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Shale Gas: Evolving Global Issues for the Environment, Regulation, and Energy Security

Jeffery R. Ray*

INTRODUCTION

Shale gas provides a significant step forward in promoting energy security and offers a potential avenue for responding to climate change—both for the European Union and the United States. The benefits far outweigh the potential problems uniquely manifested in acquiring shale gas, which include regulatory concerns brought on by rapid advancements in technology and technique.¹ These concerns, however, require additional inquiry into whether a special regulatory regime is needed for hydraulic fracturing.

This Article argues that a special regime is not necessary to regulate shale gas if the existing national regime properly addresses (or is capable of addressing by legislative amendment) the environmental, social, and sustainable development issues that the development and production of shale gas potentially creates. The U.S. regulatory regime exemplifies the above assertion. The U.S. does not have a special regulatory regime for shale gas,² nor does it need one. Instead, the United States utilizes the generalized structure of the Environmental Protection Agency (EPA) to regulate the environmental effects the industry may produce. The EPA, in turn, is granted authority from Congress, to regulate environmental concerns through the Clean Water Act,³ Energy Policy Act of 2005,⁴

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1. This Article, generally, uses a U.S. perspective when discussing shale gas. This point of view is logical, due to the recent and extensive utilization of advancements in technology and methods of hydraulic fracturing in the U.S. See 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, 370–71 (2011).

2. See Molly Wurzer, Comment, *Taking Unconventional Gas to the International Arena*, 7 *TEX. J. OIL GAS & ENERGY L.* 357, 375–80 (2011–2012).

3. 33 U.S.C. §§ 1251–1387 (2006 & Supp. 2011).

4. 42 U.S.C. §§ 15801–16524 (2006 & Supp. 2011).

the Clean Air Act,⁵ and the Safe Drinking Water Act.⁶ In the U.S., reliance is duly placed on democratic, legislative bodies and the industry to handle social issues surrounding shale gas.

Part I of this Article presents the technical, legal, and policy issues created by hydraulic fracturing in the capture of shale gas. The global significance of hydraulic fracturing will be explored in Part II; that part will also emphasize the importance of hydraulic fracturing to the U.S. and European Union. Part III concludes that the current regulatory regimes are equipped to regulate shale gas. Regulatory critique, particularly of the regulatory structures in the U.S., will be interwoven into the analysis of this Article; this critique will state the correlation between the relatively low environmental impact associated with the production of shale gas and will discuss the concomitant positive attributes of the U.S.'s regulatory regime.⁷

I. BACKGROUND: HYDRAULIC FRACTURING

Shale gas was, traditionally, commercially unrecoverable due to a lack of a technological ability to capture enough shale gas to make the venture viable.⁸ During the past few decades, a positive, price-driven market has propelled the natural gas industry to create technological innovations that have cracked open—or rather “fracked” open—the shale gas market.⁹ The traditional method of

5. 42 U.S.C. §§ 7401–7671 (2006 & Supp. 2011).

6. 42 U.S.C. §§ 300f–300j26 (2006 & Supp. 2011).

7. As a preliminary matter, it will be helpful to define certain terms in a rudimentary fashion, and it is well understood that differing definitions may apply in specific contexts. First, “sustainable development” shall mean: “development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” Rep. of The World Commission on Environment and Development, 42nd Sess., August 4, 1987. UN Doc. A/42/427. Second, “renewable energy” shall mean: “energy from renewable, non-fossil sources, namely wind, solar, aerothermal, geothermal, hydrothermal and ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases.” *Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009*, 2009 O.J. (L 140) 1, 27 (2009). Finally, “energy security” shall mean: “a condition in which a state and all, or most, of its citizens and businesses have access to sufficient energy resources at reasonable prices for the foreseeable future free from serious risk of major disruption of service.” BARRY BARTON ET AL., *ENERGY SECURITY: MANAGING RISK IN A DYNAMIC LEGAL AND REGULATORY ENVIRONMENT* 5 (2004).

8. Sakmar, *supra* note 1, at 370; Steffen Jenner & Alberto J. Lamadrid, *Shale Gas vs. Coal: Policy Implications from Environmental Impact Comparisons of Shale Gas, Conventional Gas, and Coal on Air, Water, and Land in the United States*, 53 *ENERGY POL'Y J.* 442, 442 (2013).

9. See Jeffrey C. King, *Selected Re-Emerging and Emerging Trends in Oil and Gas Law as a Result of Production from Shale Formations*, 18 *TEX.*

vertical drilling (conventional drilling) has now, at least with regard to shale gas, been made obsolete by horizontal drilling (unconventional drilling), which is now used in conjunction with hydraulic fracturing and stimulation, commonly known as fracking.¹⁰ Most significant issues in shale gas revolve around the critical and controversial method of fracking.¹¹

Fracking, as performed in current practice, is the method of injecting millions of gallons of water and a relatively small percentage of proppant (sand or small granules to hold open cracks), solvents, gels, and other additives into the wellbore at high pressures.¹² The additives, solvents, and gels are used in various portions, depending on the shale formation, to penetrate deep into the shale formation.¹³ The proppant ensures that the fractures in the shale stay open to allow the shale gas to migrate to the wellbore.¹⁴ The fracking of shale is more effective when used with unconventional, horizontal drilling.¹⁵

A well created through unconventional drilling can be described as a well that “departs from the vertical [wellbore] at a predetermined . . . point, where it begins deviating from a vertical to a horizontal trajectory.”¹⁶ Commentators Philip Whitworth and Davin McGinnis have explained that the most important improvement on unconventional drilling was the “ability to ‘steer’ a drill bit.”¹⁷ The advancements in unconventional drilling and fracking have led to a plethora of technical, legal, and policy issues.¹⁸

WESLEYAN L. REV. 1, 3–7 (2011) (noting that “frack” is an industry specific term connoting hydraulic fracturing).

