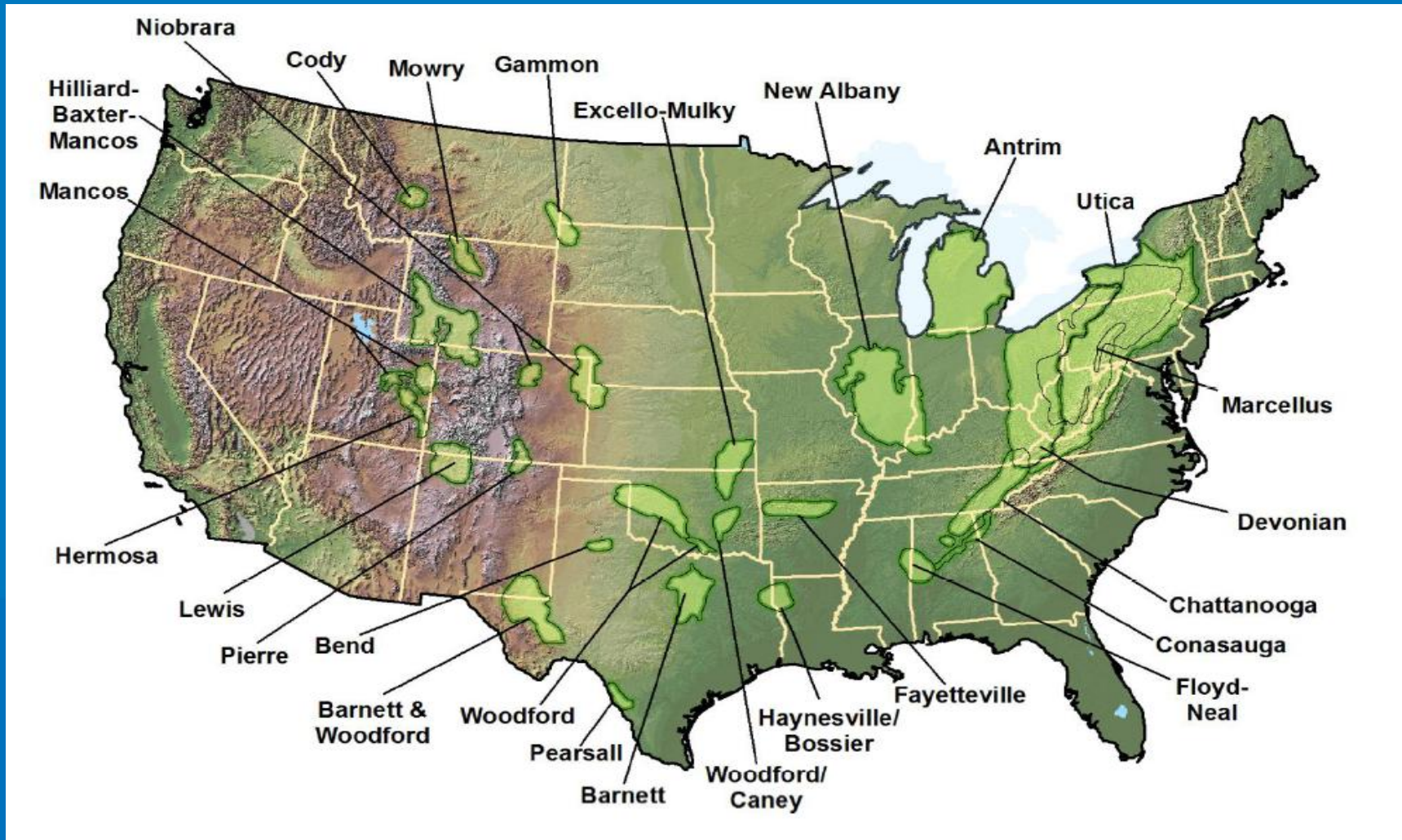
How big is the Marcellus Shale?

- ...now estimated that potential recoverable gas could be 363 trillion cu. ft. w/current technology.
- U.S. consumption annually is 20 trillion cu. ft.



