ARTICLES

Regulating Stability: State Compensation Funds for Induced Seismicity

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ABSTRACT

Earthquakes have increased in number and geographic distribution in the United States since 2009. In many cases, they appear tied to hydraulic fracturing or the disposal of wastewater from oil and gas production. Tectonic instability also shakes the public's trust in Oklahoma and other oil and natural-gas producing states. A better policy framework must evolve to meet this challenge. Existing risk management tools create uncertainty for all actors, and the legal system fails to promptly and adequately compensate earthquake victims. This Article therefore advocates for the creation of state induced seismicity compensation funds, to ensure recovery of damages for injuries or lost property, and to contain the looming liability and insurance coverage risks the industry faces. Such a tool would bring predictability and stability to this issue. In addition, a carefully designed fund could facilitate research into the drivers of induced seismicity and mitigate the risk going forward. The Article describes ten existing compensation programs, and evaluates the applicability of their design elements to a Model State Induced Seismicity Fund.

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INTRODUCTION

7:17 AM CDT, September 3, 2016: "#ImAwakeNowBecause in Oklahoma we use earthquakes as alarm clocks"[1]

7:20 AM CDT, September 3, 2016: "MOTHER NATURES 5.8 MAGNITUDE ALARM CLOCK WOKE ME UP 4 HOURS BEFORE THE GAME. THANKS #imawakenowbecause #earthquake"[2]

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1. @ErieMuhammad, TWITTER (Sept. 3, 2016, 7:17 AM), https://twitter.com/ErieMuhammad/status/772045794241196032.
2. @RaeThorpe, TWITTER (Sept. 3, 2016, 7:20 AM), https://twitter.com/RaeThorpe/status/772046495440707588.

> 7:21 AM CDT, September 3, 2016: "Good morning earthquake!! Emporia, KS #ImAwakeNowBecause"[3]

On September 3, 2016, a 5.8 magnitude ("M") earthquake struck less than ten miles northwest of Pawnee, Oklahoma.[4] The earthquake was felt hundreds of miles away, in Kansas, Illinois, Texas, and Missouri.[5] But while it was the strongest tremor ever recorded in Oklahoma,[6] the event was far from unusual. Oklahomans have weathered a 300-fold increase in 3+ M earthquakes from 2009 to 2014, compared to previous decades.[7] In 2009, Oklahoma had twenty earthquakes of 3+ M.[8] That jumped to 585 in 2014—triple the rate of similarly sized earthquakes in California[9]—and 907 in 2015.[10] In 2016, the United States Geological Survey ("USGS") determined that the chance of a damaging earthquake[11] occurring in north-central Oklahoma or southern Kansas—five to twelve percent per year—is the same as in parts of California.[12] While earthquakes slowed last year,[13] there is no guarantee that the downward trend will persist.

Oklahoma is not alone. Since 2009, numerous states have experienced a sharp uptick in what are known as induced seismic events; that is, earthquakes caused

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3. @herewegokids7, TWITTER (Sept. 3, 2016, 7:21 AM), https://twitter.com/herewegokids7/status/772046734415495168.

4. *M 5.8–14km NW of Pawnee, Oklahoma*, U.S. GEOLOGICAL SURVEY (Sept. 3, 2016), https://earthquake.usgs.gov/earthquakes/eventpage/us10006jxs#executive; *Magnitudes of Oklahoma Earthquakes Shift Upward: Revisions Follow Standard USGS Re-Analysis*, U.S. GEOLOGICAL SURVEY (Sept. 7, 2016) [hereinafter USGS Sept. 7], https://www.usgs.gov/news/magnitudes-oklahoma-earthquakes-shift-upward (updating the official magnitude of the Pawnee earthquake from 5.6 to 5.8 M).

5. *Strong Oklahoma Earthquake Felt in Kansas*, KWCH12 (Sept. 7, 2016, 5:39 PM), http://www.kwch.com/content/news/Strong-Oklahoma-earthquake-felt-in-Kansas-392239191.html.

6. USGS Sept. 7, *supra* note 4.

7. D.E. McNamara et al., *Earthquake Hypocenters and Focal Mechanisms in Central Oklahoma Reveal a Complex System of Reactivated Subsurface Strike-Slip Faulting*, 42 GEOPHYSICAL RES. LETTERS, 2742, 2742 (2015). *See also Earthquakes in Oklahoma: FAQs*, OFFICE OF THE SEC'Y OF ENERGY & ENV'T, https://earthquakes.ok.gov/faqs (last visited Mar. 19, 2017) (explaining that numbers of earthquakes are typically discussed in terms of 3+ M earthquakes, because these are the earthquake events able to be felt by most people).

8. *Oklahoma Earthquakes Magnitude 3.0 and Greater*, U.S. GEOLOGICAL SURVEY (Dec. 31, 2016), https://earthquake.usgs.gov/earthquakes/byregion/oklahoma/OKeq-graph.gif.

9. *Id.*; Rivka Galchen, *Weather Underground: The Arrival of Man-Made Earthquakes*, NEW YORKER (Apr. 13, 2015), http://www.newyorker.com/magazine/2015/04/13/weather-underground.

10. OFFICE OF THE SEC'Y OF ENERGY & ENV'T, *supra* note 7.

11. This means at least a VI on the Modified Mercalli Intensity Scale. *See The Modified Mercalli Intensity Scale*, U.S. GEOLOGICAL SURVEY, http://earthquake.usgs.gov/learn/topics/mercalli.php (last visited Mar. 4, 2017). This scale measures the observed effect of a quake, *id.*, whereas the Richter scale measures the seismic waves causing the quake, *see Earthquake Glossary: Richter Scale*, U.S. GEOLOGICAL SURVEY, https://earthquake.usgs.gov/learn/glossary/?term=Richter%20scale (last visited Mar. 19, 2017).

12. MARK D. PETERSEN ET AL., U.S. GEOLOGICAL SURVEY, 2016 ONE-YEAR SEISMIC HAZARD FORECAST FOR THE CENTRAL AND EASTERN UNITED STATES FROM INDUCED AND NATURAL EARTHQUAKES 40 (2016) [hereinafter USGS 2016], http://dx.doi.org/10.3133/ofr20161035; *see also* Michael Wines, *Drilling is Making Oklahoma as Quake Prone as California*, N.Y. TIMES, Mar. 28, 2016, at A12.

13. *Earthquake Catalogs*, OKLA. GEOLOGICAL SURVEY, http://www.ou.edu/content/ogs/research/earthquakes/catalogs.html (last updated Mar. 22, 2017) (posting data sets that indicate 3+ M earthquakes dropped from 903 in 2015 to 623 in 2016).

by human activity.[14] In 2016, for the first time ever, the USGS included induced seismic events in its earthquake hazard risk modeling.[15] The USGS identified twenty-one induced seismicity zones in the United States (including five "unresolved" zones),[16] stretching from Montana to Texas, and from Wyoming to Alabama and Ohio.[17] Induced earthquakes are on the map.

The situation has created instability in Oklahoma and other oil and natural-gas producing states. Earthquakes are on everyone's mind; a newcomer to Oklahoma City is likely to hear stories in her cab ride from the airport.[18] And when a quake occurs, neither the building stock in the central United States nor the legal framework are built to withstand this challenge. Existing risk management tools create uncertainty for all actors, and fail to promptly and adequately compensate earthquake victims. From 2010 to 2015, only nineteen percent of earthquake claims filed in Oklahoma received any payment, and more than half settled for less than $5000.[19]

This Article advocates for the creation of state induced seismicity compensation funds, in order to ensure recovery of damages for injuries or lost property, and contain looming risks associated with liability and insurance coverage that the industry faces. Moreover, a carefully designed fund could facilitate research into the drivers of induced seismicity and mitigate the risks going forward.

Scientists have known for some time that human activities—such as blasting, carbon dioxide sequestration,[20] impoundment of rivers,[21] oil and gas produc-

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14. *See* USGS 2016, *supra* note 12, at 2; Paula E. Finley, Comment, *Bringing Down the House: The Regulation and Potential Liability of Induced Earthquakes*, 4 L.S.U. J. ENERGY L. & RESOURCES 111, 116–19 (2015); PETER FOLGER & MARY TIEMANN, CONG. RES. SERV., HUMAN-INDUCED EARTHQUAKES FROM DEEP-WELL INJECTION: A BRIEF OVERVIEW 1 (2016), https://www.fas.org/sgp/crs/misc/R43836.pdf.

15. *See* Press Release, Induced Earthquakes Raise Chances of Damaging Shaking in 2016, U.S. Geological Survey (Mar. 28, 2016) [hereinafter USGS 2016 Press Release], https://www.usgs.gov/news/induced-earthquakes-raise-chances-damaging-shaking-2016. Previously, the USGS mapped these areas, but deleted the data from the risk modeling dataset. *See, e.g.*, MARK D. PETERSEN ET AL., U.S. GEOLOGICAL SURVEY, DOCUMENTATION FOR THE 2008 UPDATE OF THE UNITED STATES NATIONAL SEISMIC HAZARD MAPS 6–7 (2008) [hereinafter USGS 2008], https://pubs.usgs.gov/of/2008/1128/ (noting that USGS had deleted seismic activity related to fluid injection in Paradox Valley, Colorado, mining in Colorado and Utah, and oil production in the Dagger Draw field in New Mexico because USGS experts did not expect that "future large hazardous events will be associated with the activity"); MARK D. PETERSEN ET AL., U.S. GEOLOGICAL SURVEY, DOCUMENTATION FOR THE 2014 UPDATE OF THE UNITED STATES NATIONAL SEISMIC HAZARD MAPS 178 (2014), https://pubs.usgs.gov/of/2014/1091/.

16. USGS 2016, *supra* note 12, at 3–5. In addition, the report identified eleven regions for future consideration. *Id.* at 11.

17. *Id.* at 6.

18. Conversation with Sierra Lambeth, Taxicab Driver, in Oklahoma City, Okla. (Sept. 28, 2015).

19. *See* News Release, Okla. Ins. Comm'r, Competitiveness Concerns Raised after Data Reveals Four Companies Have 55% of Earthquake Market (May 24, 2016), https://www.ok.gov/triton/modules/newsroom/newsroom_article.php?id=157&article_id=21909; *see also* OKLA. INS. DEP'T, EARTHQUAKE INS. BULL. No. PC 2015-02 (2015) [hereinafter OKLA. INS. DEP'T 2015-02], https://www.ok.gov/oid/documents/030415_Earthquake%20Bulletin%203-3-15.pdf.

20. *See* Joel Sminchak et al., *Issues Related to Seismic Activity Induced by the Injection of CO_2 in Deep Saline Aquifers*, 2 J. ENERGY & ENVTL. RES. 32 (2002).

21. *See, e.g.*, Pradeep Talwani, *On the Nature of Reservoir-Induced Seismicity*, 150 PURE & APPLIED

tion,[22] geothermal energy,[23] and underground wastewater disposal[24]—can cause earthquakes.[25] Following an expansion in the use and scale of hydraulic fracturing to produce oil and natural gas[26] and commensurate growth in the underground disposal of hydraulic fracturing wastewater,[27] the United States experienced a large and more broadly distributed number of earthquakes, relative to historic levels of seismicity. Relying on models, standard earthquake equations, and case histories, scientists have established a general link between oil and gas activities and these seismicity trends.[28] For instance, almost all of the 3+ M earthquakes in Oklahoma have occurred in the regions where wastewater disposal occurs; in north-central Oklahoma, outside of the state's disposal zone,

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GEOPHYSICS 473, 473 (1997) ("Since the identification of a causal association of seismicity with the impoundment of Lake Mead in the early 1940s, reservoir-induced seismicity has been observed at over seventy locations worldwide." (citations omitted)).

22. *See, e.g.*, Scott D. Davis et al., *The April 9, 1993 Earthquake in South-Central Texas: Was it Induced by Oil and Gas Production?*, 85 BULL. SEISMOLOGICAL SOC'Y AM. 1888 (1995); Vitaly V. Adushkin et al., *Seismicity in the Oil Field*, 12 OILFIELD REV. 2 (2000); Jenny Suckale, *Induced Seismicity in Hydrocarbon Fields*, 51 ADVANCES IN GEOPHYSICS 55 (2009) (assembling seventy cases of hydrocarbon fields where hydrocarbon production has been related to unusually large seismic activity in the scientific literature, but noting that not all may have exhibited true induced seismicity).

23. *See, e.g.*, Donna Eberhart-Phillips & David H. Oppenheimer, *Induced Seismicity in The Geysers Geothermal Area, California*, 89 J. GEOPHYSICAL RES. 1191 (1984) (studying correlation between geothermal production and seismic activity); Bill Smith et al., *Seismicity in the SE Geysers Field*, *California, USA*, PROC. WORLD GEOTHERMAL CONGRESS 2000, 2887 (2000).

24. *See, e.g.*, J.H. Healy et al., *The Denver Earthquakes*, 161 SCI. 1301 (1968) (correlating earthquakes to wastewater injection at the Denver Rocky Mountain Arsenal); Jon Ake et al., *Deep-Injection and Closely Monitored Induced Seismicity at Paradox Valley, Colorado*, 95 BULL. SEISMOLOGICAL SOC'Y AM. 664 (Apr. 2005) (demonstrating a causal link between wastewater injection in Colorado's Paradox Valley, and thousands of small tremors).

25. *See also* FOLGER & TIEMANN, *supra* note 14, at 1 (listing reservoir impoundments, mining, withdrawal of fluids such as oil and gas, and injection of fluids into subsurface formations as induced seismicity triggers); Darlene A. Cypser & Scott D. Davis, *Induced Seismicity and the Potential for Liability under U.S. Law*, 289 TECTONOPHYSICS 239, 241–43 (1998) [hereinafter Cypser & Davis 1998] (listing numerous studies linking various injection and production activities with tremors); Craig Nicholson & Robert L. Wesson, *Triggered Earthquakes and Deep Well Activities*, 139 PURE & APPLIED GEOPHYSICS 561 (1992) (drawing lessons from more than thirty case studies of production and waste water disposal).

26. James McBride & Mohammed Aly Sergie, *Hydraulic Fracturing*, COUNCIL ON FOREIGN RELATIONS (June 10, 2015), http://www.cfr.org/energy-and-environment/hydraulic-fracturing-fracking/p31559; IHS CERA, FUELING THE FUTURE WITH NATURAL GAS: BRINGING IT HOME (2014), https://www.fuelingthefuture.org/assets/content/AGF-Fueling-the-Future-Study.pdf.

27. *See, e.g.*, K.M. Keranen et al., *Sharp Increase in Central Oklahoma Seismicity Since 2008 Induced by Massive Wastewater Injection*, 345 SCI. 448 (2014) (noting that dewatering production wells in Oklahoma—which became economic in the 2000s—initially produce up to 200 times as much water per barrel of oil as conventional production wells).

28. *See* William L. Ellsworth, *Injection-Induced Earthquakes*, 341 SCI. 142 (2013); Keranen et al., *supra* note 27 (using earthquake models to explain the swarm of earthquakes in the central United States from 2008 to 2013); Danielle F. Sumy et al., *Observations of Static Coulomb Stress Triggering of the November 2011 M5.7 Oklahoma Earthquake Sequence*, 119 J. GEOPHYSICAL RES.: SOLID EARTH 1904, 1904 (2014) (describing the possible mechanisms—fluid injection and a 5 M foreshock—"trigger[ing] a cascading failure of earthquakes along the complex Wilzetta fault system").

quakes are "generally consistent with the tectonic background activity."[29] In addition, when scientists have mapped injection volumes and reservoir pressure rates on top of earthquake records, the pressure rates lag injection by several months, but follow the shape of the injection curve, and correlate highly to the quake records.[30] Further, in some instances, research has linked or at least pointed to circumstantial evidence connecting specific injection wells to seismic events.[31]

While science has moved relatively quickly to establish a link and explore the drivers of induced seismicity in the central United States, law and policy have lagged behind. Insurance products, regulatory frameworks, and court systems have not responded quickly or adequately to the spike in manmade earthquakes. People in the Midwest turned to their homeowners insurance policies to repair and rebuild damaged homes, only to find that the policies did not cover earthquake damage,[32] or that separately purchased earthquake endorsements excluded losses caused by human-caused tremors.[33] Moreover, in some jurisdictions, a small number of actors dominate the earthquake insurance market, resulting in few choices for consumers and concerns about non-competitive pricing.[34]

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29. Cornelius Langenbruch & Mark D. Zoback, *How Will Induced Seismicity in Oklahoma Respond to Decreased Saltwater Injection Rates?*, 2 SCI. ADVANCES 1, 1–2 (2016).

30. *See id.* at 3 fig.3; *see also id.* at 4 (describing the *b* values of earthquakes in Oklahoma—noting that they follow the pattern of other known induced events and deviate from natural tremors). The variable *b* is a value of the Gutenberg-Richter law, which describes the relationship between the number and magnitude of earthquakes in a given location. *See* NAT'L RESEARCH COUNCIL, INDUCED SEISMICITY POTENTIAL IN ENERGY TECHNOLOGIES 212–13 (2013). The *b* value represents the relationship between the number of large and small earthquakes. *Id.* Generally, there are about ten earthquakes at a certain magnitude for every one earthquake at the next magnitude. *Id.* However, there are more earthquakes at the lower magnitude—i.e., a greater number of small earthquakes—when seismicity is induced, as compared to tectonic earthquakes. *See id.*

31. *See* OHIO DEP'T OF NAT. RES., PRELIMINARY REPORT ON THE NORTHSTAR 1 CLASS II INJECTION WELL AND THE SEISMIC EVENTS IN THE YOUNGSTOWN, OHIO, AREA (2012) [hereinafter ODNR 2012] (noting a likely link between injection activities at a particular well and earthquakes); Leonardo Seeber et al., *The 1994 Cacoosing Valley Earthquakes near Reading, Pennsylvania: A Shallow Rupture Triggered by Quarry Unloading*, 103 J. GEOPHYSICAL. RES. 24,505 (1998); Leonardo Seeber & John G. Armbruster, *Natural and Induced Seismicity in the Lake Erie-Lake Ontario Region—Reactivation of Ancient Faults with Little Neotectonic Displacement*, 47 GEOGRAPHIE PHYSIQUE ET QUATERNAIRE 363 (1993) (correlating 1983 earthquakes in Ohio with injection events at a Class I well in Ashtabula County). *But see* H. Gerrish & A. Nieto, *Evaluation of Injection Reservoir Information in Relation to Earthquakes in Ashtabula, Ohio*, *in* UNDERGROUND INJECTION SCIENCE AND TECHNOLOGY 377–401 (Chin-Fu Tsang & John A. Apps eds., 2005) (questioning the link); Healy et al., *supra* note 24; *see also* Cypser & Davis 1998, *supra* note 25, at 241–43.

32. NAT'L ASS'N OF INS. COMM'RS, A CONSUMER'S GUIDE TO EARTHQUAKE INSURANCE 3 (2011) [hereinafter NAIC GUIDE]; Press Release, Kan. Ins. Dep't, Consumer Alert: Earthquake Insurance Coverage is Separate from Homeowners Insurance (Jan. 21, 2016), http://www.ksinsurance.org/documents/department/consumer-alerts/Consumer-alert-earthquake-1-21-16.pdf.

33. *See, e.g.*, OKLA. INS. DEP'T 2015-02, *supra* note 19, at 1–2; OKLA. INS. DEP'T, EARTHQUAKE INS. BULL. No. PC 2015-04 (2015) [hereinafter OKLA. INS. DEP'T 2015-04], https://www.ok.gov/oid/documents/102115_EQ%20Bulletin.pdf.

34. Okla. Ins. Comm'r, *supra* note 19; Blake Watson, *Fracking and Cracking: Strict Liability for Earthquake Damage due to Wastewater Injection and Hydraulic Fracturing*, 11 TEX. J. OIL GAS & ENERGY L. 1, 29 (2016) (citing letter to the editor by Terry Lipstein, *Fracking, Earthquakes and Insurance*, DENVER POST (Apr. 26,

Federal and state regulatory frameworks were likewise found lacking. EPA sets minimum federal standards for wastewater injection wells (Underground Injection Control standards, or "UICs") under the Safe Drinking Water Act ("SDWA").[35] The statute is silent on induced seismicity; the issue is briefly addressed in rules for oil and gas (Class II) wells,[36] but only with discretionary measures.[37]

EPA has delegated primary responsibility for the Class II UIC program to forty-one states.[38] No delegated state has moved beyond EPA's minimum class II seismicity requirements.[39] Moreover, before 2011, states had no other regulations specifically targeting the induced seismicity risks posed by hydraulically fractured wells or wastewater wells.[40] Since that time, some eight states have amended regulations or made procedural changes to well permitting and operation.[41] But the changes are piecemeal; for instance, California amended its hydraulic fracturing rules in 2015[42] but not its Class II rules, despite having more than 50,000 Class II wells in the state.[43] (About 1500 of these Class II wells are strictly disposal wells; operators use the rest to enhance recovery in depleted fields.[44]) Texas rules cover injection and enhanced recovery wells,[45] while most recently, Oklahoma has expanded induced seismicity oversight to include production wells.[46]

Once an earthquake occurs, regulations to reduce the resulting harm likewise may not exist. For instance, before 2016, induced seismic events had not been

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2015, 5:03 PM), http://dpo.st/22ck3LJ (complaining that insurance coverage for induced seismicity was either not available or came with a $50,000 deductible)).

35. 42 U.S.C. § 300h (2015).

36. *See* 40 C.F.R. § 146.24(a)(2) (2016) (noting that as part of a Class II well permit application, the applicant "may" have to indicate on a map "faults if known or suspended").

37. *Id.*; *see also* UIC NAT'L TECH. WORKGRP., MINIMIZING AND MANAGING POTENTIAL IMPACTS OF INJECTION-INDUCED SEISMICITY FROM CLASS II DISPOSAL WELLS: PRACTICAL APPROACHES 3–4 (2014).

38. 42 U.S.C. § 300h-1; *Underground Injection Control: Primary Enforcement Authority for the Underground Injection Control Program*, ENVTL. PROT. AGENCY, https://www.epa.gov/uic/primary-enforcement-authority-underground-injection-control-program (last visited Mar. 27, 2017).

39. *See* OHIO DEP'T OF NAT. RES., CLASS II INJECTION AND INDUCED SEISMICITY: EMERGENCY RULES: EXECUTIVE SUMMARY 3 (2015) [hereinafter ODNR 2015] (on file with the law review).

40. *See infra* section I.B.1 (discussion of state regulatory response beginning in Arkansas in 2011).

41. *See infra* section I.B.1.

42. CAL. CODE REGS. tit. 14, § 1785.1 (West 2017). California rules define "hydraulic fracturing" to include stimulation treatment that causes or enhances production, so some enhanced recovery wells are covered here. *Id.* § 1781(k).

43. *See* CAL. REG'L WATER QUALITY CONTROL BD., CENT. COAST REGION, STAFF REPORT FOR REGULAR MEETING OF MARCH 17–18, 2016, ITEM NO. 10, at 3 (Feb. 24, 2016), http://www.waterboards.ca.gov/centralcoast/board_info/agendas/2016/march/item10/item10_stfrpt.pdf.

44. *Id.*

45. 16 TEX. ADMIN. CODE §§ 3.9, 3.46 (2017); R.R. COMM'N OF TEX., OFFICE OF GENERAL COUNSEL, ADOPTION OF AMEND. TO 16 TEX. ADMIN. CODE § 3.9, RELATING TO DISPOSAL WELLS, AND § 3.46, RELATING TO FLUID INJECTION INTO PRODUCTIVE RESERVOIRS, OIL & GAS DOCKET NO. 20-0290951 (2014), http://www.rrc.state.tx.us/media/24613/adopt-amend-3-9and3-46-seismic-activity-102814-sig.pdf.