10. H. Philip Whitworth & D. Davin McGinnis, *Square Pegs, Round Holes: The Application and Evolution of Traditional Legal and Regulatory Concepts for Horizontal Wells*, 7 TEX. J. OIL GAS & ENERGY L. 177, 179–81 (2011–2012); see also Wurzer, *supra* note 2, at 357–61; Gianna Cricco-Lizza, Comment, *Hydraulic Fracturing and Cooperative Federalism: Injecting Reality into Policy Formation*, 42 SETON HALL L. REV. 703, 712–14 (2012).

11. See Wurzer, *supra* note 2, at 366–70.

12. *Id.* at 361.

13. *Id.* at 362–63.

14. Sarah K. Adair, et al., *Considering Shale Gas Extraction in North Carolina: Lessons From Other States*, 22 DUKE ENVTL. L. & POL’Y F. 257, 262 (2012).

15. R. Marcus Cady, II, Comment, *Drilling into the Issues: A Critical Analysis of Urban Drilling’s Legal, Environmental, and Regulatory Implications*, 16 TEX. WESLEYAN L. REV. 127, 133 (2009).

16. Whitworth & McGinnis, *supra* note 10, at 179.

17. *Id.*

18. Lynn K. McKay, et al., *Science and the Reasonable Development of Marcellus Shale Natural Gas Resources in Pennsylvania and New York*, 32

A. Technical Aspects of Hydraulic Fracturing

Well known issues directly and indirectly affect shale gas plays, or drilling opportunities. Cost and transportation issues are, among other things, some of the key technical problems affecting shale gas plays in both the U.S. and abroad.

1. Cost

Unconventional drilling and fracking present an economic cost increase from that of conventional drilling.¹⁹ The added cost to the industry is notable.²⁰ However, the economic returns of a properly developed field effectively surpass the cost with substantial pecuniary benefit.²¹ The Barnett Shale alone has “created over 83,000 jobs” within its area of operation and has provided the state and local governments with “an estimated \$1.1 billion . . . through taxes and permit fees.”²² The production costs of unconventional plays are “also continuously decreasing.”²³

2. Transportation

An additional issue that involves added cost, as well as its own independent quirks, is the transportation of natural gas after its capture. Natural gas pipeline costs between \$2.8 and \$15 million per mile,²⁴ while the shipment of liquefied natural gas (LNG) presents its own particular added costs.²⁵ Natural gas can be difficult to transport if the proper infrastructure is not available—an infrastructure that requires substantial amounts of pipeline, and perhaps even LNG facilities.²⁶ Pipelines are an essential source of transportation pipelines enable well to tap delivery.²⁷ Fortunately for

ENERGY L.J. 125, 125 (2011); *see also* King, *supra* note 10, at 8–16; Whitworth & McGinnis, *supra* note 17, at 182–212; Wurzer, *supra* note 2, at 366–79.

19. King, *supra* note 9, at 3–4.

20. *See id.*

21. *See id.* at 3.

22. Cady, *supra* note 15, at 131.

23. Wurzer, *supra* note 2, at 373.

24. Wurzer, *supra* note 3, at 373 (citing Poe L. Leggette & Mark Zoback, The Groundswell of Concern and Activity Regarding Hydraulic Fracturing, Presentation at Rocky Mountain Mineral Law Foundation Workshop: Hydraulic Fracturing: Core Issues & Trends, Nov. 17, 2011).

25. ERNEST E. SMITH ET AL., INTERNATIONAL PETROLEUM TRANSACTIONS 1028 (3d ed. 2010).

26. *See* MARC HAMMERSON, UPSTREAM OIL AND GAS 293 (2011).

27. *See* King, *supra* note 9, at 6–7.

the natural gas industry, the U.S. has a relatively well-developed structure of pipelines, which amount to about 300,000 miles of interstate and intrastate natural gas pipelines.²⁸

When a pipeline infrastructure for natural gas development is absent in a given area, a precarious logistical dance is undertaken by all parties involved.²⁹ Conditional contracts are made between the operator and the purchaser of the gas and between the operator and the builder or financier of the pipeline.³⁰ Due to the long-term nature of those contracts, combined with market volatility, problems may develop.³¹ One solution is a take-or-pay clause; those clauses guarantee the operator an income even if the buyer chooses not to purchase at the contractual rate.³²

When a domestic source of natural gas is lacking, or when a pipeline infrastructure to develop domestic natural gas is absent, the import of LNG may be required.³³ LNG terminals either liquefy natural gas to 1/600th of its original volume for export, or achieve the “regasification” of LNG into its original gaseous form, thereby expanding LNG by a multiple of 600 to its original volume in order that it may be used again as a gas.³⁴ Transport is expensive; natural gas must be kept at -260° Fahrenheit during transport.³⁵ While transportation of LNG is highly technical compared to the transport of coal or oil, the global availability of shale gas deposits may offset the transportation costs significantly and provide significant improvement to energy security.³⁶

B. Legal Issues

The legal issues surrounding shale gas converge, primarily, on environmental considerations. In considering the broader issue of environmental concerns, other questions are posed—the role of regulatory authorities, the possibility of energy security, and the payment of royalty rights, for example. This list is not exhaustive.³⁷

28. ENERGY INFORMATION ADMINISTRATION, ABOUT U.S. NATURAL GAS PIPELINES: TRANSPORTING NATURAL GAS 1 (2007), http://www.eia.gov/pub/oil_gas/natural_gas/analysis_publications/ngpipeline/fullversion.pdf.

