REFLECTING RISK: CHEMICAL DISCLOSURE AND HYDRAULIC FRACTURING

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> I know no safe depository of the ultimate powers of the society but the people themselves; and if we think them not enlightened enough to exercise their control with a wholesome discretion, the remedy is not to take it from them, but to inform their discretion by education.
>
> –Thomas Jefferson, 1820[1]

> Once again the Railroad Commission is taking a lead in helping the public understand the safety of hydraulic fracturing. . . . In fact, with this new rule, Texans will know more about what is going in the ground for energy production than about the ingredients that go into their sodas.
>
> –Elizabeth Ames Jones,
> Texas Railroad Commission, 2011[2]

I. INTRODUCTION

More than twenty-five years after the Toxics Release Inventory (TRI) first made public the chemicals that industrial facilities release into the environment, states across the country are rapidly adopting a new generation of chemical disclosure policies. These policies require disclosure of chemicals injected into oil and natural gas wells during hydraulic fracturing, a technique that uses pressurized fluid to break open rock and create pathways for the hydrocarbons to flow to the surface.[3] Recent advances in the technology of high-volume hydraulic fracturing have led to a dramatic increase in oil and gas production and growing controversy about the effects of the chemicals on human health and the environment. States have overwhelmingly chosen to

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[1] Letter from Thomas Jefferson to William Charles Jarvis (Sept. 28, 1820), *in* 7 THE WRITINGS OF THOMAS JEFFERSON 177, 179 (H.A. Washington ed., 1854); Sidney M. Wolf, *Fear and Loathing About the Public Right to Know: The Surprising Success of the Emergency Planning and Community Right-to-Know Act*, 11 J. LAND USE & ENVTL. L. 217, 280 n.359 (1996).

[2] Press Release, R.R. Comm'n of Texas, Railroad Commissioners Adopt One of Nation's Most Comprehensive Hydraulic Fracturing Chemical Disclosure Requirements (Dec. 13, 2011), http://www.rrc.state.tx.us/pressreleases/2011/121311.php.

[3] *See* ALL CONSULTING & GROUNDWATER PROT. COUNCIL, MODERN SHALE GAS DEVELOPMENT IN THE UNITED STATES: A PRIMER 56 (2009).

respond to this controversy through chemical disclosure, a policy approach supported by the public and actors on both sides of the debate. In the last three years, twenty-two of the thirty-five states in which there is or could be hydraulic fracturing have adopted chemical disclosure policies.[4] Six more states are currently considering policies.[5] At the core of each policy is a requirement that oil and gas well operators disclose the identity and concentration of the chemicals they use.[6] In the contested world of hydraulic fracturing, it is remarkable that disclosure has created such unanimity.

In the face of uncertainty about the long-term health and environmental effects of a relatively recent, controversial, high-value industrial activity such as high-volume hydraulic fracturing, chemical disclosure has several virtues. The public is concerned about involuntary, unknowing exposure to a new hazard that creates latent health effects; disclosure satisfies the public's "right to know" about the chemicals to which it may be exposed. Individuals must make important decisions in relation to the activity, such as whether to test drinking water from freshwater wells; disclosure gives individuals information that improves decision-making. Chemical users may not consider the potential harm of an activity; disclosure begins to make this harm apparent to users and to the public, putting pressure on users to comply with the terms of their social license. Finally, policymakers may not be able to decide on the best policy response; disclosure gives them information they need to determine the scope of the problem and deliberate on the optimal solution.

But the very aspects of a chemical activity that make disclosure so appealing may also undermine its success, raising troubling questions about the virtues of disclosure. The newer and more complex a chemical use, the more likely it is that scientists will lack data necessary to specifically characterize the risks of the chemicals. The higher the economic value of a use, the more likely it is that chemical users will resist disclosure of information they consider a trade secret. And the more controversial a use, the

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[4] *See* discussion *infra* Part V.A.

[5] *See* discussion *infra* Part V.A.

[6] *See* discussion *infra* Part V.A. As described later in this Article, some states require disclosure of all chemicals, while others require disclosure of chemicals defined as "hazardous" under worker safety law. *See* discussion *infra* Part V.A.

more likely it is that individuals will come to different conclusions about the meaning of the disclosure. As a result, disclosure of chemicals may not help the public, policymakers, and chemical users better understand the effects of an activity and make informed decisions. At the extreme, disclosure could worsen the policy problem by feeding public mistrust and crowding out policy alternatives.

This Article examines the virtues and perils of chemical disclosure as a policy response to uncertainty about the long-term effects of high-volume hydraulic fracturing.[7] In Part II, I give an overview of the expanded chemical activity in high-volume hydraulic fracturing of wells. I explain the activity's profound impact on domestic oil and gas production and the uncertain effects of the activity on health and the environment. In Part III, I discuss the theoretical justifications for chemical disclosure. I then draw on two fields of inquiry—risk science and decision science—to consider how a disclosure policy should address uncertainty. In Part IV, I analyze the federal laws governing chemicals and identify why they fail to address chemicals used in high-volume hydraulic fracturing. In Part V, I turn to the new state disclosure policies. I explain the history of these policies, the different models of disclosure, and the emergence of a national policy through a website called "FracFocus." Finally, in Part VI, I apply the lessons of risk science and decision science to the state policies. I conclude that the policies do not adequately inform experts or the public, and I offer a new approach that combines risk data with communications tailored to individual decisions.

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[7] The growing legal scholarship on hydraulic fracturing is beginning to address disclosure as a policy approach. *See, e.g.*, Rachel Degenhardt, *Hydraulic Fracturing and Groundwater Contamination: Can Disclosure Rules Clarify What's in Our Groundwater?*, 39 ECOLOGY L. CURRENTS 39 (2012) (reviewing implementation of disclosure policies in two states); John D. Furlow & John R. Hays, Jr., *Disclosure with Protection of Trade Secrets Comes to the Hydraulic Fracturing Revolution*, 7 TEX. J. OIL GAS & ENERGY L. 289 (2011) (analyzing the policy adopted by Texas and concluding that disclosure is a positive step); Hannah J. Wiseman, *The Private Role in Public Fracturing Disclosure and Regulation*, 3 HARV. BUS. L. REV. ONLINE 49 (2013) (discussing state disclosure policies in the context of private-public partnerships); Hannah Wiseman, *Trade Secrets, Disclosure, and Dissent in a Fracturing Energy Revolution*, 111 COLUM. L. REV. SIDEBAR 1 (2011) (discussing the extent to which trade secrets should be protected); Chris Boling, Note, *Hydraulic Fracturing and Chemical Disclosure: What You Do Not Know Could Hurt You!*, 46 LOY. L.A. L. REV. 257 (2012) (critiquing state policies).

II. HYDRAULIC FRACTURING: THE CONTROVERSY

In the last nine years, oil and natural gas development has rapidly expanded in the United States, fundamentally reshaping domestic energy production. By 2020, the United States is predicted to be a net exporter of natural gas[8] and to produce more crude oil than Saudi Arabia.[9] This twenty-first century gold rush relies on a combination of two improved techniques: deep directional drilling and high-volume hydraulic fracturing.[10] By drilling long horizontal wells thousands of feet below the surface and fracturing the rock multiple times with large volumes of water-based fluid, energy companies are now able to extract substantial amounts of oil and gas from shale and other "unconventional" formations.[11] But as oil and gas development using high-volume hydraulic fracturing has expanded, so too has the scale of chemical activity. The long-term health and environmental effects of injecting large volumes of small concentrations of chemicals at this scale are uncertain and hotly debated.

A. THE BASICS OF HIGH-VOLUME HYDRAULIC FRACTURING

To appreciate the complexities of the policy problem, the technique of high-volume hydraulic fracturing must be placed in the context of recent horizontal oil and gas wells that target deep, unconventional formations. There are four stages in the life cycle of an oil or gas well: construction; completion; production; and plugging and abandonment.[12] The first two stages are most critical to comprehending the nature of the chemical activity and

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[8] U.S. ENERGY INFO. ADMIN., DOE/EIA-0383, ANNUAL ENERGY OUTLOOK 2013, at 3 (2013) [hereinafter ANNUAL ENERGY OUTLOOK 2013], *available at* http://www.eia.gov/forecasts/aeo/pdf/0383(2013).pdf.

[9] INT'L ENERGY AGENCY, WORLD ENERGY OUTLOOK 2012, EXECUTIVE SUMMARY 1 (2012), *available at* http://www.iae.org/publications/freepublications/publication/English.pdf.

[10] *See* ALL CONSULTING & GROUNDWATER PROT. COUNCIL, *supra* note 3, at 9, 46, 82.

[11] *Id.* at 46–47. Unlike "conventional" reservoirs of oil and gas, in which the hydrocarbons move freely through the interconnected pores of the rock, unconventional formations such as shale, tight sands, and carbonates trap the hydrocarbons in small pores. *Id.* at 15. Hydraulic fracturing is also used to stimulate production or extend the life of conventional wells. *Id.*

[12] *Id.* at 26.

the potential for long-term effects from high-volume hydraulic fracturing.

To construct a well, a drilling contractor drills a hole known as the wellbore, installs steel piping to encase the wellbore, and cements the casing to isolate the wellbore from the surrounding subsurface environment.[13] The contractor begins a horizontal well by drilling vertically through layers of rock to a "kickoff" point, then changes the trajectory of the wellbore so that it remains within the target formation.[14] Drilling fluid, typically composed of chemical additives in water or oil, is used to bring crushed rock to the surface and to cool and lubricate the drilling equipment.[15] As the drilling proceeds, the contractor places successively smaller steel pipes known as casing strings into the wellbore.[16] Each casing string is cemented to the formation or to the outside casing.[17] Production casing may be placed in the horizontal section of the wellbore, or the wellbore may be left uncased for an "open-hole" completion.[18] There can be several wells on one site, each extending more than a mile below the surface and one to two miles horizontally.[19]

After the well is constructed, a service company completes the well through high-volume hydraulic fracturing.[20] The horizontally drilled wellbore is separated into sections or "stages"; beginning at the farthest end of the wellbore, each stage is fractured individually.[21] The number of stages depends primarily on the length of the well and on the formation characteristics; there can be as many as twenty-five stages in a shale gas well[22] and forty

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13 *Id.* at 52.

14 *Id.*

15 EPA, EPA/600/R-11/122, PLAN TO STUDY THE POTENTIAL IMPACTS OF HYDRAULIC FRACTURING ON DRINKING WATER RESOURCES 13–14 (2011) [hereinafter EPA STUDY PLAN], *available at* http://water.epa.gov/type/groundwater/urc/class2/hydraulicfracturing/upload/hf_study_plan_110211_final_508.pdf.

16 ALL CONSULTING & GROUNDWATER PROT. COUNCIL, *supra* note 3, at 52.

17 *Id.*

18 AM. PETROLEUM INST., HYDRAULIC FRACTURING OPERATIONS–WELL CONSTRUCTION AND INTEGRITY GUIDELINES 13 (2009), *available at* http://www.apiiorg/~/media/Files/Policy/Exploration/API_HF1.pdf.

19 EPA STUDY PLAN, *supra* note 15, at 12–13.

20 *Id.* at 15.

21 ALL CONSULTING & GROUNDWATER PROT. COUNCIL, *supra* note 3, at 58.

22 NAT'L ENERGY TECH. LAB., U.S. DEP'T OF ENERGY, SHALE GAS: APPLYING TECHNOLOGY TO SOLVE AMERICA'S ENERGY CHALLENGES 5 (2011), *available at* http://www.netl.doe.gov/technologies/oil-gas/publications/brochures/Shale_Gas_March_2011.pdf.

stages in a tight oil well.[23] For each stage, the company lowers a gun loaded with shaped explosive charges into the wellbore to perforate the casing, creating holes through which fluids, and later the oil or gas, can flow.[24] The company then injects a series of engineered, water-based fluids into the well, including an acid fluid, a pad fluid, and a proppant delivery fluid.[25] The acid fluid cleans up damage to the formation caused by perforation and other well construction activities, and weakens the rock to aid in fracture initiation.[26] The pad fluid, which is injected at high pressure, initiates fractures in the formation.[27] And the proppant delivery fluid carries a proppant, such as sand, into the fractures to hold them open.[28] Finally, the company flushes the wellbore and equipment with fluid or water.[29]

The service company chooses the additives and mixes them with water on site.[30] To formulate the acid fluid, the company combines an acid solution, usually 15% hydrochloric acid in water, with a corrosion inhibitor additive and an iron control additive.[31] To formulate the pad and proppant delivery fluids, the company

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[23] Bruce E. Hicks, Assistant Director, N.D. Dep't of Mineral Res., Presentation at the Midwest Ground Water Conference: Oil & Gas Activity Update 34 (Oct. 1, 2012), https://www.dmr.nd.gov/oilgas/presentations/ActivityUpdate2012-10-01MGWAMpls.pdf.

[24] AM. PETROLEUM INST., *supra* note 18, at 14.

[25] ALL CONSULTING & GROUNDWATER PROT. COUNCIL, *supra* note 3, at 60. There are other base fluids; however, water is the critical base fluid for recent high-volume hydraulic fracturing. *Id.* at 56.

[26] *Id.* at 60–61.

[27] *Id.*

[28] *Id.* The most common proppant is sand, but other materials, such as ceramic beads, may be used. EPA STUDY PLAN, *supra* note 15, at 15.

[29] ALL CONSULTING & GROUNDWATER PROT. COUNCIL, *supra* note 3, at 60.

[30] *See id.* at 61. The company may select an additive product offered by a chemical supplier or create the product itself using bulk chemicals. N.Y. STATE DEP'T OF ENVTL. CONSERVATION, REVISED DRAFT: SUPPLEMENTAL GENERIC ENVIRONMENTAL IMPACT STATEMENT ON THE OIL, GAS AND SOLUTION MINING REGULATORY PROGRAM 5-41, 5-54 (Sept. 7, 2011), http://www.dec.ny.gov/data/dmn/redsgeisfull0911.pdf.

[31] Matthew E. Mantell, Senior Envtl. Eng'r, Chesapeake Energy Corp., Introductory Description of Hydraulic Fracturing, Presentation at the 2011 Groundwater Protection Council Annual Forum (Sept. 27, 2011), http://www.gwpc.org/sites/default/files/event-sessions/19m_Mantell_Matt.pdf; EPA, EPA/600R-11/066, Proceedings of the Technical Workshops for the Hydraulic Fracturing Study: Chemical and Analytical Methods (2011) (abstract of presentation by Rich McCordy, Chesapeake Energy Corp., entitled "High Rate Hydraulic Fracturing Additives in Non-Marcellus Unconventional Shales"). The corrosion inhibitor protects the steel casing from the acid, and the iron control agent prevents the acid from precipitating iron that could block oil or gas flow. N.Y. STATE DEP'T OF ENVTL. CONSERVATION, *supra* note 30, at 5-50.

uses one or more of three fluid systems: a "slickwater" system, which contains a friction reducer additive that "slickens" the water and makes it easier to pump the fluid; a linear gel system, which contains a gel additive that thickens the water to better carry the proppant and a breaker additive that thins the fluid so it will flow out of the formation; and a cross-linked gel system, which contains a cross-linker additive that thickens the gel fluid further and a pH additive that ensures that the cross-linker is effective.[32] In a common hybrid system, the company uses a slickwater pad and a linear gel or cross-linked gel for proppant delivery.[33] All of the fluid systems require a biocide additive, which minimizes the growth of bacteria.[34] Depending on the characteristics of the formation, the company may also include other additives: a clay stabilizer, a scale inhibitor, a surfactant, and a solvent.[35]

The chemical additives comprise a small part of the fluids. In total, the fluids contain at least 98% water and proppant by mass, and less than 2% chemical additives; some fluids contain less than 1% additives.[36] Excluding the acid, the concentration of each additive in a fluid is generally less than 1%.[37] For example, the concentration of the corrosion inhibitor in the acid fluid ranges from 0.02% to 0.05%.[38] The concentration of each additive in the remaining pad and proppant delivery fluids is similarly small. Of

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[32] Mantell, *supra* note 31, at 13–14, 16; *see also* MICHAEL J. ECONOMIDES & TONY MARTIN, MODERN FRACTURING: ENHANCING NATURAL GAS PRODUCTION 242–47, 254–57, 259–62 (2007) (discussing types of fracturing fluids and additives).

[33] Matthew E. Mantell, Senior Envtl. Eng'r, Chesapeake Energy Corp., Hydraulic Fracturing: What Is It and Why Is It Important to Environmental Laboratories, Presentation at the National Environmental Monitoring Conference, at 10 (Aug. 7, 2012), http://nemc.us/docs/2012/presentations/Tue-PM-ShaleGas-MattMantell-8-7-12.pdf.

[34] Mantell, *supra* note 31, at 13–17; ECONOMIDES & MARTIN, *supra* note 32, at 257–59.

[35] Mantell, *supra* note 31, at 13–17. A clay stabilizer prevents clay from blocking the formation; a scale inhibitor prevents deposition of minerals on the wellbore and equipment; a surfactant reduces surface tension and increases return flow; and a solvent ensures that the substances remain in solution. N.Y. STATE DEP'T OF ENVTL. CONSERVATION, *supra* note 30, at 5-50. Ten percent to twenty-five percent of wells use a scale inhibitor, and the same percentage of wells use a surfactant, according to one estimate. George E. King, *Hydraulic Fracturing 101*, J. PETROLEUM TECH., Apr. 2012, at 34, 37.

[36] *See* EPA STUDY PLAN, *supra* note 15, at 28; *see also* N.Y. STATE DEP'T OF ENVTL. CONSERVATION, *supra* note 30, at 5-51.

[37] The dilute hydrochloric acid solution comprises a small part of the total fluids but almost all of the acid fluid. Mantell, *supra* note 31, at 12.

[38] George E. King, Hydraulic Fracturing 101, at 8 (2012) (unpublished paper), *available at* http://www.onepetro.org (search for "Hydraulic Fracturing 101," then follow "Hydraulic Fracturing 101" hyperlink).

three wells in Arkansas and Pennsylvania that were each hydraulically fractured using a different fluid system, the concentration of an additive ranged from 0.008% to 0.041% in the slickwater fluid, 0.00006% to 0.10% in the hybrid slickwater/linear gel fluids, and 0.001% to 0.08% in the hybrid slickwater/cross-linked gel fluids.[39] It follows that the concentration of each chemical constituent of an additive in a fluid is even smaller, usually less than 0.05%.[40]

The volume of chemical additives is dependent on the volume of water and the types of additives. In general, the more water that the service company uses to fracture a well, the greater the volume of chemical additives. Of five Michigan wells completed through high-volume hydraulic fracturing in 2011 and 2012,[41] the smallest treatment used 5.9 million gallons of water and 67,000 gallons of additives,[42] and the largest used 21.1 million gallons of water and 205,000 gallons of additives.[43] The principal additive was the hydrochloric acid solution: the smallest treatment used 47,000 gallons,[44] and the largest treatment used 114,800 gallons.[45] The friction reducer was the second largest additive by volume: the injected volumes ranged from 6,942 gallons to 42,291 gallons.[46]

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[39] N.Y. STATE DEP'T OF ENVTL. CONSERVATION, *supra* note 30, at 5-51, 5-53 to -54 (showing three fluid compositions, two from the Marcellus Shale and one from the Fayetteville Shale). These concentrations are in the total fluid, but the volume of pad and proppant delivery fluids dwarfs the rest of the fluids.

