Water Issues Set the Pace for Fracking Regulations and Global Shale Gas Extraction

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* © 2013 Michael Esposito. J.D. candidate 2014, Tulane University Law School; B.S. 2010, University of Southern California. Michael would like to thank the *Journal* editors and Junior Members who helped edit this Comment. He would also like to thank his friends, family, and his mother Lynn for their love and support.

I. INTRODUCTION

Sherry Vargson's farmhouse in Granville Summit, Pennsylvania, receives a steady supply of water from the well situated under her property.[1] However, for the past year, she has cooked with water from a five-gallon jug because the water coming out of her faucet contains enough methane that she can light a match and see a burst of flames engulf her kitchen sink.[2] Ms. Vargson's story is a common one in rural farming communities situated on shale gas formations.[3] In these communities, natural gas has seeped into underground aquifers after drillers perform a controversial process known as hydraulic fracturing (fracking).[4] Incidents such as these have spurred a public outcry for more stringent regulation of fracking.[5] When drillers use fracking to extract natural gas, a mixture of sand, water, and various chemicals are injected deep into the ground at a high pressure to fracture shale formations.[6] The public, in the United States and the world at large, is concerned that in addition to contamination of underground and surface water, fracking "exacerbates water scarcity problems, and . . . even causes earthquakes."[7]

While many citizens are concerned about the environmental impact of fracking, this contentious drilling process has allowed the United States to access large supplies of shale gas, which has fundamentally changed the U.S. energy picture.[8] "In the United States (US), production of shale gas has expanded from around 7.6 billion cubic metres (bcm) in 1990 (or 1.4% of total US gas supply) to around 93bcm (14.3% of total

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1. Ryan Tracy, *Drillers Face Methane Concern*, WALL ST. J., Sept. 26, 2011, at A5a.
2. *Id.*
3. *'Gasland' Documentary Shows Water That Burns, Toxic Effects of Natural Gas Drilling*, HUFFINGTON POST (May 25, 2011, 5:50 PM), http://www.huffingtonpost.com/2010/06/21/gasland-documentary-shows_n_619840.html.
4. Tracy, *supra* note 1.
5. Colin McEvoy, *Anti-Fracking Protest Calls on Pa. Sen. Pat Browne To Support State Moratorium*, LEHIGH VALLEY LIVE (July 11, 2013, 2:20 PM), http://www.lehighvalleylive.com/allentown/index.ssf/2013/07/anti-fracking_protest_calls_on.html; Kristopher Settle, *Thousands Protest Fracking in Albany*, ENERGY COLLECTIVE (June 21, 2013), http://theenergycollective.com/ecskris/240046/thousands-gather-fracking-protest-albany.
6. David B. Spence, *Federalism, Regulatory Lags, and the Political Economy of Energy Production*, 161 U. PA. L. REV. 431, 438 (2013).
7. Rebecca Jo Reser & David T. Ritter, *State and Federal Legislation and Regulation of Hydraulic Fracturing*, 57 ST. B. TEX. LITIG. SEC. REP. ADVOC. 31, 31 (2011).
8. KPMG GLOBAL ENERGY INST., SHALE GAS—A GLOBAL PERSPECTIVE 2 (2011), *available at* http://www.kpmg.com/Global/en/IssuesAndInsights/ArticlesPublications/Documents/shale-gas-global-perspective.pdf.

US gas supply) in 2009."[9] As the U.S. energy market has experienced this boom, it has become evident that shale gas production, through the use of fracking, has the potential to change the global energy industry drastically.[10] Shale gas is both cheaper and cleaner than fossil fuels.[11] In addition, it is found almost anywhere on the planet, meaning it can bring greater energy independence to many nations and create domestic jobs.[12] Furthermore, conventional natural gas reserves are depleting at an extraordinary rate, meaning unconventional gas sources, such as shale gas, will need to be explored globally.[13]

However, the top environmental concern that has the potential to slow down global shale gas exploration drastically is ground and surface water contamination and depletion.[14] There are numerous studies that claim shale gas wells are responsible for the contamination of hundreds of water supplies in the United States.[15] In addition, the process of fracking itself requires large amounts of water with a single well using about 4 to 5 million gallons of water, 1 million gallons of which is contaminated wastewater.[16] This heavy demand for water poses a threat to communities situated over shale gas formations, particularly those in areas already experiencing droughts.[17] As other nations have witnessed U.S. water contamination and shortage problems due to fracking, many are questioning whether they want to explore shale gas extraction at all,[18] while others have fully embraced that fracking is a part of the future energy market and are looking to the United States as an example for effective regulation.[19]

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9. RUTH WOOD ET AL., THE TYNDALL CTR., UNIV. OF MANCHESTER, SHALE GAS: A PROVISIONAL ASSESSMENT OF CLIMATE CHANGE AND ENVIRONMENTAL IMPACTS 8 (2011) (citation omitted), *available at* http://tyndall.ac.uk/sites/default/files/tyndall-coop_shale_gas_report_final.pdf.

10. KPMG GLOBAL ENERGY INST., *supra* note 8, at 2.

11. *Id.*

12. CONT'L ECON., INC., THE ECONOMIC IMPACTS OF U.S. SHALE GAS PRODUCTION ON OHIO CONSUMERS, at EX-1 (2012), *available at* http://www.eidohio.org/wp-content/uploads/2012/02/Economic-Impacts-of-Shale-Gas-Production_Final_23-Jan-2012.pdf.

13. WOOD ET AL., *supra* note 9, at 8.

14. Robert E. Beck, *Current Water Issues in Oil and Gas Development and Production: Will Water Control What Energy We Have?*, 49 WASHBURN L.J. 423, 423-24 (2010).

15. *Id.* at 436.

16. Brian Dumaine, *Solving Fracking's Biggest Problem*, CNNMONEY (Dec. 13, 2012, 1:42 PM), http://tech.fortune.cnn.com/2012/12/13/solving-frackings-biggest-problem/.

17. *Id.*

18. Sorell E. Negro, *Fracking Wars: Federal, State and Local Conflicts over the Regulation of Natural Gas Activities*, ZONING & PLAN. L. REP., Feb. 2012, at 1, 1.

19. Susan L. Sakmar, *The Global Shale Gas Initiative: Will the United States Be the Role Model for the Development of Shale Gas Around the World?*, 33 HOUS. J. INT'L L. 369, 392 (2011).