29. See Wurzer, *supra* note 2, at 372–75.

30. See HAMMERSON, *supra* note 26, at 299–315.

31. See *id.*

32. *Id.* at 305–07; accord *Dunlop Pneumatic Tyre Co. v. New Garage & Motor Co.*, [1915] A.C. 79 (H.L.) (appeal taken from Eng.).

33. See HAMMERSON, *supra* note 26, at 293–94.

34. *LNG Overview*, FED. ENERGY REGULATORY COMM’N, <http://www.ferc.gov/for-citizens/citizen-guides/lng.asp> (last updated June 28, 2010).

35. *Id.*

36. Wurzer, *supra* note 2, at 364.

37. See, e.g., *id.* at 375–80.

However, the list is a general cross section of issues having an impact on various states within the U.S. federal regime. These problems are faced not only in the U.S., but also in other nations seeking to extract shale resources.³⁸ Before moving into a discussion of general legal issues, it is therefore appropriate to briefly contrast the U.S. regulatory regime with that of another nation: the U.K.

C. Regulatory Authority

1. Regulation in the United States

In the U.S., the regulatory agency charged with overseeing the interstate natural gas and electricity industry is the Federal Energy Regulatory Commission (FERC).³⁹ FERC was established by the Department of Energy Organization Act 1977 and clothed with legislative authority under the Natural Gas Act 1938, the Natural Gas Act 1978, the Outer Continental Shelf Lands Act, the Natural Gas Wellhead Decontrol Act.⁴⁰ However, FERC includes individual states in the decision-making process; such decisions include establishing the location of the infrastructure, as well as setting retail rates and handling distribution issues.⁴¹ Additionally, state or local authorities may regulate environmental aspects of the energy market.⁴² This multi-layered form of regulation can be complicated, and it may vary significantly from state to state.⁴³ Upstream regulation of natural gas in the U.S., as mentioned in the introduction, is not controlled by a specific, or special, regulatory agency; rather, the EPA regulates the natural gas industry based on environmental effects.⁴⁴

2. Regulation in the United Kingdom

In the U.K., the regulatory agency charged with primary oversight of the natural gas, electricity, and environmental industries

38. *Id.*

39. *The Market Under Regulation*, NATURALGAS.ORG, www.naturalgas.org/regulation/market.asp#overview (last visited Sept. 25, 2013) (follow “Overview of Current Regulation” hyperlink).

40. *Id.*

41. JIM LAZAR ET AL., THE REGULATORY ASSISTANCE PROJECT, ELECTRICITY REGULATION IN THE US 11 (Mar. 2011).

42. *See, e.g.*, 42 U.S.C. § 7661(e) (2006).

43. *See generally, e.g.*, MARGARET MYSZENSKI ET AL., CARL VINSON INSTITUTE OF GOVERNMENT, UNIVERSITY OF GEORGIA, A COMPARISON OF GROUNDWATER LAWS AND REGULATIONS FROM SOUTHEASTERN STATES (2005), <http://www.cviog.uga.edu/environmental/policy-reports/groundwater.pdf>.

44. *See The Market Under Regulation, supra* note 39.

(and thus of shale gas) is the Department of Energy and Climate Change (DECC).⁴⁵ In addition to the DECC, other applicable agencies are involved in regulating the production of natural gas, shale, or otherwise.⁴⁶ Parties wishing to produce natural gas must obtain a permit from the DECC, land-use planning permission from the applicable Minerals Planning Authority and comply with all requirements of the Health and Safety Executive.⁴⁷ However, the DECC is invasively intermingled (beyond the permitting of the Petroleum Exploration and Development Licence) in an adventure to extract natural gas in the U.K. by authority of the Parliament in Environmental Permitting (England and Wales) Regulations 2010 and the Water Resources Act 1991.⁴⁸ It is worth noting that the recent suspension of hydraulic fracturing operations in the U.K. due to two seismic events is now over.⁴⁹ Resumption of shale operations was due, in fair part, to studies conducted by the Royal Society and the Royal Academy of Engineering, both of which appear to have calmed the DECC enough to resume permitting for hydraulic fracturing operations.⁵⁰

3. Environmental Issues: Water, Sustainable Development (Carbon), and Earthquakes

a. Water

Fracking creates two distinct problems regarding water and the environment: water consumption and water pollution.⁵¹ Water consumption is particularly a problem where water scarcity exists (or has a propensity to occur) and when there is “no alternative drinking water source” other than what is being used for fracking.⁵²

45. See DEPARTMENT OF ENERGY & CLIMATE CHANGE, ABOUT SHALE GAS AND HYDRAULIC FRACTURING (FRACKING) 5 (July 30, 2013), https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/225826/About_Shale_gas_and_hydraulic_fracking.pdf [hereinafter ABOUT SHALE].

46. See *id.*

47. See ENV'T AGENCY, GUIDANCE NOTE: REGULATION OF EXPLORATORY SHALE GAS OPERATIONS 1–2 (2012), http://www.groundwateruk.org/downloads/EA_ShaleGasRegulation.pdf.

48. *Id.* at 1–2.

