

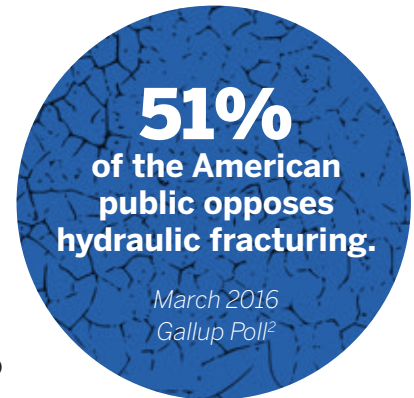
FRACKING FACTS, FANTASIES AND REGULATIONS *in Texas and Beyond*

By Paul Yale



HYDRAULIC FRACTURING IS CONTROVERSIAL — EVEN THE NAME EVOKES CONTROVERSY.

Opponents of hydraulic fracturing often spell it “fraking,” perhaps relishing the similarity to another, less polite word. Proponents of the process often refer to it as hydraulic “fracturing,” perhaps to avoid this same association. The word “fracking,” spelled with a “ck,” is also used (and appears in Webster’s Dictionary).¹



But regardless of how it is spelled, 51 percent of the American public opposes hydraulic fracturing, according to a March 2016 Gallup Poll.² This should not be surprising — the opponents of hydraulic fracturing are legion, and information about fracking in the national media almost invariably

sheds a negative light on the practice.³ Opponents of fracking say that fracking pollutes water,⁴ causes low birth rates,⁵ triggers earthquakes⁶ and abets climate change.⁷ Opponents of fracking also assert that fracking regulation is absent or wholly ineffective.⁸ According to its opponents, fracking should be banned

in the United States,⁹ as it is already in a handful of U.S. states plus France,¹⁰ Bulgaria¹¹ and other countries.¹²

Such accusations about fracking are all debatable,¹³ particularly the last one, that fracking regulation is absent or wholly ineffective. A substantial body of law has evolved in the United

1 *Fracking*, Webster’s New World College Dictionary (5th ed. 2018).

2 Art Swift, *Opposition to Fracking Mounts in the U.S.*, GALLUP (March 30, 2016), <https://news.gallup.com/poll/190355/opposition-fracking-mounts.aspx>.

3 Charles Sartain, partner, Gray Reed & McGraw LLP, presentation at the Dallas Bar Association’s 33rd Annual Review of Oil and Gas Law: “Facts and Fantasy in the Fracing Debate” (Aug. 3, 2018).

4 Justin Nobel, “*The Harms of Fracking*”: *New Report Details Increased Risks of Asthma, Birth Defects, and Cancer*, ROLLING STONE MAG. (March 13, 2018), <https://www.rollingstone.com/politics/politics-news/the-harms-of-fracking-new-report-details-increased-risks-of-asthma-birth-defects-and-cancer-126996/> (citing a report authored by Concerned Health Officials of New York & Physicians for Social Responsibility, COMPENDIUM OF SCIENTIFIC, MEDICAL, AND MEDIA FINDINGS DEMONSTRATING RISKS AND HARMS OF FRACKING (UNCONVENTIONAL GAS AND OIL EXTRACTION), (5th ed., March 2018). Discussion of water pollution allegedly caused by fracking begins on p. 48).

5 Darryl Fears, *Fracking Sites May Raise the Risk of Underweight Babies, New Study Says*, WASH. POST (Dec. 13, 2017), https://www.washingtonpost.com/news/energy-environment/wp/2017/12/13/fracking-sites-raise-the-risk-of-low-birth-weight-babies-new-study-says/?utm_term=.3cc843d530fc (citing Janet Currie, Michael Greenstone & Katherine Meckel, *Hydraulic Fracturing and Infant Health: New Evidence from Pennsylvania*, 3 SCI. ADVANCES 12 (December 2017), <http://advances.sciencemag.org/content/3/12/e1603021.full>).

6 Alison Grass, *Fracking Causes Earthquakes. Period.*, FOOD & WATER WATCH (Nov. 22, 2016), <https://www.foodandwaterwatch.org/insight/fracking-causes-earthquakes-period>.

7 *Ban Fracking Everywhere*, FOOD & WATER WATCH, <https://www.foodandwaterwatch.org/campaign/ban-fracking-everywhere> (last visited Aug. 6, 2018).

8 Nobel, *supra* note 4.

9 *Ban Fracking Everywhere*, FOOD & WATER WATCH, <https://www.foodandwaterwatch.org/campaign/ban-fracking-everywhere> (last visited Aug. 6, 2018).

10 France banned fracking in response to public opposition in 2011. In 2013, the ban was upheld in France’s highest authority of constitutional interpretation. David Jolly, *France Upholds Ban on Hydraulic Fracturing*, N.Y. TIMES (Oct. 11, 2013), <https://www.nytimes.com/2013/10/12/business/international/france-upholds-fracking-ban.html>.

11 Bulgaria enacted a fracking ban in 2012. Mirel Bran, *Bulgaria becomes Second State to Impose Ban on Shale-gas Exploration*, THE GUARDIAN (Feb. 14, 2012), <https://www.theguardian.com/world/2012/feb/14/bulgaria-bans-shale-gas-exploration>.

12 See Arthur Neslen, *The Rise and Fall of Fracking in Europe*, THE GUARDIAN (Sept. 29 2016), <https://www.theguardian.com/sustainable-business/2016/sep/29/fracking-shale-gas-europe-opposition-ban>.

13 Seth Whitehead, Opinion, *Anti-fracking Health Claims Not Supported by Facts*, THE SOUTHERN ILLINOISAN (Sept. 13, 2017), https://thesouthern.com/opinion/columnists/opinion-seth-whitehead-anti-fracking-health-claims-not-supported-by/article_17e8be29-6828-574d-b84f-c237c60ef1a7.html; see also *Compendium of Studies Demonstrating the Health and Safety Benefits of Fracking*, ENERGY IN DEPTH (April 2017), <http://eidhealth.org/wp-content/uploads/2017/04/Positive-Health-Compendium.pdf> (last accessed Aug. 6, 2018).

States over the past 10 years that seeks to regulate hydraulic fracturing. Are there gaps? Likely — the states are not uniform in their approach to regulation of fracking. As is the case with other complex industrial processes, scientific and engineering consensus on fracking regulation is not always achievable, so political compromise sometimes fills the void.

Whether hydraulic fracturing regulations are adequate, therefore, can be as much a political question as it is a scientific or engineering question. A person's political persuasions, or economic self-interest, can strongly color their objectivity when viewing hydraulic fracturing. It is not a coincidence that those states in the United States where fracking is banned are all "blue" states where the oil and gas industry plays a relatively small role in the state's economy, if any role at all.¹⁴

However, differences of opinion on hydraulic fracturing can run much deeper than "blue" state versus "red" state political orientation. Opponents and proponents of hydraulic fracturing often have starkly different attitudes toward fossil fuels in general. Many

opponents of fracking believe that fossil fuel usage is the root cause of global warming, and as such is an existential threat to civilization.¹⁵ Extreme opponents of fracking believe it is an assault on the planet and that sabotage is justified if necessary to stop the practice.¹⁶ Fracking's opponents look upon whatever success the oil and gas industry is having with fracking as a last-gasp aberration in the necessary and inevitable march toward abandonment of fossil fuels.

In contrast, supporters of hydraulic fracturing — and of the oil and gas industry more generally — believe that fossil fuels have contributed significantly to the standard of living in the United States and the rest of the world.¹⁷ While most in the oil and gas industry accept that climate change is a significant threat, supporters of hydraulic fracturing believe that continued use of fossil fuels, for at least the near term, is necessary to sustain living standards and to prevent billions of people from sliding into poverty. Supporters see fracking as a positive development, because it is helping postpone "peak oil" (i.e., the turning

point after which discovery of new oil and gas deposits cannot keep up with demand¹⁸) and the anticipated downward spiral of the world economy if oil and gas were depleted before technology can develop viable alternatives. In addition, fracking allows for greater use of natural gas in place of coal, which many argue reduces current levels of greenhouse emissions and can serve as a bridge fuel to the future.¹⁹

When opponents and proponents of fracking confront each other with such starkly different worldviews, civil discourse can degenerate. Many opponents of fracking disparage fracking supporters as climate science deniers and profiteers putting economic interests ahead of preserving the planet. Proponents often disparage opponents of fracking as hypocrites who rail against the evils of fracking while continuing to enjoy cars, airplanes, heating, plastics and the multitude of other modern conveniences made possible all or in part by fossil fuels.

Recognizing that opponents and proponents of fracking can approach the subject with such starkly different worldviews is necessary in sifting

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- 14 Fracking is currently banned in Vermont (2012), New York (2015) and Maryland (2017); nearby Massachusetts enacted a 10-year moratorium on fracking in 2016. *Vermont Becomes First State to Ban Fracking*, FOX NEWS (May 17, 2012), <http://www.foxnews.com/politics/2012/05/17/vermont-becomes-first-state-to-ban-fracking.html>; Daniel Wiessner & Edward McAllister, *New York Bans Fracking after Health Report*, REUTERS (Dec. 17, 2014, 12:06 p.m.), <https://www.reuters.com/article/us-energy-fracking-newyork/new-york-bans-fracking-after-health-report-idUSKB-NOJV29Z20141217?irpc=932>; Jon Hurdle, *With Governor's Signature, Maryland Becomes Third State to Ban Fracking*, STATEIMPACT PA. (April 4, 2017, 9:35 p.m.), <https://stateimpact.npr.org/pennsylvania/2017/04/04/with-governors-signature-maryland-becomes-third-state-to-ban-fracking/>; Ben Hellerstein, *Massachusetts Senate Approves Fracking Moratorium*, ENV'T MASS. (June 10, 2016), <https://environmentmassachusetts.org/news/mae/mass-senate-approves-fracking-moratorium>.
- 15 See, e.g., climate change activist Bill McKibben's website, 350, <https://350.org/> (last visited Aug. 6, 2018); see also DEEP GREEN RESISTANCE, <HTTPS://DEEPGREENRESISTANCE.ORG/EN/> (last visited Aug. 6, 2018).
- 16 Kyle Swenson, *Anti-fracking Activists and Anarchists are Blocking Rail Tracks in Olympia, Wash. They Don't Plan on Leaving*, WASH. POST: MORNING MIX (Nov. 29, 2017), https://www.washingtonpost.com/news/morning-mix/wp/2017/11/29/anti-fracking-activists-and-anarchists-are-blocking-rail-tracks-in-olympia-they-dont-plan-on-leaving/?noredirect=on&utm_term=.84c1f513c424.
- 17 See, e.g., ALEXANDER J. EPSTEIN, *THE MORAL CASE FOR FOSSIL FUELS* (2014).
- 18 Richardson R. Lynn, *It's Not the End of the World, But You Can See It From There: Legal Education in the "Long Emergency,"* 40 U. TOL. L. REV. 377, 378 (2009).
- 19 "Bridge fuel to the future" is a term attributed to Robert F. Kennedy Jr. in an essay in the 2009 *Financial Times* where he said, "Converting rapidly from coal-generated energy to gas is President Barack Obama's most obvious first step towards saving the planet and jump starting our economy." Opinion, *How to End America's Deadly Coal Addiction*, FIN. TIMES (July 19, 2009), <https://www.ft.com/content/58ec3258-748b-11de-8ad5-00144feabdco>. But Robert F. Kennedy Jr. later changed his mind. See Marie Cusick, *Robert F. Kennedy Jr. Calls Natural Gas a "Catastrophe,"* STATEIMPACT PA. (Oct. 3, 2013, 4:14 p.m.), <https://stateimpact.npr.org/pennsylvania/2013/10/03/robert-f-kennedy-jr-calls-natural-gas-a-catastrophe/>.

through the voluminous number of often conflicting technical papers, blog posts, internet sites and news accounts relating to hydraulic fracturing. Fracturing is a complex technical subject. Cause and effect is rarely obvious and cost-benefit analysis is never simple. Exaggerated and simplistic pronouncements about fracking, while common, are not helpful and can lead to dissemination of misinformation, deterioration of rational discourse and polarization of opinion.

This article is a brief look at facts, fantasies and regulation associated with hydraulic fracturing in Texas and beyond.²⁰ In preparing this article, the author²¹ relied heavily upon a more comprehensive treatment of the subject found in *Hydraulic Fracturing Law and Practice*.²² It was the privilege of the author to contribute to *Hydraulic Fracturing Law and Practice* as the insights and knowledge gained by working with such an esteemed group of co-authors, many of whom were much more eminently qualified to be writing about the topic than he, greatly increased his understanding of the subject.

A brief discussion of Texas regulation of hydraulic fracturing is found in Part V. The discussion is limited to statutory and agency regulation. Hydraulic fracturing is also



regulated, in a sense, by the courts. The body of hydraulic fracturing case law in the U.S. has been slow to develop and more sparse than anticipated, given the controversies and passions on both sides of the fracking debate. This is partly explainable because hydraulic fracturing has come of age relatively recently, and many cases involving fracking have settled prior to reaching appellate courts for review. Other reasons are that proving causation in tort cases involving fracking can be difficult and class certifications are problematic due to lack of commonality. Regardless, a detailed discussion of existing case law is beyond the scope of this article but can be found in *Hydraulic Fracturing Law and Practice* and other sources.²³

I. WHAT IS HYDRAULIC FRACTURING?²⁴

The American public, fueled by negative media coverage and anti-fracking activism, has many misperceptions about fracking as an industrial process. The first step to a better understanding of fracking is to define it. The following is the regulatory definition of hydraulic fracturing included within the rules of the Texas Railroad Commission, which is the state agency primarily charged with regulating the Texas oil and gas industry:

Hydraulic fracturing treatment — A completion process involving treatment of a well by the application of hydraulic fracturing fluid under pressure for the express purpose of initiating or propagating fractures in a target geologic formation to enhance production of oil and/or natural gas. The term does not include acid treatment, perforation, or other non-fracture treatment completion activities.²⁵

Note that the definition excludes “acid treatments, perforation, or other non-fracture treatment completion activities.” Fracking, contrary to many people’s perceptions, is not new. Acid fracking first came in use in the 1930s. Other forms of fracking date to the Civil War era. Hydraulic fracturing is the relative newcomer, having begun in

20 This article is an excerpted version of a paper titled “A Brief Look at the Law of Hydraulic Fracturing in Texas and Beyond” presented at the 31st Annual Energy Law Institute for Lawyers and Landmen, South Texas College of Law Houston, Aug. 29, 2018, by Yale and Sizer.