46. *See* Press Release, Okla. Corp. Comm'n, New Year, New Plays, New Plans (Dec. 20, 2016), http://www.occeweb.com/News/2016/12-20-16SCOOP-STACK.pdf.

included in USGS hazard maps.[47] Because these maps inform local building codes,[48] residential and commercial structures in induced seismic zones may not be built to withstand tremors.

Meanwhile, courts are being asked to settle claims for damages from induced earthquakes. Absent a statute or lease provision targeting this issue, courts are left to apply common law to these disputes.[49] Common law is unsettled on many fundamental questions, including whether hydraulic fracturing and wastewater injection are inherently "ultra-hazardous" activities that carry no-fault liability,[50] and what a plaintiff must show to establish that a particular well caused a seismic event and harm to a person or her property.[51] For the foreseeable future, the unfolding state of the law will create enormous uncertainty for all parties. Moreover, given the downturn in the oil and gas industry,[52] and the number of firms filing for bankruptcy in Oklahoma's seismically active region,[53] a prevailing plaintiff still may not be fully compensated. A major energy law firm identified 114 North American oil and natural gas producers that filed for bankruptcy in 2015 and 2016.[54] In 2016 alone, seventy producers filed for bankruptcy, reporting $56.8 billion in debt.[55]

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47. USGS 2016 Press Release, *supra* note 15.

48. The seismic hazard maps created by the USGS are used to update the National Earthquake Hazards Reduction Program's *Recommended Seismic Provisions*, which in turn are incorporated by the most prominent model building code, the International Building Code, and used by the American Society of Civil Engineers in their standards. *See* NAT'L INST. OF BLDG. SCI., BLDG. SEISMIC SAFETY COUNCIL, EARTHQUAKE-RESISTANT DESIGN CONCEPTS 8–10 (2010), https://c.ymcdn.com/sites/www.nibs.org/resource/resmgr/BSSC/FEMA_P-749.pdf.

49. *Common Law*, MERRIAM-WEBSTER.COM, https://www.merriam-webster.com/dictionary/common law (last visited Mar. 5, 2017) ("[T]he body of law developed in England primarily from judicial decisions based on custom and precedent, unwritten in statute or code, and constituting the basis of the English legal system and of the system in all of the United States except Louisiana."); *see, e.g.*, Native Village of Kivalina v. ExxonMobil Corp., 696 F.3d 849, 856 (9th Cir. 2012) (quoting City of Milwaukee v. Illinois, 451 U.S. 304, 314 (1981)) ("[C]laims can be brought under federal common law for public nuisance only when the courts are compelled to consider federal questions which cannot be answered from federal statutes alone.").

50. RESTATEMENT (SECOND) OF TORTS § 520.

51. *See, e.g.*, Jackson v. Jones, 907 P.2d 1067, 1073 (Okla. 1995) (describing the fact-based inquiry needed to determine whether "a causal chain between a negligent act and an injury may be broken by an intervening event—a *supervening cause*," or whether "*several events coincide*" to cause an injury); Christian v. Gray, 65 P.3d 591, 602 (Okla. 2003) (describing the distinctions made in chemical exposure cases between general causation—"whether a substance is capable of causing a particular injury or condition"—and specific causation—"whether that substance caused the particular individual's injury").

52. *See, e.g.*, Chad Wilkerson, *How Much is the Oil Downturn Hurting the Overall Oklahoma Economy?*, FED. RESERVE BANK OF KAN. CITY: OKLA. ECONOMIST (2015), https://www.kansascityfed.org//media/files/publicat/oke/2015/oil-downturn-hurting-ok-economy.pdf).

53. *See, e.g.*, Brianna Bailey, *Number of Oklahoma Energy Companies Filing for Bankruptcy to Rise in Coming Months*, THE OKLAHOMAN (Mar. 22, 2016), http://newsok.com/article/5486187; Tom Hals, *SandRidge, Breitburn Join Wave of Energy Bankruptcy Filings*, REUTERS (May 16, 2016), http://www.reuters.com/article/us-sandridge-bankruptcy-idUSKCN0Y718Y.

54. *Oil Patch Bankruptcy Monitor*, HAYNES & BOONE LLP (Dec. 14, 2016), http://www.haynesboone.com//media/files/attorney%20publications/2016/energy_bankruptcy_monitor/oil_patch_bankruptcy_20160106.ashx.

55. *Id.*

With limited insurance options, newly emerging regulatory standards, and uncertain litigation outcomes, the induced seismicity picture can be murky and frustrating for all stakeholders. Indeed, recovery for damages following an induced earthquake can be an uphill and expensive battle. Uncompensated losses fuel public concerns about earthquakes, as well as the capacity (and willingness) of government and industry to respond,[56] which in turn risks an episodic over-response by regulators, who may impose a moratorium or shut in wells unnecessarily. In this charged environment, information gathering is fraught with difficulty—well operators are understandably reluctant to share data with regulators, researchers, and the general public.[57] This reluctance delays accurate fault mapping[58] and actions to reduce the occurrence of induced seismicity.[59]

All of these outcomes can be avoided. Specifically, this Article proposes a state model compensation fund for damages caused by oil and gas induced seismicity. These types of funds can lower the burden of proof and expedite claims processing for the person seeking damages. For instance, the fund could enable property owners to recover for damage—perhaps subject to caps—without having to prove that a particular injection event or site caused the harm, thus diverting these claims from the court system and reducing litigation costs. Compensation funds can also serve to discourage risky industry behaviors—violation of rules or permit conditions could negate fund eligibility, or increase a company's payments into the fund—and reduce the liability profile for responsible injection practices. A well-designed compensation fund could replace first-party insurance products, or serve as a stopgap measure until there is a competitive insurance market for induced seismicity coverage. Finally, a state

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56. *See, e.g.*, A. McGarr et al., *Coping with Earthquakes Induced by Fluid Injection*, 347 SCI. 830, 831 (2015) (noting that seismic data must be public "[f]or purposes of transparency and avoiding public distrust"); John D. Graham et al., *Unconventional Gas Development in the USA: Exploring the Risk Perception Issues*, 35 RISK ANALYSIS 1770, 1779 (2015) (noting that "[c]oncerns tend to escalate when information about potential hazards is kept secret by business and/or government").

57. *See, e.g.*, Oliver Morrison, *Was 5.8 Earthquake Just a Foreshock? Kansas Geologist Asks*, WICHITA EAGLE (Oct. 21, 2016, 8:45 PM), http://www.kansas.com/news/local/article109811747.html; *see also* INFO. TECH. INDUS. COUNCIL, ITI RECOMMENDATION: ADDRESSING LIABILITY CONCERNS IMPEDING MORE EFFECTIVE CYBERSECURITY INFORMATION SHARING (2012), https://www.itic.org/dotAsset/2962f7a8-5b34-4729-bd8f-94cdbf29ebd3.pdf; Paul Taylor, *Liability Concerns Hold Back Data Sharing*, FIN. TIMES (Mar. 28, 2014), https://www.ft.com/content/306583f0-b5d3-11e3-a1bd-00144feabdc0.

58. *Geophysicist Says Pawnee Earthquake Happened on Newly Discovered Fault*, KWCH (Sept. 6, 2016, 10:39 PM), http://www.kwch.com/content/news/Geophysicist-says-Pawnee-earthquake-happened-on-newly-discovered-fault-392522211.html; Sean Murphy, *Oklahoma, EPA Shut Down 32 Wells Near Newly Discovered Fault Line*, INS. J. (Sept. 14, 2016), http://www.insurancejournal.com/news/southcentral/2016/09/14/426473.htm.

59. *See, e.g.*, Trent Jacobs, *Searching for Solutions to Induced Seismicity*, 66 J. PETROLEUM TECH. 60, 65 (2014) (noting that small disposal well companies may not have access to "detailed subsurface knowledge, making it difficult to assess the risk for each well" and that most states do not require daily reporting of injection volumes and pressures); *see also* 16 TEX. ADMIN. CODE § 3.9(11)(A)–(B) (2017) (disposal wells); *id.* § 3.46(i)(1)–(2) (enhanced recovery wells). *But see* OKLA. ADMIN. CODE § 165:10-5-7(c)(3)(B) (2014) (changing monthly reporting to daily reporting for disposal wells drilled into the Arbuckle formation).

could tie participation in the fund to data sharing requirements, to encourage companies to provide seismic mapping and monitoring results with the state in exchange for greater certainty and managed liability.

Part I describes existing mechanisms for managing the risk of induced seismicity—insurance, regulation, and liability theories—and provides a brief "state of play" for each. Part II explores the literature comparing the relative benefits of these risk management tools. This Part determines that, while existing tools have their benefits and should continue to be employed to some extent, compensation funds may be more effective at reducing uncertainty, compensating losses, and lowering risk in the induced seismicity context. Part III looks at existing state and federal compensation and trust funds created for other risk situations, to provide examples for the Model Induced Seismicity Fund. Part IV describes seven design elements for the Model Induced Seismicity Fund, and suggests a range of options for each element based on existing funds. Part V suggests a way to encourage data sharing alongside a compensation fund.

I. MECHANISMS FOR MANAGING THE RISKS OF INDUCED SEISMICITY

This section describes the three existing mechanisms for managing the seismic risks posed by oil and gas production and disposal activities. The section describes the state of play for each mechanism—insurance, regulation, and tort liability—as well as its shortcomings. While these tools play useful roles in managing and sometimes mitigating risk, they are insufficient in their current state to meet the induced seismicity challenge.

A. LOW MARKET PENETRATION OF EARTHQUAKE INSURANCE AND UNCLEAR COVERAGE

Two types of insurance are relevant in the induced seismicity context: first-party insurance, and third-party liability insurance.[60] First-party insurance covers the victim and her property; third-party liability insurance covers a person or company's liability to other people or property.[61] First-party earthquake insurance has low market penetration and may not be sufficiently competitive; third-party coverage is unclear.

Earthquake insurance is not new,[62] but coverage is dynamic. Over time, industry crafts new insurance products, adjusts rate structures, and expands or

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60. Benjamin J. Richardson, *Mandating Environmental Liability Insurance*, 12 DUKE ENVT'L L. & POL'Y F. 293, 295 (2002).

61. *Id.* at 322–23; *see also* Montrose Chem. Corp. of Cal. v. Admiral Ins. Co., 913 P.2d 878, 886 (Cal. 1995) (describing the difference between a first party insurance policy and a third party insurance policy).

62. *See* S. CAL. EARTHQUAKE PREPAREDNESS PROJECT, EARTHQUAKE INSURANCE: A PUBLIC POLICY DILEMMA, EARTHQUAKE HAZARDS 2 (1985), https://www.fema.gov/media-library-data/20130726-1600-20490-8046/fema_68.pdf (noting that U.S. earthquake insurance was likely created in response to the 1906 San Francisco earthquake, and that the first independent policy targeting earthquake hazards was written in 1916); *see generally* KARL V. STEINBRUGGE, EARTHQUAKES, VOLCANOES, AND TSUNAMIS: AN ANATOMY OF HAZARDS (1982).

contracts markets based on earthquake forecasting and risk trends.[63] Some scholars agree that insurance regimes play an important role in addressing emerging or hard-to-quantify risks, deploying their market-based tools to manage and minimize uncertainty.[64] And yet, there are limits to what may be insured.[65] For instance, following the devastating 1994 Northridge earthquake in northern California and models forecasting more frequent earthquakes of this magnitude, most insurers left the first-party insurance market.[66]

1. First-Party Liability Insurance

California law requires insurance companies to offer earthquake insurance with homeowners' policies;[67] as a result, months after the 1994 Northridge earthquake, "companies representing 95 percent of the California homeowners insurance market had either restricted or stopped writing homeowners policies altogether."[68] In response, the California legislature created the California Earthquake Authority, a publicly managed, privately funded entity that offers earthquake coverage.[69]

Outside of California, earthquake coverage is not a requirement for homeowners insurance. Therefore, many property owners were surprised to learn that they had no coverage when the number and magnitude of earthquakes began to rise in the central United States.[70] A late 2015 survey by the Insurance Information Institute found that only eight percent of property owners in the Midwest had separate earthquake coverage, behind the West (eighteen percent) and even the

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63. *See, e.g.*, *Our Researc*h, CALIFORNIA EARTHQUAKE AUTHORITY, http://www.earthquakeauthority.com/whoweare/Pages/research.aspx (last visited Oct. 30, 2016); E.H. FIELD ET AL., U.S. GEOLOGICAL SURVEY, UCERF3: A NEW EARTHQUAKE FORECAST FOR CALIFORNIA'S COMPLEX FAULT SYSTEM 4–5 (2015), https://pubs.usgs.gov/fs/2015/3009/pdf/fs2015-3009.pdf; *Hydraulic Fracturing*, NAT'L ASS'N OF INS. COMM'RS (Sept. 18, 2016), http://www.naic.org/cipr_topics/topic_hydraulic_fracturing.htm [hereinafter NAIC *Fracking*] (noting that the one-year model "coincides with property insurance contracts" and might influence changes in coverage terms).

64. *See, e.g.*, David A. Dana & Hannah J. Wiseman, *A Market Approach to Regulating the Energy Revolution: Assurance Bonds, Insurance, and the Certain and Uncertain Risks of Hydraulic Fracturing*, 99 IOWA L. REV. 1523, 1563–66 (2014); Richardson, *supra* note 60, at 297 (citing Jeffrey Kehne, *Encouraging Safety Through Insurance-Based Incentives: Financial Responsibility for Hazardous Wastes*, 96 YALE L.J. 403, 410–11 (1986)).

65. *See, e.g.*, Richardson, *supra* note 60, at 296 (citing JAMES L. ATHEARN ET AL., RISK AND INSURANCE 32–36 (6th ed. 1977)) (describing the ideal features of "an insurable situation"); Omri Ben-Shahar & Kyle D. Logue, *Outsourcing Regulation: How Insurance Reduces Moral Hazard*, 111 MICH. L. REV. 197, 203 (2012).

66. E.H. FIELD ET AL., *supra* note 63, at 2.

67. CAL. INS. CODE § 10081 (West 2017).

68. *Our History*, CAL. EARTHQUAKE AUTH., https://www.earthquakeauthority.com/who-we-are/cea-history (last visited May 17, 2017).

69. *See* KNOWLES, CONF. REP. COMM. ANALYSIS, A.B. 2086 (Cal. 1996).

70. *See, e.g.*, Anne Obersteadt, *Insurance Regulators Discuss Earthquake Issues and Challenges at CIPR Event*, 17 CIPR NEWSL. 4 (2015), http://www.naic.org/cipr_newsletter_archive/vol17_earthquake.pdf; *Does My Homeowner's Insurance Cover Earthquake Damage?*, RCI INS. GRP. BLOG (Nov. 22, 2010), https://rciinsurance.wordpress.com/2010/11/22/does-my-oklahoma-homeowners-insurance-cover-earthquake-damage/.

Northeast (nine percent).[71]

State insurance commissioners are working to educate homeowners about the need to acquire separate earthquake insurance.[72] While more Oklahomans have purchased earthquake coverage in recent years,[73] many are dissuaded by the costly premiums[74] and high deductibles.[75] In June 2016, the Oklahoma Insurance Department began requiring companies to file a notice before imposing rate increases, and the Department announced it may contest increases out of a concern that the market is not competitive.[76] Other would-be policy purchasers have been turned away, as insurance companies withhold new policies within 100 miles of the epicenter and up to 60 days after an earthquake of at least 3 M.[77] While the purpose of the moratorium is to exclude coverage for aftershocks, this policy can pose a serious obstacle to acquiring insurance in a seismically active region.

Those covered by earthquake insurance have faced additional frustrations when seeking payment for damages. The largest barrier to recovery has been the

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71. *What Homeowners, Renters and Drivers Know—and Ought to Know*, INS. INFO. INST. (Dec. 15, 2015), http://www.iii.org/sites/default/files/docs/pdf/pulse-wp-112415-8-final.pdf; *see also* Obersteadt, *supra* note 70 (observing that fifteen percent of Oklahomans were covered under earthquake insurance in 2015, up from two percent in 2011).

72. *See, e.g.*, Kan. Ins. Dep't, *supra* note 32; News Release, Okla. Ins. Dep't, Insurance Department Offering Help After Historic Earthquake (Sept. 6, 2016), https://www.ok.gov/triton/modules/newsroom/newsroom_article.php?id=157&article_id=25219; Steve Bottari, *Insurance Commissioner Says Office Has Been Fielding Variety of Quake Questions*, KOCO NEWS 5 (Jan. 13, 2016, 5:24 PM), http://www.koco.com/article/insurance-commissioner-says-office-has-been-fielding-variety-of-quake-questions/3857738.

73. Brianna Bailey, *Despite Few Payouts on Claims, Oklahomans are Buying Earthquake Insurance*, THE OKLAHOMAN (Jan. 4, 2016, 8:58 PM), http://newsok.com/article/5470594 (reporting that premiums written in Oklahoma rose twenty-five percent in 2014).

74. For instance, the cost of earthquake insurance for homeowners near the New Madrid Seismic Zone in Missouri rose 500% between 2000 and 2015, and coverage fell from 60% to 17.8%. MO. DEP'T OF INS., FIN. INST., & PROF'L REGISTRATION, THE STATE OF EARTHQUAKE COVERAGE: 2015 SUPPLEMENT, at 1 (2016), http://insurance.mo.gov/consumers/home/documents/Earthquake-Insurance-Report-2015-6-8-2016.pdf; *see also* Okla. Ins. Comm'r, *supra* note 19 (noting that the Insurance Dep't had received twelve rate-increase filings since August 2014, ranging from 4 to 300%).

75. *See* Patty Santos, *Oklahomans Confused about Earthquake Insurance Coverage*, KOCO NEWS 5 (Jan. 4, 2016, 6:21 PM), http://www.koco.com/article/oklahomans-confused-about-earthquake-insurance-coverage/4307634 (quoting Oklahoma Insurance Department spokesman that deductibles range from two to ten percent of a home's value); Abby Broyles, *Oklahomans Speaking up at Public Forum About Earthquakes*, KFOR (Jan. 15, 2016, 6:20 PM), http://kfor.com/2016/01/15/public-hearing-underway-at-state-capitol-over-earthquake-concerns/ (quoting the Oklahoma Insurance Commissioner noting that earthquake insurance carries high deductibles because it is meant to cover catastrophic losses).

76. Okla. Ins. Comm'r, Order In Re: Earthquake Insurance Rates, Case No. 16-0391-TRN (June 5, 2016), https://www.ok.gov/oid/documents/060716_16-0391-TRN%20GCA%20Order%20In%20Re-Earthquake%20Insurance%20Rates.pdf; *see also* News Release, Okla. Ins. Comm'r, Commissioner Doak Declares Earthquake Insurance Market Noncompetitive (June 7, 2016), https://www.ok.gov/triton/modules/newsroom/newsroom_article.php?id=157&article_id=22519.

77. Okla. Ins. Comm'r, *supra* note 19; *see also* News Release, Okla. Ins. Comm'r, Commissioner Doak Clarifies Moratoriums on Earthquake Insurance (Sept. 13, 2016), https://www.ok.gov/triton/modules/newsroom/newsroom_article.php?id=157&article_id=25560 (noting that, despite rumors that bans on new policies extend six months after an earthquake, the longest moratorium the Commissioner has seen is six days).

insurance industry's argument that existing earthquake riders only cover naturally occurring tremors.[78] In addition, many policies exclude pre-existing conditions; invoking these provisions, insurance companies have required policyholders to prove that cracks in home foundations and other damage were not caused by previous earthquakes, or by an unrelated phenomenon, such as drought.[79] Some earthquake policies do not cover damage to brick or masonry exteriors or chimneys.[80] These factors have dampened the number of claims filed, and resulted in a small rate of recovery. Of the 1094 claims filed in Oklahoma from 2010 through 2015, only 208 (or nineteen percent) received any payment, and about half of the paid claims resulted in payments of less than $5000.[81]

2. Third-Party Liability Insurance

First-party liability coverage places the burden on would-be earthquake victims to protect themselves. By contrast, well operators purchase third-party liability insurance to cover harms to others when operators are found responsible in a court of law, or under an alternate compensation regime.

There are many policies, endorsements, and riders marketed to the oil and gas industry; for the most part, their applicability to induced seismic events remains unclear. Most drilling companies hold commercial general liability ("CGL") insurance.[82] These broad policies usually include a "duty to defend" provision, meaning that if they are implicated in a lawsuit against the operator, the insurance company will direct the litigation and determine any settlement.[83] Many companies also hold business interruption ("BI") insurance to protect themselves in the

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78. *See* OKLA. INS. DEP'T 2015-02, *supra* note 19, at 2 (observing that earthquake insurance often excludes "loss due, in whole or in part, to any 'man-made' cause such as construction, mining, oil and gas exploration and production" but noting that "[a]t present, there is no agreement at a scientific or governmental level concerning any connection between injection wells or fracking and 'earthquakes'" and that the Commissioner would launch a "market conduct examination" to determine why so many claims were denied, given the "unsupported belief" that Oklahoma earthquakes were man-made); *see also* OKLA. INS. DEP'T 2015-04, *supra* note 33 (now noting an established link between earthquakes in Oklahoma and fracking waste water injection into disposal wells, noting confusion about coverage for man-made earthquakes, and directing insurance companies to clarify coverage).

79. *See* OKLA. INS. DEP'T 2015-02, *supra* note 19, at 2 (noting the Department expects any insurance company denying a claim based on a pre-existing condition to have inspected the property prior to the event triggering the claim).

80. *See, e.g.*, NAIC GUIDE, *supra* note 32, at 4 (noting that some policies do not cover brick veneer on homes); *see also* NORTH STAR MUT. INS. CO., "ALL STAR" HOMEOWNERS 16 (2017), http://northstarmutual.com/UserFiles/File/agentmanual/sd/SDAllStar.pdf (homeowner's policy noting that "loss to exterior veneer is not covered" if specific exclusion applies).

81. *See* Okla. Ins. Comm'r, *supra* note 19.

82. *See* Robert Lewin et al., *Emerging Insurance Issues in the Debate Over 'Fracking'*, INS. COVERAGE L. REP., Dec./Jan. 2013, at 23–24, http://www.stroock.com/siteFiles/Pub1287.pdf. CGL insurance is the dominant general liability policy in the United States. *Id.*; *see also* RANDY MANILOFF & JEFFREY STEMPEL, GENERAL LIABILITY INSURANCE COVERAGE: KEY ISSUES IN EVERY STATE 1 (3d ed. 2011).

83. *See* MANILOFF & STEMPEL, *supra* note 82, at 3.

event of a cessation of work;[84] contingent business interruption ("CBI") policies extend this coverage to the insured's supply chain. For instance, BI policies might be called upon if a regulator shuts down a disposal well following an earthquake, whereas CBI policies might come into play if neighboring production wells seek damages from the disposal well operator.[85]

In the 1970s—and culminating in the 1980 federal "Superfund" law that made companies strictly liable, jointly and severally liable, and retroactively liable for releases of hazardous substances[86]—insurance companies began writing "qualified"[87] and then "absolute" pollution exclusions in CGL and other contracts.[88] Pollution exclusions are heavily litigated, and the outcomes are fact-intensive, state-specific, and hard to predict.[89]

To ensure coverage for environmental harms, some firms will purchase separate pollution insurance.[90] However, this coverage is likewise fraught with uncertainty in the induced seismicity context. In June 2016, insurers filed a complaint for declaratory judgment in a federal court in New York,[91] seeking a ruling by the court that New Dominion's Site Pollution Liability Policies do not cover earthquake claims in Oklahoma.[92] Two of the arguments are particularly interesting: first, the insurers argued that earthquakes are not covered because a "pollutant" did not cause an earthquake and thus an earthquake cannot be considered a "pollution condition;"[93] and second, that the site-specific policy does not extend to harms allegedly occurring off the well site.[94] In September 2016, the court rebuffed New Dominion's attempts to move the proceeding to Oklahoma.[95]

A policy otherwise covering earthquakes might still be litigated, because of the typical policy language that covered liability must be "neither 'expected' nor

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84. NAIC *Fracking*, *supra* note 63.

