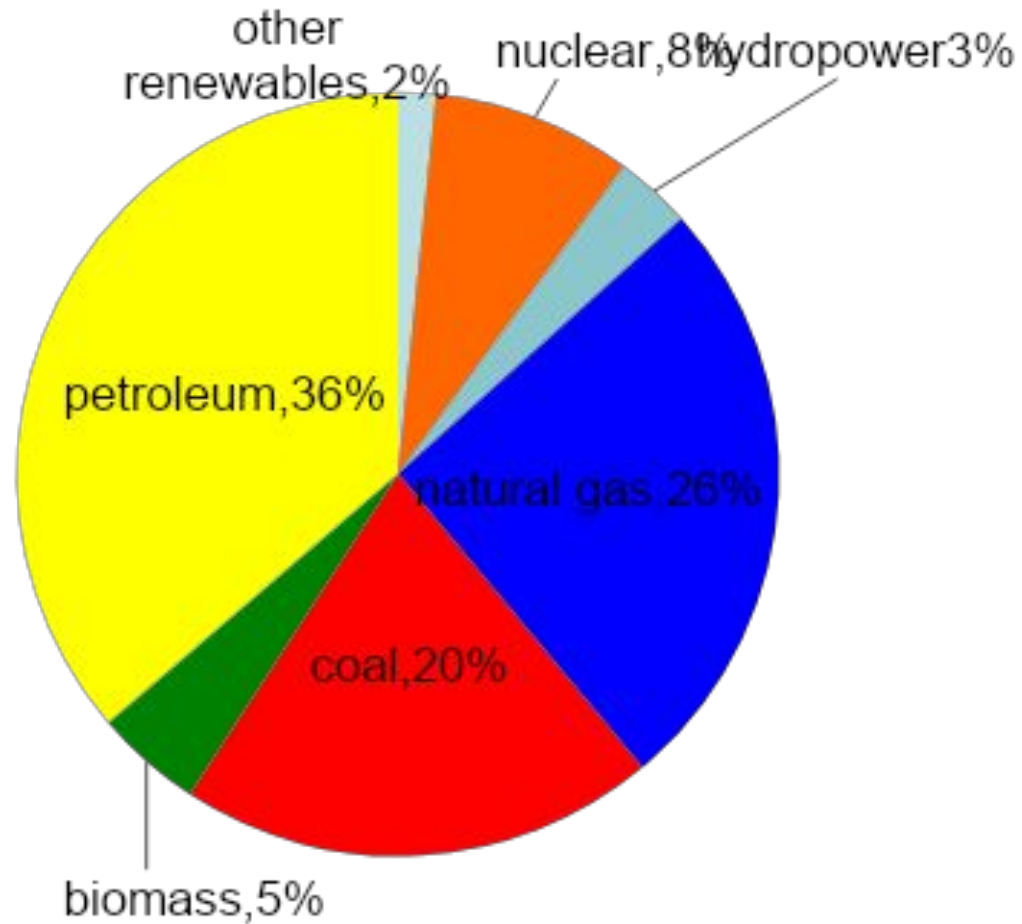


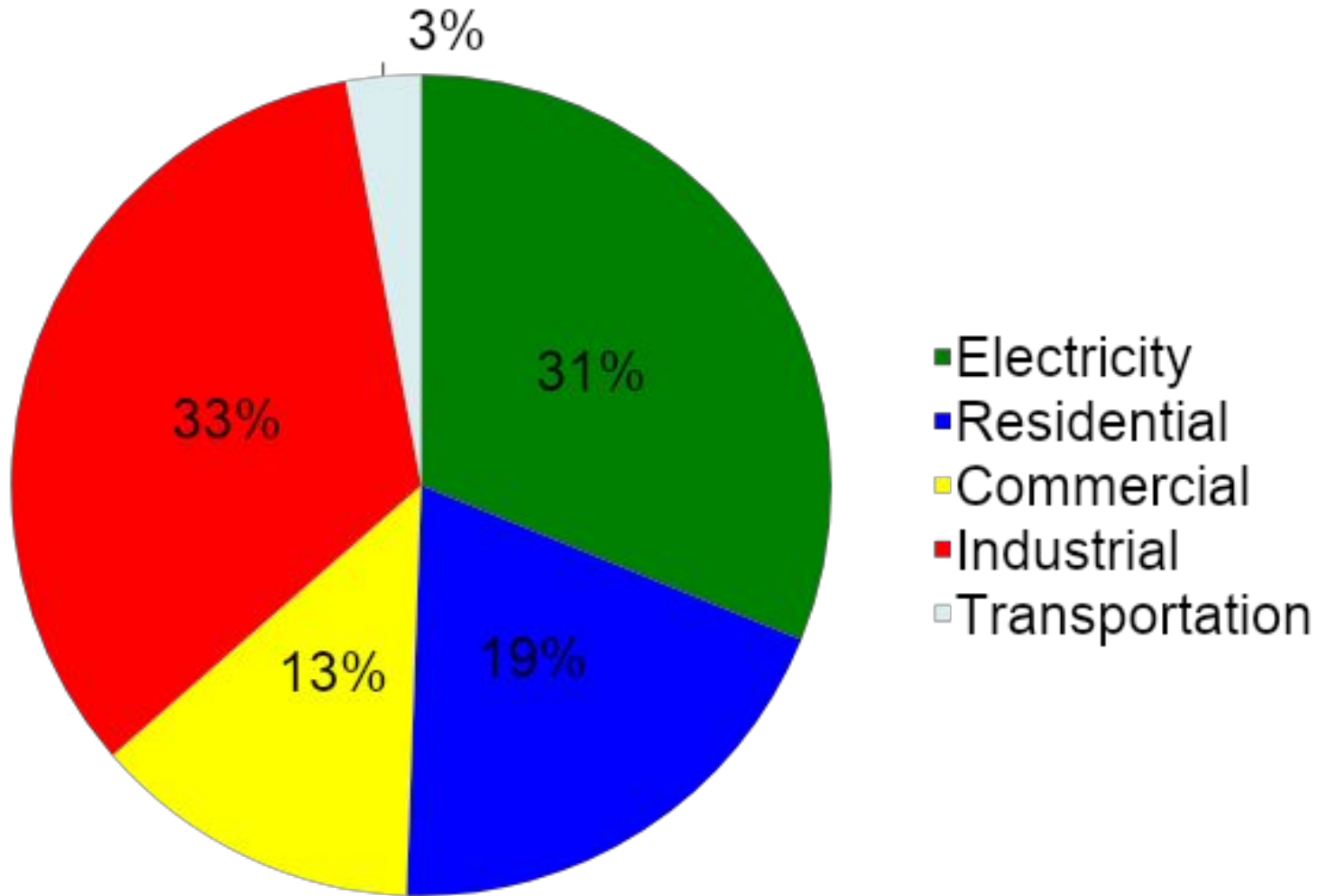
Introduction to Horizontal Hydrofracturing “Fracking”