[40] This statement is based on the author's review of many well records in different formations. Because of trade secret claims, the concentration of constituents is not linked to the concentration of additives in a fluid.

[41] The wells are the State Excelsior 1-13 HD-1, the State Excelsior 1-25 HD-1, the State Excelsior 2-25 HD-1, the State Excelsior 3-25 HD-1, and the State Garfield 1-25 HD-1, all operated by the Encana Corporation.

[42] *See Find a Well*, FRACFOCUS, http://fracfocusdata.org/DisclosureSearch/ (last visited Oct. 27, 2013) (from the drop-down menus, choose the state of Michigan, and follow the PDF hyperlink next to the State Excelsior 1-13 HD1); Encana Corp., CHEMICAL ADDITIVE USAGE: STATE EXCELSIOR 1-13 HD-1 (undated) (on file with author).

[43] *See Find a Well*, FRACFOCUS, *supra* note 42 (from the drop-down menus, choose the state of Michigan, and follow the PDF hyperlink next to the State Excelsior 3-25 HD1); Encana Corp., CHEMICAL ADDITIVE USAGE: STATE EXCELSIOR 3-25 HD-1 (undated) (on file with author).

[44] Encana Corp., CHEMICAL ADDITIVE USAGE: STATE EXCELSIOR 1-13 HD-1, *supra* note 42.

[45] Encana Corp., CHEMICAL ADDITIVE USAGE: STATE EXCELSIOR 3-25 HD-1, *supra* note 43.

[46] Encana Corp., CHEMICAL ADDITIVE USAGE: STATE EXCELSIOR 1-13 HD-1, *supra* note 42; Encana Corp., CHEMICAL ADDITIVE USAGE: STATE EXCELSIOR 3-25 HD-1, *supra* note 43.

And the corrosion inhibitor was the smallest additive by volume: the injected volumes ranged from 78 gallons to 115 gallons.[47]

Once all stages of a well are complete, only a part of the commingled fluid returns to the surface through the wellbore and is collected; the rest of the fluid remains underground.[48] In the first few days after pumping ceases, a rush of fluid flows back to the surface together with saline water and dissolved substances from the formation.[49] Saline water continues to rise through the wellbore as the well produces oil and natural gas over its lifetime; this "produced water" may also include some returned fluids.[50] The percentage of injected fluid that returns to the surface varies significantly by formation.[51] In some formations only 10% to 30% of the total fluid returns, while in other formations as much as 75% returns.[52]

B. THE STATE OF PLAY

As oil and gas companies have developed many deep shale "plays," they have turned to horizontal wells and high-volume hydraulic fracturing.[53] There are currently seven significant shale plays—the Bakken, Barnett, Eagle Ford, Fayetteville, Haynesville, Marcellus, and Woodford—and several smaller ones.[54] In the Barnett Shale underlying Texas, one of the most developed shale plays, horizontal wells in production rose from less than 400 in 2004 to more than 10,000 in 2010, or 70% of the total Barnett wells in production that year.[55] A similar transition occurred

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[47] Encana Corp., CHEMICAL ADDITIVE USAGE: STATE EXCELSIOR 1-13 HD-1, *supra* note 42; Encana Corp., CHEMICAL ADDITIVE USAGE: STATE EXCELSIOR 3-25 HD-1, *supra* note 43.

[48] EPA STUDY PLAN, *supra* note 15, at 42–43.

[49] *Id.*

[50] *Id.* at 43.

[51] *Id.* at 42.

[52] *Id.*

[53] *See What Is Shale Gas and Why Is It Important?*, U.S. ENERGY INFO. ADMIN. (Dec. 5, 2012), http://www.eia.gov/energy_in_brief/article/about_shale_gas.cfm; *see also* U.S. ENERGY INFO. ADMIN., REVIEW OF EMERGING RESOURCES: U.S. SHALE GAS AND SHALE OIL PLAYS 4–5 (2011).

[54] *See What Is Shale Gas and Why Is It Important?*, U.S. ENERGY INFO. ADMIN., *supra* note 53.

[55] *Technology Drives Natural Gas Production Growth from Shale Gas Formations*, U.S. ENERGY INFO. ADMIN. (July 12, 2011), http://www.eia.gov/todayinenergy/detail.cfm?id=2170.

starting in 2009 in the Marcellus Shale underlying Pennsylvania.[56] In the Eagle Ford Shale underlying Texas, a newer play, the use of horizontal wells spiked at the beginning of 2012.[57]

While deep horizontal wells are more expensive to drill and more complete than vertical wells, these wells typically produce much more oil and gas.[58] From 2005 to 2012, production of shale gas grew more than tenfold, jumping from just over 4% of total domestic natural gas production to 34%.[59] Meanwhile, production of tight oil from plays like the Bakken Shale also grew more than tenfold, from 4% of total crude oil production in 2005 to 32% in 2012.[60] This shift is expected to accelerate.[61] The Energy Information Administration (EIA) estimates that shale gas production will more than double by 2040, reaching 50% of total gas production.[62] Tight oil production is estimated to increase by one-and-a-half times by 2020, reaching 38% of total domestic production; production is then expected to decline to 2012 levels by 2040 after the "sweet spots" are fully developed.[63] The Bakken

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[56] *See Horizontal Drilling Boosts Pennsylvania's Natural Gas Production*, U.S. ENERGY INFO. ADMIN. (May 23, 2012), http://www.eia.gov/todayinenergy/detail.cfm?id=6390 (showing that Pennsylvania's production quadrupled between 2009 and 2011 due to horizontal drilling).

[57] *Eagle Ford Oil and Natural Gas Well Starts Rose Sharply in First Quarter 2012*, U.S. ENERGY INFO. ADMIN. (Apr. 23, 2012), http://www.eia.gov/todayinenergy/detail.cfm?id=5950.

[58] NAT'L ENERGY TECH. LAB., U.S. DEP'T OF ENERGY, DOE/NETL-2011/1478, A COMPARATIVE STUDY OF THE MISSISSIPPIAN BARNETT SHALE, FORT WORTH BASIN, AND DEVONIAN MARCELLUS SHALE, APPALACHIAN BASIN 5 (2011).

[59] *See What Is Shale Gas and Why Is It Important?*, U.S. ENERGY INFO. ADMIN., *supra* note 53 (follow the "Download Figure Data" hyperlink under the U.S. Dry Natural Gas Production chart to obtain the production figures from a spreadsheet, which show that in 2005, shale gas production was 0.75 trillion feet, and in 2012, shale gas production was 8.13 trillion feet).

[60] *Executive Summary: AEO2013 Early Release Overview*, U.S. ENERGY INFO. ADMIN. (Dec. 5, 2012), http://www.eia.gov/forecasts/aeo/er/executive_summary.cfm (follow the "figure data" hyperlink under Figure 1 to obtain the production figures from a spreadsheet, which show that in 2005, tight oil production was 0.19 million barrels per day, and in 2012, tight oil production was 2 million barrels per day).

[61] *Id.*

[62] ANNUAL ENERGY OUTLOOK 2013, *supra* note 8, at 79; *see also What Is Shale Gas and Why Is It Important?*, U.S. ENERGY INFO. ADMIN., *supra* note 53 (follow the "Download Figure Data" hyperlink under the U.S. Dry Natural Gas Production chart to obtain the production figures from a spreadsheet, which show that in 2040, estimated shale gas production will be 16.7 trillion feet and total domestic natural gas production will be 33.1 trillion feet).

[63] *See Executive Summary: AEO2013 Early Release Overview*, U.S. ENERGY INFO. ADMIN., *supra* note 60 (follow the "figure data" hyperlink under Figure 1 to obtain the production figures from a spreadsheet, which show that by 2020 estimated tight oil production will be 2.81 million barrels per day and total domestic crude oil production will be 7.47 million

Shale is predicted to produce the most, followed by the Eagle Ford Shale.[64]

For domestic production to continue its dramatic rise, ever more horizontal wells must be hydraulically fractured using high volumes of fluid each year. A successful horizontal well will initially produce oil or gas at a very high rate,[65] but production then declines steeply over the first few years.[66] The expected life of a well varies by formation.[67] A well in the Haynesville Shale play will extract almost all of the possible gas in the first five years, according to the EIA.[68] In contrast, production from a well in the Marcellus Shale play will decline less sharply, and the well may extract a low, consistent amount of gas for fifteen to twenty years.[69] To meet the predictions, existing wells must not only be replaced by new ones or re-fractured,[70] but many more new horizontal wells must also be completed. The EIA estimates that the annual number of successful completions of shale gas wells will steadily increase from approximately 4,000 in 2010 to 12,000 in 2035.[71] Based on the trends in development, the majority of these wells will likely be high-volume hydraulically fractured horizontal wells.[72]

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barrels per day, and by 2040 tight oil production will be 2.02 million barrels per day and total domestic crude oil production will be 6.13 million barrels per day).

[64] ANNUAL ENERGY OUTLOOK 2013, *supra* note 8, at 82.

[65] NAT'L ENERGY TECH. LAB., *supra* note 58, at 5.

[66] *See* Stephen A. Holditch, *Getting the Gas out of the Ground*, CEP MAGAZINE 46 (Aug. 2012) (stating that the rate of decline of a typical horizontal shale gas well can be 70% or more per year).

[67] *See* John Staub, U.S. Energy Info. Admin., Presentation to Bipartisan Policy Center 12 (June 27, 2012), http://www.eia.gov/pressroom/presentations/staub_06272012.pdf.

[68] *See id.*

[69] *See id.*

[70] A well can be re-fractured at a later date to increase production; according to the EPA, approximately 1% of shale gas wells are re-fractured every year. Oil and Natural Gas Sector: New Source Performance Standards and National Emission Standards for Hazardous Air Pollutants Reviews, 77 Fed. Reg. 49,490, 49,519 (Aug. 16, 2012) (to be codified at 40 C.F.R. pts. 60 & 63).

[71] *See* EPA, REGULATORY IMPACT ANALYSIS: FINAL NEW SOURCE PERFORMANCE STANDARDS AND AMENDMENTS TO THE NATIONAL EMISSIONS STANDARDS FOR HAZARDOUS AIR POLLUTANTS FOR THE OIL AND NATURAL GAS INDUSTRY 2–27 (2012) (reporting data from the EIA's Annual Energy Outlook 2011). Although the wells are labeled "Devonian Shale," the forecast is for all shale wells. E-mail from Alex Macpherson, Office of Air Quality Planning & Standards, U.S. Envtl. Prot. Agency, to the author (Nov. 6, 2013, 02:56 EST) (on file with author).

[72] *See, e.g.*, *Horizontal Drilling Boosts Pennsylvania's Natural Gas Production*, U.S. ENERGY INFO. ADMIN., *supra* note 56 (describing the shift to horizontal wells).

C. THE UNCERTAIN EFFECTS OF CHEMICAL ADDITIVES

Even if the EIA's predictions prove overly optimistic, high-volume hydraulic fracturing is now a significant and permanent part of oil and gas production. Yet experts and the public remain uncertain about the long-term effects on human health and the environment. For scientists to understand the risks, they must evaluate the toxicity of the fluids and the potential for human and ecological exposure; data are missing in both areas. For members of the public to understand the effects, they must evaluate the conflicting information; how to do so is unclear. The common thread that joins expert and public uncertainty is the call for chemical disclosure.

To evaluate the toxicity of the fluids, scientists require data on the hazards of the mixtures and the effects of the mixtures at different doses.[73] Ideally, this data would be collected on fluids at the time of exposure, since the composition of a fluid changes in response to the environment.[74] But because of the sheer number of wells, different fluid formulations, and possible fluid interactions, such data are not available.[75] Instead, scientists assess toxicity based on the sum of the chemical constituents.[76] Information on constituents has been very difficult to obtain. To retain their competitive advantage, manufacturers of chemical additive products and service companies are loath to provide the full composition of each fluid or the specific identities of some constituents.[77]

To evaluate the potential for exposure to the fluids, scientists need data on the composition of the mixtures released into the environment, the movement of the mixtures, and the amount of the mixtures that humans and the ecological system could

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[73] *See* EPA, EPA/630/R-00/002, SUPPLEMENTARY GUIDANCE FOR CONDUCTING HEALTH RISK ASSESSMENT OF CHEMICAL MIXTURES 15 (2000) [hereinafter EPA SUPPLEMENTARY GUIDANCE].

[74] *See* AGENCY FOR TOXIC SUBSTANCES & DISEASE REGISTRY, GUIDANCE MANUAL FOR THE ASSESSMENT OF JOINT TOXIC ACTION OF CHEMICAL MIXTURES 7 (2004).

[75] *Cf.* EPA, STUDY OF THE POTENTIAL IMPACTS OF HYDRAULIC FRACTURING ON DRINKING WATER RESOURCES: PROGRESS REPORT 44–45 (2012) [hereinafter EPA STUDY PROGRESS REPORT] (noting that from 2005 to 2010, nine service companies reported using 1,858 unique products, and each company used 67 to 450 products).

[76] EPA SUPPLEMENTARY GUIDANCE, *supra* note 73, at 27.

[77] *See* EPA STUDY PROGRESS REPORT, *supra* note 75, at 196.

encounter.[78] There are several acknowledged ways in which the fluids could enter the environment. Surface spills or uncontrolled flow from the wellbore may release the fluids into nearby surface waters or aquifers through ground infiltration.[79] The fluids may enter groundwater directly from the wellbore if the casing is of poor quality or the cementing is inadequate, conditions that the high pressures of high-volume hydraulic fracturing could exacerbate.[80] However, because high-volume hydraulic fracturing at this scale is so recent, there are little data on the incidence of these events. And whether fluids in deep formations could ever migrate upwards into sources of drinking water is under dispute.[81] The recent nature of the activity also means that there are no long-term studies to measure exposure. Scientists are only beginning to monitor groundwater around wells, a task made more difficult by the large number of wells and chemicals.[82]

The U.S. Environmental Protection Agency (EPA) is currently studying the potential effects of hydraulic fracturing on drinking water, including the process of injecting fluids and fracturing the formation.[83] The study demonstrates both the importance of the fluids' composition and the lack of data on toxicity and exposure. The EPA has identified approximately 1,000 specific and 400 generic chemical constituents used in hydraulic fracturing.[84]

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[78] EPA SUPPLEMENTARY GUIDANCE, *supra* note 73, at 23.

[79] N.Y. STATE DEP'T OF ENVTL. CONSERVATION, *supra* note 30, at 6-15, 10-2 to -4.

[80] EPA STUDY PLAN, *supra* note 15, at 28.

[81] *See, e.g.*, EPA STUDY PROGRESS REPORT, *supra* note 75, at 62 (citing differing literature). In 2011, the EPA released a controversial draft study that concluded that hydraulic fracturing was a likely source of contamination of groundwater in Pavillion, Wyoming. EPA, DRAFT INVESTIGATION OF GROUND WATER CONTAMINATION NEAR PAVILLION, WYOMING, at xiii (2011). The oil and gas industry and the states criticized the study, and the EPA later transferred the investigation to the state of Wyoming. Press Release, EPA, Wyoming To Lead Further Investigation of Water Quality Concerns Outside of Pavillion with Support of EPA (June 20, 2013).

[82] *See* U.S. GEOLOGICAL SURVEY, SUMMARY OF STUDIES RELATED TO HYDRAULIC FRACTURING CONDUCTED BY USGS WATER SCIENCE CENTERS (Aug. 22, 2012) (describing recent and proposed water quality monitoring studies, some of which include baseline monitoring prior to oil and gas development).

[83] EPA STUDY PROGRESS REPORT, *supra* note 75, at 13–14. A draft of the report is due in late 2014. Given the extensive peer and stakeholder review process promised by the Agency, the report will probably not be finalized quickly. *Id.* at 4 (noting that the report has been designated as a "Highly Influential Scientific Assessment").

[84] *Id.* at app. A (listing specific chemicals, which have unique names and identity numbers, and generic chemicals, which do not). To provide some context to these numbers, the identified constituents comprise approximately 1% of all existing substances. *See Summary of*

Service companies have disclosed the identities of an additional eighty-two constituents that they claim are trade secrets.[85] Some of the identified constituents can cause cancer or are regulated as drinking water contaminants; others are not considered to pose hazards.[86] Yet the EPA has not determined a "safe" level of exposure for more than 800 of the constituents,[87] and there is no known chemical structure for 276 of the constituents.[88] To help predict exposure, the Lawrence Berkeley National Laboratory is modeling whether migration of hydraulic fracturing fluids from deeper wells is physically and geomechanically possible.[89] The EPA also plans to conduct prospective case studies, which would include monitoring groundwater around wells; the Agency is still negotiating with oil and gas companies on the design of the studies.[90]

Meanwhile, the public both recognizes the benefits of high-volume hydraulic fracturing and is concerned about potential effects. According to most recent public opinion surveys, a majority of Americans believe that the benefits of hydraulic fracturing outweigh the risks.[91] Roughly a quarter are unsure

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the Toxic Substances Control Act, EPA, http://www2.epa.gov/laws-regulations/summary-toxic-substances-control-act (last visited Oct. 27, 2013) (stating that there are more than 83,000 existing chemical substances); 15 U.S.C. § 2607(a) (2006).

[85] EPA STUDY PROGRESS REPORT, *supra* note 75, app. A (describing the claims by companies under the Toxic Substances Control Act, and stating that the EPA has the identity information but is not releasing it to the public).

[86] *Id.* at 122 (referencing 2011 report by minority staff of U.S. House of Representatives Committee on Energy and Commerce); *see also* Theo Colborn et al., *Natural Gas Operations from a Public Health Perspective*, 17 J. HUM. & ECOLOGICAL RISK ASSESSMENT 1039, 1045–46 (2011) (finding that of 353 chemical constituents in natural gas operations, more than 75% can cause acute effects such as eye and skin irritation, nausea, headaches, and convulsions; more than 40% can cause chronic effects on organs and nervous and immune systems; more than 25% can cause cancer and mutations; and more than 40% can harm wildlife).

[87] EPA STUDY PROGRESS REPORT, *supra* note 75, at 125.

[88] *Id.* The EPA has obtained properties for 318 of the constituents and is currently calculating the properties of the remaining substances with known structures. *Id.*

[89] *Id.* at 62–63.

[90] *Id.* at 3.

[91] Kim Wolske et al., *Public Perceptions Technical Report*, *in* HYDRAULIC FRACTURING IN THE STATE OF MICHIGAN 5, app. A, tbl.7 (Graham Sustainability Inst. Integrated Assessment Report Ser. Vol. II, Report 8, 2013) (displaying results of recent national, multi-state, and state polls, in which 31% to 62% of respondents believe the benefits outweigh the risks). In a Harris Interactive poll conducted in September 2012, the respondents were equally divided on the question. *Id.*

about the relative benefits and risks.[92] At the same time, the vast majority of Americans are concerned about effects on water quality.[93] When asked what is their greatest concern about hydraulic fracturing, for example, individuals cite water contamination and the use of chemicals.[94] According to a detailed survey of public opinion in Michigan and Pennsylvania, residents believe hydraulic fracturing has more benefits than problems, both now and in the future.[95] But residents are also concerned about water contamination, groundwater contamination, and health issues.[96] A plurality in both states believes there is a moderate likelihood of serious risks to the health and environment for individuals living near wells.[97]

Realizing that there is no expert consensus on the risks,[98] the public looks to scientists rather than state regulators to help understand the effects. Americans trust the scientific community to provide the most accurate, impartial information on hydraulic

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[92] *Id.* (reporting that 8% to 38% of respondents said they were not sure, a range that narrows to 18% to 38% for national and multi-state polls).

