A Brief Look at the Law of Hydraulic Fracturing in Texas and Beyond

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I. Introduction

Hydraulic fracturing is controversial—even the name evokes controversy. Opponents of hydraulic fracturing often call and spell it "fraking," perhaps relishing the similarity to another, less polite word. Proponents of the process often refer to is 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).[2]

But regardless of how it is spelled, 51% of the American public opposes hydraulic fracturing, according to a March 2016 Gallup Poll.[3] 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.[4] Opponents of fracking say that fracking pollutes water;[5] causes low birth rates in babies;[6] causes earthquakes;[7] and abets climate change.[8] Opponents of fracking also assert that fracking regulation is absent or wholly ineffective.[9] According to its opponents, fracking

[1] The authors wish to thank Nikki Hafizi, 2018 South Texas College of Law Houston graduate and newly arrived Associate with the law firm of Gray Reed & McGraw, LLP for her capable editorial assistance in preparing this paper. Thanks are due also to Sherry Colburn, administrative assistant with the law firm of Gray Reed & McGraw, LLP for her patience and persistence in helping the authors get to the final draft.

[2] *Fracking,* Webster's New World College Dictionary (5th ed. 2018).

[3] Art Swift, *Opposition to Fracking Mounts in the U.S.*, GALLUP (Mar. 30, 2016), https://news.gallup.com/poll/190355/opposition-fracking-mounts.aspx.

[4] Charles Sartain, Partner, Gray Reed & McGraw LLP, Presentation at the Dallas Bar Association 33rd Annual Review of Oil and Gas Law: Facts and Fantasy in the Fracing Debate (Aug. 3, 2018).

[5] 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., Mar. 2018). Discussion of water pollution allegedly caused by fracking begins on p. 48.

[6] Darryl Fears, *Fracking Sites May Raise the Risk of Underweight Babies, New Study Says,* WASH. POST (December 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 (Dec. 2017), http://advances.sciencemag.org/content/3/12/e1603021.full).

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

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

[9] Nobel, *supra* note 5.

should be banned in the United States[10], as it is already in a handful of US states plus France[11], Bulgaria[12], and other foreign countries.[13]

Such accusations about fracking are all debatable[14], particularly the last one, that fracking regulation is absent or wholly ineffective. A substantial body of law has evolved in the United States over the past ten 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.[15]

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 towards 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

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

[11] 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.

[12] 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.

[13] *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.

[14] 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 (Apr. 2017), http://eidhealth.org/wp-content/uploads/2017/04/Positive-Health-Compendium.pdf (last accessed Aug. 6, 2018).

[15] Fracking is currently banned in Vermont (2012), New York (2015), and Maryland (2017); nearby Massachusetts enacted a ten-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 PM), https://www.reuters.com/article/us-energy-fracking-newyork/new-york-bans-fracking-after-health-report-idUSKBN0JV29Z20141217?irpc=932; Jon Hurdle, *With Governor's Signature, Maryland Becomes Third State to Ban Fracking*, STATEIMPACT PA. (Apr. 4, 2017, 9:35 PM), 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.

civilization.[16] Extreme opponents of fracking believe it is an assault on the planet and that sabotage, or worse, is justified if necessary to stop the practice.[17] 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 towards 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.[18] 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, in 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 demand[19]), and the downward spiral of the world economy anticipated 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.[20]

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 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

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[16] *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).

[17] 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.

[18] *See*, *e.g.*, ALEXANDER J. EPSTEIN, THE MORAL CASE FOR FOSSIL FUELS (2014).

[19] 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).

[20] "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-8ad5-00144feabdc0.
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 PM), https://stateimpact.npr.org/pennsylvania/2013/10/03/robert-f-kennedy-jr-calls-natural-gas-a-catastrophe/.

helpful and can lead to dissemination of misinformation, chilling of rational discourse, and polarization of opinion.

This paper is a "brief" look at the Law of Hydraulic Fracturing in Texas and beyond. In preparing this paper, the authors[21] have relied heavily upon a more comprehensive treatment of the subject found in *Hydraulic Fracturing Law and Practice*.[22] It was the privilege of both authors to be contributors 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 than they to be writing about the topic, greatly increased their understanding of the subject.

II. What is "the Law of Hydraulic Fracturing?"

Hydraulic fracturing is not a new process, though the combination of hydraulic fracking and horizontal drilling is a relatively recent development.[23] 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 paper.

Trying to define "the law of hydraulic fracturing" has been likened to defining "the law of mobile telephones."[24] In both instances, the laws are heavily intertwined with other areas of law. For example, hydraulic fracturing law can touch upon oil and gas, environmental, nuisance, trespass, employment, transportation, and procedural law, among a multitude of other areas of state and federal law and regulations.

Another problem with trying to define or compartmentalize hydraulic fracturing law is that it is so intertwined with laws and regulations governing conventional oil and gas extraction. Oil and gas rules and regulations applicable to conventional oil and gas operations are not suspended when a well is fracked. For this reason, the majority of oil-producing states have not put in place exhaustive new regulatory regimes addressing hydraulic fracturing because they believe their existing oil and gas regulatory regimes adequately deal with most concerns regarding the fracking process. A minority of oil-producing states have taken a more aggressive and comprehensive approach. Differing state approaches to regulation of hydraulic fracking are discussed in Part VII.

Its broad range of subject matter and the diverse regulatory regimes among the states make the "law of hydraulic fracturing" difficult to define and even more difficult to compartmentalize. But

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[21] In interests of full transparency, both of 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 paper 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 infra* Part IV for a short history of hydraulic fracturing.

[24] Attributed to Dave Neslin, Of Counsel, Davis Graham & Stubbs LLP, Presentation at the South Texas College of Law Houston 30th Annual Energy Law Institute for Lawyers and Landmen (Aug. 2017). Neslin is one of the co-authors of HYDRAULIC FRACTURING LAW AND PRACTICE (2017).

here is an attempt—the "law of hydraulic fracturing" is that body of law addressing the industrial process known as hydraulic fracturing through statutes, regulations, and case law. The law of hydraulic fracturing includes seven distinct but non-exclusive areas: 1) fracking fluid chemical disclosures; 2) wellbore integrity requirements; 3) air and water pollution prevention; 4) nuisance; 5) notices; 6) induced seismicity; and 7) local government preemption.

Hydraulic fracturing law has developed primarily at the state, not the federal, level.[25] The reasons for this are threefold. First, as Justice Brandeis observed, the states have always been the laboratories of the nation.[26] States are more nimble and more responsive to local circumstances, which is important in regulating oil and gas activities.

Second, although a Bureau of Land Management (BLM) permit is required in addition to state permits when drilling is undertaken on federal lands, onshore hydraulic fracturing has taken place more on private or state lands than on federal lands.[27] In the offshore realm, hydraulic fracturing is relatively rare—it has been estimated that less than 15% of wells drilled in the Gulf of Mexico have been fracked.[28] Geology in the Gulf of Mexico is such that fracking is less likely to aid in production enhancement.

Third, since state regulations also apply to oil and gas well drilling on BLM lands, federal fracking regulation is arguably redundant. This is part of the reason why the Trump Administration rescinded the Obama Administration's BLM fracking rule.[29]

Hydraulic fracturing law also includes case law. The body of hydraulic fracturing case law in the US 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

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[25] *See* Grace Heusner, Allison Sloto & Joshua Ulan Galperin, *Defining and Closing the Hydraulic Fracturing Governance Gap*, 95 DENV. L. REV. 191 (2017).

[26] *New State Ice Co. v. Liebmann*, 285 U.S. 262, 311 (1932) (Brandeis, J., dissenting))"It is one of the happy incidents of the federal system that a single courageous State may, if its citizens choose, serve as a laboratory; and try novel social and economic experiments without risk to the rest of the country.").

[27] Although this was partly due to the greater regulatory scrutiny of fracking on Bureau of Land Management lands than private lands, especially during the years of the Obama Administration, the primary reason is that federally owned minerals administered by the BLM are found primarily in the Rocky Mountain States. *See Administrative Boundaries Map, Public Lands Managed by the Bureau of Land Management*, U.S. BUREAU OF LAND MGMT., https://www.blm.gov/maps/frequently-requested (last accessed Aug. 7, 2018). Texas, which currently accounts for one-third of US crude oil production and one-fifth of US energy production and has led the nation in drilling permits for at least the past decade, has virtually no federally owned minerals (except in and around national parks, forests, military bases and a few other federally acquired properties). *See State Energy Profile: Texas Analysis*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/state/analysis.php?sid=TX#1.

[28] HYDRAULIC FRACTURING L&P, *supra* note 22, § 4.02[1]. In this section of the treatise, Philip B. Jordan provides an overview of the differences between onshore and offshore hydraulic fracturing while discussing federal legislation and regulation.

[29] *See infra* Part IX.3, Case Law Developments: Rulemaking Challenges and Miscellaneous.

can be difficult and class certifications are problematic due to lack of commonality. Some of the major case law developments pertaining to hydraulic fracturing are discussed in Part IX.

III. What is Hydraulic Fracturing?[30]

The first step to a better understanding of the law of hydraulic fracturing is to understand the industrial process of hydraulic fracking. The American public, fueled by negative media coverage and anti-fracking activism, has many misperceptions about fracking.

To start with, the following is the regulatory definition of hydraulic fracturing:

> 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.[31]

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 fracking is the relative newcomer, having begun in the 1940s.[32]

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 one to two 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 one to three 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 three-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

[30] The authors borrow 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 Petroleum Engineering Department and Director of the Unconventional Natural Gas and Oil Institute at the Colorado School of Mines.
[31] 16 Tex. Admin. Code § 3.13(a)(2)(J)(2018).
[32] A short history of fracking and horizontal drilling is included *infra* Part IV.

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 materials[33]) which serve to "prop open" the cracks in the shale formation to facilitate flow of oil and gas. Chemical additives[34] 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 "mini-fracks" 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 multi-well 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 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, multi-well 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. Multi-well 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 US oil patch.

[33] 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).

