GRAHAM ENVIRONMENTAL SUSTAINABILITY INSTITUTE

RISK SCIENCE CENTER

Hydraulic Fracturing in Michigan Integrated Assessment

FREDERICK A. & BARBARA M. ERB INSTITUTE UNIVERSITY OF MICHIGAN

UNIVERSITY OF MICHIGAN ENERGY INSTITUTE

Charting paths to a secure, affordable, and sustainable energy future

Agenda

- **Welcome and introduction**
- **Opening remarks**
  Bill Rustem, Director of Strategic Policy, Governor's Office
- **Brief overview of process and timeline**
- **Panel presentation and discussion**
- **Facilitated Q & A**
- **Closing remarks**

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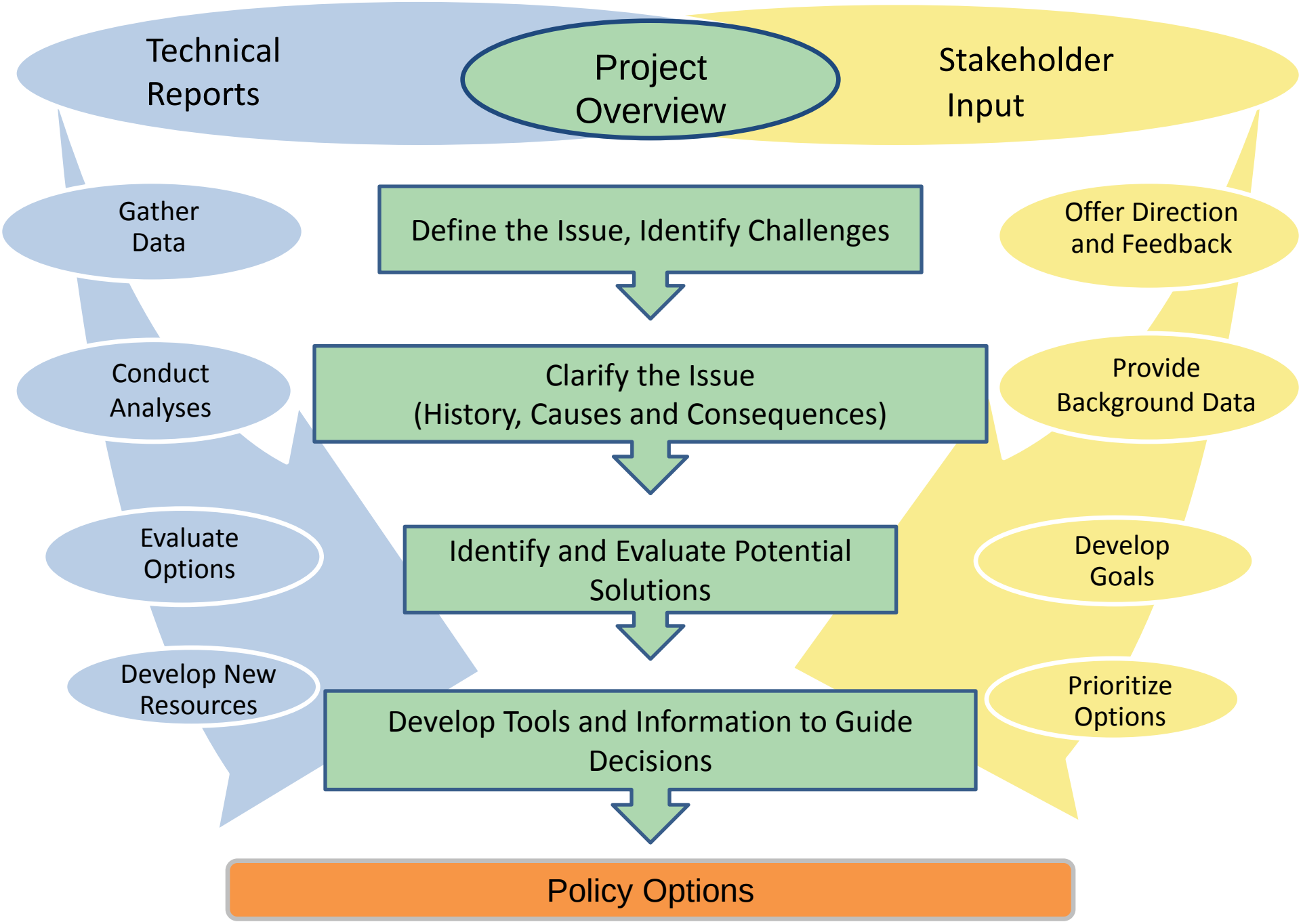
Integrated Assessment Program Objective:

To carry out the Institute's mission of sustainability problem solving by using Integrated Assessment as a methodology for connecting academics, decision makers, and stakeholders.