Shale Gas Basins in the U.S.

Source: U.S. Dept. of Energy, 2009

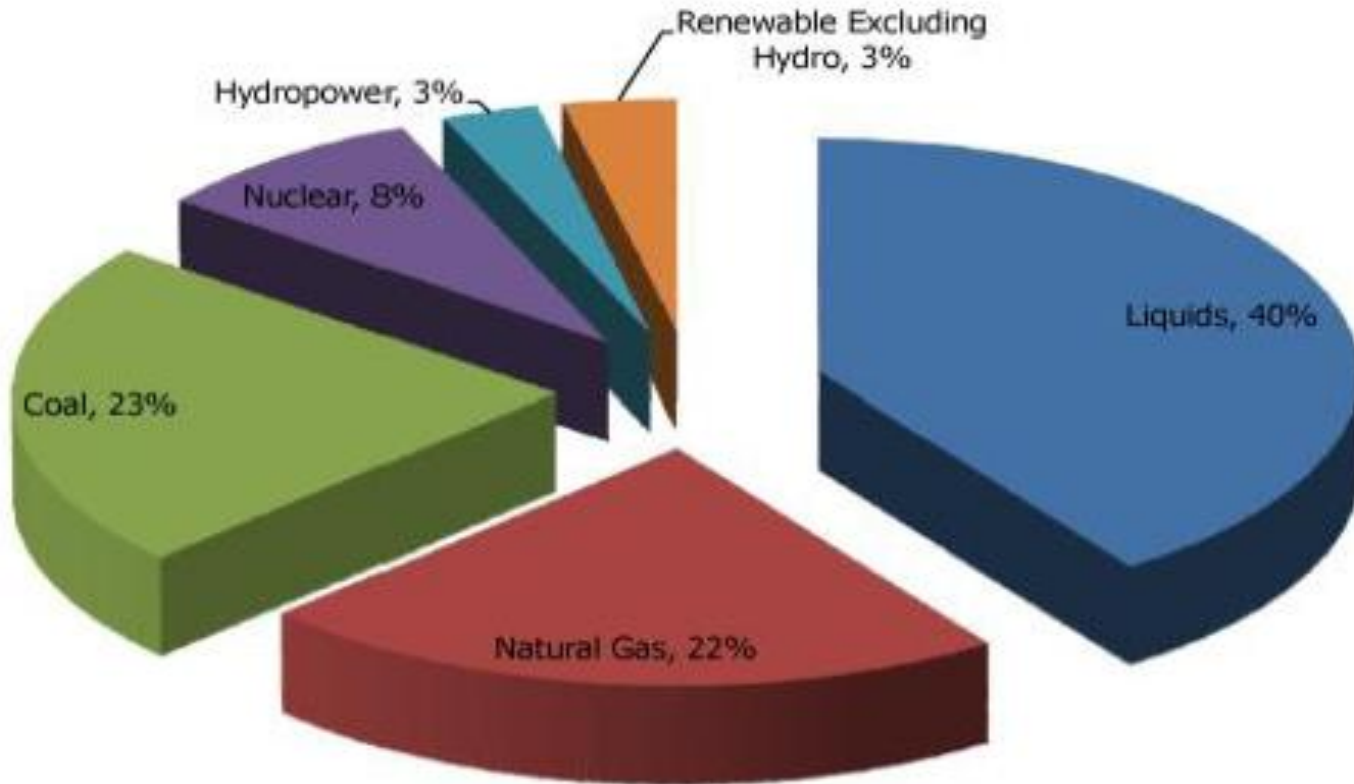


Natural Gas Facts

- Geologists estimate there may be a 100+ year supply of natural gas at current use rates
- Marcellus is largest shale play in U.S.
 - 53,000 sq. miles+
 - Lifespan to drill and extract is likely decades
- Companies reporting increasingly strong yields on Marcellus wells -2 to 10 Mmcf/d
- Transportation costs add up to 50% onto cost of gas at delivery
- Proximity to market is key for Marcellus
- 500 Marcellus wells planned for '09
- Rig count climbing in PA

