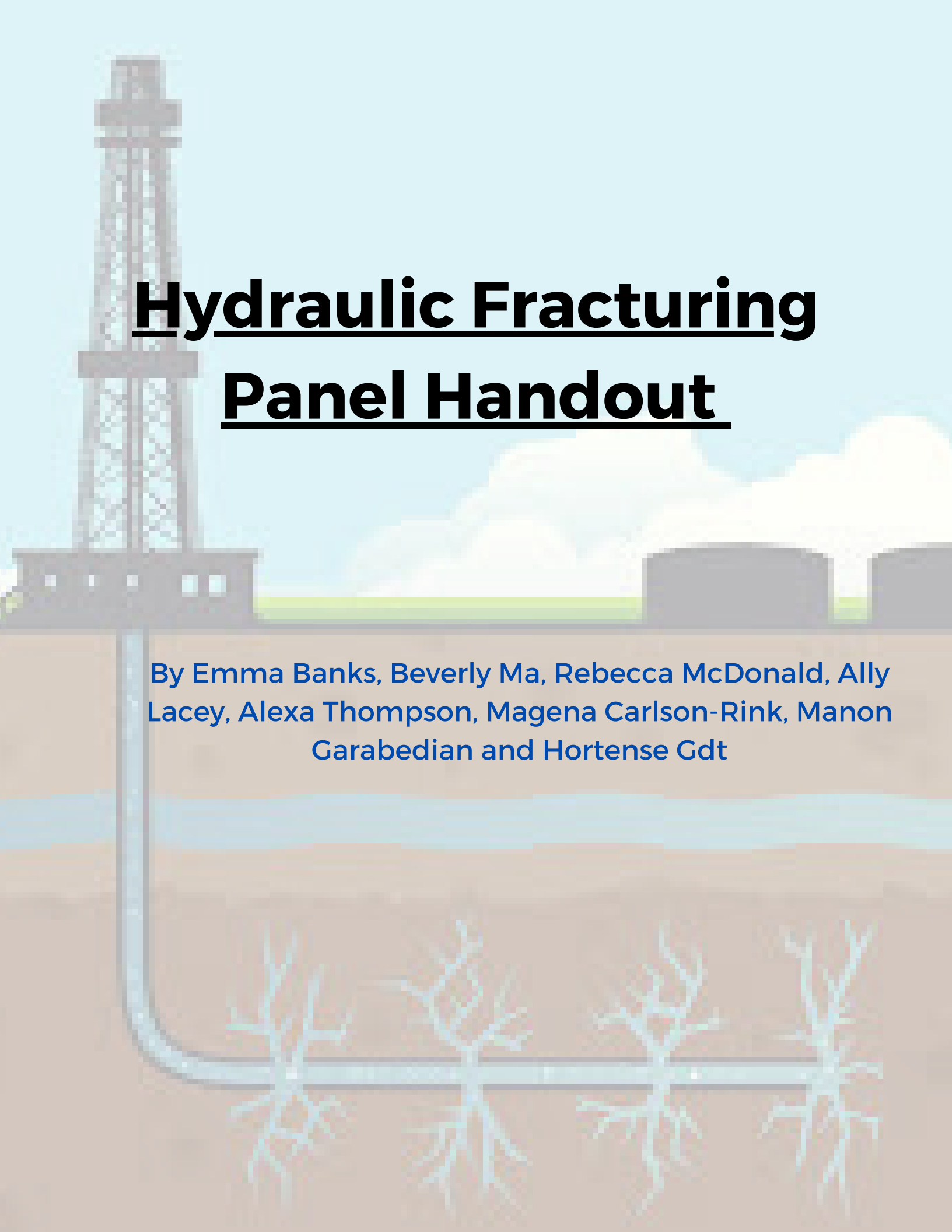

Hydraulic Fracturing Panel Handout

By Emma Banks, Beverly Ma, Rebecca McDonald, Ally Lacey, Alexa Thompson, Magena Carlson-Rink, Manon Garabedian and Hortense Gdt

HISTORY & INTRODUCTION

Introduction

By Emma Banks. GEOG 412

After achieving speculative success in 1949, the fracking business began to explode. In the 1960s, Pan American Petroleum started to use this drilling method in Oklahoma. And in the 1970s, fracking began to take off in the Piceance Basin, the San Juan Basin, the Denver Basin, and the Green River Container.