85. Lewin et al., *supra* note 82, at 27.

86. Comprehensive Environmental Response, Compensation, and Liability Act ("CERCLA"), 42 U.S.C. §§ 9601–9675 (2015).

87. *See* MANILOFF & STEMPEL, *supra* note 82, at 269–73.

88. *See id.* at 293–97; *see also* Thomas C. Gilchrist, *Insurance Coverage for Pollution Liability in the United States and the United Kingdom: Covering Troubled Waters*, 23 CASE W. RES. J. INT'L L. 109, 112–13 (1991).

89. *See* Lewin et al., *supra* note 82, at 25; *see also* MANILOFF & STEMPEL, *supra* note 82, at 2. As an aside, many wells also have Underground Resource and Equipment endorsements in their CGL policies, which might extend coverage for damage caused by well activities. *See* Lewin et al., *supra* note 82.

90. NAIC *Fracking*, *supra* note 63.

91. Certain Underwriters at Lloyd's v. New Dominion, LLC, No. 16-cv-05005, 2016 WL 3541187 (S.D.N.Y. June 27, 2016).

92. The Complaint names five pending actions in Oklahoma courts against New Dominion. *Id.* at ¶¶ 17–23.

93. *Id.* at ¶¶ 29–31.

94. *Id.* at ¶¶ 67–69.

95. *See* Certain Underwriters at Lloyd's v. New Dominion, LLC, No. 16-cv-05005, 2016 WL 4688866 (S.D.N.Y. Sept. 7, 2016). The following month, the parties jointly stipulated a voluntary dismissal of the case. *See* Certain Underwriters at Lloyd's v. New Dominion, LLC, No. 16-cv-05005, 2016 WL 8259810 (S.D.N.Y. Oct. 28, 2016).

'intended.'"[96] As the link between earthquakes and some disposal and production wells becomes more supported in the scientific literature, insurers may argue that companies should have expected a seismic event to occur, particularly if the well in question is located in an earthquake-prone area on USGS Seismic Hazard maps, or is drilled into basement rock.[97]

Beyond these novel theories for denying recovery on an insurance policy for induced seismicity damages, traditional defenses to coverage persist as well,[98] adding to the uncertainty in third-party coverage.

B. INCONSISTENT OR HESITANT AGENCY ACTION

Over the past five years, eight states have adapted existing authority or created new authority to address the risks of seismicity from oil and gas activity. For the most part, action is discretionary and applied on a case-by-case basis. The legislatures have given the regulator flexibility—useful in this dynamic environment—but also the political burden of slowing down injection or shutting in a well. This results in inconsistent application of an agency's authority. Moreover, standards differ across states. While some could argue that the differences reflect geologic and industry diversity, the differences nevertheless may stymie the development of uniform industry best practices that could reduce the risk of induced seismicity. Meanwhile, the federal government has been hesitant to enter this space, providing technical guidance and broad recommendations but so far refusing to set standards or identify uniform best practices. That is unlikely to change in the Trump Administration, given its anti-regulatory stance.[99]

1. State Activity

Reflecting a lack of information in this area,[100] states appear to be handling the risk of induced seismicity more through permit-by-permit conditions or adaptive management (akin to performance standards) than through prescriptive ap

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96. NAIC *Fracking*, *supra* note 63.

97. *See, e.g.*, F. Rall Walsh III & Mark D. Zoback, *Oklahoma's Recent Earthquakes and Saltwater Disposal*, 1 SCI. ADVANCES, no. 5, 2015, at 1 (noting "nearly all the earthquakes [in Oklahoma] are occurring in crystalline basement" and that they appear to be caused by a hydraulic connection with faults in that basement rock).

98. For instance, under an occurrence liability policy, liability limits are set on each triggering incident. *See* MANILOFF & STEMPEL, *supra* note 82, at 153–57. An insurer may want to argue that aftershocks are part of the same incident and subject to the same cap.

99. *See, e.g.*, *An America First Energy Plan*, THE WHITE HOUSE, https://www.whitehouse.gov/america-first-energy (last visited Jan. 23, 2017); *see also* Executive Order No. 13783: Promoting Energy Independence and Economic Growth, 82 Fed. Reg. 16,093 (Mar. 31, 2017).

100. *See, e.g.*, Dana & Wiseman, *supra* note 64, at 1548 (observing that "command and control regulation requires a tremendous amount of information on the part of regulators to figure out what commands to make and how to make them, as well as constant updating of information").

proaches.[101] This could change if earthquakes continue, or if a particularly cataclysmic event were to cause significant losses to property, or death.[102]

As a first step, states used pre-existing generic authority, or new non-regulatory approaches, to respond in real time to induced seismic events. As a second step, still under way, some of these states have crafted new legislative and regulatory authorities to target this issue more proactively. For instance, earthquakes initially prompted regulators to use pre-existing general authority to shut down wastewater injection wells and halt well permitting, in Arkansas in 2011,[103] and in Ohio in 2012.[104] Then in 2012, Arkansas[105] and Ohio[106] promulgated the first new state rules to manage induced seismicity from injection wells. Arkansas' rule established a "Moratorium Zone" covering parts of five counties; no permits to drill or operate a Class II well may be issued for that area.[107] Similarly, no permits will be granted within one mile of a Regional Fault or within five miles of "a

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101. *See* SHEILA OLMSTEAD & NATHAN RICHARDSON, MANAGING THE RISKS OF SHALE GAS DEVELOPMENT USING INNOVATIVE LEGAL AND REGULATORY APPROACHES 8–10 (2014) (describing the difference between prescriptive technology standards, performance standards, and case-by-case permitting).

102. *See, e.g.*, Matthew Philips, *Oklahoma's Fracking-Linked Earthquakes Raise National Security, Energy Concerns*, INS. J. (Nov. 8, 2016), http://www.insurancejournal.com/news/national/2016/11/08/431809.htm (reporting 5.0 M earthquake hit on November 7 "within a mile of what is arguably one of the country's most important strategic assets—Cushing is the largest crude oil trading hub in North America").

103. In early 2011, following a record 4.7 M earthquake, the Arkansas Oil and Gas Commission ("AOGC") halted injection at the SRE 8-12 1-17 SWD Well and the Wayne L. Edgmon No. 1 SWD Well. AOGC, Order No. 051-2011-02 (Emergency Order), General Rule B-43 Well Spacing Area (Mar. 4, 2011), http://www.aogc2.state.ar.us/Hearing%20Orders/2011/March%20(Special%20Hearing)/051A-2011-02%20Emergency%20Order%20-%20Final.pdf. The moratorium was extended several times. *See, e.g.*, AOGC, Order No. 085A-2-2011-3, General Rule B-43 Well Spacing Area (Apr. 26, 2011), http://www.aogc.state.ar.us/hearing/Orders/2011/04-April/085A-2-2011-03.pdf. Following a hearing in July, the operators of those two wells and of a third well, the Trammel Class II Disposal Well, agreed to "immediately and permanently cease all disposal operations in both disposal wells, and to properly plug the subject disposal wells by September 30, 2011." AOGC, Order No. 180A-2-2011-07, Class II Commercial Disposal Well or Class II Disposal Well Moratorium (Aug. 2, 2011), http://www.aogc.state.ar.us/hearing/Orders/2011/07-July/180A-2-2011-07.pdf. Further, the AOGC established a 1150 square mile moratorium area in the Fayetteville Shale for new disposal wells. *Id.* In a separate order issued the same day, the fourth and final operating disposal well in the area, the Moore, W.E. Estate No. 1 Commercial Disposal Well was ordered permanently shut in. AOGC, Order No. 180A-1-2011-07, General Rule B-43 Well Spacing Area (Aug. 2, 2011), http://www.aogc.state.ar.us/hearing/Orders/2011/07-July/180A-1-2011-07.pdf.

104. ODNR 2012, *supra* note 31, at 13 (noting that the Ohio's Division of Oil and Gas Resource Management ("DOGRM") had requested the well operator to cease injection at Northstar 1, the one operating injection well near Youngstown, Ohio); *id.* at 12 (noting that DOGRM had placed three other wells under construction—Northstar United 2, Northstar Khalil 3, and Northstar Collins 6—and a permit application for Northstar Nexlev 5 on hold).

105. *See* Class II Disposal and Class II Commercial Disposal Well Permit Application Procedures, 178-00.1 ARK. CODE R. § H-1(s) (West 2017) (last amended Feb. 24, 2012).

106. Governor John R. Kasich, State of Ohio, Exec. Order No. 2012-09K (July 10, 2012), http://www.governor.ohio.gov/Portals/0/EO%202012-09K.pdf (ordering the emergency amendment of Rules 1501:9-03-06 and 1501:9-03-07 of the Ohio Administrative Code, upon the request of DOGRM).

107. 178-00.1 ARK. CODE R. § H-1(s)(2) (Moratorium Zone straddles Cleburne, Conway, Faulkner, Van Buren, and White Counties).

known or identified Moratorium Zone Deep Fault."[108] Elsewhere in the state, Arkansas sets disposal well spacing requirements,[109] and requires installation of flow meters.[110]

Ohio began re-issuing Class II well permits in November 2012[111] after adopting new rules.[112] Ohio's rules were promulgated initially as emergency rules. In their final form, they authorize the Chief of the Oil and Gas Division to require "geological investigation of potential faulting" for new wells,[113] and to withhold permits based on negative test results.[114] Ohio also requires continuous pressure monitoring at the wells (older wells need only monitor and report once a month).[115] In addition, the Chief may set a "graduated maximum allowable injection pressure;"[116] when that pressure is exceeded, the injection well must shut off automatically.[117]

In 2014, the Chief began using his "geological investigation" authority to require seismic monitoring at certain production and disposal wells.[118] That same year, Ohio updated its General Permit for disposal wells, requiring seismic monitors for wells drilled within three miles of a fault or prior seismic activity.[119] The array usually includes three or four sensors about a mile from the well and from each other.[120] The Chief may direct seismic monitoring at production wells, too.[121] The agency investigates production wells when the monitors detect an event of 1.5 M or above.[122] If the monitors detect an event over 2 M, the operator

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108. *Id.* § H-1(s)(3). "Regional Fault" is defined as "the identified fault zones named by the Arkansas Geological Survey as the Clinton, Center Ridge, Heber Springs, Enders and Morrilton Fault zones." *Id.* § H-1(s)(1)(a). "Moratorium Zone Deep Faults" are "deeper faults associated with the Guy-Greenbrier Earthquake Swarm." *Id.* § H-1(s)(1)(b).

109. *Id.* § H-1(s)(5).

110. *Id.* § H-1(s)(7).

111. Aaron Marshall, *New Wave of Injection Wells on the Way in Ohio for Fracking Waste*, CLEV. PLAIN DEALER (Nov. 23, 2012, 4:00 PM), http://www.cleveland.com/open/index.ssf/2012/11/new_wave_of_injection_wells_on.html.

112. OHIO ADMIN. CODE 1501:9-3-06, 1501:9-3-07 (2017) (effective date Oct. 1, 2012).

113. *Id.* § 1501:9-3-06(C)(2).

114. *Id.* § 1501:9-3-06(D).

115. *Id.* § 1501:9-3-07(F).

116. *Id.* § 1501:9-3-06(E).

117. *Id.* § 1501:9-3-07(G).

118. *See* ODNR 2015, *supra* note 39, at 3–4; Telephone Interview with David C. Rush, Seismic Manager, Ohio Dep' of Nat. Res. (Jan. 23, 2017) [hereinafter Rush Interview].

119. Larry Nettles & Jay Rothrock, *Trends in Domestic Regulation of Shale Development*, WORLD OIL, at S-29 (Mar. 2015), http://www.velaw.com/uploadedFiles/VEsite/Resources/TrendsinDomesticRegulationofShaleDevelopmentWorldOilNettles2015.pdf.

120. David C. Rush, *State of Ohio Injection and Hydraulic Fracking Overview*, OHIO DEP'T OF NAT. RES. (Nov. 11, 2016) (on file with the law review).

121. *See* ODNR 2015, *supra* note 39, at 3–4; Rush Interview, *supra* note 118.

122. Rush, *supra* note 120; *Permit Conditions for Horizontal Wells Drilled Near Known Faults or Areas of Seismic Activity*, OHIO DEP'T OF NAT. RES. (last updated Dec. 27, 2016) [hereinafter ODNR 2016] (on file with the law review).

must halt well operations.[123] The numbers of earthquakes felt by people have been drastically reduced in Ohio since 2012.[124]

Colorado published an information paper on induced seismicity in 2012, describing the existing authorities it believed it could use to address the issue.[125] Colorado has not acted further in this space.

In 2014, Kansas Governor Sam Brownback convened a task force on induced seismicity.[126] The Task Force developed a Seismic Action Plan for installing a permanent seismic monitoring network and deploying portable seismic monitoring arrays.[127] The following year, the Kansas Corporation Commission used existing authority to order a reduction in wastewater injection volumes.[128] A subsequent order expanded the area subject to the volume limit but phased in the reductions, subject to monitoring.[129] These orders appear to have slowed the frequency of earthquakes within Kansas.[130]

In October 2014, the Texas Railroad Commission finalized rules for new Class II wells, including enhanced recovery wells.[131] Operators seeking new permits must provide a screenshot of USGS historic seismic events data for a circular area of 100 square miles around the proposed well.[132] The Railroad Commission can require more frequent monitoring and reporting of injection pressures and

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123. ODNR 2016, *supra* note 122.

124. Peter H. Milliken, *Five Years After the 4.0 Quake, Ohio is a Seismic Monitoring Leader, ODNR Official Says*, THE VINDICATOR (Jan. 1, 2017, 12:05 AM), http://www.vindy.com/news/2017/jan/01/ohio-is-a-seismic-monitoring-leader/ (reporting very few "felt" quakes—i.e., greater than 2.5 M—in Ohio since late 2011).

125. COLO. OIL & GAS CONSERVATION COMM'N, COGCC UNDERGROUND INJECTION CONTROL AND SEISMICITY IN COLORADO 2–3 (2011) (explaining that the state sets well-specific maximum surface injection pressures as a condition of permit approval and noting that in September 2011, the UIC permit review process was amended to consider seismicity).

126. Press Release, Kan. Office of the Governor, Governor Sam Brownback Names Task Force to Develop State Action Plan for Induced Seismicity (Feb. 17, 2014), https://governor.kansas.gov/governor-sam-brownback-names-task-force-to-develop-state-action-plan-for-induced-seismicity/.

127. *See* KAN. DEP'T OF HEALTH & ENV'T, KAN. CORP. COMM'N & KAN. GEOLOGICAL SURVEY, KANSAS SEISMIC ACTION PLAN (2014), http://www.kgs.ku.edu/PRS/Seismicity/2015/Seismic_Action_Plan.pdf (amended 2015).

128. *See* Kan. Corp. Comm'n, Order Reducing Saltwater Injection Rates, Docket No. 15-CONS-770-CMSC (Mar. 19, 2015), http://www.gwpc.org/sites/default/files/files/KansasCorpComm_NewRules_15-770%20Order_March2015.pdf. The order notes that when the seismic arrays installed and deployed under the Seismic Action Plan register a "Seismic Action Score" of seventeen or higher, the Kansas Geological Society will notify the Commission, which can then decide whether further regulatory action is necessary. *Id.* at ¶ 5.

129. *See* Kan. Corp. Comm'n, Second Order Reducing Saltwater Injection Rates, Docket No. 15-CONS-770-CMSC (Aug. 9, 2016), http://estar.kcc.ks.gov/estar/ViewFile.aspx/20160809115614.pdf?Id=aeae22e8-feb8-4a69-9a0b-b8d65044963c.

130. Eagle Editorial Board, O*klahoma Needs to Curb Quakes*, WICHITA EAGLE (Sept. 7, 2016, 5:04 AM), http://www.kansas.com/opinion/editorials/article100263882.html (noting that "Kansas saw a sharp reduction in earthquakes after it restricted the disposal of oilfield wastewater," but faces continued risks from earthquakes still occurring in its neighboring state, Oklahoma).

131. *See* R.R. COMM'N OF TEX., *supra* note 45, at 8.

132. 16 TEX. ADMIN. CODE §§ 3.9(3)(B), 3.46(b)(1)(C) (2017).

rates.[133] Further, the Commission can modify, suspend, or terminate permits if "injection is likely to be or determined to be contributing to seismic activity."[134] Under this new authority, following a swarm of earthquakes near Azle,[135] the Commission ordered two disposal wells to explain why their permits should not be revoked,[136] and requested enhanced well and reservoir testing at four additional wells.[137] Texas has not otherwise ordered wells shut in.

As of July 1, 2015, California requires hydraulic fracturing operations to monitor the California Integrated Seismic Network.[138] When a nearby earthquake of at least 2.7 M occurs, operations must cease until the state has consulted with the California Geological Survey and determined that "hydraulic fracturing within [the calculated] radius does not create a heightened risk of seismic activity."[139] In contrast to other state regimes, the California measures do not apply to disposal wells or geothermal operations.

On November 14, 2014, Illinois finalized rules for Class II wells[140] (enhanced recovery wells are not covered).[141] These rules generally follow the Ohio model. Class II wells must install flow meters for real-time flow rate measurements,[142] and report pressure and flow data annually.[143] A well within a six-mile radius from an earthquake measuring between 2 and 4 M will receive a "Yellow Light Alert";[144] after receiving three alerts in a year, a well must reduce its disposal volumes.[145] The state will send "Red Light Alerts" to wells within a ten-mile radius from an earthquake over 4 M.[146] Regulators can shut in wells that pose "imminent danger"[147] or are within ten miles of an earthquake epicenter if "after consultation with [the Illinois State Geological Survey], induced seismicity conditions warrant cessation."[148]

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133. *Id.* § 3.9 (11)(A)–(B); *id.* § 3.46(i)(1)–(2) (providing authority to request additional monitoring when fluids may not be confined to the injection formation).

134. *Id.* §§ 3.9(6)(a)(iv), 3.46(d)(1)(F).

135. *See* Matthew J. Hornbach et al., *Causal Factors for Seismicity Near Azle, Texas*, 6 NATURE COMM. 1 (2015).

136. Press Release, R.R. Comm'n of Tex., Railroad Commission Orders "Show Cause" Proceeding for Azle Disposal Wells (Apr. 24, 2015), http://www.rrc.state.tx.us/all-news/042415a/.

137. Press Release, R.R. Comm'n of Tex., Railroad Commission to Require Testing of Disposal Wells in Johnson County (May 8, 2015), http://www.rrc.texas.gov/all-news/05082015/ (noting also that the Commission would be collecting additional seismic data in the region).

138. CAL. CODE REGS. tit. 14, § 1785.1(a) (West 2017).

139. *Id.* § 1785.1(b).

140. Ill. Dep't of Nat. Res., Notice of Adopted Amendment, 38 Ill. Reg. 22052 (Dec. 1, 2014) (effective date Nov. 14, 2014).

141. ILL. ADMIN. CODE tit. 62, § 240.796(a) (West 2017).

142. *Id.* § 240.796(c)(1).

143. *Id.* § 240.796(c)(2) (data to be recorded); *id.* § 240.780(e) (annual reporting requirement).

144. *Id.* § 240.796(b) (defining "Yellow Light Alert"); *id.* § (d)(1) (six-mile radius).

145. *Id.* § 240.796(d)(1)–(3).

146. *Id.* § 240.796(b) (defining "Red Light Alert"); *id.* § (d)(4) (ten-mile radius).

147. *Id.* § 240.796(e).

148. *Id.* § 240.796(f).

Oklahoma was initially slow to officially acknowledge the link between hydraulic fracturing, wastewater injection, and earthquakes.[149] However, over the past three years, Oklahoma has taken steps to respond to this challenge, drawing from actions taken by other states. In 2014, seven months after Kansas created a seismic task force, Oklahoma launched the Coordinating Council on Seismic Activity, to share data about induced earthquakes and make recommendations for policy responses.[150] The Oklahoma Corporation Commission ("OCC") then updated its rules[151] to increase mechanical integrity testing frequency for high-volume disposal wells,[152] and to require daily injection volume and pressure recordings (up from monthly) for disposal wells drilled into the Arbuckle formation.[153]

The OCC has also shut in wells in response to earthquakes, much as Arkansas and Ohio did in 2011 and 2012. For instance, in response to the Pawnee earthquake in September 2016, and a 5 M earthquake in Cushing two months later, the OCC shut in or reduced operations at dozens of wells.[154]

The OCC has taken preventative steps as well. In 2015, the OCC identified an earthquake-prone "Area of Interest," where it required wells to reduce injection volumes by fifty percent unless they could establish that they were not injecting into crystalline basement rock.[155] Since then, operators have "plugged back" at least 227 disposal wells, to avoid extending into that high-risk formation.[156] In

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149. Galchen, *supra* note 9.

150. *See Earthquakes in Oklahoma: Coordinating Council on Seismic Activity*, OFFICE OF THE SEC'Y OF ENERGY & ENV'T, https://earthquakes.ok.gov/what-we-are-doing/coordinating-council-on-seismic-activity/ (last visited Mar. 29, 2017).

151. OKLA. ADMIN. CODE §§ 165:10-5-5, 10-5-6, 10-5-7 (2014).

152. *Id.* § 165:10-5-6(d) (requiring yearly mechanical integrity tests or installation of a continuous pressure monitor to be eligible for testing every five years).

153. *Id.* § 165:10-5-7(b)(3)(B). The data must be held for three years and provided to the state upon request. *Id.*

154. *See* OKLA. CORP. COMM'N, MEDIA ADVISORY—LATEST ACTION REGARDING PAWNEE AREA (Sept. 12, 2016), https://www.occeweb.com/News/2016/09-12-16Pawnee%20Advisory.pdf; OKLA. CORP. COMM'N, ADVISORY—PAWNEE (Nov. 3, 2016) [hereinafter OCC Nov. 3, 2016], https://www.occeweb.com/News/2016/11-03-16PAWNEE%20POSTING.pdf (in total, shutting in fifty-one wells; reducing injection volumes by twenty-five percent at ten wells; and reducing eight wells to their last thirty-day average); *see also* OKLA. CORP. COMM'N, ADVISORY 4—CUSHING (Nov. 8, 2016), https://www.occeweb.com/News/2016/11-08-16CUSHING%20PLAN.pdf (requiring seven wells within six miles of the Cushing quake epicenter to be shut in; sixteen wells within ten miles to reduce injection by twenty-five percent; and thirty-one wells within fifteen miles to reduce injection to their last thirty-day average).

155. OKLA. CORP. COMM'N, MEDIA ADVISORY—ONGOING OCC EARTHQUAKE RESPONSE (Mar. 25, 2015), http://www.occeweb.com/News/2015/03-25-15%20Media%20Advisory%20-%20TL%20and%20related%20documents.pdf; *see also* OKLA. CORP. COMM'N, OCC ANNOUNCES NEXT STEP IN CONTINUING RESPONSE TO EARTHQUAKE CONCERNS (July 17, 2015), http://www.occeweb.com/News/DIRECTIVE-2.pdf (expanding the Area of Interest); OKLA. CORP. COMM'N, MEDIA ADVISORY—REGIONAL EARTHQUAKE RESPONSE PLAN FOR CENTRAL OKLAHOMA AND EXPANSION OF THE AREA OF INTEREST (Mar. 7, 2016) [hereinafter OCC Mar. 7, 2016], https://www.occeweb.com/News/2016/03-07-16ADVISORY-AOI,%20VOLUME%20REDUCTION.pdf (expanding the Area of Interest still further).

