

SESYNC Case Study: Hydraulic Fracturing in Michigan

Student handout

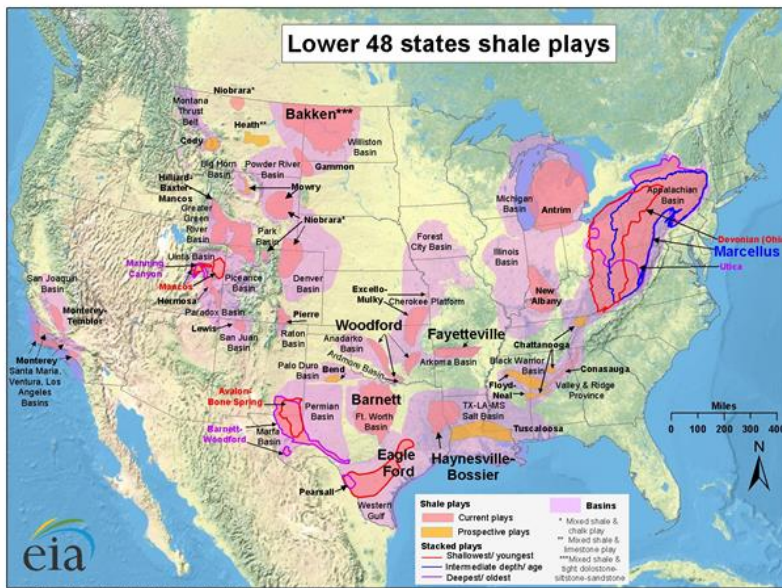
Author: Bruno Takahashi, Michigan State University
btakahas@msu.edu

*"In Michigan, we do fracking right...10,000 wells and we never had a problem."
[Michigan] "is a role model for fracking done right."*

Governor Rick Snyder

Unstable hydrocarbon prices, increasing uncertainty about energy supplies from foreign countries, and international pressure to reduce greenhouse gas emissions that are responsible for global climate change, have all contributed to the exploration of alternative energy sources and technology innovation in the energy industry. In this respect, the U.S. has increased domestic natural gas production, mainly by extracting shale gas through a controversial technology: hydraulic fracturing or hydrofracking (HF). Natural gas is perceived as a cleaner fossil fuel, and in 2010, the U.S. became the world's largest producer of natural gas, mainly due to its increasing production of shale gas. Recent technological innovations have made shale gas extraction economically viable (i.e., horizontal drilling and HF), leading to successful extraction from the Barnett shale (Texas), the Bakken shale (Ohio) and most recently the Marcellus shale (Pennsylvania; figure 1). The extraction of these resources, however, has encountered increasing public and political resistance due primarily to environmental and human health problems.

While some states have extensive experience as energy producers (i.e., Texas and Pennsylvania), other states are dealing with the ramifications of an identity change (i.e., New York and Michigan – smaller scale production histories). A lack of homogeneity in communities confronted with the possibilities or realities of drilling has become a source of conflict and public reaction, resulting in organized resistance and support. Previously these community differences had been an advantage to natural gas companies during the negotiation of leases (i.e., lack of community cohesion), but landowners are now coming together forming coalitions to negotiate private and public benefits of gas drilling; a demonstration of lessons learned. As shale gas exploration continues to spread and extraction proposed in new parts of the U.S., more states are forced to consider how to craft policies to potentially take advantage of such resources while acknowledging such lessons learned (environmental, economic, and social) from the states that preceded them.



Source: Energy Information Administration based on data from various published studies. Updated: May 9, 2011

Figure 1: Map of U.S. Shale Gas Plays by the U.S. Energy Information Administration

Governor Rick Snyder has made it clear that Michigan will continue to support the use of hydraulic fracturing as a technique to recover natural gas from deep wells. In his 2015 State of the State, Snyder announced that fracking should be part of Michigan’s energy mix in the long term along with an increased in the state’s renewable energy portfolio. Part of his argument is that oil and gas companies have been using HF in Michigan for about 50

years and most wells drilled recently also integrate horizontal drilling. While Michigan’s Department of Environmental Quality says its regulations have kept environmental problems and drilling accidents to a minimum, it has also received more calls from skeptical residents in the last couple of years than ever before. The technique has been surrounded by a high level of uncertainty and controversy in other states, such as Pennsylvania and New York. New York State became the first state in the country to ban fracking. The controversy in Michigan led Snyder to commission a study to the Graham Sustainability Institute at the University of Michigan. The 200-page study¹ raised some concerns about the protection of proprietary information, the handling of waste products, and the monitoring of impacts on water resources by the energy companies.