Technical Reports
Project Overview
Stakeholder Input
Gather Data
Define the Issue, Identify Challenges
Offer Direction and Feedback
Conduct Analyses
Clarify the Issue (History, Causes and Consequences)
Provide Background Data
Evaluate Options
Identify and Evaluate Potential Solutions
Develop Goals
Develop New Resources
Develop Tools and Information to Guide Decisions
Prioritize Options
Policy Options

Benefits of Integrated Assessment

As identified by participants in previous assessments

- Generates reports and supporting data
- Modifies perspectives
- Creates new partnerships
- Changes processes
- Leverages resources

Hydraulic Fracturing in Michigan

Key Points:

- Hydraulic Fracturing (HF) has been used in thousands of wells in Michigan for decades
- 2003 State Review of Oil and Natural Gas Environmental Regulations (not HF specific) – "*MDEQ has a well-managed oil and gas environmental regulatory program*"
- Integrated Assessment developed to focus on High Volume Hydraulic Fracturing (HVHF) but data and analyses may cover a range of activity depending on topic or issue
- Limited HVHF activity in Michigan at present
- Broad range of perspectives on benefits/problems of expanded natural gas use

Resources for the Future Expert Survey

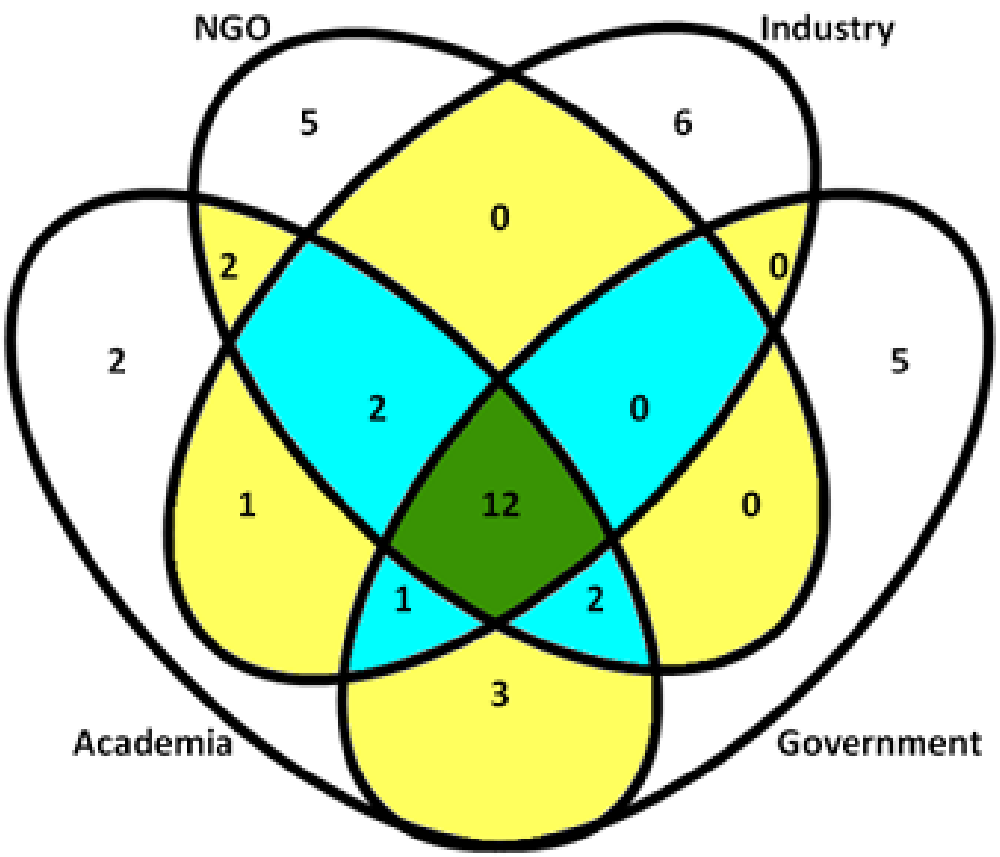
Pathways to Dialogue: What the Experts Say about the Env. Risks of Shale Gas Development

215 experts who responded to the survey questions were asked to choose from a total of 264 "risk pathways" that link specific shale gas development activities—from site development to well abandonment—to burdens such as air pollution, noise, or groundwater contamination.