21 In the interest of full transparency, the authors are employed in a law firm that predominately represents oil and gas producers. As Upton Sinclair once wrote, “It is difficult to get a man to understand something, when his salary depends on his not understanding it.” (Quoted in GARY SERNOVITZ, *THE GREEN AND THE BLACK*, 9 (2016)). Nevertheless, this article is intended as an objective look at the law of hydraulic fracturing and the public policy issues surrounding it.

22 DAVIS GRAHAM & STUBBS LLP, GRAY REED & MCGRAW LLP & VORYS, SATER, SEYMOUR AND PEASE LLP, *HYDRAULIC FRACTURING LAW AND PRACTICE* (2017) [hereinafter *HYDRAULIC FRACTURING L&P*].

23 See Chapter 36, of *Hydraulic Fracturing Law and Practice* (2017), written by Gail Wurtzler of the law firm of Davis, Graham & Stubbs LLP. See also Part IX, Case Law Development, written by Brooke Sizer of the law firm of Gray, Reed & McGraw LLP, from “A Brief Look at the Law of Hydraulic Fracturing in Texas and Beyond” presented at the 31st Annual Energy Law Institute for Lawyers and Landmen, South Texas College of Law Houston, Aug. 29, 2018.

24 The author borrowed heavily in this section from Chapter 2 of *Hydraulic Fracturing Law and Practice* (2017), written by Professor Azra N. Tutuncu, Harry D. Campbell Chair in the Petroleum Engineering Department and director of the Unconventional Natural Gas and Oil Institute at the Colorado School of Mines.

25 16 Tex. Admin. Code § 3.13(a)(2)(J)(2018).



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the 1940s.²⁶

The combination of hydraulic fracking and horizontal drilling, however, is a relatively recent development.²⁷ Most people who refer to “fracking” are referring to the utilization of both technologies in oil and gas well drilling and completion operations, and that is how the term “fracking” is used in this article.

1. Fracking — the Basics

A modern hydraulically fracked oil and gas well begins just as a conventional oil and gas well does. A drilling rig moves onto a surface site (or pad), surface casing is put in place to protect near surface water aquifers and then drilling begins. The wellbore penetrates the surface and then drills downward from 1 to 2 miles below the surface into a shale formation. Shale formations vary in thickness. The Eagle

Ford formation in South Texas, for example, is typically 300-500 feet thick. After penetrating the target formation, the wellbore bends horizontally and drilling then proceeds laterally for distances that typically range from 1 to 3 miles.

Upon completion of horizontal drilling in the “plug and perf” method of fracking, which is by far the most commonly used method in the United States, a 3-foot-long perforation “gun” is sent to near the end of the horizontal lateral (the toe) for the first stage of the fracking operation. A fracking “stage” is a 250-foot length of lateral wellbore isolated from the rest of the wellbore lateral by plugs. The perf gun then shoots off explosive charges to create 100- to 300-foot cracks in the adjoining shale formation. The cracks themselves are typically of hairline width, analogous to cracks in a block of ice.

Next, large volumes of water are injected under high pressure mixed with proppant (usually sand, but sometimes ceramic beads or other materials²⁸) that serve to “prop open” the cracks in the shale formation to facilitate flow of oil and gas. Chemical additives²⁹ are mixed with the frack water to reduce friction and enhance flow of oil and gas. This is where the term “slickwater fracking” comes from.

The frack stage is then plugged off, and the entire operation repeated in the next 250-foot stage along the lateral, then the next and so on. Hence, a fracking operation is actually a series of “minifracks” running along most of the length of the lateral. It is not unusual to have 20 to 25 stages per fracked well, and 50-stage fracking is not unheard of.

Once all the stages of the fracking operation are complete, a drill bit bores through the plugs, allowing the remaining frack fluids to flow back to the surface. Then, if all has gone well, the weight of the overburdening rock creates sufficient pressure to force oil and gas through the propped-open cracks in the formation into the wellbore and up to the surface for storing, processing and transportation to market.

What has been described so far is a single well lateral fracking operation. What is more typical, however, is multiwell drilling from a single surface pad. The number of wells drilled from a typical surface pad varies, but seven to eight wells per pad is not uncommon. The pad itself, typically the size of a football field (or two), can be used to complete multiple laterals both in different directions and in different formations, stacked one upon the

²⁶ A short history of fracking and horizontal drilling is included *infra* Part III.

²⁷ *Id.*

²⁸ While sand is the most common proppant used in hydraulic fracturing operations due to its ready availability and low cost, other proppants, such as man-made ceramics, magnesium silicate or fly ash, can also be used. John D. Furlow & Corinne V. Snow, *In the Wake of the Shale Revolution: A Primer on Hydraulic Fracturing Fluid Chemical Disclosure*, 8 TEX. J. OIL GAS & ENERGY L. 249, 251-2 (2012-13).

²⁹ For more on chemical additives, see *infra*, Part V.1, Hydraulic Fracturing Risks — 1. Water Quality.

other. A single pad containing seven to eight surface locations can be used to complete a dozen or even dozens of fracked oil and gas wells. This provides an advantage over conventional well drilling because a much smaller land area is utilized than would be the case were a comparable number of vertical wells drilled.

Besides minimizing surface impacts, multiwell pad drilling enables utilization of techniques such as “zipper fracking,” where fracking occurs in a staggered pattern between two wellbores simultaneously to optimize stress on the formation and facilitate movement of oil and gas into the wellbore. Multiwell pad drilling and zipper fracking are but two examples among the many rapidly evolving technologies used by oil and gas companies that have contributed to fracking’s success and rapid expansion throughout the U.S. oil patch.

2. Fracking – Sand and Water Usage

Each stage of a fracking operation requires several hundred thousand

pounds of proppant, (most often sand).³⁰ A typical 20-25 stage fracking operation would use around 6 million to 7½ million pounds of sand, which equals the weight of about 35,000 average American men.³¹ Fifty-stage fracking would use even more sand. Some of the largest fracked wells have reportedly used 50 million pounds of sand.³² In 2014 the U.S. oil and gas industry was estimated to have used 95 billion pounds of sand in fracking operations, roughly equivalent in mass to downtown Chicago.³³

Until recently, indigenous Texas sands were not considered to have the optimal crystallinity to serve as frack proppants and most of the sand used in fracking operations in Texas was imported from Wisconsin and other Midwestern states. However, as fracking technology has evolved, the quality differences between Texas sand and sand from the Midwest have become less consequential. Mining operations for frack sands have been on the upswing in Texas as local sources are plentiful and more cost-effective to

transport than sands from the Midwest.

Opponents of fracking are not as concerned about the diversion of sand to fracking as they are about the diversion of water. Fracking uses a lot of water. Though water volumes used in hydraulic fracturing vary by location, total water used in a frack operation is typically around 200,000 gallons per stage,³⁴ or 4 million to 6 million gallons of water for a 20-25 stage frack job.³⁵ That would be enough water to fill six to 12 Olympic-size swimming pools.³⁶ Water usage for fracking, however, has been on the upswing, with some wells reportedly using 25 million gallons of water or more.³⁷

To get all the sand and water to the wellsite requires transportation. In most frack sites in Texas, sand and water are trucked in. A typical frack job in the South Texas Eagle Ford shale area requires about 1,700 truck trips per fracked well.³⁸ To put this in perspective, that would be the equivalent of 17 miles of semitrailer trucks if lined up — for a single well. With 80 to 90 rigs running in the South

30 Task Force on Environmental and Community Impacts of Shale Development in Texas, *Environmental and Community Impacts of Shale Development in Texas*, THE ACADEMY OF MEDICINE, ENGINEERING AND SCIENCE OF TEXAS, 40 (2017), <http://tamest.org/wp-content/uploads/2017/07/Final-Shale-Task-Force-Report.pdf> [hereinafter TAMEST]. TAMEST, The Academy of Medicine, Engineering and Science of Texas, is a nonprofit brain trust composed of the Texas-based members of the National Academies of Sciences, Engineering and Medicine and the state’s Nobel Laureates.

31 SERNOVITZ, *supra* note 21, at 78.

32 Jordan Blum, *Frackers to Yield Record Highs*, HOUS. CHRON., Jan. 26, 2018, at A1.

33 SERNOVITZ, *supra* note 21, at 78.

34 TAMEST, *supra* note 30.

35 *Id.*

36 SERNOVITZ, *supra* note 21, at 78.

37 Blum, *supra* note 32.

38 TAMEST, *supra* note 30.

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Texas Eagle Ford area (March 2018³⁹), traffic injuries and fatalities have been on an upswing. Wear and tear on roads and bridges has also become a significant concern. These issues are not limited to South Texas; practically everywhere fracking is utilized, it is causing upswings in traffic injuries and fatalities and is placing strains on infrastructure.⁴⁰

3. Fracking Water Disposal and Earthquakes

Far more formation wastewater is generated from producing wells than oil. The Texas Railroad Commission estimates that 10 barrels of water are produced from conventional oil wells with every single barrel of oil, regardless of whether a well is horizontally fracked or completed as a conventional vertical well.⁴¹ Nationwide, the average ranges from seven to 10 barrels of water for each barrel of oil.⁴² This is why an industry observer quipped, “Oil companies are in the produced water business, not the oil business.”⁴³

The high salinity of produced waters in many parts of the U.S., and especially in Texas, limits the economic viability of treatment options.⁴⁴ Oil companies have recently started to recycle some of this produced water for fracking, which despite cost disadvantages reduces road traffic and mitigates the likelihood of spills.⁴⁵ But in Texas and elsewhere, most produced water is re-injected into the ground either for secondary recovery purposes or in saltwater disposal wells to keep it away from surface water and water aquifers.⁴⁶ There are about 100,000 injection wells drilled in the United States used for secondary recovery purposes.⁴⁷ There are another 30,000 wells used for wastewater disposal purposes.⁴⁸

Most of the water used in fracking operations is not recycled and flows back to the surface along with produced water.⁴⁹ However, the bulk of the water injected into most oil and gas disposal wells is naturally occurring produced water, not frack fluid flowback.⁵⁰ The percentage of fracking flowback water

in ratio to produced water being injected varies greatly by region, but across the board, it is a small portion.⁵¹ “In the Permian Basin far more water is generated over the life of a well than is initially injected for hydraulic fracturing. In the Barnett Shale region, the amounts of produced and injected water are in approximate balance over the lifetime of a well. . . . In the Eagle Ford region, only a small fraction of frack water injected ultimately returns to the surface.”⁵² In Oklahoma, frack water accounts for less than 10 percent of the water sent to injection wells.⁵³

This raises the subject of earthquakes. Despite frequent assertions to the contrary by opponents of fracking, most geologists do not believe that hydraulic fracturing causes earthquakes except under very rare circumstances.⁵⁴ Conversely, there is a growing consensus in the scientific community that if certain geologic conditions are present in a given subsurface formation, disposal of water in injection wells for either

39 Elizabeth Alford, *Eagle Ford Rig Count Increases with All Horizontal Drilling*, EAGLE FORD SHALE NEWS (March 11, 2018), <https://eaglefordshale.com/efs-news/eagle-ford-rig-count-increases-with-all-horizontal-drilling>.

40 For an excellent account of social and infrastructure impacts on shale development in the Bakken region of North Dakota, see MAYA RAO, *GREAT AMERICAN OUTPOST: DREAMERS, MAVERICKS AND THE MAKING OF AN OIL FRONTIER* (2018).

41 Aaron Powell, Comment, *Salty Plaintiffs and Industry Defenses: A Texas Lawyer’s Guide to Induced Seismicity and Salt Water Disposal Wells*, 48 TEX. TECH L. REV. 1001, 1003 (2016).

42 Keith B. Hall, *Induced Seismicity: An Energy Lawyer’s Guide to Legal Issues and the Causes of Man-Made Earthquakes*, 61 ROCKY MT. MIN. L. INST. 5-1, 5-27 (2015).

43 Gerry Morton, Senior Counsel, Carrizo Oil & Gas Inc., panel presentation at the Houston Bar Association Oil, Gas and Mineral Law Section: In-House Counsel Roundtable on Developments in Oil and Gas Transactions (Feb. 22, 2018).

44 TAMEST, *supra* note 30, at 126.

45 Jackie Benton, *Recycling Fracking Water*, FISCAL NOTES NEWSLETTER (Tex. Comptroller of Public Accounts), October 2015, <https://comptroller.texas.gov/economy/fiscal-notes/2015/october/fracking.php>.

46 Hall, *supra* note 42.

47 *Id.* at 5-22.

48 *Id.*

49 *Id.*

50 *Id.* at 5-27.

51 *Id.* at 5-28.

52 TAMEST, *supra* note 30, at 125.

53 Hall, *supra* note 42, at 5-29.

54 *Id.* at 5-37.

secondary recovery or wastewater disposal purposes can cause seismic activity severe enough to be felt at the surface.⁵⁵ This appears to be especially true in Oklahoma, where doubling saltwater disposal well volumes from 1997 to 2013 came with an increase in magnitude 3.0 or greater earthquakes from about 2.2 earthquakes annually in 2008 to 890 annually in 2015.⁵⁶

How many earthquakes can be traced back to re-injection of fracking fluid flowback water versus formation produced water? Critics of hydraulic fracking might respond that the question is irrelevant. The dramatic increases in earthquakes in Oklahoma and elsewhere over the past 10 years are not likely to have happened coincidentally — but for hydraulic fracking the large volumes of produced water being disposed of in deep-water injection wells, the root cause of the upsurge in earthquakes, would not be occurring, or at least would be occurring at much lower volumes. The additional re-injection of any fracking flowback water, in whatever percentage to produced water, simply compounds the problem.