[34] For more on chemical additives, see *infra*, Part VI.1, Hydraulic Fracturing Risks—1. Water Quality.

2. Fracking—Sand and Water Usage

Each stage of a fracking operation requires several hundred thousand pounds of proppant, (most often sand).[35] A typical 20-25 stage fracking operation would use around six million to seven-and-a-half million pounds of sand, which equals the weight of about 35,000 average American men.[36] Fifty-stage fracking would use even more sand. Some of the largest fracked wells have reportedly used 50 million pounds of sand.[37] The US oil and gas industry in 2014 was estimated to have used 95 billion pounds of sand in fracking operations, roughly equivalent in mass to downtown Chicago.[38]

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 US 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,[39] or 4 to 6 million gallons of water for a 20-25 stage frack job.[40] That would be enough water to fill six to twelve Olympic-sized swimming pools.[41] Water usage for fracking, however, has been on the upswing, with some wells reportedly using 25 million gallons of water, or more. [42]

To get all the sand and water to the wellsite requires transportation. In most frack sites in Texas, sand and water is trucked in. A typical frack job in the South Texas Eagle Ford shale area requires about 1700 truck trips per fracked well.[43] To put this in perspective, that would be the equivalent of 17 miles of semi-trailer trucks if lined up—for a single well. With 80 to 90 rigs running in the South Texas Eagle Ford area (March 2018[44]), 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

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[35] 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 non-profit brain trust composed of the Texas-based members of the National Academies of Sciences, Engineering and Medicine, and the state's Nobel Laureates.

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

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

[38] SERNOVITZ, *supra* note 21, at 78.

[39] TAMEST, *supra* note 38.

[40] *Id.*

[41] SERNOVITZ, *supra* note 21, at 78.

[42] Blum, *supra* note 40.

[43] TAMEST, *supra* note 38.

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

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.[45]

3. Fracking Water Disposal and Earthquakes

Far more formation wastewater is generated from producing wells than oil. The Texas Railroad Commission estimates that ten 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.[46] Nationwide, the average ranges from seven to ten barrels of water for each barrel of oil.[47] This is why an industry observer quipped, "oil companies are in the produced water business, not the oil business."[48]

The high salinity of produced waters in many parts of the US, and especially in Texas, limits the economic viability of treatment options.[49] 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.[50] But in Texas and elsewhere, most produced water is re-injected into the ground either for secondary recovery purposes or in salt-water disposal wells to keep it away from surface water and water aquifers.[51] There are about 100,000 injection wells drilled in the United States used for secondary recovery purposes.[52] There are another 30,000 wells used for wastewater disposal purposes.[53]

Most of the water used in fracking operations is not recycled and flows back to the surface along with produced water.[54] However, the bulk of the water injected into most oil and gas disposal wells is naturally occurring produced water, not frack fluid flowback.[55] 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.[56] "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

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[45] 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).

[46] 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).

[47] 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).

[48] 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).

[49] TAMEST, *supra* note 38, at 126.

[50] Jackie Benton, Recycling Fracking Water, FISCAL NOTES NEWSLETTER (Tex. Comptroller of Public Accounts), Oct. 2015, https://comptroller.texas.gov/economy/fiscal-notes/2015/october/fracking.php.

[51] Hall, *supra* note 50.

[52] *Id.* at 5-22.

[53] *Id.*

[54] *Id.*

[55] *Id.* at 5-27.

[56] *Id.* at 5-28.

a small fraction of frack water injected ultimately returns to the surface…."[57] In Oklahoma, frack water accounts for less than 10% of the water sent to injection wells.[58]

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.[59] 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 secondary recovery or wastewater disposal purposes can cause seismic activity severe enough to be felt at the surface.[60] This appears to be especially true in Oklahoma, where doubling salt-water 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.[61]

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 ten 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 US are a direct result of increased fracking activities—is debatable.[62] As referenced earlier, there are over 130,000 injection wells operating in the US. Most of these wells, especially the 100,000 injection wells being used to enhance secondary recovery, have little or nothing to do with fracking.[63] 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

[57] TAMEST, *supra* note 38, at 125.
[58] Hall, *supra* note 50, at 5-29.
[59] *Id.* at 5-37.
[60] Powell, *supra* note 49, at 1002.
[61] *Id.*
[62] Hall, *supra* note 50, at 5-28.
[63] *Id.* at 5-22.

fracking is complex. Conclusions drawn can be driven as much by political persuasion as they are by data and logical analysis.

IV. Fracking: A Brief History[64]

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, with the first hydraulically fracked well in Texas following shortly thereafter.[65]

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.[66] Non-explosive fracturing using acid stimulations was introduced in the 1930s.[67]

Horizontal drilling separate and apart from hydraulic fracturing is likewise not new. The first horizontal well was drilled near Texon, in West Texas, in 1929. 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 fracking techniques to develop the Barnett Shale gas field in North Texas. The founder and CEO of Mitchell Energy was long-time 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 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 multi-stage 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 George Mitchell sold the company to Devon Energy in 2001 for $3.1 billion, making himself a billionaire in the process.[68]

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[64] Part IV is sourced primarily from GREGORY ZUCKERMAN, THE FRACKERS: THE OUTRAGEOUS INSIDE STORY OF THE NEW BILLIONAIRE WILDCATTERS 17-111 (2013).

[65] HYDRAULIC FRACTURING L&P, *supra* note 22, § 24.01.

[66] 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/bitstream/111111111/30129/1/an%20overview%20of%20hydraulic%20fracturing%20and%20other%20stimulation%20technologies%20%282%29.pdf.

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

[68] In 2008, *Forbes* magazine estimated his net worth as $3.2 billion, placing him among the 500 richest people worldwide. *In Pictures: America's Energy Billionaires*, FORBES (Oct. 7, 2008, 3:30 pm), https://www.forbes.com/2008/10/07/energy-billionaires-biz-energy-cx_af_1007energybillies_slide.html.

George 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.[69] Aubrey McClendon (1959-2016), co-founder of Chesapeake Energy, helped spread fracking across the US through his company's aggressive oil and gas leasing and drilling, and his monumental personal energy, drive and charisma.[70]

But George Mitchell, who died in 2013, perhaps more than any other single individual, was responsible for the "Shale Revolution."[71] The technology Mitchell's company introduced became a template for shale plays across the state and the nation.[72] It is possible that historians will look upon George Mitchell as one of the pivotal individuals of his times, one whose impact on the world has been so game changing that he can be compared to other famous contemporaries such as Steven 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.

V. 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 & jobs; 3) more competitive US 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 US 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, [73] shale gas development has enabled the United States to continue leading the rest of the world as the largest producer of natural gas, having surpassed Russia in 2009.[74] Growth in US oil production has been even more stunning. As of July 2018, the United States is producing almost 11 million barrels of oil

[69] SERNOVITZ, *supra* note 21, at 46.
[70] *Id.* at 36-39; 42, 46.
[71] *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.
[72] TAMEST, *supra* note 38, at 30.
[73] *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/.
[74] *The U.S. Surpassed Russia as World's Leading Producer of Dry Natural Gas in 2009 and 2010*, U.S. ENERGY INFO. ADMIN. (Mar. 13, 2012), https://www.eia.gov/todayinenergy/detail.php?id=5370.

a day, up from 5 million barrels a day a decade ago.[75] That is the highest level of oil production seen in the US in over 50 years. This has caused the United States to surpass Saudi Arabia as the world's second largest producer of oil worldwide,[76] and the US is predicted to overtake Russia as the world's largest oil producer in 2018 or 2019 at latest.[77] In 2017, approximately 50% of US oil and gas production and 60% of US natural gas production was from unconventional development—that is, obtained from shale resources through hydraulic fracturing techniques.[78]

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,[79] up from slightly over 1 million barrels of oil a day in 2007, a 75% increase.[80] This upsurge in production has ended an almost 30-year statewide production decline. Texas now produces more than a 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.[81]

At year-end 2017, the US was still importing oil. Oil imports are a complicated subject because US refinery capacity has historically been weighted more towards heavier crudes imported from overseas. The US has historically exported crude for similar reasons—lack of capacity to refine domestic crudes, compounded by a "not in my back yard" attitude towards 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 US Energy Information Service began tracking the number in 1973.[82] If shale development continues on its present scale, and assuming/and if US 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.[83]

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[75] 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.

[76] *Id.*

[77] Osamu Tsukimori, *U.S. to Overtake Russia as Top Oil Producer by 2019 at Latest: IEA*, REUTERS (Feb. 26, 2018, 10:19 PM), https://www.reuters.com/article/us-energy-iea/u-s-to-overtake-russia-as-top-oil-producer-by-2019-at-latest-iea-idUSKCN1GB0C6.

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

[79] Sheela Tobben, *Texas Oil Production Climbs to All-Time High*, BLOOMBERG: MARKETS (Apr. 30, 2018, 1:44 PM) https://www.bloomberg.com/news/articles/2018-04-30/texas-oil-production-climbs-to-all-time-high-amid-strong-prices.

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

[81] HYDRAULIC FRACTURING L&P, *supra* note 22, § 24.01.

[82] Robert Rapier, *U.S. Net Petroleum Imports Plunging Toward Zero*, FORBES (Mar. 21, 2018, 9:00 AM), https://www.forbes.com/sites/rrapier/2018/03/21/u-s-net-petroleum-imports-plunging-toward-zero/#311d5dd927ba.

