State and Local Regulation of Shale Oil and Gas Development: Adaptation, Experimentation, or Chaos?

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Abstract: The United States has recently experienced a boom in unconventional oil and gas development—particularly in shale formations. States have primary regulatory authority over this development, and their varied approaches to regulation have formed a rich regulatory experiment. Much of the variation arises from legitimate differences: Technologies and their effects vary substantially, for example, by the type and depth of formation from which a resource is extracted as well as climatic, topographical, and other differences. Further, many controls on drilling are at least partially connected to land use—a traditional area of state concern typically delegated to the local level. There is a risk, however, that some regulatory experimentation in oil and gas may arise from industry capture, underfunding, and other factors that do not provide as much justification for regulatory differences. This short paper briefly introduces the rise in unconventional domestic oil and gas development and the regulatory framework for this development. It also explores the potential reasons underlying varied approaches to regulation and the benefits and risks of regulatory experimentation in this area, concluding that in some cases, more uniform controls may be necessary. The EPA is moving toward implementing these controls, but states must continue to compare regulations and justify major regulatory differences; in some cases, further regional or federal intervention may be necessary.

Oil and gas regulation occupies a rare territory within American governance. Controls on drilling and other stages of well development first emerged at the municipal and state levels,[2] and they have stubbornly remained there despite expanding federal control over most other industrial activity and its environmental effects. States hold primary responsibility for preventing waste of oil and gas during the extraction process, protecting groundwater during drilling and subsequent stages of well development, and ensuring proper handling and disposal of oil and gas waste.[3] Even the federal and regional controls that intrude tentatively into state and local realms tend to leave substantial discretion and responsibility to the states: In the Northeast, the Delaware and Susquehanna River Basin Commissions, which regulate water withdrawals for the hydraulic fracturing of gas wells and some water quality impacts of

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[2] *See* Ground Water Protection Council, State Oil and Natural Gas Regulations Designed to Protect Water Resources 13 (May 2009), *available at* http://www.gwpc.org/e-library/documents/general/State%20Oil%20and%20Gas%20Regulations%20Designed%20to%20Protect%20Water%20Resources.pdf (describing early state requirements for well plugging); (describing early municipal laws controlling nuisances associated with urban drilling); Timothy Riley, Note, *Wrangling with Texas Urban Wildcatters: Defending Texas Oil and Gas Development Ordinances Against Regulatory Takings Challenges*, 32 VT. L. REV. 349, 357 (2007) (describing Texas municipalities' early regulation of oil and gas development and a court's affirmation of this regulatory authority).

[3] For an overview of federal and state regulation, *see* Hannah Wiseman, *Regulatory Adaptation in Fractured Appalachia*, 21 VILLANOVA ENVTL. L. REV. 115 (2010); Hannah Wiseman, Regulation of Shale Gas Development, University of Texas Energy Institute White Paper (draft, 2011), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1953547. As described in that paper, federal Endangered Species Act, Clean Air Act, and Clean Water Act regulations apply to oil and gas drilling; the regulatory system is therefore not wholly state-centric.

well development, operate through the votes of state representatives and one federal member.[4] Most states, in turn, administer the few federal environmental regulations that apply to well development: They develop and issue Clean Water Act (CWA) permits to prevent pollution (such as erosion) from well sites during construction and the CWA permits required if an operator wishes to discharge waste into waters of the United States.[5] Finally, states in some instances administer air quality permits for oil and gas sources under the Clean Air Act. (Many oil and gas sources are minor and need not acquire any Clean Air Act permits.) Oil and gas regulation is perhaps only rivaled by agriculture and land use in its state-centric nature.[6]

This unusual regulatory regime has received only short periods of attention. The legal literature often leaves discussion of oil and gas law to the experts, in part due to its daunting array of technical property and technology-based concepts—from spacing regimes and pooling to casing and blowout preventers. A recent energy boom in the United States, however, has drawn oil and gas regulation into the spotlight. The oil and gas industry has long used a technique called hydraulic fracturing (also called fracing, fraccing, fracking, or hydrofracking) to draw more oil and gas out of formations than would otherwise be extracted.[7] But a new type of fracturing called "slickwater fracturing," developed in the late 1990s,[8] has revolutionized domestic energy and allowed production from formations that were previously inaccessible. Through this technique, operators develop a well pad and access road to the pad, drill a well (often both vertical and horizontal), cement casing (steel lining) into the well, perforate portions of the well and casing, and then inject between approximately 1 and 7 million gallons of water down the well at high pressure;[9] approximately 0.5% of the water consists of chemicals to aid the fracturing

[4] *See* Delaware River Basin Commission, Commissioners, http://www.state.nj.us/drbc/about/commissioners/; Delaware River Basin Compact, *available at* http://www.state.nj.us/drbc/library/documents/compact.pdf; Susquehanna River Basin Commission, Commissioners and Alternates, http://www.srbc.net/about/commissioners/commiss.htm; Susquehanna River Basin Compact, *available at* http://www.srbc.net/about/srbc_compact.pdf.