U.S. Energy Consumption

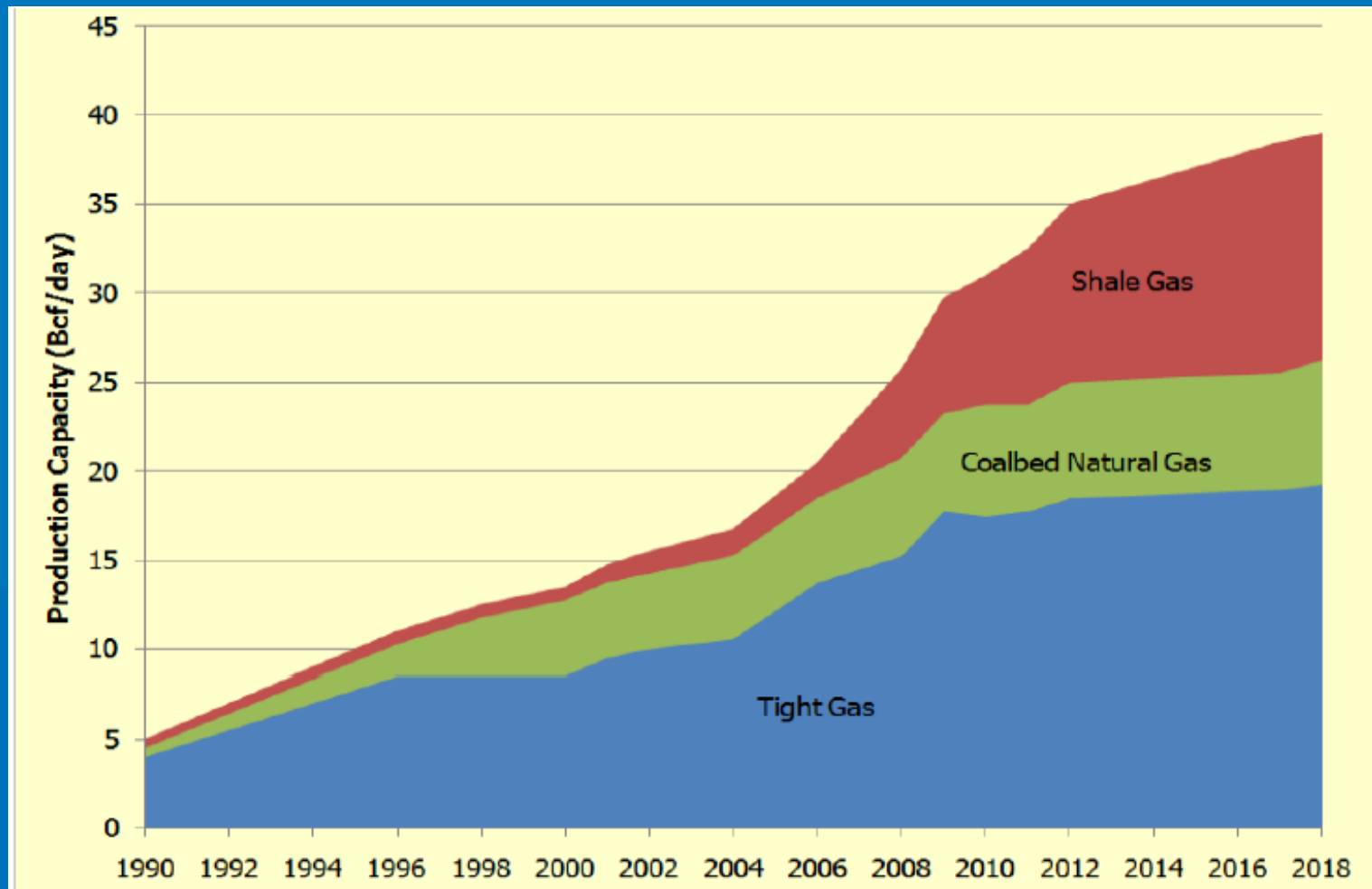
Source: Energy Information Agency, 2008



Natural Gas Production Future