Part II of this Comment will give an explanation of natural gas production and fracking. Part III will discuss how water contamination has shaped the regulatory scheme in the United States. Parts IV and V will demonstrate, by using the United Kingdom and China as examples, how, similar to the United States, water preservation has shaped and will continue to shape other nations' regulatory developments. Finally, Part VI will discuss potential solutions to water scarcity and contamination issues given that fracking is a seemingly inevitable and integral part of the world's future energy market.[20]

II. AN OVERVIEW OF FRACKING AND SHALE GAS EXTRACTION

A. Types of Natural Gas Reservoirs

All natural gas reservoirs can be classified as either conventional or nonconventional.[21] "In a conventional reservoir, natural gas has migrated from a source rock into a 'trap' that is capped by an impermeable layer of rock."[22] With these types of reserves, gas companies can access the natural gas by simply drilling directly into the reservoir.[23]

Obtaining natural gas from unconventional reservoirs is a varied and a more complicated process. Tight gas, which makes up about 30% of U.S. natural gas production, is a type of natural gas trapped in sandstone.[24] Coal Bed Methane (CBM), which accounts for approximately 8% of U.S. natural gas production, comes from underground coal seams.[25] Finally, shale gas reservoirs, the focus of this Comment, contain natural gas that is trapped in shale rock formations.[26] Conservative estimates of U.S. shale gas reserves are around 500 to 1000 trillion cubic feet.[27] While the United States currently extracts the largest amount of shale gas, other nations, such as China, have significantly larger shale gas

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20. With 335 billion toes of conventional hydrocarbons left on the planet and a usage rate of approximately 8.353 billion toes per year, conventional energy sources will be depleted in forty-eight years. Thus, unless the world drastically curbs its dependence on fossil fuels as its main source of energy, oil and gas companies will have to extract unconventional hydrocarbons, such as shale gas. Jason Obold, *Leading by Example: The Fracturing Responsibility and Awareness of Chemicals Act of 2011 as a Catalyst for International Drilling Reform*, 23 COLO. J. INT'L ENVTL. L. & POL'Y 473, 475 (2012).

21. Sakmar, *supra* note 19, at 374.

22. *Id.*

23. *Id.* at 375.

24. *Id.* at 376.

25. *Id.*

26. *Id.*

27. HALLIBURTON, U.S. SHALE GAS: AN UNCONVENTIONAL RESOURCE. UNCONVENTIONAL CHALLENGES 1 (2008), *available at* http://www.halliburton.com/public/solutions/contents/shale/related_docs/H063771.pdf.

reserves.[28] China has an estimated 4800 trillion cubic feet of shale gas reservoirs, which is almost five times greater than the U.S. deposit and by far the world's largest onshore reserve.[29] Accessing this natural gas requires a relatively new technology known as horizontal drilling and the controversial process of fracking.[30]

B. What Is Fracking?

As mentioned above, fracking is a process by which a mixture of sand, water, and various chemicals, known as the fracking fluid, is injected deep into the ground at a high pressure to fracture shale formations.[31] Before the fracking fluid is injected, drillers create a well that reaches the shale formation and then they drill horizontally in both directions.[32] Then, through a process known as perforation, a series of explosions are set off along the horizontal well to break up the shale rock.[33] Finally, the actual fracking process begins when "pump trucks are attached to the wellhead by a series of pipes and manifolds and begin to simultaneously pump fracing [sic] fluids into the wellbore, gradually increasing the pressure in the wellbore until the pressure exceeds the fracture gradient of the rock."[34] Once the fracture gradient is surpassed, small fissures are created, and these cracks in the rock are propped open by the sand in the fracking fluid, which allows natural gas to flow into the horizontal wells and eventually to the surface.[35] After the fracking fluid is injected, a large portion of the fluid, usually around 75%, returns to the surface as flowback water or produced water.[36] The unaccounted for amount remains in the shale formation and potentially seeps into the surrounding rock formations.[37] The produced water is usually placed into a containment pond or reinjected into a disposal well, which is a well drilled specifically to dispose of these harmful fluids.[38] "Either storage

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28. Timothe Feodoroff & Jennifer Franco, *Chinese Fracking Plans Prompt "Water-Grabbing" Fears*, CHINADIALOGUE (Mar. 11, 2013), http://www.chinadialogue.net/article/show/single/en/5789-Chinese-fracking-plans-prompt-water-grabbing-fears.

29. *Id.*

30. Sakmar, *supra* note 19, at 376-77.

31. Spence, *supra* note 6, at 438.

32. *Advanced Drilling Techniques*, AM. PETROLEUM INST., http://www.api.org/oil-and-natural-gas-overview/exploration-and-produciton/natural-gas/advanced-drilling (last visited Nov. 22, 2013).

33. Jesica Rivero Gilbert, *Assessing the Risks and Benefits of Hydraulic Fracturing*, 18 MO. ENVTL. L. & POL'Y REV. 169, 175 (2011).

34. *Id.*

35. *Id.*

36. *Id.* at 176; Feodoroff & Franco, *supra* note 28.

37. Gilbert, *supra* note 33, at 176.

38. *Id.*

option leads to potential spills, and as contended by many communities surrounding fracing[sic] operations, environmental contamination."[39]

Through advances in drilling technology, such as the development of horizontal drilling and the creation of more effective fracking fluids, shale gas production has become much more cost-efficient.[40] Horizontal drilling allows producers to create multiple wells from a single drilling pad, leading to huge cost savings that did not exist before the advent of this specialized form of drilling.[41] Due to these cost-saving advancements in technology, shale gas now accounts for about 20% of U.S. natural gas production.[42] The United States Energy Information Administration forecasts that shale gas will likely account for over 50% of natural gas production by 2035.[43] Shale gas production in China and the United Kingdom will likely develop at a much slower pace because both of these countries are still in the exploratory phase of production.[44] While the United Kingdom has not forecasted its future shale gas production, China has huge shale gas extraction goals with plans to pump 229 billion cubic feet of natural gas per year by 2015.[45]

C. Fracking Opposition

Each stage of the fracking process involves considerable risk, leading to a large number of concerns from environmental groups and the public at large.[46] Most of the fracking opposition centers on a growing concern for the depletion or contamination of fresh water supplies.[47] The first concern relates to cement casing failures, which can allow methane and other hazardous chemicals to migrate to underground water sources.[48] After drilling is complete and before the actual fracking process begins, the well is sealed with cement to prevent harmful fracking chemicals from permeating into the subsurface zones and aquifers.[49] Most of the media coverage concerning people lighting their faucets on fire and finding pollutants in their underground water sources

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39. *Id.*
40. KPMG GLOBAL ENERGY INST., *supra* note 8, at 2.
41. Spence, *supra* note 6, at 438.
42. CONT'L ECON., INC., *supra* note 12, at EX-1.
43. *Id.*
44. Feodoroff & Franco, *supra* note 28.
45. *Id.*
46. *Id.*
47. *See* Beck, *supra* note 14, at 424.
48. Spence, *supra* note 6, at 455.
49. James Conca, *The Fracking Solution Is a Good Cement Job*, FORBES (Sept. 10, 2012, 1:12 AM), http://www.forbes.com/sites/jamesconca/2012/09/10/the-fracking-solution-is-a-good-cement-job/.