[93] *Id.* at app. A, tbl.11 (displaying results of national and state polls conducted by the Civil Society Institute from 2010 to 2012, in which 69% to 86% of respondents said they were concerned).

[94] UNIV. OF TEXAS AT AUSTIN, ENERGY POLL TOPLINE-WAVE 4, MARCH 2013, at 18 (2013) (reporting that 40% of respondents identified water contamination as their greatest concern regarding hydraulic fracturing, 18% of respondents identified chemicals, and 17% of respondents had no concerns). *See also* Juha Siikamäki & Alan J. Krupnick, Res. for the Future, Presentation at the Resources for the Future Seminar: Managing the Risks of Shale Gas Development 9, 15 (June 27, 2013), http://www.rff.org/Documents/Events/Seminars/Shale-Gas-June-27/Siikam%C3%A4ki-presentation.pdf (reporting initial results from 2013 survey in Pennsylvania and Texas, in which 40% of respondents said they were extremely concerned about groundwater risks, and respondents in both states demonstrated the highest willingness to pay for groundwater protection).

[95] ERICA BROWN ET AL., GERALD R. FORD SCH. OF PUB. POLICY, UNIV. OF MICH., THE NATIONAL SURVEYS ON ENERGY AND ENVIRONMENT, PUBLIC OPINION ON FRACKING: PERSPECTIVES FROM MICHIGAN AND PENNSYLVANIA 10 (2013) (reporting that 52% (Mich.) and 54% (Pa.) of respondents believe there are more benefits now, and 53% (Mich.) and 54% (Pa.) of respondents believe there will be more benefits in the future).

[96] *Id.* at 12 (reporting responses to an open-ended question about the most important environmental risk of hydraulic fracturing, including "did not know" (25%-Mich., 18%-Pa.), "general water contamination" (18%-Mich., 34%-Pa.), "groundwater/well contamination" (8%-Mich., 9%-Pa.), and "health issues" (14%-Mich., 9%-Pa.)).

[97] *Id.* at 13 (reporting that 43% (Mich.) and 45% (Pa.) of respondents said that there is a moderate likelihood).

[98] *See id.* at 11 (reporting that 45% (Mich.) and 55% (Pa.) of respondents said that experts are divided).

fracturing.[99] Environmental organizations are the next most trusted source, followed by federal agencies and the oil and gas industry.[100] Only a few percent of Americans trust state agencies to provide such information.[101] Residents in Michigan and Pennsylvania are concerned, for example, that state agencies are prone to underestimating the risks: the residents are more likely to trust the opinion of state government experts if the experts conclude that there is a very high risk rather than a very low risk.[102]

Given the deep concern about effects, the trust in scientists, and the mistrust of state agencies, it is not surprising that the public overwhelmingly supports chemical disclosure. Support appears to be increasing over time. In 2010, 56% of Americans did not believe that states and the federal government were doing enough to require disclosure, and 68% supported tightening disclosure requirements and requiring studies of health and environmental effects.[103] In a follow-up survey in 2012, the percentage of Americans who supported tightening disclosure requirements surged to 78%, while 86% supported more studies.[104] The support for chemical disclosure is even more striking in the 2012 survey of Michigan and Pennsylvania residents. According to the survey, 90% of those in Michigan and 91% of those in Pennsylvania believe that companies should be required to disclose chemicals; in addition, 83% of those in Michigan and 87% of those in Pennsylvania do not believe that companies should be able to invoke trade secret protection to prevent disclosure.[105]

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[99] UNIV. OF TEXAS AT AUSTIN, *supra* note 94, at 17 (reporting that 40% of respondents trust the scientific community).

[100] *Id.* (reporting that 14% of respondents trust environmental organizations, 12% of respondents trust federal agencies, and 11% of respondents trust the oil and gas industry).

[101] *Id.* (reporting that 2% of respondents trust state agencies).

[102] *See* BROWN ET AL., *supra* note 95, at 13 (reporting that the percentage of respondents who believed that hydraulic fracturing poses a low risk increased from 25% to 33% (Mich.) and 17% to 23% (Pa.) when there was a hypothetical state finding of low risk, and the percentage of respondents who believed that hydraulic fracturing poses a high risk increased from 21% to 32% (Mich.) and 26% to 49% (Pa.) when there was a hypothetical state finding of high risk).

[103] Wolske et al., *supra* note 91, at 6, app. A, tbls.19 & 20.

[104] *Id.* at app. A, tbls.21 & 22.

[105] BROWN ET AL., *supra* note 95, at 15.

III. DISCLOSURE AND THE CHALLENGE OF UNCERTAINTY

Chemical disclosure appears to be well suited to the task of responding to both expert and public uncertainty about the effects of high-volume hydraulic fracturing. Experts need to know the chemical composition of fluids to assess risk; the public needs to know the chemical composition of fluids to learn more about an issue of concern and to make decisions. Yet uncertainty presents significant challenges in the context of a recent, controversial, and high-value chemical activity such as this one. The fields of risk science and decision science provide two different perspectives on these challenges, leading to divergent lessons for disclosure policy.

A. DISCLOSURE AND ITS JUSTIFICATIONS

In the wake of the TRI, scholars and policy actors have largely lauded disclosure of information as a revolution in environmental policy.[106] They argue that disclosure is a more efficient, effective, and democratic means of protecting human health and the environment than prescriptive measures or market-based tools.[107]

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[106] *See, e.g.*, NAT'L RESEARCH COUNCIL, NEW TOOLS FOR ENVIRONMENTAL PROTECTION: EDUCATION, INFORMATION AND VOLUNTARY MEASURES 9 (Thomas Dietz & Paul C. Stern eds., 2002) (describing the support for information disclosure and other "new tools" by conservatives as a "viable way for the new regulatory authorities to make environmental policy less antagonistic to industry concerns"); David W. Case, *The Law and Economics of Environmental Information as Regulation*, 31 ENVTL. L. REP. 10,773, 10,773 nn.6–7 (2001) (collecting conference and policy reports and noting that the EPA has made disclosure one of its top goals); John D. Echeverria & Julie B. Kaplan, *Poisonous Procedural "Reform": In Defense of Environmental Right-to-Know*, 12 KAN. J.L. & PUB. POL'Y 579, 583 (2003) (arguing that the TRI "has made enormous quantities of new information available to the public" and "spurred significant new public and private pollution control and prevention efforts"). *But see* Paula J. Dalley, *The Use and Misuse of Disclosure as a Regulatory System*, 34 FLA. ST. U. L. REV. 1089, 1126, 1131 (2007) (noting that the TRI was successful but cautioning that disclosure must have a clear purpose, mechanism, and design, and must demonstrate net benefits); William F. Pedersen, *Regulation and Information Disclosure: Parallel Universes and Beyond*, 25 HARV. ENVTL. L. REV. 151, 151–54 (2001) (arguing that disclosure can benefit substantive regulation but criticizing the TRI for its failure to accurately convey risk).

[107] *See, e.g.*, Christopher H. Schroeder, *Third Way Environmentalism*, 48 U. KAN. L. REV. 801, 813–19 (2000) (comparing the "third way" of information disclosure and market-based policies to the "prescriptive" regulation of liberalism and deregulatory conservatism); Michael P. Vandenbergh, *From Smokestack to SUV: The Individual as Regulated Entity in the New Era of Environmental Law*, 57 VAND. L. REV. 515, 529–33 (2004) (describing the rise of "informational regulation" scholarship and the arguments by "[i]nformational

Indeed, some scholars contend that disclosure is particularly useful as a first step in addressing emerging environmental policy problems.[108] Rather than adopt a solution that may not work, these scholars argue, governments should mandate disclosure to educate the public about what is known and to encourage deliberative discussion and decision-making.[109]

There are four primary justifications for chemical disclosure.[110] The first two draw from the law and economics literature: disclosure improves individual and social welfare by making the decisions of economic actors more efficient and by providing the most cost-effective approach to minimizing risk.[111] The third justification focuses on the deliberative process by which the laws governing chemical use are made: disclosure improves this process by informing citizens and environmental organizations about the chemical activity; in the pluralist model, stakeholders can participate on an equal footing with industry in decisions on the creation and administration of laws.[112] Finally, the fourth justification moves away from utilitarian analysis and treats information as an entitlement: citizens have a "right to know" about private use of chemicals, particularly when it may affect their health or their surrounding environment.[113]

First, chemical disclosure gives economic actors information that is necessary to achieve efficient outcomes, either through market transactions or through Coasean bargaining. In classic economic theory, all economic actors have relevant information on the nature of a good. In practice, however, there are several market failures related to information. As a commodity, chemical

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regulation enthusiasts . . . that disclosure may be preferable to command and control and economic regulatory instruments").

[108] Paul R. Kleindorfer & Eric W. Orts, *Informational Regulation of Environmental Risks*, 18 RISK ANALYSIS 155, 165 (1998) (stating that a new problem "may not permit wise policy choices to be made about adopting exact rights or standards, and in these cases the regulatory response may do better to encourage understanding the problem, and experimenting with alternative approaches to dealing with it").

[109] *Id.* (arguing that rushing in to address the problem with a "regulatory solution" is "not likely to work and may even do considerable harm at great expense").

[110] *See, e.g.*, Katherine Renshaw, *Sounding Alarms: Does Informational Regulation Help or Hinder Environmentalism?*, 14 N.Y.U. ENVTL. L.J. 654, 660–63 (2006) (listing four normative rationales for "adopting an informational approach to environmental regulation" that are broadly similar to these justifications).

[111] *See id.* at 660, 662.

[112] *See id.* at 661–62.

[113] *See id.* at 661.

information is a public good that will be underproduced in the market.[114] If produced, the information may not be distributed, leading to information asymmetry between producers and consumers that distorts the market.[115] Moreover, in the absence of markets, a lack of chemical information prevents those affected by the external social costs of a chemical activity from bargaining with the risk creator to reach an efficient level of environmental "use."[116] It follows that requiring chemical disclosure can correct these market failures.

Second, chemical disclosure creates incentives for chemical users to take cost-effective measures to voluntarily reduce risk.[117] This rationale does not presume that disclosure will necessarily result in the socially optimal level of risk. Instead, the goal of disclosure is to bring outside pressure to bear on chemical users, in the belief that the net health and environmental benefits will be greater than through "command-and-control" statutes.[118] According to proponents of reflexive law, disclosure invokes the social license necessary for each user to operate, rewarding those users who reduce risk and sanctioning those users who create

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[114] The firm cannot fully capture the benefit of production because the information is non-rival—meaning that multiple parties can consume the information—and, as a practical matter, non-excludable—meaning it is difficult to exclude those who have not paid a price for the information. *See* JAMES T. HAMILTON, REGULATION THROUGH REVELATION 38–39 (2005); Mary L. Lyndon, *Information Economics and Chemical Toxicity: Designing Laws to Produce and Use Data*, 87 MICH. L. REV. 1795, 1810 (1989); Cass R. Sunstein, *Informing America: Risk, Disclosure, and the First Amendment*, 20 FLA. ST. U. L. REV. 653, 655–56 (1993).

[115] ARCHON FUNG ET AL., FULL DISCLOSURE: THE PERILS AND PROMISE OF TRANSPARENCY 31 (2007); HAMILTON, *supra* note 114, at 39; *see also* Lyndon, *supra* note 114, at 1815 ("Chemical manufacturers can be thought of as free riders in this context, 'riding' on consumer ignorance: they benefit by not providing toxicity data, at the expense of consumer uncertainty and injury.").

[116] HAMILTON, *supra* note 114, at 40; Kleindorfer & Orts, *supra* note 108, at 160–61. *See generally* R.H. Coase, *The Problem of Social Cost*, 3 J.L. & ECON. 1 (1960). The extent to which information disclosure will help the parties reach a socially optimal level of risk depends on the existence of other transaction costs and the problem of free riders. If the transaction costs of organizing a community surrounding a facility are significant, disclosure will not produce an optimal outcome. *See* FUNG ET AL., *supra* note 115, at 30–31. Similarly, as Mancur Olson and others have observed, the benefits of organizing are themselves public goods that will tend to be underproduced. *See generally* MANCUR OLSON, THE LOGIC OF COLLECTIVE ACTION: PUBLIC GOODS AND THE THEORY OF GROUPS (1965).

[117] Kleindorfer & Orts, *supra* note 108, at 165; Sunstein, *supra* note 114, at 660.

[118] *See* Sunstein, *supra* note 114, at 659–60 (arguing that command-and-control programs are "extremely expensive to enforce both because of the burden they impose on government and because of the high cost of private resources that must be spent on compliance").

more risk than is acceptable.[119] Disclosure of chemicals gives the public tools to "shame" facilities and outsources the administrative costs of environmental regulation.[120] Disclosure also informs investors, invoking the pressure of the stock market.[121]

Third, chemical disclosure improves the deliberative process of policymaking, resulting in better governmental decisions on risk.[122] Disclosure provides the public—and organizations who lobby on behalf of the public—with information that they can use to participate more fully in the policy debate.[123] Stakeholders can also use the information to monitor government agencies and hold them accountable.[124] For those who are concerned that the public overestimates the risks of chemical use, such disclosure will result in more rational decisions about policy; that is, disclosure will reduce or avoid the need for prescriptive regulation.[125] For those who believe that the risks of chemical use are underestimated in public discourse because of the influence of the regulated community, such disclosure will level the playing field and result in stricter limits on harmful chemicals.[126]

Fourth, chemical disclosure gives the public information to which it is entitled and to which it has a "right to know."[127] Disclosure helps those who are likely to encounter chemicals—for example, those who live in the vicinity of chemical users—by allowing them to avoid or manage risk.[128] But the rationale goes

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[119] *See* Richard B. Stewart, *A New Generation of Environmental Regulation?*, 29 CAP. U. L. REV. 21, 142 (2001) ("In order to succeed, corporations must hold a viable social franchise as well as a healthy economic franchise.").

[120] Kleindorfer & Orts, *supra* note 108, at 162.

[121] HAMILTON, *supra* note 114, at 40–41; Bradley C. Karkkainen, *Information As Environmental Regulation: TRI and Performance Benchmarking, Precursor to a New Paradigm?*, 89 GEO. L.J. 257, 261–62 (2001).

[122] *See* Sunstein, *supra* note 114, at 657–58 ("Without better information, neither deliberation nor democracy is possible.").

[123] *Id.*

[124] Cass R. Sunstein, *Informational Regulation and Informational Standing: Akins and Beyond*, 147 U. PA. L. REV. 613, 625–26 (1999).

[125] *See* Sunstein, *supra* note 114, at 657–58.

[126] *See, e.g.*, Echeverria & Kaplan, *supra* note 106, at 588–89 (arguing that disclosure corrects political failures by creating "an effective political force to advocate for environmental protection" that counters businesses).

[127] *See id.* at 590 (arguing that disclosure expands "freedom of choice"). *See generally* Shannon M. Roesler, *The Nature of the Environmental Right to Know*, 39 ECOLOGY L.Q. 989 (2012) (arguing that the right to know is grounded in fundamental values such as self-government and human health).

[128] Echeverria & Kaplan, *supra* note 106, at 590.

beyond the utilitarian. The right to know is rooted in the anti-toxics movement and the battle by Love Canal residents for acknowledgement of the health effects of contamination and for payments to buy out their homes.[129] Unlike mainstream environmental organizations, which focused their efforts at the time on creating complex, technical responses to risk through chemical law, the anti-toxics movement argued for a community's right to know about the effects of chemicals on human health and the environment.[130] This right to know includes the community's right to make its own assessment of the risks.[131]

Each of these justifications assumes that disclosure will ultimately help the public, either directly or through intermediaries, understand the risks of a chemical activity. In some instances, the justifications assume that disclosure will provide knowledge of the risks of an activity before it occurs. For example, economic actors need perfect information about a future activity to engage in an efficient market transaction related to that activity.[132] In other instances, the justifications assume that disclosure will provide knowledge of the risks of an activity while it is occurring. For example, members of the public must be able to demonstrate a continuing violation to enforce the terms of a social license,[133] and use their knowledge of existing activities to participate in the deliberative process and monitor the actions of government.[134] And in yet other instances, the justifications assume that disclosure will provide knowledge of the risks of an activity that has already occurred. For example, members of the

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[129] ROBERT GOTTLIEB, FORCING THE SPRING: THE TRANSFORMATION OF THE AMERICAN ENVIRONMENTAL MOVEMENT 187 (1993).

[130] *Id.* at 190–91.

[131] *Cf. id.* at 189–90 (describing the characterization of anti-toxics groups as NIMBYs and quoting former New Jersey Governor Thomas Kean as recommending that there be "environmental flying squads" that would "explain the truth about an environmental hazard" to communities).

[132] *See* FUNG ET AL., *supra* note 115, at 30.

[133] *See* HAMILTON, *supra* note 114, at 41 (observing how the TRI data allowed environmentalists to focus attention on persistent polluters).

[134] *See* Sunstein, *supra* note 114, at 657 (stating that a good initial step toward increasing the democratic character of contemporary government is for government to provide enough information for people to make knowledgeable judgments).

public must exercise their right to know about past activities to take steps to mitigate the risks.[135]

There is reason to question whether this assumption holds true for individuals. The primary beneficiaries of the TRI appear to be environmental organizations, government agencies, academia, industry, and investors.[136] Environmental organizations, for example, use the data to educate members of the public in addition to putting pressure on facilities and lobbying for more stringent laws.[137] While there are celebrated examples of citizen activists negotiating with facilities in their community to reduce risks,[138] the evidence is mixed as to whether members of the public use the data to make market decisions about particular risks.[139] According to recent state- and county-level surveys, only 10% to 15% of the public is aware of the TRI.[140]

Therefore, when considering the justifications for chemical disclosure, the fundamental inquiry is to what extent the information will improve public understanding about the risks of past, ongoing, and future activities. Two fields devoted to risk—risk science and decision science—help to provide answers to this inquiry. Both fields directly confront the problem of uncertainty about the long-term effects of chemicals.

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[135] *See* Echeverria & Kaplan, *supra* note 106, at 590 ("Disclosure programs empower individual citizens exposed to environmental risks by enhancing their ability to identify the risks and take actions to avoid or minimize them.").

[136] *See* Frances M. Lynn & Jack D. Kartez, *Environmental Democracy in Action: The Toxics Release Inventory*, 18 ENVTL. MGMT. 511, 515–17 (1994) (reporting findings on how citizen groups, state agencies, and private industrial organizations use TRI data and their perception of the main impacts of that use). *Cf.* HAMILTON, *supra* note 114, at 241–43 (noting how select groups benefited from the information but that "[t]he vast majority of citizens remained rationally ignorant about the existence and operation of the TRI").

[137] Lynn & Kartez, *supra* note 136, at 515.

[138] EPA, EPA-260-R-002-004, HOW ARE THE TOXICS RELEASE INVENTORY DATA USED? 6–7 (2003).

[139] *Compare* HAMILTON, *supra* note 114, at 218–19 (discussing study that found a 1% decline in house prices near TRI facilities in the Philadelphia area when there was an increase in emissions by one standard deviation), *with id.* at 218 (discussing study that found "virtually no effect on housing prices" in Massachusetts).