Unconventional Sources

Source: American Clean Skies, 2008



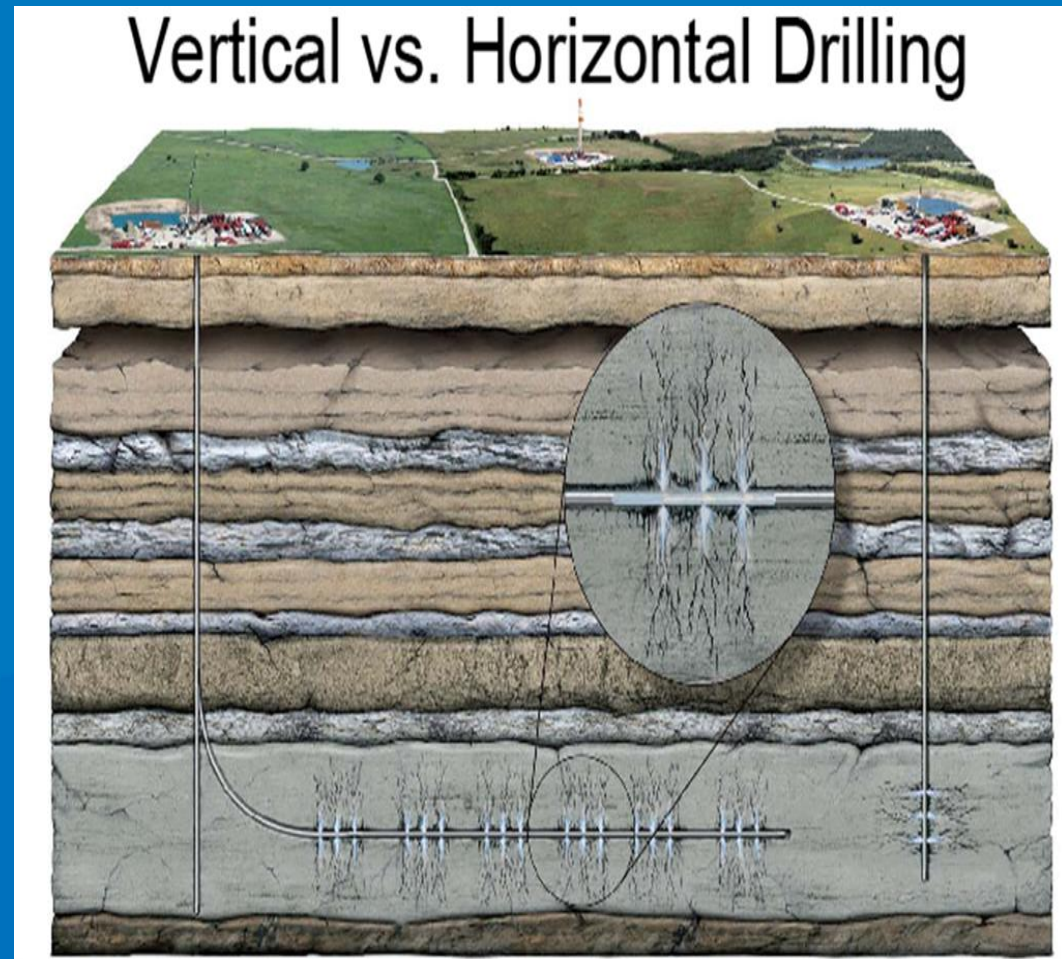
Why here? Why now?