49. *Oil and Gas: Onshore Exploration and Production*, UNITED KINGDOM DEP'T OF ENERGY & CLIMATE CHANGE, <https://www.gov.uk/oil-and-gas-onshore-exploration-and-production#resumption-of-shale-gas-exploration> (last updated Sept. 13, 2013) [hereinafter DECC].

50. See *id.*

51. See Jenner & Lamadrid, *supra* note 8, at 446–47.

52. Wurzer, *supra* note 2, at 366–67; see ANTHONY ANDREWS ET AL., CONG. RESEARCH SERV., R40894, UNCONVENTIONAL GAS SHALES: DEVELOPMENT,

Fracking uses “significantly more water upfront to unlock gas” than does coal extraction, a competing energy resource.⁵³ However, water consumption throughout the life cycle of coal—extraction to expenditure—is greater than that of shale gas.⁵⁴ Up to 90–95% of flowback water can be reused from fracturing treatments, and the amount of water needed to frack a well may be lowered by cutting-edge technology.⁵⁵

Water pollution appears to be the most controversial issue related to fracking. The EPA, as shown above, tracks and regulates water pollution effects, particularly to the water table, through the Clean Water Act⁵⁶ and Safe Drinking Water Act.⁵⁷ General water pollution issues include: (1) frack fluid contamination through natural or induced fractures; (2) groundwater contamination after flowback; and (3) well casing failure that directly contaminates the aquifer.⁵⁸

First, regulation of water pollution caused by fracking shale deposits in the U.S. is fairly unique, as it essentially regulates environmental effects as opposed to regulating how the industry itself operates.⁵⁹ Due to an EPA study, Congress enacted the Energy Policy Act of 2005.⁶⁰ The 2005 Act amended the Safe Drinking Water Act to exclude fracking generally (except for diesel) from regulation under the Act, unless “such requirements are essential” to protect “underground sources of drinking water.”⁶¹ Some states individually regulate fracking; for example, Colorado’s regulations require a chemical inventory to be kept and disclosed upon demand by the Colorado Oil and Gas Conservation Commission.⁶²

The EPA only recently noted that fracking may impact groundwater.⁶³ An EPA draft document concluded that “. . . the data

TECHNOLOGY, AND POLICY ISSUES 7–8, 15–16 (2009), <http://www.fas.org/sgp/crs/misc/R40894.pdf>; McKay et al., *supra* note 18, at 129.

53. Jenner & Lamadrid, *supra* note 8, at 446.

54. *Id.*

55. Wurzer, *supra* note 2, at 367.

56. 33 U.S.C. §§ 1311–1330 (2006 & Supp. 2010).

57. 42 U.S.C. §§ 300h to 300h-8 (2006).

58. Wurzer, *supra* note 2, at 367.

59. See Sakmar, *supra* note 1, at 399–404, 406–16.

60. 42 U.S.C. §§ 15801–16524 (2006 & Supp. 2011).

61. 42 U.S.C. § 300h-1(c) (2006); *cf.* L.E.A.F. v. U.S. EPA, 276 F.3d 1253 (11th Cir. 2001).

62. See COLO. CODE REGS. §§ 404-1:205(c), 404-1:205(f) (2012).

63. See Dominic C. DiGiulio et al., *Investigation of Ground Water Contamination near Pavillion, Wyoming* 33 (U.S. Env'tl. Prot. Agency, Working Paper No. 600/R-00/000, 2011), http://www2.epa.gov/sites/production/files/documents/EPA_ReportOnPavillion_Dec-8-2011.pdf [hereinafter EPA Draft].

[indicate a] likely impact to ground water that can be explained by hydraulic fracturing.⁶⁴ However, this link between groundwater contamination and fracking was cabined by qualifying adjectives. An alternative theory specific to the geographic continuity of that location also exists;⁶⁵ even if the well that exhibited impact to the groundwater in Pavillion, Wyoming, was linked concretely to partial contamination from hydraulic fracturing, it would be a statistical outlier.⁶⁶ Some authors have said the possibility is “extremely remote” given the thousands of other hydraulically fractured wells with no link to groundwater contamination.⁶⁷

Second, the flowback stored from the fracking process presents the potential for contamination if there occurs a “failure of a storage tank, a storage pit liner, or the line carrying fluid to the pit.”⁶⁸ While these possibilities exist, they are kept under control by industry best practices.⁶⁹ If industry best practices are unable to prevent those failures, an action for negligence, nuisance, or trespass would provide a direct remedy for persons affected by the operator’s failure.⁷⁰ In addition, regulation on the matter already exists, as the Clean Water Act utilizes the permit program in the National Pollution Elimination Discharge System to govern the disposal of flowback.⁷¹

Third, contamination caused by poor well-casing construction may contaminate an aquifer.⁷² There is little doubt that this could happen. However, the wellbore can be pressure-tested to determine if its integrity has been compromised.⁷³ Even the British Parliament has concluded that “hydraulic fracturing itself does not pose a direct risk to water aquifers, provided that the well-casing is intact before this commences,” and that the issues involved are “no different to issues encountered when exploring for hydrocarbons in conventional geological formations.”⁷⁴

64. *Id.* at viii.

65. *Id.*

66. *See generally id.*

67. King, *supra* note 9, at 16.

68. Wurzer, *supra* note 2, at 368.

69. *See* Dennis C. Stickley, *Expanding Best Practice: The Conundrum of Hydraulic Fracturing*, 12 WYO. L. REV. 321, 333–37 (2012).

70. *See* King, *supra* note 9, at 16.

71. *See* 33 U.S.C. §§ 1342 (2006 & Supp. 2011).