[140] L. CUNNEEN ET AL., CORNELL INST. FOR PUB. AFFAIRS, CORNELL UNIV., PUBLIC AWARENESS AND USE OF THE TOXICS RELEASE INVENTORY 8 (2012) (reporting that in 2012, approximately 15% of New York residents knew about the TRI); Mark Atlas, *TRI to Communicate: Public Knowledge of the Federal Toxics Release Inventory*, 88 SOC. SCI. Q. 555, 567 (2007) (reporting that in 2001, 10%–15% of residents of Wake County, North Carolina and Baltimore County, Maryland knew of the TRI).

B. THE PERSPECTIVE OF RISK SCIENCE

The primary purpose of risk science is to narrow expert uncertainty about effects through scientific assessment. A formal risk assessment determines the risks of a chemical to human health or the environment, ideally the quantified probability of a particular effect occurring at a given dose of that chemical.[141] There are four steps in this process.[142] First, a risk assessor gathers information on toxicity to determine whether the chemical poses a hazard.[143] Second, the assessor evaluates the relationship between the dose of a chemical and a particular health effect.[144] Third, the assessor gathers information about the fate and transport of the chemical through different media.[145] This information, together with surveys or observations, is used to determine the extent of exposure.[146] Finally, the assessor characterizes the risks through probabilities.[147]

Each step of the process requires significant amounts of information, particularly when the assessment is of complex mixtures composed of small concentrations of many different chemicals.[148] The demands for data lead to two types of second-order uncertainties. Risk assessors are limited by information uncertainty, which occurs "when relevant data is not collected, although it could be," or "when existing information is not made available to the decisionmaker who needs it."[149] For example, there are little toxicity data on mixtures, and the data may not be relevant if the constituents of the mixture and the concentrations of these constituents change over time as the mixture moves

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[141] *See* NAT'L RESEARCH COUNCIL, RISK ASSESSMENT IN THE FEDERAL GOVERNMENT: MANAGING THE PROCESS 18 (1983). The process of assessing health and environmental risk is similar. *Compare id.* at 18, *with* EPA, EPA/630/R-95/002F, GUIDELINES FOR ECOLOGICAL RISK ASSESSMENT (1998). *See also* NAT'L RESEARCH COUNCIL, SCIENCE AND DECISIONS: ADVANCING RISK ASSESSMENT 16 (2009) ("In the 1990s, the four-step approach . . . was adapted to ecologic risk assessment.").

[142] *See* NAT'L RESEARCH COUNCIL, RISK ASSESSMENT IN THE FEDERAL GOVERNMENT, *supra* note 141, at 19.

[143] *Id.*

[144] *Id.* at 19–20, 23–27.

[145] *Id.* at 27–28.

[146] *Id.* at 20.

[147] *Id.*

[148] AGENCY FOR TOXIC SUBSTANCES & DISEASE REGISTRY, *supra* note 74, at 7.

[149] Howard A. Latin, *The "Significance" of Toxic Health Risks: An Essay on Legal Decisionmaking Under Uncertainty*, 10 ECOLOGY L.Q. 339, 357 (1982).

through the environment.[150] Even if the data are available, science may not provide an answer at critical points in the assessment. Assessors are thus also limited by knowledge uncertainty, which "stems from a lack of adequate scientific understanding, or from situations where the collection of necessary information is infeasible."[151] For example, scientists lack knowledge about the interactions of low doses of constituents in a complex mixture.[152]

When information and knowledge uncertainty cannot be resolved, risk assessors turn first to default assumptions and safety factors.[153] These "trans-science" decisions are informed by science, but are ultimately policy choices.[154] For example, a risk assessor would prefer to have toxicity and exposure data available on a mixture so that she can characterize the risks based on the mixture itself.[155] Because such data are not usually available, the assessor uses the default assumption that the risks can be calculated by evaluating each constituent.[156] A further default assumption is that individual doses or responses can be added together to determine the total risks of a complex mixture.[157] If too many data are missing, the assessor turns instead to conducting a qualitative assessment that provides information on potential effects from exposure.[158] And if there is pervasive uncertainty, the assessor cannot complete an assessment.

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[150] AGENCY FOR TOXIC SUBSTANCES & DISEASE REGISTRY, *supra* note 74, at 7.

[151] Latin, *supra* note 149, at 357. Latin acknowledges that there is no bright line separating the two; "the marginal point at which information becomes so difficult or expensive to collect that it is effectively unobtainable will often be indistinct." *Id.*

[152] EPA SUPPLEMENTARY GUIDANCE, *supra* note 73, at 11.

[153] NAT'L RESEARCH COUNCIL, RISK ASSESSMENT IN THE FEDERAL GOVERNMENT, *supra* note 141, at 28 (terming default assumptions "inferential bridges").

[154] Wendy E. Wagner, *The Science Charade in Toxic Risk Regulation*, 95 COLUM. L. REV. 1613, 1618–29 (1995).

[155] AGENCY FOR TOXIC SUBSTANCES & DISEASE REGISTRY, *supra* note 74, at 7.

[156] *Id.* at 8.

[157] EPA SUPPLEMENTARY GUIDANCE, *supra* note 73, at 11–13. Other examples of default assumptions "include using animal data to project potential human health effects, using inhalation data to predict risks from oral exposure, . . . and using data from short-term human clinical studies or subchronic animal bioassays to project human health risks from chronic exposure." *Id.* at 15–16.

[158] *Id.* at 11.

A risk assessment is primarily designed to inform decision-makers in government who will take risk management actions.[159] The assessor characterizes risk by presenting the nature and magnitude of the risks, the populations affected, the quality of the scientific evidence, and the major uncertainties.[160] How this information is communicated to the public is usually a secondary consideration.[161] Over time, the EPA and other agencies have realized that a document containing the results of a risk assessment is a poor vehicle for communicating with the public about risk, and have sought both to include the public in the assessment process and to convey the scientific information in "products" that explain the findings in plain English.[162]

If the risk science perspective is applied to chemical disclosure, it seems clear that the disclosure policy must meet the needs of risk assessment. Without a risk assessment, the risks of an activity are unknown; it follows that the public will not be able to understand the risks. While the nominal audience for disclosure is the public, the real audience is the experts who conduct the assessment, whether they are in government, in stakeholder organizations, or in academia. Disclosure meaningfully improves public understanding if it ultimately allows the experts to characterize the risks, ideally through a quantified probability, and to explain the findings to the public. Disclosure fails if experts cannot characterize the risks by using default assumptions or by obtaining the remaining data.

C. THE PERSPECTIVE OF DECISION SCIENCE

In contrast to risk science, the primary purpose of decision science is to narrow public uncertainty about effects by communicating information the public needs to make decisions.[163]

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[159] *See* NAT'L RESEARCH COUNCIL, RISK ASSESSMENT IN THE FEDERAL GOVERNMENT, *supra* note 141, at 18–19 (defining "risk assessment" and "risk management").

[160] EPA, 601-D12-001, FRAMEWORK FOR HUMAN HEALTH RISK ASSESSMENT TO INFORM DECISION MAKING 46–48 (2012) (external review draft).

[161] *See* 2 THE PRESIDENTIAL/CONG. COMM'N ON RISK ASSESSMENT & RISK MANAGEMENT, RISK ASSESSMENT AND RISK MANAGEMENT IN REGULATORY DECISION-MAKING 41 (1997) (stating that communication about risk has been a lower priority).

[162] EPA, FRAMEWORK FOR HUMAN HEALTH RISK ASSESSMENT TO INFORM DECISION MAKING, *supra* note 160, at 50–55.

[163] Decision science combines the fields of risk perception and risk communication.

Rather than solely communicating the expert assessment of risk, decision scientists seek to understand public perception of risk, incorporate lay knowledge, and promote constructive dialogue. The most established method of risk communication is the "mental models" approach. Communication experts identify the decisions faced by the lay public, create an expert model of current scientific knowledge, compare this model to lay mental models of the processes that create and control risk, and design communications that strengthen the lay models.[164] These communications may add concepts, correct misinformation, emphasize accurate beliefs, and de-emphasize beliefs that are not important.[165] Depending on lay concerns, the communications may include the number of estimated fatalities or illnesses, the age of those affected, and the impacts on both the economy and the environment.[166]

When there is scientific uncertainty about health and environmental effects, decision scientists seek to convey the uncertainty in terms that matter to individuals making decisions. For example, decision scientists at Carnegie Mellon University used aspects of the mental models approach to create a brochure on electric power fields.[167] The brochure explains the results of animal studies and the disagreement among toxicologists about whether there are health effects.[168] It then presents three decision options: wait until there is more evidence; limit exposures through "prudent avoidance;" or invest substantial resources in limiting exposures.[169] For those who want to reduce their exposure to fields, the brochure also gives specific suggestions, such as not to use electric blankets.[170] In another example, some decision

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[164] M. GRANGER MORGAN ET AL., RISK COMMUNICATION: A MENTAL MODELS APPROACH 19–21 (2002).

[165] Baruch Fischhoff, *Risk Perception and Communication*, *in* OXFORD TEXTBOOK OF PUBLIC HEALTH 949 (5th ed. 2009). For example, individuals may believe that being "exposed" to a carcinogen means that they have received a high dose and will probably get cancer. *See* Donald G. MacGregor et al., *"How Exposed Is Exposed Enough?" Lay Inferences About Chemical Exposure*, 19 RISK ANALYSIS 649, 657–58 (1999) (finding that individuals decide whether there has been "exposure" not based on the fact of contact, but based on the nature of the contact, the amount of the chemical, and the consequences).

[166] Nick Pidgeon & Baruch Fischhoff, *The Role of Social and Decision Sciences in Communicating Uncertain Climate Risks*, 1 NATURE CLIMATE CHANGE 35, 37 (2011). *See also* Fischhoff, *supra* note 165, at 940, 943.

[167] MORGAN ET AL., *supra* note 164, at 141–51.

[168] *Id.* at 248–49.

[169] *Id.* at 250–51.

[170] *Id.*

scientists have recommended presenting the costs, risks, and uncertainties for multiple decision options involving climate change.[171] All communications must be carefully designed so they do not stoke fear, but instead improve decisions.[172]

In creating communications, decision scientists take into account the inferential rules used by individuals who are uncertain about risk. Three rules are of particular importance to a controversial chemical activity. The first is the availability heuristic: individuals judge the probability of an event by how "available" instances are, such as by the degree of media coverage.[173] The second is the affect heuristic: when considering the likelihood of the risk and the benefits of an activity, a person's "gut" feelings about the activity influence the outcome.[174] If the feeling is positive, the risks are perceived as low and the benefits as substantial; if the feeling is negative, the risks are perceived as high and the benefits as negligible.[175] The third is the asymmetry principle: individuals tend to weigh negative events more than positive events, find sources about negative events more credible, and avoid contact with those sources they distrust.[176]

The goal of decision scientists is to improve lay decision-making, not to persuade the public that an activity is acceptable. Decision scientists view risk as a multidimensional concept, reflecting many public values beyond the quantitative risk of a particular effect.[177] Rather than label the public as irrational, decision scientists acknowledge that individuals may reasonably respond to dimensions such as the nature of the harm, the degree to which impacts are delayed, the quality of scientific

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[171] Pidgeon & Fischhoff, *supra* note 166, at 37.

[172] *See* George M. Gray & David P. Ropeik, *Dealing with the Dangers of Fear: The Role of Risk Communication*, 21 HEALTH AFFAIRS 106, 106 (2002) (arguing that communication must be carefully designed so that it does not increase public fear, which is a risk that can cause health effects just as other risks do). *Cf.* Cass R. Sunstein, *Probability Neglect: Emotions, Worst Cases, and Law*, 112 YALE L.J. 61, 92 (2002) (arguing against disclosure of low-probability risks when they cannot be processed properly).

[173] Fischhoff, *supra* note 165, at 941.

[174] Paul Slovic et al., *Risk As Analysis and Risk As Feelings: Some Thoughts About Affect, Reason, Risk, and Rationality*, 24 RISK ANALYSIS 311, 312–15 (2004).

[175] *See id.* at 315–16 (finding that information on risks and benefits can change the affective evaluation, so that providing individuals with information that an activity has high risks leads to a negative feeling and the inference that the benefits are low).

[176] Paul Slovic, *Trust, Emotion, Sex, Politics, and Science: Surveying the Risk-Assessment Battlefield*, 19 RISK ANALYSIS 689, 698 (1999).

[177] Pidgeon & Fischhoff, *supra* note 166, at 35, 37.

understanding, and the perceived trustworthiness of the risk communicator.[178] For example, many members of the public view industrial activities that are recent, expose individuals to chemicals without their consent, cause potential latent harms, and are not well understood by scientists as more "risky" than activities without these characteristics.[179] Members of the public may also be concerned if they believe the risks and benefits are unfairly distributed or there are alternative technologies.[180]

If the decision science perspective is applied to chemical disclosure, it seems clear that the purpose of a disclosure policy is to help inform the public's decisions about risk. Disclosure meaningfully improves public understanding if it indirectly informs lay decision-makers by advancing scientific knowledge, or if it directly informs lay decision-makers by forming part of a carefully designed risk communication. Disclosure fails to improve public understanding if it does not help to inform lay decision-makers, leaving them uncertain and dependent on incomplete mental models and inferential rules.

IV. THE FAILURES OF FEDERAL CHEMICAL LAW

To understand why states, the oil and gas industry, and stakeholders turned to the policy approach of chemical disclosure, it is first necessary to understand why existing federal chemical law fails to address long-term uncertainty about the effects of hydraulic fracturing fluids. There are three federal laws that would seem to apply to the chemical activity: the Emergency Planning and Community Right-to-Know Act (EPCRA),[181] the primary federal law designed to inform the public about chemical risk; the Toxic Substances Control Act (TSCA),[182] the primary federal law governing the production and use of toxic chemicals; and the Safe Drinking Water Act (SDWA),[183] the primary federal

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[178] Fischhoff, *supra* note 165, at 943–45.
[179] *Id.* at 944.
[180] Vincent T. Covello et al., *Guidelines for Communicating Information About Chemical Risks Effectively and Responsibly*, *in* ACCEPTABLE EVIDENCE: SCIENCE AND VALUES IN RISK MANAGEMENT 66, 72 (Deborah G. Mayo & Rachelle D. Hollander eds., 1991).
[181] 42 U.S.C. §§ 11001–11050 (2006).
[182] 15 U.S.C. §§ 2601–2697 (2006).
[183] 42 U.S.C. § 300f (2006).

law governing underground injection of fluids.[184] Yet the nature of the chemical activity poses a fundamental challenge to these laws, including the assumptions about risk and the need for trade secret protection on which these laws are based. While high-volume hydraulic fracturing is not unique in presenting this challenge, the scope of the activity places the laws' failures in high relief.

A. THE EMERGENCY PLANNING AND COMMUNITY RIGHT-TO-KNOW ACT

The chemical activity of high-volume hydraulic fracturing fits poorly within the structure of the EPCRA. Because hydraulic fracturing fluids are mixtures of many constituents in very small concentrations, released into the environment by multiple sources, the fluids are rarely subject to the law's reporting requirements. The two "right-to-know" aspects of the law—the TRI and the emergency planning provisions—focus on the risks posed by large amounts of a single chemical at one site. Small concentrations of constituents in a chemical product are ignored, regardless of the total amount and toxicity.[185] And because manufacturers of chemical additives must invest resources in research and development to compete in the evolving market, they are likely to claim trade secret protection for active chemicals in the event that reporting is required.

Oil and gas well operators are not required to report any releases of toxic chemicals to the TRI. Neither Congress nor the EPA has chosen to include the industry in the list of industries that must submit reports.[186] This decision cannot be attributed solely to a failure of political will. A well site is unlikely to meet

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[184] The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), 7 U.S.C. §§ 136–136y (2006), governs biocides. Under FIFRA's licensing scheme, the EPA registers a biocide for specific uses, and the product label gives instructions for each use. 7 U.S.C. § 136a (2006). Use that is inconsistent with the label is prohibited. *Id.* § 136j(a)(2)(G). The EPA has approved glutaraldehyde, a common biocide additive, for use in completion fluids. EPA, EPA 739-R-07-006, REREGISTRATION ELIGIBILITY DECISION FOR GLUTARALDEHYDE 5 (2007). But state pesticide control officials have raised questions about whether other biocides are approved for this use. Gayathri Vaidyanathan, *Official Urges EPA Review, Labeling of Fracking Substances*, ENERGYWIRE (Oct. 24, 2012), http://www.eenews.net/energywire/2012/10/24/archive/5.

[185] Carcinogens that comprise less than 0.1% of the mixture and other constituents that comprise less than 1% of the mixture are not counted towards the reporting thresholds. 40 C.F.R. § 372.38(a) (2012); 29 C.F.R. § 1910.1200(d)(5)(ii) (2013).

[186] 42 U.S.C. § 11023(b)(1) (2006); 40 C.F.R. § 372.23 (2012).

the threshold of ten or more full-time workers and use of more than 10,000 pounds of a reportable chemical in a year.[187] Even if a service company hydraulically fractures multiple horizontal wells on a site, the site is still unlikely to meet the threshold for any one chemical.[188] This is true although the current list of 682 reportable chemicals and chemical categories includes several chemical constituents found in hydraulic fracturing fluids,[189] each of which is "released" into the environment by injection.[190] While the EPA could use its administrative authority to aggregate the chemical activities of multiple well sites in an area, it has so far demurred.[191]

Well operators are also generally not required to disclose hazardous chemicals on a well site to state and local emergency authorities and the public. Under the EPCRA's emergency planning provisions, an operator must submit the name of a hazardous chemical[192] or a Material Safety Data Sheet (MSDS) and an annual inventory if there are 10,000 pounds of the

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[187] 42 U.S.C. § 11023(f)(1)(A). If the toxic chemical is manufactured or processed at the facility, the threshold is 25,000 pounds. *Id.* § 11023(f)(1)(B). The EPA defines the worker threshold as 20,000 hours of work for a facility by the owner, contractors, and employees in a year. 40 C.F.R. § 372.3 (2012).

[188] For example, a well pad developed by EOG Resources in Clearfield County, Pennsylvania, contains six wells. There are two reportable chemical substances in the fluid: methanol and propargyl alcohol. Assuming that the fluid has the same density as water, the total amount of methanol used in the wells is 6,671 pounds and the total amount of propargyl alcohol is 766 pounds. *See Find a Well*, FRACFOCUS, *supra* note 42 (from the drop-down menus, choose the State of Pennsylvania, the county of Clearfield, and wells "SGL 8H-90," "SGL 13H-90," "SGL 14H-90," "SGL 15H-90," "SGL 16H-90," and "SGL 17H-90").

[189] *Compare* 40 C.F.R. § 372.65 (listing toxic chemicals under the EPCRA), *with* EPA STUDY PROGRESS REPORT, *supra* note 75, app. A (listing chemical constituents found in hydraulic fracturing fluid). *See also TRI Listed Chemicals*, EPA, http://www2.epa.gov/toxics-release-inventory-tri-program/tri-listed-chemicals (last visited Oct. 27, 2013) (containing links to lists of reportable chemicals by year).

[190] *See* 42 U.S.C. § 11049(8) (defining a "release" to include pumping or injection).

