Federalism, Regulatory Lags, and Energy Production

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ABSTRACT: *The production of natural gas from formerly inaccessible shale formations using hydraulic fracturing has expanded domestic energy supplies, lowered prices, and could stimulate the replacement of dirtier fossil fuels (coal and oil) with cleaner natural gas. At the same time, shale gas production has proven controversial, triggering intense opposition in some parts of the United States. State and local regulators have scrambled to adapt to the boom in natural gas production, raising the question of whether federal regulators should step in to supplant or supplement state regulation. This article takes a policy-neutral approach to the federalism questions at the center of that inquiry, asking which level of government ought to resolve these policy questions, rather than which level of government is likely to produce a particular favored policy outcome. Consequently, this analysis begins with four economic and political rationales that we typically use to justify federal regulation: (i) the presence of interstate "spillover" effects, (ii) the so-called "race to the bottom, (iii) the need for uniform standards for manufacturers, and (iv) the presence of an important national interest in developing and regulating an energy resource. Applying each of these rationales to the regulation of hydraulic fracturing yields several important conclusions. First, while a few of the externalities of shale gas production cross state boundaries, most are experienced locally. Second, existing federal regulatory regimes offer ample authority to address those impacts that have interstate or national scope. Third, the race to the bottom rationale does not justify federal regulation of shale gas production because shale gas states are not competing for quantity- or time-limited capital investment. Fourth, given that the impacts of hydraulic fracturing are still under study and the subject of considerable ongoing debate, there is no overriding national interest supporting the creation of a comprehensive federal licensing/regulatory regime for shale gas production, at least not yet.*

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David B. Spence*

The American energy policy landscape is undergoing a revolution.[1] The production of natural gas from formerly inaccessible shale formations using hydraulic fracturing[2] (also known as "fracking") has transformed American energy options. Only a few years ago, American policymakers foresaw a future increasingly dependent upon natural gas imports;[3] they now foresee a domestically-produced supply sufficient to serve the country's needs for as much as 100 years. That ample supply, in turn, has tamed natural gas markets. Natural gas prices had always been volatile (and frequently high), but forecasters now predict low prices into the foreseeable future.[4] Low natural gas prices could stimulate the replacement of dirtier fossil fuels (coal and oil) with cleaner natural gas (in electricity generation and transportation, respectively), hastening the long-held dream of the industry's proponents that natural gas serve as a bridge fuel to a renewable energy future.[5] At the same time, however, shale gas production has proven very controversial. The rapid increase in shale gas production has been driven in large part by production techniques (horizontal drilling and fracking) that are now in use on a much wider scale than ever before. Their use produces negative externalities[6] -- pollution and other

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1 Bloomberg news reported recently that "the U.S. is the closest it has been in almost 20 years to achieving energy self-sufficiency" and that it could become the world's top energy producer in less than 10 years. See Rich Miller, Asjylyn Loder and Jim Polson, Americans Gaining Energy Independence With U.S. as Top Producer, February 6, 2012, URL: http://www.bloomberg.com/news/2012-02-07/americans-gaining-energy-independence-with-u-s-as-top-producer.html.

2 For description of this production technique, see infra, notes 000-000 and accompanying text.

3 See Howard Rogers, Shale Gas – The Unfolding Story, 27 Oxford Review of Economic Policy 117, 118 (2011) (http://oxrep.oxfordjournals.org.ezproxy.lib.utexas.edu/content/27/1/117.short) ("As we entered the 2000s the prevailing view of gas as a cheap and plentiful energy source changed to one of concern over the ability of gas supplies to keep pace with future rising demand, particularly in the power generation sector. In North America, in 2001 domestic production began a pronounced decline and large-scale liquefied natural gas (LNG) imports appeared inevitable by 2010.").

4 One way to predict natural gas prices is to look at so-called "forward curves" produced by the New York Mercantile Exchange ("NYMEX"). These curves are based upon prices of futures contracts -- contracts for the sale of natural gas at various points in the future. The current NYMEX forward curve for natural gas projects that prices will remain at or below five dollars per million btu ("MMBTU") over the next five years. NYMEX, Gas Futures Trading: Forward Price Curve, February 8, 2012, URL: http://www.ferc.gov/market-oversight/mkt-gas/trading/ngas-tr-fwd-pr.pdf. This compares with natural gas spot prices that varied between $3 and $13 per MMBTU in the first decade of the 21st century. See U.S. Energy Information Administration, Daily Henry Hub Gulf Coast Natural Gas Spot Price, 1997-2012, URL: http://www.eia.gov/dnav/ng/hist/rngwhhdd.htm.

5 *See* Roberto F. Aguilera & Roberto Aguilera, World Natural Gas Endowment As a Bridge toward Zero Carbon Emissions, 79 Technological Forecasting and Social Change 579, 579 (2011) (http://www.sciencedirect.com.ezproxy.lib.utexas.edu/science/article/pii/S0040162511002034) ("Historically, economic growth has been primarily fuelled by coal and oil. As the world economy continues to expand over the long term, natural gas has the potential to play a significant role in satisfying energy demand and acting as a bridge towards renewable."); and Joe Nocera, How to Frack Responsibly, The New York Times, February 28, 2012 (quoting Environmental Defense Fund President Fred Krupp supporting the notion of natural gas as a bridge fuel).

6 The term "externality" refers to costs of production that are not borne by the firm, but rather are shifted to society. Externalities can be either negative or positive. For a discussion of the economics of negative externalities, see Tom

byproducts borne mostly by the community in which shale gas production occurs -- which have generated intense opposition to shale gas production in some parts of the United States and the world.[7]

State and federal regulators have scrambled to adapt[8] to the boom in natural gas production, and the controversy it has spawned. That scramble has produced a significant amount of regulatory change in states from Texas to New York. Some have reacted cautiously, banning shale gas production pending further study of its risks.[9] Others have opened their shale gas formations (called "shale plays" in the industry vernacular) to development under existing state regulatory regimes, adjusting those regimes to address new or newly-recognized risks. That process of state regulatory adjustment continues, but it has not quieted opponents of shale gas production. At the national level, the Environmental Protection Agency ("EPA") is engaged in a multiyear study of the industry, one that may yield additional federal regulation.[10]

All of which suggests a question. What (if anything) should the federal government do about shale gas production using hydraulic fracturing? Should Congress pass comprehensive federal licensing rules and/or standards governing the industry? Should the EPA use existing regulatory authority to impose further restrictions on fracking or to fill gaps in the network of state regulatory regimes? Or is the regulation of this industry better left to the states, whose varied regulatory approaches to date represent a series of experiments from which all can learn? These are questions at the intersection of federalism and regulation. They implicate questions of policy as well as principles of federalism. That is, Congress or the EPA may have preferences over policy outcomes, but so do state and local government actors, triggering the question of which level of government is the more appropriate regulator in this instance. This article will address these questions by exploring the commonly-employed theoretical rationales for regulating at the federal (rather than state) level, and applying those rationales to the risks associated with hydraulic fracturing and shale gas production. The analysis points to the conclusion that a comprehensive federal licensing/regulatory regime for shale gas production is probably unnecessary and at least premature, but that there is a role for the federal government to regulate specific aspects of shale gas production that pose a national (or global) risks or implicate national interests.

Part I of this article examines the process of hydraulic fracturing, the technological advances that have made it cheaper to produce natural gas from shale, and how fracking has affected production in three states containing large shale gas plays -- Texas, Pennsylvania, and New York. Part I also explores the air, water, groundwater, community character and other externalities associated with shale gas production, noting the ongoing debate over their significance and magnitude.

Part II examines the existing regulatory environment of hydraulic fracturing. It describes the major federal regulatory regimes to which fracking operations are subject, noting that

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Tietenberg, Environmental and Natural Resource Economics (1992), at 52–54. For a discussion of the externalities of shale gas production, see infra, section I.B.

7 For discussion of public attitudes toward shale gas production, see infra, section I.B.

8 Hannah Wiseman has referred to this process as "regulatory adaptation," and she argues that while states have adapted pretty well in the face of tremendous information asymmetries, there remain regulatory gaps to be filled. See Hannah Wiseman, Regulatory Adaptation in Fractured Appalachia, 21 Villanova Envtl L. J. 229 (2010).

9 See e.g., description of the New York and New Jersey bans, infra, at notes 000-000 and accompanying text.

10 The EPA has outlined its study plan in U.S. EPA, plan to study the potential impacts of hydraulic fracturing on drinking water sources, November, 2011, URL: http://www.epa.gov/hfstudy/HF_Study__Plan_110211_FINAL_508.pdf.

Congress has exempted the fracking process from some of those regimes. It then compares the state regulatory regimes governing hydraulic fracturing in three states with significant shale gas deposits -- Texas, Pennsylvania, and New York. The analysis notes differences in each state's approach, including their coverage, stringency, and whether the regulations use detailed prescriptions or general performance standards. It is evident from this snapshot of state regulation that state rules have lagged behind development of the industry. Part II also examines the effects of regulatory agency structure on regulatory approach. That is, does a state's regulatory approach depend upon whether the state places primary regulatory jurisdiction in the hands of an oil and gas commission (as in Texas), or the state environmental agency (as in Pennsylvania and New York)? While it is difficult to reach general conclusions in response to this question, it does appear that the Texas Railroad Commission rules governing technical issues (like well construction) are more specific than those promulgated by the New York and Pennsylvania environmental agencies; conversely, the New York and Pennsylvania agencies seem to focus more of their attention on environmental protection than the Texas commission, as one might expect.

Part III of the article addresses the federalism questions the regulation of energy facilities. While it is clear that the federal government has the power to regulate hydraulic fracturing under the Commerce Clause (because of the industry's substantial effects on interstate commerce[11]), that acknowledgment does not answer the question of where regulatory authority *ought* to lie. This analysis approaches this normative question in policy-neutral terms, placing the question of who ought to decide prior to questions about what the policy decision ought to be. Using that approach, it identifies four rationales that we typically use to justify federal regulation, namely that: (i) federal regulation is necessary to address spillover effects that cross state boundaries, (ii) economic forces tend to lead states to under regulate environmental risks (including the "race to the bottom"[12] argument for federal regulation) (iii) uniform national standards will promote efficiency for business, and (iv) important national interests in promoting and regulating the development of the resource in question necessitate a federal licensing system.[13] Part III also explores how existing energy regulatory regimes are justified using one or more of these grounds.

Part IV applies the various rationales for federal regulation developed in Part III to the production of shale gas using hydraulic fracturing. It concludes that while some of the impacts of fracking cross state boundaries, most are local. Existing federal regulations offer ample authority to address those impacts that have national scope, and some are already being addressed. The analysis does not support the race to the bottom rationale for federal shale gas regulation, since there is ample capital to develop shale gas wherever it is found. Nor does there appear to be a need for a comprehensive federal licensing regime since shale gas development seems to be proceeding apace in the absence of any such regime. Part V contains some concluding thoughts about the implications of this analysis for future regulation of hydraulic

[11] See U.S. v. Lopez, 514 U.S. 549 (1995)(establishing the "substantial effect" test); and U.S. v. Morrison, 529 U.S. 598 (2000). The Lopez and Morrison decisions involved federal attempts to regulate activities that were essentially not economic in nature. Natural gas production, by contrast, is clearly an economic activity closely connected to interstate commerce, since natural gas markets cross state lines.

[12] For a thorough description of the "race to the bottom" argument, see infra section III.B.

[13] Some scholars offer broader rationales for federal environmental regulation, rationales that focus on protecting moral rights or giving effect to the preferences of out-of-state actors even when the costs and benefits of the potentially regulated activity fall entirely within the state. For discussion of these arguments, see supra notes 000-000 and accompanying text.

fracturing and shale gas production, and recommends that EPA limit its new regulation of hydraulic fracturing to specific elements of the process that pose national (or global) risks.

I. Shale Gas Production and Hydraulic Fracturing

The last several years have seen increasing controversy over the production of natural gas from shale deposits using hydraulic fracturing. Most of that controversy surrounds the environmental, health and safety risks associated with hydraulic fracturing. Indeed, opposition to the technique has led to permanent or temporary bans on its use in France,[14] South Africa,[15] New York State,[16] and various other communities[17] throughout the world. These bans and moratoria reflect the intensity with which some local communities, or subsections of local communities, have opposed fracturing operations on environmental, health and safety grounds.[18]

A. Hydraulic Fracturing, Generally

Conventional natural gas production involves the drilling of wells into permeable or semipermeable formations in which natural gas (methane) is found under pressure, providing a way to move that gas to the surface through the well. Conventional natural gas may be found dissolved in the oil, or as a cap on top of underground oil formations (so-called "associated gas," because it was associated with oil production); alternatively, it may be found between rock formations in the absence of oil ("unassociated gas"). Geologists have long known that significant amounts of natural gas are trapped in non-permeable rock formations, including shale formations found at great depths (usually 4000-10,000 feet) below the Earth's surface.[19] In the last decade or so, oil and gas production and service companies have perfected the use of an old technique – hydraulic fracturing – to produce natural gas from shale formations in an economical (that is, cost competitive) way.

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[14] Tara Patel, France to Keep Fracking Ban to Protect Environment, Sarkozy Says, Bloomberg (Oct. 4, 2011), http://www.bloomberg.com/news/2011-10-04/france-to-press-ahead-with-shale-research-after-fracking-ban.html. (“France will maintain a ban on fracking until there is proof that shale gas exploration won’t harm the environment or “massacre” the landscape, President Nicolas Sarkozy said.”).

[15] Steve Hargreaves, The Fracking Public Relations Mess, CNN Money (June 21, 2011), http://money.cnn.com/2011/06/21/news/economy/fracking_public_relations/index.htm. (“When Maryland Governor Martin O'Malley issued an executive order banning fracking earlier this month, the state joined the ranks of New York, Quebec, Germany, France and South Africa to halt the controversial technique for extracting natural gas from shale rock.”).

[16] See infra note 000 for a fuller explanation of the New York ban.

[17] Hargreaves, supra note 000.

[18]See John Kemp, Making Fracking Politically Acceptable, Reuters (Feb. 6, 2012) http://www.reuters.com/article/2012/02/06/column-fracking-politics-idUSL5E8D62Q920120206; Jim Polsen, New Yorkers Split on Marcellus Shale Gas Drilling, Survey Finds, Bloomberg (September 21, 2011) http://www.bloomberg.com/news/2011-09-21/new-yorkers-split-on-marcellus-shale-gas-drilling-survey-finds.html; Mireya Navarro, Judge’s Ruling Complicates Hydrofracking Issue in New York, New York Times (February 22, 2012) http://www.nytimes.com/2012/02/23/nyregion/judges-ruling-complicates-hydrofracking-issue-in-new-york.html.

[19] Some shale gas formations are even deeper. For a good descript us ion of the major shale gas formations in the United States, including data on their respective depths, see U. S. Department of Energy, Modern Shale Gas Development in the United States: a Primer (2009), Exhibit 11, (“DOE, Shale Gas Primer”) URL: http://www.netl.doe.gov/technologies/oil-gas/publications/epreports/shale_gas_primer_2009.pdf.

Hydraulic fracturing involves the injection of fluids deep into the ground at high pressure to fracture rock, thereby creating openings that allow gas to flow into production wells. Advances in drilling technology (particularly, horizontal drilling) and the development of more effective fracturing fluids (or "fracking fluids") have significantly reduced the costs of producing natural gas in this way, stimulating a kind of natural gas rush into shale gas formations.[20] Fracking was first used widely in the Barnett Shale[21] (Texas) and the Haynesville Shale (Louisiana), but quickly spread to other areas, including the Marcellus Shale[22] in the northeastern United States. Americans currently consume about 21 trillion cubic feet ("tcf") of gas per year.[23] It is estimated that American shale deposits hold several hundreds of trillions of cubic feet of gas.[24] The relatively sudden availability of all of this gas has driven American natural gas prices down below $4.00 per million btu ("mmbtu"), as compared with prices exceeding $10/mmbtu in Asia.[25]

B. Environmental Impacts

The environmental impacts of hydraulic fracturing are disputed. Proponents of hydraulic fracturing, and of natural gas more generally, sometimes claim that the many hundreds of thousands of fracking jobs performed in the United States to date have not produced a single confirmed case of groundwater contamination.[26] Opponents of fracking dispute that claim, pointing to several cases of alleged contamination of drinking water by methane or fracturing fluid chemicals.[27] Disputes over the source of contamination in those cases have triggered a spate of new studies from government and academic sources.[28] Proponents of hydraulic fracturing also tout the relatively low air emissions from natural gas combustion, compared to coal or oil. As Table 1 indicates, on a per btu basis natural gas combustion produces significantly

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[20] Id., at 9-10.

[21] The Barnett Shale is estimated to hold 84 tcf of technically recoverable reserves. U.S. Geological Survey Estimate, August 23, 2011. See press release: USGS Releases New Assessment of Gas Resources in the Marcellus Shale, Appalachian Basin, August 23, 2011, at http://www.usgs.gov/newsroom/article.asp?ID=2893 (last visited October 25, 2011)

[22] The Marcellus Shale is estimated to hold 41 tcf of technically recoverable reserves. U.S. Geological Survey, assessment of undiscovered oil and gas resources of the Devonian Marcellus Shale of the Appalachian basin province, 2011, URL: http://pubs.usgs.gov/fs/2011/3092/.

[23] Id.

[24] Estimates of technically recoverable amounts of gas are frequently revised by the U.S. Energy Information Administration ("EIA") and the U.S. Geological Survey, two of the more widely followed sources of data on this topic. The EIA's estimates have fluctuated between around 400 tcf and 800 tcf recently. See Institute for Energy Research, Technically Recoverable Shale Gas Resources Jump 134 Percent (2011), URL: http://www.instituteforenergyresearch.org/2011/05/16/technically-recoverable-shale-gas-resources-jump-134-percent/.

[25] See supra note 000.

[26] Sen. James Inhofe, Opinion,: Federal Interference in Energy Development Regulation a Bad Idea, the Hill, July 19, 2011, URL: http://thehill.com/special-reports/energy-july-2011/172393-federal-interference-in-regulation-of-energy-development-a-bad-idea ("Since the first use of hydraulic fracturing … producers have completed more than 1.5 million fracturing jobs without one confirmed case of groundwater contamination from these fracked formations."); American Petroleum Institute, Empire Energy Forum, Hydraulic Fracturing Overview, January 10, 2011, URL: http://www.empireenergyforum.com/article/hydraulic-fracturing-overview.

[27] See Think Progress, Inhofe Is Wrong: Five Famous Times Fracking Contaminated Water, July 21, 2011, URL: http://thinkprogress.org/green/2011/07/21/274064/inhofe-is-wrong-five-famous-times-fracking-contaminated-our-water/.

[28] These studies are discussed infra at notes 000-000 and accompanying text.

fewer greenhouse gas emissions than either coal or oil, and an even smaller fraction of the emissions of the other major pollutants associated fossil fuel combustion. As a well-established and reliable fuel source for electric generation, inexpensive, plentiful natural gas could over time lead to the widespread substitution of natural gas-fired electric generation plants for coal-fired plants. Since coal combustion is associated with tens of thousands of premature deaths each year,[29] the substitution of natural gas- for coal-fired generation could yield substantial health benefits.[30] That is why some energy planners see natural gas as a "bridge fuel" in the process of moving from a fossil fuel economy to one fueled by renewable energy resources.[31]

Table 1: Fossil Fuel Emission Levels
(Pounds per Billion Btu of Energy Input)

Pollutant	Natural Gas	Oil	Coal
Carbon Dioxide	117,000	164,000	208,000
Carbon Monoxide	40	33	208
Nitrogen Oxides	92	448	457
Sulfur Dioxide	1	1,122	2,591
Particulates	7	84	2,744
Mercury	0.000	0.007	0.016

Source: EIA - Natural Gas Issues and Trends 1998

All of that said, the use of hydraulic fracturing to produce natural gas does have a variety of important environmental impacts.[32] First, it uses enormous quantities of water. The typical fracking operation uses 2-4 million gallons of water.[33] Depending upon the particular characteristics of the formation in which the fracturing operation occurs, between 10 percent and 40 percent[34] of that water returns to the surface as so-called "flowback water."[35] (By contrast,

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[29] See Paul R. Epstein et al., Full Cost Accounting for the Life Cycle of Coal, 1219 Annals of the N.Y. Acad. of Sci. 73, 85 (2011). For a summary of other studies estimating the external costs of coal, see External Costs of Coal, SourceWatch.org, http://www.sourcewatch.org/index.php?title=External_costs_of_coal (last visited Sept. 28, 2011).

[30] On the other hand, natural gas (methane) is itself a potent greenhouse gas. To the extent that natural gas production produces increases in fugitive emissions of natural gas from production facilities and pipelines, a move from coal- to natural gas-fired generation might not yield much in the way of greenhouse gas emissions benefits. See infra [ ]

[31] See, e.g., Joel Kirkland, Natural Gas Could Serve As a Bridge Fuel to a Low Carbon Future, Scientific American (June 25, 2010), URL: http://www.scientificamerican.com/article.cfm?id=natural-gas-could-serve-as-bridge-fuel-to-low-carbon-future; and John Podesta and Timothy Wirth, Natural Gas: a Bridge Fuel for the 21st Century (2009), URL: http://www.americanprogress.org/issues/2009/08/pdf/naturalgasmemo.pdf.

[32] For a more thorough description of the environmental consequences of hydraulic fracturing, and of some state efforts to regulate those externalities, see Wiseman, Regulatory Adaptation, supra note 000.

[33] U.S. DOE, Shale Gas Primer, supra note 000, at 64. The New York State Department of Environmental Conservation estimates that a typical frac job would require "2.4 million to 7.8 million gallons of water." N.Y. State Dept. of Envtl. Conserv'n, Supplemental Generic Environmental Impact Statement, (2009), URL: ftp://ftp.dec.state.ny.us/dmn/download/OGdSGEISFull.pdf.

[34] See U.S. DOE, Shale Gas Primer, supra note 000; and N.Y. DEC, SGEIS, supra note 000.

produced water is water that was already underground, and which can float to the surface through the well before or after hydraulic fracturing.[36]) That means that a typical fracking operation leaves as much as 1.6 million gallons of water deep below the earth's surface. In the arid areas, such as the Eagle Ford Shale in South Texas, hydraulic fracturing may strain existing water supplies.[37]

Second, fracking fluid mixtures contain toxic chemicals. These mixtures are carefully designed to fracture rock in predictable and efficient ways, and to prop open spaces in the rock in a durable way so that gas can flow into the production well. Fracking fluid mixtures are more than 99 percent water and sand, sand being the "proppant" that props open spaces in the rock in a durable way after the water pressure is reduced and the water flows away from the fractures.[38] The remainder of the mixture consists of various chemicals deemed best for fracturing the particular formation at issue by the fracturing fluid designers. Some; fracking fluid constituents are toxic,[39] or some fracking mixtures contain known carcinogens.[40] on the other hand, industry groups argue that these same constituents are commonly found in many other household products.[41] As noted above, the fracking fluids flow down through the well into the earth during the fracturing operation, and some portion of them flow back to the surface during fracturing and gas production. Thus, some of the toxic chemicals that are injected into the ground during hydraulic fracturing remain there. The oil and gas industry is developing fracking fluid mixtures that contain non-toxic or less toxic constituents, but it does not appear that these alternatives are yet in wide use.[42]

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[35] Flowback water contains constituents that were originally in the fracturing fluids, as well as dirt, silt, and other elements or contaminants added to the water during its time underground.