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Where do we get our energy?



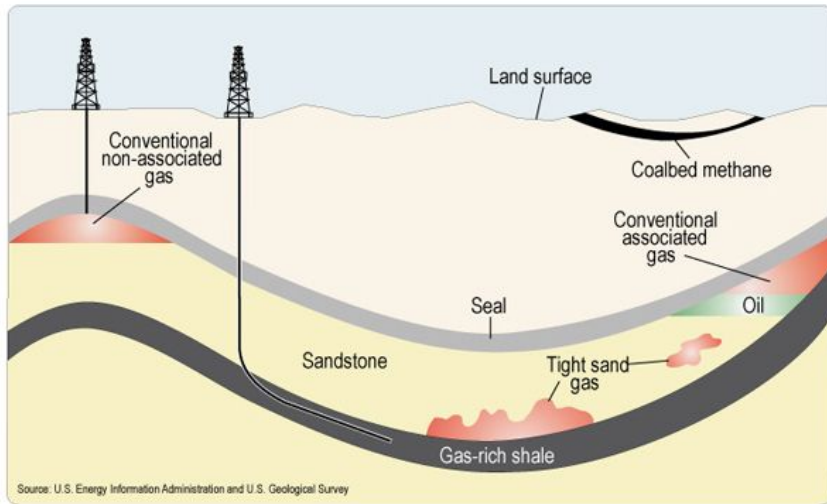
How do we use natural gas?