Public opinion about fracking in the state has remained fairly positive, and suggests a preference for policy making about fracking at the state rather than federal level. However, various anti-fracking citizen groups have organized, raising concerns about the possible environmental impacts of this technology, while challenging the claims made by industry and government about the economic benefits of it. The different outcomes in policy making in different states such as New York (banned), Pennsylvania, North Dakota, Oklahoma and Texas, suggests a possible contested scenario in Michigan.

In this case study, we will explore the socio-environmental (S-E) system governing fracking in MI. During this case study, we will explore the scientific, technical, political, social, legal, and communication sub-systems, and how they all interrelate between them.

¹ <http://graham.umich.edu/media/files/HF-IA-Draft-Summary-0220201515.pdf>

Module 1: Introduction to S-E synthesis, systems thinking, and case study

Preparation for class

In this first meeting you will be exposed to an overview of HF in Michigan and to systems thinking. Visit the website of Michigan's DEQ and read about the state's role in HF. Also read chapter 1 of the Integrated Assessment Final report and the two readings on systems thinking. Come prepared to class with 3-4 questions about the information you read. These questions can be about concepts that need clarification or things that concern you about the technology. These questions might be guided by the following questions: Are there competing explanations of, or approaches to understanding, a single substantive phenomenon? Is there a fundamental argument between or among authors? Do different authors employ different methods? Do those differences lead them to draw different conclusions? Would another methodological approach be better? Are there major shortcomings in a set of readings on a topic? How could they be addressed? What questions for future research emerge from the readings, and how might those questions be answered? Does the empirical evidence support an author's (or authors') claims? Use these same questions to drive your thinking throughout the case study.

- Michigan Department of Environmental Quality: Hydraulic Fracturing in Michigan
http://www.michigan.gov/deq/0,4561,7-135-3311_4111_4231-262172--_00.html
- Bowman, D., Gosman, S., Lacy, S., Wolske, K., Callewaert, J., Allan, M., ... & Wightman, S. (2015). High Volume Hydraulic Fracturing In Michigan Integrated Assessment Final Report.
<http://graham.umich.edu/media/files/HF-IA-Final-Report.pdf>
- Creating a smarter U.S. electricity grid. From Journalist's Resource
<http://journalistsresource.org/studies/government/infrastructure-government/u-s-electricity-smart-grid>
- Ostrom, E. (2009). A General Framework for Analyzing Sustainability of Social-Ecological Systems Science JUL 2009: 419-422

Class meeting

In class we will begin with a short introduction about HF. We will then continue with a discussion about the material you read and the questions you developed. You will work in small groups to develop your own personal mental maps of how energy in the Us is produced, distributed, and consumed.

Module 2: The scientific and technical aspects of HF

Preparation for class

Review the two readings from Journalist's Resource. These readings introduce basic scientific concepts. Then review the reports from the University of Michigan and

develop 2-4 questions about the readings utilizing the concept explained in the Journalist's Resources readings.

- Academic research and studies: How they work and why journalists should care. From Journalist's Resource
<http://journalistsresource.org/tip-sheets/research/introduction-studies-academic-research-journalists>
- Eight questions to ask when interpreting academic studies: A primer for media. From Journalist's Resource
<http://journalistsresource.org/tip-sheets/research/interpreting-academic-studies-primer-media>
- Statistical terms used in research studies; a primer for media. From Journalist's Resource
<http://journalistsresource.org/tip-sheets/research/statistics-for-journalists>
- Ellis, B. (2013). Hydraulic Fracturing in the State of Michigan-Geology/Hydrogeology Technical Report.
<http://deepblue.lib.umich.edu/handle/2027.42/102576>
- Wilson, J., & Schwank, J. (2013). Hydraulic Fracturing in the State of Michigan-Technology Technical Report.
http://deepblue.lib.umich.edu/bitstream/handle/2027.42/102575/02_Technology.pdf?sequence=1&isAllowed=y

Class meeting

We will begin with an introduction of the basic scientific concepts. Here you will share your questions, which will then be answered by the group following a collaborative approach. You will then work in small groups to apply the scientific concepts to a component of HF highlighted in the UM reports. Then each group will present their work and we will discuss them as a group.