stem from bad cement casing jobs.[50] Accordingly, "Controlling the quality of cementing and well casing is widely viewed as the most important factor in protecting water supplies and ensuring the integrity of a well."[51]

The second concern is water contamination that can occur from flowback water if the drilling company is not careful during the disposal process or if an accidental spill occurs during truck transportation.[52] Flowback water contains a number of pollutants, including chemicals used in fracking fluids, traces of oil-laced drilling mud, and other toxic substances previously trapped in the rock.[53] Most of this flowback water is pumped underground into a disposal well, but state and federal legislators, as well as environmental groups, have spoken out against this controversial disposal method, claiming that the toxic substances are seeping into water supplies and that the process wastes millions of gallons of drinking water.[54] Instead, many state legislators have proposed that the flowback water be recycled into clean drinking water[55] or reused in other fracking operations.[56]

The media has elevated many of these fracking concerns to the forefront of environmental discussions.[57] Movies, such as *Gasland* and *Promised Land*, demonstrate the harmful effects of fracking to small farming communities.[58] In addition, news companies have released countless articles expressing the concern that fracking is poisoning underground and surface water supplies.[59] Recent news articles, such as a three-part *New York Times* article concerning flowback water contaminating lakes, rivers, and other surface water sources, have

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50. *Id.*

51. Abrahm Lustgarten, *Water Problems from Drilling Are More Frequent Than PA Officials Said*, PROPUBLICA (July 31, 2009, 11:29 AM), http://www.propublica.org/article/water-problems-from-drilling-are-more-frequent-than-officials-said-731; *see also* Feodoroff & Franco, *supra* note 28.

52. Feodoroff & Franco, *supra* note 28.

53. *Id.*

54. *See* Negro, *supra* note 18, at 1.

55. *See* David Biello, *How Can We Cope with the Dirty Water from Fracking?*, SCI. AM. (May 25, 2012), http://www.scientificamerican.com/article.cfm?id=how-can-we-cope-with-the-dirty-water-from-fracking-for-natural-gas-and-oil.

56. *See* James Conca, *Fracking with Bad Water*, FORBES (Feb. 4, 2013, 2:21 AM), http://www.forbes.com/sites/jamesconca/2013/02/04/fracking-with-bad-water/.

57. *See 'Gasland' Documentary Shows Water That Burns, Toxic Effects of Natural Gas Drilling*, *supra* note 3.

58. *See* GASLAND (HBO Documentary Films 2010); PROMISED LAND (Focus Features 2012).

59. *See, e.g.*, Dumaine, *supra* note 16; Tracy, *supra* note 1.

sparked a public outcry for more stringent laws and regulations on the treatment or disposal of flowback water.[60]

In addition to concerns for clean water, air pollution caused by fracking has also received much media attention.[61] During the flowback period, "fracturing fluids, water, and reservoir gas come to the surface at a high velocity and volume. This mixture includes a high volume of VOCs [volatile organic compounds] and methane, along with air toxics [sic] such as benzene, ethylbenzene and h-hexane."[62]

Finally, there are concerns that fracking causes earthquakes.[63] Several minor earthquakes during fracking operations have been recorded near the Blackpool aquifer in the United Kingdom.[64] Furthermore, minor earthquakes have occurred in Texas in relation to fracking operations in the Barnett Shale Reservoir, causing a 4.6 magnitude earthquake to startle San Antonio residents.[65] This seismic activity has brought heightened attention to the environmental effects of fracking.[66]

III. CONCERNS FOR WATER CONTAMINATION SHAPE THE U.S. REGULATORY FRAMEWORK FOR FRACKING

A. Current Federal Regulation

Fracking has been used in the United States for over sixty years in more than a million wells.[67] Recent innovations that combine fracking with horizontal drilling have made natural gas in shale formations more easily ascertainable and cost efficient.[68] As shale gas production has expanded over the past decade, both state and federal legislators in the

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60. Ian Urbina, *Regulation Lax as Gas Wells' Tainted Water Hits Rivers*, N.Y. TIMES, Feb. 27, 2011, at A1 [hereinafter Urbina, *Regulation Lax*]; Ian Urbina, *Gas Wells Recycle Water, but Toxic Risks Persist*, N.Y. TIMES, Mar. 2, 2011, at A1; Ian Urbina, *Pressure Stifles Efforts To Police Drilling for Gas*, N.Y. TIMES, Mar. 4, 2011, at A1.

61. Gilbert, *supra* note 33, at 183.

62. *Id.* at 188-89.

63. Sheyda Aboii, *What's with All These Earthquakes in Texas?*, STATEIMPACT (June 26, 2012, 10:05 AM), http://stateimpact.npr.org/texas/2012/06/26/whats-with-all-these-earthquakes-in-texas/.

64. Charlotte Doerr, *UK DECC Commissioned Report Recommends Hydraulic Fracturing in Britain*, ENERGY BUS. L. (Apr. 25, 2012, 3:36 PM), http://www.energybusinesslaw.com/2012/04/articles/hydraulic-fracturing/uk-decc-commissioned-report-recommends-hydraulic-fracturing-in-britain/.

65. Aboii, *supra* note 63.

66. *See id.*; Doerr, *supra* note 64.

67. *Freeing Up Energy*, AM. PETROLEUM INST. 2 (July 19, 2010), http://www.api.org/policy/exploration/hydraulicfracturing/upload/hydraulic_fracturing_primer.pdf.

68. *Id.*

United States have considered a number of regulations.[69] Most legislation has focused on the potential harmful effects of fracking to U.S. water supplies.[70]

The Safe Drinking Water Act (SDWA) is the primary federal law for protecting U.S. water supplies from contamination.[71] The Environmental Protection Agency (EPA) is "responsible for administering the SDWA but a federal-state structure exists in which the EPA may delegate primary enforcement and implementation authority (primacy) for the drinking water program to states and tribes."[72] Part C of the SDWA, which protects underground drinking-water sources, requires that states that self-regulate underground injections submit an Underground Injection Control (UIC) proposal to the EPA that meets minimum standards.[73] Such standards regulate the "siting, construction, operation, closure, financial responsibility, and other requirements for owners and operators of injection wells."[74] However, until recently, the EPA has not regulated gas-production wells and did not consider fracking as part of the definition of underground injections under the SDWA.[75]

In 1997, the United States Court of Appeals for the Eleventh Circuit ruled that fracking fluids used for CBM deposits located in coal seams fit under the SDWA definition of underground injections and must either be regulated by the EPA or state UIC programs.[76] In response to this decision, the EPA began to study the impacts of CBM production on drinking-water sources to determine whether further regulation was needed.[77] In 2004, the EPA issued a final report, concluding that "the injection of hydraulic fracturing fluids into CBM wells posed little threat to underground sources of drinking water and required no further study."[78] However, some members of Congress and the EPA's professional staff criticized the report, claiming that very little research had been done on the environmental impact of fracturing fluids.[79]

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69. *Id.* at 9.
70. *Id.*
71. Sakmar, *supra* note 19, at 407.
72. *Id.* (footnotes omitted).
73. 42 U.S.C. §§ 300h to 300h-8 (2006).
74. Sakmar, *supra* note 19, at 408.
75. *Id.*
76. Legal Envtl. Assistance Found. v. EPA, 118 F.3d 1467, 1478 (11th Cir. 1997).
77. Sakmar, *supra* note 19, at 409.
78. *Id.*
79. *Id.* at 409-10.

