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Water Use and Recycling in Hydraulic Fracturing: Creating a Regulatory Pilot for Smarter Water Use in the West

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ABSTRACT

Hydraulic fracturing faces significant criticism for its water use but that attention is relatively undeserved when compared with the far greater consumption of other sectors. Even so, such criticism, combined with heightened water scarcity, ongoing industry action to reuse produced water, and environmental concerns regarding produced water disposal, creates an opportunity to pilot a regulatory system that incentivizes water conservation. The regulatory system should address a broad range of stakeholder concerns by incentivizing continuous technology development, establishing rules that are predictable and easy to enforce, and increasing water recycling in water scarce regions. This article considers multiple regulatory tools to create such a program and presents a proposal that leverages the relative strengths of these tools.

I. INTRODUCTION

Hydraulic fracturing[1] uses a lot of water, but the practice uses far less water than other sectors. From 2011 to 2013, hydraulic fracturing operations used approximately 97 billion gallons of water,[2] but this water amounts to less than one percent of water used in every state where it is practiced.[3] In Texas, which used half of all water used for hydraulic fracturing in the United States in 2012,[4] oil and gas water use is

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1. Hydraulic fracturing is also referred to as "fracing" and "fracking." The term "fracking" seems to have developed as the more common term, but both options retain political connotations. *See* Alex Ritchie, *On Local Fracking Bans: Policy and Preemption in New Mexico*, 55 NAT. RESOURCES J. 255, 262 n.41 (2014). In this article, I will use "hydraulic fracturing" because it describes the prominent role of water in the process.

2. MONIKA FREYMAN, CERES, HYDRAULIC FRACTURING & WATER STRESS: WATER DEMAND BY THE NUMBERS 5 (2014), *available at* http://www.ceres.org/resources/reports/hydraulic-fracturing-water-stress-water-demand-by-the-numbers.

3. Thomas W. Merrill & David M. Schizer, *The Shale Oil and Gas Revolution, Hydraulic Fracturing, and Water Contamination: A Regulatory Strategy*, 98 MINN. L. REV. 145, 177 (2013).

4. FREYMAN, *supra* note 2, at 49.

minimal compared to irrigation (56 percent) and municipal use (26 percent).[5] In terms of proportional water use, hydraulic fracturing is not causing the water scarcity increasingly experienced in the West.

Even so, hydraulic fracturing exacerbates water scarcity. Since 2011, almost half of all hydraulically fractured wells were in regions with high or extremely high water stress.[6] In 2011, over half of all hydraulically fractured wells were operating in drought-stricken regions.[7] A hydraulically fractured well uses up to four million gallons of water,[8] and most of the water permanently leaves the water cycle after its first use.[9] In water scarce regions, the dramatic increase in water consumption from hydraulic fracturing creates a zero sum game where each new use raises the price of water.[10] Those higher prices impact other users, especially farmers.[11] Oil and gas is not the thirstiest industry by far, but its rapid increase in consumption is a new use in water scarce regions and that increase draws attention and heated debate.[12]

The debate involving hydraulic fracturing in general, and its water use specifically, could also present an opportunity for water conservation. Hydraulic fracturing does not enjoy unwavering popularity due to continuing concerns about the impact hydraulic fracturing may have on water quality,[13] earthquakes,[14] surface owner uses,[15] and de-

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5. Jean-Philippe Nicot & Bridget R. Scanlon, *Water Use for Shale-Gas Production in Texas, U.S.*, 46 ENVTL. SCI. & TECH. 3580, 3584 (2012).

6. FREYMAN, *supra* note 2, at 6.

7. *Id.*

8. U.S. ENVTL. PROT. AGENCY, STUDY OF THE POTENTIAL IMPACTS OF HYDRAULIC FRACTURING ON DRINKING WATER RESOURCES: PROGRESS REPORT 80 (2012), *available at* http://www.epa.gov/hfstudy/pdfs/hf-report20121214.pdf.

9. *See* JOEL R. BURCAT & ANDREW T. BOCKIS, SHALE DRILLING AND HYDRAULIC FRACTURING: AN INTRODUCTION TO STATE AND FEDERAL REGULATORY ISSUES 3 (2012) (stating that wastewater from most shale plays is injected underground); FREYMAN, *supra* note 2, at 41.

10. *See* Garance Burke, *Fracking Fuels Water Fights in Nation's Dry Spots,* DENVER POST (June 16, 2013), http://www.denverpost.com/business/ci_23472294/fracking-fuels-water-fights-nations-dry-spots (reporting that oil and gas companies have paid $1,200 to $2,900 an acre foot for water typically costing $100 an acre foot in Colorado).

11. *See* Jack Healy, *For Farms in the West, Oil Wells are Thirsty Rivals,* N.Y. TIMES (Sept. 5, 2012), http://www.nytimes.com/2012/09/06/us/struggle-for-water-in-colorado-with-rise-in-fracking.html?pagewanted=all (quoting a corn and alfalfa farmer as saying, "I don't think in reality that the farmer can compete with the oil and gas companies for that water. Their return is a hell of a lot better than ours"). *But see* Burke, *supra* note 10 (quoting a farmer who sold water to a hydraulic fracturing operator to make money when he had insufficient water to plant that season).

12. *See* Burke, *supra* note 10 (quoting a Texas Groundwater Conservation District Manager) ("When you have a big problem like the drought and you add other smaller problems to it like all the fracking, then it only makes things worse.").

13. Congress directed the Environmental Protection Agency to study the potential impacts of hydraulic fracturing on drinking water, which should be available in 2014. *See*

creased demand for renewable energy.[16] As a new user, hydraulic fracturing garners attention for its water use, even though it uses far less water than older, more accepted water uses, such as agriculture.[17] At the same time, oil and gas producers are already investing in technologies to reduce freshwater consumption.[18] Whereas governments often face political pushback to encourage water efficiency,[19] a regulatory program that decreases water consumption in hydraulic fracturing could both encourage existing industry efforts and receive support from those critical of the practice.

A program to incentivize water recycling, could address another challenge for the oil and gas industry: water contamination. Oil and gas producers add chemicals to the water they use in hydraulic fracturing to increase the fractures used for oil and gas production.[20] Most of this "flowback" water returns to the surface and brings with it more water from deep underground.[21] This "produced" water contains excessive amounts of dissolved solids, including salts and naturally-occurring radioactive materials.[22] Together, the injected flowback water and the produced water from deep underground create wastewater that can contaminate limited freshwater supplies if not appropriately handled.[23] Although industry disposes of this contaminated wastewater from hydraulic fracturing, current disposal methods create environmental risks.

EPA's Study of Hydraulic Fracturing and Its Potential Impact on Drinking Water Resources, ENVTL. PROT. AGENCY, http://www2.epa.gov/hfstudy (last visited Mar. 6, 2015).

14. Thomas E. Kurth, Michael J. Mazzone, Mary S. Mendoza & Christopher S. Kulander, *American Law and Jurisprudence on Fracing*, 58 ROCKY MTN. MIN. L. INST. 4-1, 4-27 (2012).

15. *Id.* at 4-41 to 4-46.

16. Thomas W. Merrill, *Four Questions About Fracking*, 63 CASE W. RES. L. REV. 971, 981 (2013).

17. In 2010, agriculture used over 78 percent of all water withdrawn in New Mexico. JOHN W. LONGWORTH ET AL., NEW MEXICO STATE ENGINEER OFFICE, NEW MEXICO WATER USE BY CATEGORIES 2010, at i (2013), *available at* http://www.ose.state.nm.us/Pub/TechnicalReports/TechReport%2054NM%20Water%20Use%20by%20Categories%20.pdf.

18. FREYMAN, *supra* note 2, at 12.

19. Kate Galbraith, *Texas Farmers Battle Ogallala Pumping Limits*, TEX. TRIB. (Mar. 18, 2012), https://www.texastribune.org/2012/03/18/texas-farmers-regulators-battle-over-ogallala/ ("Hardberger, of the Environmental Defense Fund, said that farmers could do more to conserve. Farmers, meanwhile, say cities could do more. Lubbock, for example, draws entirely from the Ogallala right now, and seeing swimming pools full when farmers are facing restrictions 'makes it hard to swallow,' Fondren said.").

20. *See infra* notes 35–40 and accompanying text.

21. MARCUS OLIVER GAY ET AL., WATER MANAGEMENT IN SHALE GAS PLAYS 4 (2012), *available at* http://connect.ihs.com/StaticDocuments/LandingPage/WaterManagement.pdf.

22. *Id.* at 5.

23. Merrill & Schizer, *supra* note 3, at 195–96.

The most frequent environmental citations in New Mexico are for produced water spills.[24] In Pennsylvania, industry disposes wastewater from hydraulic fracturing into municipal wastewater treatment plants, which has caused documented cases of ground water contamination.[25] Generally, storage in pits can result in seepage, which could contaminate groundwater.[26] In addition to contamination, underground injection also imposes risks of seismic activity.[27] By injecting water deep underground, states lose the ability to use it in the future.[28] States, consequently, have significant reasons to encourage industry to recycle its wastewater.

Western states could increase their total available water by helping develop technology to clean all wastewater from hydraulic fracturing. If produced water, which is new to the hydrologic cycle,[29] could be cleaned to a usable level, this previously untapped resource would increase the total water budget. New water could be available for other uses. Western states, moreover, have vast untapped resources of aquifers

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24. Hannah Wiseman, *Fracturing Regulation Applied*, 22 DUKE ENVTL. L. & POL'Y F. 361, 374 (2012). For additional information on produced water spills in New Mexico in 2014, *see New Mexico Toxic Release Tracker*, CENTER FOR WESTERN PRIORITIES, http://westernpriorities.org/new-mexico-toxic-release-tracker/ (last visited Jan. 18, 2015) (reporting the largest produced water spill in New Mexico in 2014 at 3,050 barrels of contaminated water and determining that the companies that spill the most often are BOPCO, COG Production, COG Operating, and Yates Petroleum). The New Mexico Oil and Gas Conservation District issues citations, but lacks authority to require fines. Mike Soraghan, *In N.M., 3,600 Violations, 1 Court Case, 0 Fines,* EnergyWire, Nov. 14, 2013, *available at* http://www.eenews.net/stories/1059990413.

25. Sheila M. Olmstead et al., *Shale Gas Development Impacts on Surface Water Quality in Pennsylvania*, 110 Proc. Nat'l Acad. Sci. 4962, 4966 (2013), *available at* http://www.pnas.org/content/110/13/4962.full.pdf̃ml ("In 2008, monitors detected record TDS levels (mainly [chloride] and sulfates) in sections of the Monongahela River during low late summer-early fall flows, and 13 public drinking water system intakes in Pennsylvania and West Virginia exceeded secondary maximum contaminant levels under the Safe Drinking Water Act, persisting through December 2008 . . . ." "Results for [chloride] suggest that the presence of shale gas wells upstream in a monitor's watershed does not raise observed concentrations but that the treatment and release of wastewater from shale gas wells by permitted facilities upstream in a monitor's watershed does."); *see generally* Kimberly M. Parker et al., *Enhanced Formation of Disinfection Byproducts in Shale Gas Wastewater-Impacted Drinking Water Supplies*, 48 ENVIRON. SCI. TECHNOL. 11161–69 (2014).