[191] Addition of Facilities in Certain Industry Sectors; Toxic Chemical Release Reporting; Community Right-to-Know, 61 Fed. Reg. 33,588, 33,592 (June 27, 1996) (to be codified at 40 C.F.R. pt. 372). In 2012, environmental organizations petitioned the agency to add the oil and gas extraction industry. Petition to Add the Oil and Gas Extraction Industry, Standard Industrial Classification Code 13, to the List of Facilities Required to Report Under the Toxics Release Inventory (Oct. 24, 2012), *available at* http://www.foreffectivegov.org/files/info/2012.10.24_t ri_petition_final.pdf. The EPA has not yet responded to the petition.

[192] A "hazardous chemical," defined in reference to worker safety law, is any chemical that is found to create a health or physical hazard. *See* 42 U.S.C. §§ 11021(e), 11022(c); 29 C.F.R. § 1910.1200(c).

chemical at the site at one time.[193] Extremely hazardous chemicals are subject to a lower threshold.[194] Although many hazardous[195] and extremely hazardous chemicals[196] are found in high-volume hydraulic fracturing fluids, it is unlikely that a single chemical additive product or constituent would be present on the site in the threshold quantity.[197] This is in part because the well operator may choose to treat each hazardous constituent of a product as a separate chemical for purposes of reporting.[198] There is one exception to the threshold requirement. A member of the public may obtain an inventory of hazardous chemicals present in less than the threshold amounts upon a statement of "general need."[199]

If a well operator were required to submit information on hazardous chemicals, this information would be limited by manufacturers' prior trade secret claims under worker safety law.

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[193] 42 U.S.C. §§ 11021–11022 (2006); 40 C.F.R. § 370.10(a)(2)(i) (2012). The MSDS, a document designed to protect workers handling the product, contains the identity of the hazardous ingredients, the chemical properties, and the known health effects. In March 2012, the MSDS became known as a "Safety Data Sheet," or SDS. 29 C.F.R. § 1910.1200(g) (2013). Because the document is still widely referred to as a MSDS and the new requirements are not effective until 2015, this Article will use the term MSDS.

[194] *See* 40 C.F.R. § 370.10(a)(1) (requiring reporting for extremely hazardous substances if they are present at the facility in amounts greater than 500 pounds or the threshold planning quantity, whichever is less).

[195] *See infra* note 333 and accompanying text.

[196] *Compare* EPA STUDY PROGRESS REPORT, *supra* note 75, app. A (listing chemical constituents found in hydraulic fracturing fluid, including acrolein, ammonia, aniline, benzyl chloride, chlorine, ethylenediamine, formaldehyde, hydrogen fluoride, hydrogen peroxide, methyl vinyl ketone, ozone, peracetic acid, phenol, phosphine, sulfur dioxide, and sulfuric acid), *with* 40 C.F.R. § 355 app. A (listing the same constituents as extremely hazardous substances).

[197] For example, the author requested annual inventories from ten sites with high-volume hydraulically fractured wells in Michigan. Only one well operator had submitted an inventory, and none of the hazardous chemicals appeared to be constituents of hydraulic fracturing fluid. Encana Oil & Gas (USA) Corp., Tier II Emergency and Hazardous Chemical Inventory, State Wilmot 1–21 (2011) (on file with the author) (listing silica, the proppant; diesel, presumably fuel; barium sulfate, an agent to increase the density of drilling muds; and "drilling muds and associated additives"). Of the extremely hazardous chemicals, only one substance has a threshold that appears low enough to require reporting. *See* 40 C.F.R. pt. 355 app. A (listing a threshold of ten pounds for methyl vinyl ketone).

[198] *See* 42 U.S.C. §§ 11021(a)(3), 11022(a)(3) (2006); 40 C.F.R. § 370.14 (2012).

[199] 42 U.S.C. § 11022(e)(3)(C) (allowing the public to request specific Tier II inventory information for a hazardous chemical that is present in an amount less than 10,000 pounds and not in the possession of emergency authorities); 40 C.F.R. § 370.61(3) (same). Emergency authorities have discretion in deciding whether to provide the information, and there are no federal guidelines on how to exercise this discretion. 42 U.S.C. § 11022(e)(3)(C).

The Hazard Communication Standard allows a manufacturer of a mixture to protect the name of a chemical, other specific identification, and the exact concentration of a constituent from disclosure.[200] The manufacturer need not justify the claim to the Occupational Safety and Health Administration, and there is no process for the general public to challenge the claim.[201] The EPA does not review the claim when the information is required under the EPCRA. Only health professionals and employees may obtain the identity of the chemical; with the exception of medical emergencies, these professionals and employees must show an occupational health purpose, explain why other information is not sufficient, and sign a confidentiality agreement.[202]

In the unlikely event that the operator of a well site wanted to withhold additional chemical information, the EPCRA provides much more limited protection for trade secrets. For example, the operator may only withhold the specific identity of the chemical on site.[203] Thus, the chemical's exact concentration in a mixture, the amount at the site, and the generic class or category of the chemical must still be reported.[204] The operator must also justify the trade secret claim, and share an "unsanitized" version of the chemical list and inventory.[205] Any person may petition the EPA to review the trade secret claim; if the EPA finds that the claim is unjustified, the agency will disclose the information.[206] In addition, the state is required to provide information about the adverse health effects of proprietary chemicals to "any person requesting information" about the substance.[207] None of these

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[200] 29 C.F.R. § 1910.1200(c), (i)(1) (2013) (defining a trade secret as "any confidential formula, pattern, process, device, information or compilation of information that is used in an employer's business, and that gives the employer an opportunity to obtain an advantage over competitors who do not know or use it").

[201] *See id.* § 1910.1200(i)(1)(ii).

[202] *Id.* § 1910.1200(i)(2)–(13).

[203] 40 C.F.R. § 350.5(a); Trade Secrecy Claims for Emergency Planning and Community Right-to-Know Information; and Trade Secret Disclosures to Health Professionals, 53 Fed. Reg. 28,772, 28,774 (July 29, 1988) (stating that "[r]egardless of the basis for a trade secret (e.g., a chemical's presence at a facility, its use for a particular process, or its production in a certain quantity), the only information that a facility may withhold from an [EPCRA] report . . . is the specific chemical identity" and in certain circumstances, the location).

[204] 40 C.F.R. § 350.5(b)(2)(i) (2012).

[205] *Id.*

[206] 42 U.S.C. § 11042(d)(1), (3)(C) (2006).

[207] *Id.* § 11042(h)(1).

more stringent requirements apply to the trade secret claims of manufacturers of chemical additives, however.[208]

B. THE TOXIC SUBSTANCES CONTROL ACT

The chemical activity of high-volume hydraulic fracturing also fits poorly within the structure of the TSCA. Recognizing that information is necessary for effective chemicals regulation, Congress gave the EPA broad rulemaking authority to gather data on chemicals and mixtures,[209] and also imposed duties on companies to record and report what they know.[210] With a few exceptions, however, the Agency has used this authority to target large manufacturers of individual chemicals rather than the manufacturers or processors of mixtures.[211] The TSCA encourages the EPA to focus on the risks of chemical constituents apart from the risks of hydraulic fracturing fluid, and on manufacturing and processing the chemical additives rather than on the end use of high-volume hydraulic fracturing. Paradoxically, the absence of information on hydraulic fracturing fluids and the preference for regulating chemicals over mixtures makes it difficult for the EPA to require companies to test the fluids for health and environmental effects.[212]

The EPA faces several hurdles in gathering information about hydraulic fracturing fluids and their effects. At the outset, it is unclear whether the EPA can require service companies to provide data on hydraulic fracturing fluid itself.[213] The Agency can obtain

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[208] *See* 40 C.F.R. § 350.27(b) (stating that a facility is not required to submit an unsanitized version of a MSDS). The operator also need not submit an unsanitized version of an inventory.

[209] 15 U.S.C. §§ 2603, 2607 (2006).

[210] *Id.* § 2607(c), (e).

[211] *See* 40 C.F.R. §§ 704.25–.175 (2012) (requiring information only for chemical substances, not mixtures or components of mixtures); *see also id.* § 716.120 (listing chemical substances and categories of substances for which health and safety studies must be submitted, but not mixtures). *But see id.* § 799.5025 (listing some mixtures subject to testing consent orders).

[212] 15 U.S.C. § 2603(a) (requiring that the EPA first find that a chemical or mixture "may present an unreasonable risk of injury to health or the environment" or "is or will be produced in substantial quantities," and that the toxicity of a mixture "may not be reasonably and more efficiently determined or predicted by testing the chemical substances which comprise the mixture" before issuing a test rule).

[213] The EPA could collect information from service companies if they manufacture a new mixture or "process" the chemical additives into a new mixture. *See* 15 U.S.C. § 2602(10)

indirect information on the fluid from manufacturers of chemical additive mixtures, but only to the extent that the information "is necessary for the effective enforcement of [the TSCA]."[214] The EPA is also prohibited from obtaining information "with respect to changes in the proportions of the components" of chemical additives unless it makes the same determination.[215] Neither the courts nor the EPA have determined which information is necessary for effective enforcement. In response to a petition by environmental organizations, the EPA agreed in 2011 to initiate a rulemaking to obtain existing data on chemicals and mixtures used in hydraulic fracturing.[216] This data could include, for example, the identity, categories of use, and effects of chemical additives, and submission of existing health and safety studies.[217] As of late 2013, the EPA has not issued an advanced notice of proposed rulemaking.

While manufacturers and processors of chemicals or mixtures must maintain records on significant adverse reactions and immediately report substantial risks of injury to health or the environment,[218] these requirements are unlikely to provide significant amounts of information on hydraulic fracturing fluids. As above, it is unclear whether the TSCA requires service companies to gather information on fluids.[219] Companies that

(2006) (defining "process" as "the preparation of a chemical substance or mixture, after its manufacture, for distribution in commerce . . . in the same form or physical state as, or in a different form or physical state from, that in which it was received by the person so preparing such substance or mixture, or . . . as part of an article containing the chemical substance or mixture").

[214] 15 U.S.C. § 2607(a)(1)(B)(i). In contrast, the EPA could require information on constituents of hydraulic fracturing fluids as long as it acts reasonably. *Id.* § 2607(a)(1)(A).

[215] *Id.* § 2607(a)(1)(B).

[216] *See* Citizen Petition Under Toxic Substances Control Act Regarding the Chemical Substances and Mixtures Used in Oil and Gas Exploration or Production (Aug. 4, 2011), *available at* http://www.epa.gov/opt/chemtest/pubs/section_21_Petition_on_Oil_Gas_Drilling_and_Fracking_Chemicals8.4.2011.pdf; Letter from Stephen A. Owens, Assistant Adm'r, EPA, to Deborah Goldberg, Earthjustice (Nov. 23, 2011), *available at* http://www.epa.gov/oppt/chemtest/pubs/EPA_Letter_to_Earthjustice_on_TSCA_petition.pdf. The EPA denied the request for a test rule. Letter from Stephen A. Owens, Assistant Adm'r, EPA, to Deborah Goldberg, Earthjustice (Nov. 2, 2011), *available at* http://www.epa.gov/opt/chemtest/pubs/SO.Earthjustice.Response.11.2.pdf.

[217] 15 U.S.C. §§ 2607(a)(1)–(2), (c)–(d), 2602(7), 2602(10)–(11) (2006).

[218] *See id.* § 2607(c), (e) (requiring reports of injuries to the health of employees to be kept for thirty years and other reports to be kept for five years).

[219] Service companies would be subject to these requirements if they are deemed to "process" chemicals into mixtures for commercial distribution. *Id.* § 2602(10)–(11); 40

manufacture and process chemical additives are subject to the requirements, but only severe effects that are unknown to the federal government must be recorded or reported.[220] In addition, there is no requirement to investigate incidents or go beyond what the company reasonably knows.[221] The EPA has neither required submission of significant adverse reaction records on chemical additives, nor disclosed any information it has received on substantial risks of the additives.

If companies were required to submit information on additives or fluids to the EPA, the TSCA provides relatively broad protection for trade secrets and confidential commercial information.[222] In contrast to the requirement under worker safety law, however, a company must submit the confidential information to the EPA and provide a written justification.[223] Protected information may include the identity of a chemical, the composition of a mixture, the location of the chemical activity, and other information on processing and use.[224] The primary exception is health and safety studies, which the TSCA specifically exempts from confidentiality claims if no information on processes or the proportions of mixtures is released.[225] Until recently, companies could claim that a chemical identity was a trade secret because other companies

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C.F.R. § 717.3(g) (2012); TSCA Section 8(e); Notification of Substantial Risk; Policy Clarification and Reporting Guidance, 68 Fed. Reg. 33,129, 33,137 (June 3, 2003).

[220] *See* 40 C.F.R. §§ 717.3(c), 717.3(i), 717.12(b), 717.12(d) (requiring records of "reactions that may indicate a substantial impairment of normal activities, or long-lasting or irreversible damage to health or the environment," which do not include "known" human health effects or accidental spills or releases to the environment if reported under any federal authority); TSCA Section 8(e); Notification of Substantial Risk; Policy Clarification and Reporting Guidance, 68 Fed. Reg. at 33,138–39 (requiring reports on previously unknown "risk[s] of considerable concern," either because the human health effect is serious or there is "widespread and significant exposure").

[221] 40 C.F.R. § 717.10 (requiring records if there is a written or oral "allegation"); TSCA Section 8(e); Notification of Substantial Risk; Policy Clarification and Reporting Guidance, 68 Fed. Reg. at 33,137 (requiring reports of information that is in the possession of or known by the submitter, which "includes information of which a prudent person similarly situated could reasonably be expected to possess or have knowledge").

[222] 15 U.S.C. § 2613(a) (2006) (referencing the exemption in the Freedom of Information Act); 5 U.S.C. § 552(b)(4) (2006) (exempting "trade secrets and commercial or financial information obtained from a person and privileged or confidential" from disclosure).

[223] 15 U.S.C. § 2613(c)(1); *see also* 40 C.F.R. § 711.30 (2012) (listing questions that must be answered when claiming confidentiality).

[224] *See, e.g.*, 40 C.F.R. § 711.30 (granting companies the ability to assert a claim of confidentiality for these categories of chemical information under the Chemical Data Reporting rule).

[225] 15 U.S.C. § 2613(b).

could obtain process information from the chemical name.[226] In 2010, however, the EPA announced that it would begin to scrutinize these claims more carefully.[227] Unlike the EPCRA,[228] there is no process by which the public may challenge the validity of the company's claims.

C. THE SAFE DRINKING WATER ACT

Finally, the chemical activity of high-volume hydraulic fracturing fits poorly within the structure of the SDWA. Hydraulic fracturing is specifically exempt from the statute's Underground Injection Control (UIC) program unless the fluid contains diesel fuels.[229] Therefore, most oil and gas well operators need not obtain a UIC permit and meet minimum construction, operating, and monitoring requirements so that the fluids will not endanger drinking water sources.[230] But even if all operators were required to obtain a permit, the UIC program would not necessarily provide information on the risks of a mixture comprised of many constituents in very small concentrations.

The EPA's existing testing and monitoring requirements gather very little information on the potential health and environmental effects of complex mixtures. The UIC program divides wells into six classes based on the expected risk of the injected fluids.[231] Operators of "Class II" wells, which inject fluids associated with oil and gas production,[232] are only required to provide information on

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[226] *See* Claims of Confidentiality of Certain Chemical Identities Contained in Health and Safety Studies and Data from Health and Safety Studies Submitted Under the Toxic Substances Control Act, 75 Fed. Reg. 29,754, 29,756 (May 27, 2010) (stating that chemical identity "has been claimed as confidential in a significant number of health and safety submissions").

[227] *Id.* at 29,756–57.

[228] *See* 42 U.S.C. § 11042(d) (2006) (outlining procedure for public to petition for review of trade secret claims).

[229] *Id.* § 300h(d)(1)(B)(ii) (excluding from the definition of "underground injection" the "injection of fluids or propping agents (other than diesel fuels) pursuant to hydraulic fracturing operations related to oil, gas, or geothermal production activities").

[230] *Id.* § 300h (granting the EPA the authority to promulgate regulations and defining "underground injection" as "subsurface emplacement of fluids by well injection").

[231] 40 C.F.R. § 144.6 (2012). The EPA oversees the permitting program in some states, but a majority of states have primacy to enforce the requirements. *See UIC Program Primacy*, EPA, http://www.water.epa.gov/type/groumfwater/uiv/primacy.cfm (last updated Aug. 1, 2012) (stating that thirty-three states have primacy).

[232] 40 C.F.R. § 144.6(b) (including "conventional oil or natural gas production" in Class II wells).

certain physical and chemical characteristics of the fluids, such as pH, major ions, and trace elements.[233] Even operators of "Class I" wells, which accept industrial and municipal wastewater, are not required to provide comprehensive toxicity data.[234] The toxicity test to determine if the proposed injectate is hazardous detects forty-three substances.[235] In the EPA's Region 5, the operator must test for all hazardous constituents that comprise a "major portion" of the waste stream, or greater than 0.01% by mass.[236] Most constituents of hydraulic fracturing fluid would not meet this threshold.[237]

Perhaps cognizant of the limitations in its existing program, the EPA has proposed using the policy approach of chemical disclosure to gather information on hydraulic fracturing fluid containing diesel fuels.[238] In a 2012 draft guidance, the EPA recommends that a well operator submit a "detailed chemical plan describing the proposed fracturing fluid composition, including the volume and range of concentrations for each constituent," with the permit application.[239] The EPA also recommends that monitoring

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[233] *Id.* § 146.23(b)(1), (c)(1) (requiring an operator to monitor the nature of the injected fluids and report the characteristics annually); *id.* § 146.24(a)(4)(iii) (requiring an operator to submit the proposed source and an analysis of only the physical and chemical characteristics in the permit application); *see also* EPA, OMB No. 2040-0042, UNDERGROUND INJECTION CONTROL PERMIT APPLICATION 5 (2011) (listing requirements); EPA, ANNUAL ANALYTICAL REPORT FOR CLASS II INJECTION WELLS, *available at* http://www.epa.gov/region5/water/uic/forms/annual.pdf (sample disclosure form).

[234] *See* 40 C.F.R. § 146.13(b)(1), (c)(1)(i) (requiring an operator to analyze the characteristics of the actual fluid and report the data to the EPA on a quarterly basis); *id.* § 146.14(a)(7) (requiring an operator to provide the proposed source of the fluid and an analysis of the chemical, physical, radiological and biological characteristics in the permit application).

[235] *See* EPA, REGION 5–UNDERGROUND INJECTION CONTROL SECTION, REGIONAL GUIDANCE #8, PREPARING A WASTE ANALYSIS PLAN AT CLASS I INJECTION WELL FACILITIES (1994) (referencing the four characteristics of ignitability, corrosivity, reactivity, and toxicity in the Resource Conservation and Recovery Act); 40 C.F.R. § 261.24 (2012) (describing toxicity testing requirements).

[236] EPA, REGIONAL GUIDANCE #8, *supra* note 235 (applying to the midwestern states).

[237] *See supra* notes 36–40 and accompanying text.

[238] Permitting Guidance for Oil and Gas Hydraulic Fracturing Activities Using Diesel Fuels–Draft: Underground Injection Control Program Guidance #84, 77 Fed. Reg. 27,451 (proposed May 10, 2012). The guidance would only apply to the EPA, not to states that have primacy to implement the program. EPA, PERMITTING GUIDANCE FOR OIL AND GAS HYDRAULIC FRACTURING ACTIVITIES USING DIESEL FUELS–DRAFT: UNDERGROUND INJECTION CONTROL PROGRAM GUIDANCE #84, at 1 (2012).

