The Public Health Implications of Marcellus Shale Activities

Bernard D. Goldstein, MD
Department of Environmental and Occupational Health
University of Pittsburgh
Graduate School of Public Health
bdgold@pitt.edu

My View: What's the Rush to Drill the Marcellus Shale?

- There is no reasonable scenario in which non-fossil fuels or energy conservation will completely obviate our national need for fossil fuels in the next few decades
- During this time it is certain that virtually all of the natural gas within the Marcellus Shale will be tapped
- In contrast to the Gulf oil deposits, which might be tapped by other countries, the Marcellus Shale natural gas is ours
    - **So what's the rush?**

Usual Progression of Environmental and Occupational Issues Related to Human Health

1) Potentially harmful societal/industrial activities occur before necessary health and safety information is available
2) Report of adverse health outcomes potentially associated with activity
3) Major public concern
4) Inability to establish cause and effect relationship primarily because of inadequate exposure information

MARCELLUS SHALE ACTIVITIES: FOUR CERTAINTIES

1) **Surprises**

Unforeseen threats to human health will be detected.

2) **Disease Clusters**

Clusters of adverse health effects will occur in communities in which Marcellus shale activity has occurred, whether causally related or not

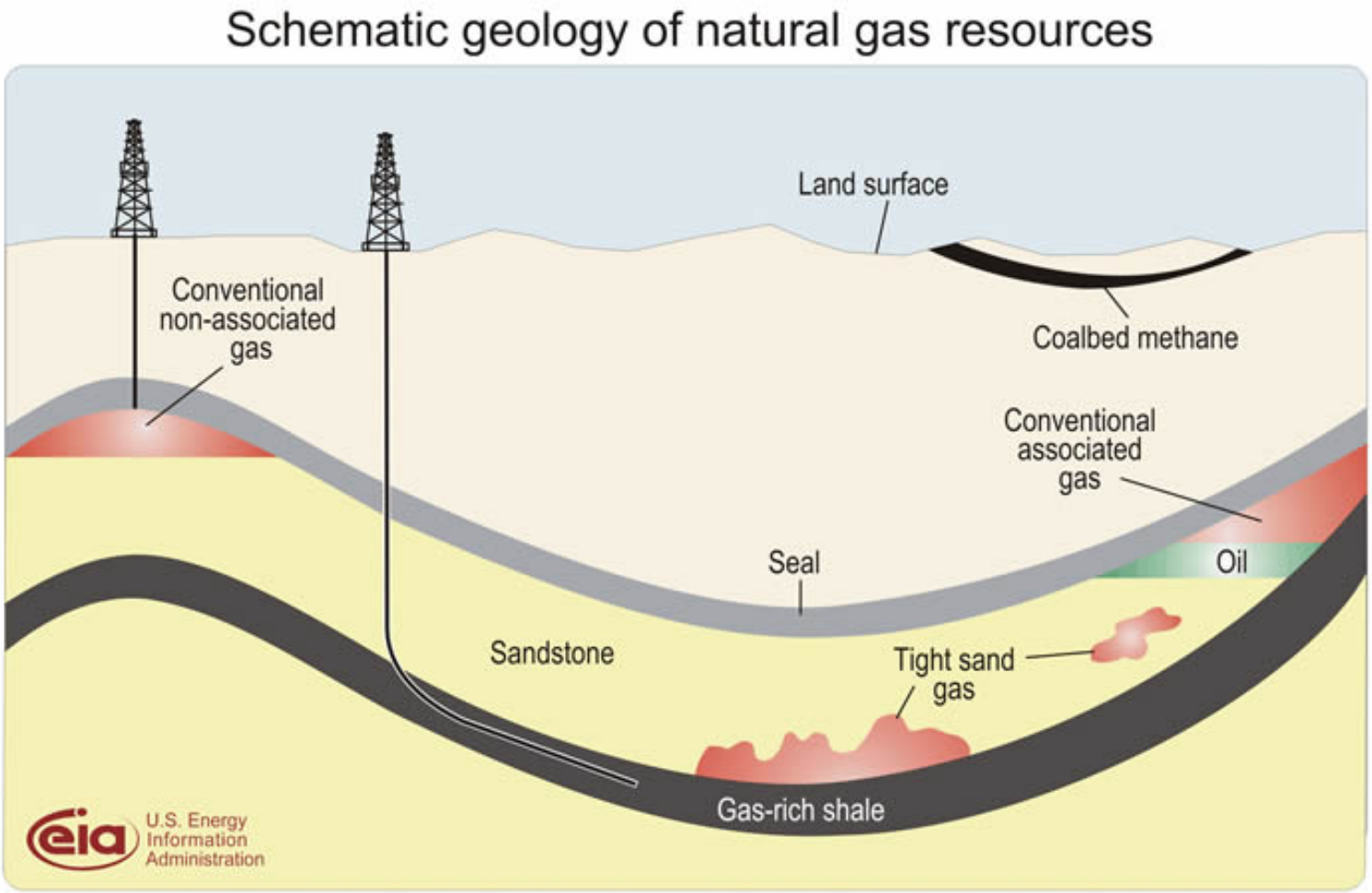
3) **Psychosocial Disruption**

Exacerbated by inadequate planning, and by uncertainty, secrecy and mistrust

4) **Less Pollution Over Time**

Industry will find ways to recycle fracking chemicals (which they buy); and emit less of their product (which they sell)

Conventional and Non-conventional Natural Gas Extraction Methodologies



Drilling Rig in Rural Upshur County, WV

12 Types of Additives for Fracking (0.5% of fluid)

Additive	Example Chemical	Purpose
Acid	Hydrochloric acid or muriatic acid	Helps dissolve minerals and initiate cracks in the rock
Antibacterial agent	Glutaraldehyde	Eliminates bacteria in the water that produces corrosive by-products
Iron control	Citric acid	Prevents precipitation of metal oxides