26. Hannah Wiseman, *Fracturing Regulation Applied*, 22 DUKE ENVTL. L. & POL'Y F. 361, 384 (2012) (noting that New Mexico had more than 200 active cases of groundwater contamination from improper pit maintenance in 2008).

27. Merrill & Schizer, *supra* note 3, at 179 ("Seismic activity related to disposal of fracturing waste in injection wells has led to regulatory responses in Ohio and Arkansas.").

28. Gay et al., *supra* note 21, at 6.

29. *See* Katie L. Benko & Jörg E. Drewes, *Produced Water in the Western United States: Geographical Distribution, Occurrence, and Composition*, 25 ENVTL. ENGINEERING SCI. 239, 239 (2008) ("Coproduced water is defined as water that is extracted from subsurface geologic formations containing oil and gas.").

with brackish water.[30] Governments and industry continue to invest in more efficient desalination technology to clean brackish water.[31] Western states stand to benefit from facilitating existing industry interest in desalination technology development.

The oil and gas industry is not employing technology to recycle its wastewater in the west because it currently does not make economic sense. On average, producers spend about 10 percent of well costs on water management needs.[32] Industry investment in recycling technology impacts on the ground practices only if producers can achieve a practical rate of return.[33] In many western shale plays, groundwater is particularly salty and injection and other disposal methods are prevalent; consequently, producers do not voluntarily recycle on a large scale where it is most needed—in the arid West.[34] Additionally, technological develop-

30. Sanjeev Kalaswad, Brent Christian & Rima Petrossian, TEX. WATER BD., BRACKISH GROUNDWATER IN TEXAS 1 (2004), *available at* http://www.twdb.state.tx.us/publications/reports/numbered_reports/doc/r363/b2.pdf ("A 2003 study . . . suggests that there is approximately 2.7 billion acre-feet of brackish groundwater in the aquifers of [Texas]."). Both produced water and brackish water contain high levels of salt; whereas produced water can contain 800–300,000 milligrams per liter (mg/L) of total dissolved solids ("TDS"), brackish water is defined as water that contains 1,000–10,000 mg/L. *See* Sheila M. Olmstead et al., *Shale Gas Development Impacts on Surface Water Quality in Pennsylvania*, 110 Proc. Nat'l Acad. Sci. 4962, 4963 (2013) (providing the TDS level for produced water); *id.* at 2 (providing the TDS level for brackish water); PA. STATE UNIV. COLL. OF AGRIC. SCI., SHAPING PROPOSED CHANGES TO PENNSYLVANIA'S TOTAL DISSOLVED SOLIDS STANDARD: A GUIDE TO THE PROPOSAL AND THE COMMENTING PROCESS 3 (2010).

31. *See generally* SANDIA NAT'L LAB. & BUREAU OF RECLAMATION, IMPLEMENTATION OF THE NATIONAL DESALINATION AND WATER PURIFICATION TECHNOLOGY ROADMAP (2003), *available at* http://www.sandia.gov/~pvbrady/DesalImplementRoadmap.pdf.

32. Gay et al., *supra* note 21, at 3.

33. *See* Matthew E. Mantell, Chesapeake Energy Corp., Produced Water Reuse and Recycling Challenges and Opportunities Across Major Shale Plays, Presentation at Envtl. Prot. Agency Hydraulic Fracturing Study Technical Workshop #4 Water Resources Management, 44 (Mar. 29–30, 2011), slides *available at* http://www2.epa.gov/sites/production/files/documents/09_Mantell_-_Reuse_508.pdf ("For example, in areas with extensive salt water disposal well infrastructure like the Barnett Shale, salt water disposal wells are in close proximity to operations, and are a low cost, low energy, safe, and effective alternative to advanced reuse.").

34. Jim Fuquay, *Water Recycling is Big Business for Oil, Gas Support Firms*, STAR TEL. (Apr. 27, 2013), http://txwra.org/images/Water_Recycling_is_Big_Business_FWST_042713.pdf (discussing how producers in the Barnett Shale initially had little incentive to recycle water, because they could "acquire plenty of water at relatively low prices, and disposal wells provided a ready means of getting rid" of the water, and noting that producers still only recycle about 5 percent of water used for hydraulic fracturing in the Barnett Shale).

ment requires a large upfront investment.[35] Since industry has already responded by recycling wastewater in regions where disposal options are scarce,[36] western states should create scarcity by capping freshwater use to a percentage of their operations, limiting disposal options through injection taxes, and mandating water use and recycling reporting. States should also expand recycling in more challenging environments by investing in technology development opportunities for desalination.

This article urges states to adopt a regulatory program that best incentivizes recycling of wastewater from hydraulic fracturing. Part II describes relevant aspects of hydraulic fracturing. Part III discusses existing regulations relevant to recycling wastewater from hydraulic fracturing. Part IV provides an overview of opportunities and challenges for developing a regulatory system to better incentivize recycling. Part V analyzes commonly employed tools—liability, command and control, marketable permits, and taxation—available for environmental regulations. Part VI then proposes a comprehensive regulatory program to incentivize recycling of wastewater from hydraulic fracturing. The proposal leverages elements of existing regulatory tools to allow oil and gas producers to recycle produced wastewater efficiently, encourage continuous innovation, invest in basic research for new technologies, and provide information for public assurance and state enforcement.

II. BRIEF INTRODUCTION TO HYDRAULIC FRACTURING

Although oil and gas producers have practiced aspects of horizontal hydraulic fracturing for decades, hydraulic fracturing recently exploded in commercial use.[37] Since 1949, the oil industry has commercially pressurized wells to cause small fractures in the geologic formation to increase production.[38] Although oil and gas producers drilled the first horizontal well in 1929, producers were unable to commercialize the process until the early 1980s.[39] In the 1940s, industry began to combine these practices with fluid additives to create more, smaller fractures that successfully release oil and gas in shale forma-

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35. David Wethe & Peter Ward, *Fracking Bonanza Eludes Wastewater Recycling Investors*, BLOOMBERG (Nov. 25, 2013), http://www.bloomberg.com/news/2013-11-26/fracking-bonanza-eludes-wastewater-recycling-investors.html.

36. *See infra* notes 82–95 and accompanying text.

37. ZHONGMIN WANG & ALAN KRUPNICK, RES. FOR THE FUTURE, A RETROSPECTIVE REVIEW OF SHALE GAS DEVELOPMENT IN THE UNITED STATES: WHAT LED TO THE BOOM? 1 (2013), *available at* http://www.rff.org/RFF/documents/RFF-DP-13-12.pdf.

38. Hannah J. 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, 122 (2009).

39. U.S. ENERGY INFO. ADMIN., DRILLING SIDEWAYS — A REVIEW OF HORIZONTAL WELL TECHNOLOGY AND ITS DOMESTIC APPLICATION 7 (1993).

tions;[40] however, researchers continue to refine these formulas.[41] Between 2005 and 2010, a perfect storm, including high natural gas prices, government policies, and private entrepreneurship, culminated in technological innovation that caused the shale gas boom.[42] From January 2011 through May 2013, approximately 39,294 wells were hydraulically fractured in the United States.[43]

Wastewater from hydraulic fracturing includes two separate types of water. To hydraulically fracture formations, oil and gas producers mix water with sand and additives to create a solution that is approximately 99.5 percent water.[44] The composition of the remaining ingredients varies from operator to operator.[45] Although the exact formulas are typically confidential for proprietary reasons, formulas generally include ingredients such as salt, acid, distillates, ethylene glycol, isopropanol, sodium, and potassium carbonate.[46] During production, 20–80 percent of that water returns to the surface as flowback water.[47] Additionally, water from deep underground accompanies the oil or gas that rises to the surface after fracturing.[48] This "produced water" naturally contains trace amounts of mercury, lead, arsenic, radioactive material such as radium, thorium, uranium, gases, and organic material. The organic material in the produced water includes volatile organic compounds.[49] The produced water's high concentration of salt, or total dissolved solids (TDS), presents perhaps the most challenges for reuse. TDS in produced water may range from 800 to 300,000 milligrams per liter (mg/L), exceeding ocean water concentrations of 35,000 mg/L.[50] Some of the greatest envi-

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40. U.S. ENVTL. PROT. AGENCY, EVALUATION OF IMPACTS TO UNDERGROUND SOURCES OF DRINKING WATER BY HYDRAULIC FRACTURING OF COALBED METHANE RESERVOIRS 4-1 (2004), *available at* nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P100A99N.TXT.

41. *Id.*

42. WANG & KRUPNICK, *supra* note 37, at 3–4.

43. FREYMAN, *supra* note 2, at 5.

44. Thomas E. Kurth et al., *American Law and Jurisprudence on Fracing*, 58 ROCKY MT. MIN. L. INST. 4-1, at 7 (2012).

45. *See id.* ("[C]ontractors are protective of the exact recipe of their fracing fluids, considering the ingredients and the ratio with which the ingredients are mixed with the water to make the fracing fluid to be trade secrets.").

46. *Id.*

47. Gay et al., *supra* note 21, at 4.

48. Merrill & Schizer, *supra* note 3, at 185 (explaining that produced water is "water that had accumulated naturally in the shale formation" that was pushed to the surface from oil and gas operations).

49. U.S. ENVTL. PROT. AGENCY, STUDY OF THE POTENTIAL IMPACTS OF HYDRAULIC FRACTURING ON DRINKING WATER RESOURCES: PROGRESS REPORT 18 n.11 (2012), *available at* http://www.epa.gov/hfstudy/pdfs/hf-report20121214.pdf.

50. PA. STATE UNIV. COLL. OF AGRIC. SCI., SHAPING PROPOSED CHANGES TO PENNSYLVANIA'S TOTAL DISSOLVED SOLIDS STANDARD: A GUIDE TO THE PROPOSAL AND THE COM-

ronmental issues surrounding the dramatic increase in hydraulic fracturing relate to the acquisition of fresh water and disposal of flowback and produced waters.