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

2. Economic Growth and Jobs

One commentator has 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 have created $1.8 to $2 trillion in additional wealth for the United States between the years 2000 and 2016. [84] Texas has benefited economically from the shale revolution more than any other state due to its high percentage of US 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.[85] 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% of the state's population was employed in the oil and gas industry and about 30% of the state's economy was tied to oil and gas.[86]

Not all of these 3.8 million jobs are in frack crews. Refinery, petrochemical, and pipeline workers and service industries (including 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,[87] making up approximately 23% of the US total of 850,000 exploration and production related jobs.[88] 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 ten years has stimulated all sectors of the oil and gas industry, not just upstream exploration and production. [89]

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 US.[90] About 11 billion dollars in Texas state tax revenues were attributed to shale resource development in 2017.[91]

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[84] SERNOVITZ, *supra* note 21, at 46.
[85] TAMEST, *supra* note 38, at 30.
[86] 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 Dollars. https://www.statista.com/statistics/188132/gdp-of-the-us-federal-state-of-texas-since-1997/
[87] TAMEST, *supra* note 38, at 30.
[88] SERNOVITZ, *supra* note 21, at 206.
[89] 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.
[90] TAMEST, *supra* note 38, at 31.
[91] Katherine Blunt, *Texas Mineral Taxes and Royalties Increased in 2017*, HOUS. CHRON. (Mar. 29, 2018, 8:02 AM), https://www.chron.com/business/energy/article/Texas-mineral-taxes-and-royalties-increased-in-12710678.php.

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% to 50% less than those in other major exporting nations.[92] 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 US is leading the world in reducing CO_2 emissions—due largely to shale gas.[93] This is because natural gas fired electric generating plants emit on average 50% less CO_2 than coal fired plants.[94] As a result, 17% less coal was burned in the US in 2014 than it was ten years earlier.[95] As one commentator has pointed out, CO_2 emissions reductions in the United States between 2007 and 2012 equaled an entire year of CO_2 emissions from Germany, the sixth largest CO_2 emitter in the world.[96]

This is one reason that US air quality has been steadily improving over the past ten years[97], which is a fact almost ignored in national media reports on hydraulic fracturing.[98] 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." [99]

Opponents of fracking will not readily concede that fracking is a net benefit in greenhouse gas reduction. It is has been asserted that wellhead, pipeline or gas plant leakage of methane cancels out the net benefit of CO_2 reductions. [100] This, however, is a subject of much debate,[101] discussed in Part VI.3.

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[92] *See* SERNOVITZ, *supra* note 21, at 1-15.
[93] *Id.* at 78.
[94] HYDRAULIC FRACTURING L&P, *supra* note 22, § 1.04[3].
[95] SERNOVITZ, *supra* note 21, at 171.
[96] *Id.* at 7, 171-72.
[97] U.S. ENVTL. PROTECTION AGENCY, 2014 NAT'L EMISSIONS INVENTORY REPORT (VERSION 2), TRENDS (Feb. 2018), https://gispub.epa.gov/neireport/2014/.
[98] SERNOVITZ, *supra* note 21, at 171-181; *see also* EPSTEIN, *supra* note 18, at 151-54.
[99] SERNOVITZ, *supra* note 21, at 193.
[100] *Id.* at 174-77 (citing conclusion in a 2011 Cornell University study).
[101] *Id.* (citing a 2013 University of Texas study rebutting the Cornell conclusions).

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 has estimated that the shale gas boom has caused natural gas prices, alone, to decrease by 47% between 2007 and 2013 which generated total consumer benefits of about $74 billion annually.[102]

It is impossible to say what today's natural gas and gasoline prices might have been had fracking never come along. Odds are, however, that they would be higher.[103] 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.[104]

6. Reduced Surface Impacts

As explained in Part III.1, horizontal drilling and fracking techniques allow for much smaller surface foot prints 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 share 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.[105]

Besides reduced space for wells, multi-pad drilling reduces the need for additional gathering lines, tank batteries, roads, pipelines, compressor stations, and other facilities as compared to 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 has also led to dramatic reductions in the US rig count and per well productivity compared to ten years ago. [106] The reduction in rig count offsets in part the increases in road traffic brought about by fracking, since fewer drilling rigs must be mobilized.

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[102] HYDRAULIC FRACTURING L&P, *supra* note 22, § 1.04[2].
[103] Sernovitz, an oil and gas investor and businessman, states that "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.
[104] HYDRAULIC FRACTURING L&P, *supra* note 22, § 1.04[2].
[105] TAMEST, *supra* note 38, at 78.
[106] SERNOVITZ, *supra* note 21, at 113. Well productivity per horizontally fracked completion is anywhere from 400% to 2000% more than conventional wells depending on the US region. HYDRAULIC FRACTURING L&P, *supra* note 22, § 1.04[4].

VI. 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 has historically has been fomented by singular incidents. The 1969 Cuyahoga River fire in Cleveland, Ohio 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 a 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.[107] The most 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 not caused not by fracking, but by biogenic methane that had been leaking into water supplies in the area of Colorado where the incident was filmed for decades. [108]

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 US states. Even where fracking was not banned, citizens demanded greater regulation, especially for disclosure of chemicals being injected down wells during the fracturing process.[109]

However, much of the concern raised by Josh 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."[110] Professor Tutuncu in *Hydraulic Fracturing Law and Practice* 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."[111]

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[107] SERNOVITZ, *supra* note 21, at 66-88.
[108] *Id.* at 69.
[109] 3 ERNEST E. SMITH & JACQUELINE LANG WEAVER, TEXAS LAW OF OIL AND GAS § 14.11(A) (2d ed. 2015).
[110] TAMEST, *supra* note 38, at 113.
[111] HYDRAULIC FRACTURING L&P, *supra* note 22, § 2.06[1][a].

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. [112] 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 fresh water aquifers from leaks in casing or oil spills, it should be remembered that 98-99% of frack fluids are sand and water. The remaining 1-2% 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 .05% of frack fluids comprising non-acid 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 anti-freeze 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 anti-freeze. However, because frack fluid contains roughly 180 times more water than chemicals, whatever toxic chemicals there might be are diluted. [113] This brings to mind the instance of a Haliburton executive drinking a glass of frack fluid at an industry conference in 2011.[114]

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.[115] 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.[116]

For example, benzene and naphthalene are known or possible carcinogens and are present in 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,

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[112] SERNOVITZ, *supra* note 21, at 79-81.
[113] *Id.* at 79.
[114] *Id.* at. 77-78.
[115] 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 VIII.1 below.
[116] HYDRAULIC FRACTURING L&P, *supra* note 22, § 1.05[3].

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 great[117] 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."[118] 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."[119]

But what is the actual risk that the 1-2% 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.[120] Furthermore, most incidents occurred prior to 1969, before the Texas Railroad Commission had revised its regulations on well casings and cementing.[121]

The federal Environmental Protection Agency (EPA) came to a similar conclusion in 2016. After conducting a multi-year 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.[122] A prior version of the same report said that hydraulic fracking had not caused "widespread, systemic" impacts on drinking water. That sentence, however, was removed in the final EPA report at the behest

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[117] See *infra* Part III 2. Four to six million gallons per well is typical, but twenty-five million gallons per well is not unheard of.

[118] TAMEST, *supra* note 38, at 122.

[119] *Id.* at 123.

[120] *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 (Aug. 2011), http://fracfocus.org/sites/default/files/publications/state_oil__gas_agency_groundwater_investigations_optimized.pdf .)

[121] 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 VII.

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

of the agency's Science Advisory Board—raising suspicions once again that politics and fracking walk hand in hand.[123]

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 US 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 Production determined there were 256 cases of water well contamination due to oil and gas drilling in the period from 2008 to first quarter of 2015, a period in which over 21,000 oil and gas wells were drilled in the state.[124] 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. [125] The Colorado Oil and Gas Commission reported that oil spills in Colorado were only 0.003% of the state's total oil production in 2014. [126]

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.[127] 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, Michigan serves as a recent reminder.[128]

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[123] *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.
[124] SERNOVITZ, *supra* note 21, at 98.
[125] *Id.*
[126] *Id.*
[127] HYDRAULIC FRACTURING L&P, *supra* note 22, § 24.01.
[128] 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 (Apr. 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.

Though accidents can happen, oil companies spend a lot of money and effort in 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.

2. Water Usage

It has been said that, "Whiskey is for drinking, but water is for fighting.[129]" Water usage in Texas, where half the state is desert or semi-arid, is always a concern. Despite recent hurricanes, periodic droughts continue to plague the state.

According to the TAMEST report, less than 1% of total water usage in Texas is devoted to hydraulic fracking, though in some regions and locales, the percentage can be much higher.[130] There has been much recent publicity, for example, about Apache Corporation'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.[131]

The topic of water usage conflicts in Texas forms a subject in itself.[132] However, use of water for fracking purposes should not be viewed in isolation:

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[129] Attributed to Mark Twain, though not by all researchers. https://quoteinvestigator.com/2013/06/03/whiskey-water/

[130] TAMEST, *supra* note 38, at 116.

[131] *See*, *e.g.*: David Hunn, *Scrutiny of Drilling Near West Texas Balmorhea Springs Intensifies*, HOUS. CHRON. (Oct. 24, 2016, 9:15 AM), 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 AM), https://www.texasobserver.org/balmorhea-fracking-endangered/.

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

- 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.[133] Natural gas fired electricity generating plants use 4 times less water than does a coal-fired plant.[134]
- In 2015, 34% of freshwater usage in the US was for cooling in power generation.[135] Freshwater usage for cooling power plants is now on the decline, thanks to fracking, and the displacement of coal by natural gas.[136]
- Biofuels are a much talked about and government supported form of alternative energy. But biofuels need water to grow corn for ethanol, 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 freshwater 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.[137] Regardless, the amount of water used for fracking is relatively small when compared to 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.[138]

So given all this, is using 1% of Texas's water resources for hydraulic fracturing inordinate, particularly when the positive economic impact on the state is considered? Whether or not devoting 1% 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. The TAMEST report make the point that production of shale resources results in emissions of greenhouse gases, photochemical air pollutants, and air toxins.[139] However, the real question when it comes to air emissions and global warming is how emissions impacts from shale gas development compare to coal, the most commonly used fuel for power generation in the world?

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[133] *Id.*, § 3.03[2][b].
[134] *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.
[135] *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.
[136] *Id.*
[137] TAMEST, *supra* note 38, at 117-18.
[138] SERNOVITZ, *supra* note 21, at 78.
[139] TAMEST, *supra* note 38, at 90.