Following the EPA's report, Congress enacted the Energy Policy Act of 2005, which deregulated much of the oil and gas industry.[80] This Act expressly exempted fracking fluids from the definition of "underground injection," stating that "the term 'underground injection' excludes the underground injection of fluids or propping agents (other than diesel fuels) pursuant to hydraulic fracturing operations related to oil, gas, or geothermal production activities."[81] This language effectively removed the EPA's authority, and the federal government's authority as a whole, to regulate the injection of fracking fluids under the SDWA.[82]

B. State Regulation

State efforts to regulate shale gas extraction and fracking have varied widely.[83] A minority of states, such as New Jersey and New York, have prohibited all "high-volume hydraulic fracturing combined with horizontal drilling," while other states have taken less drastic measures, such as regulating the use of chemicals and wastewater disposal and management.[84]

Those states that have chosen to regulate water usage in fracking operations usually focus on the disposal of flowback water, the chemical composition of fracking fluids, and the amount of water used for fracking operations.[85] In Arkansas, if House Bill 1396 passes, which addresses local concerns related to fracking in the Fayetteville Shale, it would require companies to disclose the amount of water and fracking fluids used in each operation.[86] The California legislature is also considering a similar regulation under Assembly Bill 591, which has the same requirements with an added provision that would ensure safe disposal of contaminated water.[87] In Wyoming, legislators approved new regulations on September 15, 2010, that require companies to identify water-supply wells, demonstrate wellbore integrity, and report chemical use to the Oil and Gas Conservation Commission.[88]

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80. Eric Dannenmaier, *Executive Exclusion and the Cloistering of the Cheney Energy Task Force*, 16 N.Y.U. ENVTL. L.J. 329, 331 (2008).

81. Energy Policy Act of 2005, Pub. L. No. 109-58, 119 Stat. 694.

82. Sakmar, *supra* note 19, at 410.

83. Gilbert, *supra* note 33, at 183-87.

84. N.Y. COMP. CODES R. & REGS. tit. 9, § 7.41 (2011); H.B. 1396, 88th Gen. Assemb., Reg. Sess. (Ark. 2011); Cal. A.B. 591, Reg. Sess. (Cal. 2011); S.B. 2575, 214th Leg., 1st Ann. Sess. (N.J. 2010).

85. Ark. H.B. 1396; Cal. A.B. 591; 30-3 WYO. CODE R. §§ 1(a), 12 (LexisNexis 2010).

86. Ark. H.B. 1396.

87. Cal. A.B. 591.

88. *Id.*; 30-3 WYO. CODE R. §§ l(a), 12.

While each state has created a unique regulatory scheme, there is a clear theme: regulating to protect the state's water supplies. In order to form a more cohesive and efficient law in relation to clean ground and surface water, the U.S. government should expand the SDWA to include all fracking operations. Until the federal government develops a more comprehensive regulatory system, both environmentalists and gas companies will suffer; environmentalists will have to lobby in every state with shale gas reservoirs and gas companies will have to vary operations to adhere to the patchwork of regulations developing in the United States.

C. Potential Future Regulations

The public concern for water contamination caused by fracking has risen dramatically in the last few years as shale gas extraction has quickly spread across the United States. As a result, there has been a renewed effort to amend the SDWA to include fracking.[89] In 2009, Congress introduced companion bills H.R. 2766 and S. 1215 as the Fracturing Responsibility and Awareness of Chemicals Act (FRAC Act).[90] "The FRAC Act would amend the SDWA definition of 'underground injection' to expressly include 'the underground injection of fluids or propping agents' used for hydraulic fracturing in oil and gas operation and production activities."[91] In addition, the FRAC Act would require oil and gas producers to list the chemical composition of their fracking fluids.[92] However, the 111th Congress adjourned before taking any type of action on the FRAC Act.[93]

After heightened concern for the harmful effects of fracking and a public outcry for federal regulation, the United States House of Representatives and the United States Senate both reintroduced the FRAC Act in February 2013 and June 2013, respectively.[94] Although the bill has yet to pass, the FRAC Act is now a bipartisan bill, receiving support from both Republicans and Democrats as politicians realize the

89. Sakmar, *supra* note 19, at 410-11.
90. *See* S. 1215, 111th Cong. (2009); H.R. 2766, 111th Cong. (2009).
91. Sakmar, *supra* note 19, at 410-11.
92. *Id.* at 411.
93. *Id.*
94. S. 1135, 113th Cong. (2013) (reintroducing the FRAC Act in the 113th Congress); H.R. 482, 113th Cong. (2013) (same). The FRAC Act was assigned to a congressional committee, which will consider it before sending it on to the House or Senate as a whole.

need for common-sense legislation that can fix the industry's current patchwork of differing state regulations.[95]

In addition to renewed regulation under the SDWA, some members of Congress are pushing for regulation under the Clean Water Act (CWA).[96] The CWA prohibits the discharge of pollutants into the water of the United States.[97] Under the CWA, "[A]nyone seeking to discharge a pollutant into water of the U.S. must first obtain a permit from either the EPA or an authorized state agency, according to the CWA established National Pollutant Discharge Elimination System Program."[98] Similar to the SDWA, states receive enforcement authority with the CWA laws as long as the state obtains the EPA's approval of its program.[99] Currently, these state programs or the EPA regulate either the indirect disposal of fracking wastewater through sewer systems or disposal by trucks into publicly owned treatment works.[100] The increase in public concern and the high level of political action related to fracking may lead to more stringent enforcement by the EPA under authority granted by the CWA, which would increase the number of disposal alternatives covered by these regulations.[101]

In an effort to better understand the effect of fracking on the environment, Congress has ordered the EPA to produce a report on fracking.[102] While the final report will not be released until 2016,[103] the

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95. *DeGette and Gibson Introduce Bipartisan FRAC Act*, DEGETTE HOUSE (May 9, 2013), http://degette.house.gov/index.php?option=com_content&view=article&id=1272:degette-and-gibson-introduce-bipartisan-frac-act&catid=76:press-releases-&Itemid=227.

96. 33 U.S.C. § 1251 (2006).