Module 3: Stakeholders and the legal and policy context of HF

Preparation for class

Read the following material before class. The articles provide an overview of the legal challenges related to HF in the state.

- Schroeck, N. J. (2014). Hydraulic Fracturing and Protection of Freshwater Resources in the Great Lakes State. *Ind. Int'l & Comp. L. Rev.*, 24, 113.
http://heinonline.org/HOL/Page?handle=hein.journals/iicl24&div=10&g_sent=1&collection=journals
- Skalski, A. (2013). Regulating Hydraulic Fracturing in Michigan: The Protection of Our Waters and Our People Hits Another Roadblock. *JL Soc'y*, 14, 277.
http://law.wayne.edu/journal-of-law-society/pdf/skalski_article.pdf

Optional:

- Turrel, F. J. (2012). Frack Off: Is Municipal Zoning a Significant Threat to Hydraulic Fracturing in Michigan. *Wayne L. Rev.*, 58, 279.
<http://www.law.msu.edu/king/2011-2012/Turrell.pdf>

Class meeting

You will be assigned to play the role of a stakeholder involved in policy-decision making about HF. These stakeholders are: DEQ, environmental NGO, university scientist, industry representative, and homeowners' association. You will analyze and discuss your assigned stakeholder using the material you read ahead of class with other students assigned to the same stakeholder. Then, you will be reassigned to a new group with students assigned to each one of the other stakeholders. In these new groups you will analyze the connections between each one of these stakeholders.

Module 4: Public opinion about HF and human and environmental impacts

Preparation for class

Read the following material before class:

- Basu, N. (2013). Hydraulic Fracturing in the State of Michigan-Public Health Technical Report.
- Public opinion in Michigan and Pennsylvania (report from National Surveys on Energy and Environment, University of Michigan).
<http://closup.umich.edu/files/ieep-nsee-2012-fall-fracking.pdf>
- Wolske, K., & Hoffman, A. (2013). Hydraulic Fracturing in the State of Michigan-Public Perceptions Technical Report.
http://deepblue.lib.umich.edu/bitstream/handle/2027.42/102581/08_Public%20Perceptions.pdf?sequence=1&isAllowed=y
- The impact of natural gas extraction and fracking on state and local roadways. From Journalist's Resource
<http://journalistsresource.org/studies/government/infrastructure-government/costs-shale-natural-gas-extraction-local-roads>
- The environmental costs and benefits of fracking: The state of research. From Journalist's Resource
<http://journalistsresource.org/studies/environment/energy/environmental-costs-benefits-fracking>