Modern day fracking didn't begin until the 1990s. This originated when George P. Mitchell created a new technique, which took hydraulic fracturing, and combined it with horizontal drilling. This drilling technique has enabled oil and gas producers to extract oil and natural gas from shale rock, thus increasing oil and gas production inside the US.

What enabled the oil and gas industry to extract oil from shale rock over the past 7 years was higher prices. If it weren't for higher oil prices, the capital investment needed in the oil and gas sector, wouldn't have occurred, and US oil production would have continued to decline.

Today, Hydraulic fracturing accounts for 59% of the United Sates' total crude oil production. It is estimated that fracking contributes $548Billion in GDP to the US economy.

As hydraulic fracturing has grown to account for a progressively larger share of US fossil fuel production, the number of hydraulically fractured wells has also increased dramatically. In 2000, the United States was home to just 276,000 natural gas wells, of which only 26,000 utilised hydraulic fracturing. By 2015, however, there were approximately 300,000 hydraulically fractured wells alone, more than the total number of gas wells just 15 years earlier.

TIMELINE OF HYDRAULIC FRACTURING DEVELOPMENT

- **1866: EDWARD ROBERTS WAS AWARDED PATIENT NUMBER 59,936, KNOWN AS THE "EXPLODING TORPEDO."**
- **1930S: DRILLERS USED A NON-EXPLOSIVE LIQUID SUBSTITUTE CALLED ACID, INSTEAD OF NITROGLYCERIN. THIS INNOVATION MADE WELLS MUCH MORE RESISTANT TO CLOSING, BOOSTING PRODUCTIVITY SIGNIFICANTLY.**
- **1946: FIRST UNSUCCESSFUL EXPERIMENT INVOLVING HYDRAULIC FRACTURING, WHICH OCCURRED IN KANSAS.**

1949: Halliburton performed two commercial experiments; one in Oklahoma and one more in Texas. These outcomes were far more successful.

- **1968: The rise of the Massive hydraulic fracturing (also known as high-volume hydraulic fracturing) was a technique first applied by Pan American Petroleum in Stephens County, Oklahoma, USA**

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What is hydraulic fracturing?

By Ally Lacey

Process:

1. Seismic exploration of the region
2. Drill vertical well
3. Drill horizontal well
4. Use explosives to create little holes in drill casing
5. Force water and proppants at 5000psi (very high pressure) into holes
6. Cracks propagate up to 305m outward into the rock
7. Gas flows out with "flow back" or "produced" water to surface
8. Water treated, reused, recycled or disposed of

Conventional vs unconventional gas

Conventional:

- Gas in porous layer
- Constrained by impermeable layer above
- Flows naturally to surface after drilling

Unconventional:

- Gas or oil reserve trapped in non-porous or impermeable layer
- Does not flow naturally to surface
- Must use horizontal drilling and high pressure hydraulic fracturing to release gas
- Much more difficult to extract