97. *Id.* For an explanation of the meaning of waters of the United States:

> The definition of "waters of the U.S." at 40 CFR 122.2 and 230.3(s) is a labyrinthine term that has been interpreted by the United States Supreme Court recently in *Solid Waste Agency of Northern Cook County v. U.S Army Corps of Engineers*, 531 U.S. 159 (2001) and *Rapanos v. U.S.*, 547 U.S. 715 (2006) prompting additional proposed agency guidance, which can be found at http://water.epa.gov/lawsregs/guidance/wetlands/upload/wous_guidance_4-2011.pdf.

Reser & Ritter, *supra* note 7, at 38 n.17.

98. Reser & Ritter, *supra* note 7, at 32; Clean Water Act, 33 U.S.C. §§ 1251, 1342(a).

99. Reser & Ritter, *supra* note 7, at 32.

100. *Id.*

101. *Id.*

102. Sakmar, *supra* note 19, at 411.

103. Originally set to come out in 2014, the EPA recently announced that it would postpone the release until 2016. Steve Horn, *Obama EPA Censored Key Pennsylvania Fracking Water Contamination Study*, HUFFINGTON POST (July 29, 2013, 4:02 PM), http://www.huffingtonpost.com/steve-horn/obama-epa-censored-key-pennsylvania-fracking_b_3670989.html.

EPA released a 275-page progress report in December 2011.[104] This report claimed that the most likely source of contamination to water supplies in Wyoming was from fluids used in fracking.[105] Originally, the final report was to include both computer simulations of water contamination and field tests at drilling sites.[106] However, not a single drilling company was willing to allow the EPA to test water quality before and after drilling and fracking, forcing the report to narrow its study to computer simulations only.[107] Since this study, the federal government has gained access to field testing on sites in Pennsylvania.[108] Both the Department of Energy and the EPA have released reports that conclude that there was no contamination of drinking water at their respective Pennsylvania drilling sites.[109] However, these studies alone do not prove that fracking does not pollute ground water because industry practices and the geology of underground formations differ greatly across the nation.[110] Furthermore, there have been reports that the EPA actually found groundwater contamination at its Pennsylvania test site.[111] According to an internal PowerPoint presentation obtained by a *Los Angeles Times* reporter, EPA staff members "concluded that 'methane and other gases released during drilling . . . apparently cause significant damage to the water quality.'"[112] The presentation further concluded that "methane is at significantly higher concentrations in the aquifers after gas drilling and perhaps as a result of fracking and other gas well work."[113] It is very surprising that this data was not released in 2012 along with the EPA's findings that there was no contamination at their Pennsylvania test site.[114] It is unclear why the EPA has chosen to withhold this information given that these findings will likely play a role

104. Kevin Begos, *EPA's Fracking Study May Dodge Water Contamination Frequency Issue*, HUFFINGTON POST (Jan. 6, 2013, 11:19 AM), http://www.huffingtonpost.com/2013/01/06/epa-fracking-study-water-contamination_n_2420786.html.

105. Timothy Gardner, *US Delays Finalizing Report Linking Fracking to Water Pollution*, REUTERS (Jan. 11, 2013, 1:46 PM), http://www.reuters.com/article/2013/01/11/usa-epa-fracking-idUSL1E9CB59J20130111.

106. Begos, *supra* note 104.

107. *Id.*

108. *Id.*; Horn, *supra* note 103.

109. *EPA Completes Drinking Water Sampling in Dimock, Pa.*, EPA (July 25, 2012), http://yosemite.epa.gov/opa/admpress.nsf/90829d899627a1d98525735900400c2b/1a6e49d193e1007585257a46005b61ad!opendocument; *Study Finds Fracking Chemicals Didn't Pollute Water: AP*, CBS NEWS (July 19, 2013, 5:41 AM), http://www.cbsnews.com/8301-201_162-57594498/study-finds-fracking-chemicals-didnt-pollute-water-ap/.

110. *Study Finds Fracking Chemicals Didn't Pollute Water: AP*, *supra* note 109.

111. *See* Horn, *supra* note 103.

112. *Id.*

113. *Id.*

114. *See EPA Completes Drinking Water Sampling in Dimock, Pa.*, *supra* note 109.

in the decision on whether to enact the FRAC Act or to create tighter regulations under the CWA.[115]

IV. THE UNITED KINGDOM'S ENERGY DEMANDS DRIVE SHALE GAS EXTRACTION

A. Shale Gas Extraction and Regulation in the United Kingdom

Unlike in the United States, where landowners own the resources under their land, ownership of resources in the United Kingdom is held by the state.[116] Thus, drillers in the United Kingdom must receive licenses from the Department of Energy and Climate Change (DECC) in order to exploit hydrocarbons.[117] When the DECC and U.K. legislators set up a regulatory framework for the exploitation of hydrocarbons in 1990, shale gas extraction was neither a popular technique nor a consideration for regulation.[118] The DECC issues Petroleum Exploration and Development Licenses (PEDL), which give the driller the exclusive right to hydrocarbons within a given area.[119] However, even after obtaining a PEDL, the driller must "negotiate access with landowners; seek permission from the Coal Authority if operations will penetrate coal seams; and be granted local planning permission from the Minerals Planning Authority."[120] With such a complicated regulatory scheme, the process for drilling a well for conventional natural gas is a difficult procedure with a number of legal hurdles.[121] The regulatory process for exploiting unconventional natural gas reservoirs will most likely be an even more complicated process given these established regulatory committees and the general public apprehension toward fracking.[122]

Shale gas extraction in the United Kingdom is in the exploratory stage and still many years away from U.S. levels of commercial production.[123] Shale gas formations have been found in two locations in the United Kingdom: the Blackpool aquifer in Lancashire and, more

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115. *Id.*

116. THE ROYAL SOC'Y & ROYAL ACAD. OF ENG'G, SHALE GAS EXTRACTION IN THE UK: A REVIEW OF HYDRAULIC FRACTURING 53 (2012), *available at* http://www.raeng.org.uk/news/publications/list/reports/Shale_Gas.pdf.

117. *Id.*

118. *Id.*

119. *Id.* at 53-54.

120. *Id.* at 54.

121. *See id.*

122. *See id.* Similar to that in the United States, public apprehension toward fracking is present in the United Kingdom, with large-scale protests to ban fracking. Settle, *supra* note 5; *Anti-Fracking Protest Camp Set Up Near Tarleton, Lancashire*, BBC NEWS (May 12, 2013, 12:26 PM), http://www.bbc.co.uk/news/uk-england-lancashire-22477559.