156. OKLA. CORP. COMM'N, EARTHQUAKE RESPONSE SUMMARY (Nov. 18, 2016), http://www.occeweb.com/News/2016/11-23-16EARTHQUAKE%20ACTION%20SUMMARY.pdf.

early 2016, the OCC capped injection volumes in two areas of the state to forty percent of 2014 volumes,[157] and required flow meters to monitor injection volumes.[158]

Most recently, in December 2016, the OCC issued seismicity guidelines for hydraulic fracturing in two new plays, the South Central Oklahoma Oil Province ("SCOOP") and the Sooner Trend Anadarko Basin Canadian and Kingfisher Counties ("STACK").[159] If a tremor of 2.5 M or greater occurs, the OCC will alert operators within 1.5 miles, who will implement "internal mitigation practices."[160] A tremor of 3+ M will prompt a six hour pause in operations and a technical conference call to set operating parameters; a quake of 3.5 M or more requires suspension of operations and an in-person meeting to determine next steps.[161] An Ohio regulator says that the Oklahoma regime closely follows Ohio's model.[162] Although they remain far more numerous than before 2009, the frequency of quakes has slowed in Oklahoma, a trend that may continue if production and disposal rates remain the same.[163] Some credit is due to Oklahoma's regulatory response, but the slowdown in earthquakes correlates with the downturn in production as well.[164] As production picks up again,[165] earthquakes could increase in number and magnitude.

2. Federal Activity

The federal government has appeared less willing or able to address induced seismicity from oil and gas activities than the states. This stems from a dearth of authority and few points of intersection with oil and gas activities. For instance, the EPA directly permits oil and gas disposal wells under the Safe Drinking Water

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157. *See* OCC Mar. 7, 2016, *supra* note 155; OKLA. CORP. COMM'N, MEDIA ADVISORY—REGIONAL EARTHQUAKE RESPONSE PLAN FOR WESTERN OKLAHOMA (Feb. 16, 2016), http://www.occeweb.com/News/2016/02-16-16WesternRegionalPlan.pdf.

158. *See* OCC Mar. 7, 2016, *supra* note 155.

159. Okla. Corp. Comm'n, *supra* note 46, at 1.

160. *Id.* at 3.

161. *Id.*

162. Rush Interview, *supra* note 118. Mr. Rush called the Oklahoma program "Ohio +1," referring to the fact that Oklahoma's threshold magnitudes are higher by one order at each level, possibly because Oklahoma is much more seismically active. *Id.*

163. *See* Langenbruch & Zoback, *supra* note 29.

164. Thomas Sumner, *Wastewater Cap Could Dunk Oklahoma Quake Risk*, SCIENCENEWS (Nov. 30, 2016, 2:36 PM), https://www.sciencenews.org/article/wastewater-cap-could-dunk-oklahoma-quake-risk (quoting a researcher from Colorado State University saying "[w]e're not sure that regulation is the only knob being turned").

165. *See, e.g.*, Ed Crooks & Eric Platt, *Investors Regain Appetite for U.S. Oil*, FIN. TIMES (Oct. 12, 2016) https://www.ft.com/content/dc830de2-9023-11e6-a72e-b428cb934b78 (noting OPEC's cut in production and growing efficiencies in U.S. plays to make production cheaper as two reasons for the start of a recovery); Daniel J. Graeber, *North American Rig Count Rises*, UPI (Jan. 9, 2017), http://www.upi.com/Business_News/Energy-Industry/2017/01/09/North-American-rig-count-rises/4581483963776/?spt=sec&or=bn.

Act in just nine states and on Indian lands.[166] The EPA's hesitation to act in this area mirrored a broader reluctance by the Obama Administration to be viewed as discouraging oil and gas activity,[167] and the Trump Administration's EPA is unlikely to change course.[168] When the Pawnee, Oklahoma earthquake occurred in September 2016, the EPA shut down the disposal wells it regulated on Indian land in nearby Osage County in coordination with the state.[169] Prior to the earthquake, these wells were not required to monitor and report operating parameters, as their state-regulated counterparts were.[170]

The EPA could update SDWA rules to require seismic and operating data from well operators, or describe a process for seismic risk assessments. The EPA sets minimum UIC standards for all states;[171] since the early 1980s, these standards have addressed seismicity, albeit perfunctorily.[172] For instance, the rules direct that Class II wells "shall be sited" below a confining zone that is "free of known open faults or fractures."[173] However, providing fault data in a permit application is discretionary, and limited to known or suspected faults based on publicly available data already known to the operator.[174] In addition, the permitting agency can but does not have to consider maximum injection rates.[175] Individuals

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166. *Primary Enforcement Authority for the Underground Injection Control Program*, ENVTL. PROT. AGENCY, https://www.epa.gov/uic/primary-enforcement-authority-underground-injection-control-program (last updated Feb. 6, 2017). EPA directly permits Class II wells in: Arizona, Florida, Hawaii, Iowa, Michigan, Minnesota, New York, Pennsylvania, and Virginia. *Id.* EPA had previously regulated Class II wells in Kentucky until it approved the state's request for primacy in October 2016. *See* State of Kentucky Underground Injection Control Class II Program; Primacy Approval, 81 Fed. Reg. 74,927 (Oct. 28, 2016) (to be codified at 40 C.F.R. pt. 147). Kentucky was scheduled to assume control of the program in January 2017, *see* State of Kentucky Underground Injection Control (UIC) Class II Program; Primacy Approval, 81 Fed. Reg. 95,480 (Dec. 28, 2016) (to be codified at 40 C.F.R. pt. 147), but was delayed until March 2017, *see* Delay of Effective Date for 30 Final Regulations Published by the Environmental Protection Agency Between October 28, 2016 and January 17, 2017, 82 Fed. Reg. 8499 (Jan. 26, 2017) (to be codified at 40 C.F.R. pts. 22, 51, 52, 61, 68, 80, 81, 124, 147, 171, 239, 259, 300, and 770).

167. *See, e.g.*, *Remarks by the President in the State of the Union Address*, THE WHITE HOUSE (Feb. 12, 2013), https://obamawhitehouse.archives.gov/the-press-office/2013/02/12/remarks-president-state-union-address ("Now, in the meantime, the natural gas boom has led to cleaner power and greater energy independence. We need to encourage that. And that's why my administration will keep cutting red tape and speeding up new oil and gas permits. . . . That's got to be part of an all-of-the-above-plan.").

168. *See, e.g.*, THE WHITE HOUSE, *supra* note 99 ("The Trump Administration will embrace the shale oil and gas revolution to bring jobs and prosperity to millions of Americans.").

169. OCC Nov. 3, 2016, *supra* note 154 (describing the state and federal response to the Pawnee, Oklahoma earthquake).

170. Adam Wilmoth & Paul Monies, *EPA to Shut Down Osage County Wells Following Pawnee Earthquake*, THE OKLAHOMAN (Sept. 6, 2016, 3:09 PM), http://newsok.com/article/5517005.

171. 42 U.S.C. § 300h-1(b)(1)(A) (2015). *But see id.* § 300h-4 (providing an alternate way for states to gain primacy over the Class II oil and gas program). A state seeking primacy under this section need not show that it meets EPA's minimum requirements, so long as it demonstrates that the state program is an "effective program" that protects drinking water sources. *Id.*

172. 40 C.F.R. §§ 146.21–146.24 (2016).

173. *Id.* § 146.22(a).

174. *Id.* § 146.24(a)(2).

175. *Id.* § 146.24(b)–(c).

have begun challenging EPA-issued Class II permits for failing to request and study seismic data using these authorities.[176]

In 2010, by contrast, the EPA issued detailed seismicity requirements for carbon sequestration wells (Class VI).[177] Seismic data is required for these permit applications,[178] and well operators must demonstrate that the proposed site is appropriate, considering the location of faults and fractures.[179] Fault and fracture data must also be shared if an operator seeks a shorter time for post-injection care of a site,[180] or a waiver from the standard UIC well depth requirements.[181] These requirements could provide model language for updated Class II rules; however, EPA has made no indication that it sees a need for such an update.

In 2014, the EPA's UIC National Technical Workgroup identified best management practices for reducing induced seismicity from Class II wells.[182] The report explicitly states that it does not constitute agency guidance,[183] much less a set of regulatory requirements. Only last year did the EPA begin to conduct seismic reviews—relying in part on the recommendations of the UIC National Technical Workgroup—before granting some UIC permits where it has primary Class II permitting authority.[184] That practice may not continue.

In May 2016, environmental groups sued the EPA to compel the agency to use its authority under the Resource Conservation and Recovery Act ("RCRA"), the federal hazardous waste law,[185] to regulate—among other things—the seismic risks posed by oil and gas wastewater disposal.[186] Some scholars suggest that the EPA should craft an entirely new regulatory scheme to tackle induced seismic-

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176. *See, e.g.*, Petition for Review of UIC Permit PAS2D013BIND by Judy Wanchisn & Stacy Long (Apr. 4, 2014), https://yosemite.epa.gov/oa/EAB_Web_Docket.nsf/(Filings)/29874BA48F86145685257CB40072A8D1/$File/WANCHISN%20APPEAL . . . 2.pdf; Sammy-Mar, LLC, UIC Permit Appeal 15-02, 2016 WL 3352211 (EAB 2016).

177. Federal Requirements Under the Underground Injection Control (UIC) Program for Carbon Dioxide (CO_2) Geologic Sequestration (GS) Wells, 75 Fed. Reg. 77,230 (Dec. 10, 2010); 40 C.F.R §§ 146.81–146.95 (2016); *see also* FOLGER & TIEMANN, *supra* note 14, at 17.

178. 40 C.F.R. § 146.82 (a)(2)–(3) (2016).

179. *Id.* § 146.83.

180. *Id.* § 146.92(c)(1)(vii).

181. *Id.* §§ 146.95(a)(2), (b)(1)(ii).

182. *See* UIC NAT'L TECH. WORKGRP., *supra* note 37; *see also* FOLGER & TIEMANN, *supra* note 14, at 21–23 (discussing this report).

183. *See* UIC NAT'L TECH. WORKGRP., *supra* note 37, at 3.

184. *See, e.g.*, ENVTL. PROT. AGENCY, RESPONSE TO PUBLIC COMMENTS FOR THE ISSUANCE OF TWO UNDERGROUND INJECTION CONTROL PERMITS AND THREE MAJOR MODIFICATIONS TO UIC PERMITS FOR BEAR LAKE PROPERTIES, LLC (2016), https://www.epa.gov/sites/production/files/2016-11/documents/responsetocomments.bl218219.final_.web_.pdf.

185. Solid Waste Disposal Act ("SWDA"), 42 U.S.C. §§ 6901–6992k (2015). The SWDA is often referred to as the Resource Conservation and Recovery Act ("RCRA"), after RCRA amended the SWDA in its entirety. *See* Resource Conservation and Recovery Act of 1976, Pub. L. No. 94-580, 90 Stat. 2795. This Article will hereinafter refer to the SWDA as RCRA.

186. *See* Environmental Integrity Project v. Gina McCarthy, No. 16–842, 2016 WL 6833931 (D.D.C. Nov. 18, 2016). The parties entered into a consent decree, which gives EPA until March 15, 2019 to either propose a rule revising the applicable regulations, or issue a determination that such revisions are not necessary. Consent

ity.[187] However, the outcome of the 2016 presidential election makes it less likely that the EPA will regulate in this space.[188]

Even where the federal government owns surface or mineral rights, it has been slow to respond to induced seismicity. For instance, the Bureau of Land Management's ("BLM") 2015 hydraulic fracturing rule requires permit applicants to submit geological information that could facilitate a seismicity risk assessment.[189] However, the BLM will not necessarily conduct these risk assessments. Instead, the agency has suggested that it might address induced seismicity at a programmatic level through the National Environmental Policy Act.[190] In any event, the hydraulic fracturing rule was stayed[191] and then rejected[192] by a federal district court. At the time of publication, the case was pending before the U.S. Court of Appeals for the Tenth Circuit.[193]

Otherwise, federal action in this area has focused on basic scientific research. For instance, the U.S. Department of Energy ("DOE") has published papers on seismicity from geothermal development, but these papers do not serve as binding authority.[194] The USGS conducts earthquake research under the National Earthquake Hazards Reduction Program ("NEHRP");[195] however, the USGS is not a regulatory agency and restricts its activities to science and research.

3. Building Code Regulation

To date, the federal government has had more influence in the design and incorporation of seismic building codes around the country. When the USGS publishes National Seismic Hazard reports,[196] its findings inform the NEHRP's

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Decree ¶¶ 5, 7, Environmental Integrity Project v. Gina McCarthy, No. 16–842 (D.D.C. Dec. 28, 2016), ECF No. 33.

187. *See, e.g.*, Finley, *supra* note 14, at 136–42.

188. *See, e.g.*, Brady Dennis, *Trump Taps Climate-Change Skeptic to Oversee EPA Transition*, WASH. POST (Nov. 11, 2016), https://www.washingtonpost.com/news/energy-environment/wp/2016/11/11/meet-the-man-trump-is-relying-on-to-unravel-obamas-environmental-legacy/ (noting the then-President-elect's "disdain" for the EPA and his pledge to "scrap a litany of other 'unnecessary' rules, especially those imposed on the oil, gas and coal sectors"); Chris Mooney et al., *Trump Names Scott Pruitt, Oklahoma Attorney General Suing EPA on Climate Change, to Lead the EPA*, WASH. POST (Dec. 8, 2016), https://www.washingtonpost.com/news/energy-environment/wp/2016/12/07/trump-names-scott-pruitt-oklahoma-attorney-general-suing-epa-on-climate-change-to-head-the-epa/.

189. Oil and Gas; Hydraulic Fracturing on Federal and Indian Lands; Final Rule, 80 Fed. Reg. 16,128, 16,129 (Mar. 26, 2015) (to be codified at 43 C.F.R. pt. 3160).

190. *Id.* at 16,182.

191. Wyoming v. U.S. Dep't of the Interior, 136 F. Supp. 3d 1317 (D. Wyo. 2015).

192. Wyoming v. U.S. Dep't of the Interior, No. 2:15-CV-043-SWS, 2016 WL 3509415 (D. Wyo. June 21, 2016).

193. Wyoming v. U.S. Dep't of the Interior, No. 16-8069 (10th Cir. filed June 29, 2016).

194. *See, e.g.*, ERNIE MAJER ET AL., U.S. DEP'T OF ENERGY, PROTOCOL FOR ADDRESSING INDUCED SEISMICITY ASSOCIATED WITH ENHANCED GEOTHERMAL SYSTEMS (2012), https://www1.eere.energy.gov/geothermal/pdfs/geothermal_seismicity_protocol_012012.pdf.

195. Earthquake Hazards Reduction Act of 1977, 42 U.S.C. § 7704(a)(3) (2015).

196. *See, e.g.*, USGS 2016, *supra* note 12.

Recommended Seismic Provisions,[197] which in turn are used to update industry building standards and the International Code Council's model building code.[198] The insurance industry also consults the National Seismic Hazard reports for risk modeling, and to determine insurance policy availability and rates.[199] Some scholars believe that focusing on the structural integrity of buildings in quake-prone areas would be the most practical way to reduce induced seismicity risks.[200] However, building code updates target new building stock, and are updated only occasionally, reflecting a sometimes considerable lag between new science and a response in the code.[201] In most jurisdictions, unless it undergoes a major renovation, an existing building remains subject to the code in place when it was built.[202] Some local and state jurisdictions have voluntary retrofit programs in place;[203] few places require rehabilitation or retrofit.[204]

C. UNCERTAIN TORT LIABILITY AND HIGH BARRIERS TO RECOVERY

As a default, litigants and courts will use common law—specifically, the liability theories of nuisance, trespass, strict liability, and/or negligence[205]—to

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197. *See, e.g.*, FED. EMERGENCY MGMT. AGENCY, NEHRP RECOMMENDED SEISMIC PROVISIONS FOR NEW BUILDINGS AND OTHER STRUCTURES (2009), https://www.fema.gov/media-library-data/20130726-1730-25045-1580/femap_750.pdf.

198. *See* USGS 2008, *supra* note 15, at 1–2; *see also* NAT'L INST. OF BLDG. SCI., *supra* note 48, at 8.

199. USGS 2008, *supra* note 15, at 1 (noting that the maps are used for building code updates, risk assessments, and other public policy).

200. *See, e.g.*, Julian J. Bommer et al., *A Risk-Mitigation Approach to the Management of Induced Seismicity*, 19 J. SEISMOLOGY 623, 638 (2015).

201. *See* WALTER W. HAYS, GEOLOGICAL SURVEY CIRCULAR 816, PROGRAM AND PLANS OF THE U.S. GEOLOGICAL SURVEY FOR PRODUCING INFORMATION NEEDED IN NATIONAL SEISMIC HAZARDS AND RISK ASSESSMENT, FISCAL YEARS 1980–84, at 2 (1979) ("[B]uilding codes are generally considered to lag behind the current state-of-the-art in earthquake-resistant design."); *see also* USGS PROF'L PAPER NO. 1560, 2 ASSESSING EARTHQUAKE HAZARDS AND REDUCING RISK IN THE PACIFIC NORTHWEST 502 (1998) (describing the lag between new state building codes and local ordinance updates).

202. *See, e.g.*, 36 VA. ADMIN. CODE § 103 (2016) (making clear existing buildings are subject to the code in place at the time of construction); IDAHO CODE ANN. § 39-4111 (West 2017) (limiting application of current building code to the part of an existing building that is improved or altered). *But see* Myrick v. Mastagni, 185 Cal. App. 4th 1082 (2010) (finding that a landlord could not rely on the "Act of God" defense for earthquakes when she failed to participate in a seismic retrofit program for her building).

203. *See, e.g.*, PORTLAND, OR., CODE ch. 24.85 (2015) (only requiring retrofits when an existing building undergoes extensive renovation or suffers significant damage from an earthquake); Thomas Peele & Jessica Guynn, *False Sense of Security*, CONTRA COSTA TIMES (Mar. 5, 2006), http://www.earthquakeconstruction.com/cc_times.html (noting that California lacks specific requirements at the state level for seismic retrofits, leading to shoddy work that will not prevent damage in an earthquake).

204. *See* David Listokin & David B. Hattis, *Building Codes and Housing*, 8 CITYSCAPE 21, 24 (2005) (noting that "retroactive regulations are quite rare and local in nature"). *But see* L.A., Cal. Ordinance 183893, Mandatory Earthquake Hazard Reduction in Existing Wood Frame Buildings with Soft, Weak or Open-Front Walls (Oct. 13, 2015), http://clkrep.lacity.org/onlinedocs/2014/14-1697-S1_ord_183893_11-22-15.pdf; Rong-Gong Lin II et al., *Los Angeles Will Have the Nation's Toughest Earthquake Safety Rules*, L.A. TIMES (Oct. 9, 2016), http://www.latimes.com/local/lanow/la-me-ln-earthquake-retrofit-20151009-story.html.

205. For a discussion of these theories of liability in the earthquake context, see Darlene A. Cypser & Scott D. Davis, *Liability for Induced Earthquakes*, 9 J. ENVT'L L. & LITIG. 551 (1994) [hereinafter Cypser & Davis

govern disputes over alleged harm from earthquakes. Many of the factual underpinnings of common law claims—including questions about whether an operator has exercised due care, or whether an activity is so "ultra-hazardous" that an operator must be held liable for any resulting harms—are fact-specific and highly dependent on the community where the dispute is heard.[206] In addition, it could prove difficult to establish that a particular well or injection event caused an earthquake.[207]

As of May 2015, the *American Oil & Gas Reporter* reported that fifty lawsuits related to induced seismicity had been filed in the United States.[208] None so far has resulted in a published jury verdict or court decision. Many cases are pending.[209] Others have been dismissed; for the most part, these appear to be dismissals with prejudice based on filings by the plaintiffs,[210] suggesting that the claims were settled out of court.

A new wave of lawsuits has hit Oklahoma courthouses since the September 2016, Pawnee earthquake. For instance, on November 17, 2016, a class action petition was filed against Eagle Road Oil, LLC, Cummings Oil Company, and other defendants to be named.[211] The complaint alleges harms from the Pawnee earthquake, and claims that the defendants should be strictly liable for this harm,[212] or liable under the theories of negligence,[213] private

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1994]; Keith B. Hall et al., *On Liability Issues Concerning Induced Seismicity in Hydraulic Fracturing Treatments and at Injection Disposal Wells: What Petroleum Engineers Should Know*, SOC'Y OF PETROL. ENG'RS SPE-173383-MS (2015); Emery Gullickson Richards, *Finding Fault: Induced Earthquake Liability and Regulation*, 40 COLUM. J. ENVTL. L. FIELD REP. 1 (2015); Meredith A. Wegener, *Shake, Rattle and* Palsgraf*: Whether an Actionable Negligence Claim Can be Established in Earthquake Damage Litigation*, 11 TEX. J. OIL GAS & ENERGY L. 115 (2016).

206. The Restatement of Torts provides a 6-factor test for determining whether an activity is "ultra-hazardous." RESTATEMENT (SECOND) OF TORTS § 520. Courts often use this test. *See, e.g.*, Taylor v. Hesser, 991 P.2d 35 (Okla. Civ. App. 1998); Schwartzman, Inc. v. Atchison, Topeka & Santa Fe Ry. Co., 842 F. Supp. 475 (D.N.M. 1993) (noting that New Mexico has adopted this test). Three of the six factors have to do with where the activity is located and whether the activity there is common; whether the activity is appropriate for the location; and, whether its benefits outweigh its risks. RESTATEMENT (SECOND) OF TORTS § 520.

207. In fact, recent research suggests that induced seismicity may be more the result of aggregate injection activities in a region, such as in northern Oklahoma, rather than from individual wells. *See* Walsh & Zoback, *supra* note 97.

208. Koorosh Talieh et al., *Frac Insurance: Policies Protect Against Fracturing Claims*, AM. OIL & GAS REP. (May 2015). A University of Dayton law professor has been tracking some of the recent earthquake litigation in a useful online litigation summary. *See* Blake Watson, *Hydraulic Fracturing Tort Litigation Summary*, U. OF DAYTON SCH. OF L. (last updated Apr. 14, 2017), https://udayton.edu/directory/law/documents/watson/blake_watson_hydraulic_fracturing_primer.pdf.

209. *See* Watson, *supra* note 208.

210. *See id.*

211. *See* Class Action Petition ¶¶ 1–29, Adams v. Eagle Road Oil LLC, No. CJ-2016-78 (Dist. Ct. Pawnee Cty., Okla., Nov. 17, 2016) [hereinafter Eagle Road Class Action]; *see also* Joe Wertz, *Groundwork Laid For Class-Action Lawsuit Against Oil Companies After Record Earthquake in Pawnee*, STATEIMPACT OKLA. (Nov. 18, 2016, 1:00 PM), https://stateimpact.npr.org/oklahoma/2016/11/18/groundwork-laid-for-class-action-lawsuit-against-oil-companies-after-record-earthquake-in-pawnee/.

212. Eagle Road Class Action, *supra* note 211, ¶¶ 53–57.

213. *Id.* ¶¶ 58–60.

nuisance,[214] and trespass.[215]

Across all common law claims, causation stands out as the largest obstacle to and most uncertain factor in recovery. Historically, earthquakes have been treated in courts as "acts of God," which defendants can use as a defense to liability.[216] In these induced seismicity cases, the person seeking damages must successfully allege that a particular action "releas[ed] or redirect[ed] . . . a destructive natural force," and in turn caused some harm.[217] Courts have granted relief when a defendant did not adequately prepare for the effects of a natural event; for instance, for failing to retrofit a building in a known seismic area,[218] or failing to prevent the damage of consumer products before Hurricane Sandy hit.[219] However, here, plaintiffs must demonstrate that a defendant's activities caused the earthquake—an otherwise natural phenomenon—to occur in the first place.