[5] For a more thorough description of national pollutant discharge elimination system (NPDES) permits and stormwater permits, *see* Wiseman, Regulation of Shale Gas Development, *supra* note 3. *See also* Environmental Protection Agency, State Program Status, http://cfpub.epa.gov/npdes/statestats.cfm (summarizing NPDES permitting delegation).

[6] Indeed, even agriculture's local foothold has eroded slightly as Congress authorized and the EPA implements regulation of concentrated animal feeding operations. Furthermore, statutes such as the Coastal Zone Management Act infuse small, albeit very limit, amounts of federal involvement into land use planning, as do certain Clean Water Act provisions such as total maximum daily loads that encourage the regulation of nonpoint sources, such as construction and farming, that contribute to water quality problems.

[7] *See* Coastal Oil v. Garza, 268 S.W.3d 1, 17 (Tex. 2009) (noting that "hydraulic fracturing has been commonplace in the oil and gas industry for over sixty years").

[8] *See* Railroad Comm'n of Tex., Water Use in the Barnett Shale, Jan. 24, 2011, http://www.rrc.state.tx.us/barnettshale/wateruse_barnettshale.php.

[9] *See* Daniel J. Soeder & William M. Kappel, U.S. Geological Survey, Water Resources and Natural Gas Production from the Marcellus Shale 4 (2009) (estimating that up to 3 million gallons are required for each fracture treatment); New York Dep't of Envtl. Conservation, Revised Draft Supplemental Generic Envtl. Impact Statement on the Oil, Gas, and Solution Mining Program 5-93 (Sept. 2011) (estimating that "the entire multi-stage fracturing operation for a single well would require 2.4 million to 7.8 million gallons" of water); Railroad Comm'n of Tex., Water Use in the Barnett Shale, Jan. 24, 2011, http://www.rrc.state.tx.us/barnettshale/wateruse_barnettshale.php ("Slick water fracing of a vertical well completion can use over 1.2 million gallons (28,000 barrels) of water, while the fracturing of a horizontal well completion can use over 3.5 million gallons (over 83,000 barrels) of water.").

process.[10] The water-chemical solution injected at high pressure is forced out through the perforations and fractures the formation around the well or expands existing fractures. Proppant injected with the water and chemicals props open the fractures, allowing gas to flow. A salty fluid[11] called produced water comes up naturally out of the formation and is stored in pits or tanks on site and then disposed of. Drill cuttings (rocks) also must be disposed of along with used drilling fluids and muds, and some of the injected water and chemicals flow back up out of the well in the form of "flowback" after fracturing; this, too, must be stored and disposed of, typically in an underground injection control well or through a wastewater treatment plant.

Slickwater fracturing has unlocked a surprisingly large pool of natural gas in densely-packed shale and "tight sands" formations around the country. Although estimates of reserves vary, the Energy Information Administration believes that 46 percent of America's natural gas will come from shale by 2035,[12] and some sources project that America has a very large supply of domestic natural gas remaining—with some arguing that we have at least 100 years of gas.[13] In 2009, there were approximately 1.1 million active oil and gas wells in the United States.[14] These numbers may continue to grow as technologies like hydraulic fracturing enable further production of unconventional oil and gas. Indeed, the EPA notes that "11,400 new wells are fractured each year; another 14,000 are refractured[.]"[15]

As unconventional natural gas extraction has boomed in recent years—particularly in shales around the country—concerned citizens, nonprofit groups, media sources, scientists, and some policymakers[16] have begun to question the adequacy of the state-centric regulatory system for oil and gas. *The New York Times*, for example, worried that Pennsylvania's Department of Environmental Protection had failed to ensure that wastewater from fractured wells was adequately treated before being released into rivers.[17]

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[10] New York Dept. of Envtl. Conservation, *supra* note 9, at 5-53. For a comprehensive description of the chemicals used in fracturing and their quantities, *see* U.S. House of Representatives Committee on Energy and Commerce Minority Staff, Chemicals Used in Hydraulic Fracturing (Apr. 2011), *available at* http://democrats.energycommerce.house.gov/sites/default/files/documents/Hydraulic%20Fracturing%20Report%204.18.11.pdf.

