Potential Public Health Implications of Unconventional Shale Gas Drilling

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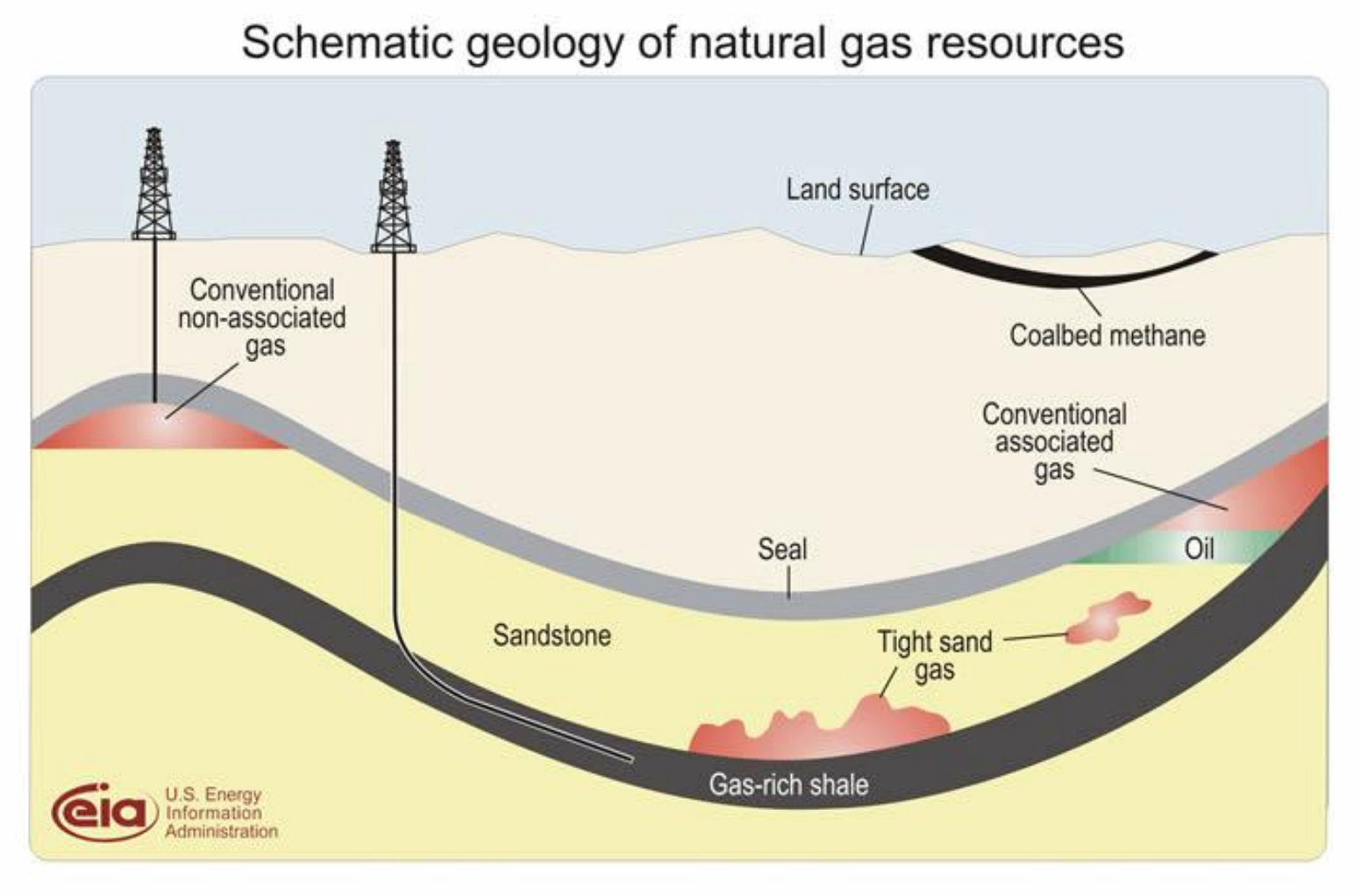
Drilling Rig in Rural Upshur County, WV

Source: WVSORO - Modern Shale Gas Development in a

from:www.fractracker.org

Conventional and Non-conventional Natural Gas Extraction Methodologies



My View: What's the Rush to Drill?

- 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 US tight shale formations will be tapped
- In contrast to the Gulf oil deposits, which might be tapped by other countries, the shale gas deposits of natural gas are ours

- So what's the rush?