III. EXISTING REGULATIONS THAT MAY INCREASE RECYCLING WASTEWATER FROM HYDRAULIC FRACTURING

Currently, governments have little regulation to incentivize recycling wastewater from hydraulic fracturing, and the most relevant regulations focus on removing regulatory barriers to recycling, monitoring the quality of other means of disposal, and reporting the amount and use of water. In 2013, Texas amended its rule to eliminate permit requirements for recycling water on-site and transferring water to another operator's lease for recycling.[51] Many other states, however, fail to even address water recycling in their oil and gas regulations.[52]

Recent changes in New Mexico demonstrate potential opportunities to reduce regulation and encourage wastewater recycling. In 2013, New Mexico published a notice clarifying that "[n]o [Oil Conservation Division] permit or authorization is required for the re-use of produced water. . . ."[53] More recently, on March 31, 2015, the New Mexico Oil Conservation Commission promulgated a rule to encourage oil and gas producers to recycle wastewater by reducing wastewater storage requirements in recycling facilities.[54] The oil and gas industry was instrumental in drafting this rule.[55] The Secretary of Energy and Minerals invited representatives from the industry to form a committee to provide expertise on the technical requirements to facilitate recycling and retain

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MENTING PROCESS 3 (2010), *available at* http://extension.psu.edu/water/conservation/consumption-and-usage/TDS-highres-updateDec09.pdf/view; *see also* 40 C.F.R. § 144.3 (1983) (setting the federal standard for drinking water at 1,000 parts per million).

51. R.R. COMM'N OF TEX., PRESS RELEASE: RAILROAD COMMISSION TODAY ADOPTS NEW RECYCLING RULES TO HELP ENHANCE WATER CONSERVATION BY OIL & GAS OPERATORS (Mar. 26, 2013), *available at* http://www.rrc.state.tx.us/pressreleases/2013/032613.php.

52. NATHAN RICHARDSON ET AL., RES. FOR THE FUTURE, THE STATE OF STATE SHALE GAS REGULATION 52 (2013), *available at* http://www.rff.org/rff/documents/RFF-Rpt-Stateof-StateRegs_Report.pdf.

53. OIL CONSERVATION DIV., NO OCD PERMIT REQUIRED FOR RE-USE OF PRODUCED WATER (Sept. 9 2013), *available at* http://www.emnrd.state.nm.us/OCD/documents/Noticeproducedwaterre-use.pdf.

54. *See* N.M. CODE R. § 19.15.34.6 (LexisNexis 2015) ("OBEJCTIVE: To encourage the recycling, reuse or disposition of produced water by use in a manner that will afford reasonable protection against contamination of fresh water and establish procedures by which persons may transport and dispose of produced water, drilling fluids and other liquid oil field waste."); *compare id.* § 19.15.34.11 with *id.* §§ 19.15.17.11(F) and 19.17.11(G)(10).

55. Telephone Interview with William Carr, Senior Counsel, Concho Resources (Apr. 15, 2015).

safe operations.[56] The rule allows oil and gas producers to store produced water in lined, mesh enclosed pits as long as the pits follow certain specifications and the producers register these "recycling containments" with the New Mexico Oil Conservation Division district office.[57] These recycling containments relax some requirements for other wastewater pits in New Mexico[58] in order to facilitate recycling.[59] All recycling facilities, including containments, however, must report all water received for recycling, account for fresh water used at the recycling facility, and report the total water volume eventually recycled.[60] The facility operator must also record sources and use of all recycled water.[61] Although this rule is a significant step towards reducing regulation to facilitate wastewater recycling, it remains to be seen whether the environmental protections will be strong enough[62] and whether the reduced requirements will significantly increase recycling.[63]

Even where states do not regulate recycling, federal law mandates that all states monitor disposal of wastewater from hydraulic fracturing

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56. *Id.*; e-mail from William Carr, Senior Counsel, Concho Resources, to Xochitl Torres Small, student, Univ. of N.M. Sch. of Law (Apr. 21, 2015, 17:01 MST) (on file with author) [hereinafter Carr e-mail].

57. N.M. CODE R. §§ 19.15.34.9(B), 19.15.34.11, 19.15.34.12 (LexisNexis 2015).

58. Although section 19.15.34.11 establishes no volume limit for the construction or design of recycling containments, sections 19.15.17.11(F) and 19.17.11(G)(10) restrict volume of temporary and permanent pits to 10 acre-feet.

59. Carr e-mail, *supra* note 56.

60. *Id.* § 19.15.34.9(E).

61. *Id.* § 19.15.34.9(F).

62. *Id.* § 19.15.34.11. This section establishes stringent siting requirements, which include a further setback requirement from a continuously flowing water source than pits governed by section 19.15.17.10(A)(1)(B). In addition, section 19.15.34.13 provides significant operational requirements and section 19.15.34.21 provides the New Mexico Oil Conservation Division with enforcement powers to cease operations. However, enforcement against the oil and gas industry is notoriously weak in New Mexico. *See* Mike Soraghan, *In N.M., 3,600 violations, 1 court case, 0 fines*, ENERGYWIRE (Nov. 14, 2013), http://www.eenews.net/stories/1059990413.

63. *See New rule clears way for NM oil producers to reuse water*, ALBUQUERQUE J. (Mar. 19, 2015), http://www.abqjournal.com/557662/biz/biz-most-recent/new-rule-clears-way-for-nm-oil-producers-to-reuse-water.html. Even if the rule successfully increases wastewater recycling on private and state lands, these provisions may not be acceptable on federal lands. The Bureau of Land Management recently released a rule for Hydraulic Fracturing on Federal and Indian Lands, which requires further setbacks from intermittent streams. *Compare* § 19.15.34.11(A)(2) *with* Hydraulic Fracturing on Federal and Indian Lands, 80 Fed. Reg. 16128. 16220 (Mar. 26, 2015) (to be codified at 43 C.F.R. pt. 3160). Although the federal regulation allows for state variances, the rule specifically restricts pit containment, *id.*, and only allows variances where the operator will still "satisfy the objectives of the regulation," *id.* at 16221. Still, the Bureau of Land Management may allow pits for recycling as a part of disposal pursuant to Onshore Order 7. *See id.* at 36162.

to protect water resources from contamination via underground migration. The federal government requires states to regulate underground injection of wastewater from hydraulic fracturing pursuant to the Safe Water Drinking Act, which includes the EPA regulated Underground Injection Control ("UIC").[64] For example, the New Mexico Oil Conservation Division monitors the safety of underground injection wells.[65] Operators must submit monitoring reports to the state to prevent leakage and conduct Mechanical Integrity Tests prior to initial injection and every five years thereafter.[66] Finally, New Mexico uses the newly developed Risk Based Data Management System, which was developed by the Ground Water Protection Council to record and track relevant safety data in underground wells.[67] At a minimum, states uphold a federal mandate to monitor waste injected underground to prevent risks to drinking water.

Some states are starting to regulate underground wastewater injection wells beyond federally required permitting and monitoring. Colorado, for example, requires commercial injection well operators to provide $50,000 for each facility.[68] Ohio charges injectors five cents per barrel for substances injected from within the regulatory district or an adjoining district and twenty cents per barrel for injected fluid from elsewhere.[69] Recently, two states and one city halted injection in specific areas due to seismic activity.[70] States are slowly, but increasingly, becoming more involved in regulating underground injection wells.

Although some states require general information reporting, few states require oil and gas producers to report fresh water use. The recently promulgated New Mexico rule requires producers to report freshwater use in recycling operations, but it does not require reporting of other freshwater use in hydraulic fracturing operations.[71] Pennsylvania requires extensive water use reporting, including the volume of water used by each source, but Texas largely exempts the oil and gas industry from any groundwater reporting requirements. Kentucky does not require reporting for ground or surface water.[72] While it is cost effective to

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64. The Safe Water Drinking Act, 42 U.S.C. § 300h (2006); 40 C.F.R. § 144.1 (1988).

65. *See generally* OIL CONSERVATION DIVISION, NEW MEXICO'S UNDERGROUND INJECTION CONTROL (UIC) PROGRAM: CLASS II WELL FACTS (n.d.), *available at* http://www.emnrd.state.nm.us/OCD/documents/UICINJECTIONWELLBROCHURE.pdf.

66. *Id.* at 5.

67. *Id.*

68. 2 COLO. CODE REGS. § 404-1:702 (LexisNexis 2008).

69. OHIO REV. CODE § 1509.22(B) (West 2010) (limiting total payment to $50,000 a year per injection site).

70. RICHARDSON ET AL., *supra* note 52, at 53 (citing restrictions in regions of Arkansas, Ohio, and Ft. Worth, Texas).

71. *See* N.M. CODE R. § 19.15.34.9(E), (F) (LexisNexis 2015).

72. FREYMAN, *supra* note 2, at 34–35, 56.

invest in recycling technology in certain regions, industry may not always have an incentive to report its percentage of freshwater use in every region. Businesses have a disincentive to report their water use when they are behind the technology curve or the businesses operate in regions where recycling is especially challenging.[73] Reporting is important, however, because it allows states to better track use, plan for disposal needs, and evaluate effectiveness of other measures.[74]

Although some states have regulations that allow and monitor recycling, existing measures are insufficient to encourage rapid large scale recycling. The challenge is even greater in the arid West, where water is scare but disposal by injection is relatively available.

IV. ENHANCING REGULATION TO RECYCLE MORE WASTEWATER FROM HYDRAULIC FRACTURING

Governments may more easily regulate efforts to recycle wastewater from hydraulic fracturing compared to other activities, such as curbing emissions or water pollution. Alternatives to recycling already require permitting as mandated by the Safe Drinking Water Act and corresponding state legislation,[75] permits for land application,[76] and quality requirements for disposal into public and private wastewater treatment plants.[77] A few states already carefully monitor water use.[78] Moreover, it is easier to measure a basic quantity of water disposed or recycled compared to quantifying pollution,[79] discharge quality,[80] or even monitoring technology requirements.[81] Consequently, any regulatory system should

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73. *See id.*, at 46 ("Investors similarly lament that they don't have full information to assess water risks.").

74. *Id.* ("Many water managers readily concede they cannot assess the impacts of new hydraulic fracturing water demands because the data is missing.").

75. The Safe Water Drinking Act 42 U.S.C. § 300h (2006); 40 C.F.R. § 144.1 (1988).

76. RICHARDSON ET AL., *supra* note 52, at 55 (Resources for the Future, June 2013) ("In 11 states, regulations explicitly allow wastewater to be used for "land treatments" such as ice and dust control or road stabilization, though some of these states require advance approval and/or apply restrictive conditions to the practice.").

77. *See* 25 PA. CODE § 78.55 (2013); N.M. CODE R. § 19.15.34 (2008); 2 COLO. CODE REGS. § 404-1:907(c) (LexisNexis 2011).

78. 25 PA. CODE § 78.122(b)(6) (2011). *But see* FREYMAN, *supra* note 2, at 34 ("Several states do not require permits at all, but only disclosure of water use over a certain threshold . . . .").

79. *See* National Primary and Secondary Ambient Air Quality Standards, 40 C.F.R. §§ 50.1–50.18 (2007).

80. *See* Criteria and Standards for the National Pollutant Discharge Elimination System, 40 C.F.R. §§ 125.1–125.139 (2006).

81. Requirements for Control Technology Determinations for Major Sources in Accordance with Clean Air Act Sections, 40 C.F.R. §§ 63.40–63.44 (1994); 40 C.F.R. § 125.3 (2000).

by its nature be simpler to implement than others that regulate more complex environmental issues.