[239] EPA, PERMITTING GUIDANCE FOR OIL AND GAS HYDRAULIC FRACTURING ACTIVITIES USING DIESEL FUELS, *supra* note 238, at 20.

requirements include "fracturing fluid composition data."[240] Operators may claim that the data are a trade secret; the statute generally protects trade secrets and "secret processes" from public disclosure after a showing "satisfactory" to the EPA.[241] The EPA extended the comment period on the guidance because of significant interest in—and criticism of—the recommendations.[242] The Agency has not issued any further updates since then.

V. THE ADVENT OF STATE CHEMICAL DISCLOSURE

The same assumptions about risk and the need for trade secret protections, combined with a faith in engineering controls, have historically led states not to regulate the chemicals used in high-volume hydraulic fracturing. After the U.S. Congress considered a bill to repeal the SDWA exemption and require disclosure of chemical constituents, however, the states rushed to adopt chemical disclosure policies. All of the states focus on the very aspects of the activity that pose a challenge to federal laws: the risks of a mixture comprised of many constituents in very small concentrations.

A. THE RUSH TO DISCLOSE

States have traditionally regulated oil and gas wells through permitting programs that govern the drilling, completion, production, and plugging and abandonment of oil and gas wells.[243] The laws seek to protect water resources by specifying the process of drilling, the integrity of well construction, and the proper plugging and abandonment of wells.[244] For example, state regulations generally prescribe the material, placement, and

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[240] *Id.* at 26.

[241] *See* 42 U.S.C. § 300j-4(d)(1) (2006). There is an exception for information that "deals with the level of contaminants in drinking water." *Id.* § 300j-4(d)(2)(B). *See also* 40 C.F.R. § 2.304(e) (2012) (stating that the exception applies to information that "deals with the existence, absence, or level of contaminants in drinking water").

[242] Permitting Guidance for Oil and Gas Hydraulic Fracturing Activities Using Diesel Fuels–Draft, 77 Fed. Reg. 40,354, 40,354 (July 9, 2012).

[243] *See* NAT'L ENERGY TECH. LAB., U.S. DEP'T OF ENERGY, STATE OIL AND NATURAL GAS REGULATIONS DESIGNED TO PROTECT WATER RESOURCES 17–30 (2009), *available at* http://energyindepth.org/wp-content/uploads/2009/03/oil-and-gas-regulation-report-final-with-cover-5-27-20091.pdf.

[244] *Id.* at 16.

number of casing strings, and how the casing is to be cemented.[245] In a 2009 survey, the Groundwater Protection Council (GWPC), a non-profit organization of state UIC and groundwater program officials,[246] found that almost all of the twenty-seven then-producing states required "surface casing" to run from the ground surface to below the deepest groundwater zone, and to be fully cemented to ensure that fluids cannot escape.[247] In addition, most states prescribed either a "waiting period" for the cement to cure or a cement integrity test.[248]

Until 2010, the oil and gas producing states primarily regulated the technique of hydraulic fracturing by requiring operators to submit a general report between thirty and sixty days after well completion.[249] Of the twenty-seven states surveyed by the GWPC, twenty-five required such a report.[250] The reports most often asked for information about the treatment depth, materials, and volumes of fluid.[251] Ten of the states required some general information about the hydraulic fracturing fluid, but none asked for a list of chemical constituents.[252] A few states went beyond reporting to require operators to obtain approval of the hydraulic fracturing treatment.[253] Wyoming specified that the fluids be designed "to prevent significant dissolution" of trona, a sodium-rich mineral found in parts of the state.[254] Yet even in these states, there was no review and approval of the specific chemical

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[245] *See id.* at 18–21.

[246] *About Us*, GROUNDWATER PROT. COUNCIL, http://www.gwpc.org/about-us (last visited Oct. 27, 2013).

[247] STATE OIL AND NATURAL GAS REGULATIONS DESIGNED TO PROTECT WATER RESOURCES, *supra* note 243, at 19 (stating that 93% of the surveyed states require surface casing below the deepest groundwater zone and 96% require cement to be circulated from bottom to top).

[248] *Id.* (stating that 78% of the surveyed states require a cement setup period or integrity test).

[249] *Id.* at 25.

[250] *Id.*

[251] *Id.*

[252] *See id.*; *see also* NAT'L ENERGY TECH. LAB., U.S. DEP'T OF ENERGY, STATE OIL AND NATURAL GAS REGULATIONS DESIGNED TO PROTECT WATER RESOURCES: REGULATIONS REFERENCE DOCUMENT (2009), *available at* http://s3.amazonaws.com/propublica/assets/natural_gas/addendum_regs_reference_doc.pdf (surveying state regulations).

[253] *See* ALA. ADMIN. CODE r. 400-1-4-.07 (2009) (requiring approval of chemical treatment or fracturing); ALASKA ADMIN. CODE tit. 20, § 25.280 (2010) (requiring approval of stimulation); 55-3 WYO. CODE R. § 22(f) (LexisNexis 2012) (requiring approval of work plans for "stimulation operations" when an operator drills in areas of trona mineral resources); *see also* LA. ADMIN. CODE tit. 43, § 105(A) (2013) (requiring approval of acidizing and perforation).

[254] 55-3 WYO. CODE R. § 22(f)(ii).

constituents to be used. Other states simply prohibited hydraulic fracturing from causing pollution,[255] or sought to control damage after the fact by requiring operators to notify the Agency and to proceed diligently to repair the damage.[256]

In June 2009, U.S. Representative Diana DeGette (D-CO) and U.S. Senator Bob Casey (D-PA) introduced the Fracturing Responsibility and Awareness of Chemicals (FRAC) Act in Congress.[257] The FRAC Act would have repealed the exemption for hydraulic fracturing in the SDWA and preempted state laws governing oil and gas wells.[258] The Act would also have required "any person using hydraulic fracturing" to report the chemical constituents in the fluid to the state or the EPA.[259] In turn, the state or the EPA would post the constituents on "an appropriate Internet website."[260] In the case of a medical emergency, the Act would have required proprietary information on formulas or the specific identity to be released.[261]

The states took swift action to counter this threat to their authority. Some states chose to regulate several different aspects of hydraulic fracturing; others just a few.[262] Some chose to include all types of hydraulic fracturing; others focused on high-volume hydraulic fracturing.[263] But all of the state policies required some form of chemical disclosure.[264] In August 2010, Wyoming became

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[255] *See* N.Y. COMP. CODES R. & REGS. tit. 6, § 554.1(a), (e) (2013) (requiring completion program to prevent pollution and migration of fluids); OKLA. ADMIN. CODE § 165:10-3-10 (2009) (prohibiting fracturing processes from causing pollution).

[256] *See* ARIZ. ADMIN. CODE § 12-7-117 (2007) (requiring immediate notification and diligent correction of damage caused by artificial stimulation); N.M. CODE R. § 19.15.16.17 (LexisNexis 2013) (requiring written notice within five days and diligent correction of damage caused by fracturing a well); N.D. ADMIN. CODE 43-02-03-27 (2010) (requiring diligent correction of damage caused by fracturing).

[257] Fracturing Responsibility and Awareness of Chemicals Act, H.R. 2766, 111th Cong. (2009); Fracturing Responsibility and Awareness of Chemicals (FRAC) Act, S. 1215, 111th Cong. (2009).

[258] H.R. 2766 § 2(a); S. 1215 § 2(a).

[259] H.R. 2766 § 2(b)(1); S. 1215 § 2(b)(1).

[260] H.R. 2766 § 2(b)(2); S. 1215 § 2(b)(2).

[261] H.R. 2766 § 2(b)(2); S. 1215 § 2(b)(2).

[262] *See generally* NATHAN RICHARDSON ET AL., RES. FOR THE FUTURE, THE STATE OF STATE SHALE GAS REGULATION (2013), *available at* http://www.rff.org/rff/documents/RFF-Rpt-StateofStateRegs_Report.pdf.

[263] *See id.*

[264] *See* MATTHEW MCFEELEY, NATURAL RES. DEFENSE COUNCIL, STATE HYDRAULIC FRACTURING DISCLOSURE RULES AND ENFORCEMENT: A COMPARISON 14 (2012), *available at* http://www.nrdc.org/energy/files/Fracking-Disclosure-IB.pdf.

the first state to adopt a disclosure policy.[265] Arkansas followed suit that December.[266] In 2011, the pace accelerated. Ten more states—Colorado,[267] Idaho,[268] Indiana,[269] Louisiana,[270] Michigan,[271] Montana,[272] New Mexico,[273] Pennsylvania,[274] Texas,[275] and West Virginia[276]—adopted policies. New York, which has placed a moratorium on hydraulic fracturing until it issues regulations, also released the first draft of its disclosure requirement.[277] In 2012, the pace accelerated even more. Four states—North Dakota,[278] Ohio,[279] Oklahoma,[280] and Utah[281]—adopted policies, the Pennsylvania General Assembly enacted an additional policy,[282] and Indiana extended disclosure to all wells.[283] The Louisiana Legislature also enacted a policy that largely mirrors the 2011 rule.[284] Regulatory agencies in an additional six states—Alaska,[285] California,[286] Mississippi,[287] Nebraska,[288] South

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[265] 55-3 WYO. CODE R. § 45(d) (LexisNexis 2010).

[266] 178-00-1 ARK. CODE R. § B-19 (LexisNexis 2013).

[267] COLO. CODE REGS. § 404-1:205A (2012).

[268] IDAHO ADMIN. CODE r. 20.07.02.055-.056 (2012).

[269] IND. CODE § 14-37-3-14.5 (2011) (applying to coalbed methane wells); 20110727 Ind. Reg. 312110432ERA (July 21, 2011) (applying to coalbed methane wells), *replaced by* 20120725 Ind. Reg. 312120430ERA (July 19, 2012).

[270] LA. ADMIN. CODE tit. 43, § 118(C) (2011).

[271] MICH. DEP'T ENVTL. QUALITY, SUPERVISOR OF WELLS INSTRUCTION 1-2011, HIGH VOLUME HYDRAULIC FRACTURING WELL COMPLETIONS 3 (2011) (applying to wells that use more than 100,000 gallons of hydraulic fracturing fluid).

[272] MONT. ADMIN. R. 36.22.608, .1015, .1016 (2011).

[273] N.M. CODE R. § 19.15.16.19 (2012).

[274] 25 PA. CODE § 78.122 (2011).

[275] TEX. NAT. RES. CODE ANN. § 91.851 (2011); 16 TEX. ADMIN. CODE § 3.29 (2012).

[276] W. VA. CODE R. § 35-8-1 to -3 (2011) (emergency rule applying to horizontal wells that require water withdrawals of 210,000 gallons or more in any thirty-day period); W. VA. CODE § 22-6A-7(e) (2011) (applying to horizontal wells that require water withdrawals greater than 210,000 gallons during any thirty-day period).

[277] 33 N.Y. Reg. 11 (Sept. 28, 2011) (applying to wells that use more than 300,000 gallons of water for hydraulic fracturing). The first draft is no longer available on the New York Department of Conservation's website.

[278] N.D. ADMIN. CODE 43-02-03-27.1 (2012).

[279] OHIO REV. CODE ANN. § 1509.10 (2012).

[280] OKLA. ADMIN. CODE § 165:10-3-10 (2012) (applying to horizontal wells beginning on Jan. 1, 2013 and other wells on Jan. 1, 2014).

[281] UTAH ADMIN. CODE r. 649-3-39 (2013).

[282] 58 PA. CONS. STAT. § 3222.1 (2012).

[283] IND. CODE § 14-37-3-8 (2012); 20120627 Ind. Reg. 312120292ERA (June 21, 2012).

[284] LA. REV. STAT. ANN. § 30:4(L) (2012) (exempting operations "conducted solely for the purposes of sand control or reduction of near wellbore damage").

[285] Alaska Oil & Gas Conservation Comm'n, Notice of Proposed Changes in the Regulations (Dec. 20, 2012), http://doa.alaska.gov/ogc/hear/HydraulicFrac.pdf.

Dakota,[289] and Tennessee[290]—proposed policies. New York released a second draft of its proposed regulations.[291] And legislatures in two more states—Kansas[292] and North Carolina[293]—gave their regulatory agencies specific authority to adopt policies. In an ironic twist, the U.S. Bureau of Land Management (BLM), which is responsible for federal mineral interests as well as Indian mineral interests, proposed a disclosure policy similar to the state policies in May of that year.[294]

The speed at which chemical disclosure has spread across the nation is stunning. There are thirty-five states in which hydraulic fracturing is or could be occurring.[295] In just three years, thirty of these states have considered a disclosure policy, and twenty-two states have policies in place. As of late 2013, California,[296] Illinois,[297] Mississippi,[298] Tennessee,[299] Nevada,[300] and South

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[286] Cal. Dep't of Conservation, Div. of Oil, Gas & Geothermal Res., Pre-Rulemaking Discussion Draft (Dec. 17, 2012), http://www.conservation.ca.gov/dog/general_information/Documents/121712DiscussionDraftofHFRegs.pdf.

[287] Miss. State Oil & Gas Bd., Statewide Rule 1.26 (June 29, 2012), http://www.sos.ms.gov/ACProposed/00018951b.pdf.

[288] Neb. Oil & Gas Conservation Comm'n, Amended Application for an Order Revising the Rules and Regulations of the Comm'n (July 24, 2012), http://www.nogcc.ne.gov/Publications/AMENDEDNE_Case12-02.pdf.

[289] 39 S.D. Reg. 117 (Dec. 17, 2012).

[290] Tenn. Dep't of Envtl. Conservation, Rulemaking Hearing Rule(s) Filing Form (Oct. 2012), http://www.tn.gov/environment/wpc/docs/fracking_rules_2012.pdf.

[291] 34 N.Y. Reg. 3 (Dec. 12, 2012); *see also High Volume Hydraulic Fracturing Proposed Regulations*, N.Y. DEP'T ENVTL. CONSERVATION, http://www.dec.ny.gov/regulations/77353.html (last visited Oct. 27, 2013).

[292] H.B. 2526 (Kan. 2012) (amending KAN. STAT. ANN. § 55-152(a)).

[293] S.B. 820 (N.C. 2012) (amending, among other provisions, N.C. GEN. STAT. § 113-391(a) to require rule for horizontal wells).

[294] Oil and Gas; Well Stimulation, Including Hydraulic Fracturing, on Federal and Indian Lands, 77 Fed. Reg. 27,691 (proposed May 11, 2012) (to be codified at 43 C.F.R. pt. 3160).

[295] According to the EIA, thirty-three states produced oil or natural gas in 2011. *Rankings: Natural Gas Marketed Production, 2011*, U.S. ENERGY INFO. ADMIN., http://www.eia.gov/beta/state/rankings/?sid=US#/series/47 (last visited Oct. 27, 2013) (listing thirty-two states, not including Missouri); *Crude Oil Production*, U.S. ENERGY INFO. ADMIN., http://www.eia.gov/dnav/pet/pet_crd_crpdn_adc_mbbl_a.htm (last visited Oct. 27, 2013) (listing thirty-one states, including Missouri). In addition, Idaho and North Carolina anticipate development.

[296] CAL. PUB. RES. CODE § 3160 (West 2013).

[297] 30 ILL. COMP. STAT. 105/5.826 (2013).

[298] 26-2 MISS. CODE R. § 1.26 (LexisNexis 2013).

[299] TENN. COMP. R. & REGS. 0400-53-01-.03 (2013).

[300] Nev. Comm'n on Mineral Res., Resolution Concerning Hydraulic Fracturing (Feb. 22, 2013), http://minerals.state.nv.us/forms/ogg/COMMISSION%20ON%20MINERAL%20RESOURCES%20RESOLUTION.pdf.

Dakota[301] have final policies. West Virginia has replaced its emergency policy with a permanent one.[302] Alaska[303] and Nebraska[304] have revised their proposed regulations after public comment; Kansas has proposed a policy;[305] Michigan has proposed a new policy;[306] and North Carolina is in the process of proposing a policy.[307] Maryland has released a draft report that recommends a policy.[308] In the most recent session, the Florida Legislature considered two bills on disclosure, one of which passed the Florida House but died in the Senate.[309] Arizona has encouraged operators to voluntarily disclose constituents.[310] Finally, the BLM has revised its proposed regulation.[311] Only Alabama,[312] Kentucky, Missouri, Oregon, and Virginia have not taken action. No other environmental issue in recent memory has spurred such a fast and uniform response by states.

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301 S.D. ADMIN. R. 74:12:02:19 (2013).

302 W. VA. CODE R. § 35-8-5.6.b.5, -10.1 (2013).

303 Alaska Oil & Gas Conservation Comm'n, Notice of Proposed Changes in the Regulations (Aug. 7, 2013), http://doa.alaska.gov/ogc/frac/02_01_Hydraulic%20Fracturing%20Public%20Notice%20and%20Additional%20Info.pdf; Alaska Oil & Gas Conservation Comm'n, Notice of Proposed Changes in the Regulations (Nov. 1, 2013), http://doa.alaska.gov/ogc/frac/03_01_Hydraulic%20Fracturing%20Public%20Notice%20and%20Additional%20Info.pdf.

304 Neb. Oil & Gas Conservation Comm'n, Second Amended Application for an Order Revising the Rules and Regulations of the Comm'n (Apr. 3, 2013), http://www.nogcc.ne.gov/Publications/NE_RulesRegsChangesAmend2.pdf.

305 Notice of Hearing on Proposed Administrative Regulations, 32 Kan. Reg. 543 (May 30, 2013).

306 Mich. Dep't of Envtl. Quality, Oil and Gas Operations, Proposed Draft (Nov. 1, 2013), http://www.michigan.gov/documents/deq/DRAFT_Hydraulic_Fracturing_Rules_438152_7.pdf.

307 N.C. Mining & Energy Comm'n, Final ESC Draft to Rules Committee (Apr. 1, 2013), http://portal.ncdenr.org/c/document_library/get_file?uuid=e6d7d88a-73a0-49d4-8404-9ad6d3c790f4&groupId=8198095.

308 MD. DEP'T OF THE ENV'T & MD. DEP'T OF NATURAL RES., MARCELLUS SHALE SAFE DRILLING INITIATIVE STUDY PART II: BEST PRACTICES 28–29 (2013).

309 H.B. 743, 2013 Leg., Reg. Sess. (Fl. 2013) (requiring disclosure, which passed in House but died in Senate committee); H.B. 745, 2013 Leg., Reg. Sess. (Fl. 2013) (specifying trade secret treatment, which died on House calendar).

310 Ariz. Oil & Gas Conservation Comm'n, Minutes of Meeting (Apr. 19, 2013), http://azogcc.az.gov/sites/azogcc.az.gov/files/meetings/M2013.04.19_0.pdf.

311 Oil and Gas; Hydraulic Fracturing on Federal and Indian Lands, 78 Fed. Reg. 31,636 (proposed May 24, 2013) (to be codified at 43 C.F.R. pt. 3160).

312 In 2000, Alabama adopted rules on coalbed methane wells in response to litigation over the applicability of the SDWA to the state's permitting program. Under these rules, the operator of certain coalbed methane wells must submit "the type [of] fluids and materials that are to be utilized" to the state as part of a proposed fracturing program. ALA. ADMIN. CODE R. 400-3-8-.03(5) (2013). This requirement lacks, however, the specific focus on chemical constituents found in recent disclosure policies.