National focus involving Industry, Government, NGO and Academia

http://www.rff.org/centers/energy_economics_and_policy/Pages/Shale_Gas.aspx

Resources for the Future Expert Survey



Of the 12 consensus risk pathways that *all* of the expert groups most frequently chose as priorities

- 7 involve potential risks to surface water quality,
- 2 involve potential risks to air quality,
- 2 involve potential risks to groundwater quality, and
- 1 is related to habitat disruption.

- Only 2 are shale gas specific; potential impact of fracturing fluids on surface water during use and storage/disposal

http://www.rff.org/centers/energy_economics_and_policy/Pages/Shale_Gas.aspx

Phase 1: Technical Reports

Phase 1: Technical Reports -the first phase of the project will involve the preparation of technical reports on key topics related to hydraulic fracturing in Michigan.

- **Human health**
- **Environment/ecology**
- **Economics**
- **Technology**
- **Social/public perception**
- **Policy/law**
- **Geology/hydrodynamics**

Each report will consider a range of impacts/issues related to the primary topic. It is likely that there will be overlaps of impacts/issues analyses, as many of the items connect to multiple topics.

Phase 2: Integrated Assessment

Phase 2: Integrated Assessment (IA) - the IA will build from the technical reports, focusing on an analysis of options regarding hydraulic fracturing in Michigan.

The IA will likely be formed around topics identified in the technical reports. Key aspects of the IA that will distinguish it from the technical reports include:

- Focus on the analysis of (policy) options,
- Collaboration and coordination across research teams to identify common themes and strategies,
- Regular engagement with decision makers, and
- Stakeholder engagement process to gauge public concerns and perceptions.

Timeline

Late March 2013	Technical Reports sent out for Peer Review and shared with Steering Committee
Late April 2013	Steering committee and Technical Report leads meet to discuss plans for Phase 2
Early June 2013	Technical Reports are released with 30 day Public Comment period
Late July 2013	Phase 2 Plans finalized
Mid 2014	Final Integrated Assessment Report released (tentative)

Project Funding

At present, the project is entirely funded by the University of Michigan.

The project is expected to cost at least $600,000 with support coming from the University of Michigan's Graham Institute, Energy Institute and Risk Science Center.

Current funding sources are limited to the U-M general fund and gift funds, all of which are governed solely by the University of Michigan.

As the project develops, the Graham Institute may seek additional funding to expand stakeholder engagement efforts. All funding sources will be publicly disclosed.

Steering Committee

- Claire Allard, Strategy Advisor, Office of Strategic Policy, State of Michigan
- Mark Barteau, Director, U-M Energy Institute
- Valerie Brader, Senior Strategy Officer, Office of Strategic Policy, State of Michigan
- John Callewaert, Int. Assessment Program Director, U-M Graham Sustainability Institute
- James Clift, Policy Director, Michigan Environmental Council
- John De Vries, Attorney, Mika Meyers Beckett & Jones; Michigan Oil and Gas Association
- Hal Fitch, Director of Oil, Gas, and Minerals, Michigan Department of Environmental Quality
- Gregory Fogle, Owner, Old Mission Energy; Michigan Oil and Gas Association
- James Goodheart, Senior Policy Advisor, Michigan Department of Environmental Quality
- Manja Holland, Research Programs Officer, U-M Graham Sustainability Institute
- Andy Hoffman, Director, U-M Erb Institute for Global Sustainable Enterprise
- Drew Horning, Deputy Director, U-M Graham Sustainability Institute
- Andrew Maynard, Director, U-M Risk Science Center
- Don Scavia, Director, U-M Graham Sustainability Institute
- Tracy Swinburn, Managing Director, U-M Risk Science Center
- Grenetta Thomassey, Program Director, Tip of the Mitt Watershed Council
- John Wilson, Consultant, U-M Energy Institute

Technical Report Leads

Technology: Johannes Schwank, Chemical Engineering; John Wilson, Energy Inst.