The first rebuttal to that argument is that its underlying premise — that the large volumes of produced water being injected in the U.S. are a direct result of increased fracking activities — is debatable.⁵⁷ As referenced earlier, there are over 130,000 injection wells operating in the U.S. Most of these

wells, especially the 100,000 injection wells being used to enhance secondary recovery, have little or nothing to do with fracking.⁵⁸ As discussed in Part VI.4, there is insufficient data to conclude that produced water injected from fracked wells is primarily responsible for earthquakes.

A second rebuttal might be that, even assuming for the sake of argument that injected produced water from fracked wells is responsible for the rise in earthquakes, the world will still need oil and gas. If fracking was not creating increased volumes of produced water, conventional well completions would fill the void and the end result would be the same.

The rebuttal to that argument might be that hydrocarbons should be kept in the ground, period, to avoid any risk, earthquakes or otherwise. Suffice to say that as with so many of the other controversies surrounding hydraulic fracturing, the causal connection between earthquakes and fracking is complex. Conclusions drawn can be driven as much by political persuasion as they are by data and logical analysis.

II. FRACKING: A BRIEF HISTORY⁵⁹

Contrary to the prevailing public perception, hydraulic fracturing as a well completion technique has been around a long time, or at least it has been when considered separately from horizontal drilling. The first hydraulically fractured well in the

world is thought to have been in Kansas in 1949, followed shortly thereafter by the first hydraulically fracked well in Texas.⁶⁰

However, before hydraulic fracturing, there was fracturing by other means. The first fractured wells in the world were in Pennsylvania in the 1860s, where nitroglycerin was used to break apart rock to stimulate oil production. Related fatalities dampened enthusiasm but explosive techniques continued to be used in fracking wells for a long time following.⁶¹ Nonexplosive fracturing using acid stimulations was introduced in the 1930s.⁶²

Horizontal drilling separate and apart from hydraulic fracturing is likewise not new. The first horizontal well was drilled in 1929, near Texon in West Texas. The 1980s and '90s saw widespread utilization of horizontal drilling techniques in the Austin Chalk in Central Texas.

Then, beginning in the early 1990s, a Houston-based independent oil company, Mitchell Energy, combined horizontal drilling and hydraulic fracturing techniques to develop the Barnett Shale gas field in North Texas. The founder and CEO of Mitchell Energy was longtime Texas oilman George Mitchell (1919-2013). Mitchell, then in his 70s, relentlessly pushed Mitchell Energy's engineers to perfect the technique that became known as "slickwater fracking." In slickwater

55 Powell, *supra* note 41, at 1002.

56 *Id.*

57 Hall, *supra* note 42, at 5-28.

58 *Id.* at 5-22.

59 Part II is sourced primarily from GREGORY ZUCKERMAN, *THE FRACKERS: THE OUTRAGEOUS INSIDE STORY OF THE NEW BILLIONAIRE WILDCATERS* 17-111 (2013).

60 HYDRAULIC FRACTURING L&P, *supra* note 22, § 24.01.

61 In the 1960s the Soviets conducted experimental fracking in some of their oil fields using underground atomic explosions. Luca Gandossi, *An Overview of Hydraulic Fracturing and Other Formation Stimulation Technologies for Shale Gas Production*, EUROPEAN COMMISSION JOINT RESEARCH CENTRE INSTITUTE FOR ENERGY AND TRANSPORT TECHNICAL REPORTS 33 (2013), <http://publications.jrc.ec.europa.eu/repository/bit-stream/11111111/30129/1/an%20overview%20of%20hydraulic%20fracturing%20and%20other%20stimulation%20technologies%20%282%29.pdf>.

62 *Hydraulic Fracturing in the United States*, WIKIPEDIA, https://en.wikipedia.org/wiki/Hydraulic_fracturing_in_the_United_States.

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fracking, special chemical additives were added to frack fluids to reduce friction and otherwise better facilitate the flow of oil and gas through the shale formation.

Slickwater fracking, combined with multistage fracking, became the key to unlocking commercial quantities of Barnett Shale gas. Mitchell Energy, financially stressed through much of the 1990s, was so successful with its new fracking techniques that Mitchell sold the company to Devon Energy in 2001 for \$3.1 billion, making himself a billionaire in the process.⁶³

Mitchell was not the only individual who played a major role in developing modern fracking techniques. EOG

Resources, led by Mark Papa, and Continental Energy, led by Harold Hamm, pioneered fracking techniques in North Dakota’s Bakken Shale play.⁶⁴ Aubrey McClendon (1959-2016), co-founder of Chesapeake Energy, helped spread fracking across the U.S. through his company’s aggressive oil and gas leasing and drilling and his monumental personal energy, drive and charisma.⁶⁵

But Mitchell, perhaps more than any other single individual, was responsible for the “shale revolution.”⁶⁶ The technology Mitchell’s company introduced became a template for shale plays across the state and the nation.⁶⁷ It is possible that historians will look

upon Mitchell as one of the pivotal individuals of his time, one whose impact on the world has been so game changing that he can be compared to other famous contemporaries such as Steve Jobs and Bill Gates. Mitchell’s contribution can best be appreciated by considering the positive impacts of fracking on both the United States and the world.

III. BENEFITS OF HYDRAULIC FRACTURING

The national media and opponents of the oil and gas industry highlight the risks of hydraulic fracturing much less than its benefits. But the benefits of fracking can be summarized in six areas: 1) growth in oil and gas production and reduction of foreign imports, 2) economic growth and jobs, 3) more competitive U.S. manufacturing, 4) greenhouse gas reduction, 5) reduced prices for consumer goods and 6) reduced surface impacts.

1. Growth in Oil and Gas Production and Reduction of Foreign Imports

Growth in U.S. oil and gas production due to shale development started in earnest in 2007. At a forecasted yearly average of 81.2 billion cubic feet of natural gas production a day in 2018,⁶⁸ shale gas development has enabled the United States to continue leading the rest of the world as the largest producer of natural gas after

63 In 2008, *Forbes* magazine estimated his net worth at \$3.2 billion, placing him among the 500 richest people worldwide. *In Pictures: America’s Energy Billionaires*, FORBES (Oct. 7, 2008, 3:30 p.m.), https://www.forbes.com/2008/10/07/energy-billionaires-biz-energy-cx_af_1007energybillionaires_slide.html.

64 SERNOVITZ, *supra* note 21, at 46.

65 *Id.* at 36-39; 42, 46.

66 *The U.S. Shale Revolution*, POLICY RESEARCH PROJECT AT THE UNIV. OF TEX. AT AUSTIN LYNDON B. JOHNSON SCHOOL OF PUB. AFFAIRS (May 15, 2015), <https://www.strausscenter.org/energy-and-security/the-u-s-shale-revolution.html>.

67 TAMEST, *supra* note 30, at 30.

68 *Natural Gas Production in U.S. to Set Records in 2018, 2019*, KALLANISH ENERGY (June 12, 2018), <https://www.kallanishenergy.com/2018/06/12/natural-gas-production-in-u-s-sets-records-in-2018-2019/>.

surpassing Russia in 2009.⁶⁹ Growth in U.S. oil production has been even more stunning. As of July 2018, the United States is producing almost 11 million barrels of oil a day, up from 5 million barrels a day a decade ago.⁷⁰ That is the highest level of oil production seen in the U.S. in over 50 years. These increased levels of production have established the United States as the world's largest oil and gas producer, an absolutely stunning development given the not so long ago predictions by so many analysts that the world, and the U.S. in particular, was on the verge of running out of oil and gas.⁷¹

These dramatic increases in US oil and gas production are directly attributable to hydraulic fracking. In 2017, approximately 50 percent of U.S. oil and gas production and 60 percent of U.S. natural gas production was from unconventional development — that is, obtained from shale resources through hydraulic fracturing techniques.⁷²

Growth in oil and gas production in Texas has been equally dramatic. Texas production in February 2018 was over 4 million barrels of oil per day,⁷³ up from slightly over 1 million barrels of oil a day in 2007, a 75 percent increase.⁷⁴ This upsurge in production has ended an almost 30-year statewide production decline. Texas now produces more than

one-third of all the oil produced in the United States, which would make Texas on a stand-alone basis a larger oil producer than all but a half-dozen or so foreign countries.⁷⁵

At year-end 2017, the U.S. was still importing oil. Oil imports are a complicated subject because U.S. refinery capacity has historically been weighted more toward heavier crudes imported from overseas. The U.S. has

historically exported crude for similar reasons — lack of capacity to refine domestic crudes, compounded by a not-in-my-backyard attitude toward new refinery construction.

The significant number, therefore, is the difference between oil exports and imports. That figure at year-end 2017 was 2.6 million barrels a day, which is the lowest level since the U.S. Energy Information Administration began

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69 *The U.S. Surpassed Russia as World's Leading Producer of Dry Natural Gas in 2009 and 2010*, U.S. ENERGY INFO. ADMIN. (March 13, 2012), <https://www.eia.gov/todayinenergy/detail.php?id=5370>.

70 Julia Payne, Devika Krishna Kumar & Dmitry Zhdannikov, *U.S. Oil Boom Delivers Surprise for Traders – and It's Costly*, REUTERS (July 15, 2018), <https://www.reuters.com/article/us-oil-traders-wti-brent/u-s-oil-boom-delivers-surprise-for-traders-and-its-costly-idUSKBN1K507S>.

71 *The United States is now the largest global crude oil producer*, U.S. ENERGY INFO. ADMIN. (September 12, 2018), <https://www.eia.gov/todayinenergy/detail.php?id=37053>. <https://www.eia.gov/todayinenergy/detail.php?id=37053> For a detailed discussion of the history of peak oil and gas theory, see Robert Bryce, *Power Hungry: The Myths of "Green Energy and the Real Fuels of the Future"*, Public Affairs (Pereus Books Group), 2010, at pp. 17-18, 29-30, 207, 214-223. And 244

72 *Frequently Asked Questions (Oil)*, U.S. ENERGY INFO. ADMIN. (March 8, 2018), <https://www.eia.gov/tools/faqs/faq.php?id=847&t=6>; *Frequently Asked Questions (Natural Gas)*, U.S. ENERGY INFO. ADMIN. (March 8, 2018), <https://www.eia.gov/tools/faqs/faq.php?id=907&t=8>.

73 Sheela Tobben, *Texas Oil Production Climbs to All-Time High*, BLOOMBERG: MARKETS (April 30, 2018, 1:44 p.m.) <https://www.bloomberg.com/news/articles/2018-04-30/texas-oil-production-climbs-to-all-time-high-amid-strong-prices>.


74 *Texas Field Production of Crude Oil*, U.S. ENERGY INFO. ADMIN. <https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=p&s=mcrfptx2&f=m>.

75 HYDRAULIC FRACTURING L&P, *supra* note 22, § 24.01.

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tracking the number in 1973.⁷⁶ If shale development continues on its present scale — and assuming/and if U.S. refining capacity is expanded to handle the growing abundance of lighter

domestic crudes — United States oil independence is a real possibility by the mid-2020s. This, again, is a stunning development given the gasoline lines of the late 1970s and concerns, especially prevalent during the 1980s and '90s, that the world would be running out of oil in the very short term.⁷⁷

2. Economic Growth and Jobs

One commentator calculated that the additional oil and gas reserves created by the shale revolution combined with the equity growth of the oil field service industry, pipelines, gathering systems and export terminals, created \$1.8 trillion to \$2 trillion in additional wealth for the United States between the years 2000 and 2016.⁷⁸ Texas has benefited economically from the shale revolution more than any other state due to its high percentage of U.S. oil and gas production.

In 2014 it was estimated that the oil and gas industry in Texas alone accounts for an annual gross product of \$473 billion and 3.8 million jobs.⁷⁹ Though the percentage of oil and gas employment and contribution to GDP varies greatly from year to year due to the rise and fall of oil and natural gas prices, in 2017 about 13 percent of the state's population was employed in

the oil and gas industry and about 30 percent of the state's economy was tied to oil and gas.⁸⁰

Not all of these 3.8 million jobs are in frack crews. Refinery, petrochemical and pipeline workers and service industries (including landmen and lawyers) are all part of the mix. If limited strictly to upstream oil and gas exploration and production, the number of oil and gas related jobs in Texas was estimated at 194,818 in 2017,⁸¹ making up approximately 23 percent of the U.S. total of 850,000 exploration and production related jobs.⁸² Oil and gas production, refining and petrochemicals, however, are closely integrated as industries. The dramatic upsurge in oil and gas production brought about by hydraulic fracking over the past 10 years has stimulated all sectors of the oil and gas industry, not just upstream exploration and production.⁸³

In addition, it is estimated that \$27 billion in royalty payments in the Permian, Eagle Ford and Haynesville shale play areas were paid to private landowners in Texas in the year 2014, an amount comprising about two-thirds of total royalty payments to private landowners in the U.S.⁸⁴ About \$11 billion in Texas state tax revenues

76 Robert Rapier, *U.S. Net Petroleum Imports Plunging Toward Zero*, FORBES (March 21, 2018, 9 a.m.), <https://www.forbes.com/sites/rrapier/2018/03/21/u-s-net-petroleum-imports-plunging-toward-zero/#311d5dd927ba>.

77 Mike Moffatt, *Will the World's Supply of Oil Run Out?*, THOUGHTCO. (April 1, 2018), <https://www.thoughtco.com/we-will-never-run-out-of-oil-1146242>.

78 SERNOVITZ, *supra* note 21, at 46.

79 TAMEST, *supra* note 30, at 30.

80 The Texas population at year-end 2017 was approximately 28 million people, <https://www.texastribune.org/2017/12/20/texas-population-grew-283-million-2017/w>. Texas GDP was about \$1.5 trillion, <https://www.statista.com/statistics/188132/gdp-of-the-us-federal-state-of-texas-since-1997/>.