72. Wurzer, *supra* note 2, at 367.

73. *See* King, *supra* note 9, at 16–17.

74. HOUSE OF COMMONS ENERGY AND CLIMATE CHANGE COMMITTEE, SHALE GAS 40 (2011), <http://www.publications.parliament.uk/pa/cm201012/cmselect/cmenergy/795/795.pdf>.

b. Carbon Emissions and Sustainable Development

In the U.S., the EPA tracks the effects of volatile organic compounds on air pollution as part of its general responsibilities under the Clean Air Act.⁷⁵ Even with carbon emissions associated with venting and flaring, natural gas-fuelled energy produces less than half of the total global warming pollutants than the equivalent amount of energy produced from coal during a 100-year life cycle.⁷⁶ Reasonable venting, flaring, and methane leaks during production and transportation of shale gas yield substantially less global warming pollutants than coal, and the amount of global warming pollutants released during shale extraction mirrors that of conventional natural gas extraction over a 100-year lifecycle.⁷⁷

There are more concerns with analyzing global warming pollutants than simply counting the number of carbon atoms released by burning natural gas as opposed to coal.⁷⁸ In fact, all the relevant data are not entirely in favor of natural gas as an environmentally beneficial energy source.⁷⁹ Fugitive emissions or gas released into the atmosphere from well completion leaks, gas storage, and gas delivery can indirectly contribute to greenhouse gas (GHG) levels.⁸⁰ By utilizing natural gas instead of coal, fewer quantities of GHGs, such as nitrogen oxide and sulphur dioxide (gases that tend to “reflect a portion of sunlight back into space”), are released into the atmosphere.⁸¹ However, the reduction of GHGs also includes significant reductions in carbon dioxide and methane, creating a medium-term and long-term (20-year and 100-year, respectively) benefit regarding the overall effect of GHGs.⁸²

A report sponsored by the U.S. Department of Energy not only shows the power production superiority of medium-term to long-term natural gas-fired plants,⁸³ but also demonstrates that the added GHGs released during capture, transportation, storage, and power

75. See *Hydraulic Fracturing*, U.S. ENVTL. PROTECTION AGENCY, <http://www2.epa.gov/hydraulicfracturing#air> (last updated July 12, 2013) (follow “Addressing air quality impacts associated with hydraulic fracturing activities” hyperlink).

76. See TIMOTHY J. SKONE ET AL., NATIONAL ENERGY TECHNOLOGY LABORATORY, LIFE CYCLE GREENHOUSE GAS INVENTORY OF NATURAL GAS EXTRACTION, DELIVERY AND ELECTRICITY PRODUCTION 28–30 (2011), <http://www.netl.doe.gov/energy-analyses/pubs/NG-GHG-LCI.pdf>.

77. *Id.* at 30.

78. See Jenner & Lamadrid, *supra* note 8, at 444.

79. *E.g.*, *id.* at 443–45.

80. See *id.*

81. *Id.*

82. *Id.* at 444–46.

83. See SKONE, *supra* note 76, at 28–30, 38.

production are more efficient at the 20-year mark and profoundly outperform coal under similar conditions during the 100-year cycle.⁸⁴ Overall, natural gas emissions can be improved through technical advancements aimed at preventing leaks during capture, transportation, and storage of natural gas.⁸⁵

Natural gas produces around half the global warming pollutants compared to coal, resulting in fewer pollutants discharged in the air to impact the health of individuals.⁸⁶ This also means that fewer pollutants are present to cause indirect economic impacts as well.⁸⁷ There is not enough data, however, to give a full analysis or reach a concrete conclusion about the indirect medical effects of natural gas emissions compared with those of coal-fired plants. One may conclude, however, that given the reduction of some pollutants and virtual elimination of others, there is potential to improve the quality of life of citizens and potentially save massive expenditures on health related costs.⁸⁸

While natural gas is not the end game for reducing our carbon footprint, natural gas does offer an opportunity to buttress energy security. Increased energy security can provide fuel that can be used in conjunction with renewable energy sources until renewable energy sources are dependable, sustainable, and affordable.⁸⁹

c. Earthquakes

Examples of hydraulic fracturing causing seismic events or earthquakes are extraordinarily rare: one study estimates that the likelihood of an occurrence could be as high as one in 10,000 for a minor earthquake.⁹⁰ A seismic event, where two tremors were felt, occurred in the United Kingdom, and hydraulic fracturing was suspended until further investigation was conducted.⁹¹ The investigation concluded there was no indication a major earthquake

84. *See id.* at 28–30.

85. *See* Jenner & Lamadrid, *supra* note 8, at 448–49.

86. *Id.* at 445–46.

87. *Id.* at 448.

88. *Id.* at 445.

89. *See generally* INT’L ENERGY AGENCY, GOLDEN RULES FOR A GOLDEN AGE OF GAS: WORLD ENERGY OUTLOOK SPECIAL REPORT ON UNCONVENTIONAL GAS (2012), http://www.worldenergyoutlook.org/media/weowebiste/2012/goldenrules/WEO2012_GoldenRulesReport.pdf.

90. C.J. DE PATER & S. BAISCH, GEOMECHANICAL STUDY OF BOWLAND SHALE SEISMICITY 50 (Nov. 2, 2011), http://www.cuadrillaresources.com/wp-content/uploads/2012/02/Geomechanical-Study-of-Bowland-Shale-Seismicity_02-11-11.pdf.