[36] For a good description of the difference between flowback water and produced water, see Institute for Energy Research, What Is Flow Back, and How Does It Differ from Produced Water?, URL: http://energy.wilkes.edu/pages/205.asp

[37] There is considerable disagreement about the degree to which hydraulic fracturing exacerbates water supply problems. A task force established by the Texas Railroad Commission to study water supply issues the Eagle Ford Shale concluded in January, 2012 that hydraulic fracturing their did not threaten local water supplies. See Railroad Commission of Texas, News Release: Eagle Ford Task Force Finds South Texas Water Supply Sufficient, January 26, 2012, URL: http://www.rrc.state.tx.us/commissioners/porter/press/012612.php. But cf., American Water Intelligence, Water Worries Shadow Eagle Ford Development (January, 2011), URL: http://www.americanwaterintel.com/archive/2/1/general/water-worries-shadow-eagle-ford-development.html (describing uncertainty about water supply for the Eagle Ford region); and Rick Spruill, Water Availability, Not Contamination, Worries Residents above Eagle Ford Shale, Caller.com., October 15, 2011, URL: http://www.caller.com/news/2011/oct/15/water-availability-not-contamination-worries/.

[38] The components of fracturing fluids have become generally known over the last few years, in part because of efforts by regulatory agencies to compel disclosure, and in part because of voluntary disclosure efforts by natural gas producers and their contractors. For a primer on fracturing fluid composition, see U.S. DOE, Modern Shale Gas, supra note 000, at __.

[39] For a thorough discussion of the toxicity of constituents of fracturing fluids used in New York State, see NYSDEC, SGEIS, supra note 000, at Section 5.4.

[40] Id.

[41] See, e.g., Ken Cohen, Fracking Fluid Disclosure: Why It's Important, Perspectives (ExxonMobil publication), August 25, 2011, URL: http://www.exxonmobilperspectives.com/2011/08/25/fracking-fluid-disclosure-why-its-important/ (detailing some of the common household products containing the same chemicals found in fracturing fluid mixtures).

[42] See Business Wire, New EPA-Aproved Fracking Fluid 100% Green, SteriFrac Makes Fracking Process Safe for Oil & Gas Industry, January 10, 2012, URL: http://www.businesswire.com/news/home/20120110005568/en/EPA-Aproved-Fracking-Fluid-100-Green; and Emran Hussain, Baker Hughes Launches Green Fracking Fluid Systems, December 9, 2010, ArabianOilandGas.com, URL: http://www.businesswire.com/news/home/20120110005568/en/EPA-Aproved-Fracking-Fluid-100-Green.

Third, fracking produces significant quantities of wastewater. Flowback water and produced water will contain not only the original fracking fluid constituents, but may also contain contaminants added to the water during its time underground. These contaminants may include salts and naturally occurring toxic elements, such as arsenic, as well as radioactivity.[43] The disposal options for this wastewater will depend upon nature of the contaminants in the wastewater, the physically available disposal options in the vicinity of the operation, as well as the state and local legal regime.[44] The menu of possibilities include direct disposal into surface waters through a point source, injection of the wastewater into an underground formation, disposal through a wastewater treatment facility, and recycling the water (that is, reuse in other fracking operations). Each of these disposal options poses different challenges. In some parts of the country, underground injection is neither easy nor available. Depending upon the characteristics of the produced water, it may be difficult or impossible to obtain the required Clean Water Act permission[45] to discharge the wastewater directly into surface waters. Similarly, some wastewater may contain radioactivity or other contaminants that interfere with the operation of sewage treatment facilities, making discharge to such facilities impossible.[46] underground injection of wastewater from hydraulic fracturing operations in the wrong location can trigger seismic events.[47] For all of these reasons, increasing quantities of flowback water and produced water are treated on site and reused in future fracturing operations.[48]

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[43] See William J. Kemble, Kingston Won't Accept Fracturing Fluids at Sewage Treatment Plant, Engineer Says, Kingston Daily Freeman, December 19, 2011 (citing problems associated with the presence of salts and radioactive materials in wastewater from fracturing operations), URL: http://www.dailyfreeman.com/articles/2011/12/19/news/doc4eee73521641a869886272.txt. Wastewater can become radioactive because of radioactive elements that enter the water deep in the ground. For a good description of these so-called "naturally-occurring radioactive materials" (or "NORM"), see U.S. EPA, Oil and Gas Production Wastes, URL: http://www.epa.gov/radiation/tenorm/oilandgas.html.

[44] For more on the regulation of wastewater disposal associated with hydraulic fracturing, see infra section __.

[45] This kind of discharge would be subject to the requirement to obtain and National Pollutant Discharge Elimination System ("NPDES") permit under section 402 of the Clean Water Act. 42 U.S.C. Section 1342.

[46] Sewage treatment facilities maintain their own NPDES permits under the Clean Water Act. However, the Clean Water Act imposes so-called "pretreatment" standards on parties that would discharge to sewage treatment plants. For example, if a discharge of wastewater to a sewage treatment facility disrupts the treatment process of the facility (for example, by killing the biological organisms that are used to treat sewage), that discharge would violate the Clean Water Act pretreatment rules. See 33 C.F.R. Section 403.3 (prohibiting discharges that cause "upset" or "bypass" of the sewage treatment plant).

[47] Underground injection of wastewater from gas production operations may have triggered earthquakes in Ohio recently. See Pete Spotts, How Fracking Might Have Led to an Ohio Earthquake, The Christian Science Monitor, January 2, 2012, URL: http://www.exxonmobilperspectives.com/2011/08/25/fracking-fluid-disclosure-why-its-important/.

[48] Don Hopey, Gas Drillers Recycling More Water, Using Fewer Chemicals, Pittsburgh Post-Gazette, March 1, 2011 URL: http://www.post-gazette.com/pg/11060/1128780-455.stm (describing one company's progress recycling wastewater in the Marcellus Shale from 80 percent of its wastewater in 2009, 90 percent in 2010, and the goal of 100 percent in 2011). Recycling may be far more common in the Marcellus Shale than elsewhere, however, due to the inavailability of inexpensive underground injection as a disposal method there. See Stephen Rassenfoss, From Flow Back to Fracturing: Water Recycling Grows in the Marcellus Shale, Society of Professional Engineers, July 2011, URL: http://www.spe.org/jpt/print/archives/2011/07/12Marcellus.pdf. In order to reuse wastewater in another fracking operation, it must be treated to remove solids and elements that can inhibit production from fractured shales. For a description of one company's proprietary recycling technology, see PetroChemTech, Marcellus Gas Well Hydrofracture Wastewater Disposal by Recycled Treatment Process, URL: http://www.prochemtech.com/Literature/TAB/PDF_TAB_Marcellus_Hydrofracture_Disposal_by_Recycle_1009.pdf.

Fourth, fracturing operations involve large amounts of construction activity and truck traffic. The operation involves the construction of a concrete drilling pad, from which the remainder of the fracking operations take place. The construction of storage facilities for water and/or chemicals used in fracking fluids change the visual character of the area. Trucks containing water, chemicals, and equipment move to and from the site for each of the multiple fracking operations that take place from the pad. These activities produce the kinds of air emissions and noise that are typically associated with construction and truck traffic. When the operation takes place in a rural area or an urban or suburban residential neighborhood, these operations change fundamentally the character of the area for the duration of the fracking activities.[49]

Fifth, the production of natural gas can produce releases of methane into the atmosphere through leaks in gas capture, gathering, storage and transmission equipment. Methane is an extremely potent greenhouse gas.[50] Depending upon the volume of methane releases from any particular natural gas production operation, those releases may obviate any greenhouse gas emissions gains associated with the substitution of natural gas for coal in electricity production or other industrial operations. However, there remains considerable uncertainty about the extent to which natural gas production and transmission operations produce methane emissions.[51]

Finally, hydraulic fracturing operations can be associated with groundwater contamination. Critics of hydraulic fracturing have suggested that fracturing operations cause the seepage of methane or fracturing fluids into groundwater wells.[52] The vast majority of hydraulic fracturing operations fracture rock a mile or more beneath existing groundwater tables. In these situations, the probability of these deep fractures causing methane or fracking fluids to

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[49] See Ian Urbina and Jo Craven McGinty, Learning Too Late of Perils in Gas Well Leases, The New York Times, December 2, 2011, at A1, for a description of the impacts of fracking operations on lessor landowners.

[50] One widely reported study estimates that nearly 8 percent of the methane produced from natural gas wells escapes into the atmosphere as the result of leaks or venting. Since methane is among the most potent greenhouse gases – it's heat trapping abilities far exceed that of carbon dioxide on a molecule by molecule basis – these methane emissions have the potential to erase any greenhouse gas emissions gains associated with switching from coal-fired power to natural gas-fired power. See Robert W. Howarth, Renee Santoro, and Anthony Ingraffea, Methane and the Greenhouse Gas Footprint of Natural Gas from Shale Formations, Climate Change Letters, 2010, URL: http://graphics8.nytimes.com/images/blogs/greeninc/Howarth2011.pdf. See also Gabrielle Petron, et al., Hydrocarbon Emissions Characterization in the Colorado Front Range-a Pilot Study, forthcoming from the Journal of Geophysical Research, URL: http://www.agu.org/pubs/crossref/pip/2011JD016360.shtml (suggesting that existing estimates of fugitive methane emissions from gas operations are underestimates). But cf., Michael Levi, Yellow Flags on a New Methane Study, (blog) Council on Foreign Relations, February 13, 2012 (identifying methodological problems with the JGR study).

[51] A report from Cambridge Energy Research Associates contends that the Howarth study is plagued by measurement and methodological errors that resulted in an overestimate of methane emissions from gas production operations. The alleged errors include failing to distinguish between methane emission rates from venting versus flaring of gas, failing to account for the standard industry practice of capturing methane in flowback water, and more. See Cambridge Energy Research Associates, Measuring Methane: Estimating Greenhouse Gas Emissions from Upstream Natural Gas Development, (Private Report, on file with author). See also David A. Kirchgessner, Robert A. Lott, R. Michael Cowgill, Matthew R. Harrison, Theresa M. Shires, estimate of methane emissions from the U. S. Natural gas industry, (Working Paper: US EPA, Research Triangle Institute, Gas Research Institute) URL: http://www.epa.gov/ttnchie1/ap42/ch14/related/methane.pdf.

[52] See e.g., Mike Soroghan, Baffled about Fracking? You're Not Alone, The New York Times, May 13, 2011, URL: http://www.nytimes.com/gwire/2011/05/13/13greenwire-baffled-about-fracking-youre-not-alone-44383.html?scp=2&sq=fracking&st=cse. For a fuller discussion of the government and academic studies of groundwater contamination associated with hydraulic fracturing, see infra, notes 000-000 and accompanying text.

migrate upward into groundwater table seems very small.[53] However, a hydraulic fracturing operation may nevertheless cause groundwater contamination in either of two ways. First, if the natural gas well is poorly constructed, methane or fracturing fluids might leak from the well while passing through groundwater tables at shallow depths. Second, if the operator does a poor job of handling fracking fluid constituents on the surface, fracking fluid constituents may be spilled on the surface and find their way down into groundwater tables.[54] Third, the disposal of wastewater or other wastes on site, if permitted by law or the lease, can result in groundwater contamination if and when lagoons or other disposal facilities leak.[55]

Much of the controversy surrounding hydraulic fracturing focuses on these impacts and the adequacy of the regulatory regimes available to minimize, mitigate or prevent those impacts. In 2009, Cabot Oil and Gas Corporation entered into a consent decree in which it agreed to pay a fine of $230,000 and to provide fresh water to residents of Dimock, Pennsylvania, whose drinking water wells were contaminated with methane.[56] While the settlement did not establish the cause of the methane contamination, the Pennsylvania Department of Environmental Protection subsequently banned Cabot from using hydraulic fracturing in the region.[57] Methane in Pennsylvania wells inspired the academy award-nominated documentary, *GasLand*, which has rallied opposition to hydraulic fracturing, particularly in the Marcellus Shale.[58] More recently, the Environmental Protection Agency ("EPA") concluded in late 2011 that fracturing fluids had contaminated drinking water aquifer in near the town of Pavilion, Wyoming,[59] though the industry disputes that conclusion.[60] These incidents and others[61] prompted the EPA study of the

[53] However, in some places (for example, in limited portions of the Marcellus Shale), shale gas is found at shallower depths. While the industry is able to accurately measure the size and location of fractures produced by fracking operations, it is not always able to predict the extent of fracturing before it happens. This uncertainty gives rise to the theoretical possibility that a fracturing operation could cause methane or fracturing fluids to find their way into groundwater tables.

[54] Soroghan, supra note 000 ("methane contamination is not caused by injecting chemicals down the well. It is caused by bad well construction during drilling").

[55] Urbina and McGinty, supra note 000 (describing fracking operations in which operators covered waste lagoons on site at the close of fracking operations).

[56] Michael Rubinkam, Pennsylvania regulators suspend Cabot oil and gas drilling over contamination of Wells in Pennsylvania, Minneapolis Star Tribune April 15, 2010, URL: http://www.startribune.com/templates/Print_This_Story?sid=90960344. Similar claims have been brought against Southwest Energy Production Company and Atlas Energy. See the Justia compendium of documents for Berish et al. v Southwest Energy Production Company, Pennsylvania District Court (Susquehanna), URL: http://dockets.justia.com/docket/pennsylvania/pamdce/3:2010cv01981/82355/; and Jon Hurdle, Pennsylvania Lawsuit Says Drilling Polluted Water, Reuters, November 9, 2009, URL: http://www.reuters.com/article/2009/11/09/us-fracking-suit-idUSTRE5A80PP20091109; and

[57] Rubinkam, supra note 000. For an analysis of the factual issues at play in groundwater contamination claims in the Marcellus Shale, see McKay et al., supra note 000 at 138-43.

[58] Some Pennsylvania residents have accused the state's environmental agency of turning a blind eye to contamination of drinking water wells by gas drilling operations. See Associated Press, W. Pa. tests: Chemicals in drilling area water, February 24, 2012, URL: http://hosted.ap.org/dynamic/stories/U/US_GAS_DRILLING_NEW_CONTAMINATION?SITE=AP&SECTION=HOME&TEMPLATE=DEFAULT&CTIME=2012-02-24-12-20-03.

[59] See U.S. EPA, Investigation of Groundwater Contamination Near Pavilion, Wyoming (draft report), December 2011.See also Jim Efstahiou, Jr., Gas Fracturing Chemicals Detected in Wyoming Aquifer, EPA says, Bloomberg News, December 8, 2011, URL: http://www.bloomberg.com/news/2011-12-08/gas-fracking-chemicals-detected-in-wyoming-aquifer-epa-says.html.

[60] The Independent Petroleum Association of America raised questions about the EPA study, which provoked a dialogue with EPA. See Six-Actually Seven-Questions for EPA on Pavilion, Energy in Depth (2012), URL: http://www.energyindepth.org/six-questions-for-epa-on-pavillion/.

environmental effects of hydraulic fracturing country on water resources.[62] EPA expects to announce preliminary results of the study in late 2012, with final results anticipated in 2014.[63]

Thus, significant uncertainty remains about the nature of the impacts of hydraulic fracturing, and how widespread those impacts are.

II. The Existing Regulatory Environment

A. Federal Regulation

There is no comprehensive federal licensing regime for onshore oil and gas development. To the contrary, in the United States the regulation of oil and natural gas exploration and production has always been primarily a state matter. Economic motives drove the earliest government interventions into oil and gas production. From the discovery of oil in Western Pennsylvania in the mid-19th century through subsequent discoveries in Texas, Oklahoma, and Louisiana in the late 19th and early 20th centuries, the American oil and gas industry experienced a series of boom-bust cycles, accompanied by wild swings in oil prices. These cycles were precipitated and exacerbated by the common law "rule of capture," which permitted any single owner of mineral rights in a multi-owner oilfield to produce as much oil as possible from the field.[64] In addition to its effects on prices, the rule of capture led to tremendous waste, because it provided a disincentive for owners to manage production (for example, by coordinating the placement of wells and production rates from those wells) so as to maintain pressure levels in the field. The result was production that was both physically and economically inefficient.[65] After the discovery of the massive east Texas field in 1930 exacerbated oversupply problems and depressed prices, producers appealed to governments to step in. State legislatures in oil-producing states began enacting "conservation" statutes authorizing state regulators to organize production so as to promote efficiency.[66] This kind of state-managed production eventually grew to include the establishment of some basic environmental, health and safety standards

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[61] In April of 2011 Chesapeake Energy, a major shale gas producer in Pennsylvania, suffered a blowout of one of its wells, causing spills of drilling fluids. See Edward McAllister, Chesapeake Stems Flow from Blown Pennsylvania Gas Well, Reuters, April 22, 2011, URL: http://www.reuters.com/article/2011/04/22/us-chesapeake-blowout-idUSTRE73K5OH20110422.

[62] U.S. EPA, Plan to Study the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources, November, 2011, URL: http://www.epa.gov/hfstudy/HF_Study__Plan_110211_FINAL_508.pdf.

[63] Id., at 7.

[64] Specifically, the so-called "rule of capture" specifies that no single owner of a portion of the field may prevent an adjoining landowner from producing oil and gas from the field, even if that production pulls minerals from under adjoining lots. See e.g., Barnhard v. Monongahela Natural Gas Co, 216 Pa. 362 (1907) for an illustrative example of the rule of capture at work. For an analysis of the rule of capture and its effects, see Bruce M. Kramer and Owen L. Anderson, The Rule of Capture: An Oil and Gas Perspective, 35 Envtl. L. 899 (2005).

[65] Production by multiple owners of a single field constitutes a classic prisoner's dilemma. While the parties might wish to cooperate in order to maximize production from a single field, there is an ever present temptation for each individual owner to defect from any cooperative arrangement, thereby garnering more revenue for him- or herself. However, if all parties to the agreement defect, the market for oil is glutted, and prices fall.

[66] The process of managing the rights of multiple owners of a single oilfield involves prorating production and sharing revenues. State commissions like the Texas Railroad Commission and the Oklahoma Corporation Commission, oversee these processes. For a brief history of the early proration orders issued by the Texas and Oklahoma commissions, see Stephen L. MacDonald, Petroleum Conservation in the United States: an Economic Analysis 37 (1971).

governing well construction and other aspects of the work.[67] These state conservation commissions continue to regulate natural gas production today in states like Texas and Oklahoma.

Most environmental regulation, however, is of more recent vintage. The modern environmental movement is a post-World War II phenomenon, and it eventually led to the federal environmental regulatory regime that we know today. During the 10 year period stretching from 1970 through 1980, Congress passed most of the major statutes that regulate environmental, health and safety today,[68] including: (i) the Clean Air Act[69] ("CAA") and Clean Water Act[70] ("CWA"), which required permits and compliance with federal standards for air and water emissions respectively; (ii) major hazardous waste regulatory legislation, such as the the Resource Conservation and Recovery Act[71] ("RCRA"), governing the ongoing management of hazardous waste generation, transportation and disposal; and (iii) public health and safety protection laws, such as the Safe Drinking Water Act[72] ("SDWA"), establishing federal drinking water protection standards, and the Occupational Safety and Health Act[73] ("OSHA"), establishing health and safety standards for the workplace.

However, this federal environmental regulatory superstructure does not always regulate environmental, health and safety risks associated with hydraulic fracturing in the same way it regulates other industries, in part because fracturing operations enjoy some exemptions from federal environmental regulation.[74] First, the SDWA regulates underground injections "which endanger drinking water sources"[75] -- including underground injection of oil and gas wastes -- through its underground injection well permitting program.[76] However, the Energy Policy Act of 2005 amended the definition of "underground injection" to exclude "the underground

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[67] See infra section II.B for examples of these rules.

[68] Some commentators have referred to this period of intense growth in federal environmental regulation as "the environmental decade." Political scientist Lettie Wenner may have been the first to coin this phrase. See Lettie M. Wenner, The Environmental Decade in Court (1982).

[69] 42 U. S. C. Section 7401, et seq.

[70] 33 U.S.C. Section 1251 et seq.

[71] 40 2U. S. C. Sections 6901 et seq. RCRA authorizes the EPA to provide "cradle to grave" regulation of hazardous waste generation, transport, treatment, storage and disposal.

[72] 42 U.S.C.Section 300f et seq.

[73] 15 U.S.C. Section 651 et seq.

[74] For a comprehensive survey of federal and state regulation of hydraulic fracturing operations, see Hannah Wiseman, Untested Waters: the Rise of Hydraulic Fracturing in Oil and Gas Production and the Need to Revisit Regulation, 20 Fordham Envtl L. Rev. 115 (2009). See also, Charles P. Groat and Thomas W. Grimshaw, Fact-based Regulation for Environmental Protection in Shale Gas Development, University Of Texas at Austin Energy Institute, 2012, Chapter 4 (survey of state regulation).

[75] 42 U.S.C.A. § 300(h) (West).

[76] Id. Section 300(h)(b)(1)(A) ("Such regulations shall require that a State program, in order to be approved under section 300h-1 of this title-- shall prohibit, effective on the date on which the applicable underground injection control program takes effect, any underground injection in such State which is not authorized by a permit issued by the State (except that the regulations may permit a State to authorize underground injection by rule."); Section 300(h-4)(a) ("For purposes of the Administrator's approval or disapproval under section 300h-1 of this title of that portion of any State underground injection control program which relates to-- (1) the underground injection of brine or other fluids which are brought to the surface in connection with oil or natural gas production or natural gas storage operations, or (2) any underground injection for the secondary or tertiary recovery of oil or natural gas,
in lieu of the showing required under subparagraph (A) of section 300h-1(b)(1) of this title the State may demonstrate that such portion of the State program meets the requirements of subparagraphs (A) through (D) of section 300h(b)(1) of this title and represents an effective program (including adequate recordkeeping and reporting) to prevent underground injection which endangers drinking water sources.").

injection of fluids or propping agents (other than diesel fuels) pursuant to hydraulic fracturing operations related to oil, gas, or geothermal production activities."[77] This provision means that fracturing operations do not require underground injection well permits under the SDWA. The history of the exemption can be traced to an EPA decision in the 1990s to exempt hydraulic fracturing because the principal function of fracking operations is not the injection of fluids into the ground (disposal), but rather gas production.[78] After an EPA study concluded that the injection of hydraulic fracturing fluids into coalbed methane wells poses little or no threat to drinking water sources,[79] Congress enacted the statutory exemption. It should be noted, however, that underground injection of wastewater from fracturing operations is subject to SDWA permitting requirements.