What is natural gas?

- Formed by organic matter (marine organisms) trapped in sedimentary rocks
- Flows like a liquid through pores in rocks
- Natural gas is one of the lightest ('thermally mature') forms of petrochemicals (oil)
- "Conventional" natural gas collects in porous rock (sandstone) domes
- "Unconventional" natural gas remains trapped in pores in tighter rocks (shale)

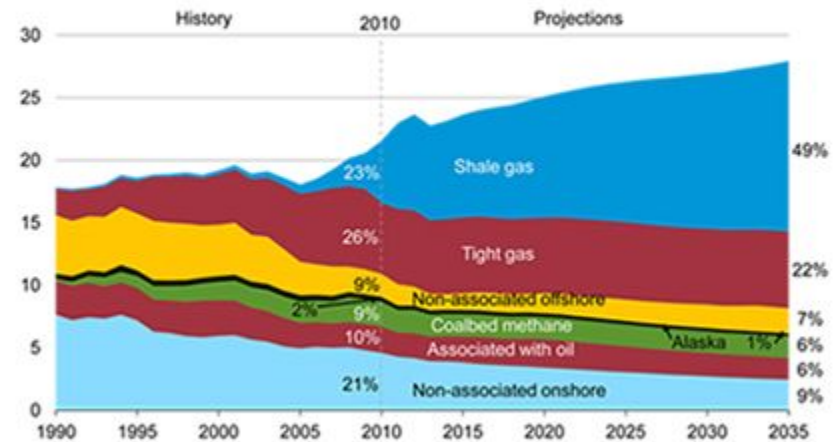
Natural Gas-Shale Gas-Unconventional Gas



- 2010-2035:
 - 29% increase in NG production
 - Most of the increase is in shale gas

U.S. Natural Gas Production 1990-2035

trillion cubic feet per year



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2012* (June 2012).

Hydraulic Fracturing

- Technique for extracting natural gas from “tight” rock structures deep below surface
- Has been used since 1950’s
- Hydraulic Fracturing involves
 - Drilling a well deep down below earth
 - Turning drill to horizontal
 - Inject 500,000 gallons of fluid to fracture shale
 - Fluid is 99% water plus sand and chemicals
 - Extracting natural gas

“High-Volume Slick-Water Horizontal Hydraulic Fracturing in the Marcellus Shale”