123. KPMG GLOBAL ENERGY INST., *supra* note 8, at 14.

recently, in the Mendips.[124] After exploratory drilling potentially caused two minor earthquakes at the Blackpool aquifer in April and May 2011, the United Kingdom temporarily banned fracking in order to assess its damages to the environment.[125] Six months after the ban, a U.K. Parliament committee assigned to look into the harmful environmental effects of shale gas production "found no evidence that fracking poses a direct risk to underground water aquifers, provided the drilling well is constructed properly."[126] Following this report, the United Kingdom lifted its ban in December 2012, giving British gas companies, such as Cuadrilla, the go-ahead to continue further exploration.[127]

Although the United Kingdom eventually lifted its ban, the environmental activists and the renewable energy lobby did not lose out completely.[128] Under the newly proposed regulatory scheme, any tremors that measure 0.5 or higher on the Richter scale will result in an automatic halt to operations.[129] This measure is relatively low when compared to the industry standard, which calls for mitigation measures if the magnitude exceeds around 1.7 on the Richter scale.[130] With a requirement of halting all operations at 0.5 or higher, drilling companies will likely face more regulatory hurdles in the near future when fracking operations begin again. In fact, the recent earthquakes at the Blackpool aquifer were a magnitude of 2.3 and 1.5.[131] Although neither of these earthquakes were felt by nearby residents, these earthquakes would require a halt of operations under the new law.[132]

B. Growing Concern for Water Contamination

While the United Kingdom has decided to push forward with shale gas production despite the earthquakes caused by fracking, environmental groups are lobbying for a renewed ban based on fracking's

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124. *Id.* at 12.

125. Laura Smith-Spark & Jim Boulden, *UK Lifts Ban on Fracking To Exploit Shale Gas Reserves*, CNN (May 3, 2013, 1:40 PM), http://edition.cnn.com/2012/12/13/business/uk-fracking.

126. KPMG GLOBAL ENERGY INST., *supra* note 8, at 12.

127. *Id.*

128. Nick Collins, *Fracking: Drilling Method 'To Be Extended' Despite Causing Blackpool Earthquakes*, TELEGRAPH (Apr. 17, 2012, 6:29 AM), http://www.telegraph.co.uk/science/science-news/9206898/Fracking-drilling-method-to-be-extended-despite-causing-Blackpool-earthquakes.html.

129. *Id.*

130. Andrew Orlowski, *Frack Me! UK Shale Gas Bonanza 'Bigger than North Sea Oil,'* REGISTER (Dec. 14, 2012), http://www.theregister.co.uk/2012/12/14/gaia_violated_by_frackers/.

131. Collins, *supra* note 128.

132. *See id.*

effect on clean water supplies.[133] A recent publication by the Tyndall Centre, which is funded by the University of Manchester and focuses on climate change research, looked toward shale gas extraction from the United States when concluding in its report that the United Kingdom should halt production plans until the risks to ground and surface water contamination can be assessed.[134] One of the top concerns is that shale gas extraction "could put considerable pressure on water supplies at the local level [g]iven that water resources in many parts of the U.K. are already under pressure."[135] After witnessing the water shortages that have been occurring throughout the United States due to fracking, U.K. environmentalists are apprehensive about moving forward with shale gas extraction.[136]

C. The United Kingdom's Future for Large-Scale Shale Gas Extraction

At first, shale gas reserves estimated by the British Geological Survey were quite low, but in September 2011, Cuadrilla, the largest oil and gas company in the United Kingdom, announced that it had found over 200 trillion cubic feet of gas in the Lancashire area.[137] While the U.K. government remains cautious about environmental concerns, this large discovery of shale gas has accelerated exploration and full-scale operations will most likely begin in 2015.[138] Until the United Kingdom's shale gas extraction is fully operational, much of their natural gas energy needs will be met by the United States.[139] In the beginning of the U.S. shale gas boom, the government kept a tight rein on the export of natural gas.[140] However, with heightened levels of natural gas driving prices low in the United States, the government now allows gas companies to sell supply internationally.[141] Recently, on March 25, 2013, the U.K. gas supplier Centrica signed an agreement with Cheniere, one of the first U.S. companies to receive clearance from the federal government to export

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133. *See* WOOD ET AL., *supra* note 9, at 6-7.
134. *Id.*
135. *Id.*
136. *Id.* at 5.
137. *Shale Gas Firm Finds 'Vast' Gas Resources in Lancashire*, BBC NEWS (Sept. 21, 2011, 3:22 PM), http://www.bbc.co.uk/news/uk-england-lancashire-14990573.
138. KPMG GLOBAL ENERGY INST., *supra* note 8, at 13.
139. Fiona Harvey, *US Shale Gas To Heat British Homes Within Five Years*, GUARDIAN (Mar. 25, 2013, 7:20 PM), http://www.guardian.co.uk/environment/2013/mar/25/us-shale-gas-british-homes-five-years.
140. *Id.*
141. *Id.*

shale gas.[142] Under the agreement, Cheniere will provide 89 billion cubic feet of liquified natural gas to Centrica, which is enough gas to heat over 1.8 million homes.[143] This agreement came about amidst concerns over the United Kingdom's dwindling natural gas supply, falling to a low point of only two days' worth of gas left in storage in early March after an unseasonable cold snap.[144] In an effort to increase natural gas storage levels and decrease foreign dependence, it is likely that the United Kingdom will move aggressively forward in its exploration of shale gas while considering the environmental concerns faced in the United States after its shale gas boom.

V. CHINA'S WATER SHORTAGE HINDERS SHALE GAS EXTRACTION

A. Current Regulation Through Water Laws

The Chinese government began shale gas exploration in 2010,[145] but as of this Comment, the government does not regulate fracking directly.[146] China has chosen not to regulate fracking because the government values economic growth over environmental protection.[147] However, as China continues to develop, water shortage problems will likely force the government to implement fracking regulations.[148] Estimates place China's shale gas deposits around 4800 trillion cubic feet, and the Chinese government has huge shale gas extraction goals with plans to pump 229 billion cubic feet of natural gas per year by 2015.[149] These operations will require no less than 485 million cubic feet of water, which will put huge pressure on an already dwindling fresh water supply.[150]

Even though China only began its shale gas exploration in 2010, it has quickly become one of Asia's leaders in unconventional shale gas extraction.[151] As this industry continues to grow, concerns for water shortages and water contamination take the forefront in the fracking

142. *Id.*
143. *Id.*
144. *Id.*
145. KPMG GLOBAL ENERGY INST., *supra* note 8, at 16.
146. James W. Adams, Jr. et al., *Emerging Centrifugal Technology in Shale Hydraulic Fracturing Waste Management: A U.S.-France-China Selected Environmental Comparative Analysis*, 34 HOUS. J. INT'L L. 561, 595 (2012).
147. *See id.* at 597.
148. *Id.* at 599-600.
149. Feodoroff & Franco, *supra* note 28.
150. *Id.*
151. *Id.*

dialogue.[152] China's water policy is defined through the Zhonghua Renmin Congheguo Shuiweran Fangzhi, or the Water Pollution Prevention and Control Law (WPPCL).[153] As a nation holding 22% of the world's population and only 7% of the world's accessible fresh water, access to clean drinking water is a very strong concern in China.[154] "Estimates have shown that China's freshwater supplies are only capable of supporting 650 million people on a sustainable basis—only half the nation's population."[155] While Chinese environmental laws and regulations are surprisingly comprehensive, they lack effectiveness, mainly due to local protectionism from government officials.[156] Chinese government officials' achievements are mainly based on Gross Domestic Product (GDP) estimates for their regions while environmental quality is not considered at all.[157] As a result, "local officials are highly motivated to pursue GDP growth at whatever costs to the environment, as short term GDP increase often means benefits and advancement opportunities."[158]