My Advice

STALL

Potential Benefits Related to UGD

- National security
- Jobs
- Replacement of coal with natural gas leading to:
  - Decrease in particulate and other forms of air pollution
  - Greenhouse gas reduction

Usual Progression of Environmental and Occupational Issues Related to Human Health

1) Potentially harmful societal/industrial activities occur before all 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

Reasons given by those not in favor of UGD

(Goldstein et al, Env Hlth Persp 120:483-486, 2012)

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**

Top 6 stressors

Stressor	Session 1 (n=33)
Denied or provided false information	79%
Corruption	61%
Concerns/complaints ignored	58%
Being taken advantage of	52%
Financial damages	45%
Noise pollution	45%

Remaining 6 stressors

Stressor	Session 1 (n=33)
Desire to move	42%
Animals died/sickened	42%
Estrangement from community	39%
Intimidation/fear of retribution	27%
Odors	13%
Light pollution	9%

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;
Energy Industry Photos. (2012). *What is Hydraulic Fracturing?* Retrieved Jan 11, 2012, from http://www.energyindustryphotos.com/what_is_hydraulic_fracturing.htm

Potential Pathways for Human Health Impacts Related to UGD

- Safety Issues
- Air Pollution
  - Worker and exposure to HF chemicals, silica, diesel exhaust and drilling compounds
  - Community exposure to air toxics, including benzene; nitrogen oxides, diesel exhaust, ozone
- Water Pollution
  - HF chemicals; flowback and produced waters on site or off site
- Light and Noise
- Psychosocial Effects
  - Exacerbated by lack of transparency and trust issues

Issues in Toxicological Testing of Hydrofracturing Compounds, Hydrocarbons, Flowback Constituents and Related Reactants 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
- Interactions with existing chemistry and geology of air, soil and water; and in waste streams

Toxicological Agents of Interest

- Three sources of toxicologically relevant agents
  - Hydrofracturing agents
  - Hydrocarbons and gases present in shale; methane, ethane, propane, BTEX, hydrogen sulfide
  - Natural constituents: brine components; barium, bromide, calcium, chloride, iron, magnesium, strontium; arsenic; radionuclides
  - ***Mixtures of any or all of above***
- Chemical reactions favored by higher temperatures and affected by other local conditions
  - Temperature in shale that favors natural gas production is ~480F
  - High pressure and salinity

Managing the Story

Is hydrofracturing old or new?

1) To the nation's benefit, new hydrofracturing-related technology now permits extraction of gas that we have long known is trapped in the tight shale formations

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

Managing the Story

Does hydrofracturing cause groundwater contamination?

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

2) Major water contamination with hydrofracturing agents has occurred as a result of unconventional shale gas drilling activities

Testimony of Michael L. Krancer, Secretary of the Department of Environmental Protection, Commonwealth of Pennsylvania

"There has been a misconception that the hydraulic fracturing of wells can or has caused contamination of water wells. This is false.

…hydraulic fracturing is only a temporary feature of natural gas development, which only lasts a few weeks.

Hydraulic fracturing of wells is not new in Pennsylvania, it has been going on here since about the 1950s and has been standard practice since about the 1980s."

From Nov. 16, 2011 testimony to the Congressional Subcommittee on Water Resources and Environment

Other Issues Affecting Public and Policymaker Understanding

- Repetitive statements that chemicals could not be harmful as they only represent 1% of the hydrofracturing fluid
- Obtaining a trade secret requires a health professional (HP) to sign legal paper. If disclosed to others, HP could be sued for total value of trade secret; if not disclosed, could violate HP's legal public health responsibility under state law.

Should information about agents to which they are potentially exposed be withheld from the public?

Dispersant used during the BP oil spill as an example

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%

Managing the Story

Should we be more worried about what is put underground or what is brought to the surface?