91. DECC, *supra* note 48.

was possible.⁹² While the earthquake issue has not been significant in the U.S. to date, the lessons learned from the U.K. seismic episode will likely be considered by Congress and state legislatures in shaping future regulations⁹³ and may even be considered by the industry in evaluating their best practice methods.

4. Energy Security

Energy security is a strategic concern for every nation, regardless of whether that state is an energy exporter or importer.⁹⁴ In recent decades, increased energy demand has led both the United States and Europe to become progressively more energy dependent upon foreign states. More precisely, energy demand is expected “to rise by more than 50% by the year 2030, approximately 80% of which would still be met by fossil fuels.”⁹⁵ This increased demand creates potential issues for energy security, environmental considerations, and investor concerns.⁹⁶ While these potential issues differ in degree from nation to nation, learning how the issues interplay and the consequences of pursuing alternative energy source options could lead to the development of sound policies that advance a national, provincial, or local regime.

The U.S., for example, could gain a substantial increase in energy security from shale gas over the next 100 years;⁹⁷ 100 years may possibly even be time enough to develop renewable technology sufficiently dependable for permanent energy security. The shale boom in the United States would thus turn into an energy revolution of sorts. Shale oil deposits in the United States may be the repository of the world’s largest and most concentrated known oil shale

92. See *id.* at 49–53.

93. See ABOUT SHALE, *supra* note 45, at 21–25.

94. The Organization of Petroleum Exporting Countries (OPEC) and the International Energy Agency (IEA) embody the necessity of energy security within their respective regimes. See ORG. OF PETROLEUM EXPORTING COUNTRIES, STATUTE (2008), http://www.opec.org/opec_web/static_files_project/media/downloads/publications/OPEC_Statute.pdf; Organisation for Economic Co-operation and Development, Decision of the Council: Establishing an International Energy Agency of the Organization, at art. 6 (Apr. 16, 1999), <http://www.iea.org/media/aboutus/history/decisionofthecouncil.pdf>. See also EMRE ÜSENMEZ, *The UK’s Energy Security in OIL AND GAS LAW: CURRENT PRACTICE AND EMERGING TRENDS* 40–45 (Greg Gordon et al. eds., Dundee University Press 2d ed. 2011).

95. *Global Energy Security*, G8 SUMMIT (July 16, 2006), <http://en.g8russia.ru/docs/11.html>.

96. See, e.g., Anatole Boute, *The Quest for Regulatory Stability in the EU Energy Market: An Analysis Through the Prism of Legal Certainty*, 37 EUR. L. REV. 675 (2012).

97. See Jenner & Lamadrid, *supra* note 8, at 442.

resources.⁹⁸ The combination of shale gas and shale oil reserves in the United States presents a profound opportunity for energy independence for the United States and potentially a positive shift toward energy security for countries engaged in free trade with the United States.⁹⁹

The U.K. and Europe, in general, have a similar paradigm regarding fuel-mix concerns within their energy security regimes, particularly in Western and Central Europe.¹⁰⁰ Continental Europe, and most likely the U.K., will become increasingly dependent upon Russian natural gas.¹⁰¹ However, the development of multiple shale deposits throughout Europe could strengthen European energy security.¹⁰² Examples of European Union members with substantial shale gas deposits include Poland and France (although France has a temporary ban on hydraulic fracturing); other European Union members have lesser or unconfirmed shale gas deposits.¹⁰³ Another substantial shale gas deposit with a direct impact upon European Union energy security is located in Turkey, a European Union candidate.¹⁰⁴ While the decisions made by these gas-rich nations may ultimately impact European Union energy security, several global deposits are large enough to substantially affect not only the European Union, but also may affect various non-European regions¹⁰⁵ or may even impact the global energy market itself.¹⁰⁶ Both of these concerns—global and regional—could be alleviated by increased energy security.¹⁰⁷

5. Royalty Payments

Royalty issues are inextricably linked to property and mineral rights. A complete review of these issues is outside the scope of this Article; however, the issues will be surveyed here. In the U.S., there

98. Harry R. Johnson et al., *Strategic Significance of America's Oil Share Resource: Volume II Oil Shale Resources Technology and Economics* 9 (2004), available at http://ds.heavyoil.utah.edu/dspace/bitstream/123456789/10015/1/StrategicsignificanceofAmericasoilshaleresource_Vol2.pdf

99. See Wurzer, *supra* note 2, 364–65.

100. See INT'L ENERGY AGENCY, *supra* note 88, at 120–29.

101. See Chris Flynn, *Russian Roulette: The ECT, Transit and Western European Energy Security*, INT'L ENERGY L. & TAX'N REV. 12, 16 (2007).

102. See INT'L ENERGY AGENCY, *supra* note 88, 120–25.

103. *Shale Gas is a Global Phenomenon*, U.S. ENERGY INFO. ADMIN. (Apr. 5, 2011), <http://www.eia.gov/todayinenergy/detail.cfm?id=811> [hereinafter *Global Phenomenon*].