Breaker	Ammonium persulfate	Allows a delayed break down of the frac gel
Corrosion inhibitor	n,n-dimethyl formamide	Prevents corrosion of pipe
Crosslinker	Borate salts	Maintains fluid viscosity
Surfactant	Isopropanol	Increases viscosity of the frac fluid
Friction reducer	Petroleum distillate	Minimizes friction
Gel Guar gum	Hydroxyethyl cellulose	Helps suspend the sand in water
Clay stabilizer	Potassium chloride	Brine carrier fluid
pH adjusting agent	Sodium or potassium carbonate	Adjusts and controls pH of the fluid
Scale Inhibitor	Ethylene glycol	Reduces scale deposits in pipe

Sources: Earthworks. (2011). *Hydraulic Fracturing 101*. Retrieved Jan 11, 2012, from http://www.earthworksaction.org/issues/detail/hydraulic_fracturing_101#CHEMICALS;
EnergyIndustryPhotos. (2008). *What is Hydraulic Fracturing and What is it Used for?* Retrieved Jan 11, 2012, from http://www.energyindustryphotos.com/what_is_hydraulic_fracturing.htm

Reasons given by those not in favor of Marcellus Shale drilling

(preliminary data)

Washington, PA public meeting with Natural Gas Subcommittee of the Secretary of Energy Advisory Board, N=59

Reason	Percent (%)
Environmental Concerns	76.3
Negative Effects on Water	66.1
Negative Effects on Air	42.4
Chemicals in Water	30.5
General Health Concerns	61.0
Health Problem in Family member attributed to drilling	20.3
Personal legal rights have been infringed upon by companies	11.9
Concerns about safety of drilling operations	33.9
Concerns about lack of regulation of industry	42.4
Bias, conflict of interest, or lack of expertise in desired subject area by members of the committee	18.6
Export of domestic natural gas resources	10.2
Depreciation in property values	3.4

Contradiction and Confusion

<u>Does hydrofracking cause groundwater contamination?</u>

1) There is no proven incident in which hydrofracking has caused groundwater contamination

2) Major water contamination has occurred as a result of Marcellus shale drilling activities

<u>Is hydrofracking old or new?</u>

1) New hydrofracking technology now permits extraction of gas trapped in the Marcellus shale

