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# The Development of “Green” Fracking

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Hydraulic fracturing, the process of fracturing rocks with pressurized fluid to release natural gas, has become one of the most important and controversial technologies of the 21<sup>st</sup> century. Most of the controversy stems from the environmental impacts associated with fracking—mainly air and water pollution. Many question if the fracking industry is doing enough to address these issues, or if they're even doing anything at all. Despite the deeply negative publicity fracking regularly receives, there have actually been many advancements in the area of “greener” fracking technologies.

The development of more environmentally friendly fracking techniques could be beneficial to the public, industry, and the environment. First, if fracking could be more environmentally friendly, it would eliminate the majority of political opposition to the practice. Since most of the dissent comes from those concerned with environmental and health impacts, lessening or eliminating these issues would remove the corresponding opposition. Less political friction would obviously be beneficial for the fracking industry, since it could continue more smoothly without protests and negative publicity.

A second reason the research and development of green fracking technologies would be beneficial is that it would reduce the threat of pollution, and consequently, climate change. Cleaning up fracking and reducing the amount of chemicals and gases the process releases into the water and air would actually benefit the public with a cleaner environment, which is a benefit regardless of political motivations. Lehigh students, many of whom come from areas in Pennsylvania affected by fracking, would definitely be affected positively if fracking adopted environmentally safer technologies.

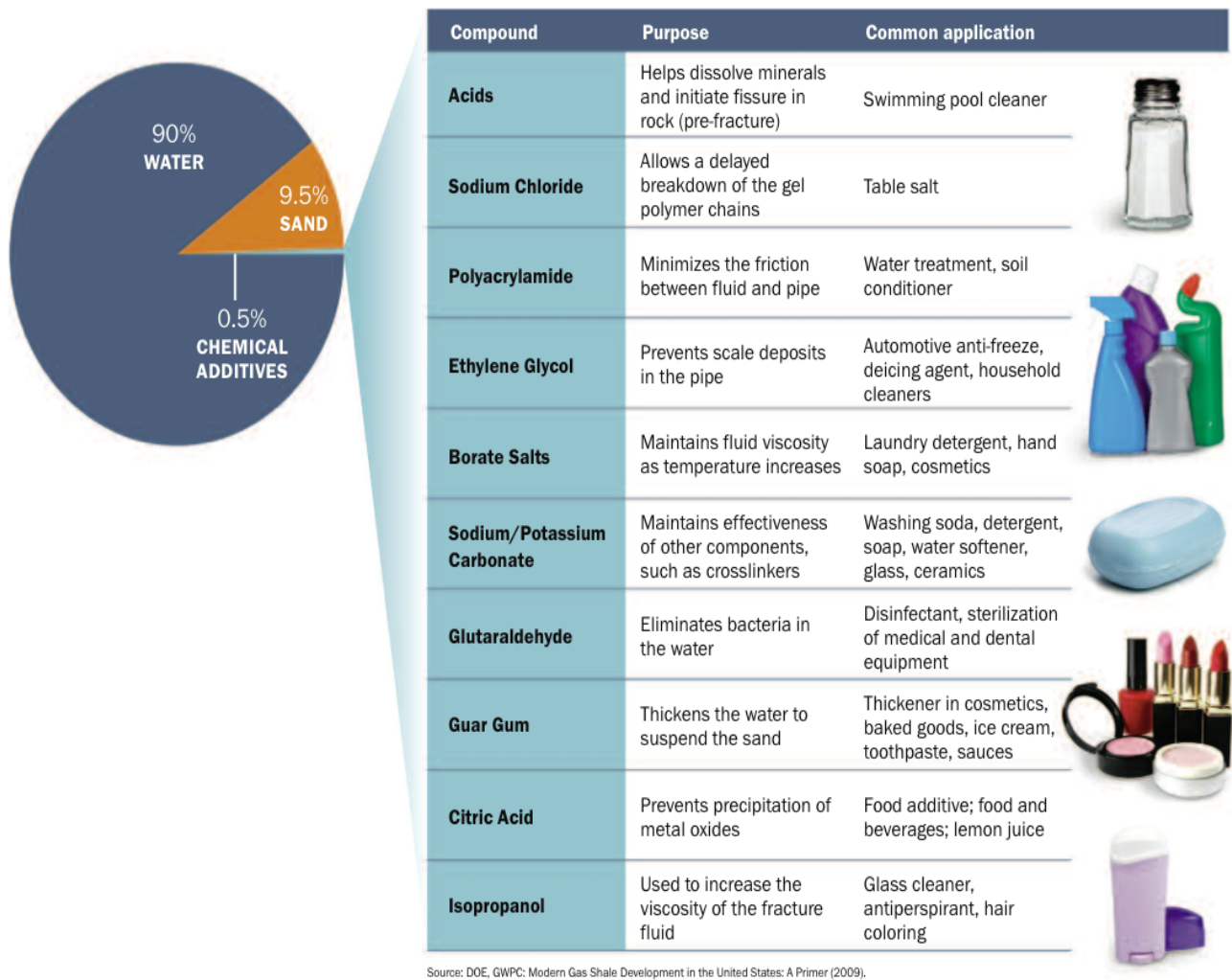
A last reason for developing environmentally friendly technologies is that they are, when used correctly, more economical than the previous processes. Gas plants are cheaper than coal plants, and greener technologies, once implemented, are cheaper to operate than previous ones. By cleaning up the fracking process and lessening political opposition, the benefits of fracking are more likely to be achieved and noticed. The recent efforts made to come up with more environmentally friendly fracking technologies have produced a wide range of results. It's undeniable that there has been progress in making fracking a cleaner method of natural gas extraction, but there are still questions that have yet to be answered about the future of this “greener” fracking dream. Are the technologies being developed legitimate? Can they be used universally to benefit all areas affected by fracking? Are all of the negative effects of fracking being addressed, or are there issues that are not being worked on? Lastly, do these advancements even matter? The burning of natural gas is cleaner than coal, but should our society really be spending time and money on a practice that is still going to release greenhouse gases and possibly accelerate global warming? There is evidence to support many opinions on this evolution of hydraulic fracturing technology.