104. *Id.*

105. See INT'L ENERGY AGENCY, *supra* note 88.

106. See *Global Phenomenon*, *supra* note 108.

107. See INT'L ENERGY AGENCY, *supra* note 88, at 86–88.

are multiple royalty regimes, both federal and state. The Bureau of Land Management is responsible for coordinating the development of oil and gas on federally owned property¹⁰⁸ and for managing the resources according to a “multiple use and sustained yield.”¹⁰⁹ Royalties from natural gas plays on federal lands are equally split between federal and state governments.¹¹⁰

Privately owned property and mineral rights are regulated by each state, which results in some jurisdictions, such as Texas, with extensive regulatory regimes, and other jurisdictions—those without significantly exploited or exploitable resources—whose regulatory regimes are not as advanced.¹¹¹ These various mineral rights create issues that are often resolved between the private citizens and the industry through court proceedings.¹¹² Among these issues are discrepancies over royalty calculations.¹¹³ Disputes often arise between the surface owner and the lessee over the right to use the surface to extract the subsoil resources.¹¹⁴ Concerns may arise over the legal rights of mineral owners who pool those rights with others and whether those rights can be diluted further through additional pooling.¹¹⁵ There is also the potential to argue whether there is a subsoil trespass from fracking fluid, and care must be taken, contractually, to determine whether royalties are affected by this potential liability.¹¹⁶ Ethical issues arise in the allocation of property and mineral rights as well, especially considering that negotiations may be unfairly dominated by the industry when dealing with less sophisticated private citizens who may not understand the negotiations.¹¹⁷ Also, private citizens may be in a disproportionately

108. Bureau of Land Management, *Energy: Oil and Gas: Leasing of Onshore Federal Oil and Gas Resources* (Oct. 20, 2009) available at http://www.blm.gov/wo/st/en/prog/energy/oil_and_gas/leasing_of_onshore.html.

109. 43 U.S.C. § 1701(a)(7) (2006 & Supp. 2011).

110. *New Energy for America*, U.S. DEP'T OF THE INTERIOR, <http://www.blm.gov/wo/st/en/prog/energy.html> (last updated Feb. 6, 2013).

111. See Laura C. Reeder, *Creating a Legal Framework for Regulation of Natural Gas Extraction from the Marcellus Shale Formation*, 34 WM. MARY ENVTL. POLY. REV. 999, 1001, 1005–007.

112. See W. James McAnelly, III et al., *Recent Developments in Texas, United States, and International Energy Law*, 7 TEX. J. OF OIL, GAS, & ENERGY L. 125, 126 (2011–2012).

113. See, e.g., *Mullinnix LLC v. HKB Royalty Trust*, 126 P.3d 909 (Wyo. 2006).

114. See, e.g., *Getty Oil Co. v. Jones*, 470 S.W.2d 618 (Tex. 1971); *Exxon Corp. v. Pluff*, 94 S.W.3d 22 (Tex. App. 2002).

115. See, e.g., McAnelly, III et al., *supra* note 115, at 133–37.

116. See *Mission Res., Inc. v. Garza Energy Trust*, 166 S.W.3d 301, 310 (Tex. App. 2005), *rev'd*, 268 S.W.3d 1 (Tex. 2008).

117. See, e.g., TOM WILBER, *UNDER THE SURFACE: FRACKING, FORTUNES, AND THE FATE OF THE MARCELLUS SHALE* 26–30 (Cornell University Press 2012).

inferior economic position that could create unconscionable bargain issues.¹¹⁸

Royalties are paid to the state in some jurisdictions.¹¹⁹ International law recognizes that the state has a sovereign right over all natural resources within its borders.¹²⁰ The U.S. regime of royalty distribution, then, is fairly unique concerning the potential payment of royalties to private individuals. However, nations facing political difficulty in proceeding with hydraulic fracturing might consider profit-sharing with private landowners to spur development; this would stimulate the popularity of utilizing the state's natural resources, while also maintaining state ownership.¹²¹

II. REGULATORY AND SOCIO-ECONOMIC CONCERNS

A. Regulation

The U.S., according to the above analysis, appears to have a substantive legal regime able to regulate the shale industry without permitting substantial environmental harm. For example, the U.S. regime regulates environmental intrusions, such as contamination of the water table, via the Clean Water Act and the Safe Water Drinking Act.¹²² The U.S. regime also has the flexibility to regulate carbon emissions through the Clean Air Act.¹²³ The United States is learning the value of regulatory and industry transparency that can help to win social acceptance, which can be intrinsically linked to the future development of the shale industry.¹²⁴ This Article does not argue that the U.S. regime could not be improved upon. However, since the U.S. has an extensive shale industry,¹²⁵ it is apparent that the general regulatory regime of the EPA is relatively effective.¹²⁶

118. *Id.*

119. See INT'L ENERGY AGENCY, *supra* note 88, at 43–44.

120. G.A. Res. 1803 (XVII), U.N. GAOR, 17th Sess., Supp. No. 17, U.N. Doc. A/5217, at 15 (Dec. 14, 1962), http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/1803%28XVII%29.

121. See Wurzer, *supra* note 2, at 381.

122. 33 U.S.C. §§ 1311–1330 (2006 & Supp. 2010) (standards and enforcement section); 42 U.S.C. §§ 300h to 300h-8 (2006).

123. 42 U.S.C. §§ 7401–7671 (2006 & Supp. 2011).

124. See INT'L ENERGY AGENCY, *supra* note 88.

125. *Id.* at 102–06.