As discussed in Part V, natural gas emits 50% less CO_2 less than coal.[140] However, methane leakage from wellheads, pipelines, and compressors can also cause air pollution. According to the EPA, methane emissions account for 1/10th of all US greenhouse emissions.[141] 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.[142]

Cornell reached this conclusion by estimating that between 3.6 to 7.9% of all produced natural gas is leaked into the atmosphere during the extraction and transportation process. [143] Since methane, the primary component of natural gas, is eighty times more potent a greenhouse gas than is CO_2,[144] Cornell concluded that the benefits derived from reduced CO_2 emissions from fracking are offset when compared to coal by a factor of somewhere between 20% to 50% over a twenty year horizon.[145]

Scientists at the University of Texas subsequently challenged the conclusions of the Cornell scientists.[146] The UT scientists agreed with an earlier EPA estimate that methane leakage from all US natural gas and petroleum systems was only around 1.5%.[147] 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. [148]

TAMEST says 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% for transportation or 3% for electricity generation.[149] A more recent national study puts the combined threshold at 4%.[150] Swinging the other way, the World Resources Institute claims that even a 1% methane leakage rate is too high for natural gas to have a net benefit over coal.[151] Contrary to that report, the *New York Times* cited Richard Miller, a Berkeley physicist and leading climate change scientist, as having concluded that it would be acceptable (but not good) to assume a 10% methane leakage rate in order for natural gas to have a net benefit over coal. [152]

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

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[140] 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).
[141] SERNOVITZ, *supra* note 21, at 175.
[142] *Id.* at 175-76.
[143] *Id.* at 176.
[144] 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 38, at 93-94.
[145] SERNOVITZ, *supra note 21*, at 176.
[146] *Id.* at 176-177.
[147] *Id.* at 176.
[148] *Id.* at 177.
[149] TAMEST, *supra* note 38, at 94.
[150] John Schwartz & Brad Plumer, *The Natural Gas Industry Has a Leak Problem*, N.Y. TIMES (June 21, 2018).
[151] SERNOVITZ, *supra* note 21, at 177.
[152] *Id.*

assessments of direct and indirect impacts on air quality from production from shale resources are complex (which is rather obvious).[153] However, TAMEST cited "observational studies" that would place most methane emissions from natural gas sources in Texas in the 0.5% to 1.5% range, and nationally from 0.5% to 5% or more.[154]

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.[155] 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 suggests, isolating the impact of shale resource development on air quality from the impact of other sources is very complex and very difficult.[156] There are other sources of air pollution from fracking besides CO_2 or methane leaks. Recall the 1700 trucks per frack job referenced in Part III. Each truck trip has associated air pollution leading to increased amounts of ozone, volatile organic compounds (VOCs), sulphur dioxides and nitrogen oxides (NOx) being leaked into the atmosphere.[157] Air pollutants are also released from natural gas compressor stations and processing plants.[158]

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 planet.[159] By one estimate, 16% of worldwide methane emissions are caused by cow flatulence, burping, and manure deposits, notwithstanding contributions from other agriculturally related sources (e.g., pigs).[160] The US 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.[161] Buildings, landfills, and the coal industry are other sources of methane emissions.[162]

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.[163] Essentially, "green completion" technology involves containing the loss of methane and other hydrocarbons during flowback,[164] or controlling flaring to convert methane into carbon dioxide and water.[165]

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153 TAMEST, *supra* note 38, at 112.
154 *Id.* at 94.
155 HYDRAULIC FRACTURING L&P, *supra* note 22, § 1.05[2].
156 TAMEST, *supra* note 38, at 101.
157 *Id.* at. 99, 101.
158 *Id.* at 91.
159 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.
160 *Id.*
161 *Overview of Greenhouse Gases: Methane Emissions*, U.S. ENVTL. PROTECTION AGENCY, https://www.epa.gov/ghgemissions/overview-greenhouse-gases#methane.
162 *Id.*
163 MARK S. GURALNICK, FRACKING: LAW AND POLICY § 20.01[D] (2016).
164 *Id.*, § 20.01[D][1].
165 SERNOVITZ, *supra* note 21, at 178.

Corporate self-interest has 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.[166]

In addition, EPA data shows that methane released in the United States has been declining since at least 1990. There was a 10% decline in methane releases between 2003 and 2013, which is 23% more than the decline rate of CO_2. During the same period, US gas production rose 32%, and this was even before the EPA's new green completion rules went into effect.[167]

But the record of accomplishment of the United States in reducing methane and CO_2 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."[168] China's CO_2 emissions have grown 3.5 times since 1993 while US CO_2 emissions have declined by 4%, making China responsible (in 2015) for 29% of the world's total CO_2 emissions as compared to 15% for the US (in 2015). [169] The proponents of fracking argue that if shale gas can displace the burning of coal in developing countries through exports of LNG from the US and other places, growth in CO_2 emissions world-wide have a shot, at least, at being reduced or at least slowed, giving renewal energy more time to expand and ultimately 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 CO_2 emissions), or potentially disastrous for the planet because of the generation of sizable volumes of atmospheric methane?[170] Proponents of fracking argue that concerns about methane emissions are overblown. Though methane is unquestionably a more potent greenhouse gas than CO_2, it dissipates in about a dozen years versus CO_2 which stays around for thousands.[171] Furthermore, there is no consensus on the threshold at which methane leakage offsets CO_2 reductions. As pointed out earlier, estimates of the "threshold" leakage range at which methane is worse for the environment than coal range from 1% to 10%.[172]

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 research[173] on the methane emissions "threshold" are unsettling given the gravity of the question.

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[166] *Id.*
[167] *Id.* at 177.
[168] *Id.* at 192.
[169] *Id.* at 190.
[170] GURALNICK, *supra* note 167, § 6.19.
[171] SERNOVITZ, *supra* note 21, at 177.
[172] *Id.*
[173] TAMEST, *supra* note 38, at 112; *see also* GURALNICK, *supra* note 167.

Furthermore, the success of the US 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.[174] 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."[175]

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 in Oklahoma history—occurred near Prague, Oklahoma, destroying at least sixteen homes.[176] One homeowner, Sandra Ladra, suffered a leg injury when her stone fireplace broke off onto her legs during the earthquake.[177] Though the Oklahoma Geologic Society concluded that the earthquake was likely attributable to natural causes,[178] other scientists disagreed[179] 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 greater earthquakes[180] in Oklahoma has been dramatic, rising from 2.2 annually in 2008 to 890 annually in 2015.[181] As discussed in Part III.3, 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.[182]

Texas has likewise been susceptible to earthquake activity, though not at so nearly high a rate as Oklahoma. The ratio of the number of magnitude 3.0 earthquakes between Oklahoma and Texas is approximately 60 to 1.[183] This is because, according to TAMEST, the majority of faults in Texas are stable and not prone to generating earthquakes.[184] Nevertheless, according to TAMEST, from

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[174] SERNOVITZ, *supra* note 21, at 177.
[175] Dave Neslin, HYDRAULIC FRACTURING L&P, *supra* note 22, § 1.04[3].
[176] SERNOVITZ, *supra* note 21, at 94.
[177] Powell, *supra* note 49, at 1002.
[178] Hall, *supra* note 50 at 5-25.
[179] *Id.*
[180] 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 50, at 5-9.
[181] Powell, *supra* note 49.
[182] *Id.*
[183] TAMEST, *supra* note 38, at 16.
[184] *Id.* at 44.

1980 to 2007 there were an average of two magnitude 3.0 or more earthquakes in Texas per year.[185] From 2007 to 2017, the number increased to twelve magnitude 3.0 or greater earthquakes per year.[186]

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.[187] The National Research Council has 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."[188] 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.[189]

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% and gas production by 26%. Water production rose commensurately, at ten times the volume.[190] 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 III.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.[191]

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.[192] 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% of injection wells have <u>not</u> been associated with earthquakes that could be felt by citizens.[193]

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[185] *Id.*
[186] *Id.*
[187] Hall, *supra* note 50, at 5-23.
[188] HYDRAULIC FRACTURING L&P, *supra* note 22, § 1.05[4].
[189] Hall, *supra* note 50, at 5-23.
[190] SERNOVITZ, *supra* note 22, at 94.
[191] *See* HYDRAULIC FRACTURING L&P, *supra* note 22, § 1.05[4].
[192] Hall, *supra* note 50, 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."
[193] HYDRAULIC FRACTURING L&P, *supra* note 22, § 24.01.

The SMU study was consistent with other studies which have concluded that the great majority of injection activities in the US will not induce seismic activity.[194] This is because a very specific set of geologic conditions must be present in order for seismicity to be induced.[195] For this reason, of the approximately 30,000 injection wells in the US that are permitted for disposal of waste water generated by oil and gas activities, only a small fraction are suspected of having induced seismicity.[196] 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 US production.[197]

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.[198]

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 VIII.4. In addition, the Texas legislature in 2015 provided funding for installation of the TexNet seismic monitoring system to improve statewide seismic monitoring capability by increasing the number of seismic monitoring stations in Texas from 18 to 43.[199]

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.[200] In the 1960s, the U.S. military injected waste water into the Rocky Mountain Arsenal near Denver, allegedly causing earthquakes.[201]

So is the threat of earthquakes a reason to ban hydraulic fracking? If so, should hydro-electric powering dams be banned, or use of geothermal energy, for the same reason? Should all 130,000 injector wells in the US be banned in order to eliminate any risk that they may contribute to

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[194] Hall, *supra* note 50, at 5-16.
[195] *Id.* at 5-16–5-17.
[196] *Id.* at 5-22.
[197] *Frequently Asked Questions (Oil)*, U.S. ENERGY INFO. ADMIN. (Mar. 8, 2018), https://www.eia.gov/tools/faqs/faq.php?id=847&t=6; *Frequently Asked Questions (Natural Gas)*, U.S. ENERGY INFO. ADMIN. (Mar. 8, 2018), https://www.eia.gov/tools/faqs/faq.php?id=907&t=8.
[198] TAMEST, *supra* note 38, at 65.
[199] *Id.* at 61.
[200] Hall, *supra* note 50, at 5-13, 17.
[201] *Id.* at 5-13.

earthquakes, irrespective of the crippling effect that might have on US conventional oil production? Conversely, and regardless of the cause, given the relatively small number of earthquakes in Texas and Oklahoma over the past ten 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 proved causal relationship between earthquakes and fracking in the first place,[202] is a question for further study.