The origins of fracking can be traced back to the 1940's, but it was not used on a large commercial scale until 2003 (EEC, 2010). As fracking gained popularity and wells sprang up all across the United States, opposition to the practice started to become more and more prominent. Fracking became a word with a connotation of pollutants, health problems, and danger. To combat those opposed to fracking, companies began researching ways to make

the practice safer and cleaner. These efforts have yielded multiple advancements that could very possibly eliminate the major environmental concerns surrounding the practice and change the fracking is done forever.

Halliburton Company, one of the world’s largest oilfield companies, has taken a lead on making technologies more environmentally friendly. One of its biggest—and most controversial—developments has been CleanStim, which is a fracking fluid supposedly formulated with ingredients from the food industry (Halliburton Co. 2013). Since the cocktail of chemicals in traditional fracking fluid has been the source of much unrest among fracking critics, a new, biodegradable alternative would be a huge step forward.

### A breakdown of the chemicals in traditional fracking fluid



Source: DOE, GWPC: Modern Gas Shale Development in the United States: A Primer (2009).

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Knowing this, Halliburton staged quite the show to prove that its new fluid was safe. In August 2011, a conference was held by the Colorado Oil & Gas Association, and Halliburton CEO Dave Lesar was a keynote speaker. He addressed public concerns about hydraulic fracturing, then showed a glass of liquid to the conference, which held the new CleanStim fluid. A fellow Halliburton executive was called up to the stage and, after feigning reluctance, took a swig of the fracking fluid.

The incident was called everything from a publicity stunt to a valuable demonstration, but it caught people's attention either way. The problem was there were still some holes in Halliburton's claims. "I thought, if this stuff was so benign, why wouldn't the CEO drink it himself?" asked Environmental Defense Fund's Mark Brownstein, quoted in an article by Catherine Tsai (Tsai, 2011). Brownstein raises an interesting point, though it seems the fluid is as safe as Halliburton claims when one considers a more recent conference that included some more CleanStim ingestion. At a Quebec Oil and Gas Association in October 2013, about two dozen executives—including Halliburton Canada's Vice President John Gorman— took a taste of Halliburton's fluid (Blake, 2013). They are all still doing well enough to tell the tale, so perhaps Halliburton really has created a safe fracking fluid. The question is, will it be used?