[11] *See* Joseph Dancy, *Solid Waste Management and Environmental Regulation of Commonly Encountered Oil Field Wastes*, 35 A ROCKY MTN. MINERAL LAW FOUNDATION SPECIAL INSTITUTE at 3 (Feb. 1994) (noting that on average, produced water contains more total dissolved solids than does seawater).

[12] U.S. Energy Information Admin., What Is Shale Gas and Why Is It Important?, Aug. 4, 2011, http://www.eia.gov/energy_in_brief/about_shale_gas.cfm.

[13] Energy Information Admin., Review of Emerging Resources: U.S. Shale Gas and Shale Oil Plays, July 8, 2011, http://www.eia.gov/analysis/studies/usshalegas/ (estimating that there at 750 trillion cubic feet of "technically recoverable shale gas resources"); NaturalGas.Org, Natural Gas Supply, http://www.naturalgas.org/business/supply.asp (using an old, higher EIA estimate of 1,897 trillion cubic feet of gas, projecting that America has a 100-year supply of natural gas).

[14] Envtl. Protection Agency, Proposed Amendments to Air Regulations for the Oil and Natural Gas Industry, Fact Sheet at 2, http://epa.gov/airquality/oilandgas/pdfs/20110728factsheet.pdf.

[15] *Id*.

[16] *See, e.g.*, Fracturing Responsibility and Awareness of Chemicals (FRAC) Act, S. 1215, H.R. 2766, *available at* http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=111_cong_bills&docid=f:s1215is.txt.pdf ; http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=111_cong_bills&docid=f:h2766ih.txt.pdf (not enacted, but proposing to reverse a 2005 exemption and regulate fracturing under the Safe Drinking Water Act as well as require disclosure of the identify of fracturing chemicals).

[17] Ian Urbina, R*egulation Lax as Gas Wells' Tainted Water Hits Rivers*, N.Y. TIMES*,* Feb. 26, 2011, *available at* http://www.nytimes.com/2011/02/27/us/27gas.html?pagewanted=all.

Other journalists noted state regulators' close ties to industry—implying regulatory capture concerns[18]—while the documentary *Gasland* aired images of flaming tapwater allegedly contaminated with methane from a fractured well.[19] New York City questioned the adequacy of certain detailed environmental conditions on high water volume fracturing proposed by New York's Department of Environmental Conservation.[20] New York's Attorney General, in turn, called for federal review of fracturing regulations proposed by a regional river basin commission, arguing that fracturing would have sweeping environmental impacts and required closer attention under the National Environmental Policy Act.[21] Scholars, too, have slowly begun to suggest a need for federal intervention or better state and local regulation, arguing that there are substantial flaws in current regulatory regimes;[22] there is still surprisingly little attention to this issue in the legal literature, however, with the exception of notes and comments in law reviews—most student-written.[23]

The lack of both descriptive and normative broad scholarly attention to the governance of oil and gas development is problematic in light of today's boom in shale gas development. Shale gas development

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[18] Mike Soraghan, *40% of Drilling Regulators Have Industry Ties*, GREENWIRE, Dec. 19, 2011, http://www.eenews.net/public/Greenwire/2011/12/19/1.

[19] Josh Fox, Gasland (2010).

[20] Letter from Carter H. Strickland, Jr., Commissions, New York City Department of Environmental Protection, to Joseph Martens, Commission, New York State Department of Environmental Conservation, RE: Comments on the Revised Draft Supplemental Generic Environmental Impact Statement on the Oil, Gas, and Solution Mining Regulatory Program, Jan. 11, 2012, *available at* http://www.nyc.gov/html/dep/pdf/natural_gas_drilling/nycdep_comments_on_rdsgeis_for_hvhf_20120111.pdf (supporting the DEC's proposed ban on hydraulic fracturing within the watershed of New York City's unfiltered water supply but expressing concerns that low volume fracturing may occur within the watershed and that certain activities associated with fracturing and drilling could endanger the city's water infrastructure, such as pipes and tunnels).

[21] Complaint, State of New York v. Army Corps of Engineers, E.D.N.Y., May 31, 2011, *available at* http://www.ag.ny.gov/media_center/2011/may/DRBC%20Complaint%20%28Final%29.pdf.