Second, there is no federal law requiring the disclosure of the composition of fracking fluids to environmental regulators. The Emergency Planning and Community Right to Know Act,[80] the primary hazardous chemicals disclosure law, includes the requirement that industries submit to EPA annually a "Toxic Chemical Release Form" describing the specific toxic chemicals used in their industrial processes, and the specific path to disposal for each.[81] However, the Toxic Chemical Release Form requirement only applies to industries within specific Standard Industrial Classification Codes;[82] oil and gas production operations fall within SIC code 13, and so are exempt from the requirement to file the form. Consequently, people concerned about the contamination of their groundwater by fracking fluids cannot use the Toxic Chemical Release Inventory [83] to determine whether there wells have been contaminated by a particular fracturing operation. On the other hand, other federal laws require fracturing operators to file material safety data sheets for each hazardous chemical present at the job site with local governments.[84] One voluntary industry disclosure effort, the website "fracfocus.org," assembles and publishes information about the contents of frack fluid mixtures from individual wells.[85] Furthermore, transportation of hazardous chemicals to and from the jobsite may be covered by reporting requirements under the Hazardous Materials Transportation Act.[86] Legislation to

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[77] Id. Section 300(h)(d)(1)(B)(ii).
[78] See Brief for Respondent at 13, Legal Envtl. Assistance Found., Inc. v. E.PA, 118 F.3d 1467 (11th Cir. 1997) 1995 WL 17057927. ("Guided by the legislative history, EPA has done just that, and has never interpreted "well injection" to include hydraulic fracturing operations related to methane production. Rather, EPA has focused the UIC program on regulation of wells at which the "principal function" is underground emplacement of fluids, not wells at which any "emplacement" is wholly incidental to production.").
[79] U.S. EPA, Evaluation of Impacts to Underground Sources of Drinking Water by Hydraulic Fracturing of Coalbed Methane Reserves. EPA 816-R-04-003 at http://www.gwpc.org/elibrary/documents/general/Evaluation%20of%20Impacts%20to%20Underground%20Sources%20of%20Drinking%20Water%20by%20Hydraulic%20Fracturing%20of%20Coalbed%20Methane%20Reservoirs.pdf.
[80] 42 U.S.C. Section 11001 et seq.
[81] See 42 U.S.C. Section 11023 (detailing the toxic chemical release form reporting requirement).
[82] Originally, the requirement applied only to SIC codes 20-39, the manufacturing industries. 42 U.S.C. Section 11023(b)(1)(A). While the EPA has expanded its coverage somewhat, the requirement remains inapplicable to the natural gas production industry.
[83] The inventory is the publicly available compendium of information aggregated from all the submitted toxic chemical release forms. The inventory can be searched here: http://www.epa.gov/tri/.
[84] See 42 U.S.C. Section 11021 (detailing the requirement that companies retain material safety data sheets on site).
[85] See FracFocus Chemical Disclosure Registry, URL: http://fracfocus.org/.
[86] 49 U.S.C. Section 5101, et seq.

require disclosure of the specific fracking fluid mixtures used in each fracturing operation was introduced into the 111th Congress,[87] but never came to a vote there.

Third, wastewater produced by fracking operations enjoys the same exemption from RCRA hazardous waste disposal regulations that applies to all oil and gas wastes. The RCRA regulatory regime requires generators, transporters and disposers of hazardous wastes to comply with a variety of (sometimes very expensive) regulatory requirements.[88] RCRA delegated to the EPA the task of developing precise definitions of hazardous wastes covered by the regulatory regime.[89] In December of 1978, the EPA issued proposed rules defining the types of hazardous characteristics that would bring solid wastes within the definition of hazardous wastes.[90] In so doing, the EPA indicated that "certain very large volume wastes," including "oil and gas drilling muds and oil production brines,"[91] may be hazardous but would be difficult to regulate because the EPA lacks information about their risks, which appear to be low.[92] This exemption was codified in the 1980 amendments to RCRA.[93] Consequently, the disposal of wastewater from fracking operations is not subject to regulation of hazardous waste under RCRA.[94] Which is not to say that disposal of fracking wastes is entirely unregulated at the federal level. As noted above, the Clean Water Act and SDWA regulate certain methods of disposal of waste water from fracking operations.[95]

Thus, despite federal regulation of some aspects of shale gas production, the fact that fracking operations enjoy exemptions from some federal regulations has exacerbated fears surrounding those operations.

B. State Regulation

[87] The law was called the Fracturing Responsibility and Awareness of Chemicals Act ("FRAC Act"). It was introduced into the 112th Congress in March of 2011, but never came to a vote.

[88] See U.S. EPA, Summary of the Resource Conservation and Recovery Act, URL: http://www.epa.gov/lawsregs/laws/rcra.html.

[89] RCRA mandated that the EPA should, "develop and promulgate criteria for identifying the characteristics of hazardous waste, and for listing hazardous waste, which should be subject to the provisions of this subchapter, taking into account toxicity, persistence, and degradability in nature, potential for accumulation in tissue, and other related factors such as flammability, corrosiveness, and other hazardous characteristics. Such criteria shall be revised from time to time as may be appropriate. 42 U.S.C.A. § 6921(a) (1976 West).

[90] 43 Fed. Reg. 58946-59022.

[91] Id.

[92] Id. at 58991-2.

[93] 42 U.S.C. 6921(b)(2)(A) (1980 West). This section provided that, "Notwithstanding the provisions of paragraph (1) of this subsection, drilling fluids, produced waters, and other wastes associated with the exploration, development, or production of crude oil or natural gas or geothermal energy shall be subject only to existing State or Federal regulatory programs in lieu of this subchapter until at least 24 months after October 21, 1980, and after promulgation of the regulations in accordance with subparagraphs (B) and (C) of this paragraph. Id. In 1988, the EPA issued its report, titled Regulatory Determination for Oil and Gas and Geothermal Exploration, Development and Production Wastes, 53 Fed. Rep. 25447, in which it explained the basis for the exemption. The EPA explained that: (1) a wide variety of management practices are utilized for these wastes, and that alternatives to these current practices are not feasible or applicable at individual sites; (2) existing State and Federal regulations are generally adequate to control the management of oil and gas wastes; and (3) imposition of RCRA hazardous waste regulations for all oil and gas wastes could subject billions of barrels of waste to regulation and would cause a severe economic impact on the industry and on oil and gas production in the U.S. Id.

[94] Presumably, most fracking fluids do not exhibit the characteristics of the hazardous waste, since whatever toxic constituents may exist in the mixture represent a minute fraction of the mixture. However, RCRA treats a mixture as a hazardous waste if any ingredient of the mixture is a hazardous waste. 40 CFR Section 261.3(a)(2)(iv).

[95] See supra notes 000-000.

State regulation of hydraulic fracturing operations varies considerably, but has grown beyond the mere regulation of property rights and production rates to include environmental (or quasi-environmental) regulation as well.[96] The two right-hand columns in Table 2 illustrate the growth of natural gas production (driven primarily by hydraulic fracturing) in three American states containing large shale gas deposits. Texas has been at the forefront of shale gas production, doubling the number of wells in the state between 2000 and 2009 by first exploiting the Barnett Shale in North Texas, and later other shale deposits within the state, most recently the Eagle Ford Shale in South Texas. New York and Pennsylvania overlay the huge Marcellus Shale. Gas production in Pennsylvania has seen sharp increases over the last decade, but production in New York has not. All three states have had regulatory regimes in place for some time governing the construction of oil and gas wells.[97] Why, then, have Texas and Pennsylvania seen a strong surge in natural gas production and hydraulic fracturing over the last decade, while New York has not? Variation in these states' regulatory approaches to hydraulic fracturing accounts for the lion's share of this disparity. Texas and Pennsylvania have applied their existing regulatory regimes for natural gas production to hydraulic fracturing operations, though both states revised their rules somewhat in early 2012.[98] For its part, New York State decided to impose a moratorium[99] on hydraulic fracturing while it studied the effects of the practice, lifting the moratorium in July of 2011 in anticipation of the establishment of new regulatory standards proposed in the fall of 2011.[100]

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96 A thorough review of state regulatory standards is beyond the scope of this article. For a good description of state regulation of hydraulic fracturing, see Wiseman, supra note 000, at __; and Groat and Grimshaw, supra note 000, at Chp. 4.

97 See descriptions of these regimes, infra, notes 000-000 and accompanying text.

98 In January of 2012, the Texas Railroad Commission promulgated new rules requiring operators to provide additional information about the makeup of fracturing fluids and other information about their operations to regulators. Tex. Admin. Code Section 329. Pennsylvania did the same in February of 2012. Corbett Signs Shale Well Impact Fee into Law, Pittsburgh Post-Gazette, Tuesday, February 14, 2012, URL: http://www.post-gazette.com/pg/12045/1210009-503.stm. For a more comprehensive description of the regulatory changes that have taken place in Pennsylvania since 2009, see Lynn Kerr McKay, Ralph H. Johnson, and Laurie Alberts Salita, Science and the Reasonable Development of Marcellus Shale Natural Gas Resources in Pennsylvania and New York, 32 Energy L. J. 125, 132-37 (2011)(recounting a variety of changes, including increases in staff changes to technical standards for well construction, discharge of wastewater, and more).

99 The New York ban was created by executive order of the governor, N.Y. Exec. Order No. 41, requiring further environmental of high-volume hydraulic fracturing in the Marcellus shale (December 13, 2010), following his veto of state legislation imposing a much broader ban. See S8129, Leg. 233d Sess. (N.Y. 2010). This followed an announcement by the Delaware River Basin Commission that natural gas producers must apply for commission approval before drilling in shale formations that lie within the Delaware River basin, an action which restricted production within New Jersey as well. See Carol R. Collier, Determination of the Executive Director concerning Natural Gas Extraction Activities in Shale Formations within the Drainage Area of Special Protection Waters, Delaware River Basin Commission (May 19, 2009), URL: http://www.state.nj.us/drbc/EDD5-19-09.pdf. See also Danny Hakim and Nicolas Confessore, Cuomo Will Seek to Lift Ban on Hydraulic Fracturing, the New York Times, June 30, 2011, URL: http://www.nytimes.com/2011/07/01/nyregion/cuomo-will-seek-to-lift-drilling-ban.html?pagewanted=print. New Jersey has also imposed a moratorium on hydraulic fracturing operations. See supra note 000.

100 The proposed rules were detailed in a Supplemental Generic Environmental Impact Statement published by the agency. See New York State Department of Environmental Conservation, Revised Draft SGEIS on the Oil, Gas and Solution Mining Regulatory Program (September 2011), URL: http://www.dec.ny.gov/energy/75370.html.

Table 2: Natural Gas Development and Regulation, 3 States[101]

	Regulator	Number of wells (production), 2000	Number of wells (production), 2009
Texas	Texas Railroad Commission	48,609	93,507
Pennsylvania	Pennsylvania Department of Environmental Protection	30,000	57,356
New York	New York State Department of Environmental Conservation	5,304	6,628

A comparison of the regulatory regimes of these states illustrates important similarities and differences between them. With respect to operational requirements applicable to gas production generally, the Texas rules appear to be more specific and prescriptive than either Pennsylvania or New York rules. All three regimes establish requirements governing well construction, including provisions to ensure that the cement casing is sufficient to prevent gas or other materials in the well from finding their way into the surrounding earth and groundwater. The Texas rules specify exactly where the well casing shall be constructed within the well,[102] the materials to be used,[103] and how the casing is to be cemented and pressure tested.[104] Pennsylvania well construction rules are more general, and are expressed as performance standards: for example, casing must be "of sufficient cemented length and strength to attach proper well control equipment and prevent blowouts, explosions, fires and casing failures."[105] The New York rules are even more general, requiring simply that "sufficient" surface casing extends "below the deepest potable fresh water level area"[106] Similarly, the Texas rules regarding blowout preventers are specific, requiring "a minimum of two remotely controlled hydraulic ram-type blowout preventers," the characteristics of which are specified in the rules.[107] The Pennsylvania and New York rules are less specific, and more likely to be articulated as performance standards.[108] These state regimes exhibit similar differences across the various other

[101] The data test in Table 2 come from the U. S. Energy Information Administration, and are available for download at: [URL]
[102] Specifically, the Texas rules require casing "from the shoe [bottom of the surface casing] to a point at least 600 feet above the shoe." 16 Tx. Admin Code Section 3.13.
[103] Id. (specifying that "all casing cemented in any well shall be steel casing," that the cement casing be installed by the "pump and plug method," and that a certain quality of cement be used).
[104] Id. (requiring the use of hydrostatic pressure testing).
[105] 25 Pa. ADC Section 78.71. Similarly, rather than specify the depth of surface casing, the rules state that the operator must ensure that the casing is of sufficient depth to protect groundwater. Id.
[106] N.Y. Comp. Code R. & Regs. Title 6, Section 554.1.
[107] 16 Tex. Admin. Code Section 3.13.
[108] For example, the Pennsylvania rules require blowout preventers only under certain conditions, 25 Pa. Code Section 78.72, while the New York rules stipulate that "wellhead connections adequate to control blowouts will be employed," including blowout preventers in areas where subsurface formations and pressures are unknown or uncertain. N.Y. Comp. Codes R. and Regs, Title 6, Section 554.4.

topics they commonly address, including requirements relating to blowout prevention, operational standards, waste disposal, and more.

All three states now require some form of disclosure by operators of the contents of their fracturing fluids.[109] With respect to waste disposal requirements, however, the Pennsylvania and New York rules seem more stringent than the Texas rules. For example, Texas rules specifically permit operators to construct and use pits for the storage of various liquids used during natural gas production, but require a separate permit for disposal of liquid wastes in pits or underground.[110] The Pennsylvania rules contain detailed construction requirements for pits used to store liquid during operations, such as the requirement that the pits contain a synthetic liner of specified thickness and integrity, and that the bottom of the pit be "at least 20 inches above the seasonal high groundwater table."[111] The rules for disposal of wastes include requirements addressing surface water disposal, disposal to municipal sewage treatment plant, and on-site or underground disposal.[112] The New York rules prohibit the pollution of land, surface water or groundwater from natural gas production activities,[113] and prohibit the storage or retention of oil in earthen reservoirs.[114] Moreover, New York's new proposed rules would impose environmental requirements far more thorough and stringent than those found either in Pennsylvania or Texas, including aggressive setback requirements from acquifers and other environmental resources, requiring the use of tanks rather than pits for onsite storage, and more.[115]

One might speculate that the differences between the state regulatory regimes are correlated with the nature of the mission of the agency given primary jurisdiction over natural gas production operations. In Texas, where the primary regulator is the oil and gas commission, natural gas operations regulations seem relatively detailed, but less directly focused on environmental protection; in New York and Pennsylvania, where the primary regulator is an environmental agency, the operational rules are general but the waste disposal rules seem particularly strong and detailed. A well-established literature within political science attributes substantive importance to these delegation decisions,[116] arguing that politicians can steer agencies in particular policy directions by establishing the agency's mission: that is, those attracted to work for the agency will tend to exhibit policy preferences that are consistent with the agency's statutory mission.[117] Agencies like the FERC or state oil and gas commissions

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[109] Texas requires participation in the Fracfocus.org disclosure program. See HB 3328 (2011). New York's proposed rules require disclosure to the New York State DEC. See SGEIS, supra note 000, at Section 8.2.1.1. Pennsylvania imposes this requirement as part of its spill prevention guidelines.

[110] 16 Tex. Admin. Code Sections 3.8, and 3.9. The rules governing disposal wells require consultation with the Texas Commission on Environmental Quality, and compliance with that agency's rules.

[111] 25 Pa. Code, Section 78.51.

[112] 25 Pa. Code Sections 58.55-60.

[113] N.Y. Comp. Code R. And Regs, Title 6, Section 556.5.

[114] Id., at Section 556.4.

[115] For a complete description of the proposed rule in New York, see SGEIS, supra note 000. For a comparison of various state rules, see Groat and Grimshaw, supra note 000, at Chapter 4.

[116] This argument has become known as the "structure and process" hypothesis, and is associated with Matthew McCubbin's, Roger Noll and Barry Weingast (sometimes known collectively in this literature as "McNollgast"). See particularly Matthew D. McCubbins, Roger G. Noll, and Barry R. Weingast, Administrative Procedures As Instruments of Political Control, 3 J.L. Econ. & Org. 243 (1987); Matthew D. McCubbins, Roger G. Noll, and Barry R. Weingast, Structure and Process, Politics and Policy: Administrative Arrangements and the Political Control of Agencies, 75 Va. L. Rev. 431 (1989).

[117] See McCubbins, Noll, & Weingast, Administrative Procedures, supra note 000, at 253–64; and McCubbins, Noll, & Weingast, Structure and Process, supra note 000, at 435–45. See also Jonathan R. Macey, who emphasizes the

were created explicitly to promote certain types of energy development, and we can infer hat those agencies' missions structure the ways in which they make difficult policy choices. Furthermore, we might infer that politicians understand this dynamic, and allocate regulatory authority to agencies with this dynamic in mind.[118]

Based upon this idea of mission-orientation, we might infer, then, that the New York and Pennsylvania legislatures allocated responsibility for regulating natural gas production to their environmental agencies in order to raise the profile of environmental issues in the natural gas regulatory process, and to ensure that environmental values were not ignored or given inadequate consideration. Correspondingly, we might infer that the Texas legislature sought to promote natural gas development over environmental values by delegating regulatory responsibility to the Texas Railroad Commission. New York's moratorium and stringent proposed rules appear to support that inference. However, it does not appear that Pennsylvania regulation of natural gas production (and of hydraulic fracturing, in particular) is generally more environmentally stringent than regulation in Texas. Furthermore, as noted above, while Texas relies upon the Texas Railroad Commission to regulate gas production, the Commission also works with the TCEQ to manage waste disposal and other pollution-related aspects of gas production. From this small sample it is difficult to discern any correlation between agency mission and regulatory stringency when it comes to the regulation of hydraulic fracturing. Rather, what stands out from this snapshot of three state systems is the variety of states' regulatory approaches, and of their ongoing efforts to adapt to emerging information about the risks of shale gas production.

III. Federalism and Energy Regulation

Different states have responded to the shale gas rush in different ways, and the EPA's study of hydraulic fracturing may yield proposals for new federal regulation of fracking. Meanwhile, the question remains, is new federal regulation necessary or advisable? Should EPA establish comprehensive risk-regulation governing hydraulic fracturing operations, permitting states to impose more stringent standards? Should Congress create a federal licensing regime for hydraulic fracturing operations, preempting state and local laws? Or should the federal government leave these issues to the states? Of course, Congress retains the constitutional right to regulate activities that have a substantial effect on interstate commerce.[119] There seems little doubt that natural gas production and its environmental externalities have a sufficient connection with interstate commerce to justify federal regulation. That question of legal authority, however, is distinct from the normative question of whether states or federal regulators are best suited to regulate in any particular instance.[120] One can conceptualize this federalism problem by putting policy first – that is, by determining the "right" policy and then determining which level of

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ways in which politicians can ''hardwire'' the agency in favor of a particular policy perspective through structural choices, including defining the agency's mission, establishing its internal organizational structure, and choosing its location within the larger executive branch. Jonathan R. Macey, Organizational Design and the Political Control of Administrative Agencies, 8 J. L. Econ. & Org. 93 (1992); and Jonathan R. Macey, Separated Powers and Positive Political Theory: The Tug of War over Administrative Agencies, 80 Geo. L. J. 671(1992).

[118] See McCubbins, Noll, & Weingast, Structure and Process, supra note 000; Lupia & McCubbins, supra note 000; and Macey, Separated Powers, supra note 000.

[119] See discussion of the Lopez and Morrison decisions, supra note 000.

[120] See Jason Scott Johnston, The Tragedy of Centralization: the Political Economics of American Natural Resource Federalism, 74 U. Colo. L. Rev. 487, 614-17 (2003) (arguing that whether an activity has a substantial effect on interstate commerce "says nothing about the general need for federal…regulation").

government can best accomplish that objective. Alternatively, one can approach this question in a policy-neutral way, by asking which level of government is best suited to determine the "best" policy? This analysis follows the latter approach because (i) it puts the federalism question first, and (ii) it seems especially appropriate to do so where, as here, there remains significant disagreement over the correct answers to the factual questions on which policy will be based.

A. Federalism and Regulation, Generally

The scholarly literature on American regulatory federalism is diverse.[121] Some scholars approach this question in rational choice turns, modeling it as a problem of aggregating preferences and responding to market failure.[122] Others reject the rational choice approach, arguing that it misses important values that ought to be considered in addressing questions of federalism.[123] This analysis will begin with four traditional rationales used to justify federal

[121] For some influential examples of this literature, see Herbert Wechsler, the Political Safeguards of Federalism: the Role of the States in the Composition and Selection of the National Government, 54 Columb. L. Rev. 543 (1954); Michael W McConnell, Federalism: Evaluating the Founders Design (1987); Edward L. Rubin and Malcolm Feeley, Federalism: Some Notes on a National Neurosis, 41 UCLA L. Rev. 903 (1994); Gary Friedman, Valuing Federalism, 82 Minn. L. Rev. 317 (1997); Matthew D. Adler and Seth F. Kreimer, the New Etiquette of Federalism, 1998 Sup. Ct. Rev. 71 (1999); Larry Kramer, Putting the Politics Back into the Political Safeguards of Federalism, 100 Columb. L. Rev. 215 (2000).

[122] This tradition includes economists and rational choice political scientists who model this problem as one of maximizing social welfare (the aggregated utility of individuals). Using this approach, regulatory authority ought to be exercised by the level of government that is best able to translate individual preferences into policy choices most accurately. This tradition arose out of a seminal article in the economics literature by Charles Tiebout. See Charles M. Tiebout, A Pure Theory of Local Expenditures, 64 J. Pol. Econ. 416 (1956). For examples of the application of this rational choice approach to regulatory federalism questions, see James E. Krier, The Irrational National Air Quality Standards: Macro and Micro-Mistakes, 22 UCLA L. Rev. 323 (1974); Richard O. Zerbe, Optimal Environmental Jurisdictions, for Ecology L. Q. 193 (1974); and William a. Fischel, Fiscal and Environmental Considerations in the Location of Firms in Suburban Communities, in Fiscal Zoning and Land Use Controls (Mills and Oates, Eds.)(1975). See also Johnston, supra note 000 at 231 (arguing that centralization may "inefficiently stifle development in order to transfer economic rents across jurisdictions…"); and the work of Richard Revesz, discussed infra, at notes 000-000 and accompanying text. Some argue that rational choice critiques of *federal* regulation are cover for attacks on regulation generally. But cf. Carol M. Browner, Partners in Protecting the Public, Washington Post, May 30, 1994 at A15 (contending that critics of "federal-state partnerships" seek to "undermine federal protection of public health and natural resources"); Rubin and Feeley, supra note 000 at 948 (arguing that federalism attacks are pretexts for attacks on regulation generally).