Class meeting

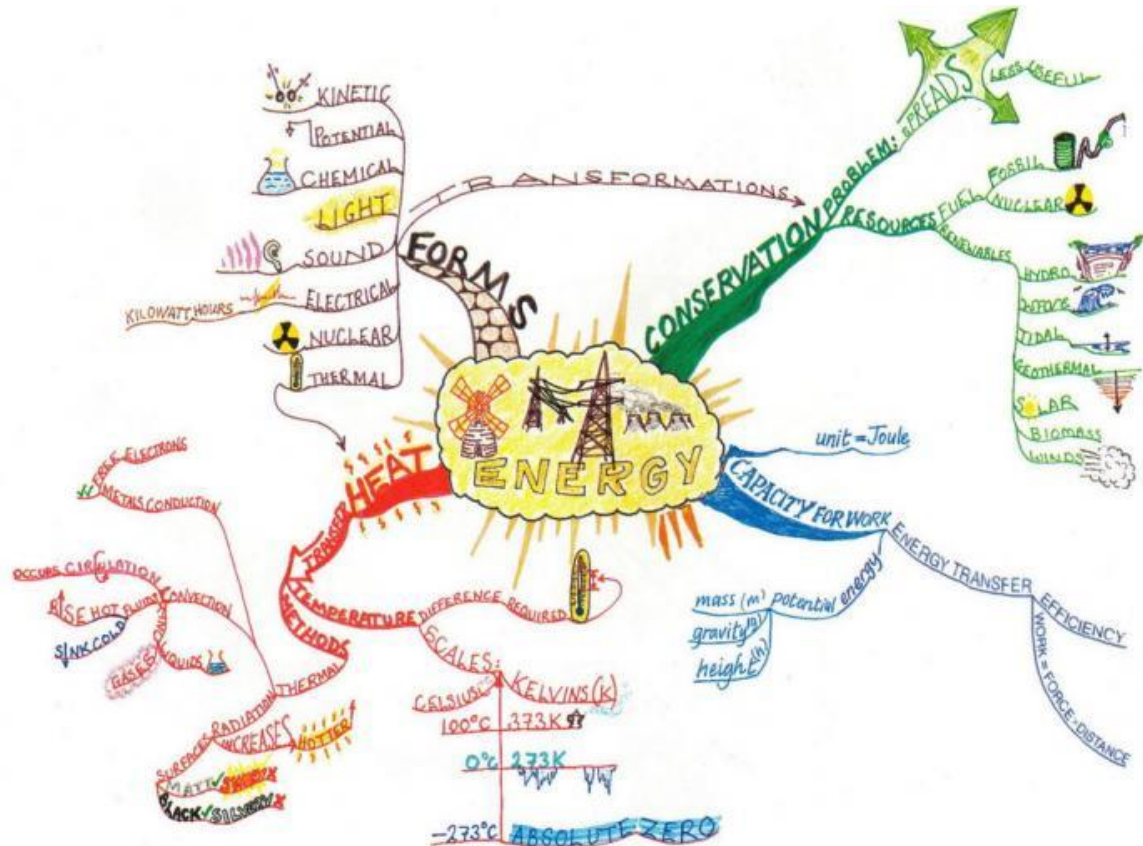
We will start with a lecture about public opinion and social science research. We will then discuss the main findings of the studies you read and their implications for public policy in Michigan. We will spend the rest of the class examining public health and environmental impacts of HF.

Module 5: Concept Mapping

Preparation for class

You will read the following reading before class:

- Novak & Cañas. The Theory Underlying Concept Maps and How to Construct and Use Them
<http://cmap.ihmc.us/docs/theory-of-concept-maps>
- What are mental models?
<http://mentalmodels.princeton.edu/about/what-are-mental-models/>



<http://www.mindwerx.com/mex/mind-map/hand-drawn/1132/energy-science-mind-map>

Class meeting

We will begin with a short lecture on mental mapping based on the material you read before class. We will then examine an online tool to create mental models called *Mental Modeler* (<http://www.mentalmodeler.org/>). You will then work in small groups to develop your own mental models about the HF system in Michigan. You will develop the map using the online tool, write a narrative that explains the map, and finally, present the map to the class.

Module 6: Media content analysis

Day 1

Preparation for class

Read the following material before class:

- Evensen, D. T., Clarke, C. E., & Stedman, R. C. (2014). A New York or Pennsylvania state of mind: social representations in newspaper coverage of gas development in the Marcellus Shale. *Journal of Environmental Studies and Sciences*, 4(1), 65-77.
- Mazur, A. (2014). How did the fracking controversy emerge in the period 2010-2012?. *Public Understanding of Science*, 0963662514545311.

You will develop 2-4 questions or statements about the methods, results or discussion sections of the studies. Think about the strength and weakness of the coverage by the media.

Class meeting

We will start with a discussion based on the questions you developed. We will then examine an academic database (Access World News) that we will use to collect news stories about HF in Michigan. You will then analyze the news stories.

Day 2

Class meeting

You will continue to analyze the news stories. You will then work with Google Trends (<https://www.google.com/trends>) to explore information seeking behaviors related to fracking. We will then compare the media data with these information seeking data.

Module 7: Data analysis and synthesis

Day 1

Preparation for class

Review the following databases before class:

- Major administrative datasets of the U.S. government — all in one place.
From Journalist's Resource
<http://journalistsresource.org/tip-sheets/research/websites-u-s-federal-government-administrative-datasets>
- Natural gas production per region:
<http://www.eia.gov/petroleum/drilling/>
- Number of producing gas wells:
http://www.eia.gov/dnav/ng/ng_prod_wells_s1_a.htm
- Demographic data:
<http://www.michigan.gov/cgi/0,1607,7-158-54534---,00.html>

Class meeting

We will closely examine each database you reviewed ahead of class. You will then work in small groups to develop research questions you would like to answer by

integrating the databases. You will then analyze the data and present 2-3 main findings to the class.