- *New technology.
- *Favorable economics



Process

- Acquire permits
 - DEP/SRBC/others
 - Water access
- Construct well site
- Drill well
- Completion process
- Pipeline



Issues Associated with Marcellus

- Leasing to landowners unfamiliar with process
 - tens of thousands
- Legal uncertainties w/lease documents
 - few trained attorneys
- Financial decisions lasting generation(s)
- Limited understanding of economics of the process



Impacts on Communities

- Rural and urban
- Long term road impacts
- New “haves” and “have nots”
- Local officials
 - new decisions
 - new skill sets
 - various legal agreements
 - road
 - water access
 - equipment storage
 - rental rates



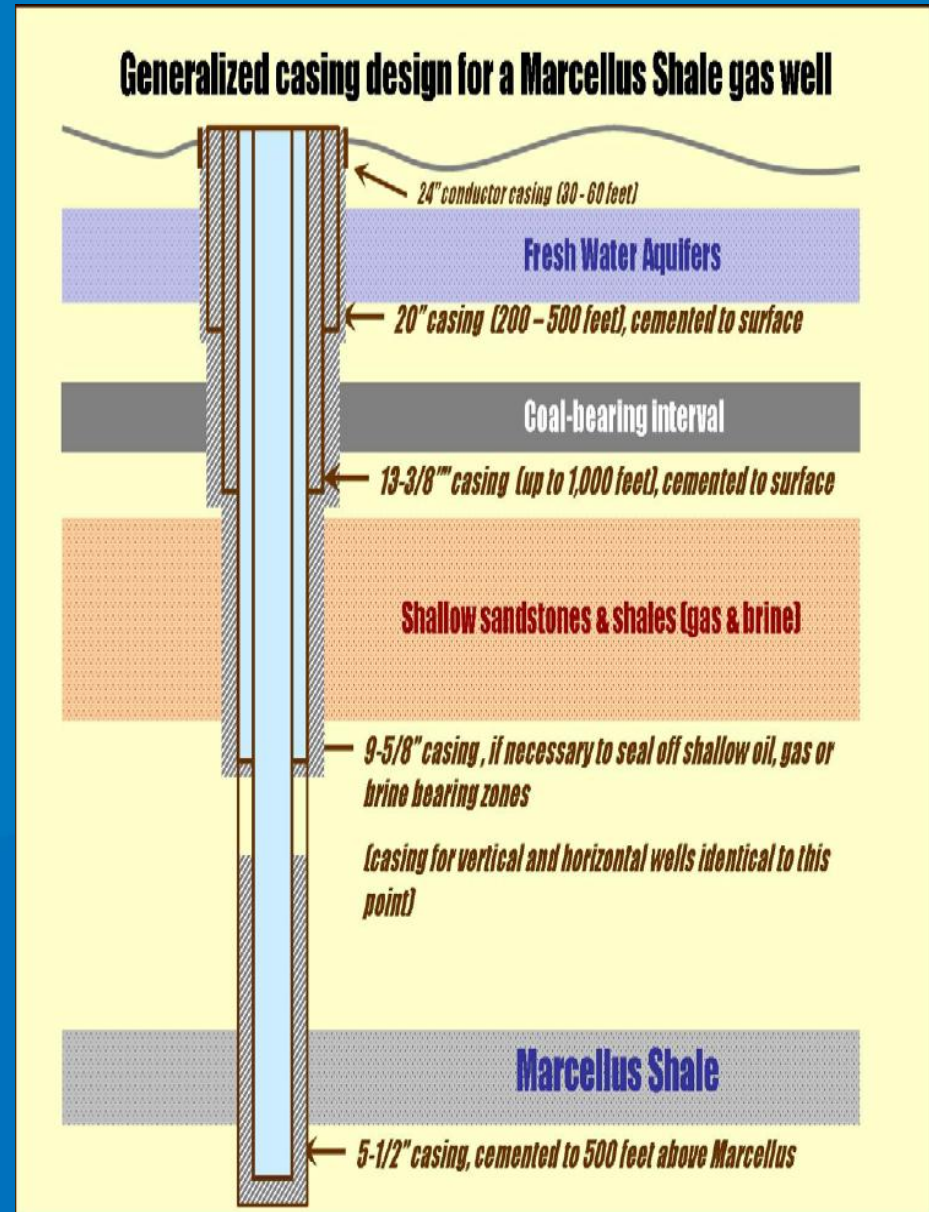
Environmental Issues

- Groundwater
- Surface waters
- Headwater streams
- Gas migration
- Sound
- Wildlife
- Erosion & Sediment
- Forest fragmentation
- Aesthetics –viewsheds