[123] Joshua Sarnoff, for example, attacks the rational choice approach directly by arguing that local decisions that fail to account for the preferences of out-of-state citizens will not be welfare maximizing decisions. Sarnoff, has argued that when Congress acts to address a problem the costs and benefits of which are felt locally, its action is legitimate because it reflects the preferences of out-of-state voters who care about the problem. Joshua D Sarnoff, the Continuing Imperative (But Only from a National Perspective) for Federal Environmental Protection, 7 Duke Envtl. L. &Pol'y 225, 243-48 ("the predominant values of a particular state are not self-evidently better than the predominant values of a nation"). This argument makes the boundaries of federal power coterminous with the boundaries of the proper exercise of federal power. One rejoinder to this view is offered by environmental economists have found that people who may never use or visit and environmental resource tend to overstate the true value they attached to its existence, because expressing a preference is costless. This is a kind of moral hazard problem is endemic to attempts to value environmental resources using stated measures of "existence value." See e.g., Daniel C. Esty, revitalizing environmental federalism, 95 Mich. L. Rev. 570 (1996). Sarnoff also argues that environmental regulation aimed at protecting basic rights renders the rational choice analysis irrelevant, noting that "if federal regulation codifies moral rights, the argument that federal regulation reduces social welfare may simply be irrelevant." Id., at 231. This view is a descendant of earlier morality-based views of environmental protection, such as that espoused by the ecologist Aldo Leopold. See generally Aldo Leopold, A Sand County Almanac (1949).

regulation of externalities,[124] and will proceed on the assumption that federal regulation is appropriate when one or more of those rationales applies.[125]

Consistent with the public economics literature on federalism, the first rationale for federal regulation focuses on the geographic scope of the externalities in question, and argues for regulation at the lowest level of government that encompasses (geographically) the costs and benefits of the regulated activity.[126] Thus, for example, federal regulation of air pollution under the Clean Air Act is justified, in part, by the fact that air pollution spills over state boundaries,[127] and provisions in that statute authorizing downwind states to petition the EPA to regulate up wind discharges[128] in other regions are evidence of that rationale. Conversely, where the effects of the to-be-regulated activity are entirely or primarily local, we might expect state or local government to be best equipped to balance those costs and benefits well.[129]

A second rationale (or set of rationales) for federal regulation focuses on the ability or willingness of state governments to regulate. Even when externalities fall primarily on locals, local governments may not be up to the job. That is, they may lack the ability to regulate effectively, due to the lack of resources or scientific competency.[130] Detecting the presence of this problem is difficult, however, because it hypothesizes a desire to regulate on the part of the

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See also Stephen Kelman, Cost-Benefit Analysis and Environmental, Safety and Health Regulation: Ethical and Philosophical Considerations, in Cost-Benefit Analysis and Environmental Regulations: Politics, Ethics, and Methods (Daniel Swartzman et al. eds., 1982); Stephen Kelman, Economists and the Environmental Muddle, Pub. Interest, Summer 1981, at 106-23; and Christopher H. Schroeder, Cool Analysis Versus Moral Outrage in the Development of Federal Environmental Criminal Law, 35 Wm. & Mary L. Rev. 251 (1993).

[124] That is, we typically justify national government regulation (as opposed to state government regulation) using any of these rationales. Rationales for federal regulation are to be distinguished from rationales for regulation generally. Rationales for regulation, such as the need to force firms to internalize externalities, the need to protect consumers in the presence of information asymmetries, etc., do not necessarily militate in favor of federal government regulation, when state regulation will be sufficient.

[125] This list of four rationales is adapted from Mennell and Stewart, supra note 000, and William N. Eskridge, Jr. and John Ferejohn, The Elastic Commerce Clause: a Political Theory of American Federalism, 47 Vand. L. Rev. 1355, 1364 (1994).

[126] See e.g., Wallace E. Oates, Thinking About Environmental Federalism, 130 Resources 14 (Winter 1998) ("The central idea emerging from the literature in public economics is that the responsibility for providing a particular public service should be assigned to the smallest jurisdiction whose geographical scope encompasses the relevant benefits and costs associated with the provision of the service.").

[127] See e.g., Peter S Menell and Richard Stewart, Environmental Law and Policy (1994), at 246 ("one possible justification [for national regulation] is the existence of substantial environmental spillovers from one state to another.")

[128] Clean Air Act Section 126, 40 2U. S. C. Section 7426 (b) ("any state or political subdivision may petition the Administrator for a finding that any major source or group of stationary sources emits" pollution causing downwind violations of ambient air quality standards). Indeed, the Clean Air Act's acid rain program (added to the statute in 1990) and its embattled program for regulating transport of nitrogen oxides in the Eastern United States address this spillover problem directly.

[129] For a good discussion of the argument for decentralizing environmental regulation, see Barry G. Rabe, Power to the States: the Promise and Pitfalls of Decentralization, in Environmental Policy in the 1990s (3d Ed., 1997) (Norman J. Vig and Michael E. Kraft, Eds.), at 31 – 52.

[130] For an example of this argument, see Gary C. Bryner, Blue Skies, Green Politics: the Clean Air Act of 1990 and Its Implementation (2d Ed., 1995) at 24-25: "[S]tate legislatures may fail to delegate sufficient authority to regulatory bodies for them to effectively implement environmental laws and may fail to provide adequate staffing of state regulatory agencies." See also Paul R. Portney, Air Pollution Policy, in Public Policies for Environmental Protection (Portney, Ed., 1990), 27-31 (detailing the failure of state focused efforts to control air pollution prior to the passage of the Clean Air Act of 1970). But cf. Rabe, supra note 000, at 32-34 (explaining the expanded state capacity and state commitment to environmental policy, generally, over the first 20 years after Earth Day).

state that has not been evidenced in the policy process. Stated differently, it might be presumptuous to assume the desire to regulate in the absence of regulation. However, the so-called "race to the bottom" hypothesis suggests that states may under-regulate because they must compete with one another for jobs and economic development by reducing environmental or other regulatory standards.[131] This race to the bottom argument is often framed as a kind of prisoners dilemma[132] in which local governments collectively would prefer more stringent regulatory standards, but cannot sustain any cooperative effort to maintain stringent regulatory standards in the face of temptation -- namely, the opportunity to attract business and jobs. Not everyone accepts the race to the bottom hypothesis,[133] and it has sparked an interesting literature examining the logical and normative implications of state and local decisions to reduce environmental standards in order to promote development.[134]

A third rationale for federal regulation applies to the manufacture of products that produce externalities, and emphasizes the need for uniform standards in certain circumstances. The argument here is that it is inefficient and/or unfair to subject manufacturers to 50 different sets of standards, one for each state; it would be far more efficient to establish a single federal standard.[135] This argument implies the need to preempt state regulation of manufacturing standards. Thus, for example, the Clean Air Act regulates the emission of pollutants from automobiles, so that automobile manufacturers need not comply with 50 different state

[131] See Richard B. Stewart, Pyramids of Sacrifice? Problems of Federalism in Mandating State Implementation of National Environmental Policy, 86 Yale L.J. 1196, 1212 (1977) (arguing that the mobility of industry poses a risk for any individual state or community that decides unilaterally to adopt high environmental standards; communities may reasonably "fear that the resulting environmental gains will be more than offset by movement of capital to other areas with lower standards"); and Kirsten H. Engel, State Environmental Standard-Setting: Is There a "Race" and Is It "To the Bottom"?, 48 Hastings L.J . 271, 275 (1997) (defending the race-to-the-bottom rationale for federal regulation). See also Menell and Stewart, supra note 000 ("states might seek to attract industry by adopting less stringent and therefore less costly environmental regulation," such that federal regulation "might be justified in order to secure for states the environmental quality that they prefer").

[132] See Mennell and Stewart, supra note 000. See also Johnston, The Tragedy of Centralization, supra note 000 (arguing that as natural resources grow increasingly scarce, locals capture the benefit of development but externalize many of the costs, providing an incentive for overdevelopment, and justifying centralized federal regulation).

[133] Perhaps the most prominent critic is Richard Revesz, who argues that states may relax environmental standards not because they are caught in a prisoner's dilemma, but rather because they are making a conscious choice to balance economic development against environmental protection. That is, some states may place a higher value on the underlying polluting activity than others, and that choice ought to be respected, says Revesz. See Richard L. Revesz, Rehabilitating Interstate Competition: Rethinking the "Race-to-the-Bottom" Rationale for Federal Environmental Regulation, 67 N.Y.U. L. Rev. 1210 (1992); see also David Schoenbrod, Time for the Federal Environmental Aristocracy to Give Up (1998) (also echoing Revesz); and Henry N. Butler & Jonathan R. Macey, Externalities and the Matching Principle: The Case for Reallocating Environmental Regulatory Authority, 14 Yale L. & Pol'y Rev. 23, 31 (1996) (echoing Revesz's argument).

[134] For a sample of these criticisms, see Sarnoff, supra note 000 (arguing that " it defies credulity to believe [states] will achieve the goals on their own" given states' inability to achieve environmental goals both before and after passage of the major federal environmental laws); and Engel, State Environmental Standard-Setting, supra note 000 (using industry location studies and empirical observation to conclude that "the preponderance of the evidence indicates that states engaged in interstate competition for industry are also engaged in a race-to-the-bottom in environmental standard-setting"). Cf., Richard L. Revesz, The Race to the Bottom and Federal Environmental Regulation: A Response to Critics, 82 Minn. L. Rev. 535 (1997) (responding to critics and reasserting his claim that state competition in a market for mobile investment can be welfare enhancing). Finally, see also Daniel C. Esty, Revitalizing Environmental Federalism, 95 Mich. L. Rev. 570 (1996) (advocating a middle ground).

[135] See Menell, supra note 000, at 247.

standards.[136] Similarly, the U.S. Department of Energy administers federal standards regulating the energy efficiency of appliances.[137]

A fourth rationale for federal regulation emphasizes an important national interest in the regulated activity, and the need to control and/or to stimulate its development through federal regulation, irrespective of the geographic distribution of its costs and benefits. The Federal Power Act of 1935 sought to promote and regulate hydroelectric development as part of the New Deal.[138] The Atomic Energy Act sought to promote and regulate the development (both peaceful and military) of nuclear energy.[139] In these two examples (nuclear power and hydropower), Congress declared the promotion of these industries and their close regulation to be in the national interest, and granted broad licensing and regulatory powers to federal agencies (the FERC and NRC, respectively).

These four explanations for federal regulation -- to address pollution spillover issues, to prevent a race to the bottom, to address a need for uniform standards, and to promote the national interest -- are the most persuasive logical arguments for federal action. Of course, regulation is a political process, and any normative analysis of regulatory federalism ought not to ignore the interest group politics of regulation.[140] Within the political science literature, traditional interest group pluralism explanations of policymaking portray groups as representatives of broader societal interests; public choice explanations,[141] by contrast, reject the notion that group pressure represents broader social preferences in any accurate way, instead emphasizing the ways in which powerful groups can control the policy process.[142] One variant of this argument

[136] Tailpipe standards and energy efficiency standards for automobiles fall into this category. See 42 U.S.C. Section 7521 (authorizing the EPA to set emission standards for automobiles). See the Energy Policy Conservation Act of 1975, 42 U.S.C. Section 6291 et seq. (authorizing the Department of Energy to establish energy efficiency standards for appliances).

[137] See the Energy Policy Conservation Act of 1975, 42 U.S.C. Section 6291 et seq. (authorizing the Department of Energy to establish energy efficiency standards for appliances).

[138] See Federal Power Act Section 10, directing the Federal Power Commission (now the FERC) to issue hydroelectric licenses on the condition that the applicant's plan is "best adapted to a comprehensive plan for improving and developing the waterway." 16 U.S.C. Section 803 (a).

[139] See 42 U.S.C. Section 2011 (a) ("it is therefore declared to be the policy of the United States that … the development, use, and control of atomic energy shall be directed so as to make the maximum contribution to the general welfare").

[140] That is, interest group pluralism treats the policy process as a tug-of-war between organized groups. Because groups undertake direct lobbying on behalf of their members, only those interests represented by groups will be heard (or at least, influential) in the policy process. Interest group pluralism was the dominant theory of American policymaking in political science in the 1950s and 60s. For a relatively recent summary and literature review, see G. David Carson, Group Theories of Politics (2007). See also, Jack L Walker, Jr, Mobilizing Interest Groups in America: Patrons, Professions and Social Movements (1991), exploring the dynamics of interest group formation and pressure.

[141] Here I am using the term "public choice" as it is often used in legal scholarship, in this context to describe work that both (i) draws on the methodology and perspective of economics to study political and policy phenomena, and (ii) ascribes selfish, "rent seeking" motives to actors in the policy process. That is not necessarily the only definition of "public choice," and as I have argued elsewhere, legal scholarship has conflated rational choice methods with normative skepticism about the ability of politics and policy to produce decisions that represents majority preferences. See e.g., David B Spence, a Public Choice Progressivism, Continued, 87 Cornell L. Rev. (2002) exploring the distinction between these two ideas, and the effect of these literatures on administrative law scholarship.

[142] Certain strains of public choice scholarship also deny the existence of any measurable "public interest." Arrow's Theorem, and the literature at it spawned, debated this question. Kenneth Arrow, Social Choice and Individual Values (1951). Specifically, Arrow's Theorem demonstrated the logical impossibility of devising collective choice mechanisms capable of satisfying simultaneously several desirable characteristics commonly thought to be essential

emphasizes the advantages business interests have in organizing and pressuring political actors.[143] Because businesses have more at stake and face fewer transaction cost impediments to organizing, they find it easier to form pressure groups than broader mass interests, many of whose potential members do not find it worth their while to contribute to the formation of a group, or are content to free ride on the efforts of others.[144] Another public choice idea, capture theory, articulates ways in which business interests can capture the regulatory process (and regulatory agencies) for their own benefit to erect barriers to entry, capture rents, and so on.[145] Capture theory has an innocent version and an insidious version. According to the insidious version, industry uses its money and other political resources to control regulatory agencies through their congressional overseers (particularly congressional committees).[146] According to the innocent version, regulatory agencies gradually come to adopt the point of view of the industry they regulate as a consequence of repeated interactions with that industry.[147] However, there is a rejoinder to capture theory as well: that is the notion of "republican moments," situations in which intense public interest in and attention to a problem leads politicians to organize mass interests for their own political gain. In this way, mass interests can sometimes overcome the advantages businesses otherwise have in the contest to influence policy decisions.[148]

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attributes of democracy. Arrow, supra. Arrow's Theorem produced an enormous scholarly reaction, including a great deal of work attempting to demonstrate ways in which constitutions and legislatures modify some of Arrow's conditions to make meaningful social choice possible. For a summary of that scholarship, see William T. Riker, Liberalism Against Populism (1980), at 65-113. However, one need not take sides on this question in order to address the question of whether federal or state regulation is more desirable in any given instance.

143 The leading work here is Mancur Olson, The Logic of Collective Active (1965).

144 Olson's argument is essentially that for mass interests, the decision whether to join a group is represented by the prisoner's dilemma game. For an in-depth treatment of the game theory aspects of this group formation problem, see Todd Sandler, Collective Action: Theory and Applications (1995).

145 Capture theory predates public choice scholarship. For some non-public choice versions of capture theory, see Charles E. Lindblom, Politics and Markets 5 (1977) (analyzing businesses' resource advantages); Theodore J. Lowi, The End of Liberalism 50–56 (1969) (discussing the rise of "interest-group liberalism"). The canon of the capture theory literature includes William A. Niskanen, Bureaucracy and Representative Government (1971) (emphasizing the ways bureaucrats use their information advantages to take advantage of politicians); Sam Peltzman, Toward a More General Theory of Regulation, 19 J.L. & Econ. 211 (1976) (portraying regulation as a private rent-seeking activity); and George J. Stigler, The Theory of Economic Regulation, 2 Bell J. Econ. & Mgt. Sci. 3, 3–4 (1971). Accord Sarnoff, supra note 000 at note 54 ("it should be obvious that the ability to spend wealth to influence policy does not provide an objective measure of value, and that policies adopted in response to campaign contributions do not necessarily increase social welfare").

146 See, e.g.., Douglas Cater, Power in Washington 26-50 (1964); John Leiper Freeman, The Political Process: Executive Bureau-Legislative Committee Relations (1965); Stigler, supra note 000, at 3; and Thomas L. Gais, Mark A. Peterson, and Jack L. Walker, Jr., Interest Groups, Iron Triangles, and Representative Institutions, in Walker, Mobilizing Interest Groups in America, supra note 000, at 123–140.

147 See, e.g., Marver H. Bernstein, Regulating Business by Independent Commission (1955); Gabriel Kolko, Railroads and Regulation, 1877-1916, at 3-6 (1965); John A. Ferejohn, The Structure of Agency Decision Processes, in Congress: Structure and Policy 441 (Matthew D McCubbins and Terry Sullivan Eds., 1987); see also David B. Spence, Managing Delegation Ex Ante: Using Law to Steer Administrative Agencies, 28 J. Legal Stud. 417, at note 19 (1999)(summarizing this literature).

148 This idea of "republican moments" comes from James Gray Pope, Republican Moments: The Role of Direct Popular Power in the American Constitutional Order, 139 U. Pa. L. Rev. 287 (1990). Dan Farber adapted it to environmental politics in Daniel A. Farber, Politics and Procedure in Environmental Law, 8 J. L. Econ. & Org. 59, 60 (1992). See also Anthony Downs, Up and Down with Ecology—The "Issue-Attention Cycle," 28 Pub. Int. 38, 38 (1972) (noting that only during the times of intense public pressure for action is it possible to overcome the usual

What do these political explanations have to do with federalism? It may be that advocates of the race to the bottom rationale for federal regulation fear that the likelihood of capture is greater at the state level than at the federal level. At least, there is a logical argument to that effect, as follows. If so-called "republican moments" can overcome pro-business bias in the policy process, and if the probability of a republican moment is a function of the amount of public attention devoted to a particular policy decision, then capture should be more prevalent at the state level, where there tends to be less policy transparency and where the policy process tends to attract less press attention.[149] Table 3 summarizes these various rationales for federal (rather than state or local) regulation.

Table 3: Rationales for Federal Regulation

Logical (Non-political) Rationales	Political Rationales
Managing spillover effects, externalities cross state lines	State governments more susceptible to capture by industry?
Lack of state willingness to regulate / "race to the bottom"	
Need for uniform national standards	
Important national interest at stake	

legislative inertia and produce major regulatory legislation). For a discussion of republican moments in the history of environmental law, see Spence, A Public Choice Progressivism, supra note 000.

[149] See e.g., Evan H. Caminker, State Sovereignty and Subordinacy: May Congress Commandeer State Officers to Implement Federal Law?, 95 Colum. L. Rev. 1001, 1013(arguing that state decision-making is particularly likely to diverge from majority preferences because of capture); Stewart, Pyramids of Sacrifice, supra note 000 1213-15 (arguing that federal agencies are less susceptible to capture); Matthew D. Zinn, Policing Environmental Regulatory Enforcement: Cooperation, Capture, and Citizen Suits, 21 Stan. Envtl. L.J. 81, 86 (2002); Warren L. Ratliff, The De-Evolution of Environmental Organization, 17 J. Land Resources & Envtl. L. 45 (1997); and David E. Adelman & Kirsten H. Engel, Adaptive Federalism: The Case Against Reallocating Environmental Regulatory Authority, 92 Minn. L. Rev. 1796, 1797 (2008). But cf. Wendy Wagner, Katherine Barnes & Lisa Peters, Rulemaking in the Shade: An Empirical Study of EPA's Air Toxic Emission Standards, 63 Admin. L. Rev. 99 (2011)(chronicling industry's disproportionate participation in EPA rulemakings).

B. Federalism and Energy Facilities, Generally

Most federal energy regulatory regimes can be justified according some combination of the first, second and fourth rationales described in the previous section. Some energy facilities are subject to a suite of risk-based regulations that focus not on a particular industry, but on controlling interstate/spillover externalities (e.g. air or water pollution) or preventing a race to the bottom across a variety of industries (including energy). These kinds of regulatory regimes are the product of republican moments, driven by public concern over the risks at issue.[150] Coal-fired power plants and oil refineries, for example, are subject to risk-based regulation by a variety of federal agencies under several federal statutes, each focused on managing a particular set of environmental, health and safety risks. Thus, new or modified coal-fired power plants and oil refineries must obtain air and water discharge permits under the Clean Air Act and Clean Water Act, respectively.[151] Because air and surface water pollution crosses state boundaries,[152] federal regulation makes sense, but federal regulators have stopped short of regulating entirely intrastate water pollution, for the most part. At the same time, coal-fired power plants must comply with OSHA worker protection regulations[153] and hazardous waste management requirements under RCRA[154] that may involve relatively few interstate impacts. Nevertheless, in the absence of such regulation, one might imagine states competing for mobile capital investment (and the resultant jobs and economic development) by lowering their regulatory standards.[155]

Many of these risk-based regulatory regimes address federalism issues head-on by employing a system of "cooperative federalism"[156] under which federal agencies establish national standards[157] and permitting requirements, but delegate to the states the authority to

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[150] See Spence, A Public Choice Progressivism, supra note 000, for an argument that groundswells of public concern, organized by political entrepreneurs in Congress, produced these laws.

[151] See these statutes' basic permitting provisions at Clean Air Act Section 111, 42 U.S.C. Section __, and Clean Water Act Section 402, 33 U.S.C. Section 1342. Some commentators argue that only a minority of Clean Air Act provisions are aimed at interstate pollution problems. See e.g., Revesz, Rehabilitating Interstate Competition, supra note 000, at 1224 (while the Clean Air Act contains "several provisions directed primarily at interstate externalities …[,] [b]y far the bulk of the provisions of the Clean Air Act … are wholly unrelated to the control of interstate externalities"). However, this conclusion is too narrowly focused on statutory provisions expressly addressing interstate externalities. In fact, the entire regulatory scheme is built around the premise that air pollution mixes unrestricted in the ambient air, and that emissions in one location will affect compliance with standards downwind.

[152] Of course, carbon dioxide (and other greenhouse gas) emissions present a global problem in that they exacerbate global warming. Long-regulated conventional pollutants (such as sulfur dioxide, nitrogen oxides and particulate matter) also travel great distances as well. The Clean Air Act's establishment of National Ambient Air Quality Standards recognizes that pollutants mix freely in the ambient air irrespective of state boundaries, as does its provisions regarding interstate transport. See supra notes 000, 000 and 000 describing the operation of section 126 of the Act governing interstate pollution problems, as well as the cross state pollution rule.

[153] See supra note 000.

[154] See supra note 000.

[155] Some contend that the race to the bottom argument is a weak one because the relative stringency of state regulatory standards plays a small role in firm location decisions. See infra note 000.

[156] See e.g., e Robert L. Fischman, Cooperative Federalism and Natural Resources Law, 14 N.Y.U. Envtl. L.J. 179, 180-81 (2005); Robert L. Fischman and Angela King, Savings Clauses and Trends in Modern Federalism, 32 Wm. & Mary Envtl. L. & Pol'y Rev. 129 (2007).

[157] Some commentators justify this kind of cooperative federalism approach as essential to promote a national interest in minimum standards, while offering states some flexibility on the implementation of those standards. See Sarnoff, supra note 000.

administer the regulatory program,[158] including the authority to issue or deny permits.[159] This structure may reserve for the states the authority to impose more stringent requirements than those found in the federal standards; in those cases, the federal standards act as a kind of regulatory minimum to which states can add or not, as they so choose.[160] Some of these risk regulation regimes limit regulators' ability to balance environmental, health and safety concerns against economic or energy security concerns. For example, OSHA and EPA regulators may not consider costs when establishing air pollution standards for work places or the ambient air, respectively.[161] Thus, for coal-fired power plants and oil refineries, no single regulator is charged with examining the environmental, health and safety risks associated with the facility in a comprehensive way. Therefore, federal regulatory responsibility for these facilities is diffuse in that each regulator focuses on only one aspect of an energy facility's operations (such as workplace safety or air emissions).[162]

Other energy facilities are subject to regulation focused not on specific risks but on the industry itself. For these facilities, Congress has decided that it is in the national interest to center most environmental, health and safety reviews in a single federal licensing process administered by a lead federal agency. Often, this allocation of power is the product of a congressional decision that the national interest requires development of a particular kind of energy. Examples

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[158] The Clean Air Act and Clean Water Act each provide that the EPA may delegate enforcement administration functions to the states. The Resource Conservation and Recovery Act, 42 U.S.C. Sec. __ is similarly structured. See also United States v. Morrison, 529 U.S. 598, 661 (2000) (describing the CAA as a system of "cooperative federalism"); Sierra Club v. U.S. E.P.A., 315 F.3d 1295, 1300 (11th Cir. 2002) (describing "division of labor" between states and the EPA as "inherent in the regime of cooperative federalism created by the CAA"); Michigan v. E.P.A., 268 F.3d 1075, 1083 (D.C.Cir.2001) (describing the CAA as "an experiment in cooperative federalism"); Envtl. Defense Fund, Inc. v. E.P.A., 82 F.3d 451, 468-69 (D.C.Cir.1996) (discussing CAA's program of federal and state cooperation and planning). The Occupational Safety and Health Act authorizes OSHA to delegate authority to administer the regulatory program to so-called "plan states" – states whose safety and health regulatory regimes meet OSHA specifications according to the approved the state regulatory plan. 15 U. S. C. Sections 651 – 678.