Even so, regulating recycled water comes with its own challenges. State regulators who enforce disposal have limited enforcement capacity.[82] In many states, an oil and gas conservation agency has the power to regulate disposal, and some such agencies have less enforcement infrastructure than corresponding environmental agencies.[83] Additionally, producers will need new technology to recycle water in especially salty formations.[84] As a result, any regulatory system must be carefully designed to sufficiently support technology development and enforcement capabilities.

The status quo of recycling depends on the location of fracking operations. Geologic and economic factors determine the availability of disposal options, and scarcity of such options determines the level of industry interest in recycling wastewater from hydraulic fracturing. In Pennsylvania, industry increasingly recycles wastewater from hydraulic fracturing because there are no underground formations in which to inject it and the only other option is to truck the polluted water for underground injection in Ohio.[85] As a result, producers recycle 80 percent of Pennsylvania's wastewater from hydraulic fracturing.[86] Producers are much slower to invest in recycling where underground injection is readily available, as in Colorado and Texas.[87] Geologic factors that impact cost, such as water quality and availability of disposal methods, have a greater impact on decisions to recycle wastewater from hydraulic fracturing than water scarcity.

Industry cannot recycle wastewater from hydraulic fracturing in some regions where water is the scarcest until it develops technology to sufficiently clean the water for reuse. One of the greatest factors in recycling wastewater from hydraulic fracturing is the initial quality of pro-

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82. Will Reisinger et al., *Environmental Enforcement and the Limits of Cooperative Federalism: Will Courts Allow Citizen Suits to Pick Up the Slack?*, 20 DUKE ENVTL. L. & POL'Y F. 1, 16–23 (2010).

83. *See* Mike Soraghan, *In N.M., 3,600 violations, 1 court case, 0 fines*, ENERGYWIRE (Nov. 14, 2013), http://www.eenews.net/stories/1059990413.

84. NAT'L ENERGY TECH. LAB., STATE OIL AND NATURAL GAS REGULATIONS DESIGNED TO PROTECT WATER RESOURCES 30 (2009).

85. Sheila M. Olmstead et al., *Shale Gas Development Impacts on Surface Water Quality in Pennsylvania*, 110 Proc. Nat'l Acad. Sci. 4962, 4966 (2013), *available at* http://www.pnas.org/content/110/13/4962.full.pdf+html.

86. Merrill & Schizer, *supra* note 3, at 179 n.165.

87. FREYMAN, *supra* note 2, at 73 ("[In Colorado, a]s in Texas, water recycling rates remain low, predominantly driven by the easy access to deep disposal wells in many parts of the state. In regions where water recycling is higher, deep disposal wells are harder to find.").

duced water, namely the salinity level.[88] In Pennsylvania, produced water from the Marcellus shale play consists of up to 200,000 milligrams per liter of TDS.[89] The low salinity level, combined with expensive disposal options and strict reporting regulations, likely impacts the high level of recycled wastewater from hydraulic fracturing. Anecdotal evidence[90] indicates that producers are conducting a similar cost benefit analysis in the Permian and Barnett shale plays in Texas. Produced water in the Barnett shale play contains 50,000–140,000 parts per million of TDS,[91] while produced water in the Permian Basin averages 89,000 parts per million TDS.[92] In the Permian Basin, the Apache Corporation recycles 100 percent of its produced water[93] in part because the water has less brine and is easier to treat.[94] With this newly developed technology, Apache also cleans other naturally occurring brackish water to use in their operations.[95] In the Barnett Shale, on the other hand, oil and gas producers use less than five percent recycled water.[96] Although current technology may allow oil and gas producers to choose recycling operations where water

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88. Katie L. Benko & Jörg E. Drewes, *Coproduced Water Occurrence and Composition*, 25 ENVTL. ENGINEERING SCI, 2, 245 (2008).

89. Gay et al., *supra* note 21, at 6.

90. Limited reporting makes it impossible to directly compare the level of recycling in these shale plays. *See* JEAN-PHILIPPE NICOT, ROBERT C. REEDY, RUTH A. COSTLEY & YUN HUANG, OIL & GAS WATER USE IN TEXAS: UPDATE TO THE 2011 MINING WATER USE REPORT 6 (2012), *available at* http://www.twdb.state.tx.us/publications/reports/contracted_reports/doc/0904830939_2012Update_MiningWaterUse.pdf ("Access to detailed information about water sources on the provider side is difficult. Large water suppliers do not necessarily track the ultimate usage of their water. Groundwater conservation districts (GCD's) do not always collect information about withdrawal amounts and eventual use of the water. A request to the Texas Commission on Environmental Quality (TCEQ) on reuse of treatment water yielded a helpful list of facilities but not the amount of water transferred, and further this does not account for direct reuse at a site. The demand side, that is, operators, is very fragmented.").

91. Mantell, *supra* note 33, at 12. Although the salinity of both Texas basins is near or less than the Marcellus Shale, incentive to recycle is less because Texas is "blessed" with underground injection. *Id.* at 20.

92. Katie L. Benko & Jörg E. Drewes, *Produced Water in the Western United States: Geographical Distribution, Occurrence, and Composition*, 25 ENTVL. ENGINEERING SCI. 239, 243 (2008).

93. Anna Driver & Terry Wade, *Fracking Without Freshwater at a West Texas Oilfield*, REUTERS (Nov. 21, 2013), http://www.reuters.com/article/2013/11/21/us-apache-water-idUSBRE9AK08Z20131121 ("Excluding outlays for its homegrown recycling system, Apache says it costs 29 cents a barrel to treat flowback water. That is a fraction of the $2.50 per barrel it costs to dispose of water using a third party.").

94. FREYMAN, *supra* note 2, at 58.

95. *Id.*

96. Jean-Philippe Nicot, Bridget R. Scanlon, Robert C. Reedy & Ruth A. Costley, *Source and Fate of Hydraulic Fracturing Water in the Barnett Shale: A Historical Perspective*, 2014 ENVI. SCI. TECH. 48, 2464, 2467.

is easiest to clean, water scarcity is a local issue, which requires conservation on a local level.[97] To successfully increase recycling on a state-wide basis, regulatory systems must help develop and apply increased technology that cleans even the saltiest of water.

On a less technical front, states face varying degrees of political barriers to implement additional regulatory control on oil and gas operations. In Colorado, political will has been a driving force for some of the strictest oil and gas regulations in the nation.[98] Yet, Colorado continues to face political battles between the industry and workforce surrounding oil and gas and a growing populous interested in banning hydraulic fracturing altogether.[99] New Mexico, in contrast, has experienced mixed results in strictly regulating the oil and gas industry. In 2008, Democrat Governor Bill Richardson's administration promulgated the strictest pit rule in the nation.[100] Upon election in 2010, Republican Governor Susana Martinez suspended the 2008 rule and initiated a review of the regulations.[101] The amended rule maintained pit lining and reporting requirements but abandoned efforts to mandate closed loop systems.[102] The revised rule allows producers to use multi-well fluid management pits,[103] which may also make it easier to recycle wastewater from hydraulic fracturing.[104] With conflicts like these in mind, oil and gas production regula-

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97. *See* FREYMAN, *supra* note 2, at 7.

98. STATE REVIEW OF OIL AND GAS ENVTL. REGULATIONS, COLORADO HYDRAULIC FRACTURING STATE REVIEW 4 (2011) ("The review team has concluded that the Colorado program is well managed and professional and generally meets the 2010 Hydraulic Fracturing Guidelines."); *see* Richardson ET AL., *supra* note 52, at 13 (ranking Colorado in the top five states for regulating all elements of hydraulic fracturing).

99. *See* Jack Healy, *With Ban on Drilling Practice, Town Lands in Thick of Dispute*, N.Y. TIMES, Nov. 25, 2012 ("'I had no idea we could upset an entire state government and a trillion-dollar industry,' said Michael Bellmont, an insurance agent who helped gather thousands of signatures and knocked on doors to persuade voters [to ban hydraulic fracturing].").

100. Mike Soraghan, *N.M. is Loosening Drilling Rules, Bucking Trends and Riling Ranchers*, E&E NEWS (Nov. 15, 2012), http://www.eenews.net/stories/1059972526.

101. *Id.*; *see also* Jim Magill, *Gas industry cheers New Mexico 'pit rule' rewrite*, 30 PLATTS GAS DAILY 111, June 11, 2013, *available at* 2013 WLNR 15464990 (reporting that, "in [Republican Susana Martinez's]successful 2010 bid to succeed Richardson, a Democrat, she campaigned on a platform to revise the [pit] rule.").

102. *See, e.g.*, N.M. CODE R. §§ 19.15.17.9(B), 19.15.17.13(F) (LexisNexis 2015); *see also* Staci Matlock, *Martinez and King sharply divided on environment*, THE SANTA FE NEW MEXICAN, Oct. 16, 2014, *available at* 2014 WLNR 28920643.

103. *Regulators repeal, replace pit rule*, Santa Fe New Mexican (June 6, 2013), http://www.santafenewmexican.com/news/local_news/article_1a277249-326e-5b85-82ef-53b4004d5a78.html.

104. *New Mexico Pit Rule Changes Agreeable to Industry*, SHALE DAILY (June 13, 2013), http://www.naturalgasintel.com/articles/4917-new-mexico-pit-rule-changes-agreeable-to-industry.

tions must be evaluated in the context of each state's current political climate.

Regulations to increase recycling of wastewater from hydraulic fracturing may be more politically palatable than other regulatory burdens. Indeed, in 2013 the New Mexico Oil Conservation Division highlighted a growing interest in recycling wastewater from hydraulic fracturing and clarified relevant regulations for the process.[105] Then in 2015, New Mexico successfully promulgated a rule to encourage recycling.[106] A spokesperson for Earthworks, an environmental group that promotes "sustainable solutions" for mineral and energy development,[107] was skeptical of the regulation's actual impact.[108] The group, however, reserved harsher criticism until the public could determine whether the rule results in any actual freshwater savings.[109] Other environmentalists are actually investing in research to increase recycling.[110] Still, others seek solely to prohibit hydraulic fracturing practices rather than improve them.[111] Increased water reuse provides a true potential win-win for politicians across the spectrum. The real challenge will be to manage opposing interests. While producers may want to remove barriers, receive incentives for technology development, and continue hydraulic fracturing, others may want to penalize wastewater disposal and potentially eliminate hydraulic fracturing altogether through overregulation.

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105. N.M. OIL CONSERVATION DIV., NOTICE OF RE-USE OF PRODUCED WATER, DRILLING FLUIDS AND OTHER LIQUID OIL FIELD WASTE (Sept. 9 2013), *available at* http://www.emnrd.state.nm.us/OCD/documents/Noticeproducedwaterre-use.pdf.

106. N.M. CODE R. §§ 19.15.34.1–19.15.34.21 (LexisNexis 2015).

107. *About Earthworks*, EARTHWORKS, http://www.earthworksaction.org/about (last visited Apr. 13, 2015).