Scientists and policymakers agree on the general causal mechanisms that give rise to induced seismicity—an increase in formation pore pressure from injection, a fault oriented in a particular way, and a permeable avenue for the fluid (or the resulting pressure) to reach the fault.[220] Therefore, a plaintiff may be able to demonstrate that the earthquake *could* have been induced. However, legal causation between a particular well or injection activity and an earthquake is much harder to establish.[221] Plaintiffs must show that activities at the well were the "proximate" cause of the earthquake and the resulting harms; that is, "the cause that in a natural and continuous sequence, unbroken by any superceding [sic] cause, both produced the injury and was necessary for the injury."[222] There are two elements of proximate cause: a showing of "cause in fact" (the "but for" cause of the earthquake) and evidence that the harm was foreseeable.[223] "These elements cannot be satisfied by mere conjecture, guess, or speculation."[224]

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214. *Id.* ¶¶ 61–64.

215. *Id.* ¶¶ 65–68.

216. *See* Gleeson v. Virginia Mid. Ry., 140 U.S. 435, 439–43 (1891). "Acts of God" are also defined sometimes in statute, for instance in the federal Superfund law. *See* 42 U.S.C. § 9601(1) (2015) (defining "act of God" as "an unanticipated grave natural disaster or other natural phenomenon of an exceptional, inevitable, and irresistible character, the effects of which could not have been prevented or avoided by the exercise of due care or foresight"). For an interesting historical view on the "Act of God" topic, see James Lewis Howe, *Act of God: A Reconsideration*, 18 WASH. & LEE L. REV. 336 (1961).

217. Finley, *supra* note 14, at 127 (citing Cypser & Davis 1994, *supra* note 205, at 563).

218. *See* Myrick v. Mastagni, 185 Cal. App. 4th 1082 (2010).

219. *See* TGI Office Automation v. Nat'l Electric Transit Corp., 2015 WL 12559873 (E.D.N.Y. Mar. 12, 2015).

220. *See, e.g.*, UIC NAT'L TECH. WORKGRP., *supra* note 37, at 9; *see also* Walsh & Zoback, *supra* note 97.

221. *See, e.g.*, Finley, *supra* note 14, at 126–28; Wegener, *supra* note 205.

222. Hale v. Brown, 197 P.3d 438, 440 (Kan. 2008).

223. *See, e.g.*, HIS Cedars Treatment Center of DeSoto, Texas, Inc. v. Mason, 143 S.W.3d 794, 798–99 (Tex. 2004).

224. *Id.*

Proving causation is fact-intensive[225] and highly technical, likely requiring expert testimony.

These lawsuits create uncertainty for all parties. While the burden to prove causation is high, companies are aware that a judge or jury could make this factual finding, and might be more inclined to do so in a case with large damages, loss of life, or otherwise appealing victims. Thus far, the vast majority of cases only relate to property damage; just one high profile case in Oklahoma, *Ladra v. New Dominion*, involves personal injury.[226] However, future harms could be more severe, generating plaintiffs that are more sympathetic to a jury. This uncertainty may explain why so many induced seismicity cases have been settled,[227] and why—so far—no case has proceeded through dispositive motions or trial.

It is certainly possible to envision scenarios where legal causation could be found. In some cases, regulators have been able to identify a specific well or group of wells likely to blame for seismic activity.[228] And in 2013, a federal court in Arkansas upheld a $300,000 jury verdict for Ruby Hiser, who alleged that nearby drilling shook her house and caused damage.[229] The defendant could not dissuade the court that Ms. Hiser had established causation.[230] Of course, establishing causation in direct vibration cases, or in lawsuits seeking damages from seismic operations,[231] is much easier than most induced seismicity cases.[232] Vibration and concussion cases tend to be more localized, and the impacted party may have more knowledge about the activities giving rise to the harms, because it viewed these activities or received notice under a lease provision.[233] By contrast, the induced earthquakes have caused damage many miles from their epicenter, on

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225. *See, e.g.*, Hiser v. XTO Energy, Inc., 2013 WL 5467186, at *3 (E.D. Ark. Sept. 30, 2013) (noting that proximate cause is a question of fact for the jury (citing Carpenter v. Auto Club Interinsurance Exchange, 58 F.3d 1296, 1301 (8th Cir. 1995))).

226. *See* Ladra v. New Dominion, LLC, 353 P.3d 529, 530 (Okla. 2015) (discussing allegations that the earthquake caused some of the brickwork on plaintiff's fireplace to crush her legs).

227. *See supra* notes 208–10 and accompanying text.

228. *See* sources cited *supra* note 31.

229. *See Hiser*, 2013 WL 5467186.

230. *Id.* at *3.

231. Companies undertake these explorations to determine where to drill for oil, gas, or other minerals. They may involve the use of explosives, or a "thumper" truck weighing about 62,000 pounds that drives around and strikes the ground with great force to send reverberations into the subsurface. *See, e.g.*, Woody Investments, LLC v. Sovereign Eagle, LLC, 362 P.3d 107, 109 (N.M. Ct. App. 2003). Operators measure the waves returning to the surface and identify the thickness and types of formations below. These thumper trucks can create the same type of damage as induced earthquakes, such as cracks in the plaster of a home. *See, e.g.*, Dean v. Paladin Exploration Co., Inc., 63 P.3d 518, 519 (N.M. Ct. App. 2015).

232. *See Dean*, 63 P.3d at 519 (recounting that the plaintiff's deposition testimony "specified that vibrations from Defendants' equipment created cracks in the plaster of his residence and that Defendants' trucks made tracks or trails on his property and caused the grass to become covered in dust," suggesting that the truck was physically on his property when and where the harm occurred).

233. *Id.* at 521 (observing that the parties had a lease in place, expressly providing that the "[l]essee shall be liable and agree to pay for all damages . . . caused by lessee's operations on said lands").

property owned by parties with no contractual agreement with a production or disposal well operator. And yet, awards in vibration and concussion cases could lay the groundwork for a more attenuated causal chain in an induced seismicity lawsuit.

The *Hiser* case also demonstrates industry's reputational concerns, particularly before a jury. The district court[234] and the Eighth Circuit[235] rejected XTO's request for a new trial on the grounds that the jury was prejudiced by extraneous information—during deliberations, jurors had discussed gas drilling causing earthquakes in Arkansas, which one juror explained "was something that most everyone I think had heard about."[236]

Litigation also raises the specter of a disposal industry slow-down. The Oklahoma Supreme Court in *Ladra* held that private citizens could sue well operators for damages from earthquakes in Oklahoma court,[237] but seemed to limit court jurisdiction in these private lawsuits to damages.[238] Some commenters query whether this precludes private citizens from asking a court to shut down a well or block new well permitting.[239] But a few cases filed inside and outside of Oklahoma have sought this broader relief. For instance, in 2016, Sierra Club sued three well operators in the Western District of Oklahoma,[240] seeking to halt all injections on the grounds that they constitute an "imminent and substantial endangerment" under RCRA.[241] Two years before, a citizens group had filed an action in federal court in Nevada, challenging the federal BLM's Environmental Impact Statement for new oil and gas development on public land, citing among other things a failure to consider seismicity.[242] Although these actions did not succeed,[243] cases like these nevertheless raise the stakes for industry.

State legislatures can direct courts to apply a particular legal standard in induced seismicity lawsuits. For instance, some plaintiffs have argued that well

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234. *Hiser*, 2013 WL 5467186, at *11.

235. Hiser v. XTO Energy, Inc., 768 F.3d 773 (8th Cir. 2014).

236. *Hiser*, 2013 WL 5467186, at *11.

237. *See* Ladra v. New Dominion, LLC, 353 P.3d 529 (Okla. 2015).

238. *See id.* at 532 (ruling that "because this case does not seek to reverse, review, or modify an [Oklahoma Corporation Commission] order, but simply seeks to recover damages, jurisdiction is proper in the district court").

239. *See, e.g.*, DANIEL M. MCCLURE ET AL., NORTON ROSE FULBRIGHT, LLP., EARTHQUAKE LITIGATION SPIKES FOLLOWING RECENT OKLAHOMA QUAKES 5 (2016), http://www.cailaw.org/media/files/IEL/Publications/2016/earthquake-litigation-vol10no1.pdf.

240. *See* Complaint at 1–3, Sierra Club v. Chesapeake Operating LLC, No. 5:16-cv-00134-F (W.D. Okla. Apr. 4, 2017), ECF No. 1.

241. Resource Conservation and Recovery Act, 42 U.S.C. § 6972(a)(1)(B) (2015).

242. *See* Complaint at 9–10, Reese River Basin Citizens Against Fracking, LLC v. BLM, No. 14-cv-00338, 2014 WL 4425813 (D. Nev. Sept. 8, 2014), ECF No. 1.

243. Both cases were dismissed. *See* Sierra Club v. Chesapeake Operating LLC, No. 5:16-cv-00134-F, 2017 WL 1287546 (W.D. Okla. Apr. 4, 2017); Reese River Basin Citizens Against Fracking, LLC v. BLM, No. 14-cv-00338, 2014 WL 4425813 (D. Nev. Sept. 8, 2014).

operators should face no-fault liability for harms caused by induced earthquakes.[244] Legislatures may take up this campaign; for instance, in 2016, Colorado State Representative Joseph Anthony Salazar sponsored a bill to hold operators strictly liable "if oil and gas operations, including a hydraulic fracturing treatment or reinjection operation, cause an earthquake that damages property or injures an individual."[245] Under his bill, plaintiffs could establish causation by showing that an "earthquake has occurred; the earthquake damaged the plaintiff's property or injured the plaintiff; and the oil and gas operations occurred within an area that has been determined to have experienced induced seismicity" in a peer-reviewed study.[246]

Given this dynamic and highly speculative context for well operators, regulators, and the general public alike, it makes sense to evaluate whether these existing risk management and compensation tools—insurance, regulation, and litigation—are adequate for addressing the induced seismicity challenge.

II. EVALUATION OF INSURANCE, REGULATION, AND LIABILITY TO REDUCE INDUCED SEISMICITY RISKS, AND THE GAP-FILLING ROLE OF A COMPENSATION FUND

The previously described tools for managing induced seismicity are not either/or propositions; they can—and often do—work side-by-side.[247] Liability can serve as a risk deterrent before regulation matures, or when companies possess more information than the regulators.[248] The judiciary may also consult regulatory regimes to identify expectations of behavior by "reasonable" actors. Under common law, compliance with a regulation or permit requirement does not generally bar lawsuits to recover damages.[249] However, courts may reference a safety standard as a reasonable standard of care, and find that companies who violate a regulation are negligent.[250] Alternatively, a legislature may direct courts or agencies to consider deviation from a regulation as evidence of negligence or

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244. *See* Ladra v. New Dominion, LLC, 353 P.3d 529 (Okla. 2015); Felts v. Devon Energy, No. CJ-2016-137 (Dist. Ct. Okla. City, Okla. filed Jan. 11, 2016).

245. H.B. 16-1310, 70th Gen. Assemb., 2nd Reg. Sess. (Colo. 2016).

246. *Id.*

247. *See, e.g.*, Dana & Wiseman, *supra* note 64, at 1569 (observing that liability and insurance regimes need not be thought of as distinct, but as "engaged in continual, co-adaptive evolution").

248. OLMSTEAD & RICHARDSON, *supra* note 101, at 2.

249. *See, e.g.*, FPL Farming Ltd. v. Environmental Processing Systems, L.C., 351 S.W.3d 306, 310 (Tex. 2011) (quoting with approval, Berkley v. R.R. Comm'n of Texas, 282 S.W.3d 240, 243 (Tex. App. Amarillo 2009), that a driver's license does not allow you to drive on your neighbor's lawn); *see also* Michael P. Moreland, *Preemption as Inverse Negligence Per Se*, 88 NOTRE DAME L. REV. 1249, 1285–86 (2013).

250. *See, e.g.*, McNeil Pharmaceutical v. Hawkins, 686 A.2d 567, 578 (D.C. 1996) (explaining that a plaintiff may "rely on a statute or regulation as proof of the applicable standard of care" in a negligence suit); Ashwood v. Clark County, 930 P.2d 740 (Nev. 1997) (distinguishing between violation of a county building code provision as negligence *per se* and merely evidence of negligence).

intentional disregard.[251] When regulatory and liability regimes operate together, they can deter risky behavior more powerfully than either tool in isolation. For instance, "parties causing other than relatively low risks are led to do more than to satisfy the regulatory standard, for their potential liability makes that worth their while."[252]

That said, liability may serve a less important risk management role when, as here, legal causation is unclear and costs a great deal to attempt to prove.[253] In those instances, the outcome is so uncertain that it may not induce companies to change their behavior. Insurance can sometimes fill the resulting gap, by providing incentives for risk mitigation through a responsive rate structure, gathering critical risk data, and avoiding what scholars call the "insolvent defendant" and "clouded causation" problems.[254]

Ideally, these tools should be deployed in a way that not only equitably *allocates* risk, but more importantly *reduces* risk.[255] If the instruments only serve to shift the risk onto other actors, then the risk profile has not changed. Multiple layers of insurance and reinsurance, for instance, may allocate responsibility, but leave most underwriters unaware of the underlying risks posed by different actors or activities, and therefore unable to induce safer behavior.[256] On the other hand, when insurance firms have insights into relative risk, they can offer lower premiums to lower-risk industry actors and property owners.[257] For instance, on January 1, 2016, the California Earthquake Authority[258] began offering twenty percent premium discounts if homeowners took basic steps to "earthquake-proof" their homes.[259] However, where risks are "irreducible"—that is, where

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251. *See, e.g.*, ALASKA ADMIN. CODE tit. 15, § 05.220 (2017) (providing that the standards for negligence or intentional disregard "may be demonstrated by any relevant evidence," including evidence that "the taxpayer has substantially deviated from the statutes or regulations in reporting income or claiming deductions").

252. Steven Shavell, *A Model of the Optimal Use of Liability and Safety Regulation*, 15 RAND J. ECON. 271, 271–72 (1984).

253. OLMSTEAD & RICHARDSON, *supra* note 101, at 2–3 (citing Shavell, *supra* note 252, at 271); *see also supra* section I.C (discussion of causation in liability).

254. *See, e.g.*, Dana & Wiseman, *supra* note 64, at 1547, 1557–58.

255. *See, e.g.*, Shahar & Logue, *supra* note 65, at 203 (distinguishing between the use of insurance for "risk shifting and risk spreading" and use of this tool "to induce risk-reducing behavior").

256. *See, e.g.*, Jan C. Bongaerts & Aline F. M. de Bièvre, *Insurance for Civil Liability for Marine Oil Pollution Damages*, 12 GENEVA PAPERS ON RISK & INS. 145, 153–54 (1987) (noting that "this cascade type of arrangement tends to reduce the transparency of the risks covered in this manner. In fact, in general, underwriters do not know how often a risk has been split in a retention part and a lay-off when they are invited to offer coverage . . . . [Moreover,] individual underwriters with an interest in diversifying their portfolios will only have a weak incentive to [screen or vet the performance of industry actors]. Since they are forced to allocate their funds over as many small sized risks as possible, they will deliberately minimize the efforts to investigate each individual risk thoroughly").

257. *See* Shahar & Logue, *supra* note 65, at 204.

258. The California Earthquake Authority ("CEA") is a publicly managed, privately funded entity that partners with residential property insurers to sell earthquake policies. CAL. INS. CODE § 10089.6 (West 2017).

259. *See* Press Release, CEA, CEA Unveils Lower Rates, More Policy Options, and Bigger Discounts for Earthquake Insurance (Jan. 4, 2016), https://www.earthquakeauthority.com/press-room/press-release/cea-unveils-

there is no way to reduce risk—the activity may be outright discouraged or made cost prohibitive through high insurance premiums, lack of coverage, or massive liability.[260]

In the short term, operators may see risk shifting as a sufficient goal,[261] particularly if they believe induced seismicity is waning in importance. Indeed, a late 2016 study observed a decrease in Oklahoma earthquakes following the economic downturn and state volume caps on wastewater disposal.[262] However, the study notes that "the induced seismic hazard in Oklahoma rapidly changes within time periods of less than 1 year if injection rates increase or decrease."[263]

If production rebounds, continued seismic activity in Oklahoma and other parts of the United States could cause more significant damage and injury,[264] undermine the industry's social license,[265] and drive aggressive regulatory action[266] that could limit subsurface disposal as an option for oil and gas wastewater. Faced with this possibility, tools that not only allocate but also reduce risk become more appealing.

To reduce the underlying risk of induced seismicity, policymakers, industry, and other stakeholders should deploy risk management tools in ways that encourage responsible behavior, compensate harms, and grow our understanding

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lower-rates-more-policy-options-and-bigger-discounts; Obersteadt, *supra* note 70.

260. *See, e.g.*, Dana & Wiseman, *supra* note 64, at 1564–65.

261. *See, e.g.*, B. Lee Wertz, Jr. & Stephan D. Selinidis, *Risk Shifting in the Oil Patch: A Guide to Extraordinary Risk Shifting*, 33 CORP. COUNS. REV. 147, 151–52 (2014) (describing broad indemnity clauses in some oil exploration and development contracts, including those shifting risk from a company that its own negligence will cause harm, and the litigation that has grown up around these provisions); Monte Whaley & John Ingold, *Oil and Gas Industry's Practice of Farming Out Work Can Have Deadly Consequences*, DENVER POST (Sept. 26, 2016), http://extras.denverpost.com/oil-gas-deaths/subcontractors.html (describing how subcontracting work in the oil and gas industry shifts liability to smaller companies and increases risk for workers).

262. *See* Langenbruch & Zoback, *supra* note 29.

263. *Id.* at 7.

264. *See, e.g.*, Paul O'Donnell, *Cushing Oil Hub Faces Emerging Threat: Earthquakes*, DALL. MORNING NEWS (Oct. 26, 2015), http://www.dallasnews.com/business/energy/2015/10/26/cushing-oil-hub-faces-emerging-threat-earthquakes (noting national security concerns as earthquakes move closer to Cushing, Oklahoma, where much of the U.S. interstate oil and gas pipelines cross); KFOR-TV & K. Querry, *Experts Predict Stronger Earthquake on the Horizon for Oklahoma*, KFOR (Jan. 8, 2016, 10:21 AM), http://kfor.com/2016/01/08/experts-predict-stronger-earthquake-on-the-horizon-for-oklahoma/.

265. *See, e.g.*, DEVON ENERGY, 2015 CORPORATE SOCIAL RESPONSIBILITY REPORT 5 (2015), http://www.socialfunds.com/shared/reports/1426551996_DevonEnergy_2015_CSR_Report.pdf ("Being the premier independent oil and natural gas company in North America requires a social license to operate earned through the trust and acceptance of our shareholders, royalty owners, neighbors, policymakers and other stakeholders."); Mary Hogan, *Securing a Social License to Operate Is More Important than Ever*, EXPLORATION & PRODUCTION MAG. (Feb. 6, 2015, 10:44 AM), http://www.epmag.com/securing-social-license-operate-more-important-ever-782186#p=full (noting that seismic activity is one of several issues which threaten the social license).

266. *See, e.g.*, Nick Cunningham, *Record Earthquake Threatens Oil and Gas Industry in Oklahoma*, OILPRICE.COM (Sept. 6, 2016, 4:15 PM), http://oilprice.com/Energy/Energy-General/Record-Earthquake-Threatens-Oil-And-Gas-Industry-In-Oklahoma.html (noting that the September 3, 2016 earthquake in Pawnee led Oklahoma to require the shut-down of thirty-seven disposal wells, and quoting an industry analyst opining, "It's hard to believe Oklahoma would move to ban fracking, but I can see where they would say to people that they have to do something else with the wastewater . . . .").

of induced seismicity. Certainly, careful design and deployment of existing tools might improve the current situation, which—as noted—is marked by insufficient insurance coverage, inconsistent regulation, and uncertain tort liability. For instance, a legislature could determine that a well operator who violates the injection volume and pressure limits in its operating permit could be found per se negligent for an earthquake occurring within a certain distance from the noncompliant well. However, in addition, this Article suggests use of a fourth tool: a compensation fund. This fund could work alongside existing tools to better calibrate risk allocation and spur risk reduction efforts.

For instance, imposition of strict liability—particularly for highly uncertain but potentially catastrophic events—can lead a company to adopt something less than the highest level of care, and then file for bankruptcy if a catastrophic event does occur.[267] This is particularly a risk when strict liability is combined with a theory of joint and several liability and retroactivity.[268] In such cases, a compensation fund (or bonding requirements or insurance, where sufficiently robust) could supplement liability rules, to ensure adequate recovery for damages. There are a number of real-world examples of this synergy. Marine oil pollution damage regimes often feature three layers: technical regulations to reduce risk, and insurance schemes and compensation funds to compensate harms if and when an incident does occur.[269] The nuclear energy compensation regime holds potentially responsible parties strictly liable, and requires them to carry insurance up to a deductible before a pooled liability compensation fund may be tapped.[270]

Additionally, a compensation fund could go a long way to meet public concerns and build trust for the industry. Many people in producing states are employed by the industry or know someone who is; and yet, the earthquakes are a physical reminder of the risks posed by oil and gas activities. Existing risk management tools are piecemeal, complex, and often not transparent—for example, citizens may not access information about a well operator's liability coverage or the outcome of an out-of-court settlement. This feeds a sense that nothing is being done to address the induced seismicity challenge. If citizens do not believe the risk is being managed, this belief erodes their trust in industry and the regulators, and puts the industry's social license at risk.

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267. Bongaerts & de Bièvre, *supra* note 256, at 152; *see* Steven Shavell, *Strict Liability versus Negligence*, 9 J. LEGAL STUD. 1, 7 (1980).

268. *See* Richardson, *supra* note 60, at 301–02.

269. Bongaerts & de Bièvre, *supra* note 256, at 147.

270. For example, the Price-Anderson Act requires nuclear reactor operations to "have and maintain" primary liability insurance up to the maximum offered in the private insurance market. 42 U.S.C. § 2210(a)–(b) (2015). In the event of a nuclear incident, this insurance coverage must be exhausted before an operator may tap the Price-Anderson fund that it has paid into to provide secondary coverage. If both of these sources are exhausted, the federal government assumes the remaining liability. *See id.* § 2210; 10 C.F.R. § 140 (2016).

One scholar has offered a seven-stage hierarchy of risk communication[271] to evaluate interactions between risky enterprises and their customers, neighbors, or the general public. To many, the oil and natural gas industry might appear firmly planted in the first stage when it comes to earthquake risks. In that most basic stage, experts "just see no need to talk about the risks in their care, as long as those risks are being kept at acceptable levels." Instead, the companies' engineers "focus on the (arduous and skilled) tasks of trying to master the design, execution, and operation of their technology."[272] A well-designed compensation fund, however, moves industry and regulators swiftly up the risk communication hierarchy to the fifth stage, where actors "acknowledge the public's right to compensation for risk."[273] This strategy is bypassed only by the stages of treating the public respectfully[274] and engaging the public as partners.[275]

At their worst, compensation funds merely shift liability for risky behavior onto the public. At their best, compensation funds fairly allocate risks and benefits while changing the risk profile (i.e., mitigating risks and expanding benefits). For instance, the fund's payment structure might be tied to the risk each operator poses. Funds might also support research into water recycling or alternative disposal methods. Or, participation in the fund might require the reporting of certain seismic information, to help researchers learn more about induced seismicity and to reduce risk drivers.