High-Volume: 5 to 10 million gallons of water per well

Slick-Water: chemicals and sand in injected water

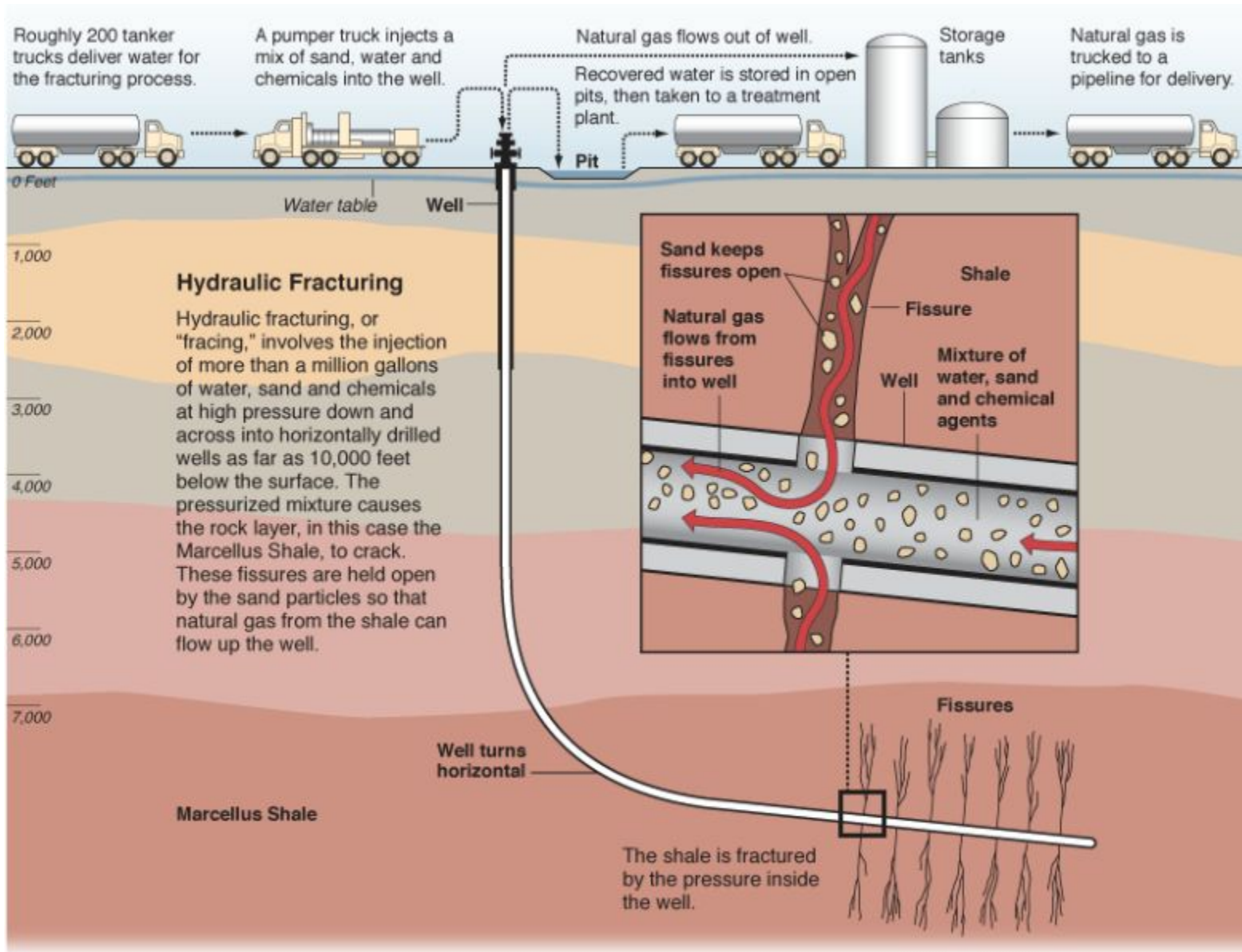
Horizontal: drill down up to 10,000 feet, turn horizontally so well extends up to 1 mile from well head (drill site)

Hydraulic Fracturing: high pressure fluid used to extract natural gas from rock