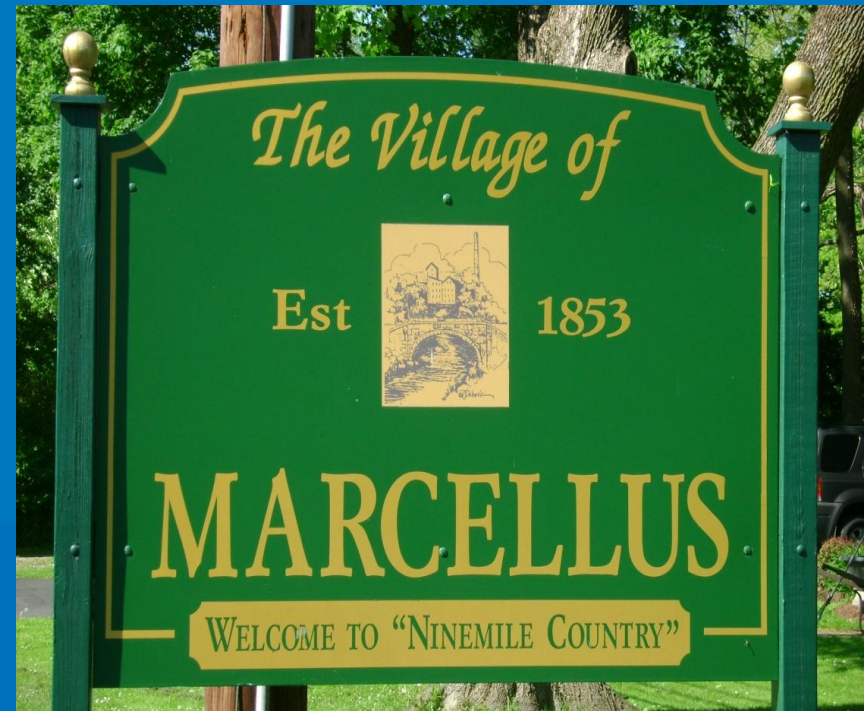
Common Marcellus well bore construction

-Well is drilled in stages with each section of the process grouted with concrete to prevent intrusion of water from deeper rock strata from reaching groundwater layers.



Education

- Huge demand for education from non-biased source such as land-grant Universities
 - Landowners
 - Elected officials
 - Agency personnel
 - Including workforce entities
 - Environmental groups
 - School teachers
 - Non-impacted residents
 - Media



Programs Offered:

- Leasing
- Water quality/testing
- UIC
- Road use agreements
- Environmental (broad)
- Wildlife considerations
- Forestry
- Economic development
- Real estate
- Regulatory
- Natural gas economics
- Legal community (PBI)
- Schools/teachers
- Workforce development
 - MSETC PSU/Penn College
- Elected officials training
- Others

Delivery

- Public webinar series
- Video conferencing
- Marcellus print materials
- Web site
- WPSU
- Media
- Multi-state outreach
 - NY, OH, WV, MD, KY
- Trusted local connections w/stakeholders
- Bridge between industry and groups
- Resources of University
 - COAS, EMS, Business, etc