[159] Sometimes federal agencies conflict with state agencies to whom they are delegated authority. For example, the EPA has threatened to revoke delegated authority to administer regulatory programs on a few occasions. The EPA has also conflicted with states over how to enforce regulatory standards. For discussion of these conflicts, see David B. Spence, The Shadow of the Rational Polluter: Rethinking the Role of Rational Actor Model Is in Environmental Law, 89 Calif. L. Rev. 917 (2001), at __.

[160] For example, the RCRA savings clause reads, in pertinent part:

> [N]o state or political subdivision may impose any requirement less stringent than those authorized under this subchapter … Nothing in this chapter shall be construed to prohibit any state or political subdivision thereof from imposing any requirements … which are more stringent than those imposed by such regulations.

40 2U. S. C. Section 6929. Similarly, the CAA states that "air pollution prevention . . . And air pollution control at its source is the primary responsibility of States and local governments." 42 U.S.C. § 7401(a)(3).

[161] The leading decisions affirming this principle in the context of the EPA's establishment of National Ambient Air Quality Standards under the Clean Air Act is Whitman v. American Trucking Associations, Inc., 531 U.S. 457 (2001). See also Lead Industries Assn., Inc. v. EPA, 647 F.2d 1130, 1148 (CADC 1980). The leading decision affirming this principle and the establishment of OSHA workplace standards is Industrial Union Department v. American Petroleum Institute (The Benzene Case), 448 U.S. 607 (1980).

[162] William Buzbee has called this the "regulatory commons" problem, likening diffuse regulatory responsibility to the problem of managing a public good over which no one has ownership rights. Buzbee argues in the regulatory commons no one has an incentive to balance costs and benefits in a comprehensive way, creating regulatory "free-riding" that mirrors the kind of free riding that economists have associated with the management of public goods. William W. Buzbee, Recognizing the Regulatory Commons: A Theory of Regulatory Gaps, 89 Iowa L. Rev. 1 (2003). For a game-theoretic treatment of the public goods management problem, and free riding generally, see Todd Sandler, Collective Action: Theory and Applications (1992), at 14-18.

of this kind of approach include the hydroelectric licensing process under the Federal Power Act[163], and the licensing of nuclear power plants under the Atomic Energy Act[164], liquefied natural gas ("LNG") terminals under both the Natural Gas Act[165] and Deepwater Ports Act,[166] surface mining of coal under the Surface Mining Control and Reclamation Act ("SMCRA"),[167] and offshore oil and gas production under the Outer Continental Shelf Lands Act.[168] Under these kinds of regimes, Congress tends to grant the federal licensing agency wide leeway to balance economic and energy security concerns against environmental, health and safety risks. Thus, for example, the Atomic Energy Act authorized the NRC (then, the "Atomic Energy Commission") to grant or deny licenses for nuclear power plants in accordance with such procedures and subject to such conditions as it may by regulation establish.[169] Similarly, the Natural Gas Act authorizes the FERC to approve onshore LNG facilities "upon such terms and conditions as the Commission find necessary or appropriate."[170]Compared to risk-based regulatory regimes, it is more common for comprehensive federal licensing regimes to preempt state and local regulation under the Supremacy Clause.[171] Thus, for example, the Supreme Court has determined that the Federal Power Act preempts most state and local regulation of hydroelectric power facilities under the Supremacy Clause.[172] Likewise, the Atomic Energy Act impliedly preempts state and local regulation of radiation hazards,[173] and the Natural Gas Act

[163] 16 U. S. C. §§791a-828c (establishing the federal hydropower licensing scheme).
[164] 42 U. S. C. §2011-2297h – 13 (1946).
[165] 15 U.S.C. §717b(e)(1)(granting FERC exclusive jurisdiction over onshore LNG terminal siting).
[166] 33 U.S.C. §§1501 and 1503
[167] 30 U.S.C. Section 1202(f)(including among the purposes of SMCRA the need to assure adequate supply of coal for the nation's "economic and social well-being," and to balance this interest against environmental and other interests). Absent this purpose, it would be difficult to reconcile SMCRA with the other rationales for federal action described here, since most of the effects of surface mining are felt locally (discharges to navigable waters being one possible exception), and the need to mine coal where one finds it makes the race to the bottom rationale a poor fit. But cf. Hodel v. Virginia Surface Mining and Reclamation Ass'n, Inc., 452 U.S. 264, 281-82 (1981), (court concludes that without federal regulation, interstate competition would create a race-to-the-bottom as states loosened their environmental standards to attract coal industry investment).
[168] 43 U.S.C. §1331 et seq.
[169] Atomic Energy Act section 7 c), now codified at 42 U.S.C. Section 2133(a).
[170] 15 U.S.C. Section 717b(3)(a).
[171] The Constitution's Supremacy Clause states simply that federal law shall be "the Supreme law of the land." U.S. Constitution, Article 6, Clause 2. Under modern Supremacy Clause jurisprudence, federal regulation may preempt state regulation explicitly, by the terms of the statute, or implicitly, when state and federal regulation conflict, or when courts decide that federal regulation is sufficiently comprehensive that it "occupies the field" leaving no room for supplemental state regulation. These principles are outlined in Capital Cities Cable, Inc. v. Crisp, 467U. S. 691, 699 (1984) and English v. General Electric Co., 496 U. S. 72, 78-79 (1990). For a good (if dated) summary of the modern case law see Stephen A. Gardbaum, the Nature of Preemption, 79 Cornell L. Rev. 767 (1994).
[172] First Iowa Hydro-Electric Cooperative v. FPC, 328 U.S. 152 (1946)(federal licensee not required to comply with Iowa permitting requirements for new dam construction because the federal regulatory scheme "leave[s] no room or need for conflicting state controls"); California v. FERC, 495 U.S. 490 (1990)(Federal Power Act preempts California minimum stream flow requirements).
[173] See Northern States Power Co. v. Minnesota, 447 F.2d 1143 (8th Cir. 1971), aff'd mem., 405 U.S. 1035 (1972) (state agency's radiation emissions regulations stricter than federal). See also Pacific Legal Foundation v. State Energy Resources Conservation & Dev. Comm'n, 472 F. Supp. 191 (S.D. Cal. 1979) (state statute forbidding state certification of nuclear powerplants until federal approval of nuclear waste disposal technology); United States v. City of New York, 463 F. Supp. 604 (S.D.N.Y. 1978) (city ordinance requiring additional license for nuclear reactors); State v. Jersey Cent. Power & Light Co., 69 N.J. 102, 351 A.2d 337 (1976) (state environmental protection agency's enforcement of state pollution laws against nuclear powerplant).

expressly preempts local law when it comes to siting natural gas facilities (including LNG terminals).[174]

However, while comprehensive licensing statutes grant wide latitude to regulatory agencies, and often preempt local law, that does not mean that states are afforded no influence in these licensing processes. To the contrary, most comprehensive federal licensing statutes require the federal licensing agency to consider state concerns in the licensing process. This is true of offshore oil and gas leasing process under the OCSLA,[175] the nuclear power plant licensing process under the Atomic Energy Act,[176] and the hydroelectric licensing process under the Federal Power Act,[177] for example. Moreover, often states can exert independent leverage in the licensing process through authority delegated to the state under federal law. For example, the Clean Water Act requires that federally-approved projects that "may result in a discharge to navigable waters" secure a certification from the applicable state that the discharge will comply with various water quality protection requirements of the Clean Water Act.[178] Many energy facilities trigger this provision.[179] Similarly, if a proposed energy project may affect the coastal zone of a state that has an approved coastal zone management plan under the Coastal Zone Management Act ("CZMA"), the federal agency with jurisdiction must make a determination that the proposed project is consistent with the state's coastal zone management plan before moving forward.[180] This kind of leverage through federal law is limited, however. When federal

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[174] See Weavers Cove Energy, LLC v. Rhode Island Coastal Resources Management Council, __ F.3d __ (1st Cir. 2009)(Federal Power Act's grant of "exclusive jurisdiction" to FERC over siting LNG facilities preempts local siting laws). See also Northern States Power Co. v. Minn., 447 F.2d 1143 (8th Cir. 1971)(holding that the Atomic Energy Act expressly preempted state law governing the disposal of radioactive waste from nuclear power plants). But cf. Pacific Gas & Elec. Co. v. State Energy Resources Conservation and Development Comm'n, 461 U.S. 190 (1983)(upholding California regulation of waste storage as "economic" rather than siting legislation, and therefore not preempted by the Atomic Energy Act). But cf. SMCRA, under which the federal government may approve a state program, thereby delegating SMCRA regulatory authority to the state. 30 U.S.C. Section 1253.

[175] See 43 U.S.C. §1331 (requiring Department of the Interior to consult with other agencies in making leasing decisions under the OCSLA).

[176] See 50 CFR Section 50.47, requiring state participation in emergency response planning during the licensing process.

[177] See 16 U.S.C. Section 803(j) (requiring the FERC to consider recommendations from other resource agencies in making licensing decisions) and 18 CFR Section 5.1 (requiring consultation with state agencies before filing hydroelectric licensing applications).

[178] Clean Water Act Section 401, 33 U.S.C. Section 1341. The term "navigable waters" had attained a specific meaning under the Supreme Court's Commerce Clause jurisprudence before Congress used it in the Clean Water Act. It had come to mean surface waters which were navigable "either in their natural or improved condition." U.S. v. Appalachian electric power Co., 311 U.S. 377 (1940).

[179] See e.g., P.U.D. No. 1 of the Jefferson County v. Washington Department of Ecology, 511 U.S. 700 (1994) (authorizing a state agency to impose so-called minimum flow requirements as a condition in a 401 certification issued to hydroelectric facility). Recently, the New York State Department of environmental conservation denied a 401 certification to Entergy Corp, which was seeking the Nuclear Regulatory Commission's relicensing of its Indian Point nuclear power plant upstate New York. See Riverkeeper, Press Release: Riverkeeper Hails New York's Decision to Deny Critical Water Quality Certificate for Indian Point (April 3, 2010), available at: http://www.riverkeeper.org/news-events/news/stop-polluters/power-plant-cases/riverkeeper-hails-new-yorks-decision-to-deny-critical-water-quality-certificate-for-indian-point/. .

[180] Specifically, CZMA section 307 (c)(1) requires federal agencies "conducting or supporting activities directly affecting the coastal zone" to ensure that those activities are "consistent with approved state management programs." 16 USC section 1456(c)(1). For examples applying this consistency requirement to energy facilities, see e.g., Secretary of Interior v. California, 464 U.S. 312 (1984)(discussing the application of the CZMA consistency requirement to offshore oil and gas leasing); and Erica Schroeder, Turning Offshore Wind On, 98 Calif. L. Rev. 1631 (2010)(discussing the application of the CZMA to the Cape wind project in Nantucket sound).

law does grant states real leverage over an energy project, that authority is usually relatively narrow. For example, states cannot use their authority to issue or deny a 401 Certification under the Clean Water Act as leverage to oppose a hydroelectric project based upon aesthetic or neighborhood character issues, because the 401 certification process is about protecting water quality.[181] Similarly, the CZMA does not give final word to the states whose coastal zone is affected. In the event the state disagrees with a federal agency's determination whether a proposed energy project is consistent with its coastal zone management plan, the final decision rests not with the state but with the Secretary of Commerce.[182]

Table 4 summarizes the kinds of federal licensing and permitting regimes that apply to various types of energy facilities, and the routes of state or local influence over the approval process for each facility. As that summary indicates, some types of energy facilities must overcome more regulatory barriers and others. Nonetheless, most regulation of energy facilities implicates a wide variety of regulatory regimes designed to regulate environmental, health and safety risks; and all of those regimes can be explained using the some combination of the four rationales for federal regulation described in Section III.A.

[181] See P.U.D. No. 1, supra note 000 (reaffirming the water quality focus of 401 certifications).
[182] See 16 U.S.C 1456(c)(1).

Table 4: Selected Energy Facility Siting/Regulatory Regimes

Energy Facility Siting	Comprehensive Federal Licensing Program?	State Regulation	Other federal regulation
Nuclear Power Plants	Atomic Energy Act / NRC	• Mostly preempted by federal regulation	• NEPA • ESA • CWA 401 Certification
Hydroelectric Plants	Federal Power Act / FERC	• Preempted by federal regulation	• NEPA • ESA • CWA 401 Certification
Fossil Fueled Electric Power Plants	No	• Licensing regimes in some states (e.g., CA) • Add-on pollution regulation	• NEPA • CAA • CWA NPDES program
Wind and Solar Farms	No (DOI approval under OCSLA for offshore wind only)	• Licensing regimes in some states (e.g., CA) • Local zoning requirements	• ESA • NEPA (if federal approval required)
Electric transmission lines	Federal Power Act / FERC	• State approval required	• ESA • NEPA
Onshore Oil & Gas Wells	No	• State conservation regulation • State environmental regulation	• NEPA (if federal approval req'd) • CWA NPDES program (wastewater disposal) • Waste disposal exempt from RCRA coverage • SDWA underground injection well permitting (but hydraulic fracturing is exempt)
Offshore Oil & Gas Wells	Outer Continental Shelf Leasing Act/ Department of interior	• No jurisdiction beyond state waters	• CZMA • NEPA • ESA • CWA NPDES program • CWA 401 Certification
LNG Terminals	Onshore: Natural Gas Act / FERC Offshore: Deepwater Ports Act/ Department of Transportation	• Onshore facilities: preempted by federal regulation • Offshore facilities: no jurisdiction beyond state waters	• NEPA • CWA NPDES program • CWA 401 Certification • CZMA • ESA
Oil Refineries	No	• Add-on pollution regulation	• CAA • CWA NPDES program • CWA 401 Certification
Natural Gas Pipelines	Natural Gas Act / FERC	• Preempted by federal regulation	• NEPA • ESA
Coal Mining	SMCRA (surface mining) FMHSA (underground mining)	• States may regulate only through federally approved plan	• NEPA • ESA • CWA 404 (dredge and fill) program

IV. Federalism and Fracking

A careful look at Table 4 reveals that hydraulic fracturing operations (as a category of onshore oil and gas production) are relatively lightly regulated by the federal government, compared to most other energy production operations. There is no federal licensing requirement, and few federal approvals are *necessarily* required as part of the fracking operation. Federal regulation *may* be triggered if the fracking operation risks harm to an endangered species,[183] will result in a discharge to surface waters[184] or a pretreatment facility,[185] or will result in underground injection of wastewater for disposal.[186] The transport of hazardous chemicals requires compliance with Hazardous Materials Transportation Act labeling and manifest requirements.[187] However, it is not uncommon for fracking operations to avoid regulation under many of these provisions.[188] If the operation requires no federal approvals, then it will not trigger ancillary federal approval such as the requirement to obtain a 401 certification from the state under the Clean Water Act[189] or undertake an environmental review under NEPA.[190] On the other hand, fracking is subject to a growing and varied list of state regulatory requirements. Given the ongoing controversy over the sufficiency of existing regulation, is there a case for comprehensive federal licensing regulation for hydraulic fracturing operations, or for a new broad regulatory regime addressing its risks? Turning once again to the rationales for federal regulation developed in Section III.A, we might ask how persuasively each rationale[191] applies to the case of hydraulic fracturing, keeping in mind the influence of politics in the regulatory process. This section will explore those questions.

A. Spillovers and the Geographic Scope of Fracking Externalities

Do the environmental, health and safety externalities of hydraulic fracturing tend to cross state lines? If so, that fact might suggest an increased role for federal regulation of hydraulic fracturing. While there remains considerable uncertainty about the environmental impacts of

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[183] That is, if the fracking operation could "take" (that is, harm) an endangered species, that will trigger regulation under section 9 of the Endangered Species Act, which prohibits actions which take endangered species. 15 U.S.C. Section 1538(A)(1)(b). Furthermore, section 7 of the Act prohibits a federal agency from approving any action that could "jeopardize the continued existence" of a listed endangered species. 15 U.S.C. Section 1536(a)(2).

[184] If the fracking operation will discharge wastewater to nearby surface waters, then a NPDES permit is required under section 402 of the Clean Water Act. 33. U.S.C. Section 1342.

[185] If the wastewater is discharged to a municipal sewage treatment plant, it will be subject to Clean Water Act pretreatment rules, which prohibit discharges which "upset" the operation of the plant war cause pollutants to "pass through" to surface waters. See 40 CFR Section 430.8.

[186] See discussion of SDWA underground injection well permitting, supra notes 000-000 and accompanying text.

[187] 49 U.S.C. Section 5101, et seq.

[188] If the wastewater is treated and recycled or disposed of on site without underground injection, none of these federal wastewater disposal approvals will be required.

[189] See supra note 000 and accompanying text.

[190] See supra note 000 and accompanying text.

[191] This section examines the spillover, race to the bottom, and the national interest rationales for federal regulation. The rationale that manufacturers need uniform federal standards seems inapplicable to this case. However, see infra section III.A.3, discussing fugitive methane emissions, a problem which seems amenable to a technical solution, perhaps one that involves manufacturing standards for pipes, valves, joints, etc. in the gas production, compression and transmission equipment industry.

fracking, an examination of what we know about those impacts suggests that most (though not all) tends to be local.

1. Water Supply

Water supply issues[192] have traditionally been a matter of state concern. Federal regulatory jurisdiction over water has traditionally been confined to (navigable) surface water bodies, or aquifers that cross state lines. Federal Commerce Clause jurisdiction under the Federal Power Act and the Clean Water Act, for example, is tied to the navigability of affected surface waters, [193] and the Federal Power Act expressly reserved to the states the power to control water supply issues.[194] Indeed, most interstate conflict over the use or management of bodies of water on state boundaries has been resolved through voluntary compacts between the affected states, though those compacts are subject to ratification by Congress.[195] Moreover, most water supply conflicts pit local uses or users against one another: farmers seeking irrigation water versus homeowners seeking drinking water, or conflict between communities using the same aquifer. These conflicts generally do not implicate national interests, and relatively rarely spill across state lines. All of which suggests that water supply issues ought to be treated as a state and local matter.

On the other hand, many commentators predict that water supply issues will become more contentious in the future as growth and the effects of climate change strain water supplies in the Southwest.[196] Fights over water supplies could lead to increased incidence of interstate conflict, which could in turn trigger federal regulation as an adjudicatory response to interstate conflict. Indeed, many of the regional compacts that exist today were the result of this kind of interstate water conflict,[197] and at some were created to protect local or regional water bodies from appropriation or diversion by the federal government on behalf of non-locals.[198] Moreover, the significance of water supply issues for hydraulic fracturing varies greatly by region. In the Eagle Ford and Barnett Shales of Texas, where drought is a problem, these issues may ultimately

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[192] This section addresses adequacy of water supply issues, as distinguished from protecting the quality of groundwater or drinking water aquifers. For groundwater quality issues, see Section IV.A.5, infra.

[193] See 16 U.S.C. Section 823(b) and 33 U.S.C. Section 1302.

[194] See 16 U.S.C. Section 821 (expressing the congressional purpose to leave state laws governing water rights undisturbed by the act).

[195] Article I, Section 10, Clause 3 of the Constitution is the Compact Clause, which reserves this power to Congress. For a good discussion of these water management compacts, see Noah D. Hall, Toward a New Horizontal Federalism: Interstate Water Management in the Great Lakes Region, 77 Colo. L. Rev. 405 (2007).

[196] See e.g., Robin Kundis Craig, Climate Change, Regulatory Fragmentation, and Water Triage, 79 U. Colo. L. Rev. 825 (2008)(arguing for centralization of water supply regulation); and Paul Faeth, U.S Energy and Water: The Challenges We Face, 54 Environment: Science and Policy for Sustainable Development 4, 9 (2012). (http://www.tandfonline.com.ezproxy.lib.utexas.edu/doi/full/10.1080/00139157.2012.639595)(calling water supply issues hydraulic fracturing's "Achilles' heel").

[197] George William Sherk, The Management of Interstate Water Conflicts in the Twenty-First Century: Is it Time to Call Uncle, 12 N.Y.U. Envtl. L.J. 764, 765 (2003) (http://heinonline.org/HOL/Page?handle=hein.journals/nyuev12&div=23&g_sent=1&collection=journals) ("There are three means by which interstate water conflicts may be resolved: litigation in the U.S. Supreme Court, negotiation of interstate compacts, or federal legislation…With great consistency, the Supreme Court has advised the states to resolve interstate water disputes among themselves.").

[198] The Great Lakes Basin Compact was created by American states bordering the Great Lakes, in part to protect water in the lakes from appropriation by the federal government on behalf of other states.

loom large.[199] In the Marcellus Shale, where water is more plentiful, water supply seems unlikely to constrain development.[200] Thus, while water supply issues may become a national issue, the threats to supply posed by fracking do not rise to that level now.

2. *Neighborhood character issues*

Neighborhood character impacts are, by definition, local. Nevertheless, they are perhaps the most significant impacts of hydraulic fracturing. From the beginning of site preparation through the completion of the fracking job,[201] hydraulic fracturing is an industrial use, with all the air quality, water quality, visual, noise, and other impacts we associate with industrialization. During the period leading up to the fracturing operation, the character of the well site changes, with the introduction of a concrete pad, tanks and/or pits for liquid storage, piping and vertical structures all of which may stand out visually against a bucolic rural or quiet residential neighborhood. Hydraulic fracturing generates an enormous amount of truck traffic, with the vehicle emissions, noise, and road stress impacts generated by thousands of vehicle trips. The fracturing operation itself shakes the ground, and the well completion process involves gas processing activities and the handling and removal of wastewater from the site. While things are much quieter during the production phase following well completion, the cumulative effects of this process are profound and atypical of the community, regardless of whether they take place in urban or rural settings.

While these impacts are local, they can pose difficult political problems for state and local governments. In rural areas, hydraulic fracturing has divided small towns, pitting longtime residents seeking additional sources of income against relatively recent arrivals seeking a peaceful refuge from the city, and those who stand to earn royalties against those who do not.[202] In urban (and presumably wealthier) areas, fracking can provoke the opposition of better funded and more sophisticated NIMBY ("not in my backyard") groups. When hydraulic fracturing produces local opposition, elected local government leaders may respond with local ordinances banning or restricting hydraulic fracturing within their borders. The City Council of Pittsburgh

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[199] See the discussion of drought in the Eagle Ford shale, supra notes 000-000 and accompanying text. Some climate science researchers believe that climate change will tend to exacerbate drought in the southwestern United States. See e.g., Jay Gulledge, Global Warming Contributing to Texas Drought, October 14, 2011, C2ES blog, URL: http://www.c2es.org/blog/huberd/global-warming-contributing-texas-drought.

[200] The New York State Energy Research and Development Authority projects increased rainfall over the next century in the Marcellus Shale area as a result of climate change. New York State Energy Research and Development Authority , Responding to Climate Change in New York State: a Synthesis Report (2011), URL: http://www.nyserda.ny.gov/~/media/Files/Publications/Research/Environmental/EMEP/climaid/responding-to-climate-change-synthesis.ashx?sc_database=web.