Marcellus Shale: Rock formation in NY, PA, OH, WV where HVHV has been taking place since 2005; other shale layers may be drilled later

“Unconventional Shale-Gas Extraction”

“Fracking”



Graphic by Al Granberg

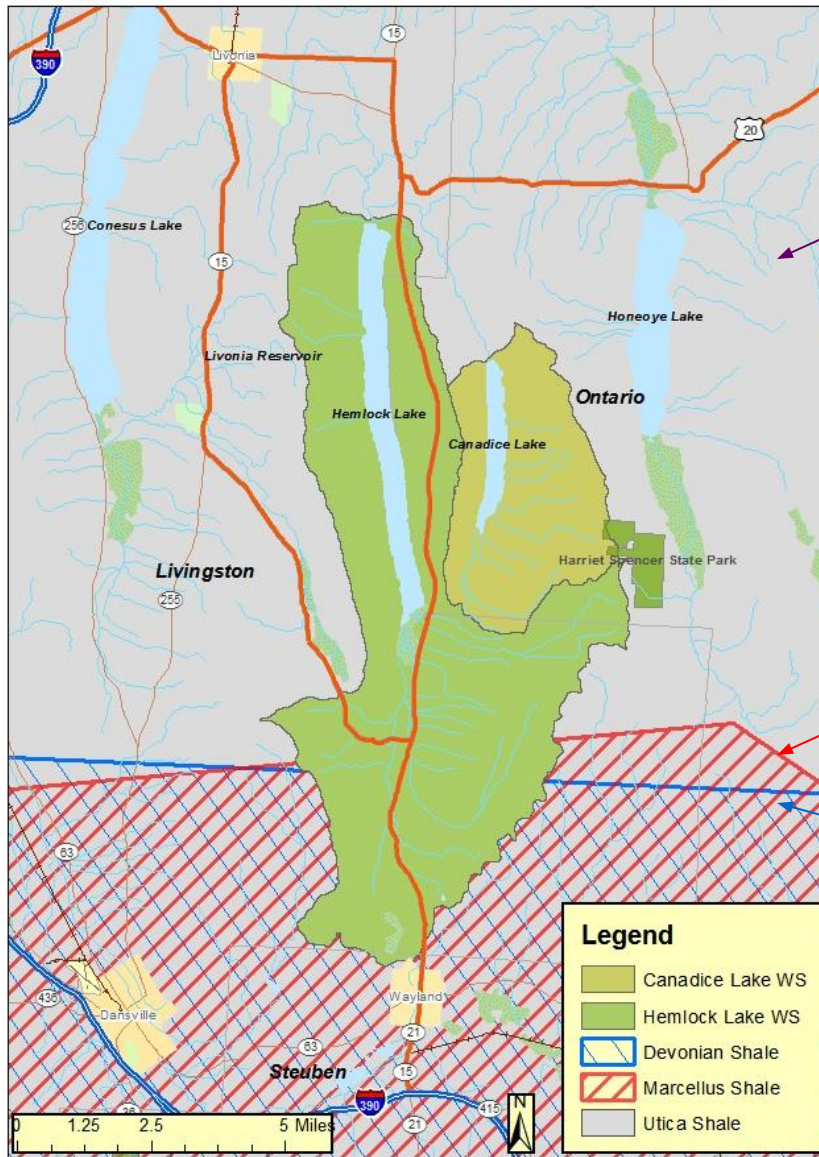
Horizontal hydraulic hydrofracturing. Courtesy www.propublica.org/special/hydraulic-fracturing