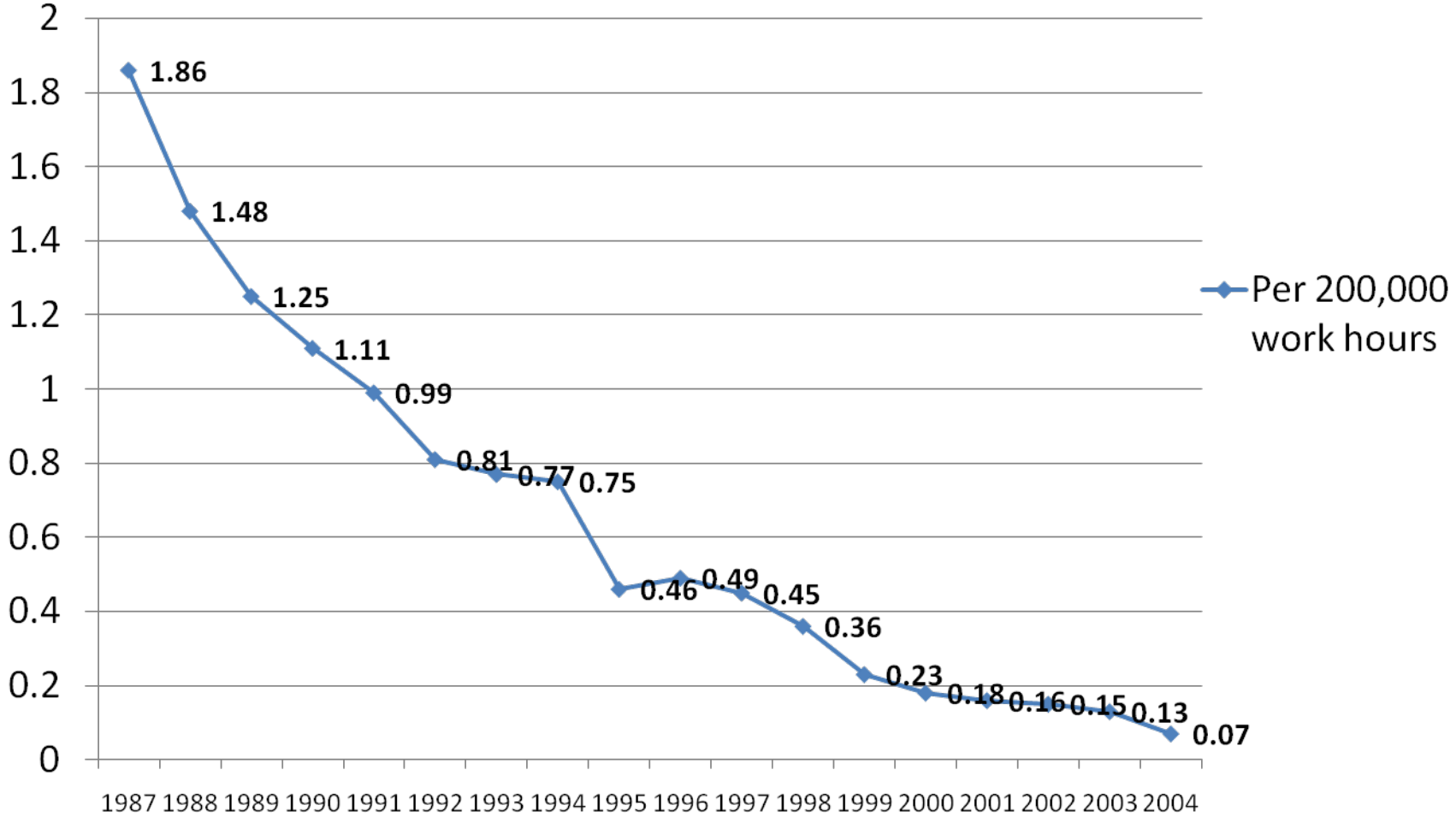
2) We have been doing hydrofracking for decades so there is nothing to worry about