81 TAMEST, *supra* note 30, at 30.

82 SERNOVITZ, *supra* note 21, at 206.

83 For example, the boom petrochemical expansion along the Houston Ship Channel. See Katherine Blunt, *Rising Oil Prices Good for More Than Oil Companies*, HOUS. CHRON. (June 8, 2018), <https://www.houstonchronicle.com/business/article/Rising-oil-prices-good-for-more-than-oil-companies-12977142.php>.

84 TAMEST, *supra* note 30, at 31.

The Brookings Institute estimated that the shale gas boom caused natural gas prices alone to decrease by 47 percent between 2007 and 2013, which generated total consumer benefits of about \$74 billion annually.⁹⁶

were attributed to shale resource development in 2017.⁸⁵

3. United States Manufacturing More Competitive

According to the Boston Consulting Group, the United States enjoys a “global energy advantage” due to the shale revolution, with wholesale gas prices one-third of those in most other industrialized countries and electricity prices 30-50 percent less than those in other major exporting nations.⁸⁶ The dramatic growth in natural gas production in Texas and elsewhere has lowered natural gas prices and therefore feedstock prices for manufacturing, which lowers overall manufacturing costs. Lowered manufacturing costs has helped to offset generally higher labor costs in the United States versus foreign competitors.

4. Greenhouse Gas Reduction

A particularly inconvenient fact for

opponents of fracking is that the U.S. is leading the world in reducing carbon dioxide emissions — due largely to shale gas.⁸⁷ This is because natural gas fired electric generating plants emit on average 50 percent less CO₂ than coal fired plants.⁸⁸ As a result, 17 percent less coal was burned in the U.S. in 2014 than was burned 10 years earlier.⁸⁹ As one commentator pointed out, CO₂ emissions reductions in the United States between 2007 and 2012 equaled an entire year of CO₂ emissions from Germany, the sixth-largest CO₂ emitter in the world.⁹⁰

This is one reason that U.S. air quality has been steadily improving over the past 10 years,⁹¹ which is a fact almost ignored in national media reports on hydraulic fracturing.⁹² To quote the same commentator, “Nothing over the last decade, probably ever, has done more to limit coal emissions and keep tar sands — the Canadian tar sands, mainly — in the ground than the

American shale revolution.”⁹³

Opponents of fracking will not readily concede that fracking is a net benefit in greenhouse gas reduction. It has been asserted that wellhead, pipeline or gas plant leakage of methane cancels out the net benefit of CO₂ reductions.⁹⁴ This, however, is a subject of much debate,⁹⁵ discussed in Part IV.3.

5. Reduced Prices for Consumers

Another inconvenient fact for opponents of fracking is that increased production of oil and gas due to fracking has been a positive development for consumers. The Brookings Institute estimated that the shale gas boom caused natural gas prices alone to decrease by 47 percent between 2007 and 2013, which generated total consumer benefits of about \$74 billion annually.⁹⁶

It is impossible to say what today’s natural gas and gasoline prices might be had fracking never come along.

85 Katherine Blunt, *Texas Mineral Taxes and Royalties Increased in 2017*, Hous. Chron. (March 29, 2018, 8:02 a.m.), <https://www.chron.com/business/energy/article/Texas-mineral-taxes-and-royalties-increased-in-12710678.php>.

86 See SERNOVITZ, *supra* note 21, at 1-15.

87 *Id.* at 78.

88 HYDRAULIC FRACTURING L&P, *supra* note 22, § 1.04[3].

89 SERNOVITZ, *supra* note 21, at 171.

90 *Id.* at 7, 171-72. It was reported, however, in late 2018 that carbon emissions in the United States rose by 3.4%, marking the second largest annual gain in more than two decades — surpassed only by 2010 when the U.S. economy bounced back from recession. See *Preliminary US Emissions Estimates for 2018*, RHODIUM GROUP (January 8, 2019), <https://rhg.com/research/preliminary-us-emissions-estimates-for-2018/>. This may be partially explainable by increased manufacturing and the overall robust U.S. economy. The Trump administration’s relaxation of environmental regulations may have also played a role though the causality behind the increase is a highly complex question.

91 U.S. ENVTL. PROTECTION AGENCY, 2014 NAT’L EMISSIONS INVENTORY REPORT (VERSION 2), TRENDS (February 2018), <https://gispub.epa.gov/neireport/2014/>.

92 SERNOVITZ, *supra* note 21, at 171-181; see also EPSTEIN, *supra* note 17, at 151-54.

93 SERNOVITZ, *supra* note 21, at 193.

94 *Id.* at 174-77 (citing conclusion in a 2011 Cornell University study).

95 *Id.* (citing a 2013 University of Texas study rebutting the Cornell conclusions).

96 HYDRAULIC FRACTURING L&P, *supra* note 22, § 1.04[2].

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Odds are, however, that they would be higher.⁹⁷ Lower oil and gas prices translate to lower prices for a wide range of consumer products derived from fossil fuels, not just fuel, electrical and heating costs.⁹⁸

6. Reduced Surface Impacts

As explained in Part II, horizontal drilling and fracking techniques allow for much smaller surface footprints for drilling and completion operations than is the case for conventionally drilled vertical oil and gas wells. As The Academy of Medicine, Engineering and Science of Texas (TAMEST) concluded in a 2017 report on the environmental and community impacts of shale development in Texas:

The vast number of new wells

drilled in shale formations in Texas since 2007 have had substantial spatial impacts on the landscape. However, horizontal wells have a smaller impact than the equivalent number of vertical wells would have had. When operators use a single well pad for multiple wells, surface impacts are significantly reduced.⁹⁹

Besides reduced space for wells, multipad drilling reduces the need for additional gathering lines, tank batteries, roads, pipelines, compressor stations and other facilities compared with the equivalent number of conventional vertical wells. Horizontal drilling also enables directional drilling under nature preserves, lakes, rivers and buildings and structures.

The advent of shale drilling also

led to dramatic reductions in the U.S. rig count and per well productivity compared with those of 10 years ago.¹⁰⁰ The reduction in rig count offsets in part the increases in road traffic brought about by fracking, since fewer drilling rigs must be mobilized.

IV. HYDRAULIC FRACTURING RISKS

There are risks and concerns associated with hydraulic fracturing as well as benefits. These risks and concerns can be grouped as follows: 1) water quality, 2) water usage, 3) air quality/climate change, 4) earthquakes, 5) land use, 6) transportation and 7) social issues.

1. Water Quality

Environmental activism in the United States historically has been fomented by singular incidents. The 1969 Cuyahoga River fire in Cleveland prompted the passage of the federal Clean Water Act and helped spawn the creation of the Environmental Protection Agency. The Love Canal episode near Niagara Falls, New York, in the late 1970s spawned CERCLA — the Superfund Act. The Three Mile Island incident near Harrisburg, Pennsylvania, in 1979 was a turning point in global development of nuclear power, halting what until that time had been historic growth both in the United States and abroad.

With hydraulic fracturing, however, instead of a specific incident, it was 2010 HBO documentary *Gasland* by Josh Fox that as much as anything else turned the tide of public opinion in the United States against fracking.¹⁰¹ The most

97 Sernovitz, an oil and gas investor and businessman, states: “If the U.S. shale revolution hadn’t happened, oil and gas prices would probably be triple what they are today ...” *supra* note 21, at 9.

98 HYDRAULIC FRACTURING L&P, *supra* note 22, § 1.04[2].

99 TAMEST, *supra* note 30, at 78.

100 SERNOVITZ, *supra* note 21, at 113. Well productivity per horizontally fracked completion is anywhere from 400 to 2,000 percent more than conventional wells depending on the U.S. region. HYDRAULIC FRACTURING L&P, *supra* note 21, § 1.04[4].

101 SERNOVITZ, *supra* note 21, at 66-88.

iconic scene in *Gasland* was the lighting of a match to a kitchen faucet, which then erupted into flame. Ironically, it was later demonstrated that the gas leakage from the faucet was caused not by fracking, but by biogenic methane that had been leaking for decades into water supplies in the area of Colorado where the incident was filmed.¹⁰²

But the impact of *Gasland* on the public perception of natural gas drilling in the United States has been likened to the impact of Rachel Carson's 1960s book *Silent Spring*, which led to a nationwide ban on DDT. Soon after *Gasland*, international opposition to fracking took root, leading to legislative bans on fracking in a handful of European countries and in several U.S. states. Even where fracking was not banned, citizens demanded greater regulation, especially for disclosure of chemicals being injected down wells during the fracturing process.¹⁰³

However, much of the concern raised by Fox in *Gasland* and other opponents of fracking over water quality is not rooted in facts. According to TAMEST, "the depth separation between oil bearing zones and drinking water bearing zones in Texas makes direct fracturing into drinking waters unlikely, and it has not been observed in Texas."¹⁰⁴ In *Hydraulic Fracturing Law and Practice*, Professor Azra Tutuncu concurred more broadly, speaking not only of Texas but of other oil producing states, of which she wrote,

"[it is]... extremely unlikely that any fracture can propagate far enough through all the intervening rock formations to contaminate a drinking water aquifer."¹⁰⁵

Both of these expert conclusions are supported by common sense. Shale oil and gas is produced from what has been called the "most impermeable rock in the history of the oil business" and is generally separated from the surface by 1 to 2 miles of near-equally impermeable overburdening rock.¹⁰⁶ It is highly improbable, if not impossible, for direct contamination of water aquifers to occur due to fracking operations conducted a mile or more below the aquifer. If anything, fracking is less of a direct threat to water supplies than most conventionally drilled oil and gas wells, which are often completed and produced at shallower depths and in much more permeable formations.

But what about casing leaks or surface spills of frack fluid after it returns to the surface? Even if water was migrating into freshwater aquifers from leaks in casing or oil spills, it should be remembered that 98-99 percent of frack fluids are sand and water. The remaining 1-2 percent is mostly acid, which has been used to frack oil and gas wells since the 1930s. Acid, in small quantities, is also used in many consumer products, including laundry detergents and swimming pool cleaners.

That leaves about 0.05 percent

of frack fluids comprising nonacid chemical additives. These additives generally include:

- Guar — thickening agent, edible, also in ice cream, chewing gum and toothpaste (all edible).
- Friction reducers — petroleum distillates, also in dyes, synthetic detergents and fabrics.
- Scale inhibitors — methanol and ethylene, also in antifreeze and windshield wiper fluid.

As the list illustrates, most all the chemicals in frack fluids are no more dangerous than chemicals typically in and around the average household's kitchen sink. Not that it is wise to drink antifreeze. However, because frack fluid contains roughly 180 times more water than chemicals, the toxic chemicals that might be present are diluted.¹⁰⁷ This brings to mind the instance of a Haliburton executive drinking a glass of frack fluid at an industry conference in 2011.¹⁰⁸

However, as opponents of fracking are quick to point out, oil companies can obtain trade secret protection that exempts them from disclosing all chemical ingredients of frack fluids.¹⁰⁹ A widely publicized 2011 congressional report made much of the fact that in a study of 780 million gallons of fluid used in hydraulic fracturing operations between 2005 and 2009, over 750 chemicals were used, including 29 that contained known or possible carcinogens.¹¹⁰

102 *Id.* at 69.

103 3 ERNEST E. SMITH & JACQUELINE LANG WEAVER, TEXAS LAW OF OIL AND GAS § 14.11(A) (2d ed. 2015).

104 TAMEST, *supra* note 30, at 113.

105 HYDRAULIC FRACTURING L&P, *supra* note 22, § 2.06[1][a].

106 SERNOVITZ, *supra* note 21, at 79-81.

107 *Id.* at 79.

108 *Id.* at 77-78.

109 For example, HB 3328 in Texas contains provisions that allow companies to protect their proprietary frack formulas as trade secrets. See HYDRAULIC FRACTURING L&P, *supra* note 22, § 24.02[2][a] and Part VI.1.

110 HYDRAULIC FRACTURING L&P, *supra* note 22, § 1.05[3].

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For example, benzene and naphthalene, both of which are suspected carcinogens, have been found present in some hydraulic fracturing fluids. Benzene is also present in cigarette smoke and naphthalene is found in mothballs and toilet cleaners. Given the small overall percentage of chemicals found in frack fluids, most

of which are not toxic, common sense suggests that the percent of benzene, naphthalene and other carcinogens in frack fluids would be extremely minimal — perhaps near-microscopic.

In rebuttal, opponents of fracking can correctly point out that though the percentage of dangerous chemical additives in frack fluids may be small, the volumes of fluids injected in hydraulically fracked wells are so great¹¹¹ that even a small percentage of chemical additives can be significant. Even if frack formations are buried too deep for there to be any realistic chance of direct contamination of water supplies, indirect contamination of water supplies through casing leaks or surface spills is always a possibility.

In this instance the opponents of fracking have a valid point — the real threat to water supplies from fracking is not from direct contamination of water supplies by frack fluids leaching up from miles below the surface, but from indirect contamination of frack fluids coming from casing leaks or surface spills. As TAMEST explains, the “evidence suggests that any direct impacts of fracturing or formation fluids on potential drinking water zones in Texas are more likely to be caused by near surface leaks during injection or production, or by spills at the surface rather than migration from the point of injection.”¹¹² TAMEST continues: “because of the industrial nature of [oil and gas activities], there is, and always

will be some probability of casing failure leading to near surface contamination or contributing to surface spills due to flow up the failed casing.”¹¹³

But what is the actual risk that the 1-2 percent component of frack fluids that might include acid or toxic chemicals would return in significant quantities back to the surface and find its way, through leaks in failed casing, into drinking water aquifers? In a 2011 study of 211 groundwater contamination incidents in Texas associated with oil and gas well drilling and completion, none were associated with hydraulic fracturing.¹¹⁴ Furthermore, most incidents occurred prior to 1969, before the Texas Railroad Commission revised its regulations on well casings and cementing.¹¹⁵

The federal Environmental Protection Agency came to a similar conclusion in 2016. After conducting a multiyear study of the potential drinking water effects of fracking, the EPA wrote that fracking “can impact drinking water resources under some circumstances,” but noted that such impacts “range in frequency and severity” depending on operational, local and regional factors.¹¹⁶ A prior version of the same report said that hydraulic fracturing had not caused “widespread, systemic” impacts on drinking water. That sentence, however, was removed in the final EPA report at the behest of the agency’s Science Advisory Board — raising suspicions

111 See *infra* Part II 2. While 4 million to 6 million gallons per well is typical, 25 million gallons per well is not unheard of.