Shale Gas Plays, Lower 48 States



Source: Energy Information Administration based on data from various published studies.
 Updated: March 10, 2010

Shale Gas Plays in the Hemlock & Canadice Lake Watersheds



Utica Shale (deepest)

Marcellus Shale (middle)

Devonian/Ohio Shale (shallowest)

Map prepared by Wayne Howard of Solara Concepts
using data from the U.S. Energy Information Administration (EIA)
(www.eia.gov)



View of 40-acre spacing. Jonah field in Rocky Mountains. Courtesy of www.shaleshock.org



Horizontal Hydrofracturing Rig, November 2009 in Moreland, PA. Wikipedia Commons – photo by Ruhrfisch

Status of Fracking in NYS

- Currently, not permitted
- Environmental Impact Statement (EIS) needed prior to permitting
- Waiting for NYS Department of Environmental Conservation (DEC) approval of Generic EIS (GEIS)
- “Health review” by NYSDOH

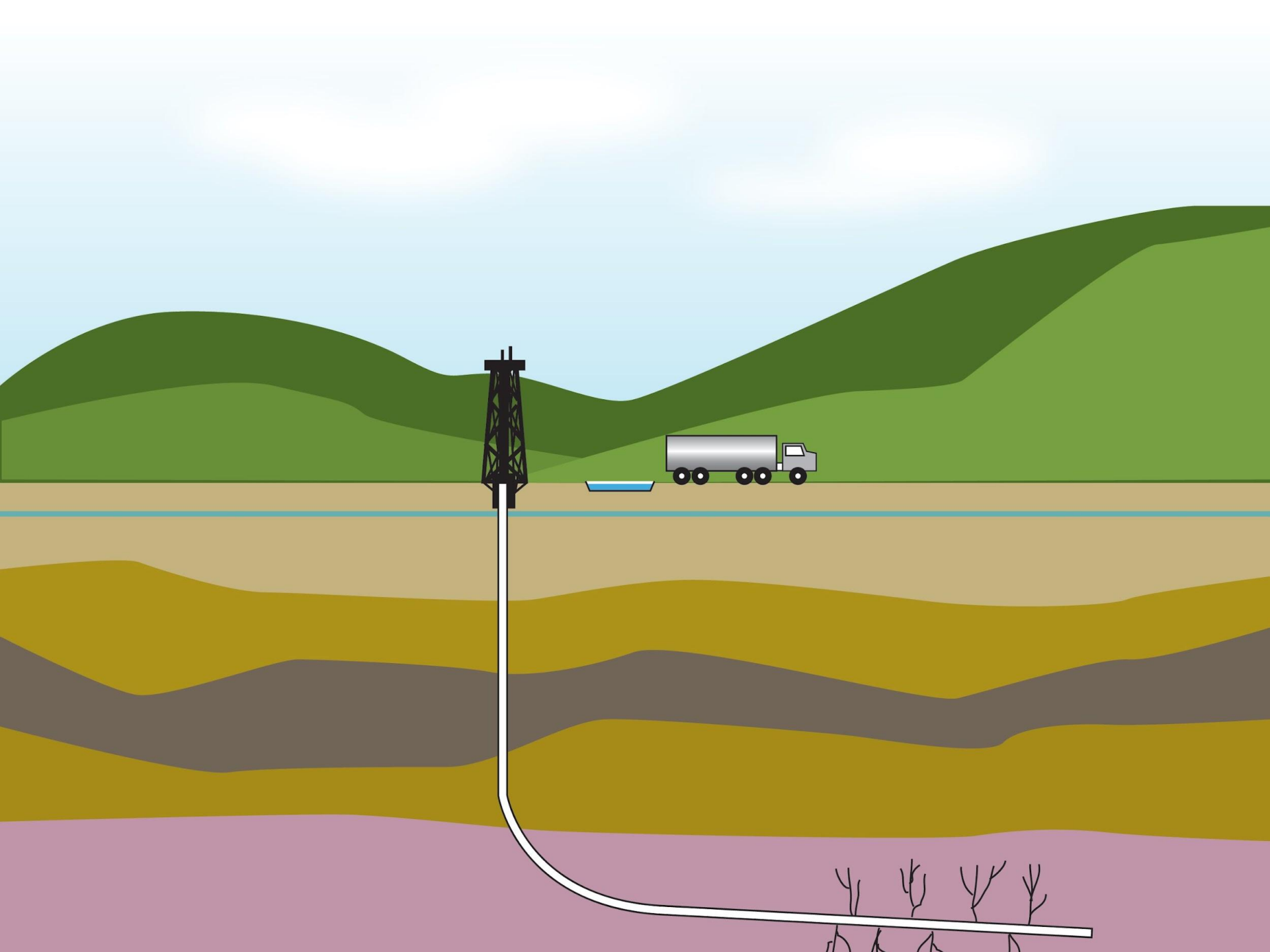
What is the evidence – and information needs - for health effects of hydrofracking?