ACCIDENT

vs

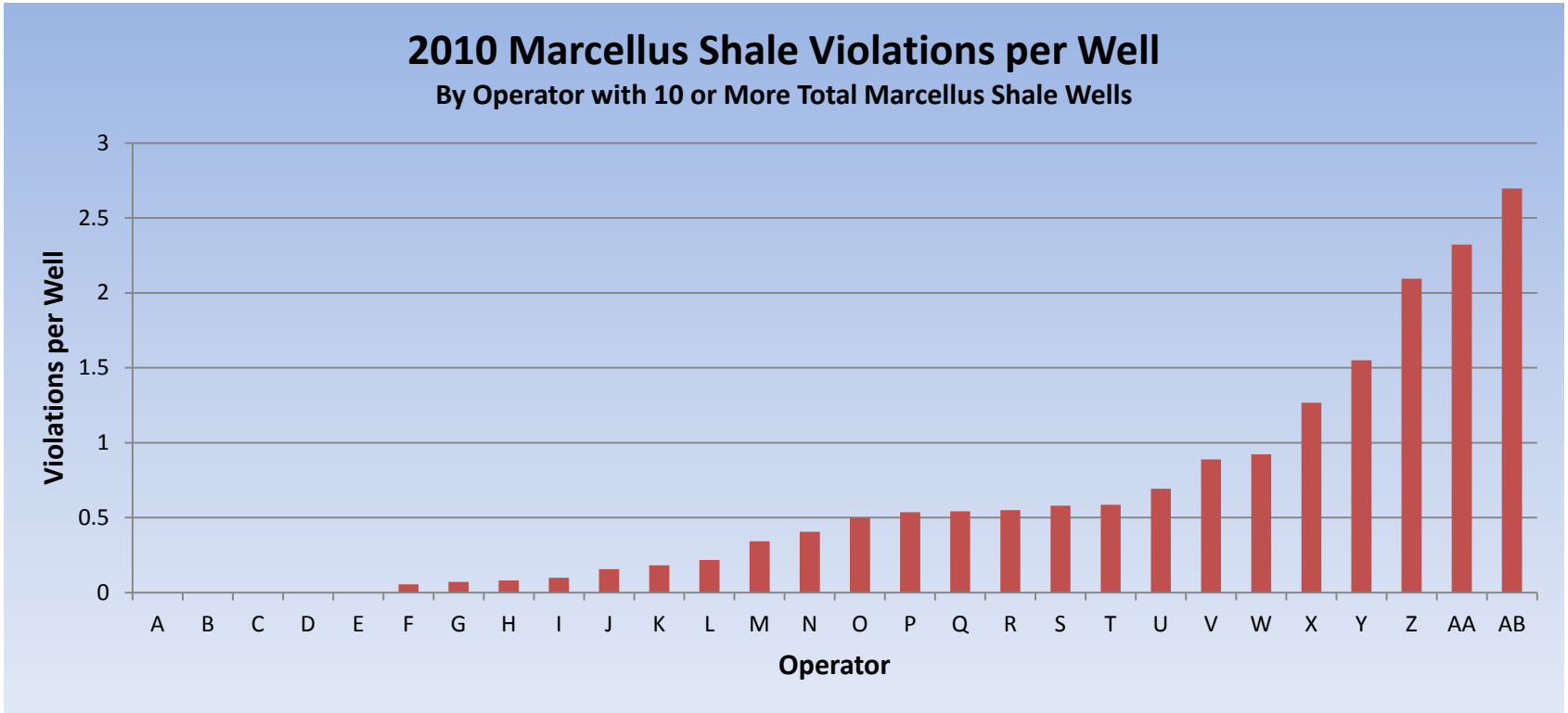
INCIDENT

Alcoa Lost Workday Performance 1987-2004



Center for Healthy Environments and Communities

Preliminary Findings



Why Are We Worried?

Multiple pathways to adverse health impacts exist

- Worker health and safety
- Air pollution
- Water pollution
- Soil pollution
- Noise pollution
- Community safety: traffic, explosions, fires; crimes
- Psychosocial disruption
- Sustainability
- Global climate change

Impacts on Individuals:

When drilling occurs, it may continue 24 hours/day for several weeks, depending on the number of wells on a pad.

from:www.fractracker.org

Beyond Chemical Releases and Their Potential Health Impacts:

- Co**mmunity impacts that can**
  - Create stress that directly impacts individuals' health
  - Create change in the physical and social environments that indirectly contribute to health problems

  including heart disease, diabetes, obesity, mental health and other health impacts.

COREXIT 9500 MSDS: NALCO

(edited)

2. COMPOSITION/INFORMATION ON INGREDIENTS

Our hazard evaluation has identified the following chemical substance(s) as hazardous:

Hazardous Substance(s)	**(w/w)**
- Distillates, petroleum, hydrotreated light	10.0 - 30.0%
- Propylene Glycol	1.0 - 5.0%
- Organic sulfonic acid salt (Proprietary)	10.0 - 30.0%