[22] *See, e.g.*, Mark Latham, *The BP Deepwater Horizon: A Cautionary Tale for CCS, Hydrofracking, Geogengineering, and Other Emerging Technologies with Environmental and Human Health Risks*, 36 WM. & MARY ENVTL. L. & POL'Y REV. 31, 58. 59 (2011) (arguing that "the current federal regulatory approach is insufficient to protect human health and the environment from the risks associated with hydraulic fracturing" and that the EPA's "after-the-fact, piecemeal approach to regulation is inefficient, ineffective, and will not likely result in a regulatory regime governing hydraulic fracturing that sufficiently protects human health and the environment"); Hannah Wiseman, *Untested Waters: The Rise of Hydraulic Fracturing in Oil and Gas Development and the Need to Revisit Regulation*, 20 FORDHAM ENVTL. L. REV. 115 (2009) (criticizing the EPA's 2004 study of the effects of a different type of fracturing used in coalbeds, describing federal exemptions, and calling for, at minimum, a study of the adequacy of the existing regulatory regime); Wiseman, Regulatory Adaptation, *supra* note 3 (introducing some state regulatory regimes, exploring federal exemptions of oil and gas from environmental regulation, and suggesting the potential need for federal regulation of certain aspects of oil and gas development). *But see* Wes DeWeese, *Fracturing Misconceptions: A History of Effective State Regulation, Groundwater Protection, and the Ill-Conceived Frac Act*, 6 OKLA. J. L. & TECH. 49 (2010) (arguing that state regulation is adequate).

[23] *See, e.g.*, Beren Argetsinger, Comment, *The Marcellus Shale: Bridge to a Clean Energy Future or Bridge to Nowhere? Environmental, Energy, and Climate Policy Considerations for Shale Gas Development in New York State*, 29 PACE ENVTL. L. REV. 321 (2011); Adam J. Bailey, Comment, *The Fayetteville Shale Play and the Need to Rethink Environmental Regulation of Oil and Gas Development in Arkansas*, 63 Ark. L. Rev. 815 (2010); Emily C. Powers, Notes and Comments, *Fracking and Federalism: Support for an Adaptive Approach that Avoids the Tragedy of the Regulatory Commons*, 19 J.L. & POL'Y 913 (2011); Matt Willie, *Comment: Hydraulic Fracturing and "Spotty" Regulation: Why the Federal Government Should Let States Control Unconventional Onshore Drilling*, 2011 B.Y.U. L. REV. 1743 (2011).

both enables the drilling of more wells and adds new stages to the well development process.[24] The growth in sheer well numbers expands the potential environmental effects associated with development, including erosion from well pad and access road development, methane contamination of underground water when wells drilled are improperly cased and cemented,[25] pollution of surface and/or subsurface sources with drilling materials and wastes, and increased emissions of air pollutants,[26] among other effects. The addition of slickwater fracturing to the production process also introduces new potential environmental concerns, including the production of more waste that could be improperly handled and disposed of, transportation of new chemicals to well sites and the mixing of chemicals on these sites (thus expanding spill concerns), higher water consumption,[27] and increased pressures on well casing, which could potentially lead to further methane migration concerns.[28] A range of incidents at fractured well sites so far shows that although many have been minor, some have posed risks to environmental resources.[29] Operators have spilled fracturing chemicals or flowback water that migrated into ditches along access roads.[30] Wells have blown out ("exploded")[31] during fracturing, spewing chemicals into a creek.[32] Tanks with faulty valves or holes and improperly maintained pits have in some cases leaked large quantities of produced water.[33]

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[24] For a description of the potential environmental impacts of the sheer rise in well numbers, *see* Hannah Wiseman, *Risk and Response in Fracturing Policy*, draft, on file with author.

[25] *See* Wiseman, Regulation of Shale Gas Development, *supra* note 3, at 51, n. 73 (listing gas migration incidents associated with drilling). *See also* Stephen G. Osborn, *Methane Contamination of Drinking Water Accompanying Gas-well Drilling and Hydraulic Fracturing*, 108 PROCEEDINGS NATL. ACADEMY OF SCI. 8172 (May 17, 2011), *available at* http://www.nicholas.duke.edu/cgc/pnas2011.pdf.

[26] For a more complete description of potential effects, *see* Wiseman, Regulation of Shale Gas Development, *supra* note 3.

[27] Much of the water use for fracturing appears to be "consumptive" because much of the water injected does not flow back up out of the well but remains trapped in the shale. *Cf.* Susquehanna River Basin Commission, Accommodating a New Straw in the Water: Extracting Natural Gas from the Marcellus Shale in the Susquehanna River Basin 1, n.2 (Feb. 2009), *available at* http://www.srbc.net/programs/docs/Marcellus%20Legal%20Overview%20Paper%20%28Beauduy%29.pdf.PDF (explaining that one regional commission that regulates withdrawal of water for fracturing defines consumptive use as "loss of water 'due to transpiration by vegetation, incorporation into products during their manufacture, evaporation, injection of water or wastewater into a subsurface formation from which it would not reasonably be available for future use in the basin, or any other process by which the water is not returned to the waters of the basin'" (citing 18 C.F.R. § 806.3)).