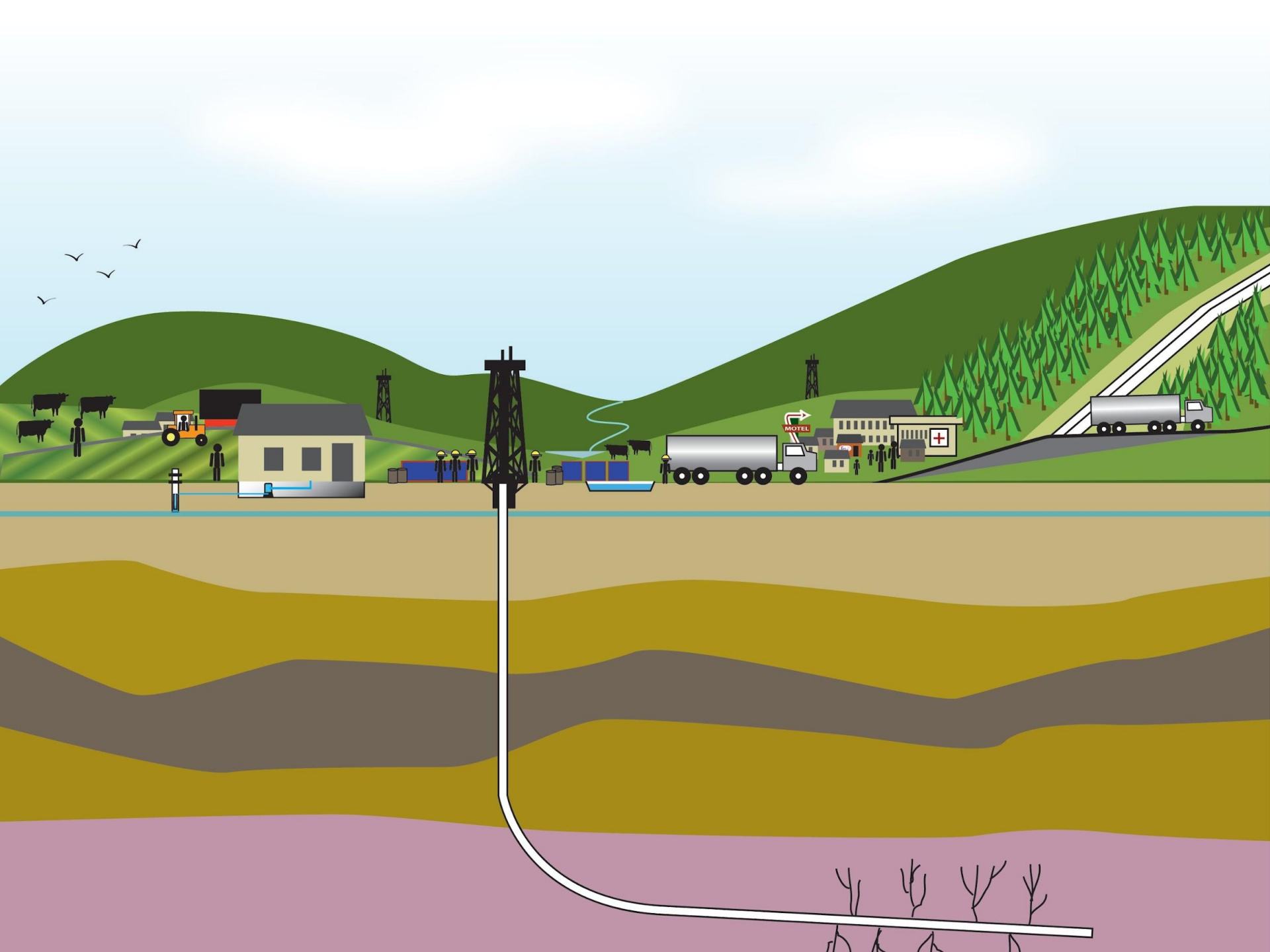
Depends on...

- What is 'hydrofracking'?
- What is a 'health effect'?
- What counts as 'evidence'?

Community Information Needs Assessment

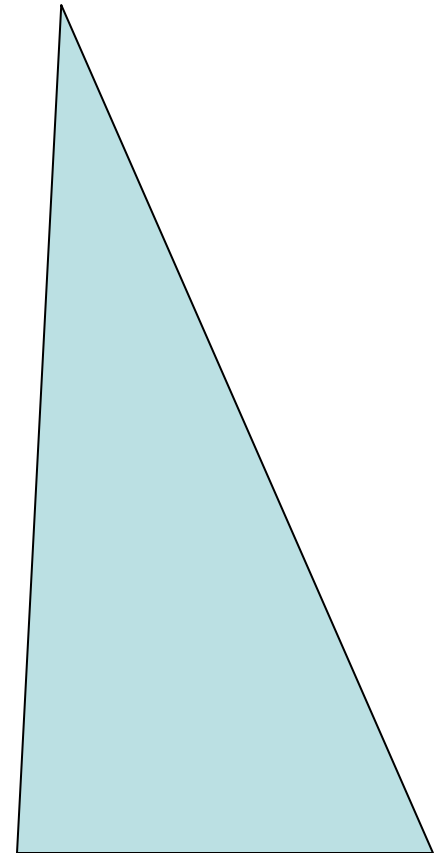
- NIEHS funded collaborative supplement
- Ohio, North Carolina,
- Interviewed 50 'informed' community leaders
- Idne





1:What is 'hydrofracking'?

- Industrial practice of injecting fluids into shale
- All activities at well site (drilling, fracking, flaring, storage of water/chemicals)
- Physical processes associated with unconventional shale gas extraction (trucks, compressor stations, pipelines)
- Changes in communities and economies resulting from shale gas development



2. What is a 'health effect'?

- Health impacts/symptoms directly caused by hydrofracking
- Changes in incidence of disease associated with increased hydrofracking
- Changes in environmental quality or animal health that could affect humans
- Well-being/quality of life (stress, conflict, wealth, sense of belonging/community)

Worker health and safety

- Exposure: occupational
- “Typical” industrial/mechanical injuries (falls, accidents)
- Chemical burns/exposures
- Air emissions
- Silica sand

Surface water and health

- Exposure: fish/game consumption, air, contact recreation, farm animals
- Fracking chemicals/flowback water
- Spills
- Waste water disposal
- Changes in water quantity/flow displacing other uses (agriculture, wildlife, etc.)