Geology/hydrodynamics: Brian Ellis, Civil and Environmental Engineering

Environment/ecology: Allen Burton, School of Natural Resources & Env.; Knute Nadelhoffer, Dept. of Ecology and Evolutionary Biology

Human health: Nil Basu, School of Public Health

Policy/law: Sara Gosman, Law School

Economics: Roland Zullo, Inst. for Research on Labor, Employment, & the Economy

Social/public perception: Andy Hoffman and Kim Wolske, Erb Institute for Global Sustainable Enterprise

TECHNOLOGY – key areas

- Technical issues related to hydraulic fracturing technologies and related gas recovery
  - Emphasis on methods used in Michigan
- Identification of issues that require additional research
  - Emphasis on Utica-Collingwood shales and the deeper
  - A-1 and A-2 carbonate deposits

TECHNOLOGY - approach

- Status and Trends
  - Brief History of Gas in Michigan
  - Recovering More of the Resource

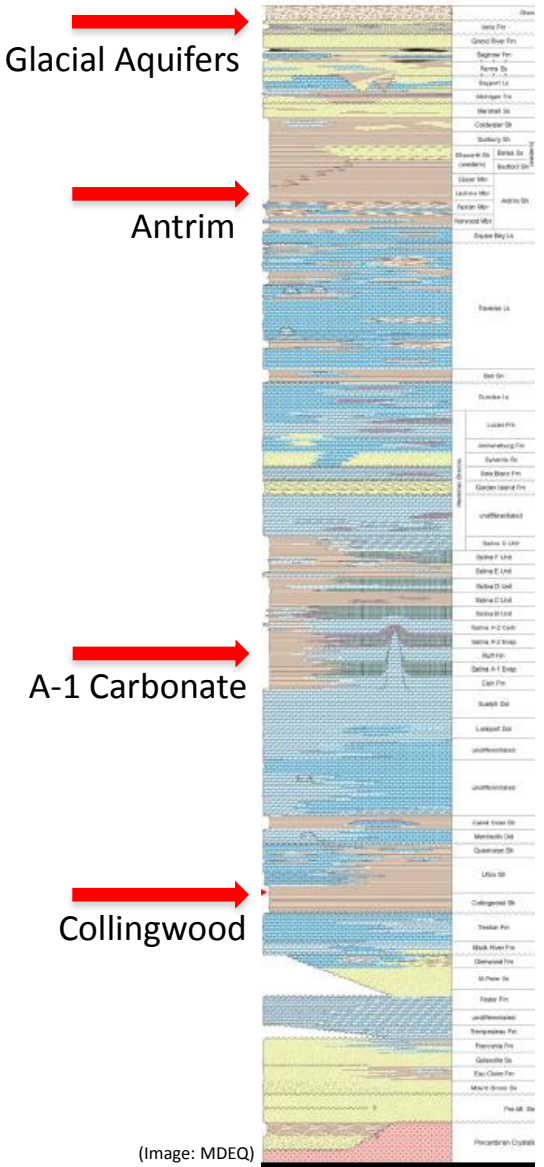
- Challenges and Opportunities
  - Review of technical aspects of current methods for enhanced gas recovery
  - Well stimulation technologies used in Michigan
  - Outlook for future practices in Michigan

TECHNOLOGY – sources of information

- Michigan Department of Natural Resources
- Energy Information Administration, Department of Energy
- Peer-reviewed scientific literature

GEOLOGY – key areas

- Proximity of unconventional reservoirs to subsurface drinking water resources
- Potential fluid migration pathways
- Factors controlling chemical composition of flowback fluids
- Disposal of flowback fluids



(Image: MDEQ)

GEOLOGY - approach

(Image: MDNR)

- Review literature, assess current state of knowledge, identify data gaps
- Provide broad overview of Michigan basin geology
- Compare/contrast with experiences in other states

GEOLOGY – sources of information

- MDEQ oil and gas database, GeoWebFace
- Peer-reviewed literature
- Other literature: government reports, industry reports, news articles, etc.