5. Land Resources

The reduced surface footprint that multi-well 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 fracking. 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 an implied easement is held by the mineral lessee 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.*[203]

Texas, unlike some other oil producing states, has no Surface Damages Act. Such Acts 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 back-door 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 VIII.5.[204]

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[202] Hall, *supra* note 50, at 5-17–5-19.

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

[204] HB 40, passed by the 84th Texas Legislature effective May 18, 2015, and codified in Texas Nat. Res. Code § 81.0523, preempts municipal and other local regulation of hydraulic fracturing except for certain limited exercises of municipal

Other losers are breeds of wildlife not protected by the Endangered Species Act, and their enthusiasts. Can the oil and gas industry co-exist with the Dunes Sage Brush Lizard and the Lesser Prairie Chicken? Some may flippantly say, "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 Sage Brush 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.[205]

6. Transportation

Earlier mention was made of the approximately 1700 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.[206] Developing a typical shale oil or gas well was estimated by TAMEST to be the rough equivalent of over 20 million passenger cars a year in resulting pavement impacts.[207]

TAMEST estimated the road impact in Texas caused by shale resource development to be $1.5- $2.5 billion dollars in damages a year.[208] In 2017, this was offset by $11 billion dollars in increased state tax revenues.[209]

But with the road impacts comes air pollution, noise, increased risks of oil spills and, sadly, traffic injuries and fatalities.[210] The quality of life in communities through which shale-related truck traffic must travel is prone to deteriorate.[211] 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.

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police powers in § 81.0523(c). Even then, the ordinances cannot be commercially unreasonable and cannot prohibit oil and gas operations which are conducted by a reasonably prudent operator. § 81.0523(c)(2) & (3).

[205] TAMEST, *supra* note 38, at 80.

[206] *Id.* at 132.

[207] *Id.* at 135.

[208] *Id.* at 145.

[209] Katherine Blunt, *Texas Mineral Taxes and Royalties Increased in 2017*, HOUS. CHRON. (Mar. 29, 2018, 8:02 AM), 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.

[210] TAMEST p. 140.

[211] *Id.* at 158.

Non-local 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.[212] 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 between high and low-wealth areas."[213]

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 Key Stone Pipeline and protests of Native American tribes in the Dakotas. 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.[214]

VII. State Regulation of Hydraulic Fracturing: One Size Does Not Fit All

Earlier the law of hydraulic fracturing was compartmentalized into seven areas, which at risk of redundancy, are repeated again (non-exclusive): 1) fracking fluid chemical disclosures; 2) wellbore integrity requirements; 3) air and water pollution; 4) nuisance; 5) notices; 6) induced seismicity; and 7) local government preemption.[215]

So how do US states approach regulation of fracking? One approach is to ban it completely, or place a moratorium on it, as has been done in Vermont (2012), New York (2015), Massachusetts (2016), and Maryland (2017).[216]

A second approach is to regulate it comprehensively—to the point of extinction. The best example of this is the Illinois Hydraulic Fracturing Regulatory Act,[217] also called the Illinois Frack Act, which was signed by Illinois Governor Pat Quinn in 2013. The Illinois Frack Act, which runs 40 pages

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[212] *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)).
[213] *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)).
[214] Dennis Sadowski, *Catholic Voices Raise Moral Concerns in Country's Fracking Debates*, CATHOLIC NEWS SERVICE (Dec. 11, 2013, 12:00 AM), 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.
[215] See *infra* Part II.
[216] See *infra* note 15.
[217] 225 Illiniois Comp. Stat. Ann § 732/1-1 *et seq.* (2013).

not counting its accompanying "Illinois Hydraulic Fracturing Tax Act,"[218] is easily the most extreme fracking statute in the United States.

Under the Illinois Frack Act, practically anyone has standing to object to fracking permits, with or without a nexus to the state. The Act includes highly detailed notices and public comment periods. Its accompanying Frack Tax Act[219] includes a special tax on fracked wells to offset road impacts, administration of the law, regulating, etc. Local government regulation is not only not preempted, it is required for approval of fracking permits.

The net result of the Illinois Frack Act of 2013 has been that as of the time of this paper being written in the summer of 2018, only one fracking permit has ever been applied for under the Act. That permit was later withdrawn when the operator, Woolsey Petroleum, decided it could not live with the conditions of the permit.[220] Thus, the Illinois Frack Act has effectively halted fracking in Illinois, home of the Illinois Basin, which is the largest and arguably most unexplored oil and gas basin in the US. Some say the New Albany Shale, which lies within the Illinois Basin, could rival the Eagle Ford and the Bakken as a major oil shale oil producing formation. [221]

Meanwhile, Illinois in 2018 is having a financial crisis and is at risk of becoming the first US state with a junk bond credit rating due to massively underfunded public employee pension plans.[222] So how much tax revenue from oil and gas in Illinois is being left on the table due to the Illinois Frack Act? As it is sometimes said—"Go figure."

Though not to such an extreme as Illinois, other states have comprehensive fracking regulation statutes as well. These states include Pennsylvania,[223] California,[224] and Alaska.[225] Though comprehensive regulations are imposed, none of these states, unlike Illinois, have regulated fracking to extinction (though California is close[226]). Pennsylvania is one of the leading states in the United States in shale gas production, accounting for 19% of total US natural gas production in 2017, which places it second to Texas in total US natural gas production.[227]

The third, and more mainstream approach to regulation of hydraulic fracturing, is incremental regulation. Instead of passing comprehensive statutes like the Illinois Frack Act, these states have

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[218] GURALNICK, *supra* note 167, § 3.02[I]
[219] 35 Ill. Comp. Stat. Ann. § 450/2-5 *et seq.*
[220] Alex Ruppenthal, *Fracking Permit is First to be Approved in Illinois*, WTTV: CHICAGOTONIGHT (Sept. 1, 2017), https://chicagotonight.wttw.com/2017/09/01/fracking-permit-first-be-approved-illinois.
[221] Keith Schaefer, *Illinois Basin's New Albany Shale: The Next Big U.S. Horizontal Oil Play?*, OIL AND GAS INVS. BULL. (Sept. 23, 2013), https://oilandgas-investments.com/2013/oil-and-gas-financial/illinois-new-albany-shale-oil/.
[222] Tina Sfondeles, *State's Bond Rating "Uncommonly Low" due to "Crisis-like Budget Environment*, CHI. SUN-TIMES (Apr. 6, 2018, 10:47 PM), https://chicago.suntimes.com/business/states-bond-rating-uncommonly-low-due-to-crisis-like-budget-environment/.
[223] HYDRAULIC FRACTURING L&P, *supra* note 22, § 34.
[224] *Id.*, § 7.
[225] *Id.*, § 5.
[226] *See Fracking in California: Production*, BALLOTPEDIA, https://ballotpedia.org/Fracking_in_California#Production.
[227] *Pennsylvania's Natural Gas Production Continues to Increase*, U.S. ENERGY INFO. ADMIN.: TODAY IN ENERGY (Apr. 23, 2018), https://www.eia.gov/todayinenergy/detail.php?id=35892.

added, incrementally, to their existing regimes of oil and gas regulation to address some of the main concerns of citizens, particularly with regard to drinking water protection. These categories of states could be further divided into more incremental (Colorado,[228] Ohio,[229] and Louisiana[230]), and more measured incremental (Oklahoma,[231] North Dakota,[232] Montana,[233] Wyoming,[234] Alabama,[235] and Texas[236]).

The last category of states are those states that have only minimally addressed hydraulic fracking with new regulations. The attitude in these states is that except for frack fluid disclosure, few other new regulations are needed because existing oil and gas law rules and regulations already address the major concerns. States in this category include Mississippi,[237] Nebraska,[238] Kansas,[239] New Mexico,[240] and Utah.[241]

VIII. 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[242], relies heavily on its existing regime of regulating conventional oil and gas operations developed over the past 125 years.[243]

But Texas decided it was appropriate to add new regulations applicable to hydraulic fracturing in these five areas: 1) chemical disclosures; 2) well integrity, testing, and technical treating requirements; 3) notices; 4) seismicity; and 5) local bans on fracking (state preemption).

1. Chemical Disclosures

As Professors Smith and 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

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228 HYDRAULIC FRACTURING L&P, *supra* note 22, § 8.
229 *Id.*, § 33.
230 *Id.*, § 22.
231 *Id.*, § 23.
232 *Id.*, § 15.
233 *Id.*, § 11.
234 *Id.*, § 20.
235 *Id.*, § 25.
236 *Id.*, § 24.
237 *Id.*, § 30.
238 *Id.*, § 12.
239 *Id.*, § 10.
240 *Id.*, § 14.
241 *Id.*, § 18.
242 *See infra* Part VII.
243 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.

injected down wells during the fracturing process and the threat posed to groundwater supplies." [244] Despite the actual risks associated with hydraulic fracking fluids (see Part VI.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.[245]

The Texas "Disclosure of Composition of Hydraulic Fracturing Fluids" Act, also called the "Texas Hydraulic Fracturing Fluid Disclosure Act," was passed in 2011 and was signed into law by then Governor Rick Perry.[246] This was followed by Texas Railroad Commission Statewide Rule 29, titled "Hydraulic Fracturing Chemical Disclosure Requirements" and adopted on January 2, 2012.[247]

Under TRRC 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 and the trade name, supplier, and a brief description of the intended use or function of each additive.[248] Chemical ingredients and maximum concentrations must also be disclosed.[249] The operator must then ensure that the disclosure information is posted on the FracFocus website.[250]

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 Groundwater Protection Council and Interstate Oil and Gas Compact Commission. Essentially, it is an 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, at least, 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 February 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 fracking began in the 1940s.