The second issue that concerns critics of fracking is just that: even if there are new, cutting edge technologies coming out that make fracking safer, will companies spend the time and money to implement them completely? In the case of one past advancement, Dopefree connections, the turnover was successful and actually ended up being more efficient than the old technology. Before Dopefree technology became popularized, pipe-dopes (liquid lubricants manually applied to thread connections together) were the norm (Houston Advanced Research Center 2013). These lubricants often contained heavy metals that could be dangerous to workers, they froze in sub-zero temperatures, and they would sometimes become contaminated with debris or sand due to their stickiness (Tenaris Inc. 2012). The introduction of a dope-free coating was met with enthusiasm, and was implemented for most wells.

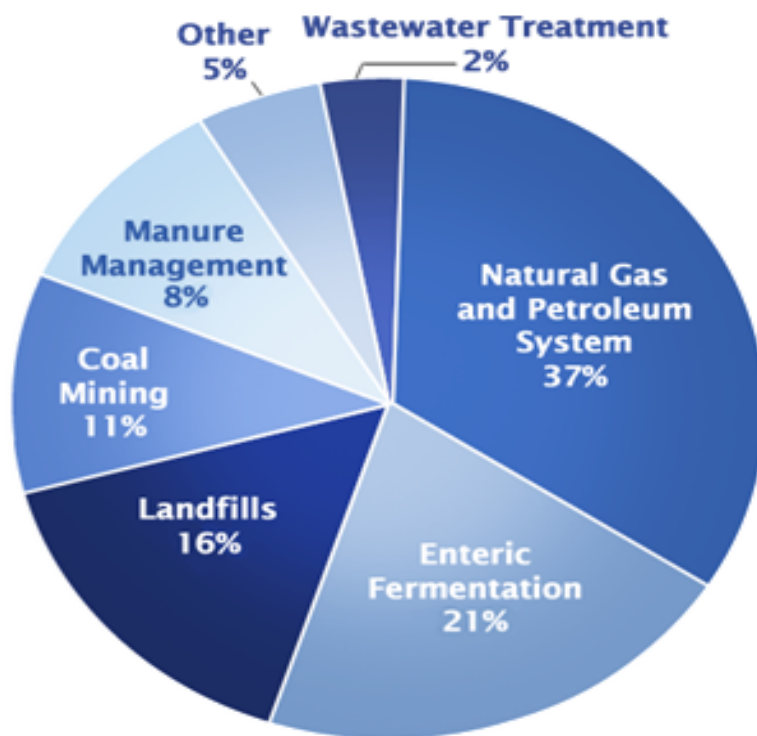
Another new technology is a membrane distillation process by General Electric. "The membrane distillation system is mainly used to concentrate produced water from the hydraulic fracturing process, and is expected to reduce produced water disposal costs and enable water use," according to water-technology.net (2013). Produced water includes all wastewater produced in the fracking process. Water that emerges from the well after production begins is often salty water that was contained in the shale. Having been successfully tested in Texas, the new technology also proved to consume less energy than traditional methods (water-technology.net 2013).

At first, it looks like developing this system was a great use of time and money—it reduces time, energy and the likeliness of a toxic spill. But, according to Mark Boling, President of V+ Development Solutions, the technology will not be useful everywhere. The technology would only be practical in places that are very dry or where the water is high in salinity (Bullis, 2013). Despite this, the new distillation system is being celebrated as another step forward in making fracking more environmentally friendly, and also a more

cost-effective practice. Its cost-effectiveness is a main reason it could be assumed fracking companies would be open to implementing this new system.