However, in 2008, amendments to the WPPCL addressed this problem by adding water protection, along with economic growth and social development, to the factors considered when evaluating government officials.[159] In addition, the new amendments require officials to take countermeasures and actions to prevent and treat water pollution, including a performance evaluation to address whether the official accomplished water protection objectives.[160] This legal framework has the potential to serve as a strong backbone as China moves forward with its fracking expansion. However, China will need more comprehensive laws that specifically address shale gas extraction, horizontal drilling, and fracking and cannot rely solely on local officials for the regulation of this growing industry.

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152. *See id.*

153. Law of the People's Republic of China on the Prevention and Control of Water Pollution Act (promulgated by the Standing Comm. Nat'l People's Cong., Feb. 28, 2008, effective June 1, 2008) (China), *available at* faolex.fao.org/docs/texts/Chn23549.doc.

154. Adams et al., *supra* note 146, at 596; Don Hinrichsen, *Freshwater: Lifeblood of the Planet*, GOOD NEWS BAROMETER (Feb. 26, 2007), http://www.goodnewsbarometer.com/PDF gallery.htm.

155. Adams et al., *supra* note 146, at 596.

156. *Id.* at 597.

157. *Id.*

158. *Id.*

159. *Id.*

160. *Id.* at 597-98.

B. China's Water Shortage Issue and the Future of Shale Gas Extraction

Because of China's very limited water supply and the growing need for clean water as its economy continues to grow, water shortage problems will be a major hindrance to shale gas extraction.[161] Even though China is still in the exploratory stage of shale gas extraction, it has already faced water shortage problems due to fracking.[162] Recently, a drilling operation in the Shaanxi Province encountered complications, and local officials temporarily had to cut off water supplies to nearby cities.[163] Similar to the drilling operation in Shaanxi, most of the nation's shale gas formations lie in areas with very limited water resources.[164] As fracking operations continue to expand in these regions, it is very likely that there will be more water shortage problems.[165] One Chinese news source summed up the situation with fracking and dwindling water supplies quite well:

> China's embrace of fracking may seem attractive on the surface, but its darker consequences are already becoming obvious. Handing over power to determine how land and water is used and how the environment is managed to fracking corporations and their quest for profit is not a path to a sustainable and liveable future for China's citizens.[166]

Furthermore, China's water supplies have recently faced catastrophic damage unrelated to oil and gas drilling.[167] For instance, in early March 2013, 60,000 dead pigs were found in the Jiapingtang River just sixty miles from Shanghai.[168] The pigs belonged to farmers who dumped them upriver after they died from circovirus, a common disease among pigs that is not known to be infectious to humans.[169] Pigs are not the only contaminants that are regularly dumped into the Jiapingtang River—"[t]oday [the river] is inky black, covered in a slick of lime green algae, and it smells like a blocked drain."[170] Many rivers throughout China, which serve as large water sources for most major cities, have suffered

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161. Feodoroff & Franco, *supra* note 28.
162. *Id.*
163. *Id.*
164. *Id.*
165. *Id.*
166. *Id.*
167. *See* Nicola Davison, *Rivers of Blood: The Dead Pigs Rotting in China's Water Supply*, GUARDIAN (Mar. 29, 2013, 12:09 PM), http://www.guardian.co.uk/world/2013/mar/29/dead-pigs-china-water-supply.
168. *Id.*
169. *Id.*
170. *Id.*

similar contamination that forces more than 500 million people to use water contaminated by human and industrial waste.[171] Without the proper regulations, fracking operations could lead to further contamination if Chinese gas companies were disposing of flowback water improperly or incorrectly cementing the well. The United States has agreed to help China with its expansion goals for shale gas.[172] While the current U.S. regulatory framework is not perfect, it is better than China's current lack of any significant regulatory scheme. With the help of the United States, China may be able to further develop its fracking regulations so that it may navigate a safer expansion into the shale gas energy industry that maintains and preserves clean water supplies.

VI. RECOMMENDATIONS FOR THE REGULATION OF GLOBAL SHALE GAS PRODUCTION

A. A Good Cement Casing Job

Many drilling companies claim that only 1% of wells have faulty cement jobs that lead to harmful chemicals contaminating subsurface land and aquifers, but environmentalists, such as Scott Anderson of the Environmental Defense Fund, say up to 15% of all cement jobs are bad.[173] Whether it is actually 1%, 15%, or, most likely, somewhere in between, these cement jobs are ripe for regulation.[174] Such regulations could greatly reduce the level of underground water and subsurface soil contamination. "Lots of outrage has been directed towards the fracking itself, but the worse culprit is a bad cement job. Almost all of the TV spots, heart-breaking stories of homeowners, and burning faucets are actually from bad cement jobs, not the fracking."[175] A number of U.S. states have passed laws that regulate the casing and cement standards for wells.[176] For example, "Texas rules specify exactly where the well casing must be constructed within the well, the materials to be used, and how the casing is to be cemented and pressure tested."[177] However, other states have not set regulations for cement casing, effectively allowing gas

171. *See Water Pollution in China*, FACTS & DETAILS, http://factsanddetails.com/China/Cat10/Sub66/items391.html (last visited Nov. 22, 2013).

172. *See* Sakmar, *supra* note 19, at 391-92 ("In November 2009, China and the United States signed a Memorandum of Understanding to jointly cooperate in assessing China's shale gas resources and, consequently, promote investments in this area.").

173. Conca, *supra* note 49.

174. *Id.*

175. *Id.* (citation omitted).

176. Spence, *supra* note 6, at 455-56.

177. *Id.* at 455 (footnotes omitted).

companies to inadequately cement shale gas wells.[178] In order to ensure the protection of U.S. water supplies, the federal government needs to create cement-casing standards that apply to all states. Such standards would result in less water contamination in the United States as well as serve as an example for nations that are still in the exploratory phase of shale gas extraction.

B. Fracking with Contaminated Water

In an effort to limit the amount of fresh water used for fracking, the Pennsylvania Department of Environmental Protection (PADEP) has been encouraging drillers to use contaminated water from old mining operations.[179] According to PADEP, "more than 300 million gallons of polluted water from decades of coal mining operations, flows into the state's rivers and streams every day . . . resulting in '4,000 miles of biologically dead rivers and streams.'"[180] Last year alone, U.S. drillers used 40 billion gallons of fresh water to frack, which is "almost half of the acid mine drainage generated each year."[181] There are clear environmental benefits to drillers using this contaminated water supply for their fracking operations.