Another feature of the law that critics of fracking did not like was its provision for trade secret protection.[251] 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 would in turn discourage investment in development of new technologies. Critics, on the other

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[244] 3 ERNEST E. SMITH & JACQUELINE LANG WEAVER, TEXAS LAW OF OIL AND GAS § 14.11(A) (2d ed. 2015).
[245] 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).
[246] Tex. Nat. Res. Code Ann. § 91.851.
[247] 16 Tex. Admin. Code § 3.29.
[248] GURALNICK, *supra* note 167, § 3.02[H] (citing 16 Tex. Admin. Code § 3.29(c)(1)(a), implementing Texas Nat. Res. Code Ann. § 91.851).
[249] *Id.*
[250] FRACFOCUS, HTTPS://FRACFOCUS.ORG/ (last visited Aug. 6, 2018).
[251] Tex. Nat. Res. Code Ann. §91.851(a)(3)-(7), implemented by 16 Tex. Admin. Code § 3.29(3).

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. [252] For this reason, many companies have listed all the components of frack fluids on the FracFocus website without bothering to claim trade secret protection. [253] 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.[254]

Opponents of fracking in Texas also criticized the exemption of wells fracked before February 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.[255] 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. [256]

To assuage critics, the Act also includes provisions for challenging trade secret protection provided certain eligibility requirements are met.[257] Operators may not withhold any information requested by health care professionals or emergency responders.[258]

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 statues and regulations nationwide.[259] 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."[260]

2. Well Integrity, Testing, Technical Treating Requirements

In Part III.3, 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.[261]

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[252] SERNOVITZ, *supra* 21, at 79.
[253] *Id.*
[254] *Id.*
[255] HYDRAULIC FRACTURING LAW, *supra* note 22, § 24.02[2][c].
[256] *Id.*
[257] Tex. Nat. Res. Code Ann. § 91.851(a)(4) & (5).
[258] *Id.*, § 91.851(a)(7).
[259] HYDRAULIC FRACTURING L&P, *supra* note 22, § 24.02[2][c].
[260] *Id.*
[261] TAMEST, *supra* note 38, 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."

But due to the public outcry over fracking, in 2014 the Texas Railroad Commission revised its Statewide Rule 13, "Casing, Cementing, Drilling, Well Control, & Completion Requirements." [262] Rule 13 establishes the technical standards for casing and cementing oil and gas wells to protect groundwater and to prevent blowouts.[263] Well integrity requirements are the first line of defense in protecting water supplies from subsurface oil and gas operations, including hydraulic fracking.

TRRC Rule 13 is highly technical and not easily understood by those without a petroleum engineering degree.[264] A detailed summary of the Rule is found at § 24.02[4] [a] of *Hydraulic Fracturing Law and Practice*.

In Part VI.1, it was explained that the geology in Texas is such that it is highly unlikely that a well would ever be fracked within 1000 feet of a drinking water aquifer. However, if this happened, the Texas Railroad Commission applies a set of very specific, technical requirements that minimize the chances of public drinking water supplies ever being contaminated by fracking operations.[265]

Besides well casing requirements, TRRC Rule 13 requires surface controls to be put in place governing gas well well-heads ("Christmas Trees") to prevent leaks and to ensure adequate safety controls to prevent blowouts. Even the Environmental Defense Fund has praised revised TRRCC 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.[266]

3. Notices

Texas, unlike Illinois and other states with more comprehensive fracking regulation, 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 TRRC Rule 29 already discussed.[267] There is some room for municipalities to expand notice requirements if "commercially reasonable" under HB 40 (Texas Natural Resources Code §81.0523) discussed in Part VIII.5 below.

As with any other well drilled in Texas, the Railroad Commission requires operators under Statewide Rule 16 to file a completion report with the Commission 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.[268] The completion report is filed on a form W-2 which has a blank to indicate if a hydraulic fracking operation was performed.[269]

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[262] 16 Tex. Admin. Code § 3.13 (2018).
[263] HYDRAULIC FRACTURING L&P, supra note 22, § 24.02[4][a].
[264] *Id.*
[265] 16 Tex. Admin Code § 3.13 (a)(7)(A)-(D).
[266] HYDRAULIC FRACTURING L&P, *supra* note 22, § 24.02[4][a].
[267] 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].
[268] 16 Tex. Admin. Code § 3.16(b)(1).
[269] *See supra*, text accompanying note 233.

4. Seismicity

A mentioned in Part VI.4, 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 9[270] and 46,[271] 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.[272] 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.[273] 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, reducing pressures, and or increasing monitoring.[274] 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.[275]

Upon application for a Class II injection well permit,[276] the TRRC requires printed screen shots showing all historical seismic events within 100 miles of the proposed well. TRRC then determines whether the well should be permitted with no restrictions (green light), not be permitted (red light), or allowed to proceed, but with caution (yellow light), and subject to shut down based on future data.

The Commission 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.[277] Operators must perform monthly monitoring and report annual injection rates and pressures.[278] The Commission may require more frequent monitoring and reporting in areas where conditions warrant.[279]

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[270] 16 Tex. Admin. Code § 3.9.
[271] 16 Tex. Admin. Code § 3.46.
[272] Hall, *supra* note 50, at 5-20.
[273] *Id.* at 5-21.
[274] *Id.*
[275] *Id.*
[276] 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.
[277] HYDRAULIC FRACTURING L&P, *supra* note 22, § 24.02[8].
[278] *Id.*
[279] *Id.*

5. Local bans on Fracking (State Preemption)

Local versus state control over hydraulic fracking is a contentious issue among oil producing states. (See *infra* Part IX.1). 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. In November 4, 2014, Denton voters passed a hydraulic fracturing ban, criminalizing a standard industry practice.[280] 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 (TXOGA) claiming that the ban conflicted with Texas Railroad Commission and Texas Commission on Environmental Quality Rules and was therefore invalid under the preemption doctrine.[281]

In response, the 84th Texas Legislature passes HB 40, effective May 18, 2015, codified in Texas Nat. Res. Code § 81.0523. The law preempts 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.[282]

Following the passage of HB 40, the City of Denton repealed its ordinance banning hydraulic fracturing on June 17, 2015.[283] The TXOGA lawsuit was rendered moot and was dismissed.[284]

It is tempting to say that HB 40 resolved the question of whether or not Texas localities may ban or unreasonably burden fracking operations.[285] Under HB 40, with some very narrow exceptions for municipalities, such efforts appear preempted by statewide regulation of drilling permits by the Texas Railroad Commission.[286]

However, the statute leaves many questions unanswered.[287] 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?[288] One commentator implies that HB 40 merely took the preemption debate to the next level.[289]

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[280] 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 AM), https://www.texastribune.org/2015/09/18/texas-drops-suit-over-dead-denton-fracking-ban/.
[281] HYDRAULIC FRACTURING L&P, *supra* note 22, § 24.01.
[282] § 81.0523(c)(2) & (3)
[283] Mose Buchle, *Denton Repeals Fracking Ban*, TEX. TRIB. (June 17, 2015, 9:00 AM), https://www.texastribune.org/2015/06/17/denton-repeals-fracking-ban/.
[284] Jim Malewitz, *Texas Drops Suit over Dead Denton Fracking Ban*, TEX. TRIB. (Sept. 18, 2015, 11 AM), https://www.texastribune.org/2015/09/18/texas-drops-suit-over-dead-denton-fracking-ban/.
[285] HYDRAULIC FRACTURING L&P, *supra* note 22, § 24.02[9].
[286] *Id.*
[287] *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).
[288] HYDRAULIC FRACTURING L&P, *supra* note 22, at § 24.02[9], referring to discussions in §24.01 and §24.02[5].
[289] *See* Elkind, *supra* note 291.

IX. Case Law Development

The last major component of the law of hydraulic fracturing is case law. The body of hydraulic fracturing case law in the United States is sparser than what may be anticipated, given the intensity of opposition to fracking. This dearth of case law is partly explainable because hydraulic fracturing has come of age relatively recently and many cases involving fracking settle prior to reaching the appellate courts for review. So far, most hydraulic fracturing litigation can be divided into three areas of law: 1) local government preemption; 2) tort law; and 3) a miscellaneous hodgepodge of rulemaking challenges, permit challenges, citizen's suits, and contract claims involving fracking.

1. Local Government Preemption

Preemption occurs when one more powerful governmental authority enacts laws and regulations that govern a lesser governmental authority.[290] The most common type of preemption is when federal authorities preempt state authorities. Usually, federal preemption occurs in situations where no regulation exists on a subject, or low-level regulation is implemented in piecemeal fashion. Then, to develop consistent standards, the federal authority will pass a law that overrides all state level laws. States can also preempt laws and regulations at the local level. This latter kind of preemption, called intrastate preemption[291], is the focus of this subsection. Preemption generally can occur in three ways: by express preemption, implied (or field) preemption and operational (or conflict) preemption.[292]

Historically, oil and gas regulation occurs primarily at the state level. However, following an explosion of development in shale plays across the country and accompanying negative media coverage, several local government entities became particularly aggressive in their attempts to regulate fracking. The 2014 ban on fracking in Denton, Texas (discussed *infra* Part VIII.5) was the first attempt in the nation by a local municipality to ban fracking within its city limits. As discussed above, the state authorities effectively wiped out Denton's regulations by passing a state law that overrode the local ordinance.

Preemption can also happen in the reverse order, with a state preempting the local authorities even before the local authorities pass any regulations related to the area. In the 2013 case of *Robinson Twp. v. Commonwealth of PA*[293], municipalities in Pennsylvania challenged a state law which restricted

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[290] *Preemption Conflicts between State and Local Governments*, BALLOTPEDIA, https://ballotpedia.org/Preemption_conflicts_between_state_and_local_governments.

[291] *See* Uma Outka, *Intrastate Preemption in the Shifting Energy Sector*, 86 U. COLO. L. REV. 927, 941 (2015).