The next three sections build from existing funds to identify fund design elements for a Model Induced Seismicity Compensation Fund.

III. OTHER FUNDS, FOR USE AS POSSIBLE MODELS

As noted, long before the recent rise in earthquakes in Oklahoma and surrounding states, a range of human activities had been linked to earthquakes.[276] However, the use of compensation funds for induced seismicity has been extremely limited.[277] Some states have established carbon sequestration funds, but in most cases these funds merely provide a revenue source for site monitoring, and are silent on liability.[278] Funds in North Dakota and the European Union

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271. *See* Baruch Fischhoff, *Risk Perception and Communication Unplugged: Twenty Years of Process*, 15 RISK ANALYSIS 137, 137–38 (1995).

272. *Id.* at 138.

273. *Id.* at 141–42.

274. *See id.* at 142.

275. *See id.* at 142–43.

276. *See supra* notes 20–25 and accompanying text.

277. Two utilities and federal royalties fund projects to mitigate the impact of geothermal production in the Geysers field in Northern California, but—for the most part—the funds are not used to address seismicity. *See infra* section III.H.

278. *See, e.g.*, WYO. STAT. ANN. § 35-11-318(d) (2010) (stating that Wyoming's management of the carbon sequestration fund "shall not constitute a waiver by the state of Wyoming of its immunity from suit, nor does it constitute an assumption of any liability by the state for geologic sequestration sites"); *see also* ELIZABETH

assume long-term liability and cover some claims for damages.[279] However, these funds are more focused on whether the carbon dioxide remains sequestered than on the seismic risks in the injection phase,[280] and in any case merely shift liability between the private sector and government. The funds do not serve to mitigate risk, or establish a public compensation process.[281]

Funds in other contexts may prove more useful as models. This Part explores ten such funds. The Fishermen's Contingency Fund compensates damage to fishing equipment caused by inadequately marked offshore oil and gas infrastructure.[282] The international oil tanker conventions,[283] the Offshore Pollution Liability Association, Ltd.,[284] the federal Oil Spill Liability Trust Fund,[285] and the Texas Coastal Protection Fund[286] pay response costs and damages for oil spills. The Oklahoma Energy Resources Revolving Fund[287] is used to clean up abandoned and orphaned oil and natural gas well sites. The federal Leaking Underground Storage Tank Trust Fund[288] and the Indiana Underground Petroleum Storage Tank Excess Liability Trust Fund[289] respond to oil leaks from underground storage tanks. The Geysers Geothermal Mitigation Funds[290] address community concerns related to geothermal production, while the Illinois Dry-

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ALDRICH ET AL., ENERGY POLICY INST., ANALYSIS OF LIABILITY REGIMES FOR CARBON CAPTURE AND SEQUESTRATION: A REVIEW FOR POLICYMAKERS 18 (2011), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2269331 (discussing same).

279. *See* ALDRICH ET AL., *supra* note 278, at 14–16 (describing the North Dakota and EU regimes). Montana's fund offers a site operator the option of paying into a fund for long-term site management or retaining long-term liability. MONT. CODE ANN. § 82-11-181(1)(a) (2009). If an operator pays into the fund, Montana assumes liability for incidents occurring thirty years after a site closes. *Id.* § 82-11-183(11)(b)(ii); *see also id.* § 82-11-183(3) (noting that the state may issue a certificate of completion only after twenty-five years have lapsed since closure of site); *id.* § 82-11-183(6) (requiring site monitoring for another twenty-five years after issuance of the certificate); and *id.* § 82-11-183(7) (enabling transfer of liability to the state after twenty-five years of monitoring).

280. *See* Alexandra B. Klass & Elizabeth J. Wilson, *Climate Change and Carbon Sequestration: Assessing a Liability Regime for Long-Term Storage of Carbon Dioxide*, 58 EMORY L. J. 102, 119 (2008) (noting that seismic risks are likely small with "properly-managed sites").

281. *See id.* at 159–60 (noting these shortcomings and then proposing methods for addressing these concerns). *But see* Wendy B. Jacobs & Debra Stump, *Proposed Liability Framework for Geologic Sequestration of Carbon Dioxide* (Harv. L. Sch., Emmett Envtl. L. & Pol'y Clinic, Working Paper, revised Nov. 2010), http://belfercenter.ksg.harvard.edu/files/Proposed%20Liability%20Framework%20for%20Geological%20Sequestration%20of%20Carbon%20Dioxide.pdf (proposing a more robust compensation scheme for carbon sequestration); CCS Bill—Discussion Draft (Apr. 9, 2010) (on file with the law review) (legislation drafted but not introduced during the 111th Congress, proposing a carbon capture and sequestration compensation fund with a three-tiered liability scheme).

282. *See infra* section III.A.

283. *See infra* section III.B.

284. *See infra* section III.C.

285. *See infra* section III.D.

286. *See infra* section III.E.

287. *See infra* section III.F.

288. *See infra* section III.G.

289. *See infra* section III.G.

290. *See infra* section III.H.

cleaner Environmental Response Trust Fund[291] prevents and responds to releases of toxic chemicals from drycleaning facilities. Finally, the National Vaccine Injury Compensation Program[292] compensates victims and their families for death or injury correlated to a vaccine.

These funds were studied for seven specific design elements, discussed in greater detail in Part IV: (1) fund creation and management, (2) fund purpose, (3) sources of revenue, (4) liability, (5) methods for ensuring solvency, (6) limits on the use of the fund, and (7) modification and termination. Some funds were used to gather more information about a risk or problem; this feature will be discussed in greater detail in Part V.

A. THE FISHERMEN'S CONTINGENCY FUND[293]

Congress created the Fishermen's Contingency Fund in 1978, as part of the Outer Continental Shelf Lands Act Amendments.[294] The Amendments sought to meet concerns raised by the 1969 Santa Barbara oil spill, and President Richard Nixon's move to expand offshore oil leasing. The Fund addressed fishermen's concerns "over [drilling's] possible effects on their livelihoods."[295] It compensates commercial fishermen for lost work after gear entanglement with offshore oil and natural gas infrastructure.[296]

The Fund collects fees from leaseholders, exploration permittees, and pipeline easement holders.[297] Congress gave the Department of Commerce flexibility to set fees, up to a statutory cap of $5000 per year;[298] in addition, the Fund "may at no time exceed $2,000,000."[299]

The National Marine Fisheries Service ("NMFS")[300] uses the Fund to pay eligible claims to commercial fishermen.[301] No incident caps or liability caps are

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291. *See infra* section III.I.

292. *See infra* section III.J.

293. 43 U.S.C. §§ 1841–1847 (2015).

294. Outer Continental Shelf Lands Act Amendments of 1978, Pub. L. No. 95-372, 96 Stat. 629.

295. *See* California v. Watt, 668 F.2d 1290, 1295–96 (9th Cir. 1981) (citing H.R. REP. NO. 590 (1977), 1978 U.S.C.C.A.N. 1450).

296. 43 U.S.C. § 1843(c)(1); 50 C.F.R. § 296.1 (2016).

297. 43 U.S.C. § 1842(a)(1)(B); 50 C.F.R. § 296.3(b); 30 C.F.R. § 1218.152 (2016).

298. 43 U.S.C. § 1842(b)(1).

299. 43 U.S.C. § 1842(a)(1).

300. 43 U.S.C. § 1845(d), (f)–(g); 50 C.F.R. §§ 296.6(e)(1)–(3), 296.7–296.11. The Secretary of the Interior has delegated this responsibility to NOAA's NMFS. *See* UNDER SEC'Y OF COMMERCE FOR OCEANS AND ATMOSPHERE AND ADM'R OF THE NAT'L OCEANIC AND ATMOSPHERIC ADMIN., DIRECTIVE NO. DOO 10-15, § 3(gg)(3) (Dec. 12, 2011), http://www.osec.doc.gov/opog/dmp/doos/doo10_15.html (describing delegation of the Fishermen's Contingency Fund from the Secretary of Commerce to NOAA); *see also* U.S. DEP'T OF COMMERCE, NOAA ORGANIZATIONAL HANDBOOK, TRANSMITTAL NO. 61, DELEGATIONS OF AUTHORITY—ASSISTANT ADMINISTRATOR OF FISHERIES 2 (Feb. 24, 2015), http://www.corporateservices.noaa.gov/ames/delegations_of_authority/transmittal-61.pdf (describing delegation from NOAA to the NMFS).

301. 43 U.S.C. § 1842(a)(2)(B). In addition, funds may be used for attorneys' fees, *id.* §§ 1842(a)(2)(C), 1845(e), and administrative expenses (up to eight percent of the Fund), *id.* § 1842(a)(1).

mentioned in the law. However, the Fund serves as a secondary tier of recovery, requiring any available insurance to be applied first.[302] From 2006 through 2016, 124 of 192 Fund claims were approved, with an average award of $12,623.[303]

A fisherman alleging damage must file a report within fifteen days of returning to port,[304] and a claim ninety days from the date damage was incurred.[305] The claim must establish what structure caused the damage and that it is associated with offshore oil and gas activity.[306] The Fund presumes damage if a report was timely filed, the fishing boat was in a location affected by oil and gas infrastructure, there was no record of the infrastructure on the most recent nautical maps, and the infrastructure was not properly marked.[307] On the other hand, no payment will be made if a fisherman was negligent or at fault for the damage.[308] Once the NMFS makes a claim determination, any person may seek review in federal district court.[309] A fisherman may be prosecuted for filing a fraudulent claim.[310]

When Commerce receives a claim, it notifies the National Ocean Survey, to map previously unidentified infrastructure.[311] The Department also alerts owners of infrastructure, who can admit or deny responsibility for the damage.[312] If a party admits responsibility, Commerce recovers funds from them.[313] If the Department later finds that a responsible party denied responsibility at the outset, that party will pay for the costs of the proceedings on top of damages.[314]

A successful claimant assigns the Fund his or her legal rights of recovery;[315] any monies recovered are also deposited into the Fund.[316]

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302. *Id.* § 1843(c)(2)(D); 50 C.F.R. § 296.4(c)(4).

303. E-mail from Christopher P. McEntee, Financial Services Division, Nat'l Marine Fisheries Serv., to author (Mar. 24, 2017, 12:09 PM) (on file with the law review).

304. 43 U.S.C. § 1844(2); 50 C.F.R. § 296.5(a).

305. 43 U.S.C. § 1843(a)(1) (establishing ninety days as the minimum, but allowing the Secretary of the Interior to extend by rule); 50 C.F.R. § 296.5(c).

306. 50 C.F.R. § 296.7(a).

307. 43 U.S.C. § 1844(3)–(4); 50 C.F.R. § 296.7(b). The Secretary of the Interior must issue rules on color coding, stamping, and labeling oil and gas infrastructure. 43 U.S.C. § 1843(b).

308. 43 U.S.C. § 1843(c)(2)(A); 50 C.F.R. § 296.4(c)(1). The regulations provide five examples of negligence or fault. *See id.* § 296.2.

309. 43 U.S.C. § 1845(i); 50 C.F.R. § 296.15.

310. 50 C.F.R. § 296.6(e)(4).

311. 50 C.F.R. § 296.6(a)(2).

312. 43 U.S.C. § 1845(c); 50 C.F.R.§ 296.6(c)(1).

313. 50 C.F.R. § 296.6(c)(3).

314. 43 U.S.C. § 1845(h)(3); 50 C.F.R. § 296.12(a).

315. 43 U.S.C. § 1845(h)(2); 50 C.F.R. § 296.14(a).

316. 43 U.S.C. § 1842(a)(1)(C); 50 C.F.R. §§ 296.3(c), 296.14(c).

B. THE INTERNATIONAL CONVENTION ON CIVIL LIABILITY FOR OIL POLLUTION DAMAGE,[317] PROTECTION AND INDEMNITY CLUBS,[318] AND THE INTERNATIONAL OIL POLLUTION COMPENSATION FUND[319]

On March 18, 1967, the oil tanker *Torrey Canyon* ran aground near Cornwall, England, carrying 120,000 tons of crude oil. Unable to recover the ship, the United Kingdom bombed the hull to sink it,[320] then used what was described as an "excessive and indiscriminate use" of chemical dispersants on the escaping oil.[321] As the oil slick reached hundreds of miles of coastline in the United Kingdom and France, both governments struggled to recover damages and response costs.[322] The British government sought only a fraction of the costs incurred from the tanker owners,[323] and yet even this was an uphill battle. At one point, an English lawyer reportedly boarded another ship in the owner's fleet, pretending to be a whiskey salesman; once on board, the story goes, he attached a writ to seize the ship for compensation.[324]

Public outcry about this disaster and the gross underpayment of damages drove the adoption of the 1969 International Convention on Civil Liability for Oil Pollution Damage. Under the Convention, tankers are strictly liable for pollution caused by spills[325] in member states or their territorial waters[326] (and jointly and severally liable, if multiple tankers are involved)[327] up to a present-day limit of

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317. International Convention on Civil Liability for Oil Pollution Damage, Nov. 29, 1969, 973 U.N.T.S. 3 [hereinafter 1969 Convention] (amended versions cited *infra* in relevant footnotes).

318. *See* International Group Agreement 1985, U.K. P&I Club [hereinafter P&I Agreement], http://www.ukpandi.com/knowledge/article/international-group-agreement-1985-1020/ (last updated Sept. 27, 2010) (amended versions cited *infra* in relevant footnotes).

319. International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, Dec. 18, 1971, 1110 U.N.T.S. 57 [hereinafter 1971 Fund] (amended versions cited *infra* in relevant footnotes).

320. Patrick Barkham, *Oil Spills: Legacy of the Torrey Canyon*, THE GUARDIAN (June 24, 2010, 3:00 AM), https://www.theguardian.com/environment/2010/jun/24/torrey-canyon-oil-spill-deepwater-bp.

321. *Torrey Canyon, United Kingdom, 1967*, INT'L TANKER OWNERS POLLUTION FED'N LTD. (May 23, 2014), http://www.itopf.com/in-action/case-studies/case-study/torrey-canyon-united-kingdom-1967/.

322. *See* Jaclyn A. Zimmermann, *Inadequacies of the Oil Pollution Act of 1990: Why the United States Should Adopt the Convention on Civil Liability*, 23 FORDHAM INT'L L. J. 1499, 1506 (1999) (citing NICHOLAS J. HEALY & DAVID J. SHARPE, CASES & MATERIALS ON ADMIRALTY 875 (3d ed. 1999)).

323. Harm to the British Coast was assessed at $8 million, *see* Henry J. McGurren, *The Externalities of a Torrey Canyon Situation; An Impetus for Change in Legislation*, 11 NAT. RES. J. 340, 340 (1971), but the British government sought just £3 million from the tanker owners, *see* Barkham, *supra* note 320.

324. Barkham, *supra* note 320. Initially, a court enjoined all parallel actions and approved a stipulation that the ship owners would only receive $50 in compensation (that is, the value of the bombed-out vessel). *See* Zimmermann, *supra* note 322, at 1506–07.

325. 1969 Convention, *supra* note 317, art. III(1). The Convention spells out a few limited defenses to strict liability, including an act of war, an intentional act by a third party, or negligence of a government. *Id.* art. III(2).

326. 1969 Convention, *supra* note 317, art. II.

327. 1969 Convention, *supra* note 317, art. IV.

$139.6 million.[328] The limit is lifted where actual fault is shown.[329]

Tanker owners must carry insurance up to the liability limit;[330] the owners use private Protection and Indemnity ("P&I") Clubs to meet this requirement.[331] The Clubs formed the International Group of the P&I Clubs to act as their mutual insurer and to negotiate with reinsurers for the group.[332] All Clubs must sign the International Group Agreement, which ensures that Clubs do not set unreasonably high or low premiums,[333] or enable risky vessels to switch clubs too easily.[334] The Agreement seeks to "ensure that the Members of each association contribute equitably to its expenses and losses" in a way that "estimate[s] fairly the risk that [each member] represents."[335]

When an incident occurs, the responsible tanker owner establishes a fund for claimants.[336] Claims must be filed within three years from the date the damage occurred, but in no case more than six years from the date of the incident.[337] No other claims can be made—outside the time period or above the limit—against the tanker, in any venue.[338]

In 1971, countries adopted a second convention to create the International Oil Pollution Compensation ("IOPC") Fund.[339] Tanker owners were solely responsible under the Convention; by contrast, the Fund collects fees assessed on large oil receivers (i.e., companies purchasing more than 150,000 tons of oil annually).[340] The Fund also assumes claimants' rights to recover funds from third parties.[341]

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328. 1969 Convention *supra* note 317, art V(1). At the outset, the limit was the equivalent of $15.4 million. Bongaerts & de Bièvre, *supra* note 256, at 149. In 2000, the limit for liability under the 1969 Convention was raised to the present-day limit. *See* Adoption of Amendments of the Limitation Amounts in the Protocol of 1992 to Amend the International Convention on Civil Liability for Oil Pollution Damage, 1969, IMO Res. LEG.1(82) (Oct. 18, 2000), http://www.imo.org/blast/blastDataHelper.asp?data_id=15849&filename=LEG1(82).pdf (raising limit to 89,770,000 "units of account"). For consistency with INT'L OIL POLLUTION COMP. FUNDS, LIABILITY AND COMPENSATION FOR OIL POLLUTION DAMAGE 3 (2011), conversion from British pounds to U.S. dollars was done using rates from October 2011.

329. 1969 Convention, *supra* note 317, art. V(2).

330. 1969 Convention, *supra* note 317, art. VII(1).

331. Bongaerts & de Bièvre, *supra* note 256, at 147.

332. *Id.* at 147, 153.

333. *See, e.g.*, P&I Agreement, *supra* note 318, ¶ 3(6) (retaining access to reinsurance for a club offering a lower premium to a vessel, if the original club set an unreasonably high premium); *id.* ¶¶ 3(7), 3(8) (setting a deadline for charging that the original premium was unreasonably high, and describing the consequences of each finding); *id.* ¶ 4(1) (prohibiting any club from offering an unreasonably low premium to a new vessel).

334. *See, e.g.*, *id.* ¶ 2(2) (requiring any new club offering a vessel a competitive premium to ask for the operator's record, defined in ¶ 1(1) as "all matters which might materially affect an underwriter's assessment of the risk of insuring that Operator's vessels and the appropriate premium and basis of quotation").

335. *Id.* at "Whereas" cl. 2–4.

336. 1969 Convention, *supra* note 317, art. V(3).

337. 1969 Convention, *supra* note 317, art. VIII.

338. 1969 Convention, *supra* note 317, art. III(4).

339. 1971 Fund, *supra* note 319.

340. *Id.* art. 10. The amount is set by the Convention's Assembly. *See id.* art. 11.

341. *Id.* art. 9.

The IOPC Fund compensates any person unable to obtain "full and adequate compensation" under the 1969 Convention, because no liability attached, because the tanker owner was unable to meet its obligations, or because damages exceeded the Convention's liability limits.[342] The Fund limits overall liability for any one incident to $316 million, which includes the cap set under the Convention.[343]

Finally, a 2003 protocol creates a third tier of compensation.[344] The Supplementary Fund, also funded by fees assessed on large oil purchasers,[345] increases the overall liability limits for a single incident to $1.166 billion.[346] Membership is optional.[347]

In addition to paying claims for damages, the Convention[348] and the IOPC Fund[349] compensate owners for spill response costs. Since 1992, they also cover spill prevention efforts by tanker owners.[350]

On the one hand, the universe of eligible claims has changed over time. For example, the geographic scope was expanded to include a country's Exclusive Economic Zone ("EEZ," up to 200 miles from a country's coast).[351] On the other hand, recoverable damages for environmental harm have been limited under the Convention to "reasonable measures of reinstatement actually undertaken or to be undertaken."[352]

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342. *Id.* art. 4(1)(a)–(c).

343. *Id.* art. 4. At the time the Fund went into force, the maximum amount payable for any one incident was $49.6 million. Bongaerts & de Bièvre, *supra* note 256, at 149 (converting the currency to U.S. dollars). In 2000, the limit under the Convention was raised to the current limit. *See* Adoption of Amendments of the Limits of Compensation in the Protocol of 1992 to Amend the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1971, IMO Res. LEG.2(82) (Oct. 18, 2000), http://www.imo.org/blast/blastDataHelper.asp?data_id=15850&filename=LEG2(82).pdf (indicating liability limits had been raised to 203 million "units of account"); *see also* INT'L OIL POLLUTION COMP. FUNDS, *supra* note 328, at 3 (converting this amount to U.S. dollars).

344. *See* Protocol of 2003 to the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1992, IMO Doc. LEG/CONF.14/20 (May 16, 2003) [hereinafter 2003 Protocol], *in* INT'L OIL POLLUTION COMP. FUNDS, *supra* note 328, at 43.

345. 2003 Protocol, *supra* note 344, art 10.

346. *Id.* art. 4.

347. *Id.* art. 19(2).

348. 1969 Convention, *supra* note 317, art. V(8).

349. 1971 Fund, *supra* note 319, art. 5(7).

350. International Convention on Civil Liability for Oil Pollution Damage, art. II(b), Nov. 27, 1992, 1956 U.N.T.S. 255 [hereinafter 1992 Convention]; International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, art. 3(b), Nov. 27, 1992, 1953 U.N.T.S. 330 [hereinafter 1992 Fund]; *see also* Michael Faure & Hui Wang, *Compensating Victims of a European Deepwater Horizon Accident: OPOL Revisited*, 62 MARINE POL'Y 25, 30 (2015) (noting recovery for costs incurred in "pure threat removal").

351. 1992 Convention, *supra* note 350, art. II(a)(ii); 1992 Fund, *supra* note 350, art. 3(a)(ii); *see also* Reinhard H. Ganten, *Oil Pollution Liability Amendments Adopted to Civil Liability and Fund Conventions*, 2 OIL & PETROCHEMICAL POLLUTION 93, 95 (1985).

352. 1992 Convention, *supra* note 350, art. I(6)(a); *see also* Ganten, *supra* note 351, at 98.

C. OFFSHORE POLLUTION LIABILITY ASSOCIATION LIMITED ("OPOL")

The Tanker Conventions only address vessel pollution. Oil companies operating in the North Sea created OPOL to ward off another potential convention or regulation to control spills from drilling platforms.[353] The purpose was "to provide an orderly means for compensating and reimbursing any Person who sustains Pollution Damage and any Public Authority which incurs costs for taking Remedial Measures" after an offshore oil spill.[354] While the agreement is voluntary, the United Kingdom now requires companies to join OPOL as a condition for receiving a permit to drill in U.K. waters.[355]

An OPOL member is strictly liable for pollution damages and response actions (with some exceptions),[356] up to a $250 million cap.[357] Membership is conditioned on a showing of financial assurance equivalent to the cap,[358] and the payment of necessary dues, assessments, and other fees.[359] However, OPOL is not a fund, but a guarantee: members are responsible as a group to cover damages "in the event that a Party fails to satisfy its obligations."[360] Each company's share is based on the number of wells it operates.[361]

Fund coverage is limited in a number of ways. First, "pollution damage" is defined to cover only direct loss or damage.[362] Second, a claimant must provide information as "reasonably required" by the potentially responsible party; if the parties dispute this standard, they must settle their disagreement in arbitration.[363] Third, claimants have just one year to make a claim.[364] Because OPOL is a private agreement among companies, it cannot prevent non-parties from seeking relief through member country court systems.[365] Therefore, claimants may file

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353. Faure & Wang, *supra* note 350, at 26.

354. Offshore Pollution Liability Agreement, pmbl., Sept. 4, 1974 (last amended Dec. 1, 2015) [hereinafter OPOL Agreement], http://www.opol.org.uk/agreement.htm.