112 TAMEST, *supra* note 30, at 122.

113 *Id.* at 123.

114 *Id.* (citing Scott Kell, Report to the Groundwater Protection Council, State Oil and Gas Agency Groundwater Investigations and Their Role in Advancing Regulatory Reforms, A Two-State Review: Ohio and Texas (August 2011), http://fracfocus.org/sites/default/files/publications/state_oil_gas_agency_groundwater_investigations_optimized.pdf.)

115 TAMEST at 123. Since the 1969 Railroad Commission revisions to its rules, well construction practices with cemented steel casing have significantly mitigated the risk of contamination of groundwater supplies by casing leaks and surface spills. Furthermore, the Railroad Commission in 2014 revised its Rule 13 to require additional oversight for hydraulic fracturing within 1,000 feet of the base of protected water. TAMEST at 121. This is discussed *infra* Part VI.

116 HYDRAULIC FRACTURING L&P, *supra* note 22, § 1.05[1].

once again that politics and fracking walk hand in hand.¹¹⁷

In any event, casing leaks and surface spills are as likely to occur due to conventionally drilled vertical wells as horizontally fracked wells. For example, Cabot Oil in 2008 drilled some of the first test wells in the Marcellus formation near Dimock in northeast Pennsylvania. Cabot's early operations in Pennsylvania suffered due to the lack of experience of its drilling crews in a state that had not seen significant oil and gas development in over a hundred years. The wells were poorly cased and cemented, and natural gas leaked into nearby water wells. Dimock then became the battle cry for opposition to fracking in the Eastern U.S. and elsewhere. However, the leakage from Cabot's wells occurred before the wells were fracked — and the gas came from formations several thousand feet above the Marcellus Shale. But in *Gasland* and elsewhere, it was implied that what happened at Dimock was the norm in the oil and gas business, not an aberration.

Statistics, however, do not support such a conclusion. The Pennsylvania Department of Environmental Protection determined there were 256 cases of water well contamination due to oil and gas drilling from 2008 to the first quarter of 2015, a period in which over 21,000 oil and gas wells were drilled in the state.¹¹⁸ Statistics from other states are similar. In North Dakota, it was estimated that during an eight-year period of 61 billion gallons of oil produced, only 18 million gallons of oil were spilled or leaked.¹¹⁹ The

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Colorado Oil and Gas Conservation Commission reported that oil spills in Colorado were only 0.003 percent of the state's total oil production in 2014.¹²⁰

Obviously the oil and gas industry does not have a perfect record in preventing oil and gas casing leaks and pipeline spills. The broader question is whether the number of such leaks and spills has been catastrophic or, conversely, are such leaks so rare and sporadic that they are eclipsed by the benefits of fossil fuels?

About 1.5 million oil and gas wells have been drilled in Texas since the inception of its oil and gas industry almost 150 years ago.¹²¹ Yet, Texans have lived with the risks of leaks from oil and gas wells for all this time without the state becoming an environmental wasteland.

Furthermore, the oil and gas industry has no monopoly on pollution. Industrial societies live with manifold other risks to water supplies coming from a multitude of sources. Flint,

117 *Id.*, n. 115. The EPA had previously (in 2015) concluded that there were “few, if any, documented cases of frack fluids contaminating groundwater.”

SERNOVITZ, *supra* note 21, at 175.


118 SERNOVITZ, *supra* note 21, at 98.

119 *Id.*

120 *Id.*

121 HYDRAULIC FRACTURING L&P, *supra* note 22, § 24.01.

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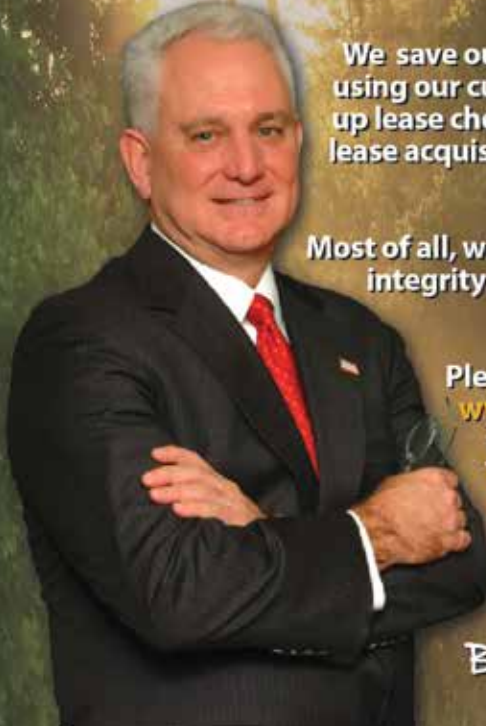

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Michigan, serves as a recent reminder.¹²²

Though accidents can happen, oil companies spend a lot of money and effort on preventing surface spills and leaks from storage facilities and pipelines. This is because oil companies are not in the business of leaking or spilling oil; they are in the business of selling it. Oil companies also want to avoid litigation and the costs of remediation.

This is mostly lost, however, on the opponents of hydraulic fracking, for two reasons. First, it is much easier to talk about banning hydraulic fracking than it is to talk about banning conventional oil and gas drilling. Most Americans are not yet willing to give up their gasoline-powered automobiles or do without the other modern conveniences brought on by fossil fuels. The public realizes that a certain amount of oil and gas drilling is necessary to sustain both the economy and living standards. Banning all oil and gas well drilling would be pressing the envelope too far.

Second, some opponents of fracking exploit the lack of knowledge that most Americans, understandably, have of shale geology and modern well casing and cementing practices. Fanning the flames of technophobia is much easier than having a rational, data-driven dialogue on the risks of hydraulic fracking. The water quality debate over hydraulic fracking epitomizes this perhaps as much as any other issue associated with the process.

122 Merrit Kennedy, *Lead-Laced Water in Flint: A Step-by-Step Look at the Makings of a Crisis*, NAT'L PUB. RADIO: THE TWO-WAY (April 20, 2016), <https://www.npr.org/sections/thetwo-way/2016/04/20/465545378/lead-laced-water-in-flint-a-step-by-step-look-at-the-makings-of-a-crisis>.

In 2015, 34 percent of freshwater usage in the U.S. was for cooling in power generation. Freshwater usage for cooling power plants is now on the decline, thanks to fracking and the displacement of coal by natural gas.¹³⁰

2. Water Usage

It has been said, “Whiskey is for drinking, but water is for fighting.”¹²³ Water usage in Texas, where half the state is desert or semiarid, is always a concern. Despite recent hurricanes, periodic droughts continue to plague the state.

According to the TAMEST report, less than 1 percent of total water usage in Texas is devoted to hydraulic fracking, though in some regions and locales, the percentage can be much higher.¹²⁴ There has been much recent publicity, for example, about Apache Corp.’s Alpine High project in West Texas, which has generated controversy over potential impact of its water withdrawals in the area around the Balmorhea Springs.¹²⁵

The topic of water usage conflicts in Texas forms a subject in itself.¹²⁶ However, use of water for fracking purposes should not be viewed in isolation:

Coal fired gas plants also use water. A typical 500-megawatt coal fired plant uses as much water in a year as 500-

600 hydraulic fracking operations.¹²⁷ Natural gas fired electricity generating plants use four times less water than does a coal fired plant.¹²⁸

In 2015, 34 percent of freshwater usage in the U.S. was for cooling in power generation.¹²⁹ Freshwater usage for cooling power plants is now on the decline, thanks to fracking and the displacement of coal by natural gas.¹³⁰

Biofuels are a much hyped and government subsidized form of alternative energy. But biofuels need water to grow corn for ethanol and biodiesel, and much of that is from irrigated water.

Of all the forms of alternative energy, solar power from panels uses the least water. However, the most efficient and productive use of solar power is with solar thermal energy, which uses a lot of water. Even pure solar energy production requires water for panel cleaning.

Critics of fracking might point out the fresh water used for fracking is injected underground, whereas water used for cooling in power plants can

be more easily reused. Use of brackish water, including recycled produced water, is on the upswing in fracking operations.¹³¹ Regardless, the amount of water used for fracking is relatively small compared with almost all other energy sources. But concerns about water withdrawals for fracking purposes persist. This is one of the reasons why hydraulic fracturing has not taken root in California.¹³²

So given all this, is using 1 percent of Texas’ water resources for hydraulic fracturing inordinate, particularly when the positive economic impact on the state is considered? Whether or not devoting 1 percent of freshwater supplies in Texas to fracking is a good or a bad idea is once again a question of perspective, and sympathies either for or against hydraulic fracturing and the oil and gas industry more generally will inevitably play into the analysis.

3. Air Quality & Climate Change

Perhaps the biggest controversy involving the risks of fracking concerns greenhouse gas emissions.

123 Attributed to Mark Twain, though not by all researchers, <https://quoteinvestigator.com/2013/06/03/whiskey-water/>.

124 TAMEST, *supra* note 30, at 116.

125 See, e.g.: David Hunn, *Scrutiny of Drilling Near West Texas Balmorhea Springs Intensifies*, HOUS. CHRON. (Oct. 24, 2016, 9:15 a.m.), <https://www.houstonchronicle.com/business/article/More-environmentalists-scrutinize-Balmorhea-area-10096473.php>; David Hunn, *Apache “disappointed” in Earthworks Tactics at Balmorhea*, HOUS. CHRON.: FUEL FIX (Nov. 3, 2016), <https://fuelfix.com/blog/2016/11/03/report-apache-drilling-could-contaminate-balmorhea-pool/>; Naveena Sadasivam, *Huge Oil Discovery May Endanger Solace of Balmorhea*, THE TEX. OBSERVER (Nov. 22, 2016, 9:41 a.m.), <https://www.texasobserver.org/balmorhea-fracking-endangered/>.

126 HYDRAULIC FRACTURING L&P, *supra* note 22, § 24.02[4][b] – 24.02[5].

127 *Id.*, § 3.03[2][b].

128 *Water Use Declining as Natural Gas Grows*, CLIMATE CENTRAL (June 30, 2015), <http://www.climatecentral.org/news/water-use-declines-as-natural-gas-grows-19162>.

129 *Summary of Estimated Water Use in the United States in 2015*, U.S. GEOLOGICAL SURVEY & U.S. DEP’T OF INTERIOR., 42 (2018), <https://pubs.usgs.gov/circ/1441/circ1441.pdf>.

130 *Id.*

131 TAMEST, *supra* note 30, at 117-18.

132 SERNOVITZ, *supra* note 21, at 78.

The TAMEST report makes the point that production of shale resources results in emissions of greenhouse gases, photochemical air pollutants and air toxins.¹³³ However, the real question when it comes to air emissions and global warming is how do emissions impacts from shale gas development compare with coal, the most commonly used fuel for power generation in the world?

As discussed in Part IV.4, natural gas emits 50 percent less CO₂ than coal.¹³⁴ However, methane leakage from wellheads, pipelines and compressors can also cause air pollution. According to the EPA, methane emissions account for one-tenth of all U.S. greenhouse emissions.¹³⁵ Because of this, according to a 2011 Cornell University study much publicized by the national

media, natural gas produced by fracking is actually worse for the environment than coal.¹³⁶

Cornell reached this conclusion by estimating that between 3.6 and 7.9 percent of all produced natural gas is leaked into the atmosphere during the extraction and transportation process.¹³⁷ Since methane, the primary component of natural gas, is 80 times more potent a greenhouse gas than

133 TAMEST, *supra* note 30, at 90.

134 Some contrarians argue that this is not necessarily a good thing. See GREGORY WRIGHTSTONE, *INCONVENIENT FACTS: THE SCIENCE THAT AL GORE DOESN'T WANT YOU TO KNOW* (2017).

135 SERNOVITZ, *supra* note 21, at 175.

136 *Id.* at 175-76.

137 *Id.* at 176.