There are many possible reasons for this turn of events. No doubt, the fear that the federal government would usurp the states' traditional authority over oil and gas wells pushed the states to act quickly.[313] Public pressure to reveal the chemical constituents was strong, and the oil and gas industry supported disclosure in the hope that it would calm the growing controversy.[314] But the policies were also relatively easy to adopt. Almost all producing states already required well operators to report information on the treatment. Moreover, disclosure fit comfortably within the educational efforts taken by states to address public concern. For the many state officials that were surprised by the public's reaction to high-volume hydraulic fracturing, the policies provided an opportunity to continue educating citizens about the "real" risks and to explain why the existing permitting programs protected water resources.[315]

B. THE THREE MODELS OF DISCLOSURE

All of the state policies are comprised of five elements: (1) the object of disclosure shares (2) the subject chemical information on the total hydraulic fracturing fluid (3) through a specific means (4) to the designated audience (5) while ensuring the confidentiality of trade secrets.[316] Using these elements, the policies can be divided into three models: the reporting model, the regulatory model, and the public education model. Each model utilizes a distinct combination of elements. Some states have adopted one model; others have adopted two.

The reporting model follows the states' existing approach to chemical use. The primary purpose of the policy is to create a

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[313] *See, e.g.*, Mead Gruver, *Wyoming Approves Fracking Disclosure Rules*, BOSTON.COM (June 8, 2010) (quoting Wyoming Governor Freudenthal as saying that it is imperative that hydraulic fracturing continue, "[b]ut it is imperative that it continue in a way that is properly supervised and overseen by the Wyoming Oil and Gas Commission").

[314] Mike Soraghan, *Natural Gas Company's Disclosure Decision Could Change Fracking Debate*, GREENWIRE (July 15, 2010) (stating that disclosure "reflects the desire of industry to get out ahead of the issue to prevent federal regulation of the key drilling practice called hydraulic fracturing").

[315] *See, e.g.*, *About Us*, FRACFOCUS, http://fracfocus.org/welcome (last visited Oct. 27, 2013) (stating that the "primary purpose of this site is to provide factual information concerning hydraulic fracturing and groundwater protection").

[316] *Cf.* FUNG ET AL., *supra* note 115, at 39–49 (describing five common characteristics of "targeted transparency" policies).

record on each well, so that the state can respond to an incident involving the fluids. The state may also use the information to track trends in chemical use over time. In a typical policy, the well operator—the object of disclosure—must submit additional information on chemicals in the fluid to the state through the means of filing a well completion report after the treatment. The subject of disclosure ranges from MSDSs to lists of chemical constituents and their concentrations. Because the audience is the state, the policy does not necessarily address how to communicate information to the public. The state may post some information on its website, but the public generally accesses the reports through public records law or by searching an online version of the state's regulatory database.[317] The state is also likely to rely on established exceptions for trade secrets, whether in its governing oil and gas law or in public records law.

Pennsylvania's initial disclosure policy uses the reporting model. Within thirty days after completion, the operator of a hydraulically fractured well must submit a stimulation record to the state as part of the well completion report.[318] The record includes a descriptive list of the chemical additives and the concentration of each additive in the fluid.[319] For every additive, the operator must provide a list of the hazardous constituents in the product MSDS, the chemical names, and the unique Chemical Abstracts Service (CAS) numbers.[320] The operator is also required to submit the concentration of each constituent.[321] Non-hazardous constituents need only be disclosed if the state makes a written request.[322] There is no provision for public disclosure; the public may view the information by making a records request or by

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[317] As of 2009, twenty-two states had adopted a database system known as the Risk-Based Data Management System. *See* Interstate Oil & Gas Compact Comm'n, *Risk-Based Data Management System*, GROUNDWORK, May 11, 2009, at 3. The system was originally designed to provide states with data on injection wells, and then was expanded to include production wells and an "e-commerce" platform for the oil and gas industry. *Id.* at 4. Some states also give the public access to certain database information. *See, e.g.*, *infra* note 331.

[318] 25 PA. CODE § 78.122(b)(6) (2011).

[319] *Id.* § 78.122(b)(6)(i)–(ii).

[320] *Id.* § 78.122(b)(6)(iii). The CAS number is the "gold standard" of chemical identification. *See CAS REGISTRY–The Gold Standard for Chemical Substance Information*, CHEMICAL ABSTRACTS SERVICE, http://www.cas.org/content/chemical-substances (last visited Oct. 27, 2013).

[321] 25 PA. CODE § 78.122(b)(6)(iv).

[322] *Id.* § 78.122(d).

inspecting the records in a state office.[323] Information in the report may be designated as a trade secret or as confidential, and the state then determines whether to release the designated information to the public using the state's Right-to-Know Law.[324]

The regulatory model expands the states' regulatory program. The primary purpose of the policy is to inform agency decision-making so that regulators can weigh the risks, decide whether to approve the activity, and ensure compliance. In a typical policy, the well operator—the object of disclosure—must submit additional information on chemicals in the fluid to the state through the means of permitting forms and reports. The subject of disclosure varies, but always includes information on the proposed chemical use and information on the actual chemicals used. Because the audience is the state, the public generally finds the information through records requests or online state databases. If confidentiality provisions are included in the policy, the operator may be allowed to assert broad trade secret claims as long as all information is given to regulators.

Wyoming, the first state to adopt a disclosure policy, uses the regulatory model. Before hydraulically fracturing a well, the owner, operator, or service company must provide to the state, "for each stage of the well stimulation program, the chemical additives, compounds and concentrations or rates proposed to be mixed and injected."[325] Each additive must be listed by function, such as acid or biocide, and by proposed rate or concentration.[326] The chemical constituents of the additive must also be identified by chemical name and the unique CAS number.[327] Prior approval is required for the use of volatile organic compounds such as benzene, toluene, ethylbenzene, and xylene, and petroleum distillates.[328] Within thirty days after hydraulic fracturing, the owner or operator must report the details of each stage of the actual treatment, including

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[323] *See generally* 65 PA. CONS. STAT. §§ 67.101–.3103 (2012) (Pennsylvania's Right-to-Know Law).

[324] 25 PA. CODE § 78.122(c).

[325] 55-3 WYO. CODE R. § 45(d) (LexisNexis 2011) (emphasis in original omitted).

[326] *Id.* § 45(d)(i), (iii).

[327] *Id.* § 45(d)(ii).

[328] *Id.* § 45(g). The Wyoming Oil and Gas Conservation Commission clarified that it would focus on the listed substances and not on the entire class of volatile organic compounds. Memorandum from Thomas E. Doll, State Oil & Gas Supervisor, to All Operators (Aug. 24, 2010), http://groundwork.iogcc.org/sites/default/files/WY_Memo_adopt_Rules_Aug2010.pdf.

the name, function, concentration or rate, and amount of each chemical additive and chemical constituent.[329] An owner or operator may request that the state provide confidentiality protection to proprietary information under the state's public records law.[330] There is no provision for public disclosure; the public may access the information through a records search of the database on the state website.[331]

Finally, the public education model discards the traditional tools of reporting and permitting and offers information directly to the public. The primary purpose of the policy is to educate individuals who are concerned about risk. In a typical policy, the service company or chemical supplier—the object of disclosure—must give additional information on chemicals in the fluid to the well operator, who in turn provides the information directly to the public. The state is now a facilitator and translator, not a regulator. The data are online, easily accessible, and presented together with explanations of the key issues. The subject of disclosure varies, but at a minimum includes the identity and maximum concentration of hazardous chemical constituents, as defined in worker safety law. When an operator withholds information because it is confidential, the policy requires the operator to clearly state that it is doing so. The policy may also limit trade secret protection by requiring disclosure of other identifying information or by ensuring that health professionals

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[329] 55-3 WYO. CODE R. § 45(h)(ii). Although this part of the rule only refers to chemical additives, the Wyoming Oil and Gas Conservation Commission expects operators to report the information by chemical constituent. *See, e.g.*, Nicholas Kusnetz, *Wyoming Fracking Rules Would Disclose Drilling Chemicals*, PROPUBLICA (Sept. 14, 2010), http://www.propublica.org/article/wyoming-fracking-rules-would-disclose-drilling-chemicals (quoting the Supervisor of the Commission as saying, "What we've explained to the operators and what we expect is each of these components, whatever is in that mix, will have to be disclosed.").

[330] 55-3 WYO. CODE R. § 45(f); WYO. STAT. ANN. § 16-4-203(d)(v) (2011) (exempting "[t]rade secrets, privileged information and confidential commercial, financial, geological or geophysical data furnished by or obtained from any person" from disclosure).

[331] *See* WYO. OIL & GAS CONSERVATION COMM'N, http://wogcc.state.wy.us/ (last visited Oct. 27, 2013) (follow "Wells" hyperlink to search database by number, well name, and location, or follow "Completions" hyperlink to search by date, then select a well, click on + sign next to "Approvals/Notice," click on + sign next to "Sundries Form 4," then follow "Notice of Intent Fracture Treat/Enhance" hyperlink or "Subsequent Report Fracture Treat/Enhance" hyperlink to view forms; for trade secret submissions and the Commission's responses, begin at the main page and follow the "Notices, Memo's [sic] and Details" hyperlink, and then the "Approved Trade Secrets" hyperlink).

receive information when there is an incident involving hydraulic fracturing fluid.

Texas was the first state to adopt a policy using the public education model. After hydraulically fracturing a well, the service company or supplier must provide the well operator with information about the chemical use.[332] The operator is then required to submit the information within thirty days of completion to an independent website known as FracFocus.[333] FracFocus is managed by the GWPC and the Interstate Oil & Gas Compact Commission (IOGCC), composed of the governors of the oil and gas producing states.[334] For each chemical additive, the operator must disclose the trade name, the name of the supplier, and a brief description of the intended use or function.[335] The operator must also provide a list of the chemical constituents of the additives, including the CAS numbers, and the actual or maximum concentrations of hazardous substances.[336] No information is provided directly to the state unless FracFocus is inoperable.[337] On FracFocus, the public may browse the map-based interface for a well; each well is linked to a standardized information sheet.[338] Texas's policy includes detailed trade secret provisions, including a process for nearby landowners to challenge claims, and exceptions for health professionals and emergency responders based on those in worker safety law.[339] If the identity of a constituent is withheld, the operator must disclose the chemical family name or a similar description on FracFocus.[340]

As can be seen in Figure 1, the vast majority of states that have adopted or proposed a disclosure policy have chosen the public education model pioneered by Texas. Of the states that use one

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[332] 16 TEX. ADMIN. CODE § 3.29(c)(1) (2012).

[333] *Id.* §§ 3.16(b), 3.29(a)(8), 3.29(c)(2)(A); *FracFocus Chemical Disclosure Registry*, FRACFOCUS, http://fracfocus.org/ (last visited Oct. 1, 2013).

[334] *About Us*, FRACFOCUS, *supra* note 315; *About Us*, INTERSTATE OIL & GAS COMPACT COMM'N, http://www.iogcc.state.ok.us/about-us (last visited Nov. 4, 2013).

[335] 16 TEX. ADMIN. CODE § 3.29(c)(2)(A)(ix).

[336] *Id.* § 3.29(c)(2)(A)(x)–(xiii).

[337] *Id.* § 3.29(c)(2)(B).

[338] *See Find a Well*, FRACFOCUS, *supra* note 42 (showing each information sheet, which includes not just the chemical information, but the date of hydraulic fracturing, the type of well, the vertical depth, and the total volume of water used).

[339] 16 TEX. ADMIN. CODE § 3.29(c)(4), (e)–(g).

[340] *Id.* § 3.29(c)(2)(C).

model, nine states—Colorado,[341] Louisiana,[342] Nevada,[343] North Dakota,[344] Ohio,[345] Oklahoma,[346] South Dakota,[347] Texas,[348] and Utah[349]—have public education policies that either require or allow reporting to FracFocus. Four more states—Kansas,[350] Michigan,[351] Nebraska,[352] and North Carolina[353]—have proposed such policies. Of the states that use a combination of models, six states—California,[354] Mississippi,[355] Montana,[356] Pennsylvania,[357] Tennessee,[358] and West Virginia[359]—have adopted public education policies that require or allow reporting to FracFocus, and two states—Alaska[360] and New York[361]—are considering doing so.

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[341] COLO. CODE REGS. § 404-1:205A(B)(2) (2012) (requiring disclosure to FracFocus unless inoperable).

[342] LA. ADMIN. CODE tit. 43, § 118(C)(4) (2011) (allowing disclosure to FracFocus).

[343] Nev. Comm'n on Mineral Res., *supra* note 300 (requiring disclosure to FracFocus).

[344] N.D. ADMIN. CODE 43-02-03-27.1(g) (2012) (requiring disclosure to FracFocus).

[345] OHIO REV. CODE ANN. § 1509.10(F) (West 2012) (allowing disclosure to FracFocus).

[346] OKLA. ADMIN. CODE § 165:10-3-10(b) (2012) (allowing disclosure to FracFocus or to the state, in which case the state will post the information on FracFocus).

[347] S.D. ADMIN. R. 74:12:02:19 (2013) (requiring disclosure to FracFocus).

[348] 16 TEX. ADMIN. CODE § 3.29(a)(8), (c)(2)(A) (2012) (requiring disclosure to FracFocus unless inoperable).

[349] UTAH ADMIN. CODE r. 649-3-39(1) (2013) (requiring disclosure to FracFocus).

[350] Kan. Corp. Comm'n, Notice of Hearing on Proposed Administrative Regulations (June 4, 2013), http://kcc.ks.gov/pi/hearing_kar_081513.htm (proposing to create KAN. STAT. ANN. §§ 82-3-1400 to -1402, which would require disclosure to FracFocus or state).

[351] Mich. Dep't of Envtl. Quality, *supra* note 306 (proposing to create MICH. ADMIN. CODE r. 324.1406, which would require disclosure to FracFocus unless unavailable).

[352] Neb. Oil & Gas Conservation Comm'n, *supra* note 288 (proposing to create 267 NEB. ADMIN. CODE § 3-43, which would require disclosure to FracFocus).

[353] N.C. Mining & Energy Comm'n, *supra* note 307 (proposing disclosure to FracFocus unless inoperable and advance disclosure of chemicals by "approved contractors").

[354] CAL. PUB. RES. CODE § 3160(g) (West 2013) (allowing disclosure to FracFocus while state creates its own website).

[355] 26-2 MISS. CODE R. § 1.26(11) (2013) (allowing disclosure to FracFocus).

[356] MONT. ADMIN. R. 36.22.608, .1010, .1015, .1016 (2011) (allowing disclosure to FracFocus).

[357] 58 PA. CONS. STAT. § 3222.1(b)(1)–(2) (2012) (requiring disclosure to FracFocus).

[358] TENN. COMP. R. & REGS. 0400-53-01-.03 (2013) (requiring disclosure to FracFocus).

[359] W. VA. CODE R. §§ 35-8-5.6.b.5, -10.1 (requiring operators of horizontal wells to disclose to FracFocus).

[360] Alaska Oil & Gas Conservation Comm'n, *supra* note 285 (proposing to create ALASKA ADMIN. CODE tit. 20, § 25.283(a)(13), (h)–(i), which would require disclosure to both FracFocus and the state).

[361] N.Y. Dep't Envtl. Conservation, Revised Express Terms 6 NYCRR Parts 550 through 556 and 560 (2012), http://www.dec.ny.gov/docs/administration_pdf/rhvhfet550556570.pdf (proposing to create N.Y. COMP. CODES R. & REGS. tit. x, § 560.3(d), .5(h), which would require disclosure to both FracFocus and the state).

Only Arkansas[362] and Illinois[363] have chosen to adopt public education policies that use state websites as the sole means of disclosure.

Figure 1: State Disclosure Models

C. THE INFLUENCE OF FRACFOCUS

Because of the popularity of the public education model, FracFocus is not just a means of disclosure. The standardized reporting requirements that apply to all operators who submit data to the site, and the manner in which information is presented

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[362] Arkansas requires service companies to prepare a master list of all chemicals used in hydraulic fracturing treatments in the state. 178-00-1 ARK. CODE R. § B-19(l)(3) (LexisNexis 2013). The state Oil and Gas Commission then posts the lists on its website. *See Well Fracture Information*, ARK. OIL & GAS COMM'N, http://www.aogc.state.ar.us/Well_Fracture_Companies.htm (last visited Nov. 7, 2013).

[363] 30 ILL. COMP. STAT. 105/5.826 § 1-110 (2013) (directing state to "create and maintain an online searchable database that provides information related to high volume horizontal hydraulic fracturing operations on wells that, at a minimum, include . . . chemical disclosure information").

on the site, have, in effect, created a nationwide disclosure policy built on the public education model. Some states explicitly recognize this policy by deferring to FracFocus to specify the information required;[364] other states attempt to control the policy by threatening to use other means of disclosure if the site is not improved.[365]

The FracFocus policy can result in more information than would otherwise be provided. Many operators began to report information to FracFocus before the states adopted disclosure policies. In the first year of the site, operators reported half of all hydraulically fractured wells.[366] Operators in states that do not currently have a disclosure policy are also reporting.[367] In some states that do have a disclosure policy, operators must submit additional information such as the maximum concentration of each ingredient in the additive.[368] And in states that have only a regulatory or reporting policy and do not make information easily available, FracFocus provides a simple means for the public to access information that is also submitted to the state.[369]

The FracFocus policy can also result in less information, by in practice preempting more stringent state policies.[370] In Ohio, for

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[364] *See* N.D. ADMIN. CODE 43-02-03-27.1(g) (2012) (requiring operator to "post on the fracfocus chemical disclosure registry all elements made viewable by the fracfocus website"); 58 PA. CONS. STAT. § 3222.1 (2012) (requiring operator to "complete the [FracFocus] form and post the form on [FracFocus] . . . in a format that does not link chemicals to their respective hydraulic fracturing additive"); UTAH ADMIN. CODE r. 649-3-39(1) (2012) (requiring operator to report the "amount and type of chemicals used in a hydraulic fracturing operation . . . to www.fracfocus.org").

[365] COLO. CODE REGS. § 404-1:205A(b)(3) (2012) (requiring disclosure through a state website if FracFocus is not made searchable by geographic area, ingredient, CAS number, time period, and operator); 58 PA. CONS. STAT. § 3222.1(b)(6) (2012) (requiring investigation into the feasibility of disclosure through a state website if FracFocus is not made searchable by the same criteria).

[366] Stan Belieu, Deputy Dir., Neb. Oil & Gas Conservation Comm'n, Presentation on FracFocus Chemical Disclosure Registry at the 19th Annual IPEC Conference (Oct. 30, 2012).

[367] *See, e.g.*, *Find a Well*, FRACFOCUS, *supra* note 42 (as of November 5, 2013, showing 52 wells in Alaska and 315 wells in Kansas, both states that have only proposed a disclosure policy).

[368] *See, e.g.*, *id.* (from the drop-down menu, choose the state of Oklahoma, then click on any well marker for the information sheet, which shows the maximum concentration in the additive even though the state does not require the information).

[369] *See, e.g.*, *id.* (as of November 5, 2013, showing 2,072 wells in Wyoming and 1,605 wells in New Mexico, both of which require reporting only to the state).