[28] For sources describing methane migration incidents and potential incidents, *see supra* note 25.

[29] *See* Hannah Wiseman, Fracturing Regulation Applied, DUKE ENVTL. LAW & POLICY FORUM __ (symposium, forthcoming 2012) (describing the violations at well sites at which operators fractured a well); Hannah Wiseman, State Enforcement of Shale Gas Regulation, draft white paper, University of Texas Energy Institute (2011) (on file with author) (also describing violations).

[30] *See, e.g.*, Permit no. 035-21179, Clinton County, Jan. 2011 (describing incidents involving the discharge of ethylene glycol to a well pad and flowback water to a drainage ditch), from Penn. Dep't. of Envtl. Protection, Oil & Gas Inspections – Violations – Enforcements, updated Nov. 17, 2011, *previously available at* http://www.dep.state.pa.us/dep/deputate/minres/oilgas/OGInspectionsViolations/OGInspviol.htm (on file with author). *See also* Wiseman, Fracturing Regulation Applied, *supra* note 30 (describing more incidents); Wiseman, Enforcement, *supra* note 30 (same).

[31] For a definition of blowouts, *see* Wiseman, Regulation of Shale Gas Development, *supra* note 3, at 49.

[32] *See* Edward McAllister, *Chesapeake Stems Flow From Blown Pennsylvania Gas Well*, REUTERS, Apr. 22, 2011, *available at* http://www.reuters.com/article/2011/04/22/us-chesapeake-blowout-idUSTRE73K5OH20110422

[33] *See, e.g.*, Permit no. 238585, Bossier Parish, Mar. 2009 (describing how produced water migrated to a swampy area) (Excel file of violations on file with author); Permit no. 30-039-25947, New Mexico, incident no. nDGF0100955815, Jan. 2001 (violation on file with author) (describing how 142 barrels of produced water

Incidents associated with oil and gas waste generally—not fracturing itself—also demonstrate the potential risks introduced by all forms of well development, including both conventional and unconventional fractured wells. An underground injection control well in Texas containing produced water from drilling, for example, leaked into a Midland aquifer, causing substantial contamination.[34] The operator had filed for bankruptcy, making it difficult for the city and the state oil and gas agency to recover remediation costs.[35] Ohio also recently shut down an injection well for oil and gas and fracturing waste disposal that appears to have been linked to localized earthquakes.[36]

Many of the environmental effects of shale gas development and other unconventional development enabled by fracturing have long been associated with oil and gas development. The handling and disposal of salty produced water, for example, is not a new problem. But fracturing increases the number of drilled wells in addition to introducing new environmental risks. This leads to the question of whether existing regulatory regimes for controlling these risks are adequate and whether we need to reconsider the state-centric system of oil and gas regulation.

Regulation of oil and gas development—residing primarily with states—varies substantially in some areas, and some states have updated their regulations more than others to account for recent drilling and fracturing booms. As explained in detail in "Regulation of Shale Gas Development,"[37] while all states require the casing of wells to protect underground water, for example, the required depth of the casing below groundwater varies,[38] and some states have narrative standards rather than requiring specific depths. Some states mandate that well operators test nearby water supplies prior to drilling and fracturing;[39] others do not, although the threat of litigation may incentivize baseline testing if

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overflowed from a tank and 70 barrels were recovered). *See also* Wiseman, Fracturing Regulation Applied, *supra* note 30 (describing more incidents); Wiseman, Enforcement, *supra* note 30 (same).

[34] *See In Re: Heritage Consolidated LLC, et al.*, Case No. 10-36484-hdh-11, U.S. Bankruptcy Court for the Northern District of Texas, Dallas Division, City of Midland's Motion for Estimation of Claims for Purposes of Allowance, Voting, and Determining Plan Feasibility, and Request for Determination that Remediation Claim is Entitled to Administrative Expense Priority (explaining that it "became clear that one (or more) of the Debtors' (injection well operator's) underground injection wells . . . leaked" and "resulted in the release of a tremendous amount of water contaminated with chloride (and other harmful elements) into the Cenozoic Pecos Alluvium Aquifer"). Note that this well likely did not contain any wastes from fracturing. As explained in the body of the text, it is important to understand both the traditional risks associated with oil and gas drilling—since fracturing enables (and requires) the drilling of new wells—and new risks introduced by the fracturing process, which is one stage of the well development process for many wells, particularly those in shales.

[35] *See id*.