One very important problem associated with the research and development of greener fracking technologies is that even if the process of drilling for natural gas is improved, burning it will still be damaging to the environment, no matter how much “cleaner” it is than coal. “Given that it’s a fossil fuel that emits CO<sub>2</sub>, unless we can affordably capture the carbon, which no one is even talking about since it’s ‘relatively clean,’ it’s not a viable option for the long term,” according to engineer and author Bob Siegel (Siegel, 2012). There is debate as to whether funding research into greener fracking is even useful from an environmental standpoint—won’t the inevitable release of pollutants like methane, CO<sub>2</sub> and nitrogen oxides counteract any positive advancement made in the realm of green fracking technology? Maybe not, since at least the accidental release of methane is becoming not so inevitable.

### U.S. Methane Emissions, By Source



Source: Energy Acuity,(2012). <http://www.energyacuity.com/blog/bid/252378/Stemming-the-Flow-of-Natural-Gas-Leaks-in-Fracking>

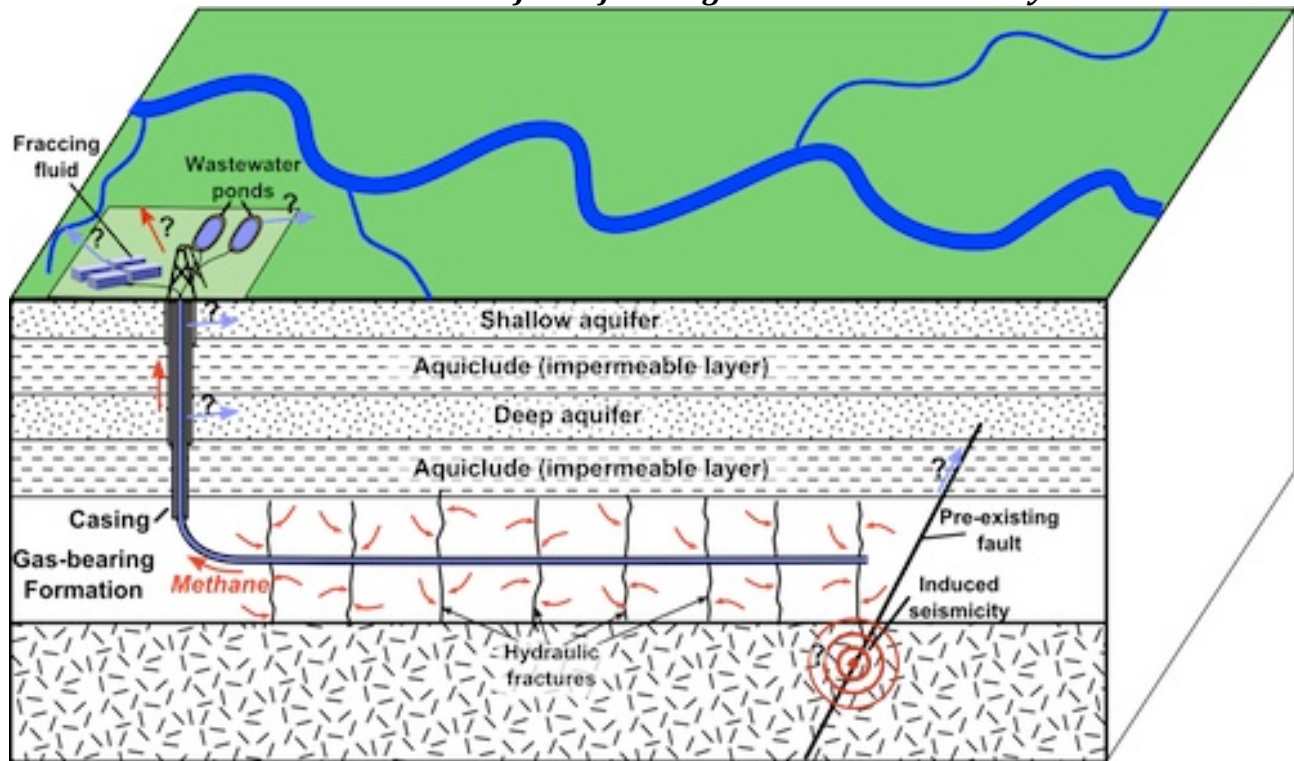
A system known as Green Completion, also called Reduced Emissions Completions (REC's), has been developed for use and is now being implemented across the country. An REC requires natural gas to be captured immediately after the well is completed, rather than flaring it off (burning it) or letting it be released into the atmosphere. Since 2000, REC's have been reducing methane emissions (EPA 2011), and on April 17, 2012, the Environmental Protection Agency issued new regulations requiring the implementation of REC's on all natural gas wells that are hydraulically fractured (EPA 2012). There will be a grace period until January 1, 2015, after which it will be officially required that all well owners or operators use only REC's. Although the primary reason for the new regulation is environmental, the REC's also provide an economical benefit. Since the excess natural gas produced is now being captured instead of lost or burned, it can be used for energy. The graph above shows methane emissions before REC's are mandated.