[370] *See generally* KATE KONSCHNIK ET AL., ENVTL. LAW PROGRAM POLICY INITIATIVE, HARVARD LAW SCH., LEGAL FRACTURES IN CHEMICAL DISCLOSURE LAWS: WHY THE VOLUNTARY CHEMICAL DISCLOSURE REGISTRY FAILS AS A REGULATORY COMPLIANCE TOOL

example, an operator is required to report the total volume of the hydraulic fracturing fluid and the maximum concentration of each additive in the fluid to FracFocus.[371] Operators do not appear to be complying with the requirement because the standardized form does not call for this information.[372] Some states require an operator that withholds the identity of a constituent as a trade secret to meet the applicable standard in state law and to provide the chemical family or a similar descriptor.[373] But FracFocus states that proprietary information is to be withheld using the standard in worker safety law, which does not require other identifying information to be disclosed.[374] In Texas, an operator must provide the name and contact information of the person making the trade secret claim on FracFocus, yet once again the FracFocus form does not include a place for the information.[375]

Moreover, the structure of FracFocus makes it difficult for states to ensure compliance with disclosure requirements. All laws are challenged by compliance, and there is no easy means of determining whether the extent of non-compliance on FracFocus is better or worse than in other contexts. But the sheer number of wells—as of late 2013, the site contains data on almost 56,000 wells[376]—makes careful oversight improbable. The entities that operate the site, the GWPC and the IOGCC, do not have authority to enforce state policies, and it is unclear to what extent states are aware of submissions.[377] Compliance is particularly an issue for

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(2013), *available at* http://blogs.law.harvard.edu/environmentallawprogram/files/2013/04/4-23-2013-LEGAL-FRACTURES.pdf (arguing that FracFocus is "not an acceptable regulatory compliance method for chemical disclosure" due to three general shortcomings: the timing of disclosure, the substance of disclosure, and the extent of nondisclosure).

[371] OHIO REV. CODE ANN. § 1509.10(A)(10)(b), (F) (2012).

[372] *See Find a Well*, FRACFOCUS, *supra* note 42 (from the drop-down menu, choose the state of Ohio, then click on any well marker for the information sheet).

[373] *See, e.g.*, COLO. CODE REGS. § 404-1:205A (2012).

[374] *About Us*, FRACFOCUS, *supra* note 315 ("The listing of a chemical as proprietary on the fracturing record is based on the 'Trade Secret' provisions related to Material Safety Data Sheets (MSDS) . . . at 1910.1200(i)(1).").

[375] *Compare* 16 TEX. ADMIN. CODE § 3.29(c)(2)(C), *with Find a Well*, FRACFOCUS, *supra* note 42 (from the drop-down menu, choose the state of Texas, then click on any well marker for the information sheet). *But see* Stan Belieu, *Debunking Myths about FracFocus*, GROUNDWATER COMMUNIQUE NEWSLETTER (Groundwater Prot. Council), Oct. 2012, at 1 (stating that the website discloses "ALL of the information required by the[ ] states with respect to 'hydraulic fracturing chemical disclosure' ").

[376] *FracFocus Chemical Disclosure Registry*, FRACFOCUS, *supra* note 333.

[377] *Compare* KONSCHNIK ET AL., *supra* note 370, at 1, *with FracFocus Responds to Harvard Study*, FRACFOCUS, http://fracfocus.org/node/344 (Apr. 24, 2013) ("FracFocus not only

trade secret claims, since they directly limit the amount of information. Of the states that use FracFocus, only California reviews and approves the claims.[378]

VI. RE-ENVISIONING CHEMICAL DISCLOSURE

Taken together, the state policies provide much more information on the chemicals used in high-volume hydraulic fracturing than federal law and prior state laws. Indeed, this Article has relied on information generated by the policies to explain the chemical activity. But the amount of information does not necessarily measure the success of the policy in responding to long-term uncertainty about the health and environmental effects of the activity. By the standards of risk science and decision science, the FracFocus policy fails to meaningfully improve public understanding of risk. States should heed the lessons of the two fields and take a new approach to disclosure, one that combines additional data with neutral risk communications.

A. LEARNING FROM RISK SCIENCE

From the perspective of risk science, state disclosure policies meaningfully improve public understanding if risk assessors can ultimately characterize the cumulative risks of the chemical activity. By this logic, policies must at a minimum provide complete, detailed information on the composition of the fluids. The information must be presented in a way that allows experts to easily compare chemical compositions across wells. When default assumptions cannot resolve critical second-order uncertainties in the risk assessment, such as the potential for exposure, states must require production of new information. Once the risks are characterized, the risks—not necessarily the underlying data—must be shared with the public.

Judged against this standard, the FracFocus policy fails to meaningfully improve public understanding. The policy is both too

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notifies states of the submission of disclosures and provides them with lists of such disclosures on a routine basis, it allows states to download the data from the disclosures so that it can be incorporated into the states [sic] own data system.").

[378] CAL. PUB. RES. CODE § 3160(j) (West 2013); *see also* MCFEELEY, *supra* note 264, tbl.V (displaying table showing that Colorado, Ohio, and Pennsylvania require the operator to submit a written submission to the state).

broad and too narrow in scope. The site requires well operators to disclose information that is extraneous to risk assessment, such as the purpose of each chemical additive. At the same time, critical data are missing. The site primarily requires disclosure of chemicals that have been identified as hazardous by manufacturers.[379] The data on these chemicals are limited by inadequate reporting and trade secret claims. When the EPA searched FracFocus to find constituents of hydraulic fracturing fluids, for example, the Agency could specifically identify all of the constituents in just 2% of the FracFocus well records.[380] Approximately 15% to 20% of records included at least one chemical that had been designated a trade secret.[381] While a few states require well operators to provide additional data on toxicity or exposure, these data are not on FracFocus. The site also makes it difficult to conduct a nationwide risk assessment because it limits search capabilities and presents the data in individual records rather than in a database.[382] Finally, FracFocus does not communicate the risks to the public, for the obvious reason that these risks have not been calculated.

To satisfy risk science, the GWPC, the IOGCC, and the states must first focus on resolving the uncertainties of experts, not the

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[379] *Frequently Asked Questions*, FRACFOCUS, http://fracfocus.org/faq (last visited Oct. 27, 2013) (follow "What chemicals are being disclosed on this website?" hyperlink for answer, "All chemicals that would appear on a Material Safety Data Sheet (MSDS) that are used to hydraulically fracture a well . . . "). When states mandate disclosure of all constituents, the FracFocus form allows well operators to list the non-hazardous constituents separately from the hazardous constituents in a product.

[380] EPA STUDY PROGRESS REPORT, *supra* note 75, at 61 (stating that 184 of 12,173 well records "had ingredient lists that fully matched the EPA CASRN list").

[381] *Id.* ("Operators reported at least one chemical ingredient as 'CBI,' 'proprietary,' or 'trade secret' in 1,924 well records."); *see also* Ben Elgin et al., *Fracking Secrets by Thousands Keep U.S. Clueless on Wells*, BLOOMBERG (Nov. 30, 2012, 12:01 AM), http://www.bloomberg.com/news/2012-11-30/frack-secrets-by-thousands-keep-u-s-clueless-on-wells.html (reporting that "[d]rilling companies in Texas . . . claimed [trade secret] exemptions about 19,000 times" between January and August of 2012, and "[n]ationwide, companies withheld one out of every five chemicals they used in fracking").

[382] *See Find a Well*, FRACFOCUS, *supra* note 42. *Cf.* Mike Soraghan, *Hydraulic Fracturing: FracFocus Can't Replace Full, Public Disclosure, Groups Say*, ENERGYWIRE (May 21, 2012), http://eenews.net/public/energywire/2012/05/21/1 (quoting Mike Paque, Executive Director of the GPC, as saying "[w]e did not set out to build a national environmental analytic tool or website . . . I guess no good deed goes unpunished"). An organization called SkyTruth "scraped" data from FracFocus to create a database for 2011 and 2012 wells. *Fracking Chemical Database*, SKYTRUTH, http://frack.skytruth.org/fracking-chemical-database (last visited Oct. 27, 2013).

general public. The FracFocus site should provide experts with a complete database of the chemical compositions of fluids and a repository for other critical risk information. To provide experts with trade secret information, FracFocus may have to limit disclosure to scientists and require confidentiality agreements with those outside government.[383] Additional data that are necessary to risk assessment could be collected by either public or private actors. The oil and gas industry and chemical manufacturers, however, are more likely to do so efficiently. To obtain needed data on toxicity, states could shift the burden to well operators to produce information demonstrating that the hazards of proposed chemical additives are at least as low as those of other additives.[384] To obtain needed data on exposure, states could require operators to conduct testing of nearby freshwater wells and report the results.[385] There must be quality controls to ensure that all of the reported data are useful. Once the risks have been characterized, they should then be communicated to the public.

B. LEARNING FROM DECISION SCIENCE

From the perspective of decision science, state disclosure policies meaningfully improve public understanding if they ultimately help individuals to make better decisions related to high-volume hydraulic fracturing. In this context, individuals face many different decisions: whether to lease minerals, whether to drink groundwater, whether to buy or sell land, whether to participate in the policy debate. Policies inform these decisions by providing useful data to risk scientists or individuals. In the former case, the policies must provide risk scientists with data

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[383] *Cf.* Letter from Thomas Field et al. to Cathy P. Foerster, Comm'r, Alaska Oil & Gas Conservation Comm'n (Apr. 1, 2013) (letter by several law professors arguing that Alaska should not provide protection for asserted trade secrets).

[384] *See* N.Y. DEP'T ENVTL. CONSERVATION, *supra* note 361 (proposing to create N.Y. COMP. CODES R. & REGS. tit. x, § 560.3(d)(1)(viii), which would require operators to demonstrate that the proposed additives "exhibit reduced aquatic toxicity" and "pose at least as low a potential risk to water resources and the environment as all known available alternatives," or show that the alternatives are not as effective or are not economically feasible).

[385] *See* COLO. CODE REGS. § 404-1:609 (2013) (requiring baseline testing before hydraulic fracturing, within six to twelve months after, and again within five to six years); 30 ILL. COMP. STAT. 105/5.826 § 1-80(b) (2013); N.Y. Dep't Envtl. Conservation, *supra* note 361 (proposing to create N.Y. COMP. CODES R. & REGS. tit. x, § 560.5(d)).

that reduce their uncertainty about potential effects of the chemical activity and that also result in knowledge that improves individuals' decisions. In the latter case, the policies must provide individuals with data that, when explained, improve their decisions. States must communicate the information in a neutral way to retain their credibility. The communications must be carefully designed, and yet reach as many individuals as possible before they make decisions. And the final judgment about the acceptability of the risk must be left to individuals.

Judged against this standard, the FracFocus policy fails to meaningfully improve public understanding. For the reasons discussed above, partial data on chemical composition is unlikely to generate expert knowledge, particularly not if the knowledge must inform decisions related to specific wells. The data are also very unlikely to help landowners who live near wells make decisions about their property or interested citizens make decisions about the policy debate—the apparent focus of the site's communications. A landowner who clicks on "Looking for information about a well site near you?" and then opens the well record will not know whether to sell her property after reading the names and concentrations of twenty or more chemical constituents. FracFocus promises to "put th[e] chemical information into perspective" by "provid[ing] objective information."[386] But the information is not connected to specific decisions,[387] and the tone of the communication suggests that individuals should not worry about understanding the chemical data, since the chemicals are present in very small concentrations and stay far underground, and the current laws protect the public from any harm.[388] Even a landowner's decision to test a freshwater well is not informed by the data.[389]

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[386] *About Us*, FRACFOCUS, *supra* note 315.

[387] *See, e.g.*, *What Chemicals Are Used*, FRACFOCUS, http://fracfocus.org/chemical-use/what-chemicals-are-used (last visited Oct. 27, 2013) (listing the most commonly used chemicals, offering tips on how to learn the specific identity of a chemical, and providing links to federal government and university websites that contain more information on health and environmental effects of individual chemicals).

[388] *See Chemical Use in Hydraulic Fracturing*, FRACFOCUS, http://fracfocus.org/water-protection/drilling-usage (last visited Oct. 27, 2013) (stating that "chemicals are needed to insure that the fracturing job is effective and efficient," and noting that a "typical fracture treatment will use very low concentrations of between 3 and 12 additive chemicals"); *Groundwater Protection & Water Usage*, FRACFOCUS, http://fracfocus.org/groundwater-protection (last visited Oct. 27, 2013) ("Pure, clean groundwater. Nothing can replace it. That

To satisfy decision science, the GWPC, the IOGCC, and the states must focus on resolving the uncertainties that prevent individuals from making good decisions. This requires officials, in partnership with decision scientists, to identify the universe of decisions that individuals must make, learn how individuals understand the chemical activity of high-volume hydraulic fracturing, and compare this understanding to the understanding of experts. Once officials have gathered this information, they can then focus on the decisions. The tone of the materials must be scrupulously neutral to garner public trust, and the site should avoid relying on the conclusions of the oil and gas industry. It should also make clear that its "customers" are members of the general public.[390] One critical aspect of the communication will be conveying the extent of scientific uncertainty in ways that assist individuals in making decisions. This avoids sending the message that no evidence of harmful effects is equivalent to no risk. As more studies are completed, the results should be integrated into the communication.

C. A PROPOSAL

Combined, the perspectives of risk science and decision science lead to a surprising conclusion: to truly improve public understanding about risk, disclosure of chemicals should be

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is why fresh-water aquifers are protected through strictly regulated exploration and production practices."); *Hydraulic Fracturing: The Process*, FRACFOCUS, http://fracfocus.org/hydraulic-fracturing-how-it-works/hydraulic-fracturing-process (last visited Oct. 27, 2013) (presenting text and figures from a 2010 magazine article by an employee of Pinnacle, a Halliburton Company, including the author's conclusion that "hydraulic fractures are not growing into groundwater supplies, and therefore, cannot contaminate them").

[389] *Groundwater Quality and Testing*, FRACFOCUS, http://fracfocus.org/groundwater-protection/groundwater-quality-testing (last visited Oct. 27, 2013) (advising nearby landowners to test their wells before oil or gas wells are hydraulically fractured, and to consult with professionals after the disclosure so they can decide whether to conduct additional testing).

[390] *Compare FracFocus Chemical Disclosure Registry*, FRACFOCUS, *supra* note 333 (stating that upgrades will "dramatically enhance the site's functionality for the public, state regulatory agencies and industry users"), *with* Press Release, FracFocus, FracFocus 2.0 to Revolutionize Hydraulic Fracturing Chemical Reporting Nationwide (May 29, 2013), http://fracfocus.org/node/347 (stating that upgrades will "dramatically improve the site's functionality for state regulatory agencies, industry and public users"). *See also* Benjamin Haas et al., *Fracking Hazards Obscured in Failure to Disclose Wells*, BLOOMBERG (Aug. 14, 2012, 6:26 PM), http://www.bloomberg.com/news/2012-08-14/fracking-hazards-obscured-in-failure-to-disclose-wells.html (reporting that the American Petroleum Institute and America's Natural Gas Alliance pay part of the site's operating costs).

designed to inform experts who can assess that risk. At the same time, individuals must have information so they can make important decisions. To achieve both of these goals, FracFocus should be separated into two sections that respond to the needs of each audience. One section of the site, which may be restricted, should offer risk scientists the most complete data possible on high-volume hydraulic fracturing fluids from across the country.[391] The other section of the site, which must be open to all, should offer individuals the most accurate information they need to make decisions. Utilizing the existing FracFocus site is a pragmatic choice. Disclosure policy has already coalesced around the site. The states have invested significant resources in FracFocus, and the site is well known among stakeholders and the oil and gas industry. But utilizing the site can also be justified normatively. The site has the potential to be a model for cooperative state policy on a controversial environmental and energy issue.

At a minimum, every state should require the operator of each well to disclose the complete identity and concentration of all constituents of fluids after high-volume hydraulic fracturing. To ensure that well operators are held accountable for the information they disclose, the data must be disclosed directly to the state, as part of the state's regulatory program. Operators may request protection for data they consider to be a trade secret, but the states should review the operators' claims. States are then responsible for adding the data to the database on FracFocus so that scientists have access to it. Because of the paucity of exposure data, all states should also require operators to monitor groundwater around wells and report the data to the state for inclusion in the database. In addition to providing important information for risk assessment, this monitoring alleviates the need for individuals to know the chemical composition of fluids in order to conduct baseline testing of freshwater wells.

FracFocus should offer tailored risk communications for each type of decision related to high-volume hydraulic fracturing. Some decisions—such as whether to participate in the policy debate—may require general information about the issue and an

[391] Almost all new oil or gas wells are hydraulically fractured. Because the chemical activity of concern is high-volume hydraulic fracturing, the database should focus on these types of wells. States will need to agree on the definition of "high-volume" hydraulic fracturing.

explanation of the extent of scientific uncertainty. Other decisions—such as whether to lease minerals—may require both general information on leases and specific information on well operators, such as an operator's compliance history. Yet other decisions—such as whether to buy or sell land—may require very specific information about the location of proposed and existing wells. In addition to narrative descriptions, the site could harness the existing graphical interface to provide needed information. To provide individuals with useful information and to regain public trust, the states should partner with decision scientists trained in the mental models approach.

This proposal is not a panacea. Even with the information on FracFocus, members of the public may find it difficult to use the levers of informational regulation to respond to multiple, short-term sources of risk. The transaction costs of Coasean bargaining are prohibitive when communities must bargain with many operators. Citizen activists may not be able to enforce the terms of a social license against so many potential violators. Participants in democratic deliberation may be overwhelmed by the scale of the chemical activity. And the right to know is diminished when individuals do not know where to focus their attention.[392] Just as there were studies on the TRI, it will be important to continually evaluate the effectiveness of the disclosure policies.

VII. CONCLUSION

This Article set out to answer the following question: do the state chemical disclosure policies effectively respond to uncertainty about the long-term health and environmental effects of high-volume hydraulic fracturing? In their current form, the unfortunate answer is no. The policies are not likely to reduce either scientific or public uncertainty in a way that meaningfully improves public understanding of risk. In fact, it is more likely

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[392] This is not to say that the prospect of disclosure has had no effect. Two service companies announced "green" chemical additives after the FRAC Act was introduced in Congress, although no toxicity data have been released. *See, e.g.*, Press Release, Halliburton, Halliburton Introduces CleanStim™ Fracture Formulation, Launches New Microsite on Hydraulic Fracturing Fluids Disclosure (Nov. 15, 2010), http://halliburton.com/public/news/pubsdata/press-release/2010/corpnws_111510.html; *Green Frac*, CHESAPEAKE ENERGY, http://www.chk.com/Corporate-Responsibility/EHS/Environment/Green-Frac/Pages/Information.aspx (last visited Oct. 27, 2013).

that these policies feed public mistrust of state governments and the oil and gas industry.

Based on the perspectives of risk science and decision science, this Article proposes a new approach—more Jeffersonian, less Texas Railroad Commission. Rather than "helping the public understand the safety of hydraulic fracturing,"[393] this proposal seeks to "inform [the public's] discretion"[394] through better risk assessment and risk communication. If adopted, the new FracFocus-centered policy does not solve the problem of uncertainty. It does, however, require the states to provide much more information to the public on the bounds of that uncertainty. Whether the public will then exercise its control with "a wholesome discretion,"[395] we can only see.

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393 *See* Press Release, R.R. Comm'n of Texas, *supra* note 2.
394 *See* Letter from Thomas Jefferson to William Charles Jarvis, *supra* note 1.
395 *See id.*