[201] Once the fracturing operation is complete and the well is producing natural gas, its local impacts are less significant. The well pad marks a permanent change on the surface of the land, and so has a permanent visual impact. However, the noise, truck traffic, and vibrations associated with the fracturing operation itself did not continue into the production phase.

[202] Peter Appelbome, Drilling Debate in Cooperstown New York Is Personal, the New York Times, October 31, 2011, URL: http://www.nytimes.com/2011/10/30/nyregion/in-cooperstowns-fight-over-gas-drilling-civility-is-fading.html?pagewanted=all ("The dispute has pitted neighbor against neighbor, and has often set people who live in suburbs or villages against the farmers and landowners who live outside them"). See also Eliza Griswold, situation normal all Fracked up, the New York Times Magazine, November 17, 2011, at 44 ("In Amwell Township [Pennsylvania], your opinion of fracking tends to correspond with how much money you're making and with how close you live to the gas wells, chemical ponds, pipelines and compressor stations springing up in the area.").

passed an ordinance banning hydraulic fracturing within the city limits in late 2010,[203] and other communities within the Marcellus Shale have taken similar actions.[204] Most local communities have zoning codes, specifying where industrial uses may or may not take place. However, because towns, villages and counties are political subdivisions of the state, state law may preempt local law just as federal law sometimes preempts state law. On the other hand, some states have so-called "home rule" provisions which expressly reserve to local governments the power to regulate property use.[205]

For example, despite the State's home rule provision, the New York State Environmental Code expressly preempts local laws regulating oil and gas production (while permitting local control over roads and real property taxes).[206] In at least one case the New York courts have invalidated a local zoning ordinance that would have imposed a bond requirement and permit fee on prospective natural gas producers, citing the statutory preemption provision.[207] However, there is contrary precedent as well,[208] including a February 2012 New York State trial court decision upholding a local ban on fracturing in the town of Dryden, New York under the state constitution's home rule provision.[209] In Pennsylvania, the gradual migration of fracturing operations from rural to more urban settings has provoked legislation there proposing to limit the ability of local communities to control fracturing operations through zoning laws.[210] By contrast, the New York legislature is now considering legislation that would expressly permit local communities to use zoning laws to limit or exclude hydraulic fracturing within their borders.[211] In Texas, some of Barnett Shale communities use zoning laws to steer hydraulic fracturing and other gas production activities to areas zoned for industrial uses.[212]

These stories indicate that states and local governments are continuing to grapple with the question of how (and how much) to regulate hydraulic fracturing. As difficult as these issues

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[203] CBS/AP, Pittsburgh Bans Natural Gas Drilling, CBS News, URL: http://www.cbsnews.com/stories/2010/11/16/national/main7060953.shtml.

[204] Sabrina Tavernise, As Gas Drilling Spreads, Towns Stand Ground over Control, The New York Times, December 14, 2011 (describing opposition to fracking in the town of South Fayette, Pennsylvania).

[205] For example, New York's constitution has just such a provision. See e.g., New York Constitution, Article IX, Section 2(b).

[206] 23 NY Code, Section 23-0303(2).

[207] Envirogas, Inc. v. Town of Kiantone, 112 Misc. 2d 432 (1982), aff'd 89 A.D.2d 1056 (4th Dep't,1982). That case did not involve hydraulic fracturing, however.

[208] For a good discussion of state preemption of local law in New York and Pennsylvania, see Michelle L. Kennedy, The Exercise of Local Control over Gas Extraction, 22 Fordham Envtl. Law Rev. 375 (2011).

[209] In that case the judge reasoned that local *regulation* of oil and gas development is preempted, but that communities retain their ability to block industrial uses within their borders using zoning laws. See Rachel Stern, Judge: Dryden Can Block Gas Drilling in Community, The Ithaca Journal, February 21, 2012, URL: http://www.theithacajournal.com/article/20120221/NEWS01/202210394/Judge-Dryden-can-block-gas-drilling-community?odyssey=mod|newswell|text|Local%20News|p.

[210] Tavernise, supra note 000 ("As energy companies move to drill in densely populated areas from Pennsylvania to Texas, battles are breaking out over who will have the final say in managing the shale gas boom.").

[211] This law has passed the New York State Assembly, and as of this writing is under consideration in the New York State Senate. It is designated as 3472 – 2011, URL: http://open.nysenate.gov/legislation/bill/S3472-2011. Presumably, any state or local bans enacted after drillers have secured rights to the mineral estate might be vulnerable to regulatory takings claims if the owners could reasonably expect to drill under prior law. See e.g., Lucas v. South Carolina Coastal Council, 505 U.S. 1003 (1992)(regulation which prohibits any economically beneficial use of the property interest amounts to a taking). But cf., Keystone Bituminous Coal Assn. v. DeBenedictis, 480 U.S. 470 (1987)(upholding a local anti-subsidence ordinance against the mining companies taking claim).

[212] See, e.g., City of Cedar Hill, Texas, Zoning Code, URL: http://www.cedarhilltx.com/index.aspx?NID=915.

are, they are issues of state and local concern. Ongoing battles over local ordinances, and over whether state regulatory requirements ought to preempt local requirements are understandable, even appropriate. Local governments are political subdivisions of the state, and ultimately these issues will and should be resolved at the state level.[213]

3. *Fugitive Greenhouse Gas Emissions*

At least one of the impacts of hydraulic fracturing is clearly not merely a local concern: that is the emission of methane from natural gas gas gathering and processing operations. This is a problem that is not peculiar to hydraulic fracturing, but rather affects all gas production and processing operations. This research is in its infancy, and there is a great deal of disagreement about the actual numbers. However, according to preliminary analyses by Cornell University, the EPA, the Environmental Defense Fund ("EDF"), and others, some gas production operations permit significant amounts of methane to escape into the atmosphere.[214] Nevertheless, whatever the correct numbers are, it seems clear that natural gas production produces fugitive emissions of methane. These emissions are not merely of local concern, because methane is a potent greenhouse gas (far more potent than carbon dioxide); methane emissions contribute to a problem that not only extends beyond state boundaries, but beyond national boundaries as well. Even small amounts of methane can have significant climate change impacts. These effects can, if significant enough, cancel out any climate change benefits associated with replacing coal combustion with natural gas combustion (for example, in electricity production). Indeed, concern about the effects of fugitive methane emissions from natural gas production has led some environmental groups to reverse their policies in support of natural gas as a bridge fuel to help the economy wean itself from fossil fuels.[215]

How might federal regulation address methane emissions from hydraulic fracturing operations? Fugitive methane emissions are one focus of the ongoing EPA study of hydraulic fracturing. Assuming the agency concludes that fugitive methane emissions are a significant problem worthy of federal attention, does it have existing authority to regulate those omissions? As a preliminary matter, it seems clear that methane is a pollutant subject to EPA regulation under the Clean Air Act. The Supreme Court's 2007 *Massachusetts v. EPA*[216] established that greenhouse gases fall within the statutory definition of "air pollutant."[217] That decision led eventually to the EPA's 2009 greenhouse gas tailoring rule, which regulates methane as a greenhouse gas.[218]

The tailoring rule will require new or modified major sources of methane to obtain a permit, and to employ best available control technology ("BACT") to control its emissions of

[213] See Section IV.B, infra, for a discussion of the effects of politics on these regulatory conflicts.
[214] Howarth, supra note 000.
[215] See supra note 000.
[216] 549 U. S. 497 (2007).
[217] Id., at __ ("Carbon dioxide, methane, nitrous oxide, and hydrofluorocarbons are without a doubt 'physical and chemical substances which are emitted into the ambient air,' and hence within the statutory definition).
[218] 40 C.F.R. § 98.6 ("Greenhouse gas or GHG means carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), sulfur hexafluoride (SF6), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and other fluorinated greenhouse gases as defined in this section."); 40 C.F.R. § 52.21(b)(49)(i) ("Greenhouse gases (GHGs), the air pollutant defined in § 86.1818–12(a) of this chapter as the aggregate group of six greenhouse gases: Carbon dioxide, nitrous oxide, methane, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride, shall not be subject to regulation except as provided in paragraphs (b)(49)(iv) through (v) of this section.").

greenhouse gases.[219] Major sources are those emitting 25,000 tons or more of carbon dioxide equivalent ("CO_2e") annually.[220] Methane is a greenhouse gas, and the CO_2e of 25,000 tons of carbon dioxide per year is 1000 tons of methane per year. Thus, if a natural gas production facility emits more than 1000 tons of methane per year,[221] it is covered by the EPA rule. The Congressional Research Service estimates that methane emissions from natural gas production facilities comprise less than 1.5 percent of American greenhouse gas emissions annually, but natural gas systems are the third largest source of anthropogenic methane emissions in the United States.[222] It is not clear, however, that hydraulic fracturing operations (and/or subsequent production from fracked wells) will be covered by the EPA rule. The EPA estimates that about 45 percent of natural gas pipeline compressors would be classified as major sources under the rule, though industry representatives estimate that the number could be as high as 75 percent.[223] While it remains to be seen how many hydraulic fracturing operations or fracked production wells would be covered by the existing tailoring rule, it appears that EPA has the authority to set its regulatory threshold at a level lower than 25,000 tons per year of CO_2e, if it concludes that doing so is necessary to protect public health and the environment.[224] Thus, if after completion of its hydraulic fracturing study the EPA concludes that fugitive methane emissions pose such a risk, it could address those omissions directly by expanding the tailoring rule to cover emissions from hydraulic fracturing operations and/or fracked production wells.

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[219] 40 C.F.R. § 52.21(j)(2)&(3) ("A new major stationary source shall apply best available control technology for each regulated NSR pollutant that it would have the potential to emit in significant amounts. A major modification shall apply best available control technology for each regulated NSR pollutant for which it would result in a significant net emissions increase at the source. This requirement applies to each proposed emissions unit at which a net emissions increase in the pollutant would occur as a result of a physical change or change in the method of operation in the unit.").

[220] 40 C.F.R. § 98.2(a)(2) ("The GHG reporting requirements and related monitoring, recordkeeping, and reporting requirements of this part apply to the owners and operators of any facility that is located in the United States or under or attached to the Outer Continental Shelf (as defined in 43 U.S.C. 1331) and that meets the requirements of either paragraph (a)(1), (a)(2), or (a)(3) of this section; A facility that contains any source category that is listed in Table A–4 of this subpart and that emits 25,000 metric tons CO2e or more per year in combined emissions from stationary fuel combustion units, miscellaneous uses of carbonate, and all applicable source categories that are listed in Table A–3 and Table A–4 of this subpart."). Some sources are subject to higher thresholds. 40 C.F.R. § 52.21(b)(49)(iv)&(v) ("Beginning January 2, 2011, the pollutant GHGs is subject to regulation if: (a) The stationary source is a new major stationary source for a regulated NSR pollutant that is not GHGs, and also will emit or will have the potential to emit 75,000 tpy CO2e or more; or (b) The stationary source is an existing major stationary source for a regulated NSR pollutant that is not GHGs, and also will have an emissions increase of a regulated NSR pollutant, and an emissions increase of 75,000 tpy CO2e or more; and, (v) Beginning July 1, 2011, in addition to the provisions in paragraph (b)(49)(iv) of this section, the pollutant GHGs shall also be subject to regulation (a) At a new stationary source that will emit or have the potential to emit 100,000 tpy CO2e; or (b) At an existing stationary source that emits or has the potential to emit 100,000 tpy CO2e, when such stationary source undertakes a physical change or change in the method of operation that will result in an emissions increase of 75,000 tpy CO2e or more.").

[221] The EPA's proposed rules governing fugitive emissions from gas production operations estimate that fugitive emissions from hydraulically fractured wells are about 200 times those of conventional gas Wells, primarily because of gaseous compounds that escaped to the atmosphere during the production of low back water. The EPA estimates emissions of about 23 tons of volatile organic compounds per fracturing operation, which implies that methane emissions ought to be less than 1000 tons per year. See infra note 000.

[222] Kelsi Bracmort, et al., Methane Capture: Options for Greenhouse Gas Emission Reduction, Congressional Research Service, May 10, 2010, URL: http://www.cnie.org/NLE/CRSreports/10Jun/R40813.pdf.

[223] See U.S. EPA, Tailoring Rule, supra note 000, at __.

[224] Indeed, one of the challenges to the tailoring rule is based upon the argument that EPA has set the threshold too high, and that it is not authorized under the statute to ignore smaller sources.

In addition to the possibility of direct regulation of methane emissions under the tailoring rule, it appears that EPA can reduce climate change risks from fugitive methane emissions another way. The EPA has long regulated fugitive emissions of volatile organic compounds ("VOCs") and sulfur dioxide from natural gas processing units,[225] and recently proposed a suite of new rules strengthening the regulation of those emissions.[226] VOCs are organic chemical substances with sufficiently high vapor pressures to vaporize under normal temperatures and conditions. The EPA regulates VOCs as precursors of ozone, and therefore defines VOCs as organic chemical compounds that participate in atmospheric photochemical reactions.[227] The agency's list of VOCs includes several methane compounds, and measures taken to reduce emissions of these listed compounds will reduce methane emissions correspondingly.[228] The EPA recently proposed rules that would apply to hydraulic fracturing operations, and seek a 95 percent reduction in VOC emissions from hydraulically fractured gas wells.[229] These regulations do not require individual permits or impose a technology-based emissions standard. Instead, they impose operational performance standards; these are specified procedures designed to minimize emissions, including standards governing well completion[230] following hydraulic fracturing operations.[231] For example, the rules require "green" well completion, a series of measures to separate salable natural gas from liquids, and combustion of gas that would otherwise be vented.[232] The rules also specify leak control equipment for compressors, mandate emissions reductions from storage tanks, among other things.[233] The EPA projects a reduction in methane emissions of about 62 million metric tons as a result of its proposed rules, which represents about a 26 percent in emissions from the natural gas sector.[234]

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[225] 40 CFR Part 60, Subpart KKK—Standards of Performance for Equipment Leaks of VOC From Onshore Natural Gas Processing Plants. Natural gas "processing" comprises the activities by which gases separated from liquids upon production, and various compounds are separated from methane or to prepare natural gas for introduction into the pipeline system. These rules cover processing operations, and explicitly do not cover operations upstream of processing. The EPA also regulates VOCs emissions from refineries under its Leak Detection and Repair ("LDAR") program. 40 CFR Parts 60, subpart GGG--Standards of Performance for Equipment Leaks of VOC in Petroleum Refineries.

[226] U.S. EPA, Oil and Natural Gas Sector: New Source Performance Standards and National Emission Standards for Hazardous Air Pollutants Reviews, 76 Fed. Reg. 52738 (August 23, 2011).

[227] 40 CFR Section 51.100(s).

[228] See U.S. EPA master list of volatile organic compounds, URL: http://www.epa.gov/iaq/base/voc_master_list.html.

[229] 76 Fed. Reg. at 52744 (rule covers natural gas production and processing, including onshore production and processing).

[230] Well completion refers to steps immediately preceding production from the well, and can include inserting and cementing-in well casing as well as hydraulic fracturing to stimulate production. Flowback water may be produced during this phase, and the production of flow backwater can entail significant venting of methane and non-methane VOCs to the atmosphere. Id., at 52757 ("wells that are fractured generally have great amounts of emissions because of the extended length of the flowback required to purge the well of the fluids and sand that are associated with the fracturing operation").

[231] Id.

[232] Id. The EPA estimates that of the 25,000 or so new wells constructed annually, only about 3-4000 currently use green completion. The agency estimates that as a result of the rule, 21,000 wells will use green completion. Id.

[233] Id. In this respect, EPA's rules might be justified using the second rationale for federal regulation – the desirability of having uniform equipment standards for manufacturers on efficiency grounds. The EPA need not specify technology standards, but rather could performance standards for technology, such as maximum leakage rates for compressors, pipe joints, etc. Alternatively,

[234] Id., at 52792.

Presumably, the EPA's ongoing study of hydraulic fracturing will continue to examine the issue of fugitive methane emissions from fracturing operations and production from fractured wells. Given that the agency has yet to finalize its rules on fugitive emissions from natural gas production operations, it seems likely that the agency will have ample opportunity to incorporate lessons learned from the hydraulic fracturing study into its final rules. The EPA may choose to strengthen existing requirements governing fugitive methane emissions, or it could establish model standards for states to follow, similar to model building codes established by the Department of Energy to promote energy efficiency.[235] Thus, it appears that EPA is well-suited to address the climate change impacts of hydraulic fracturing operations should its study of the industry dictate that existing emissions control measures are insufficient.

4. Wastewater Disposal

Some methods for disposing of hydraulic fracturing wastewater, such as disposal directly or indirectly to interstate waters, have a direct interstate effect. These disposal methods are already subject to federal regulation under the Clean Water Act.[236] Similarly, disposal of fracking wastewater that cannot satisfy Clean Water Act disposal requirements (because the wastewater contains radiation picked up while underground by drill cuttings in the flowback water, or found naturally in produced water from the well[237]) is also subject to existing federal regulatory regimes governing the disposal of low-level radioactive wastes.[238] Outside the northeast, operators may dispose of wastewater using underground injection wells, and that process is federally regulated under the SDWA.

However, there remain some troubling regulatory issues associated with wastewater disposal. First, underground injection of wastewater may be associated with seismic activity (earthquakes) in some locations, though some fear that hydraulic fracturing operations (rather than wastewater disposal operations) are to blame.[239] If an underground injection well is put in the wrong location, seismicity can result, as increasing quantities of wastewater are injected into the underground well. The ability of underground injection of fluids to trigger seismic events is well documented,[240] and recent earthquakes linked in news reports to fracturing operations in Ohio,[241] Oklahoma,[242] and Arkansas[243] all appear to be the product of disposal of wastewater

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[235] See U.S. Dep't. of Energy, Status of State Energy Codes, http://www.energycodes.gov/states/ (last visited March 22, 2011) (providing maps and current status for commercial and residential building energy codes operable at state levels). Alternatively, as James Connaughton has suggested, federal agencies could use the National Technology Transfer and Advancement Act, Public Law 104-113 (2005) to incentivize states to develop and standardize new technologies. Personal communication with author, March 2, 2012.

[236] See discussion of Clean Water Act regulation of direct discharges to surface waters and discharges to pretreatment facilities, supra notes 000-000 and accompanying text.

[237] This radiation is often described as "naturally occurring radioactive material" or "NORM."

[238] The Low-Level Radioactive Waste Policy Act governs disposal of low-level radioactive wastes. See 42 U.S.C. Section 2021b.

[239] Henry Fountain, Add Quakes to Rumblings Over Gas Rush, the New York Times, December 12, 2010.

[240] See e.g., U.S. EPA, Technical Program Review: Underground Injection Control Regulations, July, 2001, Appendix A, URL: http://water.epa.gov/type/groundwater/uic/upload/2004_5_3_uicv_techguide_uic_tech_overview_uic_regs.pdf.

[241] Id. (noting that quakes reported in Ohio appear to be associated with a deep wastewater disposal well located near a fault line), URL: http://www.nytimes.com/2011/12/13/science/some-blame-hydraulic-fracturing-for-earthquake-epidemic.html?pagewanted=all.

[242] John Daly, U.S. Government Confirms Link between Earthquakes and Hydraulic Fracturing, oil price.com, November 8, 2011, URL: http://oilprice.com/Energy/Natural-Gas/U.S.-Government-Confirms-Link-Between-

from gas production operations. The SDWA underground injection well permitting program regulations authorize EPA to consider seismicity and proximity to faults when permitting various classes of underground injection wells, but there is no such admonition in connection with Class II wells, the class of wells governing disposal of oil and gas wastes. The EPA and state agencies to which it has delegated permitting jurisdiction do have the power to shut down permitted underground injection wells in the event the well is triggering earthquakes;[244] however, the EPA may wish to consider adding seismicity to the lists of reviews it undertakes for Class II wells. Furthermore, some experts believe that "micro-seismicity" can result directly from hydraulic fracturing operations under certain conditions,[245] though fracturing-induced tremors ought to be far smaller in magnitude than those associated with underground injection for disposal, all else equal.[246] The SDWA cannot address the seismic risks (if any) associated with the injection of fracturing fluids underground, since fracturing operations are exempt from SDWA permitting requirements.[247] Should the exemption from SDWA underground injection well permitting requirements for hydraulic fracturing operations be revoked?

Certainly, earthquakes can be felt across state lines, depending upon their location and magnitude. On the other hand, there have been the tens of thousands of hydraulic fracturing operations per year over the last several years, and very few incidents of seismicity associated with fracking. Of those few, the weight of the evidence so far supports the inference that wastewater disposal through underground injection is the more likely culprit. Experts who see a potential connection between the fracturing process itself and earthquakes seem to believe that fracturing-induced tremors are likely to be quite small. Nonetheless, like many issues associated with hydraulic fracturing, this one requires further study. At the present time, the seismic risks associated with fracturing do not seem sufficiently large to support subjecting each fracturing operation to SDWA permitting. If further analysis reveals a stronger connection between the fracturing process and earthquakes, a more measured response would be for states and/or Congress to restrict hydraulic fracturing operations near known fault lines.

Second, some of the worst reported contamination associated with hydraulic fracturing operations is associated with on-site disposal of wastes, such as covering and leaving in place waste lagoons that leaked into groundwater. Some of these methods may have been permitted by

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Earthquakes-and-Hydraulic-Fracturing.html (noting that the Oklahoma quakes were near 181 underground injection wells for disposal of wastewater).

[243] Alec Liu, Earthquakes in Arkansas May Be Man-Made, Experts Warn, Fox News, March 1, 2011, URL: http://www.foxnews.com/scitech/2011/03/01/fracking-earthquakes-arkansas-man-experts-warn/ (ascribing Arkansas quakes to underground injection wells).

[244] See 40 CFR Part 126.

[245] Austin A. Holland, Examination of Possibly Induced Seismicity from Hydraulic Fracturing in the Eola Field, Garvin County, Oklahoma, Oklahoma Geological Survey Report, 2011, URL: http://www.ogs.ou.edu/pubsscanned/openfile/OF1_2011.pdf (hypothesizing that depending upon subsurface conditions, water used in the fracturing process could cause small tremors). See also Gary White, Cuadrilla Admits Drilling Caused Blackpool Earthquakes, The Telegraph, November 2, 2011, URL: http://www.telegraph.co.uk/finance/newsbysector/energy/8864669/Cuadrilla-admits-drilling-caused-Blackpool-earthquakes.html (experts concluded that small tremors were "very likely" caused by fracturing operations).

[246] Fountain, supra note 000 ("Scientists say the likelihood of that link is extremely remote, that thousands of fracking and disposal wells operate nationwide without causing earthquakes, and that the relatively shallow depths of these wells mean that any earthquakes that are triggered would be minor"); NYSDEC, SGEIS, supra note 000 at ES-19 ("there is essentially no increased risk to the public, infrastructure, or natural resources from induced seismicity related to hydraulic fracturing," in part because the micro-tremors created by fracturing "are too small to be felt, or to cause damage at the ground surface or to nearby wells").

[247] See supra note 000 and accompanying text.

state rules in effect at the time.[248] Certainly the effects of these externalities are felt locally, and states have every incentive to address them. Indeed, it appears that state laws have been amended to prohibit these sorts of on-site, surface disposal options.[249] New York's proposal to require the use of lined tanks rather than pits for liquid storage at drill sites aim at this problem. The next subsection addresses groundwater contamination issues directly.