Build Out of Infrastructure

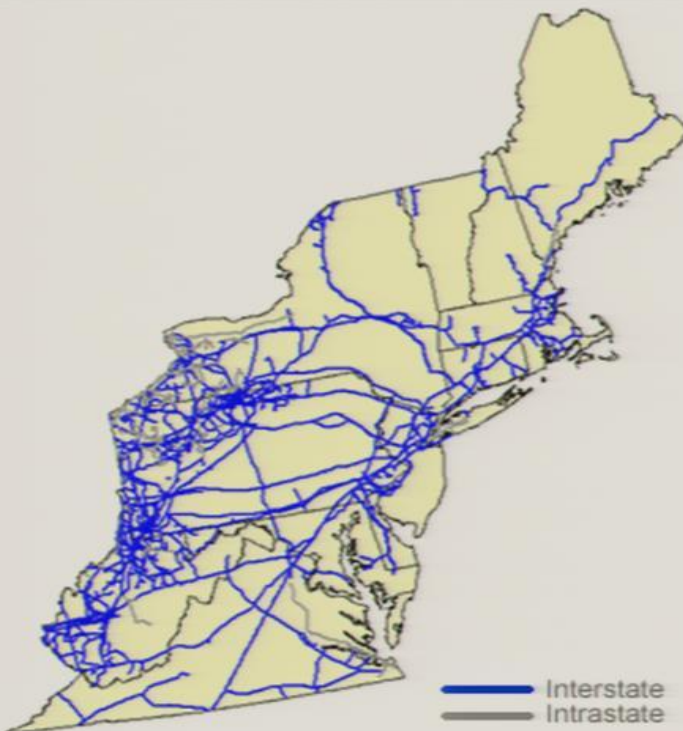
Key components:

- Pipeline
- Compressors
- Gas Processing Plants
- Water Treatment/Injection (availability)
- Oil Field Service Companies
- Regulatory Agencies –monitoring the process
- Work force needs

Pipelines

Source: MarkWest Corp., 2009

Challenge: Moving Gas to Market



- ▶ Historically, PA's gas supply focused in western PA
- ▶ Pipeline network built around this supply hub
- ▶ Typically accommodates low pressure low volume gas



North East Pipeline Network



Pipelines

- Critical to development of well
- Little high pressure gathering capacity in PA
- No eminent domain for gathering lines
- FERC for interstate transmission lines.
- Placement of lines
- Various impacts & considerations

Water



- Cradle to grave permit(s)
- Thousands of gals. to drill, millions to frac
- Lease opportunities for landowners
- Sourced from:
 - mainly larger streams/rivers
 - impoundments

Treatment

- Very expensive
- Weak link in process
 - Limited options
 - Limited final disposal
- New regs in PA
- Reclaiming supplies
 - Wastewater
 - Acid Mine Drainage
- Reuse/recycle



Deep Well Injection

- Industry prefers option due to cost and env'tl reasons
- Multiple wells already
- Does geology support additional sites?
- Deeper formations
- Wells planned for '09?
- Strategic locations
 - highly profitable
 - truck traffic



Oil Field Services

- Most needed drilling services scaled for Marcellus were not in Appalachian basin
 - New regional centers in WV/PA/Southern Tier NY
- Critical link in development
- Many new high tech positions
- New short line rail demand, commercial real estate interest, airport traffic, engineering offices, road re-construction, housing development.

Marcellus Economics

- 35+ energy companies looking at Marcellus and increasing
 - \$5 Billion+ collectively for Marcellus activity
 - Some selling other assets to reposition here
- Ancillary businesses
 - Millions in private investment already
 - Ex: water treatment, food services, transport, retail sales, diesel repairs, equipment rental

Opportunities/challenges in Pennsylvania: **Economic & Workforce**

- **Businesses**
 - Existing local businesses benefit?
 - ‘New’ local businesses?
 - Attract outside businesses?
- **Workers & Residents**
 - Local residents/workers HAVE the skills?
 - Locals LEARN the skills?
 - Youth LEARN the skills & stay?
 - Newcomers to move into state?

Impacts on other sectors – tourism?

Community and Local Government Issues

- Roads & Bonding
- Water
- Population growth and change
- Infrastructure
 - emergency preparedness
 - human service, education
- Housing needs
- Cultural change (conflicts?)
- Economic development
- Environmental impacts
- Workforce development opportunities

Ultimate Impacts...

- People
- Communities
- Environment





www.naturalgas.psu.edu

www.pct.edu/msetc