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is CO₂,¹³⁸ Cornell concluded that the benefits derived from reduced CO₂ emissions from fracking are offset when compared with coal by a factor of somewhere between 20 and 50 percent over a 20-year horizon.¹³⁹

Scientists at the University of Texas subsequently challenged the conclusions of the Cornell scientists.¹⁴⁰ The UT scientists agreed with an earlier EPA estimate that methane leakage from all U.S. natural gas and petroleum systems was only around 1.5 percent.¹⁴¹ At those levels, according to the UT researchers, the conclusion of the Cornell scientists that natural gas is worse for the environment than coal would appear suspect. Not surprisingly, the Cornell scientists scoffed at the UT scientists and their “fatally flawed” study.¹⁴²

TAMEST said using natural gas instead of coal produces a climate benefit if methane emissions (leaks) along the entire supply chain are kept at less than 1 percent for transportation or 3 percent for electricity generation.¹⁴³ A more recent national study puts the combined threshold at 4 percent.¹⁴⁴ Swinging the other way, the World

Resources Institute claims that even a 1 percent methane leakage rate is too high for natural gas to have a net benefit over coal.¹⁴⁵ Contrary to that report, The New York Times cited Richard Muller, a Berkeley physicist and leading climate change scientist, as having concluded that it would be acceptable (but not good) to assume a 10 percent methane leakage rate in order for natural gas to have a net benefit over coal.¹⁴⁶

Given the inconsistencies and incompleteness of data on methane emissions and thresholds for net benefit over coal, TAMEST concluded that more research is needed and that comprehensive assessments of direct and indirect impacts on air quality from production from shale resources are complex (which is rather obvious).¹⁴⁷ However, TAMEST cited “observational studies” that would place most methane emissions from natural gas sources in Texas in the 0.5-1.5 percent range, and nationally from 0.5 to 5 percent or more.¹⁴⁸

As the Cornell/UT debate evidences, and as is so often the case with any technical conclusions about hydraulic

fracking, air emission impacts of hydraulic fracturing are the subject of proliferating and often conflicting studies and commentaries.¹⁴⁹ So how can researchers isolate the air quality impacts of fracking and how large a percentage of total air pollution is caused by fracking? As TAMEST suggested, isolating the impact of shale resource development on air quality from the impact of other sources is very complex and very difficult.¹⁵⁰ There are other sources of air pollution from fracking besides CO₂ or methane leaks. Recall the 1,700 trucks per frack job referenced in Part I.2. Each truck trip has associated air pollution leading to increased amounts of ozone, volatile organic compounds, sulfur dioxides and nitrogen oxides being leaked into the atmosphere.¹⁵¹ Air pollutants are also released from natural gas compressor stations and processing plants.¹⁵²

However, ozone and NOx is leaked into the atmosphere by many other industrial sources, including automobiles. So is methane. For example, humans have helped to cultivate about 1.5 billion cows on the

138 John Schwartz & Brad Plumer, *The Natural Gas Industry Has a Leak Problem*, N.Y. TIMES (June 21, 2018), <https://www.nytimes.com/2018/06/21/climate/methane-leaks.html>; see also TAMEST, *supra* note 30, at 93-94.

139 SERNOVITZ, *supra* note 21, at 176.

140 *Id.* at 176-177.

141 *Id.* at 176.

142 *Id.* at 177.

143 TAMEST, *supra* note 30, at 94.

144 John Schwartz & Brad Plumer, *The Natural Gas Industry Has a Leak Problem*, N.Y. TIMES (June 21, 2018).

145 SERNOVITZ, *supra* note 21, at 177.

146 *Id.*

147 TAMEST, *supra* note 30, at 112.

148 *Id.* at 94.

149 HYDRAULIC FRACTURING L&P, *supra* note 22, § 1.05[2].

150 TAMEST, *supra* note 30, at 101.

151 *Id.* at 99, 101.

152 *Id.* at 91.

planet.¹⁵³ By one estimate, 16 percent of worldwide methane emissions are caused by cow flatulence, burping and manure deposits, notwithstanding contributions from other agriculturally related sources (e.g., pigs).¹⁵⁴ The U.S. Environmental Protection Agency considers the agricultural sector to be the primary methane-emitting industrial sector in the United States, edging out the oil and gas industry, the second-highest emitter.¹⁵⁵ Buildings, landfills and the coal industry are other sources of methane emissions.¹⁵⁶

Both sides of the fracking debate argue over whether methane leakage is a growing or a shrinking problem. The Obama EPA issued new methane emission rules in 2012 that went into effect in 2015. These rules require operators to use “green completion” technology for fracked gas wells — ending an era of flaring gas.¹⁵⁷ Essentially, green completion technology involves containing the loss of methane and other hydrocarbons during flowback,¹⁵⁸ or controlling flaring to convert methane into carbon dioxide and water.¹⁵⁹

Corporate self-interest also plays a part in decreasing methane emissions — capturing and selling methane is

more profitable than leaking it. Devon Energy boasts it has been using green completion technology exclusively since 2004, well before the EPA required it.¹⁶⁰ ExxonMobil recently announced greenhouse gas reduction measures that are expected to lead to significant improvements in emissions performance by 2020, including a 15 percent decrease in methane emissions and a 25 percent reduction in flaring.¹⁶¹ ExxonMobil affiliate XTO Energy said it has reduced methane emissions from its operations by 9 percent since 2016.¹⁶²

In addition, EPA data shows that methane released in the United States has been declining since at least 1990. There was a 10 percent decline in methane releases between 2003 and 2013, which is 23 percent more than the decline rate of CO₂. During the same period, U.S. gas production rose 32 percent, and this was even before the EPA’s new green completion rules went into effect.¹⁶³

But the record of accomplishment of the United States in reducing methane and CO₂ releases should not be viewed in isolation. Reducing greenhouse gas emissions from China, India and other emerging countries has been called the “grand battle in the fight against climate

change.”¹⁶⁴ China’s CO₂ emissions have grown 3.5 times since 1993 while U.S. CO₂ emissions have declined by 4 percent, making China responsible (in 2015) for 29 percent of the world’s total CO₂ emissions compared with 15 percent for the U.S. (in 2015).¹⁶⁵ Proponents of fracking argue that if shale gas can displace the burning of coal in developing countries through exports of LNG from the U.S. and other places, growth in CO₂ emissions worldwide have a shot at being reduced or at least slowed, giving renewable energy, nuclear energy, battery powered automobiles and other less CO₂ emitting sources of energy more time to expand and take hold.

This, however, circles back to the fundamental issue of whether wholesale conversions from coal to natural gas generated power plants internationally will be a solution to global warming (through reductions of CO₂ emissions) or potentially disastrous for the planet because of the generation of sizable volumes of atmospheric methane.¹⁶⁶ Proponents of fracking argue that concerns about methane emissions are overblown. Though methane is unquestionably a more potent greenhouse gas than CO₂, it dissipates

153 George Dvorsky, *We’ve Grossly Underestimated How Much Cow Farts are Contributing to Global Warming*, GIZMODO (Sept. 29, 2017), <https://gizmodo.com/we-ve-grossly-underestimated-how-much-cow-farts-are-con-1818993089>.

154 *Id.*

155 *Overview of Greenhouse Gases: Methane Emissions*, U.S. ENVTL. PROTECTION AGENCY, <https://www.epa.gov/ghgemissions/overview-greenhouse-gases#methane>.

156 *Id.*

157 MARK S. GURALNICK, *FRACKING: LAW AND POLICY* § 20.01[D] (2016).

158 *Id.*, § 20.01[D][1].

159 SERNOVITZ, *supra* note 21, at 178.

160 *Id.*

161 <https://news.exxonmobil.com/press-release/exxonmobil-announces-greenhouse-gas-reduction-measures>

162 <https://news.exxonmobil.com/press-release/exxonmobils-xto-energy-announces-progress-methane-emissions-reduction-program>

163 *Id.* at 177.

164 *Id.* at 192.

165 *Id.* at 190.

166 GURALNICK, *supra* note 158, § 6.19.

in about a dozen years versus CO₂, which stays around for thousands.¹⁶⁷ Furthermore, there is no consensus on the threshold at which methane leakage offsets CO₂ reductions. As pointed out earlier, estimates of the “threshold” leakage range at which methane is worse for the environment than coal is 1-10 percent.¹⁶⁸

Furthermore, is the oil and gas industry being unfairly singled out to blame for methane leakage and its impact on climate change? Given the significant role of cow flatulence in worldwide methane emissions, and at risk of sounding flippant, perhaps humans, as the advertisement of one well-known fast food chain suggests, should “eat more chicken.”

Opponents of fracking might correctly point out that the incompleteness and inconsistencies in research¹⁶⁹ on the methane emissions threshold are unsettling given the gravity of the question. Furthermore, the success of the U.S. in reducing its methane emissions may not be easily replicated in China, India and other less developed countries where the infrastructure — and regulatory processes — may not be up to the challenge, at least in the short run.

The question of methane emissions aside, another serious criticism of fracking is that the very success of industry — in both reducing emissions and making oil and gas more affordable — is postponing the switch to renewable forms of energy and thereby aggravating global warming.¹⁷⁰ As another author of *Hydraulic Fracturing Law and Practice* put it, there is concern that “cheap and plentiful oil and natural gas may prove too popular, thereby diminishing the market penetration of renewable resources and resulting in a bridge that leads nowhere.”¹⁷¹

4. Earthquakes

Fracking is often blamed for the increase in seismic activity in Oklahoma and elsewhere. For example, in November 2011, a magnitude 5.7 earthquake — the largest

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in Oklahoma history — occurred near Prague, destroying at least 16 homes.¹⁷² One homeowner, Sandra Ladra, suffered an injury when her stone fireplace broke off onto her legs during the earthquake.¹⁷³ Though the Oklahoma Geological Survey concluded that the earthquake was likely attributable to natural causes,¹⁷⁴ other scientists disagreed¹⁷⁵ and pointed to nearby injector wells as the probable cause. Prague soon became another battle cry for anti-fracking activists.

The recent increase in the number of magnitude 3.0 or

¹⁶⁷ SERNOVITZ, *supra* note 21, at 177.

¹⁶⁸ *Id.*

¹⁶⁹ TAMEST, *supra* note 30, at 112; *see also* GURALNICK, *supra* note 166.

¹⁷⁰ SERNOVITZ, *supra* note 21, at 177.

¹⁷¹ Dave Neslin, HYDRAULIC FRACTURING L&P, *supra* note 22, § 1.04[3].

¹⁷² SERNOVITZ, *supra* note 21, at 94.

¹⁷³ Powell, *supra* note 41, at 1002.

¹⁷⁴ Hall, *supra* note 42 at 5-25.

¹⁷⁵ *Id.*

greater earthquakes¹⁷⁶ in Oklahoma has been dramatic, rising from 2.2 annually in 2008 to 890 annually in 2015.¹⁷⁷ There is a growing consensus in the scientific community that these increases in seismic activity are a result of disposal of produced wastewater in proximity to existing faults.¹⁷⁸

Texas has likewise been susceptible to earthquake activity, though not at such a high rate as Oklahoma. The ratio of the number of magnitude 3.0 earthquakes between Oklahoma and Texas is approximately 60 to 1.¹⁷⁹ This is because, according to TAMEST, the majority of faults in Texas are stable and not prone to generating earthquakes.¹⁸⁰ Nevertheless, according to TAMEST, from 1980 to 2007 there were an average of two magnitude 3.0 or more earthquakes in Texas per year.¹⁸¹ From 2007 to 2017, the number increased to 12 magnitude 3.0 or greater earthquakes per year.¹⁸²

But is it fair to blame fracking for the upsurge of earthquakes in Oklahoma, Texas and elsewhere? Scientists almost uniformly agree that hydraulic fracturing very rarely causes seismicity.¹⁸³ The National Research Council reported that hydraulic

fracturing “does not pose a high risk for inducing felt seismic events” largely because of the relatively short duration of the injection process and short volumes of fluids involved.¹⁸⁴ It is commonly estimated that over 1 million wells have been hydraulically fracked worldwide, but there are only about a half-dozen instances where evidence suggests that hydraulic fracturing may have induced seismicity.¹⁸⁵

The rebuttal from opponents of fracking might be that even if there is no direct causal relationship between fracking and seismicity, there is indirect causation because, but for fracking, the large volumes of produced water would not have been injected in the first instance. For example, from 2010 to 2014, oil production in Oklahoma increased by 90 percent and gas production by 26 percent. Water production rose commensurately, at 10 times the volume.¹⁸⁶ Much of this water is disposed of in injection wells. Fracking is responsible for much of the increase in oil, gas and water production in Oklahoma, especially in the Woodford, STACK and SCOOP shale play areas. It would be tempting to conclude, therefore, that fracking is

responsible for the increased number of earthquakes caused by produced water injection.

But the causal link between fracked well produced water disposal and earthquakes is very speculative. As mentioned in Part I.3, over 100,000 injection wells have been drilled in the United States for secondary recovery purposes and another 30,000 drilled for wastewater injection purposes. Most of these injection wells are used for conventional oil and gas operations and have nothing to do with fracking. Most of the earthquakes in Oklahoma, for example, are occurring outside the areas of the two most active shale plays, the STACK and SCOOP, which are located in West Central and South Central Oklahoma.¹⁸⁷

Furthermore, there is conflicting and inconsistent data on how many of the earthquakes in recent years occurring in Texas, Oklahoma and elsewhere have been induced by industrial activities as distinguished from natural causes.¹⁸⁸ There is also conflicting data on how serious a problem injector wells really are. In the Barnett Shale region of North Texas, according to a 2015 SMU study, 99 percent of injection wells have

176 Typically an earthquake must have a magnitude of 3.0 to 3.9 to be felt, though magnitude 3.0 to 3.9 earthquakes rarely cause damage. Magnitude 4.0 to 4.9 earthquakes are usually felt, but seldom cause significant damage. For an earthquake to cause significant damage, it must be magnitude 5.0 or higher on the Richter scale. An earthquake of 6.0 to 7.0 on the Richter scale would be considered strong, and one higher than 7.0, such as the San Francisco earthquake of 1906 (7.8 on the Richter scale), would likely be considered catastrophic. Hall, *supra* note 49, at 5-9.

177 Powell, *supra* note 41.

178 *Id.*

179 TAMEST, *supra* note 30, at 16.

180 *Id.* at 44.