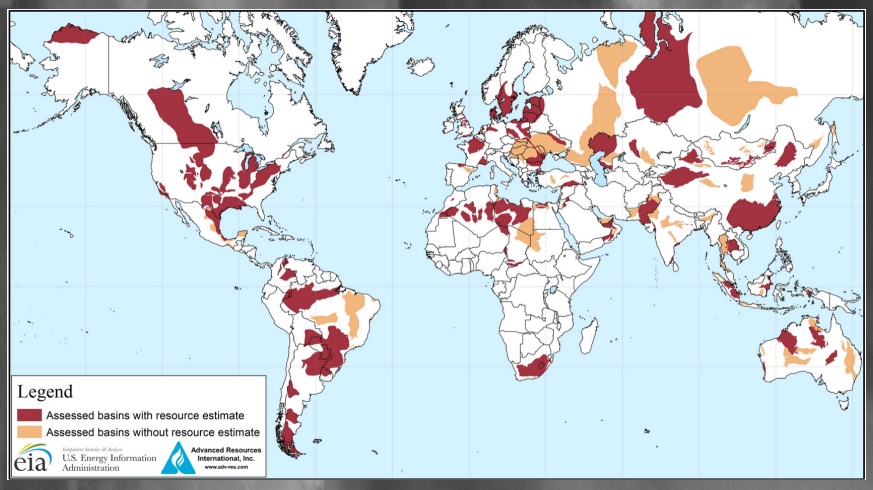

Figure from US Energy Information Administration, showing global distribution of shale basins and potential to extract unconventional gas globally. The map shows 48 shale basins in 32 countries

Main difference is the use of these unconventional techniques:

-Multi-stage fracking
-Horizontal drilling

which means...

- Well can be used up to 20 times
-Each time targeting different regions
-Each frack job can take 3-10 days
-Much larger output of natural gas

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ENVIRONMENTAL IMPACTS

By: Rebecca McDonald

There are four main environmental concerns surrounding hydraulic fracking:

1. Water consumption

Each well consumes ~8,000 to 80,000 m3 of water over its lifetime. Decreased water availability puts stress on aquatic and terrestrial systems resulting in ecosystem shifts. However, fracking is far less water intensive than any other non-renewable energy source.

2. Water pollution

Thousands of products can be added to fracking fluid (150,000L per well). These products range from acids to biocides to proppants to "trade secrets". If leaks occur, these chemicals enter ecosystems where they can cause acidification, reproductive issues, antibiotic resistance, and other negative environmental impacts. However, leakage has been shown to be mitigable with proper regulation and improved technology. It also must be remembered that coal releases a huge volume of chemical runoff and increases sediment loading.

3. Climate change/air pollution

Fracking produces less than half the CO2 emissions of coal, nearly 0 SO2 or Hg, and less NOx and particulates than coal. However, as natural gas is composed mainly of methane (21-23 times more potent than CO2), its escape increases the negative impact of fracking on climate change. Additionally, 37% of fracking additives are volatile; once airborne, these compounds decrease air quality.

4. Land Use

While the ~ 3 hectare surface disturbance of a single well site is small compared to highly destructive coal mining, the combined impact of 100s of wells results in a large amount of land disturbance. Furthermore, access roads result in habitat fragmentation which can seriously impact animal migration patterns.

3 other issues worth mentioning:

Noise pollution

~80-250 days per well

Induced seismic activity

Fluid injection disposal wells have resulted in "felt" earthquakes

Radioactivity

Naturally occurring radioactive materials or radioactive tracers can be leaked into the environment

Overall, the environmental impact of fracking will depend on whether the industry trajectory supports a shift towards renewables or expands to push renewables out of the picture.

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Health Risks & Social Impacts

By: Alexa Thompson

Individual Risks/Impacts

- Physical symptoms such as fatigue, headaches, ocular and dermatologic irritation, confusion and delirium may be experienced.
- Neurological symptoms such as problems with balance, disorientation and fainting, cognitive deficits, developmental delays, and neural tube defects in infants may be experienced.
- Increased rates of respiratory, gastrointestinal, immunological, endocrine and sensory illnesses are experienced.
- Increased sense of powerlessness, fear, betrayal, guilt, anger, stress, anxiety, depression and sleep disturbances are experienced
- Increased rates of cancer and infertility arise as well.