[36] *See* Henry Fountain, Disposal Halted at Well after New Quake in Ohio, N.Y. Times, Jan. 1, 2011, *available at* http://www.nytimes.com/2012/01/02/science/earth/youngstown-injection-well-stays-shut-after-earthquake.html. *See also* Austin Holland, Oklahoma Geological Survey, Examination of Possibly Induced Seismicity from Hydraulic Fracturing in the Eola Field, Garvin County, Oklahoma (2011), *available at* http://www.ogs.ou.edu/pubsscanned/openfile/OF1_2011.pdf ("Cases of clear anthropogenically-triggered seismicity from fluid injection are well documented with correlations between the number of earthquakes in an area and injection, specifically injection pressures, with earthquakes occurring very close to the well.").

[37] *Available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1953547.

[38] *See, e.g.*, New York Dept. of Environmental Conservation, supra note 9, at 7.4.1.2 (proposed) (75 ft. or into bedrock, whichever deeper (100 ft. primary and principal aquifers); 25 Pa. Admin. Code § 78.83 (2011) (50 ft. or into consolidated rock, whichever is deeper); W. VA. CODE R. § 35-4–11.4 (2011) (30 ft.).

[39] *See, e.g.*, MICH. ADMIN. CODE R. § 324.1002 (West 2011); New York Dept. of Envtl. Conservation, *supra* note 9, at 1-10 (proposed); OHIO ADMIN. CODE § 1501:9-1-02(F) (West 2011).

landowners grant the operator entry. Pennsylvania applies a rebuttable presumption that well water contamination within 1,000 feet of a well and within six months after the completion of drilling was caused by the well operator;[40] other states lack similar protections, relying on the common law to sort out these types of disputes. Some states require that well sites, wells, and/or surface waste pits be set back certain distances from surface water, ground water, and other natural resources; the required distances for setbacks vary substantially.[41] Other states, such as Texas, have few setback requirements.[42]

In addition to varied regulatory substance, states' efforts to identify violations of regulations and engage in enforcement activity also appear to vary substantially (as described in "State Enforcement of Shale Gas Development Regulation").[43] Some states tend to note procedural violations such as operators' failure to obtain a drilling permit and post a sign; others seem to focus more closely on spills. States also have varied inspection and enforcement capacity, which is correlated with state well numbers to varying degrees.[44]

Many of these differences are justified by legitimate variations among states. States with predominantly dry weather conditions may not be as concerned that surface waste pits will overflow and cause waste to enter a nearby stream, for example. Those in which most fracturing occurs thousands of feet below the lowest source of fresh water—as shale fracturing often does—may be less concerned about the possibility that chemicals will migrate upward through thousands of feet of shale into water. And with respect to varying types and levels of violations and enforcements, it is possible that certain types of violations tend to occur in some states but not others due to the identity of operators and site-specific conditions.

Other, less legitimate differences, however, may also cause regulatory variation. As with any form of regulation, public choice theory might suggest that state regulators receive undue influence from organized industry actors with the most to gain or lose from regulations. Indeed, many oil and gas commissions—tasked both with conserving oil and gas when it is produced and with environmental protection[45]—may sometimes focus more on the former than on the latter.[46] Agencies also suffer from tight budgets and understaffing concerns, thus limiting their ability to update rules and enforce them even if they have the will to do so. Finally, some states simply may not be aware of others' approaches to regulations; with better communication, they might consider changes, particularly as they experience booming production.

In determining whether existing oil and gas regulation is adequate and should remain primarily at the state level, we should look to these justifications and their legitimacy as well as traditional questions that motivate federalism debates. State regulators, who have administered technical requirements such

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[40] 58 PENN. STAT. § 601.208 (2011).
[41] *See, e.g.*, 19.15.17.10 NEW MEXICO ADMIN. CODE (2011) (300 ft. between tanks/pits and streams); 58 Penn. Stat. § 601.205 (2011) (150 ft. between well or well site and stream).
[42] Texas's only statewide setback requirement appears to be for dwellings. *See* Tex. Local Govt. Code § 253.005(c) (2011). Some municipalities in Texas, however, have additional setback requirements. *See infra* note 55.
[43] *Available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1992064.
[44] *See id*.
[45] *See* Ground Water Protection Council, *supra* note 2, at 13-17 (describing agencies dual tasks).
[46] *See, e.g.*, Mike Soraghan, *Drilling Regulators Pull Double Duty as Industry Promoters*, GREENWIRE, Nov. 30, 2011, http://www.eenews.net/public/Greenwire/2011/11/30/1 (quoting Wyoming's Oil and Gas Supervisor, who stated, "We're there to regulate and promote, if you will").