181 *Id.*

182 *Id.*

183 Hall, *supra* note 42, at 5-23.

184 HYDRAULIC FRACTURING L&P, *supra* note 22, § 1.05[4].

185 Hall, *supra* note 42, at 5-23.

186 SERNOVITZ, *supra* note 21, at 94.

187 See HYDRAULIC FRACTURING L&P, *supra* note 22, § 1.05[4].

188 Hall, *supra* note 42, at 5-28. “Some people are skeptical of the conclusion that injection disposal is responsible for the overall increase [in detected seismicity], believing that the available evidence does not yet justify such a conclusion.”

not been associated with earthquakes that could be felt by citizens.¹⁸⁹

The SMU study was consistent with other studies concluding that the great majority of injection activities in the U.S. will not induce seismic activity.¹⁹⁰ This is because a very specific set of geologic conditions must be present in order for seismicity to be induced.¹⁹¹ For this reason, of the approximately 30,000 injection wells in the U.S. that are permitted for disposal of wastewater generated by oil and gas activities, only a small fraction are suspected of having induced seismicity.¹⁹² The question becomes, of this relatively small set of injector wells, how much fracking well produced water was disposed of versus produced water from conventional wells? Conventional well production still accounts for more than half of U.S. production.¹⁹³

As with so many other technical issues associated with fracking, data on produced water injections is both difficult to obtain and can be inconsistent and conflicting. According to TAMEST, ongoing research efforts — both academic and industrial — are needed to fully inform the public, the Texas Legislature and the Texas Railroad Commission of the risks of earthquakes that may occur due to produced water injection.¹⁹⁴

Regardless of the cause, and the seemingly low magnitude of the overwhelming majority of earthquakes associated with injection wells, dangers posed by earthquakes should not be minimized. Because of these risks, regulators in Texas, Oklahoma and other states are more closely scrutinizing injector well applications and are putting in place what have been called “traffic light systems” designed to halt produced water disposal near known faults, as discussed in more detail in Part V.4. In addition, the Texas Legislature in 2015 provided funding for installation of the TexNet Seismic Monitoring

189 HYDRAULIC FRACTURING L&P, *supra* note 22, § 24.01.

190 Hall, *supra* note 42, at 5-16.

191 *Id.* at 5-16-5-17.

192 *Id.* at 5-22.

193 *Frequently Asked Questions (Oil)*, U.S. ENERGY INFO. ADMIN. (March 8, 2018), <https://www.eia.gov/tools/faqs/faq.php?id=847&t=6>; *Frequently Asked Questions (Natural Gas)*, U.S. ENERGY INFO. ADMIN. (March 8, 2018), <https://www.eia.gov/tools/faqs/faq.php?id=907&t=8>.

194 TAMEST, *supra* note 30, at 65.



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Program to improve statewide seismic monitoring capability by increasing the number of seismic monitoring stations in Texas from 18 to 43.¹⁹⁵

Despite regulatory progress, and as with practically everything else about fracking, the opponents of fracking are prone to exaggerate the risks of earthquakes and media attention is unrelenting. But the oil and gas industry has no monopoly on industrially induced earthquakes. Although the oil and gas industry's injection activities receive most of the attention, dams, geothermal operations and other activities besides oil and gas can also induce seismicity.¹⁹⁶ In the 1960s, the

U.S. military injected wastewater into the Rocky Mountain Arsenal near Denver, allegedly causing earthquakes.¹⁹⁷

So is the threat of earthquakes a reason to ban hydraulic fracking? If so, for the same reason, should hydroelectric powering dams or the use of geothermal energy be banned? Should all 130,000 injector wells in the U.S. be banned in order to eliminate any risk that they may contribute to earthquakes, irrespective of the crippling effect that might have on U.S. conventional oil production? Conversely, and regardless of the cause, given the relatively small number of earthquakes in Texas and Oklahoma

over the past 10 years that have caused significant property damage or injuries (and so far, no fatalities), are the risks of earthquakes from fracking reasonably acceptable? Once again, the answer to those questions often depends as much on a person's political perspective on the oil and gas industry as it does on science and engineering analysis.

Though the evidence is strictly anecdotal, news accounts of earthquakes in Texas and Oklahoma appear to be on a downward trajectory despite the fact that fracking activities are still robust in both states. Whether this is because new regulations are doing their job or because there never was a proven causal

195 *Id.* at 61.

196 Hall, *supra* note 42, at 5-13, 17.

197 *Id.* at 5-13.



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relationship between earthquakes and fracking in the first place¹⁹⁸ is a question for further study.

5. Land Resources

The reduced surface footprint that multiwell pad drilling provides is one benefit of hydraulic fracturing. But as with everything else about fracking, its impact on land resources is complex.

There are winners and losers when it comes to the surface impact of hydraulic fracturing. Oil and gas companies, royalty owners and taxing authorities are among the winners. However, what about the severed surface owner whose land withstands the worst of surface operations for fracking but who enjoys none of the royalty income? In Texas and most other oil producing states, the mineral estate is dominant over the surface estate. This means that the mineral lessee holds an implied easement for/to reasonable use of the surface limited (in Texas) only by the “accommodation doctrine” per the 1971 Texas Supreme Court decision in *Getty Oil Co. v. Jones*.¹⁹⁹

Texas, unlike some other oil producing states, has no Surface Damages Act. Such regulations level the playing field more between surface owners and oil companies by requiring larger damage payments and more accommodation of the surface owner than is required under common law.

In Texas, given the absence of such a statute, a severed surface owner relying strictly upon contract rights is limited by whatever reservations of rights may have occurred in the original mineral severance document — which usually means few, if any, contractual rights at all.

Other losers, as alluded to earlier under the discussion of water usage, are local farmers and ranchers who may be suffering from loss of groundwater needed for agricultural operations due to groundwater withdrawals for hydraulic fracturing purposes. This has led some Groundwater Conservation Districts in Texas to backdoor their way into regulating hydraulic fracking by either charging fees for permits or restricting water usage for hydraulic fracking purposes, citing agricultural or drinking water needs. This raises a question under HB 40 as to whether GCDs have authority to do this, as discussed in Part VI.5.²⁰⁰

Other losers are breeds of wildlife not protected by the Endangered Species Act and their enthusiasts. Can the oil and gas industry coexist with the dunes sagebrush lizard and the lesser prairie chicken? Some may flippantly ask, “Who cares?” However, this is a real issue for wildlife enthusiasts and regulators and is one that the oil and gas industry should not take lightly. Much concern arose among Texas oil

and gas operators during the Obama administration when the EPA proposed adding the dunes sagebrush lizard and the lesser prairie chicken to the federal endangered species list. Were such listings to occur, they could severely affect, or even halt, shale development in parts of Texas and New Mexico. In Texas, both species are now covered by voluntary conservation plans overseen by state agencies.²⁰¹

6. Transportation

Earlier mention was made of the approximately 1,700 truck trips per frack job needed to develop Eagle Ford Shale resources in South Texas. Frack trucks are not the only trucks using Texas roads as part of shale development. Often, oil must be trucked out due to lack of pipeline capacity. Drilling contractors and other service companies also use Texas roads. Most Texas rural and county roads were not designed to carry the extent of truck traffic currently associated with shale oil and gas development.²⁰² TAMEST estimated that development of a typical shale oil or gas well is the rough equivalent of over 20 million passenger cars a year in resulting pavement impacts.²⁰³

TAMEST also estimated that shale resource development causes \$1.5 billion to \$2.5 billion in damages a year to Texas roads.²⁰⁴ In 2017, this was

198 Hall, *supra* note 42, at 5-17-5-19.

199 *Getty Oil Co. v. Jones*, 470 S.W.2d 618, 623 (Tex. 1971).

200 HB 40, passed by the 84th Texas Legislature effective May 18, 2015, and codified in Texas Nat. Res. Code § 81.0523, pre-empts municipal and other local regulation of hydraulic fracturing except for certain limited exercises of municipal police powers in § 81.0523(c). Even then, the ordinances cannot be commercially unreasonable and cannot prohibit oil and gas operations that are conducted by a reasonably prudent operator. § 81.0523(c)(2) & (3).

201 TAMEST, *supra* note 30, at 80.

202 *Id.* at 132.

203 *Id.* at 135.

204 *Id.* at 145.

offset by \$11 billion in increased state tax revenues.²⁰⁵

But with the road impacts come air pollution, noise, increased risks of oil spills and, sadly, traffic injuries and fatalities.²⁰⁶ The quality of life in communities through which shale-related truck traffic must travel is prone to deteriorate.²⁰⁷ Increased economic benefits and tax revenues do not necessarily compensate for such losses.

7. Social Impacts

Much of shale development occurs

in rural areas or near small towns that withstand the worst from increased traffic congestion, road impact, wastewater disposal and traffic fatalities and injuries. Nonlocal mineral owners are often the prime beneficiaries of shale gas development. Much of the increased tax revenues from shale development go to state and federal — not local — tax coffers. On the other hand, the influx of shale workers and their employers into such areas can create opportunities and jobs in service industries such as motels, restaurants

and stores.

Social justice issues also arise from fracking. A study conducted in the Eagle Ford Shale region of Texas indicated that injection wells were disproportionately permitted near communities with large percentages of minorities and high levels of poverty.²⁰⁸ The study also suggested that “discrepancies in locations of new wastewater disposal wells may be driven by and contribute to differences in political capital between people of color and white communities and

²⁰⁵ Katherine Blunt, *Texas Mineral Taxes and Royalties Increased in 2017*, HOUS. CHRON. (March 29, 2018, 8:02 a.m.), <https://www.chron.com/business/energy/article/Texas-mineral-taxes-and-royalties-increased-in-12710678.php>. The article says this was up from \$9.4 billion paid in 2016, according to the Texas Oil and Gas Association.

²⁰⁶ TAMEST *supra* note 30, at 140.

²⁰⁷ *Id.* at 158.

²⁰⁸ *Id.* at 162 (citing Jill E. Johnston, Emily Werder & Daniel Sebastien, *Wastewater Disposal Wells, Fracking, and Environmental Injustice in Southern Texas*, 106(3) AM. J. PUB. HEALTH 550 (2016)).

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between high- and low-wealth areas.²⁰⁹

Religious issues have also arisen due to shale development. The best-known shale development confrontation over religion has been the Standing Rock episode involving the Dakota Access Pipeline and protests of Native American tribes in the Dakotas who opposed the pipeline's impact on sacred burial sites. However, such religious objections to shale development are

not limited to Native Americans. Many other religious denominations, including mainline Christian denominations, have expressed concern or opposition to hydraulic fracturing.²¹⁰

V. TEXAS REGULATION OF HYDRAULIC FRACTURING

So what type of concerns do Texas regulators address regarding hydraulic fracking? Largely, Texas concerns

are similar to all the other concerns discussed so far. Texas, as a state with a more measured, incremental approach to new fracking regulations than some other states,²¹¹ relies heavily on its existing regime of regulating conventional oil and gas operations developed over the past 125 years.²¹² But Texas decided it was appropriate to add new regulations applicable to hydraulic fracturing in these five

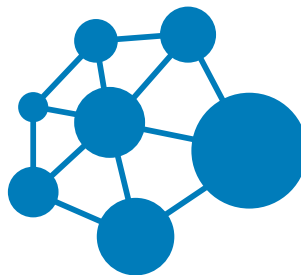
209 *Id.* (citing Jill E. Johnston, Emily Werder & Daniel Sebastien, *Wastewater Disposal Wells, Fracking, and Environmental Injustice in Southern Texas*, 106(3) AM. J. PUB. HEALTH 550, 554 (2016)).

210 Dennis Sadowski, *Catholic Voices Raise Moral Concerns in Country's Fracking Debates*, CATHOLIC NEWS SERVICE (Dec. 11, 2013, 12 a.m.), <http://www.catholicnews.com/services/englishnews/2013/catholic-voices-raise-moral-concerns-in-country-s-fracking-debates.cfm>; see also Jeff Goliher, *Why I'm Opposed to Fracking*, THE EPISCOPAL CHURCH (Jan. 30, 2012), <https://www.episcopalchurch.org/library/article/why-i%E2%80%99m-opposed-fracking>.

211 See, for contrasting examples, the discussions of fracking regulation in California, Colorado, and Illinois in HYDRAULIC FRACTURING LAW, *supra* note 22, §§ 7, 8, and 27.

212 For a history of the Texas Oil and Gas Industry and its development of oil and gas regulations, see HYDRAULIC FRACTURING LAW, *supra* note 22, § 24.01.

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areas: 1) chemical disclosures, 2) well integrity, testing and technical treating requirements, 3) notices, 4) seismicity and 5) local bans on fracking (state pre-emption).

1. Chemical Disclosures

As Professors Ernest E. Smith and Jacqueline Lang Weaver put it when discussing public opposition to fracking in Texas and elsewhere, “the loudest call from citizens was for disclosure of the chemicals that were being injected down wells during the fracturing process and the threat posed to groundwater supplies.”²¹³ Despite the actual risks associated with hydraulic fracturing fluids (see Part IV.1), the public outcry after the HBO documentary *Gasland* in 2010 was so severe that oil and gas producing states began passing Hydraulic Frack Fluid Disclosure Laws. Texas was among the first states to do this.²¹⁴

The Texas Disclosure of Composition of Hydraulic Fracturing Fluids Act, also called the Texas Hydraulic Fracturing Fluid Disclosure Act, was passed in 2011 and signed into law by then-Gov. Rick Perry.²¹⁵ This was followed by Texas Railroad Commission Statewide Rule 29, Hydraulic Fracturing Chemical Disclosure Requirements, adopted on Jan. 2, 2012.²¹⁶

Under Texas RRC Rule 3.29(c)(1)(a), within 15 days following the completion of a fracking treatment on a well, the supplier or the service company must disclose to the operator of the well each additive used in the fracking fluid, the trade name, the supplier and a brief description of the intended use or function of each additive.²¹⁷ Chemical ingredients and maximum concentrations must also be

²¹³ 3 ERNEST E. SMITH & JACQUELINE LANG WEAVER, TEXAS LAW OF OIL AND GAS § 14.11(A) (2d ed. 2015).

²¹⁴ John D. Furlow & Corinne V. Snow, *In the Wake of the Shale Revolution: A Primer on Hydraulic Fracturing Fluid Chemical Disclosure*, 8 TEX. J. OIL GAS & ENERGY L. 249, 255 (2012-13).

²¹⁵ Tex. Nat. Res. Code Ann. § 91.851.

²¹⁶ 16 Tex. Admin. Code § 3.29.

²¹⁷ GURALNICK, *supra* note 159, § 3.02[H] (citing 16 Tex. Admin. Code § 3.29(c)(1)(a), implementing Texas Nat. Res. Code Ann. § 91.851).

disclosed.²¹⁸ The operator must then ensure that the disclosure information is posted on the FracFocus website.²¹⁹

Texas was one of the first states to make disclosure on the FracFocus website mandatory for operators. What is FracFocus? It is a website launched in 2011, co-developed by the Oklahoma City-based Ground Water Protection Council and Interstate Oil and Gas Compact Commission. Essentially, it is a national online registry that operators use to disclose the content of frack fluids. The registry is then accessible to the general public, including regulators, landowners, environmental groups and plaintiff's lawyers. The theory behind the new chemical disclosure requirements was that the more data disclosure and transparency, the more opportunity to trace groundwater contamination caused by hydraulic fracturing.