Ground water and health

- Exposure: private drinking water wells
- Methane
- Fracking chemicals
- NORM (Naturally Occurring Radioactive Materials)
- Naturally occurring heavy metals
- Chemical interactions

Air quality and health

- Exposure: inhaled by workers, neighbors, regional communities
- Diesel engines (trucks, compressors, etc.)
 - particulates, ozone precursors
- Fugitive emissions from wells
- Evaporation from storage ponds
- Aggregate/cumulative impacts

Disasters, accidents and health

- Flooding may wash chemicals into local waters/contaminate soil
- Earthquakes associated with injection wells
- Explosions/spills may cause injury or contaminate environment

Community health

- Noise and light pollution
- Stress and mental health (environmental concerns, economic change, conflict)
- Population/community change (workers)
- Impacts on health services (visits to emergency room, disaster/spill response, new disease concerns)
- Increased housing costs/demand
- Benefits from improved economy

3: What counts as 'evidence'?

- Stories/reports from affected citizens, health care providers, or organizations
- Newspaper articles
- Evidence of past impact?
- Predictions of future impacts?
- Government agency reports
- Peer-reviewed publications

Does uncertainty trump knowledge?

- What will be the extent of drilling, where, over what time?
- What engineering practices, control systems, and mitigation will be used?
- What chemicals are used, released, how much, where, when?
- What are the health effects of exposures?
- Accidents, spills, natural disasters...

Can decisions be 'science-based' despite uncertainty?

- “More research is needed”
- Precautionary principle
- Regulate, monitor and manage
- Pilot test (adaptive management)
- Uncertainty will persist
 - Latency of health impacts
 - Variation in geography/technology
 - Long-term processes
 - Unpredictable events

Tapping into public health

- Beyond “environment versus economics”
- Public health professionals as a resource:
 - Communication networks
 - Access to health data/analysis
 - Local monitoring/management
- Body of experience includes:
 - Disaster response (Gulf Oil, flooding)
 - Emerging disease
 - Surveillance/epidemiology

American Public Health Association

“The public health perspective has been inadequately represented in policy processes related to HVHF. Policies that anticipate potential public health threats, require greater transparency, use a precautionary approach in the face of uncertainty, and provide for monitoring and adaptation as understanding of risks increases may significantly reduce negative public health impacts of this approach to natural gas extraction.”

Policy statement 20125 “The Environmental and Occupational Health Impacts of High-Volume Hydraulic Fracturing of Unconventional Gas Reserves” is publicly available in the APHA policy statement database. Here is the direct link:

<http://www.apha.org/advocacy/policy/policysearch/default.htm?id=1439>

Challenges of discussing hydrofracking

- Polarized:
 - Big business v. small communities
 - Environment v. economy
 - Fracking v. no-fracking
- Distribution of costs and benefits
- Multidisciplinary – different “frames”
- Uncertainty and conflicting information
- “People listen to people who agree with them”

Presentations

- Kent Gardner
- Tony Ingraffea

Upcoming Events on Hydrofracking

- **Tuesday, April 16 7pm at RIT**
Rochester Committee on Scientific Information
Dr. Richard Young and Thomas Shelley
Xerox Aud – Rm 2580, James E. Gleason (Engineering) Building 9
- **Wednesday, April 17, 2:30pm at SUNY Geneseo**
“Fighting Fracking: A View From the Trenches”
David & Helen Slottje:
MacVittie College Union Ballroom
- **Friday, April 19 2pm at UR**
Assessing Emissions from the Transport of Sand, Water, and Waste in High-Volume Hydraulic Fracturing Activities
Dr. Karl Korfmacher
Dewey 2-110D
- **Thursday, May 9, 6pm at RIT**
Dr. David Carpenter and Dr. David Kowalski
NTID Panera Auditorium