as well casing and plugging regulations since the 1930s[47] (and earlier, in some cases), have the most expertise even if in some cases they lack the resources to implement this expertise. In requiring certain types and depths of casing, for example, or certain liners for waste storage pits on the surface, states also deal with uniquely local issues entwined with land use, such as soil and formation types and the presence of water. States and local governments are closer to the ground and most familiar with these issues. In experimenting with different types of regulation, states also appear to be communicating with each other—at least to some extent—and perhaps learning lessons from each other. In writing and rewriting restrictive conditions on slickwater fracturing during a moratorium, for example, New York's Department of Environmental Conservation has looked to incidents in Pennsylvania, which has rushed ahead with fracturing, and has attempted to apply lesson from these incidents.[48] The State Review of Oil and Natural Gas Environmental Regulations—a group of state regulators and industry and nonprofit representatives—also writes voluntary standards for drilling and fracturing and, if states agree, reviews state oil and gas programs to determine whether the programs comply with these standards and suggest improvements.[49] An association of state regulators called the Ground Water Protection Council similarly recommends best practices to protect groundwater during drilling and fracturing[50] (in addition to advocating against federal regulation).[51] Further, the GWPC has worked with industry to create a website on which operators voluntarily disclose the fracturing chemicals used at each of their well sites.[52]

Some municipalities, too, have been highly involved in regulating the effects of drilling and fracturing. Even in states where local regulation of oil and gas development is preempted, such as Pennsylvania,[53] municipalities may implement certain zoning regulations that limit the districts in which development may occur.[54] In Texas and New Mexico, several cities have implemented detailed requirements for higher bonding amounts,[55] the use of special pits for containment of waste on the surface,[56] mandatory casing depths,[57] and the use of tanks that meet American Petroleum Institute specifications.[58]

Although state and local regulation and associated regulatory experimentation has clear benefits, concerns about capture and transboundary environmental effects caution against wholesale reliance on this level of governance. Two regional commissions, for example—the Susquehanna and Delaware River

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[47] *See supra* note 2.
[48] New York State Department of Environmental Conservation, Fact Sheet: What We Learned from Pennsylvania, http://www.dec.ny.gov/docs/administration_pdf/pafactsheet072011.pdf.
[49] State Review of Oil & Natural Gas Environmental Regulations, http://www.strongerinc.org.
[50] Ground Water Protection Council, About Us, http://www.gwpc.org/about_us/about_us.htm.
[51] Ground Water Protection Council, *supra* note 2, at 7 (concluding that "[s]tate oil and gas regulations are adequately designed to directly protect water resources"); Ground Water Protection Council, Resolution Requesting Legislative Clarification of the Definition of "Underground Injection" in the Safe Drinking Water Act, *available at* http://www.gwpc.org/advocacy/documents/resolutions/res00-7.htm (urging that hydraulic fracturing is not "underground injection" under the Safe Drinking Water Act).
[52] *See* FracFocus.org.
[53] 58 Pa. Cons. Stat. Ann. § 601.602 (West 2011).
[54] *Cf.* Huntley & Huntley, Inc. v. Borough Council of Oakmont, 964 A.2d 855, 865–69 (Pa. 2009).
[55] *See, e.g.*, City of Fort Worth, Texas, Ordinance No. 18449-02-2009, *available at* http://fortworthtexas.gov/uploadedFiles/Gas_Wells/090120_gas_drilling_final.pdf; City of Arlington, Texas, Ordinance No. 11-068, *available at* http://fortworthtexas.gov/uploadedFiles/Gas_Wells/090120_gas_drilling_final.pdf.
[56] *Supra* note 55.
[57] Farmington, New Mexico Oil and Gas Code § 19-3-4 (2011).
[58] Farmington, New Mexico Oil and Gas Code § 19-3-11 (2011).

Basin Commissions—have operated for several decades to regulate states' shared use of these rivers and associated water quality and quantity effects. These commissions have substantially expanded their efforts as thousands of new wells have been fractured or proposed in the region.[59] The EPA also has recently questioned Pennsylvania's assurance that its wastewater treatment plants—operating under Clean Water Act permits issued by the Commonwealth of Pennsylvania under delegated authority—were adequately treating millions of gallons of flowback and produced water being discharged into rivers.[60] The EPA has since promised federal wastewater treatment standards for waste from shale gas development by 2014.[61] It also has proposed Clean Air Act regulations to control emissions of volatile organic compounds during the shale gas well flowback process.[62]

Beyond these effects with clear interstate concerns (river and air pollution, for example), Congress and the EPA may need to consider "intruding" into states' traditional regulatory territory depending on the results of a study being conducted by EPA and other analyses of the risks of drilling and fracturing. If there is indeed a high risk of contamination of underground water as a result of drilling and fracturing, then Congress likely should re-consider its 2005 exemption of fracturing from the definition of "underground injection" in the Safe Drinking Water Act—an act designed to prevent this very type of contamination. The EPA also should ensure that states are adequately administering the Safe Drinking Water Act program that applies to underground injection control wells, in which millions of gallons of oil and gas waste are disposed of. As described above, improperly constructed UIC wells can contribute both to localized earthquakes and contamination of underground water.