The successful development and implementation of REC's is an important step forward in the industry's fight against emissions and consequently, accelerated climate change. Methane, along with carbon dioxide, is a greenhouse gas responsible for trapping radiation. According to the EPA (2011), the gas captured by REC's between 2000 and 2009 was enough to represent an additional \$1.5 billion of gas sale revenue. This much gas was saved even before it was announced that REC's would become required, so the additional revenue from captured gas in the future will undoubtedly be much higher.

Although there are some great strides being made to reduce the pollution associated with fracking, there are some environmental impacts associated with the practice that are still, for the most part, unaddressed. The issue of induced earthquakes or seismicity caused by deep injection wells has been a lesser-known, though still important, issue with fracking that is cited by critics. The majority of concern about earthquakes associated with fracking is focused on the injection of wastewater rather than on the drilling itself (Ellsworth, 2013).

According to the U.S. Geographical Survey (USGS), "more than 300 earthquakes above a magnitude 3.0 occurred in the three years from 2010-2012, compared with an average rate of 21 events per year from 1967-2000" (Ellsworth, 2013). There is still debate about exactly how much of this seismicity is man-made, but it is generally accepted that there are places where earthquakes are clearly associated with the deep injection of wastewater. These earthquakes are rarely noticeable, let alone powerful enough to cause annoyance or damage, but the idea of any sort of man-made seismicity is enough to alarm the public.

### *A Demonstration of how fracking could cause seismicity*



Source: Calwatchdog.com (2013). <http://calwatchdog.com/2013/10/14/study-questions-whether-fracking-causes-earthquakes/>

The problem is, from a scientific standpoint, induced seismicity on the small scale that is occurring at now is not enough of an issue to garner research and solutions being presented. The public associates earthquakes with high risk, and, as a whole, rejects the idea of any sort of manmade earthquake as an acceptable side effect of fracking. “The current regulatory frameworks for wastewater disposal wells were designed to protect potable water sources from contamination and do not address seismic safety” (Ellsworth, 2013). Not much attention is being paid to this particular issue, at least when compared to the concern fracking companies have demonstrated over air and water pollution. The USGS “hopes to increase research efforts to understand the causes and effects of injection-induced earthquakes,” (Ellsworth, 2013) but there is no evidence of any concrete projects that have been started. This concern is evidence that while some of the issues of fracking are being addressed, there are still problem areas that are not receiving the research attention that the public would like.

Hydraulic fracturing, like any other process for harvesting energy, has its pros and cons. There are definitely issues surrounding it, environmental and otherwise that have yet to be solved. However, the efforts of drilling companies have already yielded some impressive advancements in technologies like Green Completion and Halliburton’s CleanStim fluid. Through further research, more environmental issues associated with fracking could be

addressed, and the process could be a successful and more accepted part of energy production.