Community Risks/Impacts

- Two opposing views:
  - Fracking as a means to support, promote, and encourage thriving in a community.
  - Fracking as a disrupter to community thriving.
- Gender/sex imbalances
  - Transformation into a male dominated population.
  - Entrance of prostitution and sex trafficking.
  - Increased rates of crime, violence, sexual assault, and sexually transmitted diseases.
- Communities experience disruptions of social cohesion, erosion of community pride, feeling of being exploited, and a breakdown of shared community values.

Mobile Worker Risks/Impacts

- Men move to fracking communities in search for increased wages, leaving their support systems and normal routines behind.
- This movement perpetuates "frontier masculinity" which involves rugged individualism, emotional toughness, and self-reliance. This often results in an internalization of stressors.
- This social isolation may contribute to substance misuse and violence.
- Men sometimes bring their families with them which contributes to increased foster care cases in affected areas, increased domestic violence and usage of women's shelters, and increased food insecurity and distribution of food stamps.
- Many workers (and their families) end up homeless due to unavailability and extreme prices.
- Host communities are often hostile towards workers and view them as "dirty outsiders".
- Many workers lack access to resources and health benefits.

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Economic Impacts

By Beverly Ma

Economic Development

- Fracking projects create hundreds of thousands of jobs, and employ individuals from a variety of fields
  - the creation of jobs can aid with reducing poverty
- The cost of energy from unconventional gas is cheaper than from a conventional source .
  - Projects can help a country's industry be more competitive in the global market
- For some nations, it is argued that fracking resources provide the opportunity to produce their own gas and eliminate dependency on outside suppliers.
  - i.e Israel, U.S.A
- Unclear Profitability

Hydraulic Fracturing & the U.S

- Within the US itself, the abundance of resources from fracking has drastically reduced the prices of shale gas
  - 50 - 66% cheaper than gas from a conventional well.
  - i.e Marcellus Shale Reserve in Pennsylvania, predicted to have enough resources to supply U.S national consumers energy for 45 years
- As a result of cheaper gas, the U.S has become a very attractive place for manufacturing industries to invest in, as well as for other nations to enter into joint venture agreements on new and existing projects
- Geopolitical Relationships
  - Mexico is the largest export
  - Reducing Europe's dependency on Russia

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Politics and Public Opinion

By: Magena Carlson-Rink

For Fracking Framing

- **Cleaner than oil and coal:**
  - Advocates of Fracking believe in its potential to provide exorbitant amounts of energy for less emissions than other fossil fuels
- **Energy Security and Independence**
  - After the US started using shale gas it was able to become a net exporter of energy and had a surplus of coal which they sold to Europe
  - Countries that don't depend on others for their energy supply increases their independence
- **Economic Development**
  - Increased number of jobs
  - Economic investment in the area
  - Build up of infrastructure

Against Fracking Framing

- **Environmental Degradation**
- **Damage to Human Health**
- **Land Disputes**
  - Lack of proper informed consent for Indigenous nations
  - unequal power relationships
- **Distrust of large scale energy projects**
  - government streamlining project without, for example an EIA and poor transparency

Political Priorities

- **Environmental vs. Economic**
- **Local Communities vs. Large Projects**
- **Influence of Political Ideologies**
  - those who live outside the area surrounding a fracking site are more likely to form their stance on fracking based on their political ideology
- **Misinformation**
- **High Levels of uncertainty**
  - Example: difficult to monitor groundwater contamination is as it is exempt from the US Safe Water Drinking Act
- **Polarization**

Case Study: Poland and Russia Energy Independence

Due to Poland's past as part of the Soviet Union, there is a strong desire to be energy independent from Russia. Although only 13% of energy in Poland comes from gas, 80% of that gas is supplied by Russia. Therefore, fracking has been introduced as an extremely effective way to gain energy independence. Aided by positive media coverage that emphasizes the economic viability of fracking there has been little push back against fracking and those who do speak out are associated with being unpatriotic. This case study illustrates the important influence of geopolitics and identity politics on this issue.