355. Faure & Wang, *supra* note 350, at 28; *Licence Assignments*, U.K. OIL & GAS AUTH., https://www.ogauthority.co.uk/licensing-consents/licensing-system/licence-assignments/ (last visited Apr. 5, 2017).

356. OPOL Agreement, *supra* note 354, cl. IV(B)(1)–(4).

357. *Id.* cl. IV(A). Of that amount, up to half may be used to reimburse cleanup costs, and up to half may be used to pay claims. *Id.* cl. IV(A)(1)–(2).

358. *Id.* cl. II(C)(1). Financial assurance may be shown through insurance, a guarantee, or qualification as a self-insurer. *See* OPOL, FORM B: RULES FOR ESTABLISHMENT OF FINANCIAL RESPONSIBILITY (Jan. 1, 2016), http://www.opol.org.uk/downloads/Form_B_(1%20Jan%2016).pdf.

359. OPOL Agreement, *supra* note 354, cl. II(C)(3).

360. *Id.* cl. II(C)(4), cl. III(2).

361. OPOL, Articles of Association of the Offshore Pollution Liability Association Limited, at art. 4.3, app. ¶ 3 (Sept. 4, 2014) [hereinafter OPOL Articles], http://www.opol.org.uk/downloads/opol-articles-4Sept14.pdf.

362. OPOL Agreement, *supra* note 354, cl. I(14); *see also* Faure & Wang, *supra* note 350, at 30 (noting that the "direct" limitation may foreclose claims for personal injury, economic losses, or environmental harms).

363. OPOL Agreement, *supra* note 354, cl. V(1); *see also id.* cl. IX.

364. *Id.* cl. VI.

365. *See, e.g.*, EEOC v. Waffle House, 534 U.S. 279, 294 (2002) ("It goes without saying that a contract cannot bind a nonparty.").

lawsuits instead to recover for damages;[366] however, OPOL payouts are conditioned on "necessary releases,"[367] and claimants are told that payment may not be used as an admission of liability.[368]

Effective January 1, 2016, the OPOL Agreement clarifies that subcontracting the operation of an offshore facility will not relieve an operator of its obligations.[369]

D. OIL SPILL LIABILITY TRUST FUND[370]

The United States helped to negotiate the tanker compensation regimes (the Convention and the IOPC Fund).[371] But it did not join these regimes, in part because of stated concerns that the liability limits were too low.[372] Instead, for spills in U.S. waters, Congress established the Oil Spill Liability Trust Fund ("Oil Spill LTF") in 1986.[373] Four years later, following the Exxon Valdez oil spill,[374] Congress built an extensive oil spill prevention, response, and compensation regime around this Fund.[375]

The Oil Spill LTF is funded through a tax on crude oil or imported petroleum product,[376] government cost-recovery actions,[377] and oil spill penalties.[378] In 1990, the Oil Spill LTF also received one-time transfers from defunct funds.[379] The Fund pays for initial oil spill response costs, and administrative costs associated with oil spill prevention, response, and enforcement.[380] It also pays oil spill damage claims[381] when responsible parties are not identified, not solvent, or have hit their liability limit.

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366. *See* Faure & Wang, *supra* note 350, at 28.

367. OPOL Agreement, *supra* note 354, cl. VII.

368. *Id.* cl. VIII(D).

369. *Id.* cl. I(10) (defining "operator"); *see also Offshore Pollution Liability Agreement*, OPOL, http://www.opol.org.uk/agreement.htm (last visited Apr. 5, 2017) (noting that this amendment was agreed to on Dec. 1, 2015).

370. 26 U.S.C. § 9509 (2015); 33 U.S.C. §§ 1321(s), 2701–2720 (2015); 33 C.F.R. § 136 (2016).

371. *See* Zimmermann, *supra* note 322, at 1516–17 (citing WU CHAO, POLLUTION FROM THE CARRIAGE OF OIL BY SEA: LIABILITY AND COMPENSATION 332 (1996); Tyler J. Savage, *North American Oil Pollution: Who is Liable for a Canadian/American Catastrophe?*, 4 ROGER WILLIAMS U. L. REV. 335, 346 (1998).

372. *See* sources cited *supra* note 371.

373. 26 U.S.C. § 9509; Omnibus Budget Reconciliation Act of 1986, Pub. L. No. 99-509, § 8033, 100 Stat. 1959.

374. *See Exxon Valdez Oil Spill*, NOAA OFFICE OF RESPONSE & RESTORATION, http://response.restoration.noaa.gov/oil-and-chemical-spills/significant-incidents/exxon-valdez-oil-spill (last modified Apr. 5, 2017, 11:50 AM).

375. 33 U.S.C. § 1321(s); *id.* §§ 2701–2720; Oil Pollution Act of 1990, Pub. L. No. 101-380, 104 Stat. 484.

376. 26 U.S.C. § 9509(b)(1). Before January 1, 2017, the tax was eight cents a barrel. After that time, it increased to nine cents a barrel. *See id.* § 4611(c)(2)(B).

377. *Id.* § 9509(b)(2)–(3).

378. *Id.* § 9509(b)(8).

379. *Id.* § 9509(b)(4)–(7).

380. *Id.* § 9509(c); 33 U.S.C. § 2712. Administrative costs are capped. *Id.* § 2712(a)(5).

381. *Id.*

Initially, a responsible party (usually the owner, operator, or lessee of the vessel or facility that has discharged oil)[382] is strictly liable for all removal costs and damages.[383] Congress set a $50 million cap on removal costs,[384] as well as total liability limits: removal costs plus $75 million for an offshore facility, and $350 million for an onshore facility and deepwater port.[385] These caps do not apply when willful negligence or willful misconduct are shown.[386] Responsible parties must maintain financial responsibility.[387]

After a cap is hit, the Oil Spill LTF covers removal costs and damages,[388] up to $1 billion per incident.[389] The Fund may not pay a claim if the pay-out would cause the Fund's balance to dip below $30 million.[390]

Claims must be made within three years for damage claims, and within six years for response-cost claims.[391] Each claimant must demonstrate damages and describe how they "were caused by, or resulted from" the oil spill,[392] and disclose insurance or other sources of compensation.[393] Finally, no one can make a claim against the Fund if the discharge or any resulting response costs or damages were caused by their gross negligence or willful misconduct.[394] Once a claim is paid, the Fund is released from future liability, and assumes the claimant's rights to recover from other parties.[395] Criminal penalties may be assessed for fraudulent claims.[396]

The Oil Spill LTF was audited every three years through 2016, and is now audited every five years.[397] The Oil Pollution Act and the Oil Spill LTF do not preempt state oil spill claims, or state oil spill compensation funds.[398] In fact, a number of state spill compensation funds operate alongside the Oil Spill LTF.[399]

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382. *Id.* § 2701(32).

383. *Id.* § 2702(a). The exception to this is where the responsible party can establish that a third party caused the damage. *Id.* §§ 2712(b), 1321(g).

384. *Id.* § 1321(f)(2)–(3).

385. *Id.* § 2704(a). EPA may adjust the onshore cap downwards, but not below $8 million. *Id.* § 2704(d)(1). In addition, EPA is directed to increase the limits to keep pace with the Consumer Price Index. *Id.* § 2704(d)(4).

386. *Id.* § 2704(c)(1)(A).

387. *Id.* § 2716. Failure to maintain this financial responsibility could result in penalties, *id.* § 2716a(a), a judicial order terminating operations, *id.* § 2716a(b), or seizure of a vessel, *id.* § 2716(b)(3).

388. *See, e.g.*, *id.* § 2708(b).

389. 26 U.S.C. § 9509(c)(2)(A)(i) (2015). A separate per-incident cap of $500 million is set for natural resource damage claims. *Id.* § 9509(c)(2)(A)(ii).

390. *Id.* § 9509(c)(2)(B).

391. 33 U.S.C. § 2712(h); 33 C.F.R. § 136.101(a) (2016).

392. 33 C.F.R. § 136.105.

393. *Id.* §§ 136.111, 113.

394. 33 U.S.C. § 2712(b).

395. 33 C.F.R. § 136.115(a); *see also* 33 U.S.C. § 2712(f) (noting that payment of any claim out of the Fund gives the United States all rights of the claimant to recover from the responsible party).

396. 33 C.F.R. § 136.9.

397. 33 U.S.C. § 2712(g).

398. *Id.* § 1321(o)(2); *id.* § 2718.

399. *See, e.g.*, N.Y. NAV. LAW § 181; (McKinney 2015); Texas Coastal Protection Fund, *infra* section III.E.

E. TEXAS COASTAL PROTECTION FUND[400]

After the 1989 Exxon Valdez spill, and following tanker oil releases in the Gulf of Mexico and the Houston Ship Channel in 1990,[401] the Texas legislature enacted a state oil spill response statute.[402] This regime—designed to "support and complement" the federal Oil Pollution Act[403]—included the creation of a Texas Coastal Protection Fund.

The Coastal Protection Fund provides "immediately available funds" for oil spill response and prevention[404] in Texas coastal waters.[405] In all cases when a spill occurs, the owner of a tanker or marine terminal is strictly liable, up to limits based on the facility and its size.[406] Separate liability caps exist for natural resources damages.[407] The limit is lifted where the threatened or actual discharge was caused by gross negligence or willful misconduct.[408] Owners must maintain financial responsibility to cover this liability.[409]

It also serves as a secondary or tertiary tier of compensation for damages.[410] Claims under $50,000 must be filed with the responsible party first; if there is no response after thirty days, the claimant may file with the Coastal Protection Fund.[411] Claims over $50,000 must be filed with the responsible party, then the federal Oil Spill LTF, and finally, the state Coastal Protection Fund.[412]

All claims for damages must be filed with the Coastal Protection Fund within six months.[413] Damages are defined as a "direct, documented loss of, injury to, or loss of use of any real or personal property or natural resources injured by an unauthorized discharge of oil," lost revenues to state and local governments, and "direct, documented loss of income, profits, or earning capacity" of fishermen.[414]

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400. Oil Spill Prevention and Response Act of 1991, TEX. NAT. RES. CODE ANN. §§ 40.001–40.304 (West 2017).

401. Steve G. Buschang, *The History and Evolution of the Texas Coastal Oil Spill Planning and Response Atlas and Toolkit*, ECO MAG. (Apr. 1, 2016), https://www.ecomagazine.com/featured-stories/the-history-and-evolution-of-the-texas-coastal-oil-spill-planning-and-response-atlas-and-toolkit (describing the June 1990 spill by tank vessel *Mega Borg* in the Gulf of Mexico—which released 4.6 million gallons of oil—and a collision of two Apex barges in the Houston Ship Channel later that year—which released 700,000 gallons of oil).

402. Oil Spill Prevention and Response Act of 1991, Tex. Sess. Law Serv. ch. 10 (West).

403. NAT. RES. § 40.002(d).

404. *Id.* § 40.151(a); *see also id.* §40.003(22) (defining response costs).

405. *Id.* § 40.003(2).

406. *Id.* § 40.202(a)(1) (setting liability caps at $1 million for barges of 300 tons or less that do not carry oil as cargo, $5 million for barges up to 8000 tons, and $600 for every additional gross ton up to the limit of the Coastal Protection Fund); *id.* § (a)(2) (setting liability caps for terminal facilities). The responsible party has some limited defenses to strict liability. *See id.* § 40.204.

407. *Id.* § 40.203(c)–(d).

408. *Id.* §§ 40.202(c)(1), 40.203(f).

409. *Id.* § 40.201.

410. *Id.* § 40.151(a); *see also id.* § 40.152(a)(2)–(4).

411. *Id.* § 40.159(b)(2).

412. *Id.* § 40.159(b)(1).

413. *Id.* § 40.159(c).

414. *Id.* § 40.003(7)(A).

In addition, the Fund covers erosion control projects,[415] efforts to plug abandoned or orphaned wells on state-owned submerged lands,[416] and a spill education program[417] for fishing and recreational boats, ferries, and cruise ships.[418]

The Coastal Protection Fund collects monthly fees from owners of oil shipped in tankers to Texas.[419] The fee starts at 1.33 cents per barrel of crude oil,[420] but is suspended when the state's Fund exceeds $20 million,[421] reinstated when the Fund drops below $10 million,[422] and raised to 4 cents when the balance is low and a recent oil spill threatens to deplete the Fund.[423] At no point may the Coastal Protection Fund exceed $50 million.[424] Claims may be paid on future income of the Fund.[425]

Claimants are free to sue a responsible party up to the law's liability limits, rather than seek compensation from the Coastal Protection Fund.[426] However, if they receive awards from the Fund, they lose all rights to further claims for the same incident,[427] and they abrogate their legal rights against third parties.[428] The state may seek to recover funds based on these rights, or monies owed to it from responsible parties.[429]

F. THE OKLAHOMA ENERGY RESOURCES REVOLVING FUND

At least one scholar has suggested expanding the Oklahoma Energy Resources Revolving Fund to compensate damages for induced seismicity.[430] The state legislature established the Revolving Fund[431] in 1992, as part of the Oklahoma Independent Energy Education and Marketing Act.[432] The Oklahoma Revolving Fund supports "environmental cleanup and remediation projects related to oil and gas pollution."[433] Since 1994, it has spent $100 million to restore 15,000

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415. *Id.* § 40.152(a)(9).
416. *Id.* § 40.152(a)(10).
417. *Id.* § 40.152(a)(5).
418. *Id.* § 40.304.
419. *Id.* § 40.154.
420. *Id.* § 40.155(a).
421. *Id.* § 40.155(a).
422. *Id.* § 40.155(b).
423. *Id.* § 40.155(c).
424. *Id.* § 40.151(b).
425. *Id.* § 40.162.
426. *Id.* § 40.256.
427. *Id.* § 40.160(c)–(d).
428. *Id.* § 40.160(d).
429. *Id.* § 40.153; *see also id.* § 40.161 (directing the Texas Land Commissioner to diligently pursue reimbursements, and to use the court system to secure reimbursement).
430. Wegener, *supra* note 205, at 139.
431. OKLA. STAT. ANN. tit. 52, § 288.7 (West 2017).
432. 1992 Okla. Sess. Law Serv. ch. 257 (West).
433. tit. 52, § 288.7(B).

orphaned and abandoned well sites.[434] As is suggested by the description of these sites, no companies exist to pursue for restitution; instead, industry as a whole funds the enterprise. By statute, at least half of the funds must be spent on projects from a priority list compiled by state agencies.[435]

The Fund receives revenues from an assessment (one-tenth of one percent) of the gross revenues for oil, natural gas, or other fossil fuels produced in the state.[436] The assessments are voluntary, and companies that do not wish to participate may seek reimbursement.[437] Most companies have participated; however, in recent years, a few larger companies have backed out of the program.[438] The Fund may also receive money from donations, grants, contributions, and gifts from any public or private source.[439] The Board may invest monies in federal or state government obligations, deposits in a Federal Reserve System bank, or in obligations fully guaranteed by the United States.[440]

The Board consists of representatives of the independent oil producers and major oil companies, a member of a royalty owner association, and two representatives of crude oil purchasers.[441] The Oklahoma Revolving Fund periodically terminates under Oklahoma's Sunset Law;[442] the Board and the Fund are next up for sunset review by July 1, 2017.[443]

G. THE FEDERAL LEAKING UNDERGROUND STORAGE TANK TRUST FUND AND THE INDIANA UNDERGROUND PETROLEUM STORAGE TANK EXCESS LIABILITY TRUST FUND

In 1984,[444] Congress amended the federal RCRA.[445] At the time, up to 100,000 underground fuel storage tanks were actively leaking and EPA projected another 350,000 could begin leaking within five years.[446] The amendments established a tank inventory,[447] directed EPA to issue rules,[448] and required a

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434. Ashley Barcum, *OERB Reaches 15,000th Site and $100 Million Milestone*, OKLA. ENERGY RES. BD. (Apr. 14, 2016), http://www.oerb.com/industry/advancing-energy-blog/80/oerb-reaches-15000th-site-and-100-million-milestone.

435. tit. 52, § 288.7(B).

436. *Id.* § 288.8A.

437. *Id.* § 288.5E.

438. Interview with Chad Warmington, President, Oklahoma Oil & Gas Association (Sept. 14, 2016).

439. tit. 52, § 288.7(A).

440. *Id.* § 288.11(A).

441. *Id.* § 288.4(C)–(G).

442. OKLA. STAT. ANN. tit. 74, § 3908(5) (West 2017).

443. tit. 52, § 288.3.

444. The Hazardous and Solid Waste Amendments of 1984, Pub. L. No. 98-616, 98 Stat. 3221.

445. 42 U.S.C. §§ 6901–6992k (2015).

446. H.R. REP. NO. 98-1133, at 128 (1984) (Conf. Rep.), *cited in* Kevin R. Duncan & B. Todd Bailey, *Innocence Amid "LUST": The Innocent Buyer and Leaking Underground Storage Tanks Containing Petroleum*, 7 BYU J. PUB. L. 245, 246 (1993).

447. 42 U.S.C. § 6991a(c).

448. *Id.* § 6991b(a); *see* 40 C.F.R. § 280 (2016). These rules were initially promulgated in 1988; they were recently updated, in 2015. *See* Revising Underground Storage Tank Regulations—Revisions to Existing

minimum of $1 million in financial assurance for each tank, for each occurrence.[449]

In 1986,[450] Congress established the Leaking Underground Storage Tank ("LUST") Trust Fund[451] to fund responses when EPA cannot identify a solvent tank owner or operator, and to enable emergency responses.[452] The LUST Trust Fund receives congressional appropriations,[453] and revenue from a 0.1% tax on motor fuels, fuels from refineries, terminals, or points of import, and fuel used in commercial waterway transportation.[454] In addition, EPA or a state (under a cooperative agreement with EPA) can seek to recover costs for emergency responses, to replenish the LUST Trust Fund.[455]

Most of the dollars appropriated to the LUST Trust Fund flow to states in cooperative agreements with EPA,[456] or to states delegated primary responsibility for the federal underground storage tank program.[457] EPA may also underwrite state-run tank owner/operator training programs.[458]

Indiana was delegated authority to implement the federal storage tank RCRA program in 2006.[459] By that point, Indiana had been running a state tank response program for seventeen years, since 1989.[460]

In 1996, Indiana amended its fund and renamed it the Excess Liability Trust ("ELT") Fund.[461] The ELT Fund is used to satisfy liabilities of tank owners and operators, indemnify third parties, and fund tank inspections and state inspector training.[462] Per-incident payments are capped at $2.5 million; annual payouts are limited as well.[463] Within these limits, the ELT Fund will cover a tank owner/operator. Prior to 2016, coverage was conditioned on a tank owner/operator paying all tank registration fees, complying with the state's storage tank regime,

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Requirements and New Requirements for Secondary Containment and Operator Training, 80 Fed. Reg. 41,566 (July 15, 2015) (to be codified at 40 C.F.R. pt. 280 and 281).

449. 42 U.S.C. § 6991b(d); *see* 40 C.F.R. § 280.93.

450. Superfund Amendments and Reauthorization Act of 1986, Pub. L. No. 99-499, 100 Stat. 1613.

451. 26 U.S.C. § 9508(a) (2015).

452. 42 U.S.C. § 6991b(h)(1).

453. *Id.* § 6991m.

454. 26 U.S.C. § 9508(b) (describing taxes detailed in 26 U.S.C. §§ 4041(d), 4081, and 4042).

455. 42 U.S.C. § 6991b(h)(6).

456. *Id.* § 6991c(f)(3)(A).

457. *Id.* § 6991c(f)(3)(B).

458. 42 U.S.C. § 6991i; 40 C.F.R. § 280.242.

459. Indiana; Final Approval of State Underground Storage Tank Program, 71 Fed. Reg. 39,213 (July 12, 2006) (to be codified at 40 C.F.R. pt. 280).

460. An Act to Amend the Indiana Code Concerning Underground Storage Tanks, 1988 Ind. Legis. Serv. 69-1988 (West). The Fund as originally designed did not meet EPA's requirements to operate as evidence of financial responsibility under the federal underground storage tank rules. *See* B&R Oil Co., 8 E.A.D. 39, 57 (EPA 1998).

461. An Act to Amend the Indiana Code Concerning the Environment, 1996 Ind. Pub. L. No. 9-1996 (West).

462. *See* IND. CODE ANN. § 13-23-7-1 (West 2017).

463. *Id.* § 13-23-8-8.

and submitting a corrective action plan.[464] Since July 1, 2016, these conditions have been dropped.[465]

Payment is subject to deductibles. Historically, deductibles ranged from $20,000 to $35,000, depending on the technical compliance status of the tank, as well as the existence of particular safety features.[466] As of July 2016, the law sets a uniform deductible of $15,000, without regard to the tank's condition.[467]

The ELT Fund receives money from storage tank registration fees,[468] appropriations, gifts and donations, inspection fees,[469] and bond revenue.[470] Interest earned on the State Treasurer's investment of ELT Fund dollars is also deposited.[471] If funds are limited, priority cleanups—or those posing an "immediate and significant threat to the environment"—are conducted first.[472]

The statute does not bar an owner/operator from filing lawsuits to recover from other responsible parties.[473] Nor does the ELT Fund limit the liability of a tank owner/operator.[474] Fraudulent claims on the Fund are treated as felonies.[475]

Indiana has imposed a number of mechanisms to ensure the solvency of the ELT Fund. An underground storage tank financial assurance board[476] tracks claims[477] and evaluates the annual financial statement, to ensure the Fund's financial health.[478] In addition, the state board of accounts audits the ELT Fund biannually.[479]

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464. *Id.* § 13-23-8-4(a) (amended 2016 by An Act to Amend the Indiana Code Concerning Environmental Law, 2016 Ind. Legis. Serv. 96-2016 (West)).

465. IND. CODE § 13-23-8-4(a).

466. *See id.* § 13-23-8-3 (repealed 2016).

467. *See id.* § 13-23-9-1.3; *see also* David R. Gillay & Amy E. Smith, *Indiana Eases Access, Expands Cap for Eligible Underground Storage Tank (UST) Corrective Action Costs*, NAT'L L. REV. (Mar. 25, 2016), http://www.natlawreview.com/article/indiana-eases-access-expands-cap-eligible-underground-storage-tank-ust-corrective. In 2007, the federal Government Accountability Office ("GAO") issued a report raising concerns about the solvency of underground storage tank trust funds. *See* U.S. GOV'T ACCOUNTABILITY OFFICE, GAO-07-152, LEAKING UNDERGROUND STORAGE TANKS: EPA SHOULD TAKE STEPS TO BETTER ENSURE THE EFFECTIVE USE OF PUBLIC FUNDING FOR CLEANUPS (2007). The GAO noted that low deductibles ($25,000 or less) shifted the burden of payment away from any particular tank owner, and might create a disincentive for tank owners to avoid releases. *See id.* at 5, 32.

468. IND. CODE § 13-23-12-1.

469. *Id.* § 13-23-7-2(3).

470. *Id.* § 13-23-7-2(4).

471. *Id.* § 13-23-7-5.

472. *See id.* § 13-23-8-6 (referencing the priority system established in § 13-23-11-7(a)(1)(D)).

473. *Id.* § 13-23-13-11.

474. 328 IND. ADMIN. CODE 1-3-6 (West 2017).

475. IND. CODE § 13-23-9-6.

476. *Id.* § 13-23-11-1.

477. *See id.* § §13-23-11-7.

478. 328 IND. ADMIN. CODE 1-2-2(2).