12 Types of Additives for Fracking (0.5% of fluid)

Additive	Example Chemical	Purpose
Acid	Hydrochloric acid or muriatic acid	Helps dissolve minerals and initiate cracks in the rock
Antibacterial agent	Glutaraldehyde	Eliminates bacteria in the water that produces corrosive by-products
Iron control	Citric acid	Prevents precipitation of metal oxides
Breaker	Ammonium persulfate	Allows a delayed break down of the frac gel
Corrosion inhibitor	n,n-dimethyl formamide	Prevents corrosion of pipe
Crosslinker	Borate salts	Maintains fluid viscosity
Surfactant	Isopropanol	Increases viscosity of the frac fluid
Friction reducer	Petroleum distillate	Minimizes friction
Gel Guar gum	Hydroxyethyl cellulose	Helps suspend the sand in water
Clay stabilizer	Potassium chloride	Brine carrier fluid
pH adjusting agent	Sodium or potassium carbonate	Adjusts and controls pH of the fluid
Scale Inhibitor	Ethylene glycol	Reduces scale deposits in pipe

Sources: Earthworks. (2011). *Hydraulic Fracturing 101*. Retrieved Jan 11, 2012, from http://www.earthworksaction.org/issues/detail/hydraulic_fracturing_101#CHEMICALS;
EnergyIndustryPhotos. (2008). *What is Hydraulic Fracturing and What is it Used for?* Retrieved Jan 11, 2012, from http://www.energyindustryphotos.com/what_is_hydraulic_fracturing.htm

Disclosures Not Required Under the New PA Law

Notwithstanding any other provision of this chapter, a vendor, service provider or operator shall not be required to do any of the following:

(1) Disclose chemicals that are not disclosed to it by the manufacturer, vendor or service provider.

(2) Disclose chemicals that were not intentionally added to the stimulation fluid.

(3) Disclose chemicals that occur incidentally or are otherwise unintentionally present in trace amounts, may be the incidental result of a chemical reaction or chemical process or may be constituents of naturally occurring materials that become part of a stimulation fluid.

Potential Concerns related to Health Impacts: Issues in Toxicological Testing of Fracking Compounds and **Mixtures**

- Fate and transport
- Hazard of individual compounds and of mixtures
  - To individual species; including humans
  - To ecosystem
- Dose
- Persistence
- Bioconcentration and biomagnification
- Degradation and reaction products
  - Of hydrofracking chemicals
  - Of natural gas components following interaction with chemical
- Interactions with existing chemistry and geology of air, soil and water; and in waste streams

Language of the Executive Orders Creating Unconventional Natural Gas Drilling Advisory Committees

"…task the Secretary of Energy Advisory Board (SEAB) with establishing a subcommittee…to develop, within six months, consensus recommended advice to the agencies on practices for shale extraction ***to ensure the protection of public health*** and the environment" (emphasis added)

-President Barak Obama in
Blueprint for a Secure Energy Future (March 2011)

The Marcellus Shale Safe Drilling Initiative will assist State policymakers and regulators in determining how gas production from the Marcellus shale in Maryland can be accomplished ***without unacceptable risks of adverse impacts to public health, safety***, the environment and natural resources" (emphasis added)

-Maryland Governor Martin O'Malley in
Executive Order 01.01.2011.11: The Marcellus Shale Safe Drilling Initiative (June 2011)

"WHEREAS, the Commonwealth takes seriously its responsibility to ensure the development of natural gas in a manner that protects the environment and ***safeguards the health and welfare of its citizens***" (emphasis added)

-Pennsylvania Governor Tom Corbett in
Executive Order 2011-011: Creation of Governor's Marcellus Shale Advisory Commission (March 2011)

How many individuals with any health expertise would be expected to be among the 52 members of these three advisory committees?

Committee Composition

PA Governors Marcellus Shale Advisory Commission (N=31)

Government (n=10)	Academia (n=1)	Environmental Groups (n=4)	Civil Society Groups (n=5)	Industry (n=11)
Dept. of Environmental Protection	Penn State University, Professor of Geosciences	Chesapeake Bay Foundation		
Dept. of Agriculture		Nature Conservancy		
Dept. of Community & Economic Development		Western Pennsylvania Conservancy		
Dept. of Conservation and Natural Resources		PA Environmental Council		
Dept. of Transportation				
Governor's Energy Executive				
PA Public Utility Commission				
PA Emergency Management Agency				