5. *Groundwater Contamination*

Perhaps the highest profile risk – the one that has garnered the most public attention – is the risk that fracturing operations will contaminate groundwater, particularly drinking water wells. Fracking fluids may be mixed and stored onsite in lagoons; flowback and produced water also accumulate on site before disposal. If operators manage chemicals and water at the surface improperly, they can spill, and leach into groundwater. Likewise, during the production phase methane can find its way into groundwater through leakage if the production well is improperly constructed,. Public fears, however, center on the possibility that the fracturing operation itself may pose risks to groundwater.

Traditionally, the regulation of groundwater contamination has been left to the states. The Clean Water Act's permitting jurisdiction extends only to navigable surface waters[250] and adjacent wetlands,[251] and leaves to the states the task of regulating discharges to groundwater. The federal government does get involved in the protection of drinking water, including underground drinking water aquifers. As already noted, the SDWA protects drinking water sources in a number of ways, including through the establishment of EPA's underground injection well permitting requirements, requirements from which fracturing operations are exempt.[252] Presumably, the race to the bottom provides the primary rationale for federal regulation under the SDWA.

Because of the public attention focused on groundwater contamination risks, the EPA, other regulatory agencies and various academic and other research institutions have begun to study the risk hydraulic fracturing operations pose to drinking water wells. A 2011 Cornell University study found a higher incidence of methane contamination and drinking water wells located close to natural gas wells,[253] though that study's methodology did not permit the authors to determine whether the methane contamination preceded or followed the drilling or operation of the gas wells nearby. A 2011 Penn State University study sampled drinking water wells before and after hydraulic fracturing operations nearby, and found no significant increase in well

[248] See supra note 000.
[249] See description of the amendment of Pennsylvania laws, supra note 000, and of the proposed New York rules, supra note 000.
[250] Section 301 of the Clean Water Act prohibits discharges of pollutants except pursuant to permits issued under the Act. 33 U.S.C. Section 1311. The Act defines "discharge of a pollutant" to mean the "addition of any pollutant to navigable waters from a point source." 33 U.S.C. Section 1362(12)(A).
[251] The Act defines "navigable waters" to include "waters of United States," 33 U.S.C. Section 1362(7). Supreme Court decisions have made it clear that the definition excludes groundwater that is not adjacent or hydrant logically connected to navigable surface waters. See Solid Waste Agency of Northern Cook County, 531 U.S. 159 (2001); and United States v. Riverside Bayview homes, Inc., 474 U.S. 121 (1985).
[252] See supra note 000 and accompanying text.
[253] See Howarth et al., supra note 000, at

contamination (by methane or fracking fluid constituents) after fracturing operations.[254] Earlier findings by MIT researchers[255] reached similar (though tentative) conclusions. A National Academy of Sciences ("NAS") study reached mixed conclusions, finding no evidence of groundwater contamination by fracking fluids or wastewater,[256] but some evidence that levels of thermogenic methane (that usually found in deep shale formations) were higher in shallow groundwater aquifers near natural gas production wells than elsewhere in the same aquifers.[257] Preliminary findings from an ongoing University of Texas study echoes the Penn State study.[258] On the other hand, anecdotal evidence of methane contamination in Pennsylvania and the EPA's conclusion that fracking fluid constituents found their way into groundwater near Pavilion, Wyoming points toward the continuing possibility of groundwater contamination.

How, then, can one reconcile this conflicting evidence? One possibility is that the academic studies released to date are simply missing real examples of contamination that can, under the wrong circumstances, result directly from fracturing. Different regions have different geological characteristics, and perhaps some regions are particularly susceptible to groundwater contamination from fracturing in ways that those examined in the Penn State and Texas studies are not. However, because of the great vertical distance (usually a mile or more) between fracturing operations and drinking water aquifers and the relative darts of evidence supporting fracking-induced contamination, the more reasonable inference is that incidents of groundwater contamination from shale gas production are probably not the direct result of the fracturing process. Rather, it seems more likely that the contamination incidents were the product of poor well construction and/or chemicals handling at the surface. If that is so, these incidents can be viewed as problems of compliance with existing regulations (since state laws require wells to be constructed so as to prevent leakage and chemicals handling the surface so as to prevent spills). Poor compliance, in turn, could be a function of inadequate enforcement or deterrence at the state level. Given that fracturing operations over the last decade have numbered at least in the tens of thousands,[259] some incidents of contamination from noncompliance (including significant noncompliance) with the rules is to be expected, statistically. In any case, these groundwater issues are local.

In sum, shale gas production can produce some risks that cross state boundaries, such as the those associated with disposal of wastewater into interstate waters or fugitive emissions of

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[254] Elizabeth W. Boyer, Bryian R. Swistock, James Clark, Mark Madden, and Dana E. Rizzo, The Impact of Marcellus Gas Drilling on Rural Drinking Water Supplies, October 2011, URL: http://www.rural.palegislature.us/documents/reports/Marcellus_and_drinking_water_2011_rev.pdf.

[255] Gregory S. McCrae and Carolyn Ruppel, The Future of Natural Gas: an Interdisciplinary MIT Study, at 39 ("With over 20,000 shale wells drilled in the last 10 years, the environmental record of shale gas development has for the most part been a good one…").

[256] Stephen G. Osborn, Avner Vengosh, Nathaniel R. Warner, and Robert B. Jackson, Methane Contamination of Drinking Water Accompanying Gas Well Drilling and Hydraulic Fracturing, Proceedings of the National Academy of Sciences (2011) ("We found no evidence for contamination of drinking-water samples with deep saline brines or fracturing fluids.").

[257] Id., at 2-3 ("The data do suggest gas-phase transport of methane upward to the shallow groundwater zones sampled for this study").

[258] Groat and Grimshaw, supra note 000 ("“hydraulic fracturing of shale formations to extract natural gas has no direct connection to reports of groundwater contamination."); see also, Bradley Hargrove, UT Study: Fracking Not Polluting Groundwater, Dallas Business Journal, December 10, 2011.

[259] Estimates of the number of fracturing operations vary widely. The NAS study cites a figure of "more than 20,000," while industry sources suggest much higher numbers.

methane. Some of these risks are already adequately addressed by federal law. Others, such as the risk of fugitive methane emissions, may not be. However, it appears that most of the externalities of hydraulic fracturing are experienced locally. Water supply issues, impacts to local character, and groundwater contamination are risks that are almost always borne by locals. Theoretically, then, states ought to be best suited to address those risks through regulation, particularly since most of the direct economic benefits of shale gas production are captured by locals as well. In such situations, we might infer that those costs and benefits ought to be balanced within the confines of the state's political system. That inference should be true if the state is willing and able to translate popular preferences into policy efficiently, a question that is the subject of the next section.

B. State Capacity and the "Race to the Bottom"?

If most of fracking's effects are local, the state should be in the best position to balance costs and benefits, and ought to build its regulatory capacity and regulatory infrastructure accordingly. However, some critics of state efforts to regulate hydraulic fracturing have challenged the capacity of states to regulate the process adequately,[260] and those critics include at least some EPA officials. Commenting on the recently-proposed New York fracking regulations, the EPA Region II administrator questioned whether the New York State Department of Environmental Conservation had sufficient staffing and other resources to handle the job.[261] Certainly, different states have reacted to the fracking rush differently. New York, however, seems an unlikely candidate for capture, since it's government is controlled by Democrats and its regulatory authority of gas production lies with the state's environmental agency. Indeed, New York has moved cautiously, studying the problem, revising its regulations prior to permitting new fracturing wells, for the most part.[262] Hence the relatively slow growth in the number of gas wells drilled in New York over the last decade, at least compared to Pennsylvania and Texas.[263] Those latter two states, for their part, have been less cautious. Both states have had considerably more recent experience with natural gas production than New York,[264] but their experiences with growth in this industry have been different: hydraulic fracturing seems to have produced more problems and controversy in Pennsylvania than in Texas. Do these differences reflect a race to

[260] See Tavernise, supra note 000, quoting Brian Coppola, the chairman of the Board of Supervisors of Robinson Township, Pennsylvania, alleging that "The state [environmental agency] is not capable of monitoring even the most basic parts of this industry."

[261] Brian Nearing, EPA Questions Fracking Study, Albany Times-Union, January 12, 2012, URL: http://www.timesunion.com/local/article/EPA-questions-fracking-study-2499294.php (reporting that regional administrator Judith Enck "questioned whether DEC, which has been dealing with staff cuts in recent years, is ready to oversee natural gas drilling"). If one were to put desired policy outcomes before federalism principles, then one could justify federal regulation whenever a state's regulatory response to a problem seems inadequate. As noted, supra at note 000 and accompanying text, this analysis puts federalism principles before policy, and so addresses the question of which level of government is best suited to determine the appropriate policy response. In addition, In May of 2011 the EPA sent a letter to the Pennsylvania DEP asking the state agency to do a better job regulating hydraulic fracturing. Melissa Troutman, Pennsylvania Marcellus Shale Records Are Incomplete, The Erie Wire, June 29, 2011, URL: http://www.eriewire.org/archives/12066/section/economy/.

[262] See supra notes 000-000 and accompanying text. As noted previously, New Jersey has followed a similar approach.

[263] See supra Table _.

[264] Id.

the bottom in which local policymakers regulate less than they would like to in their efforts to attract natural gas industry jobs and dollars?

A recent University of Texas study examined state enforcement capacity in shale gas producing states, finding "wide variation" in the ratio of enforcement staff to the number of shale gas wells, but concluding that "most states with current shale gas and related development have enforcement capacity necessary to address at least some complaints associated with oil and gas development and to conduct independent enforcement actions."[265] This is a relatively circumspect statement, and the University of Texas study took a closer look at only four states, including Texas (but excluding New York and Pennsylvania) .[266] Given that regulatory agencies routinely face budgetary constraints and information asymmetries in their efforts to regulate and monitor industry, it may very well be that rapid expansion in shale gas production has overwhelmed regulators in some states, particularly those without significant past experience with natural gas production.[267] Is this simply part of the regulatory lag problem? Can we assume that as locals experience the externalities of hydraulic fracturing, they will enlist their political leaders to regulate?

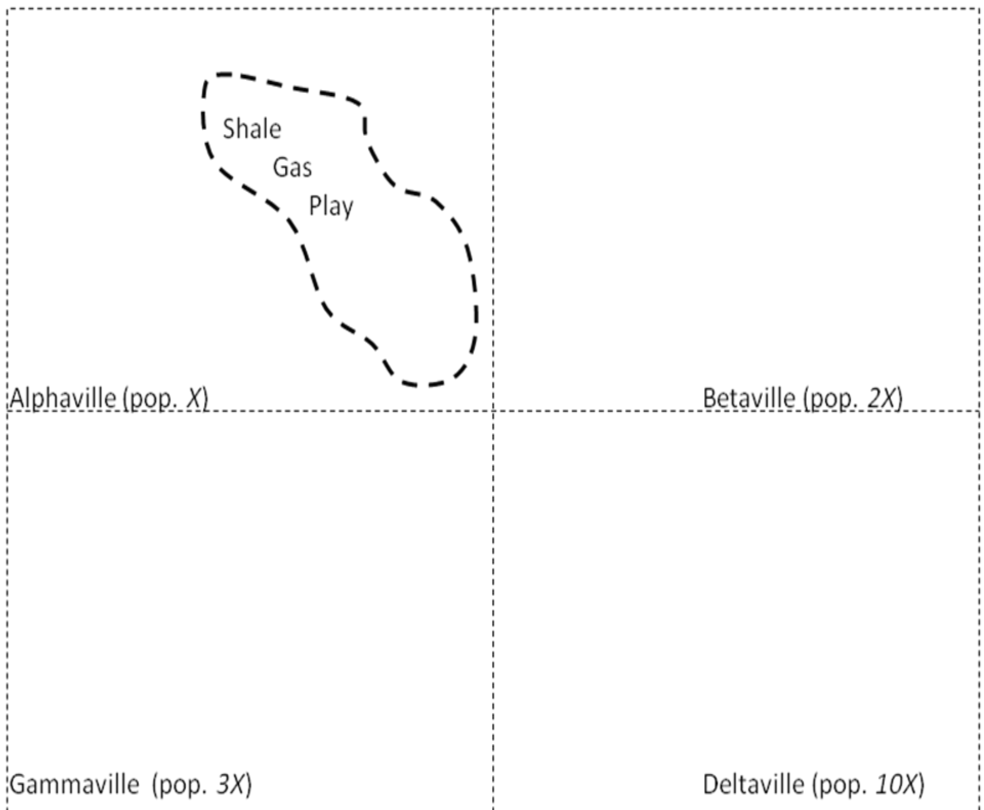
Decisions governing shale gas regulation are unlike the typical race to the bottom scenario, such as a decision to locate a new manufacturing plant in one of several candidate states. In the latter case, multiple states compete for a single (or small number of) large and long-lived capital investments. One (or a few can win), most will lose. While the manufacturing plant can be constructed (absence legal impediments) almost anywhere, hydraulic fracturing occurs only where shale gas deposits are found, and companies will invest in natural gas production wherever gas can be profitably produced. Investment in production in one state does not preclude simultaneous investment in another; to the contrary, companies will invest simultaneously in hundreds or thousands of wells. States are not chasing limited investment capital, as in the usual race to the bottom scenario; rather, in shale gas production, investment capital is chasing production opportunities. Thus, a state does not risk losing the economic benefits of shale gas development unless the regulatory costs it imposes on production are sufficient to render otherwise profitable production unprofitable. Even then, the state does not lose that capital to another state forevermore; that capital may yet return when and if natural gas prices increase sufficiently to make production profitable within the state. Thus, state regulation of natural gas production ought not to be characterized by a race to the bottom.

On the other hand, there is at least a theoretical argument that unless the costs and benefits of shale gas production are evenly distributed throughout the state, state regulators may tend to under-regulate because those who bear the costs of fracking are outnumbered by those who do not. Consider Figure 1, which depicts a potentially productive shale gas area within the hypothetical "ABC State." Consistent with the discussion in the previous section, most of the external costs of shale gas production will fall primarily on the residents of Alphaville, though we might imagine some costs falling beyond the boundaries of Alphaville. Of course, Alphaville will capture some of the benefits of shale gas development as well, in the form of royalty payments to landowners, jobs, and the indirect economic benefits of production. The residents of Betavilla, Gammaville, and Deltaville may also capture some of the benefits of production,

[265] Groat, supra note 000, at 51.
[266] Id., at 50-54.
[267] Absent a race to the bottom, states ought to regulate as they understand the risks of fracking. If state budgets are inadequate to fund a proper regulatory response, regulators can charge permitting and other regulatory fees sufficient to fund the state regulatory apparatus.

including some of the ripple effects (secondary economic effects and state budgetary effects) of shale gas production. If the costs are more closely concentrated near the shale gas production area (in Alphaville) than the benefits, it may be that the more numerous residents of Betavilla, Gammaville, and Deltaville will cast their vote in favor of relatively light regulation, outvoting their Alphaville counterparts. In that case, the residents of Alphaville may be forced to suffer externalities that would have been outlawed or more closely regulated if they had fallen upon a majority of the residents of ABC State.

Figure 2: ABC State



One solution would be to permit local governments to retain a veto over shale gas production within their borders. That way, those closest to the costs and benefits will be able to dominate the policy decision. Indeed, the countless local debates taking place nationwide over whether to permit shale gas development, while heated, seem to reflect the very sort of political conflict (over the relative merits of development versus environmental protection) that one might expect to see in a well functioning local democracy.[268] On the other hand, providing local jurisdictions with a veto over shale gas production creates the potential for overregulation, because it creates the possibility that development with positive social net benefits can be vetoed by locals who bear most of the costs of development. The real problem is that the distribution of

[268] See accounts of divisions within local communities over the relative benefits of fracking, supra notes 000-000 and accompanying text.

the costs and benefits of production will never fall neatly within the boundaries of any political jurisdiction. [269]

How, then, to address the risks of under- or over-regulation caused by geographically mismatched costs and benefits? One possible solution to the problem of under-regulation is for the winners (those who benefit from development) to compensate the losers) those who bear the external costs). However, compensation is a much neater solution theoretically than practically, in part because of moral hazard problems and political distortions.[270] We might resolve this question by asking whether under-regulation or over-regulation is the bigger problem? If shale gas development is left to states and their political subdivisions to sort out, the danger of overregulation appears to be fairly remote, because most of the costs and benefits of production will be experienced by voters within the (potentially) regulating jurisdiction. Despite some states' home rule provisions, states can preempt local law, and it seems unlikely that local vetoes will prevent positive net benefit shale gas development for long. If under-regulation is likely to be the more common problem, it is difficult to see how federal regulation can help, since the mismatch between the set of people who bear the costs and those who reap the benefits is even greater at the national level.[271] Moreover, in some shale gas producing states (like those of the Marcellus Shale), producing areas are fairly widely distributed, reducing the intrastate geographic mismatches between the relative distributions of costs and benefits pictured in Figure 1. For all of these reasons, a race to the bottom rationale for federal regulation of hydraulic fracturing is not a persuasive one.

C. National Interest in Shale Gas Development?

Is there a national interest in regulating and/or promoting natural gas production from shale using hydraulic fracturing, like the national interest previously articulated by Congress in promoting hydroelectric and nuclear energy development? National interest rationales for existing comprehensive energy facility licensing regimes have been predicated on important national needs (akin to national emergencies) or important security objectives arising around a

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[269] The race to the bottom literature explores this problem of the mismatch between the distribution of costs and benefits, on the one hand, and the distribution of votes within the decision-making polity, on the other. See Revesz, rehabilitating interstate competition, supra note 000, at 1228-36 (arguing that voters as well as businesses will sort themselves into jurisdictions whose regulatory standards match their preferences, so that social welfare will be maximized by allowing locals to establish regulatory standards that balance environment and development according to their wishes); Johnston, supra note 000 (arguing that federal control over public goods is inefficient). Daniel Ingberman demonstrates that this mismatch problem exists whenever the distribution of costs and impacts is imperfect, even within a single jurisdiction. See Daniel Ingberman, Siting Noxious Facilities: Are Markets Efficient?, 29 J. Envtl. Econ. & Mgmt. S-20 (1995), whose analysis also demonstrates that this problem exists even when all costs and benefits remain within the jurisdiction, because if impacts are concentrated on those closest to the noxious facility, a majority of voters within that boundary will suffer less than average impacts. See also Wallace E. Oates & Robert M. Schwab, Economic Competition Among Jurisdictions: Efficiency Enhancing or Distortion Inducing, 35 J. Pub. Econ. 333, 351 (1988) (arguing that state jurisdictional competition will not result in efficiency enhancement if policy decisions deviate from the will of the public or if there are "conflicts of interest within a heterogeneous community").

[270] See, e.g. Howard Kunreuther & Doug Easterling, The Role of Compensation in Siting Hazardous Facilities, 15 J. Pol'y Analysis & Mgmt. 601 (1996). For a discussion of the problems associated with compensation schemes, see Baumol & Oates, supra note 000, at 23.

[271] This is part of Revesz' response to critics of his critique of the race to the bottom hypothesis. See Revesz, Law and Economics, supra note 000 at 542 ("given the standard public choice argument for federal environmental regulation, it is not clear why the problems observed at the state level would not be replicated at the federal level").

particular industry. Thus, for example, the Atomic Energy Act was passed to control and regulate the development of the most potentially-destructive force then known to humankind. Congress' decision to center the regulation of that development process in a single federal agency (the Nuclear Regulatory Commission) was based, in significant part, on safety and national security reasons.[272] The Federal Power Act was part of a suite of New Deal laws aimed at promoting energy infrastructure and development in rural areas during the Great Depression.[273] It was part of a pro-development response to a national emergency, which in Congress' view necessitated the delegation of strong powers to the Federal Power Commission to preempt state regulation of hydropower. Congress has also tended to apply the national interest rationale to energy facilities that produce externalities extending across state lines or in national waters. Thus, the centralized regulatory system governing leasing of oil exploration on the outer continental shelf addresses not only energy security but also high-magnitude environmental risks in national waters.[274]

The last decade has seen many tens (probably hundreds) of thousands of hydraulic fracturing operations conducted nationwide. Those operations have yielded tens of reports of environmental, health and safety problems caused by fracking. We cannot be certain yet whether those reports signify potential problems inherent in the industry, or reflect the expected incidence of compliance failures with otherwise adequate regulations. The remains honest disagreement on these questions. Numerous governmental and nongovernmental organizations are studying the environmental, health, and safety impacts of fracking operations. Many of the problems being studied seem likely to be amenable to technical or process solutions which can be implemented by states, or by using existing federal regulatory authorities. In this setting, it seems unnecessary, and certainly premature, to conclude that shale gas production has created the kind of pressing national need that would justify a centralized federal licensing/regulatory regime.

On the other hand, it appears at first glance that regulation promoting natural gas development might be justified on energy security grounds, since natural gas is a plentiful domestic resource.[275] Historically, natural gas markets have been characterized by price volatility,[276] reflecting a market in which (i) demand varied considerably over the short-term,[277]

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[272] In its statement of purposes, the Atomic Energy Act acknowledges " the paramount objective of making the maximum contribution to the common defense and security," as well as the promotion of world peace. 42 U.S.C. section 2011.

[273] In that case, the national interest was an economic development interest, and the Federal Power Act of 1935 promoted that interest along with the Rural Electrification Act of 1936,7 U.S.C. Section 901 et seq., and the Tennessee Valley Authority Act of 1933, 16 U.S.C. § 831, et seq.

[274] See discussion of OCSLA, supra notes 000-000 and accompanying text. Similarly, Congress sought to stimulate development of LNG imports as an energy security measure by establishing a centralized national licensing regime for LNG terminals.

[275] It is important to make a distinction between "energy security" and "dependence upon imports." Some analysts argue that the United States will always import and export energy as a function of its active participation in world markets, and that it is important not to equate energy security with the absence of dependence upon imports. Nevertheless, it seems almost axiomatic to acknowledge that the increased amounts of domestic resources can enhance energy security, all else equal.

[276] Domestic U.S. natural gas prices were distorted considerably, however, by federal regulation between 1955 and 1985. Between 1955 and 1978, the Federal Energy Regulatory Commission regulated wellhead prices (at the direction of the Supreme Court), leading to such serious shortages that Congress enacted the Natural Gas Policy Act of 1978, which gradually deregulated wellhead prices over the next several years. For a full chronology of these events, see Richard J. Pierce, Jr., Reconsidering the Rules of Regulation and Competition in the Natural Gas Industry, 97 Harv. L. Rev. 345 (1983). For a description of the strange and unpredictable trajectory of natural gas

particularly in colder climates where natural gas was used as the primary heating fuel, and (ii) there was (and is) insufficient storage capacity[278] to cope with large, short term variation in demand. Since the mid-1980s, natural gas demand in the United States increased steadily,[279] as did imports -- until 2005. Around that time, natural gas prices began to separate from oil prices, and imports began to decline.[280] A big part of the reason for these developments was the new availability of plentiful, domestically produced shale gas.[281] The availability of large quantities of domestically produced gas has stabilized natural gas markets, reducing prices from more than $13/MMBtu in 2006 to less than $3/MMBtu in January 2012.[282] This ample supply offers American policymakers and consumers the increased energy security that comes with the knowledge that the United States has domestic reserves sufficient to meet consumer demand for a long time to come.[283]

However, the nature of the energy security gains provided by this source of domestic supply depends upon a number of factors. Currently, Americans use natural gas primarily for domestic heating and cooking, and electricity generation. A reliable supply of inexpensive natural gas could alter the profile of natural gas in the American electric generation mix. Natural gas-fired generation currently comprises a little more than 20 percent of the American electric

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prices during the slow deregulation process under the NGPA, see James M. Griffin and Henry B. Steele, Energy Economics and Policy (1986) at 301-03.