108. *New rule clears way for NM oil producers to reuse water*, ALBUQUERQUE J. (Mar. 19, 2015), http://www.abqjournal.com/557662/biz/biz-most-recent/new-rule-clears-way-for-nm-oil-producers-to-reuse-water.html.

109. *Id.*

110. Patrick J. Kiger, *Green Fracking? 5 Technologies for Cleaner Shale Energy*, NAT'L GEOGRAPHIC DAILY NEWS (Mar. 19, 2014), http://news.nationalgeographic.com/news/energy/2014/03/140319-5-technologies-for-greener-fracking/ ("'Natural gas is a potential energy bounty for the country, and development is probably inevitable,' said Ben Ratner, a project manager for the nonprofit Environmental Defense Fund. . . . 'That's why we're investing our energy into doing everything, from science to policy to working with companies, to maximize the potential climate advantage that gas has over coal . . . .'").

111. *See* Ellen M. Gilmer, *De-escalating' War of Words in Colo. Still an Elusive Goal for Top Industry Group*, E&E News (June 10, 2013), http://www.eenews.net.lawproxy.unm.edu/energywire/stories/1059982551/search?keyword=environmentalists+fracking+compromise.

V. REGULATORY TOOLS TO ESTABLISH WORKABLE REGULATORY SYSTEM

States do not need to start from scratch to establish a workable regulatory system to increase recycling of wastewater from hydraulic fracturing. Since the environmental movement began in the 1970s, the United States developed different types of regulatory tools to address environmental concerns.[112] Each type of system—liability, cap and trade, command and control, and taxation—has its own strengths and weaknesses. Some systems are better suited than others to address different environmental concerns.[113] Recycling wastewater from hydraulic fracturing will benefit most from a system that is easy to enforce with existing infrastructure, supports increasing development of technology, encourages recycling in every basin, and is politically viable.[114] The following assessment evaluates liability, command and control, marketable permits, and taxation to establish a regulatory system that addresses these specific needs.

A. Liability

Liability regulations designate a specific action as wrongful and allow third parties to sue those who commit that action for the harm it causes.[115] Damage payments then provide a source of funds to remedy environmental harms. Governments impose liability retroactively, but liability creates a threat of litigation for future harm.[116] Litigation, however, is both slow[117] and an inefficient use of resources.[118] In addition, governments typically use it to punish damaging actions that are outside acceptable behavior norms because it works by making such actions ille-

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112. Robert B. McKinstry Jr., James McElfish, Michael Jacobson & Derald J. Hay, *Legal Tools that Provide Direct Protection for Elements of Biodiversity*, 16 WIDENER WIDW L.J. 909, 911 (2007).

113. *See* Michael Faure, *Effectiveness of Environmental Law: What Does the Evidence Tell Us?*, 36 WM. & MARY ENVTL. L. & POL'Y REV. 293, 301–19 (2012).

114. *See supra* notes 75–110 and accompanying discussion.

115. Merrill & Schizer, *supra* note 3, at 209.

116. *See* Faure, *supra* note 113, at 301.

117. Robert E. Beck, *Current Water Issues in Oil and Gas Development and Production: Will Water Control What Energy We Have?*, 49 WASHBURN L.J. 423, 440 (2010) ("However, with the water resource, the primary focus should be on protecting the resource from damage and not on the recovery of damages afterwards.").

118. Jerome M. Organ, *Superfund and the Settlement Decision: Reflections on the Relationship Between Equity and Efficiency*, 62 GEO. WASH. L. REV. 1043, 1043 (1994) ("CERCLA's critics continue to complain about delays in accomplishing remediation and about excessive transaction costs attributable to litigation resulting from CERCLA's liability system.").

gal.[119] Liability encourages actors to take action to avoid punishment for large scale environmental harm, but it is difficult and slow to implement and does little to encourage the best behavior out of a range of legal behavior.

Consequently, liability regulation is an unsuitable solution for increasing recycling. States lack the resources to initiate large-scale litigation.[120] More importantly, legislation that makes water consumption illegal is a drastic step. Inefficient water use, regrettably, is not an action outside of acceptable norms.[121] Many water users do not conserve or recycle water[122] and the oil and gas industry should not be held to a higher standard while other actors face no similar repercussions. A liability scheme for all water waste would require a definition of excessive water use, which would likely need to vary by industry and location.[123] Even if such action were politically viable, a suitable regulatory system would require a hard line that could be difficult to reflect and encourage tech-

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119. Merrill & Schizer, *supra* note 3, at 209 (noting that pure liability allows injured persons to sue "if the perpetrator has breached the relevant duty of care" and further finding that liability may be suitable to regulate water pollution risks). While liability may present an opportunity to safeguard against threats to water quality from hydraulic fracturing, it is less suitable to increase waste water recycling in hydraulic fracturing.

120. *See* Faure, *supra* note 113, at 302 ("There is equal evidence that the administrative costs (a large part consisting of legal fees paid to the lawyers) of Superfund (especially litigation) can be spectacularly high as well.").

121. *See* Janet C. Neuman, *Beneficial Use, Waste, and Forfeiture: The Inefficient Search for Efficiency in Western Water Use*, 28 ENVTL. L. 919, 923 (1998) (asserting that the beneficial use doctrine "allows, and even encourages, inefficient water use").

122. *See, e.g.*, Derek Adrian Hoye, *Aligning Visions for the Bay-Delta: Market-Based Ecosystem Restoration Through Agricultural Efficiency Improvements*, 3 GOLDEN GATE U. ENVTL. L.J. 209, 236 (2009) (advocating for a stricter definition of reasonable use to increase agricultural conservation, concluding that "[e]nforcement must begin with increased accountability for irrigators"); Colorado v. New Mexico, 467 U.S. 310, 339 n.2, (1984) (Stevens, dissenting) (arguing that the majority erred by refusing to equitably apportion water despite "essentially undisputed" evidence that "at least 2,000 acre-feet of water were being wasted by just one of the four principal users in New Mexico").

123. *See* Robert A. Pulver, *Liability Rules As A Solution to the Problem of Waste in Western Water Law: An Economic Analysis*, 76 CALIF. L. REV. 671, 722 (1988) ("Since water demand varies among water districts, an irrigation technique that is efficient in one river basin may not be efficient in another."). Pulver actually argues that liability could encourage water conservation, for irrigation practices and water conveyance. *Id.* at 725. Even in this narrow application, he relies on state agency capacity to administer such a system with "expert knowledge of irrigation techniques and water needs within specific river basins," advocating for agency publication of specific conveyance guidelines and enforcement with measures such as daily onsite inspection, aerial surveillance, and mechanical measuring devices. *Id.* at 722–24.

nological advances.[124] Most water users and water regulators would likely agree that liability is neither a practical option nor a politically feasible means to increase recycling of wastewater from hydraulic fracturing, since water is cheap and states do not require the most efficient water use.

B. Command and Control

Command and control regulations prescribe rules to directly control harmful activities.[125] A command and control regulation imposes absolute limits on regulated behavior, and in its purest form, mandates the type of technology necessary to achieve that goal.[126] For example, command and control regulations require ships to carry lifeboats and cars to have seat belts.[127] Command and control regulations also include permitting[128] and reporting requirements.[129] Perhaps the greatest benefit of command and control regulation is that it provides certainty to industry, regulators, and environmentalists alike.[130] With clear costs, businesses may more easily plan.[131]

Critics raise a number of arguments, however, against command and control regulations. Governments set command and control regula-

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124. Such a system would face the same challenges as command and control regulations to define changing standards and technology. *See infra* notes 127–32 and accompanying text.

125. Timothy F. Malloy, *The Social Construction of Regulation: Lessons from the War Against Command and Control*, 58 BUFF. L. REV. 267, 268 (2010).

126. *See* David M. Driesen, *Is Emissions Trading an Economic Incentive Program?: Replacing the Command and Control/Economic Incentive Dichotomy*, 55 WASH. & LEE L. REV. 289, 297 (1998) (noting that although it is generally accepted that command and control regulations mandate technology, such command and control regulations are the exception not the rule).

127. Merrill & Schizer, *supra* note 3, at 206.

128. *See* Walter G. Wright, Jr. & Albert J. Thomas III, *The Federal/Arkansas Water Pollution Control Programs: Past, Present, and Future*, 23 U. ARK. LITTLE ROCK L. REV. 541, 550–51 (2001) (discussion the Clean Water Act's permitting system).

129. Faure, *supra* note 100, at 319 ("[R]elative cost efficiency of various instruments (emission taxes, emission standards and technology standards) also needs to be compared with the information, monitoring, and costs of enforcement instruments (criminal fines, administrative fines, civil sanctions) to find an optimal combination of various instruments.").

130. *See* Adam Babich, *A New Era in Environmental Law*, COLO. LAW., Mar. 1991, at 435, 438 (noting that command and control regulations "comprise a system familiar to the regulated community, environmentalists, lawyers and politicians").

131. Merrill & Schizer, *supra* note 3, at 207 ("Especially in making significant long term investments, firms may prefer certain—even if potentially excessive—costs to highly uncertain costs.").

tions and typically apply them equally to all businesses.[132] Whereas independent business decisions reflect costs and benefits for each business, government regulations are more often based on technological ability.[133] Consequently, command and control regulations can cause inefficient investments where some entities must invest in expensive solutions to achieve the same environmental goals that a more efficient entity could accomplish with fewer resources.[134] Moreover, although command and control regulations are not necessarily limited to technology-based "design standards,"[135] reliance on existing technological ability to set the standards can slow adaption to innovation.[136] At the same time, a static control does not allow for more efficient alternatives to compliance, which can stifle economic development in regions where compliance is not cost effective.[137] Command and control may not, therefore, be the most politically viable solution.[138] Although command and control establishes a hard line that holds everyone accountable, it lacks the dynamism and flexibility necessary for technological advancement.

Further, rigid command and control standards would harm small oil and gas producers and fail to continuously incentivize recycling wastewater from hydraulic fracturing. Whereas large-scale operators may have the economies of scale to invest in technology and recycle water throughout their operations, it may be less economically feasible for small independent producers to invest in the same expensive technology

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132. *Id.* at 206.

133. *Id.* at 207.

134. Driesen, *supra* note 126, at 307–309 (further arguing that should be balanced against expense of public resources to enforce a non-uniform system).

135. Malloy, *supra* note 125, at 283–84 ("Generally speaking, regulatory standards can be structured either as 'design standards' or 'performance standards.' A design standard requires the facility to use a specific type of equipment or work practice to control emission. A performance standard instead sets an emission rate or other measure of performance to be attained, leaving it to the regulated entity to select the particular technology or work practice."); *see* Driesen, *supra* note 126, at 297 n.57 (noting that even the Clean Water Act's Best Available Technology standards, a frequently cited example of technology based command and control, also requires performance standards that may be satisfied through a choice of techniques).