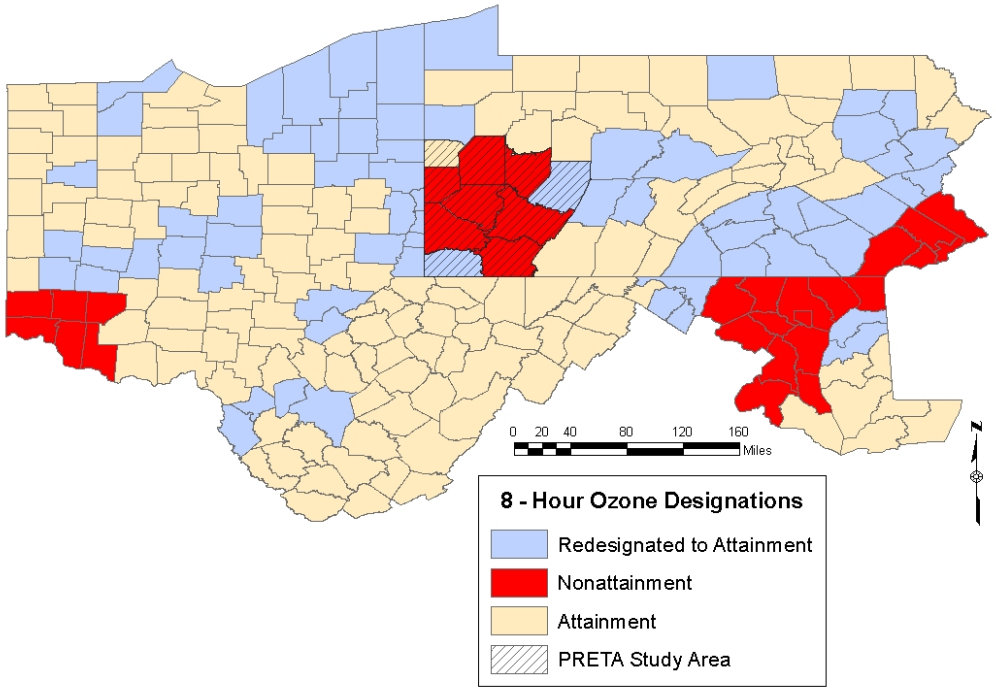
Agencies, Sub-Agencies, and Commissions specified to receive funding from PA impact fee

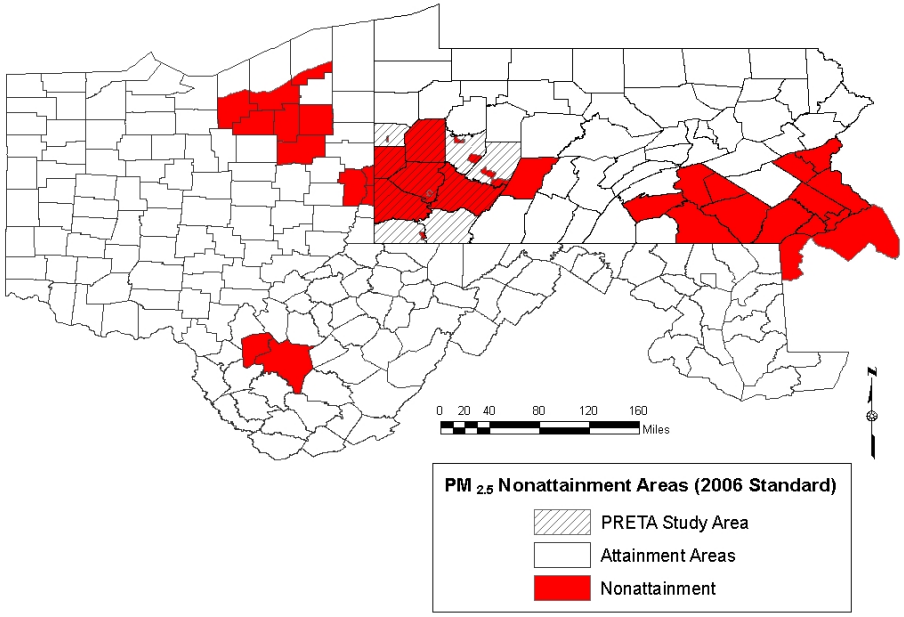
1. County Conservation Districts
2. State Conservation Commission
3. Pennsylvania Fish and Boat Commission
4. Public Utility Commission
5. Department of Environmental Protection of the Commonwealth
6. Pennsylvania Emergency Management Agency
7. Office of State Fire Commissioner
8. Department of Transportation
9. Natural Gas Energy Development Program (DEP)
10. Counties and municipalities
11. Housing Affordability and Rehabilitation Enhancement Fund
12. Commonwealth Financing Authority
13. Environmental Stewardship Fund
14. Motor License Fund (DOT)
15. Pennsylvania Infrastructure Investment Authority
16. Department of Community and Economic Development
17. Hazardous Sites Cleanup Fund