The Texas frack fluid disclosure requirements applied only to frack operations undertaken after Feb. 1, 2012, and were not retroactive. Critics of hydraulic fracturing did not like this, but the Legislature decided it was impractical to make the law retroactive given the hundreds of thousands of wells drilled in Texas since hydraulic fracturing began in the 1940s.

Another feature of the law that critics of fracking did not like was its provision for trade secret protection.²²⁰ Oil companies had pressed for trade secret protection because without it, competitors could imitate or use reverse engineering and thus deprive operators of their proprietary technologies. This



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would in turn discourage investment in development of new technologies. Critics, on the other hand, look upon trade secret protection as a loophole that gives oil companies a license to inject any chemicals they wished.

Some say that the need for trade secret protection is overblown. As one commentator observed, the real secret about frack fluids is that most likely, there is little difference between one oil company's proprietary frack fluid formulas and that of others.²²¹ For this reason, many companies have listed all the components of frack fluids on the FracFocus website without bothering to claim trade secret protection.²²² In retrospect, the industry's obsession

with trade secret protection appears to have played into the hands of opponents of fracking by notching up public paranoia.²²³

Opponents of fracking in Texas also criticized the exemption of wells fracked before Feb. 1, 2012, from the act's disclosure requirements despite the practical problems of including tens of thousands or more of wells and the paucity of evidence that any of them may have been responsible for groundwater contamination.²²⁴ FracFocus itself was criticized, along with the Texas Railroad Commission, for its failure to implement procedures that would independently verify the contents of the disclosures.²²⁵

²¹⁸ *Id.*

²¹⁹ FRACFOCUS, [HTTPS://FRACFOCUS.ORG/](https://fracfocus.org/) (last visited Aug. 6, 2018).

²²⁰ Tex. Nat. Res. Code Ann. §91.851(a)(3)-(7), implemented by 16 Tex. Admin. Code § 3.29(3).

²²¹ SERNOVITZ, *supra* 21, at 79.

²²² *Id.*

²²³ *Id.*

²²⁴ HYDRAULIC FRACTURING LAW, *supra* note 22, § 24.02[2][c].

²²⁵ *Id.*

To assuage critics, the act also includes provisions for challenging trade secret protection provided certain eligibility requirements are met.²²⁶ Operators may not withhold any information requested by health care professionals or emergency responders.²²⁷

Despite its critics, the Texas Hydraulic Fracturing Fluid Disclosure Act and its accompanying Texas Railroad Commission Statewide Rule 29 have become models for hydraulic

fracturing disclosure statutes and regulations nationwide.²²⁸ Together they “introduced a new level of transparency designed to both allay public fears of water contamination and to facilitate collection of raw data that could be used to study the impacts of hydraulic fracturing more scientifically.”²²⁹

2. Well Integrity, Testing, Technical Treating Requirements

In Part IV.1, reference was made to

TAMEST’s conclusion that in Texas, the depth of separation between zones where fracking occurs and water tables is generally separated by thousands of feet of overburdening rock. This makes direct contamination of water supplies by hydraulic fracking unlikely in Texas.²³⁰

But due to the public outcry over fracking, in 2014 the Texas Railroad Commission revised its Statewide Rule 13, Casing, Cementing, Drilling, Well Control, and Completion

226 Tex. Nat. Res. Code Ann. § 91.851(a)(4) & (5).

227 *Id.*, § 91.851(a)(7).

228 HYDRAULIC FRACTURING L&P, *supra* note 22, § 24.02[2][c].

229 *Id.*

230 TAMEST, *supra* note 37, at 113. “The depth separation between oil-bearing zones and drinking-water bearing zones in Texas makes direct fracturing into drinking water zones unlikely and has not been observed in Texas.”

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Requirements.²³¹ Rule 13 establishes the technical standards for casing and cementing oil and gas wells to protect groundwater and to prevent blowouts.²³² Well integrity requirements are the first line of defense in protecting water supplies from subsurface oil and gas operations, including hydraulic fracturing.

Texas RRC Rule 13 is highly technical and not easily understood by those without a petroleum engineering degree.²³³ A detailed summary of the rule is found at § 24.02[4] [a] of *Hydraulic Fracturing Law and Practice*.

In Part IV.1 it was also explained that the geology in Texas is such that it is highly unlikely that a well would ever be fracked within 1,000 feet of a drinking water aquifer. However, if this happens, the RRC Rule 13 provides for a set of very specific, technical requirements that minimize the chances of public drinking water supplies ever being contaminated by fracking operations.²³⁴

Besides well casing requirements, RRC Rule 13 requires surface controls to be put in place governing gas well wellheads (Christmas trees) to prevent leaks and to ensure adequate safety controls to prevent blowouts. Even

the Environmental Defense Fund has praised revised RRC Rule 13 as putting Texas on the forefront among states when it comes to well integrity practices designed to prevent methane leakage, water contamination and blowouts.²³⁵

3. Notices

Texas has no notice requirements in its oil and gas rules and regulations that specifically address hydraulic fracturing other than the FracFocus chemical disclosure requirements of RRC Rule 29 already discussed.²³⁶ There is some room for municipalities to expand notice requirements if “commercially reasonable” under HB 40 (Texas Natural Resources Code § 81.0523).

As with any other well drilled in Texas, the Railroad Commission requires operators under Statewide Rule 16 to file a completion report with the RRC within 90 days after completion of an oil or gas well or within 150 days after the date drilling operations were completed, whichever is earlier.²³⁷ The completion report is filed on a form W-2, which has a blank to indicate if a hydraulic fracturing operation was performed.²³⁸

4. Seismicity

Regulators in Texas and elsewhere have developed what is often called a “traffic light” system to address induced seismicity. This is provided for by Texas Railroad Commission Statewide Rules 9²³⁹ and 46,²⁴⁰ which were amended in 2014. The amendments to Statewide Rules 9 and 46 apply to injector wells, not to hydraulic fracturing per se.

What is a traffic light system? A traffic light system consists of monitoring injection rates and pressures and the surrounding area for seismic activity.²⁴¹ If no activity is detected, or if only low magnitude seismic events are detected, the company has a “green light” to continue its injection operations.²⁴² If seismic events above a certain magnitude are detected, the company has a “yellow light,” which allows it to go forward but requires precautions to be taken. Such precautions can include reducing injection rates, decreasing pressures and/or increasing monitoring.²⁴³ Finally, if seismic events above a certain magnitude are detected, or perhaps multiple events that individually might only trigger a yellow light, then the company has a “red light” and must cease operations.²⁴⁴

²³¹ 16 Tex. Admin. Code § 3.13 (2018).

²³² HYDRAULIC FRACTURING L&P, *supra* note 22, § 24.02[4][a].

²³³ *Id.*

²³⁴ 16 Tex. Admin. Code § 3.13 (a)(7)(A)-(D).

²³⁵ HYDRAULIC FRACTURING L&P, *supra* note 22, § 24.02[4][a].

²³⁶ TRRC form W-2, upon which well completion reports are to be filed, asks whether a hydraulic fracturing operation was performed and, if so, what type (acid, fracking or others). Form W-2 also requires disclosure of the amount and kind of material used and the depth intervals where the operation occurred. HYDRAULIC FRACTURING L&P, *supra* note 22, § 24.02[3][b].

²³⁷ 16 Tex. Admin. Code § 3.16(b)(1).

²³⁸ See *supra*, text accompanying note 232.

²³⁹ 16 Tex. Admin. Code § 3.9.

²⁴⁰ 16 Tex. Admin. Code § 3.46.

²⁴¹ Hall, *supra* note 42, at 5-20.

²⁴² *Id.* at 5-21.

²⁴³ *Id.*

²⁴⁴ *Id.*

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Upon application for a Class II injection well permit,²⁴⁵ the Texas RRC requires printed screenshots showing all historical seismic events within 100 miles of the proposed well. The RRC then determines whether the well should be permitted with no restrictions (green light), not be permitted (red light) or allowed to proceed with caution (yellow light) and subject to shutdown based on future data.

The RRC may also require additional information such as logs, geologic cross sections and pressure front boundary

calculations to show that the disposal fluids will remain confined if the well is operated in areas where there is an increased risk of fluid migration.²⁴⁶ Operators must perform monthly monitoring and report annual injection rates and pressures.²⁴⁷ The Railroad Commission may require more frequent monitoring and reporting in areas where conditions warrant.²⁴⁸

5. Local Bans on Fracking (State Pre-emption)

Local versus state control over

hydraulic fracking is a contentious issue among oil producing states. Texas has been no exception. Denton, Texas, the home of the University of North Texas, is a suburban community located north of Dallas-Fort Worth. Voters in Denton became concerned about Barnett Shale development and its potential impact on their community. On Nov. 4, 2014, Denton voters passed a hydraulic fracturing ban, criminalizing a standard industry practice.²⁴⁹ Ironically, the first municipal ban on hydraulic fracking in the United States arose in Texas. The ban was immediately challenged with a lawsuit filed by the Texas Oil and Gas Association claiming that the ban conflicted with Texas Railroad Commission and Texas Commission on Environmental Quality rules and was therefore invalid under the pre-emption doctrine.²⁵⁰

In response, the 84th Texas Legislature passed HB 40, effective May 18, 2015, codified in Texas Nat. Res. Code § 81.0523. The law pre-empts municipal and other local regulation of hydraulic fracturing except for certain limited exercises of municipal police powers in § 81.0523(c). Even then, the ordinances cannot be commercially unreasonable and cannot prohibit oil and gas operations conducted by a reasonably prudent operator.²⁵¹

Following the passage of HB 40, the city of Denton repealed its ordinance banning hydraulic fracturing on June 17, 2015.²⁵² The TXOGA lawsuit was

245 A Class II injection well is defined by the EPA for purposes of amendments to the Safe Drinking Water Act of 1974 (as amended in 1986 and 1996, see <https://www.epa.gov/sdwa>) as a well used only to inject fluids associated with oil and natural gas production. Class II fluids are primarily brines (salt water) that are brought to the surface while producing oil and gas. See <https://www.epa.gov/uic/class-ii-oil-and-gas-related-injection-wells>.

246 HYDRAULIC FRACTURING L&P, *supra* note 22, § 24.02[8].

247 *Id.*

248 *Id.*

249 HYDRAULIC FRACTURING L&P, *supra* note 22, § 24.02[4][a]; see Jim Malewitz, *Texas Drops Suit over Dead Denton Fracking Ban*, TEX. TRIB. (Sept. 18, 2015, 11 a.m.), <https://www.texastribune.org/2015/09/18/texas-drops-suit-over-dead-denton-fracking-ban/>.

250 HYDRAULIC FRACTURING L&P, *supra* note 22, § 24.01.

251 § 81.0523(c)(2) & (3)

252 Mose Buchle, *Denton Repeals Fracking Ban*, TEX. TRIB. (June 17, 2015, 9 a.m.), <https://www.texastribune.org/2015/06/17/denton-repeals-fracking-ban/>.

rendered moot and was dismissed.²⁵³

It is tempting to say that HB 40 resolved the question of whether or not Texas localities may ban or unreasonably burden fracking operations.²⁵⁴ Under HB 40, with some very narrow exceptions for municipalities, such efforts appear pre-empted by statewide regulation of drilling permits by the Texas Railroad Commission.²⁵⁵

However, the statute leaves many questions unanswered.²⁵⁶ Did the Legislature intend HB 40 to strip local governments and other political subdivisions of all ability to regulate hydraulic fracturing within their borders? For example, what about Groundwater Conservation Districts? Do they have no ability to control water withdrawals for hydraulic fracturing in drought-prone areas?²⁵⁷ One commentator implied that HB 40 merely took the pre-emption debate to the next level.²⁵⁸

VI. THE FUTURE?

It seems as though the wave of new regulations governing hydraulic fracturing has abated over the past couple of years. At the state level, this abatement has occurred in part because most oil producing states have passed statutes or new regulations governing hydraulic fracturing and the need for additional regulations has not seemed pressing. The election of Donald Trump as president in 2016 and his administration's emphasis on easing regulatory burdens explains the lightening of regulations at the federal level.

In Texas, the economic boost to the state's economy provided by shale development plus the Legislature's confidence in the ability of the Texas Railroad Commission and the Texas Commission on Environmental Quality to oversee regulation of oil and gas activities consistent with environmental protections is, for now, keeping the Legislature's focus away from new fracking regulations. But the Legislature is meeting again this year. Anti-fracking activism in Texas remains a potent force.²⁵⁹ Only time will tell whether activism will move the needle of public opinion to support bans or other forms of more extreme fracking regulation in Texas and elsewhere. 🏠

253 Jim Malewitz, *Texas Drops Suit over Dead Denton Fracking Ban*, TEX. TRIB. (Sept. 18, 2015, 11 a.m.), <https://www.texastribune.org/2015/09/18/texas-drops-suit-over-dead-denton-fracking-ban/>.

254 HYDRAULIC FRACTURING L&P, *supra* note 22, § 24.02[9].

255 *Id.*

256 See Stephen Elkind, Note, *Preemption and Home-Rule: The Power of Local Governments to Ban or Burden Hydraulic Fracturing*, 11 TEX. J. OIL GAS & ENERGY L. 415, 416 (2016).

257 HYDRAULIC FRACTURING L&P, *supra* note 22, at § 24.02[9], referring to discussions in §24.01 and §24.02[5].

258 See Elkind, *supra* note 255.

259 See, e.g., the website of anti-fracking activist Sharon Wilson, TXSHARON'S BLUE DAZE, <http://www.texassharon.com> (last visited Aug. 9, 2018).



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