[292] A state law that expressly states an intention to override local government authority effectuates express preemption. Field preemption occurs when state law is so extensive in its scope and purpose that it impliedly occupies an entire field of law. Operational, or conflict preemption, is also a type of implied preemption that involves analyzing the extent to which state and local interests create policy conflicts. The analytical rules of conflict preemption differ among jurisdictions. Conflict preemption appears to be the most effective preemption claim.

[293] 52 A.3d 463 (Pa. Commw. Ct. 2012), *aff'd in part*, *rev'd in part*, 83 A.3d 901 (Pa. 2013).

their ability to adopt local regulations regarding oil and gas operations. In order to promote the development of the Marcellus Shale, the legislature[294] and governor of Pennsylvania had enacted Act 13.[295] The Act was intended to promote reasonable development of the Commonwealth's oil and gas resources by restricting the ability of local municipalities to adopt their own patchwork of regulations on oil and gas operations.[296] In a battle over the legality of Act 13, the courts ultimately affirmed in part, and reversed in part, finding some provisions of the act to be unconstitutional. Namely, the legislature's attempt to specify that statewide rules on oil and gas preempted local zoning rules and to allow oil and gas operations in all zoning areas was struck down. The main remaining effect of the law is the Impact Fee, which will raise over $209 million in 2018.[297]

In the Louisiana case of *St. Tammany Parish Gov't v. Welsh* [298], Helis Oil & Gas Company, LLC, obtained a drilling permit to drill a well in the a suburban area as designated in the parish zoning map. The St. Tammany Parish sued the Office of Conservation Commissioner, seeking declaratory relief that the local zoning ordinance made the drilling permit illegal. A Louisiana statute, La. Rev. Stat. Ann. § 30:28F (2018), provides that a political subdivision is "hereby expressly forbidden…to prohibit or in any way interfere with the drilling of a well…by the holder of…a [duly-authorized] permit." Citing the statute and part of the Louisiana Constitution, the appeals court found express preemption and explained that it was clearly the legislature's intent for state regulation to preempt local municipalities from enacting zoning ordinances that restrict oil and gas activity. The Louisiana Supreme Court declined to hear the case[299] and Helis was allowed to proceed with its drilling plan. Ultimately, after drilling an exploratory well and analyzing the results, Helis abandoned the project.

In a New York case, *Wallach v. Town of Dryden*[300], the town of Dryden amended its zoning ordinance to ban all activities related to oil and gas exploration, extraction, and storage, thus effectively banning hydraulic fracturing. The Court of Appeals of New York heard this case in a consolidated appeal, also considering another New York town, Middlefield, that had similarly prohibited fracking through zoning provisions. Norse Energy Corp. (which had leased 22,000 acres in Dryden) challenged the ban on the grounds that it was preempted by the state Oil, Gas and Solution Mining Law ("OGSML"). Norse's preemption argument centered around a supersession clause in OGSMA, which stated that "The provisions of this article shall supersede *all local laws or ordinances relating to the regulation of the oil, gas and solution mining industries*…"[301], with the exception of local government rights related to roads or property taxes. The court narrowly interpreted the supersession clause to apply only to local ordinances regulating oil and gas operations, not to land use restrictions and prohibitions. Consequently, the court affirmed the intermediate appellate court's finding that the Oil, Gas and

[294] "In February 2012, the Pennsylvania General Assembly passed Act 13 — a sweeping law regulating the oil and gas industry—which, *inter alia*, repealed parts of the existing Oil and Gas Act of 1984…" *Robinson Twp. v. Commonwealth*, 147 A.3d 536, 542 (Pa. 2016).
[295] *Robinson Twp.*, 52 A.3d at 468 (Pa. Commw. Ct. 2012).
[296] 58 Pa.C.S. § 3301-04; *Robinson Twp. v. Commonwealth*, 637 Pa. 239, 252-53, 147 A.3d 536, 544 (2016).
[297] Marie Cusick, *Pennsylvania's Gas Impact Fees rise to $209 Million This Year*, STATEIMPACT PA. (June 21, 2018, 2:40 PM), https://stateimpact.npr.org/pennsylvania/2018/06/21/pennsylvanias-gas-impact-fees-rise-to-209-million-this-year/.
[298] 199 So. 3d 3 (La. Ct. App. 2016).
[299] *St. Tammany Parish. Gov't v. Welsh*, 194 So. 3d 1109, 1109 (La. 2016).
[300] 16 N.E.3d 1188 (N.Y. 2014).
[301] *Id.* at 1195-96.

Solution Mining Law did not expressly or impliedly preempt the ordinance in either of the towns. However, the issue was rendered moot by New York State's subsequent 2015 ban on fracking.

Colorado has been a particularly active state in the preemption arena when it comes to hydraulic fracturing.[302] In *The City of Longmont, Colo. v. Colo. Oil & Gas Ass'n* [303], the citizens of Longmont, Colorado in 2012 voted to ban hydraulic fracturing within the city. The Colorado Oil and Gas Association ("COGA") sued the city to invalidate the regulation based on preemption. COGA prevailed and the case was then appealed and transferred directly to the Colorado Supreme Court. The Colorado Supreme Court found that that there was implied, operational preemption and invalidated the ordinance. The Court reasoned that because state law expressly allows hydraulic fracturing, all bans are preempted. A second, similar Colorado case, *City of Fort Collins v. Colo. Oil and Gas Ass'n*[304], had the same outcome when the court hold that a five-year moratorium on hydraulic fracturing was preempted by the Conservation Act.

2. Tort Cases Involving Hydraulic Fracking

As of mid-2017, fewer than 100 tort cases involving hydraulic fracturing have been filed nationwide, with most of the lawsuits in eight states (Arkansas, Colorado, Louisiana, New York, Ohio, Pennsylvania, West Virginia, and Texas). Of those filed cases, only a handful have been tried. Claims usually include nuisance, negligence, trespass, strict liability for an abnormally dangerous activity, and negligence.[305]

While referred to as hydraulic fracturing cases, many of the actual allegations concern other aspects of oil and gas operations such as ground and/or surface water contamination, air emissions, seismic activity, noise, light, traffic and other disturbances.[306] Opponents of hydraulic fracking tend to make no distinction between injuries allegedly caused by fracking and injuries arising from more conventional oil and gas operations. Holding hydraulic frackers responsible for all oil field pollution, irrespective of origins or causation, fits nicely into the anti-fracking narrative.

The reasons for the sparsity of tort cases is a matter of speculation, but difficulties in proving causation and a lack of commonality for class action certification purposes undoubtedly have a bearing. For example, in *Tucker v. Southwestern Energy Co.*[307], the Plaintiffs claimed that hydraulic fracturing contaminated the Tuckers' water well and the Berrys' air and they sued Southwestern Energy Company alleging nuisance, trespass, negligence and strict liability. The complaints were based

[302] In recent times, Colorado courts have ruled on various express and implied preemption issues that can affect hydraulic fracturing. These issues have involved complete bans on oil and gas drilling (*Voss v. Lundvall Bros.*, 830 P.2d 1061 (Colo. 1992)); land use regulations (*Bd. of Cty. Comm'rs v. Bowen/Edwards Assocs.*, 830 P.2d 1045 (Colo. 1992), *Colo. Mining Ass'n v. Bd. of Cty. Comm'rs*, 199 P.3d 718, 722 (Colo. 2009)); and other preemption issues involving regulatory requirements, such as fees and operator obligations regarding record access (*Town of Frederick v. N. Am. Res. Co.*, 60 P.3d 758 (Colo. Ct. App. 2002), *Bd. of Cty. Comm'rs v. BDS Int'l, LLC,* 159 P.3d 773 (Colo. Ct. App. 2006)).
[303] 369 P.3d 573 (Colo. 2016).
[304] 369 P.3d 586 (Colo. 2016).
[305] *See* HYDRAULIC FRACTURING L&P, *supra* note 22, § 36.03.
[306] *Id.* at § 36.01.
[307] No. 1:11-cv-44-DPM, 2012 U.S. Dist. LEXIS 20697, (E.D. Ark. Feb. 17, 2012).

on conclusions and general statements (e.g. wells have been fractured within a mile of the property; the water well used to be fine, but then started to smell (to paraphrase)). Neither plaintiff showed proof that the Southwestern Energy Company wells did anything to cause the contamination. The court found that the Plaintiff's allegations were "too thin on some critical facts" because they only used general statements and did not plead specific facts. Ultimately, the court granted a joint motion to dismiss all claims against one of the defendants. The parties then settled and the case was dismissed.[308]

In a 2008 Pennsylvania case, *Ely v. Cabot Oil & Gas Corporation*[309], the plaintiffs sued Cabot for injuring their access to safe water from the wells on their property. The water pollution was allegedly the result of the defendants' natural gas drilling operations near their homes. The allegations included breach of contract, fraudulent inducement, private nuisance, negligence, negligence per se, violations of environmental laws, and that natural gas drilling was an abnormally dangerous activity subject to strict liability. All claims were dismissed, expect for negligence and private nuisance. During trial, the plaintiffs put on evidence outside the proper scope of their claims still at issue. The jury found for the plaintiffs and awarded $4.24 million in damages; however, the appellate court vacated the judgement. Before a new trial occurred, the parties settled.[310]

In another recent Arkansas tort case,[311] it was demonstrated how public opinion has been swayed by anti-fracking public sentiment. The plaintiff sought to recover for damage to her house allegedly caused by XTO's drilling operations. Hydraulic fracturing had not been discussed during the trial by either party. However, during deliberations it was reported that several jurors discussed hydraulic fracturing and asked the court whether hydraulic fracturing operations had been conducted. The court responded by advising the jurors that they had all of the evidence necessary for the case. The jury ultimately found for the Plaintiff and awarded her $100,000. XTO moved for a mistrial based on the jurors' conversation. The court denied the motion, holding that the court's instruction to the jury eliminated any risk of prejudice and that XTO did not show that the hydraulic fracturing discussion has prejudiced or altered the verdict.