136. Malloy, *supra* note 125, at 284 (acknowledging a nuanced criticism that "theoretical flexibility is lost in practice because firms are pressured to adopt the underlying reference technology on which the performance standard had been based.").

137. Driesen, *supra* note 126, at 307 ("Because facilities have unequal compliance costs, uniform standards demand relatively expensive reductions from some facilities without securing greater reductions from facilities with lower compliance costs."). Consequently, development may simply not be viable in certain regions.

138. *Id.* at 309 ("Lobbyists for regulated industries may use the term 'command and control' without regard to accuracy, because it helps undermine the political legitimacy of traditional regulation.").

to clean a much smaller amount of water. Meanwhile, a static limit without flexibility to trade between producers provides little incentive to continuously invest in better technology to clean water. A strict static limit could also restrict development in places where water is too salty to clean with current technology. Command and control standards lack flexibility, which could harm both the diverse industry makeup and technological development.[139]

Still, government entities should consider altering existing command and control regulations to help enforce a regulatory incentive system by removing current barriers to recycling and increasing reporting requirements. As discussed previously, some states no longer require permits to recycle on-site or transfer water to another operator for recycling in drilling operations.[140] A more recent New Mexico rule provides relaxed storage standards for recycling options.[141] States should continue this trend. States should also implement reporting requirements, which may help enforce the regulatory system and build public support along the way.[142] Pennsylvania, for example, requires producers to report the amount of wastewater they recycle.[143] Producers have even more of an incentive to invest in recycling if an informed public is watching. Reporting requirements also help investors evaluate the long term risks of a project.[144] Since reporting can be burdensome for industry and unhelpfully dense, such requirements should be narrowly tailored and consolidated in a format that is easy to understand.[145]

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139. *See* David Blackmon, *Why Oil & Gas Should Be Regulated By The States*, FORBES (Oct. 15, 2013, 1:04 PM), http://www.forbes.com/sites/davidblackmon/2013/10/15/why-oil-gas-should-be-regulated-by-the-states/ ("This is the difference between being regulated at the state level by state agencies who understand their various resources bases and stakeholder groups and can get permits issued in a matter of days, and being regulated in a command-and-control, one-size-fits-all manner that federal regulations inevitably become.").

140. *See supra* note 52, at 44 and accompanying text.

141. *Compare* N.M. CODE R. §§ 19.15.34.1–19.15.34.21 (LexisNexis 2015) *with* N.M. CODE R. §§ 19.15.17.1–19.15.34.16 (LexisNexis 2015).

142. Merrill & Schizer, *supra* note 3, at 149 ("In addition, the public must believe that shale drilling is safe. Otherwise, the shale revolution could be vulnerable to regulatory overkill, as media stories about flaming water faucets, brown well water, and sickly farm animals prompt widespread public apprehension about water contamination.").

143. 25 PA. CODE § 78.122(b)(6)(vi) (2011).

144. *See* FREYMAN, *supra* note 2, at 46 ("Investors similarly lament that they don't have full information to assess water risks.").

145. *See* Merrill & Schizer, *supra* note 3, at 208 ("One must remember, however, that gathering and disseminating information can be costly, and that information overload can be counterproductive.").

C. Marketable Permit Systems

Marketable permit systems, also known as "cap and trade," create property rights based on a particular activity and allow businesses to trade those rights within government regulated markets.[146] Governments establish scarcity by capping the activity,[147] but retain flexibility by allowing businesses to trade credits.[148] The market to trade credits can vary by limiting trade to within a localized region or allowing bigger markets that span political jurisdictions.[149] Marketable permits seek to "harness private-sector financial calculations in the market on a day-to-day basis" to limit environmental harm.[150]

Cap and trade offers several benefits that distinguish it from its "crankier sibling, the 'command-and-control' regulation."[151] Prior to the defeat of the Waxman-Markey greenhouse gas cap and trade legislation in 2009,[152] marketable permits were more politically palatable than tax-based regulation[153] in large part because the federal government effectively regulated pollutants that cause acid rain in the 1990s.[154] Critics specifically highlight several factors that contributed to the success of the Acid Rain Program: rigorous enforcement made possible by strict report-

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146. Babich, *supra* note 130, at 438.

147. Daniel A. Farber, *Pollution Markets and Social Equity: Analyzing the Fairness of Cap and Trade*, 39 ECOLOGY L.Q. 1, 5 (2012) ("The permits have scarcity value because emissions are subject to an overall cap. . . .").

148. *Id.* at 4 ("[Cap and trade] sets a rigid cap on emissions of a target pollutant for a constellation of regulated entities but also leaves them significant discretion to decide how to comply.").

149. Alice Kaswan, *Environmental Justice and Domestic Climate Change Policy*, 38 ENVTL. L. REP. NEWS & ANALYSIS 10287, 10292 (2008).

150. Janet E. Milne, *Environmental Taxation in the United States: The Long View*, 15 LEWIS & CLARK L. REV. 417, 421 (2011).

151. Bruce R. Huber, *How Did RGGI Do It? Political Economy and Emissions Auctions*, 40 ECOLOGY L.Q. 59, 60 (2013).

152. American Clean Energy and Security Act of 2009, H.R. 2454, 111th Cong. (2009); *see also* Chris Good, *Almost Every 2012 Republican Candidate Has a Cap-and-Trade Problem*, THE ATLANTIC (May 13, 2011, 7:30 AM), http://www.theatlantic.com/politics/archive/2011/05/almost-every-2012-republican-has-a-cap-and-trade-problem/238776/. According to the Environmental Protection Agency, the legislation would have established "an economy wide cap & trade program" and created "other incentives and standards for increasing energy efficiency and low carbon energy consumption." Office of Atmospheric Programs, U.S. Environmental Protection Agency, *EPA Analysis of the American Clean Energy and Security Act of 2009 H.R. 2454 in the 111th Congress* 3 (June 23, 2009), *available at* http://www.epa.gov/climatechange/Downloads/EPAactivities/HR2454_Analysis.pdf.

153. *See* Milne, *supra* note 150, at 428 n.34 (noting that the historical preference for marketable permits is in part attributable to "the bruising experience with President Clinton's proposed Btu tax in 1993"). It is unclear whether this historical preference remains the case.

154. Driesen, *supra* note 126, at 318.

ing requirements, careful monitoring, and relatively simple regulated sources.[155] Cap and trade can effectively encourage pollution reductions if the system provides anticipated, staged reductions and adequate monitoring.[156] Cap and trade also helps sustain diverse markets with businesses of varied resources. Whereas command and control regulations require all businesses to invest in mandated technology, cap and trade allow businesses to choose whether to invest in upgrading technology or purchase credits to come into compliance.[157]

Yet cap and trade permits also present challenges. To create a workable system, the government must not only determine a limit but also establish a market.[158] The time lapse between enactment and credit creation can actually slow transition because industry may worsen behavior before the cap is set or delay improvements until after the cap is set in order to receive credit for those improvements after the market opens.[159] Moreover, allowing industry to trade credits for taxed behavior can exacerbate local impacts in places where individual facilities may purchase permits to continue their behavior.[160]Businesses purchase credits where compliance is more difficult, and when that is concentrated in a localized area, it creates a "hot spot" that remains out of compliance.[161] Often, these hot spots exist in communities with less political capital to influence business decisions.[162] It is arguably more difficult to enforce cap and trade regulations than technology-based command and control regulations because agencies must continually monitor the regulated ac-

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155. Scott Schang & Teresa Chan, *Federal Greenhouse Gas Control Options from an Enforcement Perspective*, 2 SAN DIEGO J. CLIMATE & ENERGY L. 87, 93 (2010).

156. *See* Driesen, *supra* note 126, at 318, 325 (describing successful attributes of the Clean Air Act amendment to stop acid rain).

157. *See* Byron Swift, *How Environmental Laws Work: An Analysis of the Utility Sector's Response to Regulation of Nitrogen Oxides and Sulfur Dioxide Under the Clean Air Act*, 14 TUL. ENVTL. L.J. 309, 343 (2001) ("Allowance trading encouraged utilities to seek out 'least-cost' compliance options among their plants in order to minimize the cost of compliance. Such strategies can be clearly seen in firms' decisions to install scrubbers on the largest plants, where the cost per ton of emission reductions would be the lowest. . . .").

158. *See* Sidney A. Shapiro & Thomas O. McGarity, *Not So Paradoxical: The Rationale for Technology-Based Regulation*, 1991 DUKE L.J. 729, 745 (1991) (describing the challenges to setting up an effective market).

159. *See* U.S. GEN. ACCOUNTING OFFICE, VEHICLE EMISSIONS: EPA PROGRAM TO ASSIST LEADED-GASOLINE PRODUCERS 20 (1986) ("The introduction of inter-refinery trading into the lead phasedown program probably slowed the pace of environmental improvement. EPA's 1985 trading rule actually led to increased production of leaded gasoline in 1985.").

160. Adam Babich, *A New Era in Environmental Law*, 20 COLO. LAW. 435, 438 (Feb. 1991).

161. Stephen M. Johnson, *Economics v. Equity: Do Market-Based Environmental Reforms Exacerbate Environmental Injustice?*, 56 Wash. & Lee L. Rev. 111, 129 (1999).

162. *Id.* at 131.

tion.[163] Industry also has an incentive "to exaggerate the value of reduction credits[,]" which must be carefully monitored.[164] Cap and trade is not necessarily the best solution for complex systems that are difficult to regulate and require immediate change.

Finally, marketable permits with a static limit do not necessarily produce continuous or uniform innovation. Cap and trade likely offers more of an incentive for innovation beyond the regulated limit because businesses have the incentive to reduce the regulated activity to sell additional credits.[165] Even so, all businesses in the market will reach equilibrium where businesses are below the static limit by either purchasing credits to pay for the regulated activity or reducing their activity and selling credits. At that point, businesses have no incentive to develop new technology to further reduce the regulated activity.[166] Marketable permits may also reduce innovation by allowing industry to reform behavior in facilities where it is easiest rather than investing in new technologies to reduce the behavior across the board.[167] This elective efficiency may not only reduce innovation but also exacerbate local impacts where it is harder to reduce the regulated activity.

Market based permits offer some opportunities for regulating recycling of wastewater from hydraulic fracturing but pose challenges to avoid localized water scarcity and continue technological development beyond the imposed cap. Since state regulators already measure wastewater from hydraulic fracturing and permit its disposal, cap and trade provides opportunities to increase recycling while allowing flexibility. By allowing permit trading instead of imposing a general cap, businesses with less initial investment capacity may have a better opportunity to remain competitive. If states act now, the time lag to set up the system

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163. *See* Sidney A. Shapiro & Thomas O. McGarity, *Not So Paradoxical: The Rationale for Technology-Based Regulation*, 1991 DUKE L.J. 729, 748–49 (1991) (arguing that technology based "strategies are less expensive to enforce because inspectors are only required to determine whether a firm has installed the required technology and continues to operate it properly").