[277] An examination of monthly demand in the United States reflects considerable seasonal variation. See U.S. Energy Information Administration, Natural Gas Consumption in the United States, 2006-2011(January 2012). (http://www.eia.gov/naturalgas/monthly/pdf/table_02.pdf)

[278] See U.S. EIA, Natural Gas Markets, supra note 000 ("Like wellhead natural gas supplies, other sources of natural gas supply were also relatively inelastic. For example, while the volume of weather-sensitive natural gas consumption has grown, the capability of natural gas storage facilities to reduce high prices during periods of high winter demand appears to have diminished.").

[279] See U.S. Energy Information Administration, U.S. Natural Gas Total Consumption: 1949-2010 (January 2012) (accessed February 24, 2012) (http://205.254.135.24/dnav/ng/hist/n9140us2a.htm).

[280] See Reinout De Bock & José Gijón, Will Natural Gas Prices Decouple from Oil Prices across the Pond?, International Monetary Fund Working Paper 1, 19 (2011) (http://www.imf.org/external/pubs/ft/wp/2011/wp11143.pdf) ("Econometric analysis shows that the tight link between US gas and spot oil prices has weakened. This decoupling coincided with a significant increase in the production of non-conventional gas (especially shale gas) in the US. The additional supply has discontinued plans for sizable LNG imports into the US."); see also id. at Figure 4.

[281] It is not that plentiful supplies of domestically produced gas prevent Americans from being dependent upon unstable, faraway regimes; to the contrary, the vast majority of American natural gas imports already come from Canada and Mexico. However, imports of liquefied natural gas ("LNG") were beginning to comprise an increasing percentage of American imports prior to the decline in imports owing to the increased availability of domestic shale gas in the early 2000s. Five new LNG import terminals were permitted within the last 7 years, though some of those terminals are now being converted to export terminals. The lion's share of LNG imports in recent years have come from Algeria, Egypt, and Trinidad and Tobago.

[282] See U.S. Energy Information Administration, Natural gas spot prices near 10-year lows amid warm weather and robust supplies, (February, 1 2012) (accessed February 24, 2012) (http://www.eia.gov/todayinenergy/detail.cfm?id=4810) ("Average spot natural gas prices for January were $2.68/MMBtu. Spot natural gas prices in January 2012 reached their lowest level in 10 years except for a 4-day period over the Labor Day weekend in 2009.").

[283] Estimates of reserves are stated as a function of price, among other things. Thus, the amount of recoverable reserves in any gas formation at price X will be less than the amount recoverable at price 2X. In late 2011, the United States Energy Information Administration revised its estimate of recoverable reserves in American shale gas formations downward by about 41 percent, a revision that is partly attributable to the fall in natural gas prices caused by the glut. U.S. Energy Information Administration, Annual Energy Outlook 2012, URL: http://www.eia.gov/forecasts/aeo/er/pdf/0383er%282012%29.pdf.

generation mix,[284] and has been the fastest-growing electric generation fuel (by generating capacity) over the last decade.[285] Increasing our natural gas-fired electric generating capacity does little or nothing to increase energy security, since the fuels natural gas would displace are domestically produced. Coal-fired power generation (a little less than 50 percent of the current generation mix), nuclear power (about 20 percent), and renewable power (about 10 percent) all rely on domestically available sources.[286] However, if the United States were to expand its uses of natural gas to include transportation fuels, domestic natural gas might displace some petroleum imports, further enhancing the country's energy security. An examination of the conversion of the United States vehicle fleet from gasoline to natural gas is beyond the scope of this article, but it is clear that such a conversion is technically feasible. Many government and corporate vehicle fleets currently run on natural gas,[287] and there is at least one commercially available consumer automobile model that runs on natural gas.[288] On the other hand, a larger scale conversion would require a very large investment in infrastructure for refueling a natural gas powered vehicle fleet, an investment that seems unlikely given the dearth of proposals in Congress or the federal energy bureaucracy promoting any such investment.[289] Absent a national commitment to such a conversion, the energy security argument for a national licensing regime to ensure natural gas production remains an unpersuasive one.

Such a regime might be justified in furtherance of another national objective, however: namely, the protection of public health and the environment through the reduction of air pollution. Two 2011 studies -- one by public health and medical professionals, and another by economists -- are illustrative examples of a larger literature pointing toward the conclusion that

[284] See Energy Information Association, Electric Power Annual 2010: Summary Statistics for the United States 1999-2010 (November 2011) (accessed February 26, 2012) http://205.254.135.7/electricity/data.cfm#summary.

[285] Id.

[286] See U.S. Energy Information Administration, Electric Power Annual 2010, URL: http://www.eia.gov/electricity/annual/pdf/table1.2.pdf.

[287] See Marcy Wood Werpy, et al., White Paper on Natural Gas Vehicles: Status, Barriers, and Opportunities, U.S. Department of Energy (2009) http://www1.eere.energy.gov/cleancities/pdfs/clean_cities_workshop_natural_gas.pdf ("In general, the NGV strategy in the United States has been to pursue high-fuel-use, urban fleets capable of central refueling. This market includes fleets of buses, trash haulers, taxis, and shuttle, delivery, port, and airport vehicles. According to the American Public Transit Association 2009 Public Transportation Fact Book, nearly 19 percent of the nation's full-sized transit bus fleet, or about 12,000 vehicles, operate on natural gas.

[288] See Craig Trudell & Alan Ohnsman, Chrysler to Begin Natural Gas Truck Sales, Bloomberg (Jan. 11, 2012), http://www.bloomberg.com/news/2012-01-11/chrysler-to-begin-selling-natural-gas-powered-pickups-to-fleets-this-year.html. ("Honda Motor Co. is the only automaker selling cars with compressed natural-gas engines to retail customers in the U.S. with its $26,155 Civic Natural Gas sedan. The model, formerly the Civic GX, has sold mainly in California and a small number of other U.S. states that have fueling facilities.").

[289] See Gustavo Collantes & Marc W. Melaina, The Co-Evolution of Alternative Fuel Infrastructure and Vehicles: a Study of the Experience of Argentina with Compressed Natural Gas, 39 Energy Policy 664, 664 (2011) http://www.sciencedirect.com.ezproxy.lib.utexas.edu/science/article/pii/S0301421510007901 ("A common denominator of alternative fuel polices has been the discussion over how to coordinate the development of a refueling infrastructure with the deployment of alternative fuel vehicles. This discussion arose during the implementation of the alternative fuel provisions of the California Low Emission Vehicle and Clean Fuels program of 1990 for the case of methanol and natural gas, during the development of California's Hydrogen Highways initiative in 2004–2005 for the case of hydrogen, during the development of various state biofuel programs in 2006–2007 for the case of E85, and currently for states such as the State of Washington in the process of deployment of grid-enabled vehicles. This coordinated development is a primary concern of the U.S. Clean Cities program, which cultivates communication and collaboration among diverse networks of stakeholders, including automakers and fuel providers. Despite these efforts, there have been few U.S. success stories to date (e.g., E85 in Minnesota) among a long list of stalled or failed programs.").

the displacement of coal-fired generation by natural gas-fired generation would yield enormous public welfare benefits. The first study, reported in the *Annals of the New York Academy of Sciences* (a multidisciplinary scientific journal), examined the health effects of the coal industry on a lifecycle basis, estimated health impacts (premature deaths, illness, and injuries) from coal extraction, processing, transport, and combustion, and sought to quantify the value of these external costs.[290] The authors, who comprised a large group of researchers from various public health and academic institutions,[291] estimated that these externalities cost the American public as much as half a trillion dollars each year,[292] and "conservatively" estimated that if these costs were internalized (that is, borne by the industry), the price of electricity generated from coal would "double or triple."[293] The second study, reported in the *American Economic Review*, offered a framework for integrating environmental externalities into national economic accounts, and applied the framework to compare (quantify) damages associated with air pollution emissions from 820 industries (including all of the major polluting industries) with the value added to the economy by those industries.[294] The authors concluded that the ratio of environmental damages to value added for seven of those industries (including oil- and coal-fired power plants, but not natural gas-fired power plants) is greater than one.[295] The authors concluded further that coal-fired combustion created by far the largest amount of environmental damage, which they estimated at approximately $53 billion per year.[296] By contrast, they estimated environmental damages from natural gas-fired production to be less than $1 billion per year.[297] The authors estimated the costs of coal-fired generation to be approximately 2.8 cents per kilowatt hour (cents/kwh), from oil fired generation to be 2 cents/kwh, and from natural gas-fired generation to be approximately 0.1 cents/kwh.[298]

According to both of these studies, the bulk of the harm from coal combustion is attributable to mortality resulting from emissions of conventional air pollutants, primarily sulfur dioxide, fine particles, and nitrogen oxides. By comparison, environmental harm from greenhouse gas emissions pales in comparison, representing well under 1 percent of the harm estimated in the *American Economic Review* analysis. Stated differently, these studies imply that "the regulated levels of emissions from the [coal-fired power] industry are too high."[299] Other

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[290] Paul R. Epstein, Jonathan J. Buonocore, Kevin Eckerle, Michael Hendryx, Benjamin M. Stout III, Richard Heinberg, Richard W. Clapp, Beverly May, Nancy L. Reinhart, Melissa M. Ahern, Samir K. Doshi, and Leslie Glustrom, Full Cost Accounting for the Life Cycle of Coal in "Ecological Economics Reviews," Robert Costanza, 1219 Ann. N.Y. Acad. Sci. 73 (2011) (Karin Limburg & Ida Kubiszewski, Eds.).

[291] These included the Harvard Medical School, the Harvard School of Public Health, the Boston University School of Public Health, the Department of Pharmacology at Washington State University, and the Department of Community Medicine at West Virginia University.

[292] Epstein et al., supra note 000 at __.

[293] Id., at __.

[294] Nicholas Z. Muller, Robert Mendelsohn, and William Nordhaus, Environmental Accounting for Pollution in the United States Economy, 101 American Economic Review 1649 (2011).

[295] Mueller, et. al, supra note 000, at 1665 (Table 2). The ratio of environmental damage to value added was higher for oil fired generation (5.13) and from coal-fired generation (2.20), and higher still for solid waste combustion and incineration (6.72). However, the ratio for natural gas-fired generation was less than .10. Id., at 1664.

[296] Id. The next largest amount of environmental damage was associated with the livestock production industry, at $14.8 billion. Since the authors did not report the environmental damage number for natural gas-fired power production, it must be less than $4 billion per year. Id., at 1665.

[297] Id., at 1669.

[298] By way of comparison, electricity prices for American households range between 8 and 17 cents per kwh.

[299] Muller et. al, supra note 000, at 1672.

studies have reached similar conclusions,[300] and offer further support for the notion that coal combustion imposes very large mortality, morbidity and environmental costs on American society, costs that dwarf those associated with natural gas-fired power.[301] Of course, in 1970 Congress established a national policy aimed at exactly this sort of harm when it resolved to "protect and enhance the quality of the nation's air resources so as to promote the public health and welfare and the productive capacity of its population" through the passage of the Clean Air Act.[302]

Does the existence of a national policy in favor of cleaner air imply the need to use federal regulation to promote shale gas development? Not necessarily. The need to promote the national interest in cleaner air by promoting shale gas development (thereby reducing coal combustion) seems less pressing for two reasons. First, the Clean Air Act already provides an adequate vehicle for addressing coal-fired power plant emissions. Existing EPA rules already regulate emissions of sulfur dioxide, particulate matter, and ozone precursors from coal-fired power plants,[303] and the Obama administration is moving forward with new rules aimed at reducing emissions of mercury,[304] carbon dioxide,[305] and nitrogen oxides[306] from coal-fired power plants. While regulatory action to address emissions from coal-fired has been contentious and halting,[307] these new rules are apparently sufficiently stringent to have attracted

[300] A 2009 National Academy of Sciences study estimated the annual non-climate related external damages from 406 coal-fired power plants to be $62 million, or about 3.2 cents per kwh. National Academy Of Sciences, Press Release: Report Examines It in Health and Environmental Costs of Energy Production and Consumption in U. S. (October 19, 2009), URL: http://www.usclimatenetwork.org/resource-database/NAS%20study%20on%20costs%20of%20energy.pdf. Studies of the effects of coal on the states of Kentucky and West Virginia concluded that the net benefits of coal to their states were negative. See also Melissa Fry Konty and Jason Bailey, The Impact of Coal on the Kentucky State Budget, Mountain Association for Community Economic Development ( ), URL: http://www.maced.org/coal/documents/Impact_of_Coal-Exec_Summary.pdf. A study by the West Virginia Ctr. For Budget and Policy and the Consulting Firm Downstream Strategies reached a similar conclusion about the effects of coal on the West Virginia state budget. See Associated Press, Researchers Push for Higher Taxes, Fees, Fines on Coal, September 13, 2010, URL: http://www.wvgazette.com/News/201009130914.

[301] See National Academy of Sciences, supra note 000 ("burning natural gas generated far less damage than coal, both overall and per kilowatt-hour of electricity generated").

[302] 42 U. S. C. Section 7401.

[303] Emissions of conventional pollutants like sulfur dioxide, particulate matter, and nitrogen oxides from new or modified coal-fired power plants have long been regulated under the Clean Air Act. In addition, the acid rain program regulates the emission of acid rain precursors (like sulfur dioxide) from older coal-fired power plants. For history of these regulatory programs, and in early history of the efforts to regulate mercury emissions from coal-fired power plants, see David B Spence, Coal-Fired Power in a Restructured Electricity Market, 15 Duke Envt'l Law & Pol'y Forum 187 (2005).

[304] U.S. EPA, National Emission Standards for Hazardous Air Pollutants From Coal and Oil-Fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial-Institutional, and Small Industrial-Commercial-Institutional Steam Generating Units, 77 Fed. Reg. 9304 (February 16, 2012) (regulating mercury emissions from coal-fired power plants as toxic emissions under section 112 of the Clean Air Act for the first time). One byproduct of the new mercury rule will be reductions in particulate matter emissions, and the most serious health costs associated with coal-fired power plants are associated with particulate matter emissions. See supra notes 000-000 and accompanying text.

[305] See discussion of the EPA's "tailoring rule" for greenhouse gases, supra, note 000 and accompanying text.

[306] see discussion of the EPA's "cross state pollution rule," supra note 000 and accompanying text.

[307] See Spence, Coal-Fired Power, supra note 000.

the intense opposition of industry.[308] Second, the market seems to be providing sufficient incentives for shale gas development on its own, without federal help, at least for the time being. The glut of gas has caused prices to fall to unprecedented lows.[309] Nor does it seem likely that a cascade of state and local bans on shale gas production will constrain supply anytime soon. To the contrary, each state is addressing local conflicts over shale gas production on its own terms. Under current conditions, then, comprehensive federal licensing legislation for shale gas production seems unnecessary, at least for the time being.

Finally, there are two existing regulatory regimes to which proponents of comprehensive federal regulation of shale gas production might point as precedents – that is, regulatory regimes that were based upon a stated national interest in regulating despite the local nature of the externalities involved. One such regime is the Safe Drinking Water Act, which is difficult to justify on national emergency or interstate pollution externalities grounds.[310] The protection of groundwater – even for drinking purposes – seems primarily a local concern, yet Congress made its protection a matter of federal responsibility. On the other hand, as a risk regulation regime covering multiple industries, the SDWA (including its underground injection well program) can be justified on race to the bottom grounds in ways that federal regulation of the hydraulic fracturing cannot. That is, in the absence of federal regulation protecting drinking water wells, one can at least imagine a narrowly self-interested waste disposer forum-shopping for a state in which disposal is unregulated.[311] As a matter of historical reality, it seems that the SDWA was Congress' response to a perceived instance of state regulatory failure. The statute authorizes light-handed regulation, designed to push states to ensure that drinking water is safe. Congress made a policy judgment that the SDWA was necessary to protect public health, and had the Constitutional power to regulate.[312] For purposes of this analysis, the notion that federal regulation is necessary to provide a backstop and (and a push) to state regulation presumes a desired policy outcome. This analysis has focused on where the choice ought to lie. There is an ongoing process of documenting and measuring the environmental, health and safety impacts of hydraulic fracturing, and of its benefits (including environmental benefits) as well as its costs. We do not yet have a clear picture of either, and the SDWA's regulation of similarly localized activities does not seem reason enough to federalize the regulation of shale gas production.

A second useful precedent for proponents of federalizing the regulation of shale gas production is the Surface Mining Control and Reclamation Act. That statute created a federal licensing regime for coal mining, one deemed necessary by Congress because of the importance of the coal industry to the national economy and because state environmental regulation had failed.[313] The regulatory program established by SMCRA established federal standards that can be administered by states with federally-approved programs, thus providing minimum federal

[308] See e.g., Matthew L. Wald, New Air Quality Rules for Power Plants in the Dispute, the New York Times, December 2, 2011, URL: http://www.nytimes.com/2011/12/02/science/earth/dispute-over-new-air-pollution-rules-for-power-plants.html.

[309] See supra note 000.

[310] See Revesz, The Law and Economics of Federalism, supra note 000 at 540 ("environmental problems such as the control of drinking water quality [entail] virtually no interstate pollution externalities").

[311] Even here, however, the race to the bottom seems unpersuasive. Anyone who recklessly or knowingly contaminates a drinking water source faces liability risks irrespective of the SDWA. That statute seems aimed more at pushing states to regulate drinking water sources than to prevent a race to the bottom.

[312] See discussion of the statute's structure and objectives, supra, at note 000.

[313] See Olivier a. Taillieu, The DC Circuit Review – August 1996 – July 1997: Energy and Natural Resources Law, 66 Geo. Wash. L. Rev. 956 (1998)(prior to the enactment of SMCRA mining was plagued by undercapitalized firms that cause environmental harm).

standards to which states must adhere. Most of the impacts of surface mining are felt locally in the form of denuded land and changes in the character of the area, just as in the hydraulic fracturing context.[314] The coal industry was certainly a nationally important industry (even a strategic one) at the time of SMCRA's enactment, but one could argue that the natural gas industry is becoming equally important within the American energy policy environment. On the other hand, the impacts of surface mining were well understood at the time of SMCRA's passage, and they dwarf those associated with hydraulic fracturing.[315] Yet the differences or similarities between surface mining and shale gas production are matters of judgment, and SMCRA remains an example of federal regulation of an essentially local (albeit enormous) environmental problem, one probably not plagued by significant race to the bottom problems. Again, the mere fact that Congress has exercised federal regulatory authority in the past in situations that do not fit the traditional rationales for federal regulation neatly does not constitute a strong case for regulating shale gas production now.

V. Conclusion: The Case for Narrow Federal Regulation Only

The case for more regulation of shale gas production may turn out to be a strong one. Indeed, to many it appears that regulation has lagged behind the industry's growth, which has triggered controversy and public opposition to fracking in some places, and a process of adaption by regulators. Controversy over hydraulic fracturing will be resolved politically, by actors whose concern for principles of federalism will probably be dwarfed by their desire to promote or restrict hydraulic fracturing for policy reasons. Opponents and proponents of shale gas production mobilize their supporters and advance their arguments for and against regulation at all levels of government. Local ordinances, state laws or federal laws addressing (permitting, prohibiting, or regulating) fracking are the product of this political conflict: opponents of fracking may prevail in one setting, proponents of fracking in another. The product of these political processes is a seemingly-messy regulatory environment, one characterized by fragmentation and fluidity. A single federal regulatory regime for shale gas production would certainly be a much neater solution, at least conceptually. A federal licensing regime could both preempt unnecessarily restrictive local laws and establish uniform minimum standards applicable cross the country. Such an approach would relieve producers from having to worry about multiple state regulatory regimes; and a system of well-drawn rules might provide a minimum level of environmental protection in the event states or localities fail to regulate adequately.

However conceptually neat that solution sounds, it is problematic for at least two reasons. First, it assumes that federal government actors (Congress or the EPA) can do a better job of regulating -- of balancing the costs and benefits of hydraulic fracturing -- than state and local government officials whose constituents are experiencing directly most of those costs and benefits. The vast majority of negative externalities from shale gas production are experienced locally. Whatever the *potential* imperfections of the local policymaking process (susceptibility to capture, or a race to the bottom), the most important impacts of shale gas production – changes in local character of the community, potential contamination of groundwater, and water supply issues -- are matters of local concern. Moreover, despite regulatory lags in some places, state and local governments appear to be adjusting to new information about the local risks associated

[314] As with natural gas production, coal mining has some interstate impacts, but most of those can be addressed through existing federal authorities, such as the Clean Water Act.

[315] For a summary of the impacts to land and water from surface mining, see Taillieu, supra note 000.

with hydraulic fracturing and shale gas production. Local governments are amending their ordinances and states are amending their state regulatory regimes to respond to newly- or better-understood risks. Both Texas and Pennsylvania have recently strengthened their regulations governing hydraulic fracturing, and New York is about to put a new regulatory regime for fracking into place. There is no evidence to suggest that the states' varying approaches to these questions reflect capture of their regulatory processes by industry; an equally likely explanation is that each state is balancing the costs and benefits of development differently. For these reasons, the enactment of a comprehensive licensing program or broad federal regulation focused on shale gas production seems, at the very least, premature at this time.

The better option is for the federal government to restrict its regulation of fracking, for now, to those aspects of the industry that produce interstate effects or implicate established national interests. Hydraulic fracturing can entail air pollution that poses a threat to established national air pollution standards and greenhouse gas emissions reduction goals, and the EPA is well-equipped to address those risks under the Clean Air Act. In particular, the EPA is studying the problem of fugitive methane emissions from natural gas production operations. This is a problem afflicting all natural gas production, not simply fracturing operations. Nevertheless, the explosive growth in natural gas production means that fugitive emissions have grown accordingly. Given its interest in reducing greenhouse gas emissions, we can expect EPA to propose additional limits on fugitive emissions in the future, perhaps as a byproduct of its study of the risks of hydraulic fracturing. Likewise, the risks associated with the disposal of fracking wastewater to surface waters, sewage treatment facilities, or underground injection wells can be addressed by the Clean Water Act and the Safe Drinking Water Act, respectively. EPA has the power to propose new effluent standards governing the issuance of NPDES permits for the disposal of wastewater from fracturing operations, and pretreatment standards for the disposal of that wastewater to municipal sewage treatment plants. Both problems are within the domain of its ongoing study of hydraulic fracturing, and we might anticipate new rules addressing those risks as well.

Continuing regulatory adjustment by states (and by the EPA using existing federal authorities), then, is an appropriate response to rapid change, and is to be expected. The use of hydraulic fracturing to produce natural gas from shale formations is, despite its explosive growth, still a relatively young industry. Its growth has caught regulators by surprise, and they are responding in myriad ways. We are still learning about the impacts of this form of natural gas production. It stands to reason that as we learn, we can adapt. Based upon the application of the principles of federalism to this regulatory issue, federal regulators ought to let that process of learning and adaptation play out mostly in the states, intervening only to address risks of national concern.