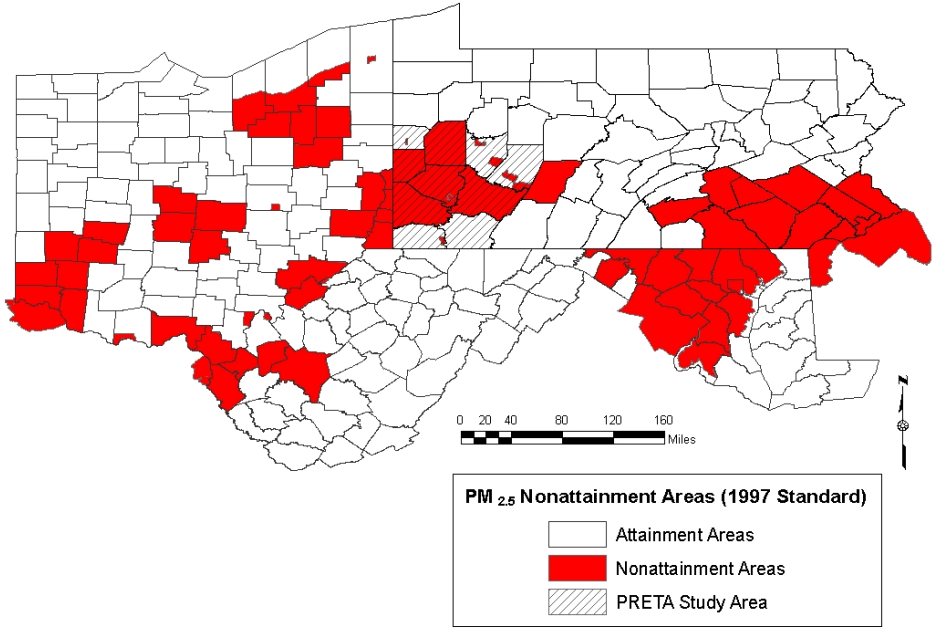
Point Sources as Non-Point Sources: Air Quality Issues

- Allowable emissions from the thousands or tens of thousands of Marcellus Shale sources may easily exceed that of a major new point source (e.g., an oil refinery).
- Classically, non-point sources do not pose immediate risks in their neighborhood (e.g., nitrogen runoff from individual farms), but do so in aggregate (e.g., the dead zones of Chesapeake Bay or Gulf of Mexico).
- Marcellus Shale activities pose both local and aggregate risk.
- They are being regulated primarily as individual local point sources.

NAAQS designations throughout PA, OH, MD, and WV







Watch out for TE-NORM

Technologically-Enhanced Naturally Occurring Radiation

- Naturally occurring radioactivity is not infrequently associated with oil and gas deposits
- Working these deposits can lead to the unanticipated concentration or displacement of radioactivity (e.g., will there be more radioactivity in drinking water? Will more radon be off-gassed into the basements of homes near a drill site?)

Image: Chris Wilkins/AFP/ Getty Images

Image: Exxon Valdez Oil Spill Trustee Council

Effects of the Exxon Valdez Oil Spill

"When the *Exxon Valdez* ran aground in Prince William Sound, it spilled oil into a social as well as a natural environment"

Palinkas, LA et al. *Human Organization* 52:1-13, 1993

Social Determinants of Health (World Health Organization)

"…the circumstances in which people are born, grow up, live, work and age, and the systems put in place to deal with illness. These circumstances are in turn shaped by a wider set of forces: economics, social policies and politics"

(see Satcher, D. *Public Health Reports* 125:6-7, 2010

Community Engagement

- Any attempt to understand and respond to the potential adverse health consequences of Marcellus Shale activities will fail unless the community, including community health workers, are involved.
  - Causally related health impacts will be missed
  - Negative findings will be dismissed

- **Sustainability**: to create and maintain conditions, under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic, and other requirements of present and future generations

(National Academies of Sciences: Sustainability at the US EPA, 2011).

Sustainability

- **Requires transdisciplinary approaches to complex environmental issues.**
- **Approaches must include a comprehensive evaluation of environmental, economic and social/health issues.**
- **Multigenerational equity is central**.