ECOLOGY – key areas

- Site disturbance and resulting erosion with solids and nutrient inputs into sensitive streams
- Water withdrawal impacts to neighboring streams/wetlands during drought conditions
- Review of operation "footprint" decision making in light of sensitive ecological areas
- Quality control during operations and site construction

ECOLOGY - approach

- Review literature
- Identify data gaps
- Consider relevant issues related to the assessment of environmental quality and ecological risk assessments
- Water Withdrawal Assessment Tool, Wetlands Protection Program, Biological assessments, GIS tools
- Identify likely stressors and substantiated with limited, but excellent, peer-reviewed literature

ECOLOGY – sources of information

- Existing data and studies. However, material is very limited particularly with respect to pre- and post-monitoring studies.
- Internet search, colleagues, professional conferences, industry studies
- Federal agency reports and status updates
- Peer-reviewed literature

HUMAN HEALTH – key areas

- A number of hazards have been identified
  - Workplace: accidents, silica, toxic chemicals…
  - Ecosystem: water & air pollution, ecosystem services…
  - Community: risk perception, "boomtown" impacts…

- Hazard ≠ Risk

- Relative tradeoffs & human health risk/benefits need careful consideration

HUMAN HEALTH - approach

- Review evidence
- Identify data gaps in MI & elsewhere
- Consider all data and studies (anecdote reports → peer-reviewed scientific papers) from everywhere (largely US-based)
- Identify and describe likely hazards (=Hazard Identification report)

HUMAN HEALTH – sources of information

- Peer-reviewed literature
- Federal agency reports and status updates
- Non peer-reviewed reports, anecdotes, newspaper articles
- Limited data and scientific studies, especially for Michigan
- Fracfocus
- Internet, colleagues, conference proceedings, industry studies/websites

POLICY/LAW – key areas

- Laws governing life cycle of a HF well
- Level of government
- Type of law
- Policy approach

POLICY/LAW - approach

- Research on status of federal, state, local law
- Research on legal and policy scholarship
- Comparative analysis of states

POLICY/LAW – sources of information

- Legal and policy databases
- Government publications/websites
- Other comparative state analyses

ECONOMICS – key areas

- Provide an overview of the major economic issues related to the natural gas extraction industry (hydraulic fracturing) in Michigan, with an emphasis on employment.

- Estimate the employment effects of expanding natural gas extraction:
  1. Direct industry employment
  2. Indirect supplier employment
  3. Induced regional employment

ECONOMICS - approach

- The overview will describe four economic topics relevant to gas extraction: (1) private royalties and leases, (2) state revenues from royalties, taxes, leases and storage, (3) changes in property values, and (4) employment.

- Our employment analysis will involve matching regional job counts with industry activity. Our goal is to prepare employment projections based on several industry scenarios.

ECONOMICS – sources of information

- The general overview is based on administrative data, interviews and the literature.

- The Employment analysis will combine Quarterly Census of Employment and Wage data with data on Michigan production and well development from the Department of Environmental Quality. We will employ a longitudinal, spatial regression technique to estimate direct, indirect and induced employment.

SOCIAL/PUBLIC PERCEPTIONS – key areas

- What does the public think about "fracking?"
- What factors influence perceptions?
- What might we expect if HVHF increases in MI?
- What is the nature of the dialogue about fracking in Michigan?

SOCIAL/PUBLIC PERCEPTIONS – approach and sources of information

- National & State-level perceptions (opinion poll data)
  - Awareness of issue
  - Degree of support/opposition
  - Perceived risks and benefits
  - Support for related policy measures
- Community-level perceptions (academic studies – TX,PA, NY)
  - Perceived risks and benefits
  - How do perceptions differ across & within communities?
  - How do perceptions change as development progresses?
- Analysis of key issues raised by MI Stakeholders
  - How do industry, state agency and nonprofit groups differ in their views?
  - What are the primary areas of concern?

SOCIAL/PUBLIC PERCEPTIONS – approach and sources of information

- Risk Perception literature
  - How do technical experts and the lay public view risk differently?
  - What can we learn from other controversial issues? (e.g., nuclear power, hazardous waste)
  - What steps might we take to create a more productive dialogue that respects all involved parties?

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http://graham.umich.edu/ia/hydraulic-fracturing.php

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