126. See *id.*

B. Social

Certain populations, particularly those not previously exposed to drilling or mining operations, have voiced environmental concerns and uncertainties.¹²⁷ Social concerns range from a significant increase in traffic from water trucks, to societal rejection of the industry as a whole due to a lack of public understanding or a lack of industry transparency.¹²⁸ The International Energy Agency has methodically noted that transparency in the pursuit of an unconventional play could provide an adequate, or acceptable, level of understanding, which would lead to acceptance of exploration and development of an unconventional play—assuming proper safeguards are present.¹²⁹

C. Global Economic Concerns

The U.S. experience in shale gas has proven relatively cost effective and has spurred global recognition of advanced and effective techniques for shale hydrocarbon extraction.¹³⁰ It is comparatively cheaper to extract shale hydrocarbons in North America than in other regions. For example, geological variances, technologically-advanced drilling rigs, the quantity of rigs, the ability to lease large areas for exploration, and the superiority of the continent's overall infrastructure all militate toward cheaper production costs in North America.¹³¹ Financial incentives to invest in shale resources, transmission network, and research and development seem to be, among other things, the appropriate response to mitigate the increased cost.¹³²

III. OBSERVATIONS, CONCLUDING REMARKS, AND SUGGESTIONS

Shale gas has created a new and dynamic energy paradigm. There are additional pecuniary costs involved in extracting shale gas when compared to conventional natural gas—especially considering expensive pipelines and LNG facilities, as well as refrigerated shipping requirements.¹³³ However, these added costs are counter-

127. See INT'L ENERGY AGENCY, *supra* note 88, at 20–21.

128. *Id.* at 42–45.

129. See generally *id.*

130. See generally INT'L ENERGY AGENCY, *supra* note 88.

131. PAUL STEVENS, CHATHAM HOUSE, THE 'SHAPE GAS REVOLUTION' 13–14 (Sept. 2010), available at http://www.chathamhouse.org/sites/default/files/public/Research/Energy,%20Environment%20and%20Development/r_0910stevens.pdf.

132. See *id.* at 4–7, 11.

133. See Wurzer, *supra* note 2, at 364; *LNG Overview*, *supra* note 33.

balanced by the benefits of global geological availability and increased energy security. Not only is shale gas an equalizer in energy security, but it is also an ideal option for a transitional energy resource until renewable energy resources are stable and sustainable.¹³⁴

A. Water

Shale gas, statistically, is far more environmentally friendly than coal when considering global warming pollutants expelled¹³⁵ and the potential for water reuse.¹³⁶ Water contamination concerns regarding well casings are not any more problematic than those presently used in conventional hydrocarbon production. Nonetheless, potential for water contamination should still be monitored, as there are water contamination concerns surrounding fracking. However, these concerns are generally overstated. Perhaps the more invasive issue is the level of water consumption in sensitive areas. While reuse of flowback water will reduce water consumption, regulators should be mindful that over-taxing water resources could lead to a push for incentives to advance technology that would further reduce the level of water consumption.

B. Earthquakes

The earthquake concern is perhaps only nominal; both current industry knowledge of geological properties and lessons learned through studies performed after a seismic events have yielded significant information that may prevent future significant seismic activity caused by hydraulic fracturing.¹³⁷ While these geologic factors are now better understood by the industry, regulators face a decision. They must decide whether to require certain prescriptive seismic surveys, or whether to simply leave it to industry best practices while encouraging further surveys of the geological properties and techniques via a goal-based method of regulation.¹³⁸

Energy security may be achieved through development of shale gas.¹³⁹ The considerable shale reserves of the United States provide an option for strategic self-sustainability while reducing GHGs.¹⁴⁰ Europe can mitigate its expanding reliance on Russia and other

134. See Jenner & Lamadrid, *supra* note 8, at 450.

135. *Id.* at 443–46.

136. See Wurzer, *supra* note 2, at 367.

137. de Pater, *supra* note 89, 45–47.

138. See *id.* at 53; see also, Stickle, *supra* note 68, at 333–35.

139. See INT'L ENERGY AGENCY, *supra* note 88, at 11.

140. See generally, Jenner & Lamadrid, *supra* note 8.

states by developing its own shale reserves.¹⁴¹ Globally, nations should pursue technical and logistical capabilities necessary to develop their shale reserves.

C. Other Concerns

Royalty distribution is also a concern when dealing within the U.S. and global shale gas regimes. Some European states own the mineral rights within their boundaries.¹⁴² However, states often have difficulty gaining popular support for producing shale gas;¹⁴³ those states may desire to implement a profit sharing mechanism with property owners and retain ownership and licensing or contractual rights of the natural resources to the state, in order to build popular support for fracking. At a minimum, royalty distribution could strengthen energy security by providing populist support to prevent untimely shelving of shale resources.¹⁴⁴ This statement is particularly true in the EU, where a minority of states possess large shale resources.¹⁴⁵

Regarding regulation concerns, the U.S. regime has a broad scope. Regulating shale resources from the margin has been an efficient method thus far, and the approach appears to be appropriate for other nations with adequate regulatory systems in place. The U.S.'s lack of a special regulatory authority to regulate the extraction of shale resources and the concomitant development of shale resources in the U.S. without significant environmental harm both indicate a special regulatory agency is not required to manage shale resources effectively. Therefore, shale gas regulation could be effective by regulating the "fringe," an approach that would entail regulating only the effects on the environment (or on society and individuals) without a special regulatory agency.

CONCLUSION

The benefits of shale gas provide strong reasons in favor of exploring for, developing infrastructure for, and utilizing natural gas for energy production. There are arguments that establish that shale gas has at least some negative, or at least diminished positive, aspects. However, when viewing the issue from a balanced perspective—and with a mind toward the contextual background of

141. See INT'L ENERGY AGENCY, *supra* note 88, at 120–23, 130.

142. *E.g., id.* at 43–44.

143. France is an example. *Id.* at 126.

144. *Id.* at 122.

145. See *id.* at 121.

environmental and energy security concerns, in particular—shale gas has demonstrated a highly competitive advantage in the energy paradigm.