1) Our major toxicological concern should be the hydrofracturing chemicals
2) Our major toxicological concern should be what is brought up from underground

Managing the Story

1) We are appropriately told that the northeast is different than the west in that the scarcity of water for hydrofracturing is not a major problem

2) We are **NOT** told that the geology of the west tends to favor underground injection of flowback water while that of the northeast does not

Environmental Recidivism: Disclosures Not Required Under New State Laws

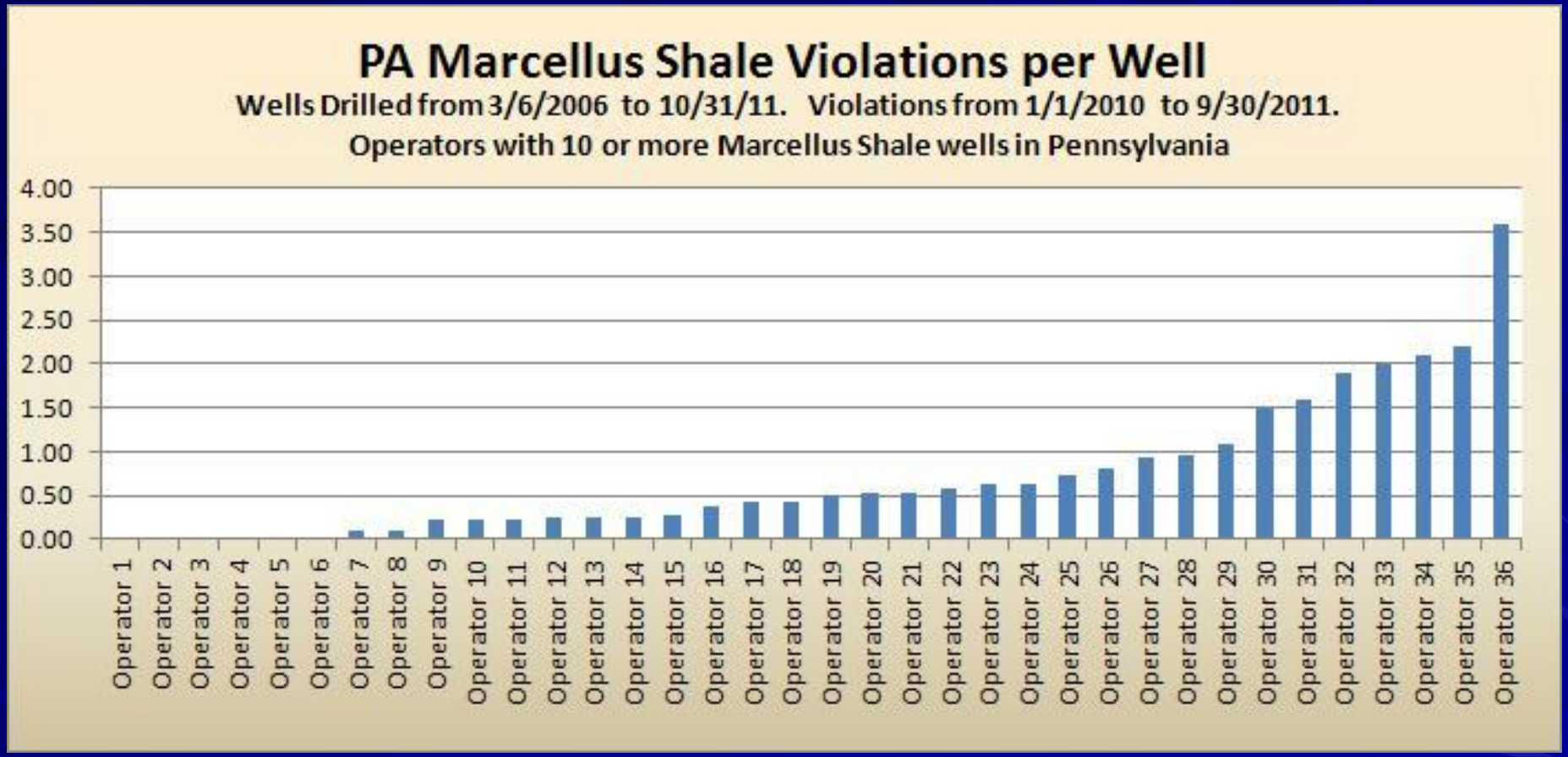
Notwithstanding any other provision of this chapter, a vendor, service provider or operator **shall not be required** to do any of the following:

(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.

Emphases added



Source: FracTracker. (2011). *FracTracker.* Retrieved Jan 11, 2012, from http://www.fractracker.org/

Managing the Story

- Exposure and ecological effect studies are under way with cooperating industry

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

(Goldstein et al, Env Hlth Persp 120:483-486, 2012)

"…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 resource***s" (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)

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 and be litigated in communities in which unconventional shale gas drilling 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)

My Advice

STALL