However, many drillers are wary of using the mine water because they could incur major environmental liability. "Anyone considering the use of [contaminated mine water] for natural gas extraction activities has the potential to incur long-term liability because just the act of moving contaminated water gives you total responsibility for it in the future."[182] To limit the risk to drillers, Pennsylvania legislators enacted the Environmental Good Samaritan Act, which provides protection from civil liability for companies using contaminated mining water.[183] In addition, drillers can obtain a Consent Order and Agreement with PADEP, which will protect them from long-term treatment obligations for the mine water.[184]

While such a large amount of contaminated mine water may be unique to Pennsylvania, there are many abandoned coal mines

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178. *Id.*

179. Conca, *supra* note 56.

180. Susan Phillips, *Pennsylvania's DEP Offers Acid Mine Drainage Water to Drillers*, STATEIMPACT (Jan. 9, 2013, 1:16 PM), http://stateimpact.npr.org/pennsylvania/2013/01/09/pennsylvanias-dep-offers-acid-mine-drainage-water-to-drillers/.

181. Conca, *supra* note 56.

182. *Id.*

183. *Id.*

184. *Id.*

throughout the United States that produce contaminated water.[185] If PADEP is able to decrease drillers' use of freshwater supplies by encouraging them to use contaminated mine water, other states' environmental protection agencies will likely follow. Other nations with dwindling water supplies, such as China, will need to create laws that will encourage drillers to use various types of contaminated water instead of using fresh water supplies. Such encouragement could lead to the conservation of billions of gallons of fresh water.

C. Decontaminating Wastewater from Fracking

According to the United States Accountability Office, oil and gas wells in the United States produce at least 9 billion liters of contaminated water per day, which is an underestimate because this number does not reflect the amount of brine, fracking fluid, and other contaminated water that flows back up a well with the oil and natural gas.[186] As shale gas extraction through the use of fracking continues to grow at a rate of 48% per year in the United States, there is a growing concern with the amount of contaminated water the industry is producing.[187] The main issue is that these large volumes of contaminated water are laced with everything from naturally radioactive minerals to harmful chemicals, and "there are not a lot of cost-effective options for treating it, other than dumping it down a deep well."[188] Because of the high cost of recycling this contaminated water, more than 90% of it is disposed of by dumping it down one of the nation's 150,000 disposal wells.[189]

Currently, no federal law exists for the disposal and treatment of contaminated water from fracking operations.[190] However, some states, such as Pennsylvania, have created state regulations that make it difficult to drill disposal wells.[191] As a result, operators in Pennsylvania must truck produced water to Ohio at a cost of $15 per barrel and drill disposal wells there at a cost of a least $5 million per well.[192] In addition, states experiencing prolonged droughts, such as Texas, have suspended water use for fracking in certain drought-stricken areas.[193] With water-scarcity problems and tighter state regulations, the industry has responded with a

185. *Id.*
186. Biello, *supra* note 55.
187. *Id.*
188. *Id.*
189. *Id.*
190. *See* Urbina, *Regulation Lax*, *supra* note 60.
191. Biello, *supra* note 55.
192. *Id.*
193. *Id.*

number of cost-efficient ways to recycle and reuse water from fracking operations.[194] For example, a company in California, Plains Exploration & Production Company (PXP), has developed a cost-effective way to treat contaminated water using membranes that costs around $8.50 per barrel, and another company in Georgia, Ecologix Environmental System, has adapted a process from the food industry that can treat contaminated water at the drilling site, which drastically reduces transportation costs.[195] In the alternative, there is another company, GASFRAC Energy Services, that has created a way to frack without water, using a recyclable gel instead.[196]

As these cost-efficient methods for recycling contaminated water continue to develop, nations need to consider regulating wastewater from fracking operations. These regulations should ban the use of disposal wells and require the recycling of fracking fluids and wastewater or the use of waterless fracking. Such regulations could serve as a regulatory scheme that could be used by other nations, such as China and the United Kingdom, to help alleviate the danger of water shortages caused by the rise in shale gas extraction.

D. Fracking with Food

An even better alternative to developing and enforcing regulations that require the safe decontamination of fracking fluid is to have no contamination at all. Halliburton has developed a new form of fracking fluid that is made with ingredients from the food industry rather than the chemical industry.[197] However, this is a very recent development, and Halliburton has not released information on how many of its wells use this new fracking fluid or how much the fluid costs.[198] As fracking fluids that do not harm the environment or contaminate water develop, legislators should consider banning the use of certain chemicals in fracking fluids. For nations with developing shale gas markets, such regulations could prevent similar contamination issues that the United States has suffered from due to the harmful chemicals used in fracking fluids.

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194. *Id.*

195. *Id.*; Dumaine, *supra* note 16.

196. Biello, *supra* note 55.

197. Steve Hargreaves, *Clean Fracking: Moving To Replace Chemicals*, CNNMONEY (Nov. 16, 2011, 11:41 AM), http://money.cnn.com/2011/11/16/news/economy/clean_fracking/index.htm.

198. *Id.*

VII. CONCLUSION

In the United States, shale gas has already changed the energy picture, allowing businesses and consumers to lower their energy costs and giving the economy a much-needed boost.[199] Most nations are currently exploring shale gas exploration, but whether shale gas becomes a game-changer on a global level will require the industry to "surmount tremendous reputational and regulatory hurdles."[200] Many nations are concerned about the contamination or depletion of their clean water supplies, viewing expansion into fracking as a trade-off of environmental concerns for economic growth.[201] However, these nations can have economic growth from shale gas extraction without devastation to the environment and to water supplies if the proper regulatory framework is implemented in the early stages of development.

At the world's current rate of hydrocarbon consumption, conventional reservoirs will be depleted in forty-eight years.[202] Unless nations immensely alter their energy mix, oil and gas companies will have to tap into the world's unconventional fossil fuels, such as shale gas. Therefore, shale gas extraction is most likely an inevitable part of the global energy market, and fracking is a necessary process in order to extract this unconventional source of hydrocarbons. In order to ensure that the world's water supply is not contaminated while also meeting energy demands, nations will have to develop a comprehensive legal framework that regulates shale gas extraction, fracking, and horizontal drilling. As the nation at the forefront of the shale gas boom, the United States will inevitably serve as a model for other nations' regulatory schemes and development plans for shale gas extraction. If the United States is able to pass federal law that will form a more cohesive regulatory scheme, and provide uniform environmental protection throughout the country, U.S. fracking law has the potential to serve as a beneficial model for other nations.

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199. CONT'L ECON., INC., *supra* note 12, at EX-1.
200. *See* KPMG GLOBAL ENERGY INST., *supra* note 8, at 3.
201. *Id.*
202. Obold, *supra* note 20, at 475.