In still another Arkansas fracking case, *Hill. v. Southwestern Energy Co.*[312], plaintiffs claimed that hydraulic fracturing waste deposited by Southwestern in an abandoned and plugged well had migrated onto their property. The well Southwestern Energy Company drilled—the "Campbell well" — was 180.3 feet from the property line. Southwestern Energy Company leased a surface area of 3.29 acres and disposed of approximately 7.6 million barrels of fracking waste. It was shown that if the leased area were 100% porous (which it was not), it would hold just under 1.1 million barrels. The 8th Circuit Court of Appeals held that the trial judge abused its discretion by excluding an expert report—the jury, not the trial court, should be the one to "decide among the conflicting views of different experts."

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308 *Tucker v. Sw. Energy Co.*, No. 1:11-cv-44-DPM, 2012 U.S. Dist. LEXIS 97238, at *3 (E.D. Ark. 2012).
309 2017 U.S. Dist. LEXIS 49075 (M.D. Pa. Mar. 31, 2017).
310 David DeKok, *Cabot Oil & Gas Settles Fracking Lawsuit with Pennsylvania Families*, REUTERS (Sept. 26, 2017, 12:14 PM), https://www.reuters.com/article/us-pennsylvania-fracking-cabot-oil-gas/cabot-oil-gas-settles-fracking-lawsuit-with-pennsylvania-families-idUSKCN1C12GO.
311 *Hiser v. XTO Energy, Inc.,* No. 4:11CV00517 KGB, 2013 U.S. Dist. LEXIS 57841 (E.D. Ark. Apr. 23, 2013) and 2013 U.S. Dist. LEXIS 140667 (E.D. Ark. Sept. 30, 2013).
312 858 F.3d 481 (8th Cir. 2017).

The appellate court also held that it was "a reasonable inference" that the fracking waste may have migrated across the property line. The case is currently scheduled for jury trial on November 5, 2018.

The most significant reported tort case in Texas involving hydraulic fracturing to date has been *Coastal Oil & Gas Corp. v. Garza Energy Trust*[313], which involved a claim that Coastal's hydraulic fracturing operations cross a leased boundary and drained gas under the neighboring tract. The district court and appellate court found for the plaintiff. The Texas Supreme Court reversed.

A case similar to *Coastal* in Oklahoma, *Max Oil v. Range Resources*[314], involved trespass and nuisance claims based on allegations that Range's hydraulic fracturing treatments in the Mississippian formation decreased oil and gas production from three older wells completed in the Red Fork and Oswego Formations. The matter was ultimately dismissed as being barred under Oklahoma's two-year statute of limitations.

A court in a more recent case in Pennsylvania examined similar facts to those brought forward in *Coastal* in Texas but came to a different conclusion. In *Briggs v. Southwestern Energy Prod.*[315], a trial court granted summary judgement against a plaintiff who had argued that hydraulic fracturing constituted conversion and trespass. The trial court sided with Southwestern Energy, which claimed that the Rule of Capture, which had been long recognized in Pennsylvania, allowed its fractures emanating from a well on an adjoining tract that it had under lease, to drain natural gas from beneath plaintiff's property, even though it did not have a lease with the plaintiff. When the landowner appealed the judgment, three judges heard the case and overturned the trial court, finding that the Rule of Capture did not apply and reviving plaintiff's trespass claim against Southwestern Energy. Southwestern Energy petitioned for the Superior Court to rehear the case *en banc*, but the court declined. Southwestern Energy has now appealed the case to the Pennsylvania Supreme Court.[316] If the case returns to the trial court, the burden will be on the plaintiffs to provide technical proof that Southwestern Energy's fractures entered the plaintiffs' property and collected gas as a result. The Pennsylvania appellate court noted these "evidentiary difficulties."[317]

As discussed in Part III.3, the relationship between hydraulic fracking and wastewater disposal causing earthquakes is indirect. Nevertheless, and fairly or not, the words "hydraulic fracturing" and "earthquakes" have become nearly synonymous in national media accounts and on anti-fracking websites. Thus, though not involving hydraulic fracking per se, in an Oklahoma tort case, *Ladra v. New Dominion, LLC*,[318] Sandra Ladra, a Prague, Oklahoma, resident, brought suit against New Dominion, and a number of other oil and gas companies. She alleged that their operation of wastewater disposal wells had caused an earthquake, which in turn caused her injuries. Ms. Ladra's injuries resulted in 2011

313 268 S.W.3d 1 (Tex. 2008).
314 2017 U.S. App. LEXIS 4424 (10th Cir. Mar. 14, 2017).
315 185 A.3d 153 (Pa. 2018).
316 *PA Superior Court Rejects Southwestern "Briggs" Trespass Appeal*, MARCELLUS DRILLING NEWS (June 12, 2018), https://marcellusdrilling.com/2018/06/pa-superior-court-rejects-southwestern-briggs-trespass-appeal/.
317 *Briggs*, 185 A.3d at 163.
318 353 P.3d 529 (Okla. 2015).

when a magnitude 5.7 earthquake caused pieces of her stone fireplace to break off and fall onto her legs.

Proceeding under theories of negligence and strict liability, Sandra Ladra appears to be the first plaintiff in the nation to seek to impose tort liability on oil and gas companies for injuries associated with allegedly man-made earthquakes caused by injector wells. Her trial is reportedly scheduled for November 2018.

In another Oklahoma case involving earthquakes, *Pawnee Nation of Oklahoma v. Eagle Road Oil LLC*[319], the Pawnee Indian Tribe alleged that disposal of wastewater from wells that were hydraulically fractured induced earthquakes and damaged tribal buildings. The case was filed in Pawnee Nation District Court. On October 2017, arguments were made that the Pawnee Nation did not have jurisdiction to hear the case and that it should have been brought in state district court. However, a ruling was made that the Pawnee Nation had jurisdiction and the case would continue. As of the publication of this paper, there is an evidentiary hearing reportedly scheduled for late August, 2018.

3. Rulemaking Challenges and Miscellaneous

The third wave of fracturing litigation has been a hodgepodge of rulemaking challenges, permit challenges, citizen's suits, and contract claims. Perhaps the most noteworthy rule making challenge to hydraulic fracturing to date was *Wyoming v. US Dep't of the Interior*.[320] In 2015, during the Obama Administration, the Bureau of Land Management promulgated a hydraulic fracturing rule applicable to onshore development of federal and Indian lands and minerals.[321] A federal district court in Wyoming in June 2016 subsequently vacated the BLM rule on the merits, holding that Congress had not delegated the Department of the Interior legal authority to regulate hydraulic fracturing.[322] Donald Trump was elected President in 2016 and the BLM rescinded the rule in December 2017, resulting in the case being dismissed as unripe.[323] However, California and a number of environmental groups are now suing over the rescission of the rule.[324]

In another rulemaking challenge, opponents of hydraulic fracking in Colorado petitioned the Colorado Oil and Gas Conservation Commission (COGCC) to promulgate a new rule that would require the COGCC to not issue drilling permits, unless it can be shown to not adversely impact the environment. The decision was appealed to the Denver District Court—which held that the COGCC must balance development of oil and gas with the protection of public, health, safety and welfare and that COGCC's denial was rational. The decision was then appealed to the Colorado Court of Appeals, which reversed the decision 2-1. The Colorado Attorney General has filed a petition for writ of certiorari with the Colorado Supreme Court on behalf of the COGCC.[325]

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[319] Case No. Civ-2017-803 (Dist. Ct. Pawnee Nation).
[320] 136 F.Supp. 1317 (D. Wyo. 2015).
[321] *Id.* at 1326.
[322] *Wyoming v. US Dep't of the Interior*, 2016 U.S. Dist. LEXIS 82132 (D. Wyo. 2015 June 21, 2016).
[323] *Wyoming v. Zinke*, 871 F.3d 1133, 1146 (10th Cir. 2017).
[324] 2018 U.S. Dist. LEXIS 119379 (N.D. Cal. July 17, 2018).
[325] Martinez v. COGCC, 2017 Colo. App. LEXIS 339 (Colo. Ct. App. Mar. 23, 2017)

Federal environmental rules generally allow "citizen suits" or actions by which private citizens, including activist organizations, can sue governmental and private entities for violations of federal rules. One such example arose in Oklahoma when the Sierra Club sued Chesapeake Operating, LLC, alleging that injection of liquid waste from oil and gas activities had increased the number and severity of earthquakes.[326] The federal district court dismissed the case on two grounds: (i) the *Burford* [327]abstention doctrine and (ii) the primary jurisdiction doctrine. The *Burford* abstention doctrine allows for dismissal when federal jurisdiction would interfere with state administrative agencies. Since the Oklahoma Corporate Commission holds the authority to regulate injection wells in Oklahoma, the court held that the Sierra Club could seek redress by petition to the Oklahoma Corporate Commission for the primary relief requested (i.e., the immediate reduction of wastewater disposal).

For a more comprehensive summary of hydraulic fracturing case law, see the treatise HYDRAULIC FRACTURING LAW AND PRACTICE § 36 (2017) and its upcoming 2019 update.

X. The Future?

It seems as though the wave of new regulations governing hydraulic fracking 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 fracking 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.[328]

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 meets again in 2019. Anti-fracking activism in Texas remains a potent force.[329] 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.

Likewise, fracking litigation still seems to be in its infancy. Despite causation and class certification problems, new cases will likely arise over hydraulic fracking and related oil field operations; to the extent they succeed, they will breed other cases. Once again, time, as always, will tell.

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[326] *Sierra Club v. Chesapeake Operating, LLC*, 248 F.Supp. 3d 1194 (W.D. Okla. 2017).
[327] *Burford et al v. Sun Oil Co et al*, 63 S. Ct. 1098 (1943).
[328] See *infra* Part IX.3 for a discussion of *Wyoming et al v. US Dep't of the Interior*, 136 F.Supp. 1317 (D. Wyo. 2015) and the rescission of Obama era BLM fracking rules in Part IX.3.
[329] *See*, *e.g.*, the website of anti-fracking activist Sharon Wilson, TXSHARON'S BLUE DAZE, HTTP://WWW.TEXASSHARON.COM/ (last visited Aug. 9, 2018).