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Regulations & laws

Hortense Gaudriot

I- Legal context

Countries using or considering use of hydraulic fracturing have implemented different regulations,including developing federal and regional legislation, and local zoning limitations. Hydraulic fracturing has become a contentious environmental and health issue with Tunisia and France banning the practice and a de
facto moratorium in place in Quebec and some of the states of the US.
Historically, hydraulic fracturing has been a victim of a legal vacuum, i.e. for a long time there was no regulation. From the 1950s to 2000, it was neither permitted nor prohibited. This lack of regulation allowed its development, especially in the United States.

Therefore, the legal context is not unified internationally, it differs from country to country and state to state. It evolves little by little (as we can see with the introduction of new principles and the progressive taking into account of environmental problems) but it is always a victim of a lack of information from decision-makers and especially of the influence of lobbies. Tensions between industrial lobbies and the actors responsible for environmental regulation, i.e. elected officials, agencies, administrations and NGOs. Example: Ethics Watch & the example of the pressure exerted by the oil and gas lobby on American political decision-makers and their administrations.

II- Laws and regulations in US: State VS Federal regulation debate

Generally speaking, there is no fixed case law in the United States, which is explained by the fact that legislation is recent and most litigation is fairly recent. Moreover, the courts have long lacked information on the indirect impacts and dangerousness of fracturing operations. Judges often try to take into account the local disadvantages and benefits of gas production. However, many judges have recognized the "abnormally dangerous" nature of fracturing. In addition, new information and data on gas leaks could change the case law. Lawyers are also sometimes misinformed, and horizontal drilling under residential areas and private property raises issues of trespassing and liability for damage.

III- Other countries

Canada : Four out of Canada's 10 provinces currently have province-wide bans on fracking: the provinces of New Brunswick, Newfoundland, Nova Scotia and Quebec

France : France has launched a reform of its mining code and
banned fracturing for gas exploration and exploitation in 2011. France became the first country to ban hydraulic fracturing, And this decision was deemed to be in conformity with the French Constitution by the Constitutional
Council.

UK : In March 2019, the High Court found the UK government's policy was unlawful and failed to consider the climate impact of shale gas extraction. In November 2019 the UK government imposed a moratorium against fracking

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CASE STUDY

BARNETT SHALE, TEXAS, USA

By: Manon Garabedian

The case of Barnett Shale in Texas, US, is a great example of hydrofracking. The production of natural gas through fracking started in 1981. Barnett Shale is one of the largest onshore production of natural gas. It illustrates the economic benefits of the industry although the production decreased since 2012. It's also a good case to study the environmental issues raised by the fracking industry, as there is an increasement of complaints from the citizens because of health issues. Barnett Shale is also an interesting case as it addresses the issue of the multi-tiered institutional regulations.

Environmental issues and regulations

A study in the Barnett Shale area was conducted to determine the impact of fracking activities on the air quality and the impact on human health (Bunch et al. – 2014). The City of Fort Worth also conducted a similar experience (2 months period here) on the ambient air and concluded that the observed level chemicals didn't reach a concentration that would impact human health.

Also, it is pointed out that the composition of chemicals in the air can also be blurred because of other pollutants with the urban areas.

The TCEQ (Texas Commission on Environmental Quality) show that there are potential issues with VCOs and NGOs that could impact human health. Plus, there is an increasement of citizens' complaints about health effects due to fracking activities.
Since 2017, Texas regulations required fracking operators to complete and submit a list of chemicals used during the fracking process.

Clean-up programs by the Railroad Commission of Texas, the Oil and Gas Regulation and Cleanup (OGRC) Fund, to developed guidance documents for spill cleanup, site cleanup, and waste minimization.

Some numbers:
Barnett Shale in 2015:

- $11.8 Billion in gross Product per year
- 107,650 Permanent jobs

Production 2019:

- Over 430 Million cubic feet of dry natural gas per day
- 80% of the region's output

"Drilling into unconventional reserves is potentially analogous to offshore oil in terms of impact," Tinker says

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