Understanding the ideal allocation of regulatory authority over drilling and fracturing in shale formations and other sources of unconventional oil and gas will require much more information. Thankfully, the EPA has begun studying at least one type of risk—potential water quantity and quality effects associated with shale gas[63]—but much more is needed. As we collect more information, we must ensure that

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[59] *See* Delaware River Basin Commission, Revised Draft Natural Gas Development Regulations, *available at* http://www.nj.gov/drbc/library/documents/naturalgas-REVISEDdraftregs110811.pdf; Susquehanna River Basin Commission, Natural Gas Well Development in the Susquehanna River Basin, Jan. 2010, a*vailable at* http://www.srbc.net/programs/docs/ProjectReviewMarcellusShale%28NEW%29%281_2010%29.pdf (describing the Commission's activities in controlling Marcellus Shale development).

[60] *See* Letter from Michael Krancer, Acting Secretary, Pennsylvania Dept. of Environmental Protection, to Mr. Shan M. Garvin, Regional Administrator, U.S. EPA Region III, Apr. 6, 2011, *available at* http://www.epa.gov/region03/marcellus_shale/Shawn_Garvin_Letter-April_6_2011.pdf; Letter from Shawn M. Garvin, Regional Administrator, to Michael Krancer, Acting Secretary, Mar. 7, 2011, *available at* http://www.epa.gov/region3/marcellus_shale/PADEP_Marcellus_Shale_030711.pdf; Letter from Shawn M. Garvin, Regional Administrator, to Michael Krancer, Acting Secretary, May 12, 2011, *available at* http://www.epa.gov/region03/marcellus_shale/pdf/letter/krancer-letter5-12-11.pdf ("We encourage you to move quickly to adopt water quality standards for the protection of drinking water and aquatic life uses, and to ensure that water quality criteria are applied throughout designated waterbodies, including at the point of wastewater discharge.").

[61] Envtl. Protection Agency, EPA Announces Schedule to Develop Natural Gas Wastewater Standards, Oct. 20, 2011, http://yosemite.epa.gov/opa/admpress.nsf/d0cf6618525a9efb85257359003fb69d/91e7fadb4b114c4a8525792f00542001!OpenDocument.

[62] 76 F.R. 62738, Aug. 23, 2011, *available at* http://www.gpo.gov/fdsys/pkg/FR-2011-08-23/pdf/2011-19899.pdf.

[63] Envtl. Protection Agency, Plan to Study the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources , Nov. 2011, *available at* http://water.epa.gov/type/groundwater/uic/class2/hydraulicfracturing/upload/hf_study_plan_110211_final_508.pdf.

existing regulations[64] are sufficiently precautionary to protect against the many potential risks not yet adequately studied. Some states have updated their regulations in recognition of enhanced drilling and fracturing activity, while others have not. Some have issued interim guidance,[65] while others have implemented formal rule modifications.[66] The situation does not amount to chaos; indeed, the existing layered regulatory approach assures basic protections. But the regulatory landscape may be slightly closer to chaos than to controlled, calculated regulatory adaptation or experimentation. Better communication among states (and municipalities, federal officials, and industry representatives), more comprehensive review of risks and existing regulation and standards, and continued attention to actual effects observed at well sites will be necessary to form an effective regulatory regime for unconventional oil and gas development.

[64] Any thorough review of existing controls also must take into account industry standards and practices.

[65] *See, e.g.*, State of Michigan, Dep't of Envtl. Quality, Supervisor of Wells Instruction 1-2011, http://www.michigan.gov/documents/deq/SI_1-2011_353936_7.pdf (issuing guidance); West Virginia Dept. of Envtl. Protection, http://www.dep.wv.gov/oil-and-gas/Pages/default.aspx (issuing guidance and proposing new regulations).

[66] *See, e.g.*, Arkansas Oil and Gas Conservation Commission Rule B-19, http://www.shalegas.energy.gov/resources/060211_arkansas_rule.pdf; Montana Dept. of Natural Resources and Conservation, http://bogc.dnrc.mt.gov/PDF/FinalFracRules.pdf.