164. Driesen, *supra* note 126, at 310.

165. Natalie M. Derzko, *Using Intellectual Property Law and Regulatory Processes to Foster the Innovation and Diffusion of Environmental Technologies*, 20 HARV. ENVTL. L. REV. 3, 51 (1996); *see also* Parisa Smith, *Can the Success of Carbon Emission Cap-and-Trade Market Be Predicted Based on the EPA's Acid Rain Program?*, 6 APPALACHIAN NAT. RESOURCES L.J. 57, 78 (2012) (noting that business investment in scrubbers actually delayed investment in longer term, more sustainable solutions and prolonged the life of high-emitting facilities).

166. Driesen, *supra* note 126, at 325 ("Once the polluters regulated by a trading program have reached an equilibrium providing the reductions that the governmental body required, no incentive for further reductions exists.").

167. *Id.* at 334 ("The low-cost facilities probably have a greater ability to provide reductions without substantial innovation than high-cost facilities.").

may not hinder the overall success of the program so long as the system achieves necessary results upon establishment. While a marketable permit system may successfully achieve more efficiency, it will cause industry to postpone investment in technology where it is more costly to clean saltier water. If the market is defined too broadly, industry will only clean wastewater from hydraulic fracturing in regions where the water is relatively inexpensive to clean. In markets that contain different qualities of underground water, industry will purchase credits for the areas with saltier water. Since some of the hardest to clean water occurs in regions with the greatest water scarcity, such a system would do little to address local price increases and pressure on existing uses.

To avoid this problem, governments could limit localized impacts by limiting markets to within a basin. Typically, water quality does not drastically vary across a basin.[168] Similarly, disposal costs only differ marginally across a basin.[169] A basin-wide market should provide a wide enough range of operations to allow enough options for producers to buy and sell credits.[170]

Water market forces will also push producers towards recycling in water scarce regions as long as the entire basin is regulated. Although water is relatively cheap, it will be relatively more expensive in places where it is in higher demand. Where fresh water costs more, producers will have more of an incentive to recycle. Challenges will remain where basins span state lines and only one state regulates wastewater recycling. Governments should pursue inter-jurisdictional regulations to the extent that it is possible. Water managers have long dreamt of managing watersheds across jurisdictions.[171] Although inter-jurisdictional watershed management may still be too complex to realize,[172] perhaps the same political will can drive an inter-jurisdictional water conservation program.

Even so, cap and trade may not be the most effective at continuing to drive innovation once businesses have found an equilibrium—where all remaining businesses have purchased or sold enough credits to eco-

168. Katie L. Benko & Jörg E. Drewes, *Coproduced Water Occurrence and Composition*, 25 ENVTL. ENGINEERING SCI, 2, 245 (2008).

169. *See* Alison Sider et al., *Drillers Begin Reusing 'Frack Water'*, WALL ST. J. (Nov. 20, 2012), http://online.wsj.com/news/articles/SB10001424052970203937004578077183112409260 (noting that frac-wastewater disposal cost "varies from state to state").

170. Derzko, *supra* note 165, at 53 ("A marketable permit regime may also be ineffective where there is either a very small or a very large number of polluters.").

171. William deBuys, *Visions of Western Governance: Powell and His Successors*, 23 J. LAND RESOURCES & ENVTL. L. 15, 15–16 (2003).

172. G. Tracy Mehan, III, *A Symphonic Approach to Water Management: The Quest for New Models of Watershed Governance*, 26 J. LAND USE & ENVTL. L. 1, 14 (2010) ("So it is necessary to work over, under, around, and through the political boundaries that appear to constrain watershed perspective.").

nomically comply. Once businesses have developed sufficient technology to make the entire market compliant, the cost of a credit will not be enough to further spur investment to develop better technology to recycle even more water. Even cap and trade's most successful application, ending acid rain in the 1990s, did not spur new innovation; instead, it disseminated standard methods of emission-control.[173] Although a nuanced cap and trade system can solve valuable issues such as flexibility for a diverse market and even localized change, it still does little to truly incentivize new technological innovation.

Cap and trade comes closer to addressing regulatory needs to increase wastewater recycling than liability or command and control. Cap and trade allows flexibility for producers to determine the best ways to contribute to an overall increase in recycling. Localized markets would ensure that recycling improves in saltier basins as well. Lastly, capped disposal would spur some technological innovation. Yet, innovation would stop once businesses reach equilibrium below the cap. As such, cap and trade alone would likely not develop the technology necessary to recycle the dirtiest water.

D. Taxation

Taxation resembles command and control regulation and regulation through liability, but it retains valuable differences.[174] Similar to liability rules, taxes "set a price on an externality which is imposed only after it is generated."[175] Like command and control regulations, taxes impose a cost for risky or harm-causing actions and limit consequent harm.[176] Unlike command and control regulations, however, industry retains the choice to pay to continue to engage in behavior because it is not banned outright.[177] Since governments can tax an activity at any level, governments can choose whether to set a limit and tax only after a certain point, increase the tax as the activity increases, or tax a specific amount of the activity. If the cost of the tax is higher than the cost of developing technology to control the activity, industry will develop new technology.[178] As the technology develops, industry increasingly saves more money compared to paying the tax.[179] Meanwhile, policy makers

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173. Driesen, *supra* note 126, at 318.

174. Merrill & Schizer, *supra* note 3, at 209 n.317.

175. *Id.*

176. Kyle D. Logue, *Coordinating Sanctions in Tort*, 31 CARDOZO L. REV. 2313, 2325 (2010).

177. Milne, *supra* note 150, at 421.

178. *See* Malloy, *supra* note 125, at 344 (describing the conventional view that taxes can encourage businesses to actively seek cost-effective innovations).

179. Driesen, *supra* note 126, at 342.

can dedicate taxes paid to further address the problem.[180] Taxation drives quick change by regulating actions on a relatively immediate basis, empowers industry decision-making, continuously drives innovation, and produces revenue for the government.

Taxation also has its challenges. Whereas cap and trade markets determine credit prices, a governmental body establishes and quantifies taxes. Taxes to force technology innovation require precision to continuously shift behavior.[181] Governments must also ensure that technological innovation is possible and not too heavy a burden for businesses to profitably sustain.[182] Unlike cap and trade, the government, not entrepreneurial businesses, profits from charging regulated activities. Taxes also become political lightning rods, which cause uncertainty as politicians threaten to remove and replace taxation schemes from one legislative session to the next.[183] Although taxes can incentivize continuous improvements in environmental performance, governments must carefully craft them to decrease the targeted activity without significantly injuring the industry to avoid political backlash.

States could incentivize recycling by taxing businesses that inject the wastewater underground. With a carefully designed system, producers would have an immediate incentive to recycle less salty water even where disposal methods are available. To address the existing technology gaps, the legislature could use incoming taxes to "pay" for research and development programs to implement technology and support efforts to develop economically viable techniques to clean even saltier water.[184] Governments could tax water injection at a higher rate in regions dealing with intense water scarcity to encourage technological development and recycling. A tax on underground injection would rely on the existing tax enforcement structure,[185] underground injection regula-

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180. Milne, *supra* note 150, at 443.

181. *See id.* at 447 (noting the precision needed for taxes intended to shift to known technology options).

182. *Id.* at 446–47 ("The end result often is not an idealized Pigouvian tax, but instead what one might consider a pragmatic Pigouvian approach—a second-best tempered by equity, economic impact, administrative feasibility, and political considerations.").

183. *See* Driesen, *supra* note 126, at 342.

184. Government supported research and development was vital to the hydraulic fracturing boom, and arguably more influential than tax breaks for industry development. ZHONGMIN WANG & ALAN KRUPNICK, RFF DP 13–12, A RETROSPECTIVE REVIEW OF SHALE GAS DEVELOPMENT IN THE UNITED STATES: WHAT LED TO THE BOOM? 3–4 (2013).

185. *See* Milne, *supra* note 150, at 425 (noting that "environmental tax instruments reflect the characteristics of the tax regimes to which they are harnessed . . . .").

tion,[186] and reporting requirements for ratio of water use to provide ongoing revenue for research and development and continuous incentive for technological dissemination.

VI. PILOT PROGRAM FOR COMPREHENSIVE REGULATORY PROGRAM TO INCENTIVIZE WASTEWATER RECYCLING FROM HYDRAULIC FRACTURING

To best achieve both continuous technical improvement and provide cost effective alternatives to small businesses, governments should: implement a hybrid system of marketable permits and underground injection taxes; employ taxes to provide research and development for new technological development; and loosen regulations to make recycling easier and support joint recycling initiatives. This hybrid system of marketable permits and taxes would increase recycling in all basins and continue to develop technology to clean dirtier water. The ability to trade permits would add flexibility for considerably smaller producers. The government could improve enforcement by maintaining regulations for other disposal methods and increasing reporting requirements for water use and water recycling percentages. If successful, such a hybrid pilot program could provide a foundation to encourage recycling and conservation for other water users.

A cap and trade system should cap producers at a percentage of freshwater use and then allow businesses to trade credits for any additional amount of water recycled. By capping a percentage, smaller producers would not face a proportionately larger requirement than bigger producers (as they would be if freshwater were capped at a raw quantity). By trading a raw quantity, small producers could not game the system by selling proportionate reductions to larger companies, reducing the overall amount of water recycled. The percentage would have to be determined based on the specific details of particular basins. Basins vary in water quality,[187] which may realistically impact the percentage of water that can be recycled. In some developing shale plays, recycled wastewater would be insufficient to supply the existing water needs for hydraulically fracturing a new well.[188] Consequently, the percentage cap would have to take into account available supply compared to current

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186. Due to the Safe Water Drinking Act, all states already regulate underground injection to some degree. NATHAN RICHARDSON, MADELINE GOTTLIEB, ALAN KRUPNICK & HANNAH WISEMAN, THE STATE OF STATE SHALE GAS REGULATION 52 (2013).

187. Katie L. Benko & Jörg E. Drewes, *Produced Water in the Western United States: Goegraphical Distribution, Occurrence, and Composition*, 25 ENVTL. ENGINEERING SCI, 2, 239 (2008).

188. FREYMAN, *supra* note 2, at 39.

need. A carefully set percentage cap would be fair to all producers and allow each producer to evaluate how to most efficiently comply while providing a significant decrease in total freshwater used.

The system should also include a small tax on all underground injection to continuously encourage technology development and to pay for government support for research and development. The business incentive to avoid taxation at all levels bolsters the cap and trade incentive, selling credits, to continue technology development. Revenue could also sustain government research and development for new technology. By combining these traits, the regulatory program would create a triple incentive for businesses to implement new technology.