## Profiles of Key Groups and Organizations

### 1. Halliburton Company

Halliburton is one of the world's largest oilfield companies. Since it really is up to the fracking industry to begin implementing new technologies, it's crucial that Halliburton has taken a proactive approach to researching and developing green technologies. Its Cleansuite System Technologies (enhancement technologies designed to make fracking safer) include the Cleanstim fluid, Cleanstream service (using UV light to replace biocides), and Cleanwave treatment system (using electricity to treat flowback water.) Halliburton Co. can be contacted through its website

Link: <http://www.halliburton.com/>

### 2. The U.S. Environmental Protection Agency (EPA)

The EPA is a federal government agency that aims to protect human and environmental health by enforcing laws enacted by Congress. Since the EPA is the agency that sets regulations (such as the one mandating REC's), it is a vital part of the fight for environmentally friendly fracking technologies. Without an agency to enforce rules, regulations and policies, there would be no way to monitor if the industry was actually taking strides towards a greener future. The EPA has ten regional offices, and can also be contacted by phone or through their website, under the "Contact Us" tab.

Link: <http://www.epa.gov/>

### 3. Environmentally Friendly Drilling Systems (EFDSystems)

EFDSystems is a program started by three scientists as a resource for "unbiased science" in relation to the oil and gas industry. They participate in research and ally with universities and national labs to help the industry move towards a greener future. The program's emphasis on collaboration and straightforward science is a great example for other programs interested in environmentally friendly technologies. Their website includes contact information for the three founders of the program and other important persons under both the "Contact Us" tab, and on various other pages.

Link: <http://www.efdsystems.org/>

### 4. General Electric (GE)

GE, like Halliburton, has played a valuable role in leading the industry into a new era of environmentally conscious technology. With its work on the membrane distillation system, it has obviously taken an interest in improving fracking technology. Even more so, there has been a successful test of the distillation technology, proving that the company is serious about implementing these kinds of technologies. GE is a multinational corporation with many ways to influence and assist on the road to green technology. Its website has links to all of its social media, and a contact form for any questions. Link: <http://www.ge.com/>



## Important Web Resources

### 1. Rigzone

Rigzone, which describes itself as “your gateway to the oil and gas industry,” is a great resource for the latest news on developments in fracking technology. It also provides a very thorough directory of companies involved in drilling. It covers a wide range of information and is a great place to go for news updates on many aspects of fracking.

Link: <http://www.rigzone.com/>

### 2. Energy in Depth

<http://energyindepth.org/>

Energy In Depth was launched by the Independent Petroleum Association of America (IPAA) and is designed to share facts about developing and utilizing the U.S.'s onshore energy stores. It is more on the pro-fracking side, but does provide some good links to news stories, developments in the fracking world and polls.

Link: <http://energyindepth.org/>

### 3. Environmental Engineering and Contracting Inc.

EEC, a company that provides environmental consulting services, is a good website to visit to get a different perspective on fracking. Though it isn't a specifically fracking-oriented site, there are explanations on how things like wastewater and compliance are dealt with from a regulatory standpoint. EEC explains the way sites are assessed for environmental compliance, and compliance is obviously a big part of fracking becoming greener.

Link: <http://www.eecworld.com/>

### 4. Energy From Shale

Energy From Shale is another website with the aim of providing factual information for the public about hydraulic fracturing. It is clearly in favor of fracking, since it provides a large section on the benefits of fracking, but it is a useful resource for learning about some of the more positive aspects of fracking. There is a section on environmental commitment that provides insight into wastewater, emissions, earthquakes, and drilling sites.

Link: <http://www.energyfromshale.org/hydraulic-fracturing>

### 5. EPA-Hydraulic Fracturing

This branch of the EPA's main website focuses on fracking, and is a clear, reliable resource for information. This site is especially useful for finding facts about new and current regulations, laws on fracking, and how the EPA is working to make fracking more environmentally friendly. It is balanced in the sense that it provides factual information, but would obviously fall into the category of being more interested in health and environmental effects than profits.

Link: <http://www2.epa.gov/hydraulicfracturing>

## For More Information

1. Triple Pundit  
<http://www.triplepundit.com/about/>
2. FracFocus  
<http://fracfocus.org/>
3. U.S. Geological Survey  
<http://pubs.usgs.gov/bul/1951/report.pdf>
4. What Is Fracking?  
<http://www.what-is-fracking.com/>
5. Scientific American  
<http://www.scientificamerican.com/article.cfm?id=can-fracking-be-done-without-impacting-water>
6. ScienceMag  
<http://www.sciencemag.org/>

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