Finally, government must support the purpose of cap and trade regulations and the taxation requirements with command and control regulations that facilitate, rather than hinder, wastewater recycling. Governments should remove regulations, such as water storage requirements and restrictions on wastewater pooling between hydraulic fracturing producers, to allow businesses to recycle more easily. On the other hand, governments must require water use and recycling information to both aid enforcement and garner public support. Finally, governments must closely monitor water disposal trends and regulate other injection alternatives to avoid disposal in new, less environmentally sound ways. This four tiered approach—marketable permits, taxation, research and development, and command and control regulation—achieves greater water use efficiency by both regulating and supporting the oil and gas industry, which supports entire regions currently struggling with water scarcity.

Still, such a system faces challenges. Governments must consider existing water use and water demand, regional price and quality variations, price barriers to technology development, and costs of implementation to design an effective tax and a marketable permit system. Any initiative to increase an industry's cost of production will be controversial. Before the legislature proposed to regulate greenhouse gases through cap and trade, marketable permits were more politically palatable than taxation.[189] On the other side, environmental groups are unlikely to readily support tax breaks for oil and gas producers,[190]

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189. Milne, *supra* note 150, at 444 (2011) ("It remains to be seen whether the political gap between a trading regime and a carbon tax has narrowed sufficiently to swing the pendulum toward a carbon tax . . . .").

190. Carrie Cecil, *Budget Battles: Would the Obama Administration's Proposal to Eliminate Oil and Gas Tax Subsidies Injure the Industry?*, 8 PITT. TAX REV. 209, 211 (2011) ("Proponents of the repeal of these provisions believe that increasing taxation on oil and gas would reduce the amount of capital employed in the oil and gas industry while encouraging substitution of other energy sources including coal, nuclear and renewable sources."). In 2015,

especially in the context of hydraulic fracturing. Even so, the combined approach and a shared desire to increase recycling may be enough to create political will to pass a comprehensive system.[191]

Water efficiency looks different in different industries, but general lessons from a pilot program that incentivizes water conservation in hydraulic fracturing could translate to other water uses. Some municipalities are slowly starting to use desalination plants to add water to the system.[192] As technology develops, municipalities could transfer such operations for expanded use. Other cities are exploring water recycling through "toilet to tap" technology.[193] If the oil and gas system achieves success by increasing water efficiency and eventually decreasing costs, a cap and trade system on percentage of freshwater use could incentivize municipal systematic change as well.

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two Texas state representatives introduced bills to provide tax breaks for oil and gas producers that recycle wastewater from hydraulic fracturing. *See* Tex. H.B. 4035, 84th Leg. R.S. (2015); Tex. H.B. 4021, 84th Leg. R.S. (2015); Jess Davis, *Texas Pols Want Tax Credits For Alternate Fracking Fluids*, LAW360 (Mar. 16, 2015, 9:36 PM ET), http://www.law360.com/articles/631579/texaspolswanttaxcreditsforalternatefrackingfluids. Republican State Representative Drew Darby, who sponsored H.B. 4035, described the bill not as a tax cut but as "a shift in where taxes are paid." Angela Neville, *Bills: Promoting Green Fracking Through Tax Credits*, TEXAS LAWYER (Mar. 30, 2015), http://www.texaslawyer.com/id=1202721799825/Bills-Promoting-Green-Fracking-Through-Tax-Credits?slreturn=20150328002353. Representative Darby further asserted that the credits for water recycling or investment in local community colleges shifted the tax payment to local communities rather than the state. *Id.* ("In this case, [the tax goes] directly to local communities in the form of water or community colleges. . . ."). Despite Representative Darby's efforts to promote his bill as an incentive for private investment, *id.*, neither bill has received a vote in the Ways and Means Committee. *See History: Bill H.B. 4035*, TEXAS LEGISLATURE ONLINE, www.legis.state.tx.us/BillLookup/History.aspx?LegSess=84R&Bill=HB4035 (last visited Apr. 14, 2015); *History: Bill H.B. 4021*, TEXAS LEGISLATURE ONLINE, www.legis.state.tx.us/BillLookup/History.aspx?LegSess=84R&Bill=HB40321 (last visited Apr. 14, 2015).

191. Indeed, rare but exciting collaborations between industry and activists are already occurring. *See* FREYMAN, *supra* note 2, at 5, 70 (touting efforts by the Center for Sustainable Shale Development, a collaborative industry and NGOs that has established performance standards that require operators to recycle at least 90 percent of wastewater from hydraulic fracturing by 2014).

192. NAT'L RESEARCH COUNCIL, DESALINATION: A NATIONAL PERSPECTIVE 19–24 (2008). Indeed, "[d]esalination plants have been built in every state in the United States, although nearly half of the plants are small facilities built for specific industrial needs." *Id.* at 17.

193. Deborah Sullivan Brennan, *Tide turns for water purification plan*, UT SAN DIEGO (Apr. 27 2013), http://www.utsandiego.com/news/2013/Apr/27/tap-toilet-water-purification-potable-reuse/.

The greatest water user in the West is agriculture;[194] however, it is also one of the most politically insulated users.[195] As water becomes more valuable, farmers may benefit from desalination technology to utilize brackish water in aquifers that currently is unusable. Downstream farmers also increasingly battle water quality issues as chemicals and salts build up in water that farmers reuse throughout the system.[196] With the right investments, farmers and governments could adapt technology from oil and gas to create cleaner water for farming.[197] Cleaner water also produces more, better quality crops.[198] The hybrid program would bring significant benefit to farmers, which could garner support from the agricultural community and make the program politically feasible.

Finally, once proven in other industries, farmers and other users might be more amenable to cap and trade systems to encourage efficiency. Currently, states limit water use to "beneficial use"[199] but do not discriminate beyond that basic threshold.[200] In addition, the system must increasingly grapple with other values, such as environmental flows[201] and maintaining traditional agriculture communities,[202] which the mar-

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194. U.S. GEOLOGICAL SERVICES, SUMMARY OF ESTIMATED WATER USE IN THE UNITED STATES IN 2005 (2009), *available at* http://pubs.usgs.gov/fs/2009/3098/pdf/2009-3098.pdf.

195. Alan O. Sykes, *The Questionable Case for Subsidies Regulation: A Comparative Perspective*, 2 J. LEGAL ANALYSIS 473, 475–76 (2010) ("Because the concentrated interests of producers command greater political support than the diffuse interests of consumers, national governments find it much easier to emulate the vices of protection than the virtues of free trade.") (internal quotations omitted).

196. San Joaquin River Exch. Contractors Water Auth. v. State Water Res. Control Bd., 183 Cal. App. 4th 1110, 1122 (2010) (finding that regulators had sufficient evidence that nonpoint agriculture-based salt discharge caused water salinity to place the river on Clean Water Act's section 303(d) list).

197. Alisa Odenheimer & James Nash, *Israel Desalination Shows California Not to Fear Drought*, BLOOMBERG NEWS, Feb. 12, 2014 (citing San Diego investment in desalination, which costs more than other supply, "has some reliability benefits that are very important to the regional economy").

198. STEPHEN GRATTAN, UNIV. OF CAL. AGRIC. AND NATURAL RES., PUB. 8066, *Irrigation Water Salinity and Crop Production*, 1 (2002), *available at* http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_010748.pdf.

199. *See* COLO. CONST. art. XVI, § 6.

200. Michael Toll, *Reimagining Western Water Law: Time-Limited Water Right Permits Based on A Comprehensive Beneficial Use Doctrine*, 82 U. COLO. L. REV. 595, 606 (2011) ("As a result, very little evolution toward the efficient use of water has taken place within the beneficial use doctrine.").

201. *See* PUD No. 1 of Jefferson Cnty. v. Washington Dep't of Ecology, 511 U.S. 700, 719 (1994) (holding that states may impose minimum stream flow conditions as part of state and federal antidegradation regulations under the Clean Water Act).

202. *See* JOSÂE A. RIVERA, ACEQUIA CULTURE: WATER, LAND, AND COMMUNITY IN THE SOUTHWEST 164 (1998) (discussing potential conflicts between state adjudication of individual rights and community governed acequias).

ket does not appropriately consider. A cap and trade or taxation system might encourage increased efficiency in agriculture, establish funds to support traditional agriculture communities, and make more water available for environmental flows.

VII. CONCLUSION

If states want to increase recycling of wastewater from hydraulic fracturing, governments must make alternative options scarce and remove regulations that inhibit recycling. Any accompanying regulatory system must be predictable and implemented in a way that is relatively easy to enforce, incentivizes continuous technology development, and achieves recycling in water scarce regions even where it may be harder to achieve.

Consequently, state governments should: (1) create a marketable permit system that caps a percentage of freshwater use in hydraulic fracturing and establishes a basin wide market to trade credits; (2) tax options for disposal of un-recycled wastewater from hydraulic fracturing based on water scarcity within a basin; (3) use the tax revenue to sustain government research in new recycling technology; and (4) refine command and control regulations to further encourage recycling where enforcement is already ongoing and increase reporting requirements to document regulatory success.

As the discussion further defines such a regulatory system, legislatures should continue to evaluate additional considerations, such as timing of water use,[203] energy conservation,[204] and intellectual property's role in technology development.[205] In addition, states should continue to work collaboratively to conjunctively manage inter-jurisdictional shale basins, particularly where states also share underground aquifers.

To be fair, increased regulation of water consumption in hydraulic fracturing is largely undeserved. To impose new water efficiency requirements on an industry responsible for less than one percent of the nation's total water consumption may be counter intuitive and discrimi-

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203. Depending on water demand and technology limits, states may consider incentivizing use of fresh water during the winter months, when there is less demand for agriculture, by providing offsets for such agreements.

204. *See* FREYMAN, *supra* note 2, at 39 ("Recycling water doesn't always make sense. In some cases water returning to the surface may be insufficient volume or too contaminated (whether with salt, heavy metals or naturally occurring radioactive materials) to clean without using large amounts of energy.").

205. *Cf.* Peter Behr, *Fracking Founder's Foundation Searches for Shale Gas Answers*, ENERGYWIRE (Oct. 28, 2013) (noting that the person who developed hydraulic fracturing chose to "leave his intellectual property to others in the industry in order to boost U.S. gas and oil.").

natory. It may also seem unwise to use political capital to establish these largely undue regulations when the industry's impact on other environmental harms, such as methane emissions,[206] may be far more deserved.

Yet in some regions, the oil and gas industry is already a leader in water conservation. The industry stands to gain political support and pacify objectors by piloting a program to take water conservation further. Water use remains a vital issue for farmers and environmentalists alike. In such a situation, undue regulation may be necessary to explore solutions to a problem that impacts everyone. Increased recycling of wastewater from hydraulic fracturing benefits all water users, environmentalists, and even the oil and gas industry. These interests, which are often at odds, may build trust by collaborating on such a system.

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206. *See* Jennifer Oldham, *Colorado First State to Clamp Down on Fracking Methane Pollution*, BLOOMBERG (Feb. 23, 2014), http://www.bloomberg.com/news/2014-02-24/colorado-first-state-to-clamp-down-on-fracking-methane-pollution.html.