479. IND. CODE § 13-23-7-7.

In 1996, the Indiana legislature established a second underground petroleum storage tank trust fund ("Trust Fund").[480] The Trust Fund receives money from EPA grants, recovery and enforcement actions, appropriations, gifts, donations, tank registration fees and penalties,[481] and interest earned on Trust Fund investments.[482] The Trust Fund pays for cleanups[483] and enforcement.[484] Half of the Trust Fund fees must be used to pay for response actions that are ineligible for funding from the ELT Fund.[485]

H. THE GEYSERS GEOTHERMAL MITIGATION FUNDS

The Geysers is the world's single largest geothermal resource developed for power generation.[486] Producing from private, state, and federal property, and spanning Sonoma and Lake Counties,[487] the field provides about sixty percent of electricity needs for California north of San Francisco.[488] Calpine Corporation is the largest geothermal operator in the area.

When production declined in the 1980s, operators began injecting recycled water from nearby communities to create more steam. Within a few years of the start of this practice, the region was experiencing a fair number of earthquakes. Through 2004, thousands of small tremors were occurring each year, including sixteen to eighteen quakes of 3+ M.[489] More recently, this activity has slowed with geothermal production trends. From October 1, 2015 through March 31, 2016, just seventy-nine seismic events took place; none exceeded 3 M.[490]

Federal and private funding streams have been directed to Lake County to mitigate damages posed by geothermal activity; however, few claims for earthquake damages have been entertained. In 1980, California passed a law directing forty percent of the state's share of federal geothermal leasing royalties to

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480. *Id.* § 13-23-6-1; *see also* An Act to Amend the Indiana Code Concerning Environmental Law, 1996 Ind. Legis. Serv. 1-1996 (West).

481. IND. CODE § 13-23-6-2.

482. *Id.* § 13-23-6-4.

483. The statute describes circumstances in which the state would take on a corrective action. *See id.* § 13-23-13-2.

484. *Id.* § 13-23-13-6(a). The Trust Fund also covers administrative expenses. *Id.* § 13-23-6-3. Administrative expenses are capped at eleven percent of all expenditures. *Id.* § 13-23-13-6.

485. *Id.* § 13-23-13-6(b)(2).

486. *About Geothermal Energy*, THE GEYSERS, http://www.geysers.com/geothermal.aspx (last visited Apr. 6, 2017).

487. Telephone Interview with Danielle Matthews Seperas, Manager, Government & Community Affairs, Calpine Corporation (Jan. 17, 2017) [hereinafter Seperas Interview].

488. THE GEYSERS, *supra* note 486.

489. Sara Pratt, *Gauging the Geysers with Quakes*, GEOTIMES (Sept. 2004), http://www.geotimes.org/sept04/geophen.html#geysers.

490. Seismic Monitoring Advisory Committee, Final Meeting Minutes (May 9, 2016), http://www.geysers.com/media/Meeting%20Agenda%20for%20November%2014,%202016%20and%20Final%20Meeting%20Minutes%20from%20May%209,%202016.pdf.

counties that produce geothermal energy.[491] Counties must use the funds for listed purposes only; these include geothermal mitigation projects.[492] The 2005 Energy Policy Act followed California's lead, and directed an additional twenty-five percent of federal geothermal royalties to impacted counties.[493] In 2015, approximately $700,000 flowed into Lake County from federal royalties.[494]

In 2004, the Lake County Board of Supervisors established a Geothermal Impact Mitigation Fund to allocate federal royalties to Anderson Springs and Cobb Valley, the most impacted towns.[495] Each community has a committee to administer the funds.[496] Both committees include a Board supervisor, four community representatives, and a Calpine representative. All meetings are open to the public. The Anderson Springs Committee includes a second geothermal operator.[497] The committees review project applications and propose expenditures to the Board.[498] Projects include general community development projects, such as the acquisition of 1520 acres for the Mount Konocti County Park.[499]

In the mid-2000s, Calpine offered additional funding to the Anderson Springs and Cobb Valley committees, which was used to remove hazardous trees after the Valley Fire in 2015, build a running track at a local school, and install water tanks for the Anderson Springs Community Service District.[500] Calpine sought to expand the geothermal operations, and the gesture was intended to support communities where seventy percent of its workforce resides. From 2005 to 2017, annual Calpine contributions to each committee have ranged from $25,000 to $70,000,[501] for a total of $1,479,990.[502]

The Cobb Valley committee does not accept earthquake damage applications. The Anderson Springs committee, however, does entertain these types of submittals, and does not cap the limit on the claims. The Northern California Power

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491. *See* CAL. PUB. RES. CODE § 3821 (West 2017); *see also Millions of Dollars to Return to Sonoma and Lake County*, CLOVERDALE REVEILLE (June 25, 1980), http://clv.stparchive.com/Archive/CLV/CLV06251980P12.php.

492. CAL. PUB. RES. CODE § 3823.

493. Energy Policy Act of 2005, Pub. L. No. 109-58, § 224, 119 Stat. 594, 662–63 (codified at 30 U.S.C. § 1004).

494. Seperas Interview, *supra* note 487.

495. Board of Supervisors, County of Lake, State of California, Res. No. 2004-199, A Resolution Establishing a Geothermal Impact Mitigation Fund for the Communities of Anderson Springs and Cobb Valley in Lake County (Dec. 7, 2004), http://www.andersonsprings.org/Compensation/07dec2004lakecountygeothermalfundresolution.pdf (copy of enacted resolution on file with the law review).

496. *See id.* at Exhibit A.

497. *See id.*

498. *See id.*

499. E-mail from Danielle Matthews Seperas, Manager, Government & Community Affairs, Calpine Corporation, to author (Apr. 28, 2017, 4:37 PM) [hereinafter Seperas E-mail] (on file with the law review); *see also Mt Konocti County Park*, KONOCTI REGIONAL TRAILS, http://konoctitrails.com/trails/mt-konocti-county-park/ (last visited Apr. 28, 2017).

500. Seperas E-mail, *supra* note 499.

501. Seperas Interview, *supra* note 487.

502. Seperas E-mail, *supra* note 499.

Agency pays these claims, up to $30,000 per year.[503] In addition, by committee vote, the Calpine funding can be used to fund seismicity damage.[504] Separately, the Lake County Board of Supervisors established a Seismic Monitoring Advisory Committee in the 1990s.[505] That committee monitors seismic activity in the Geysers field, and keeps the community informed.[506]

I. THE ILLINOIS DRYCLEANER ENVIRONMENTAL RESPONSE TRUST FUND

The Illinois legislature created the Drycleaner Environmental Response Trust Fund in 1997.[507] The Fund supports environmental remedial actions by drycleaning facilities, and insures these facilities for their environmental risks.[508] Two accounts are established in the Fund, to pursue each goal.

The legislation requires operating drycleaning facilities to purchase a license.[509] It also imposes a graduated drycleaning solvent tax, with the level of tax tied to the risk posed by different types of solvent used at a facility.[510] All license fees and taxes go to the Fund.[511] In addition, the Fund receives civil penalties[512] and interest on the State Treasurer's investment of the Fund.[513] The Drycleaner Environmental Response Trust Fund Council assumes the legal rights of claimants to the remedial action account, and may recover costs for the Fund from responsible parties.[514]

The remedial action account funds cleanups at operating and defunct drycleaning facilities.[515] Remedial responses and claims on the Fund may not be used as evidence of liability in third party lawsuits.[516] Owners or operators of these facilities are eligible to make claims against the account, if they demonstrate that

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503. *Id.* Anderson Springs was already a small community, but following the Valley Fire of 2015, it was—by one report—"nearly 80 percent wiped out." *See PD Editorial: Valley Fire's Staggering Toll is Still Growing*, PRESS DEMOCRAT (Sept. 14, 2015), http://www.pressdemocrat.com/opinion/4478420-181/pd-editorial-valley-fires-staggering. Approximately twelve homes remain in this town. *See* Seperas Interview, *supra* note 487; Seperas E-mail, *supra* note 499.

504. Seperas E-mail, *supra* note 499.

505. *See Seismic Monitoring Advisory Committee (SMAC)*, CALPINE CORP., http://www.geysers.com/smac.aspx (last visited Mar. 24, 2017).

506. *Id.*

507. 415 ILL. COMP. STAT. ANN. 135/1 (West 2017); Drycleaner Environmental Response Trust Fund Act, 1997 Ill. Legis. Serv. Pub. Act No. 90-502 (West).

508. 415 ILL. COMP. STAT. ANN. 135/10(b).

509. *Id.* § 135/60.

510. *Id.* § 135/65(a); ILL. ADMIN. CODE tit. 35, § 1500.55(a) (West 2017). The lowest tax is for "green" solvents; the regulations describe what a drycleaning facility must provide to demonstrate that a solvent is environmentally friendly. *Id.* § 1500.55(b).

511. 415 ILL. COMP. STAT. ANN. 135/70.

512. *Id.* § 135/69.

513. *Id.* § 135/10(a).

514. *Id.* § 135/50(e); ILL. ADMIN. CODE tit. 35, § 1500.40(f)(9).

515. 415 ILL. COMP. STAT. ANN. 135/40(a).

516. *Id.* § 135/55(b).

a release occurred at their facility, that they timely reported the release, and that—at the time of the release—they were in compliance with all reporting and technical operating requirements.[517] Active facilities must also demonstrate that they have environmental liability coverage up to $500,000[518] and basic containment structures in place.[519] Available insurance must be used before the Fund is tapped.[520]

The second account in the Fund is a state-run drycleaner insurance program.[521] The insurance account is funded through appropriations, allocated Fund dollars and investment income, and insurance premiums.[522] Companies may purchase up to $500,000 of environmental insurance (their liability limit) from this account.[523] The legislation set flat premiums for the early years of the Fund;[524] premiums for later years are based on risk factors.[525] An owner/operator can only recover under the insurance program if they report a release within twenty-four hours, and file a claim "as soon as is reasonably possible."[526] In addition, coverage is subject to deductibles.[527] As of 2002, the insurance account covered 922 sites in Illinois.[528]

When a claim is filed, the Fund Administrator initially hears the claim; the Administrator's decision may be appealed to the Fund's full Council, and then to an administrative law judge ("ALJ").[529]

The Fund is audited.[530] No payment can exceed the current balance[531] or reduce availability of funds for higher-priority sites.[532] In addition, the regulations only allow recovery for releases that were discovered between July 1, 1997 and July 1, 2006.[533]

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517. *Id.* § 135/40(b)–(c); ILL. ADMIN. CODE tit. 35, § 1500.40(a)–(b).

518. 415 ILL. COMP. STAT. ANN. 135/40(c)(6).

519. 415 ILL. COMP. STAT. ANN. 135/40(c)(5); ILL. ADMIN. CODE tit. 35, § 1500.40(b)(6).

520. 415 ILL. COMP. STAT. ANN. 135/40(f)(9); ILL. ADMIN. CODE tit. 35, § 1500.40(f)(6).

521. One presentation noted that the intent behind the fund was to try to transition drycleaners to a private insurance market "at a future date." *See* Patrick Eriksen, *Illinois Drycleaners Pollution Liability Insurance*, STATE COAL. FOR REMEDIATION OF DRYCLEANERS (May 8, 2002), https://drycleancoalition.org/docs/2002/attb.pdf.

522. 415 ILL. COMP. STAT. ANN. 135/45(b).

523. *Id.* § 135/45(c).

524. *Id.* § 135/45(e).

525. ILL. ADMIN. CODE tit. 35, § 1500.50(d)(5).

526. *Id.* § 1500.50(o).

527. 415 ILL. COMP. STAT. ANN. 135/40(e).

528. Eriksen, *supra* note 521.

529. ILL. ADMIN. CODE tit. 35, § 1500.60(a). A final decision by the ALJ may be appealed to a state court. *Id.* § 1500.60(k).

530. 415 ILL. COMP. STAT. ANN. 135/80.

531. *Id.* § 135/10(d).

532. The regulations describe how to prioritize actions when the Fund is limited. Factors include proximity to receptors. *See* ILL. ADMIN. CODE tit. 35, § 1500.40(g).

533. *Id.* § 1500.40(b)(4).

J. NATIONAL VACCINE INJURY COMPENSATION PROGRAM[534]

Unlike the other funds described in this part, the National Vaccine Injury Compensation Program does not relate to the oil and natural gas sector, or to environmental damages. However, several features of this program—including the way it addresses causation, liability, and information gathering—seem innovative and important to consider when designing a new compensation fund on any issue.[535]

Following allegations that the "DPT" vaccine[536] caused brain damage, most drug manufacturers stopped producing the vaccine, and the sole remaining manufacturer lost its insurance coverage.[537] In response, Congress created the National Vaccine Injury Compensation Program in 1986.[538] The program provided compensation for vaccine-related injury or death,[539] while encouraging the production of vaccines by ending no-fault liability for manufacturers.[540] At the center of the program is the National Vaccine Injury Compensation Fund. Congress appropriates taxpayer dollars to the Fund;[541] in addition, the Department of Health and Human Services ("HHS") deposits monies recovered from drug manufacturers.[542]

HHS maintains a "Vaccine Injury Table," which lists eligible vaccines, "the injuries, disabilities, illnesses, conditions, and deaths resulting from the[ir] administration . . . and the time period" for symptoms to emerge.[543] Any person who believes they or a loved one were injured or died as the result of listed conditions associated with and occurring within the listed time period for a given vaccine[544] can pursue compensation in the U.S. Court of Federal Claims,[545] after applying the victim's health insurance coverage.[546] The statute discourages filing lawsuits in any other state or federal court, capping damages at $1000[547] and preventing the claimant from seeking further recovery from the Fund.[548]

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534. 42 U.S.C. §§ 300aa-1–300aa-34 (2015); 42 C.F.R. §§ 100.1–100.3 (2016).

535. *See* Jacobs & Stump, *supra* note 281, at 16.

536. The DPT shot contains vaccine for diphtheria, pertussis (whooping cough) and tetanus. *See Deadline Looms for Victims of Required DPT Immunizations*, N.Y. TIMES (Jan. 20, 1991), http://www.nytimes.com/1991/01/20/nyregion/deadline-looms-for-victims-of-required-dpt-immunizations.html.

537. Joan Beck, *How a Media Scare on Vaccines Started a 'Near Epidemic'*, CHI. TRIB. (Mar. 26, 1990), http://articles.chicagotribune.com/1990-03-26/news/9001250062_1_pertussis-vaccine-dtp-whooping-cough.

538. National Childhood Vaccine Injury Act of 1986, Pub. L. No. 99-660, § 2110, 100 Stat. 3755, 3758.

539. 42 U.S.C. § 300aa-10(a).

540. *Id.* § 300aa-22(b).

541. *Id.* § 300aa-15(j).

542. *Id.* § 300aa-17(b).

543. *Id.* § 300aa-14; 42 C.F.R. § 100.3.

544. 42 U.S.C. § 300aa-11(c). The petition must also demonstrate that the victim received the vaccine in the United States, while in the U.S. armed services, or from a U.S. drug manufacturer. *See id.*

545. *Id.* § 300aa-11(a).

546. *Id.* § 300aa-15(h).

547. *Id.* § 300aa-11(a)(2)(A).

548. *Id.* § 300aa-11(a)(7).

Claims must be filed within thirty-six months of the manifestation of injury.[549] HHS, rather than the drug manufacturer, is the named respondent.[550] If a claimant is successful, the Department assumes the petitioner's legal rights and may seek recovery from the implicated manufacturer.[551]

Once a special master has made a claim determination, either party may appeal the decision to the U.S. Court of Federal Claims.[552] Decisions of that court may be appealed to the Federal Circuit.[553] Death awards are capped at $250,000;[554] program administrators are directed to cap damages for specified injuries as well.[555] In no case can punitive damages be assessed.[556]

A person can pursue a claim through the program, receive a decision on compensation, and then forego that compensation and sue the drug manufacturer in federal or state court.[557] However, that person may not recover for no-fault "unavoidable" side effects[558] or a failure to warn;[559] moreover, they will have to rebut a presumption that the manufacturer acted properly.[560]

An advisory commission oversees the program and recommends changes to the Vaccine Injury Table based on the latest research.[561] Meanwhile, a task force on safer childhood vaccines makes recommendations to HHS about how to reduce the risks of vaccines.[562]

The program requires health care providers to maintain vaccine records,[563] and report on any incident that matches those listed in the Vaccine Injury Table.[564] Once information that identifies a victim is redacted, these reports are made available to the public.[565] Drug manufacturers must also prepare and maintain records on vaccine production, to submit to HHS upon request.[566] Criminal penalties are available for manufacturers that destroy or conceal information.[567]

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549. *Id.* § 300aa-16(a). More stringent state statutes of limitation are preempted. *Id.* § 300aa-16(c).
550. *Id.* § 300aa-12(b)(1).
551. *Id.* § 300aa-17(a).
552. *Id.* § 300aa-12(e)(1).
553. *Id.* § 300aa-12(f).
554. *Id.* § 300aa-15(a)(2).
555. *Id.* § 300aa-15(a)(1)(A), (a)(3)(A).
556. *Id.* § 300aa-15(d)(1).
557. *Id.* §§ 300aa-15(f), 300aa-21(a).
558. *Id.* § 300aa-22(b).
559. *Id.* § 300aa-22(c).
560. *Id.* § 300aa-22(b)(2).
561. *Id.* § 300aa-19. The latest updates to the Vaccine Table took effect on February 21, 2017. National Vaccine Injury Compensation Program: Revisions to the Vaccine Injury Table, 82 Fed. Reg. 6294 (Jan. 19, 2017) (to be codified at 40 C.F.R. pt. 100).
562. 42 U.S.C. § 300aa-27(b)–(c).
563. *Id.* § 300aa-25(a).
564. *Id.* § 300aa-25(b).
565. *Id.* § 300aa-25(c).
566. *Id.* § 300aa-28(a).
567. *Id.* § 300aa-28(b).

IV. DESIGN ELEMENTS OF A MODEL INDUCED SEISMICITY COMPENSATION FUND

Drawing from the funds described in Part III, this part proposes a Model Induced Seismicity Compensation Fund for the oil and gas industry. While the case studies introduced in Part III display a wide range of design details, this diversity may be organized by design element, offering policymakers options within a logical framework. Below, the seven common design elements for compensation funds are described in greater detail, with a range of options for each identified as possibly relevant in the induced seismicity context. The categories overlap; and yet, considering each element on its own may facilitate discussions around a model fund. The seven elements are: (1) fund creation and management, (2) fund purpose, (3) sources of revenue, (4) liability, (5) methods for ensuring solvency, (6) limits on the use of the fund, and (7) modification and termination.

A. DESIGN ELEMENT ONE: FUND CREATION/MANAGEMENT

The funds discussed in Part III were created through a number of instruments: private contract, state statute, federal statute, and international convention. They are also managed in different ways, ranging from strictly private arrangements (OPOL, for instance, in Europe), to purely public management (like the NMFS administering the Fishermen's Contingency Fund). Some take a hybrid management approach—the Oklahoma Energy Resources Revolving Fund is established by law, but is managed by a Board that consists of members of the oil and gas industry[568]—while public and private funding streams operate in parallel to compensate damages in The Geysers geothermal field.[569]

Private entities may create a private compensation fund because they see it as a way to forestall public regulation. This was the impetus for OPOL's creation.[570] Or, private actors may view a private fund as a way to allay concerns and positively engage with a community, as with Calpine's contributions.[571] When private actors forge their own compensation fund, they get to set the terms rather than reacting to terms set for them by public actors. Indeed, they may be in a better position to design a fund that calibrates payments to risk or denies coverage for a participant who behaves in a certain way. Over time, this might lead to less risky behavior if the payment differential is large enough that operators see a benefit in qualifying for the lower payments.

There are downsides to a purely private arrangement, however. Private parties may not limit their overall liability; although their fund might cap expenditures by year or by incident, the parties ultimately responsible for the harm do not have

568. OKLA. STAT. ANN. tit. 52, § 288.4 (West 2017).
569. *See supra* section III.H.
570. *See* Faure & Wang, *supra* note 350, at 26.
571. *See* Seperas Interview, *supra* note 487.

legally enforceable liability caps in place. Moreover, private parties may not deny claimants the right to seek recovery in a court of law.[572] OPOL requires claimants receiving money from this fund to sign releases; however, there is nothing in that agreement that prevents claimants from suing in the first place.[573] Therefore, working with government to create a fund may afford more opportunities to limit exposure and streamline the avenues through which claimants may recover. As reflected in the examples in Part III, a government-created fund may still be managed in part by private interests, or may operate alongside or as guarantee to a private arrangement.

B. DESIGN ELEMENT TWO: FUND PURPOSE/ELIGIBLE USES

At first blush, this design element seems superfluous; obviously, compensation funds are designed to compensate for harms caused. However, there exists a great deal of variety in the uses these funds are created to serve. In fact, some of the funds do not provide a claims process at all. For instance, the Oklahoma Energy Resources Revolving Fund ("Oklahoma Revolving Fund")[574] and the federal Leaking Underground Storage Tank ("LUST") program[575] exist solely to fund response activities, because they focus on cleanup of abandoned sites, or sites owned by defunct or insolvent firms. The Geothermal Impact Mitigation Funds in Lake County, California direct federal royalties and company dollars to mitigation and community development projects, but their role in compensating damages from earthquakes or other impacts to individual property owners is limited.[576]

At the heart of most funds described in Part III is a streamlined compensation regime.[577] Moreover, so long as there is an identifiable and solvent responsible party, most of the funds serve as a secondary or even tertiary tier of compensation, after insurance coverage is applied and liability caps are met. For instance, the Fishermen's Contingency Fund[578] and the Vaccine Fund[579] will not provide payment where first- or third-party insurance is available to cover the harm. The tanker oil spill regime requires tankers to reach a liability cap covered by private insurance clubs before the funds may be tapped.[580] The Texas Coastal Protection Fund only pays claims over $50,000 after the claimant has tried to recover from a

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572. *See, e.g.*, EEOC v. Waffle House, 534 U.S. 279, 294 (2002) ("It goes without saying that a contract cannot bind a nonparty.").

573. *See supra* section III.C.

574. *See* OKLA. STAT. ANN. tit. 52, § 288.7(B).

575. 42 U.S.C. § 6991b(h)(1) (2015).

576. *See supra* section III.H.

577. *See, e.g.*, the Federal Oil Spill LTF, *supra* section III.D.

578. 43 U.S.C. § 1843(c)(2)(D) (2015).

579. 42 U.S.C. § 300aa-15(g).

580. *See supra* section III.B.

responsible party and the federal Oil Spill LTF.[581]

The remedial action account in the Illinois Drycleaner Trust Fund serves as a backstop to insurance held by drycleaning businesses; however, in this instance, the state also runs an insurance account out of the same trust fund to provide the required coverage.[582]

For some funds, the claimant can bring any alleged harm to the fund for consideration.[583] In others, such as the National Vaccine Fund, compensable claims are limited to those conditions recognized by HHS as linked to particular vaccinations.[584] In addition, funds compensate different harms. The federal Oil Spill LTF pays for spill response costs and damage claims.[585] The Coastal Protection Fund also funds response actions and compensates claims;[586] in addition, it specifies that it will compensate lost revenue to state and local governments.[587]

Some funds underwrite other activities as well. The Indiana Excess Liability Trust ("ELT") Fund funds tank inspections and trainings to reduce the risk of releases.[588] The Coastal Protection Fund supports state erosion control projects, and the plugging of abandoned wells in submerged state lands.[589] Many funds reimburse response costs incurred by a responsible party, whether as a matter of course,[590] or once the responsible party's liability cap is reached.[591] Several funds cover acts of prevention or mitigation, including the tanker conventions[592] and the federal Oil Spill LTF.[593]

In the earthquake context, a compensation regime should be the top priority for any induced seismicity compensation Model Fund. Were such a fund established in Oklahoma, for instance, this would provide a relatively easier avenue for relief to hundreds of homeowners who have struggled to get insurance payments or face hefty litigation costs with uncertain outcomes. It might also lead to fewer lawsuits going forward.

Something like the Oklahoma Revolving Fund could work when many wells implicated in an earthquake are abandoned or owned by defunct or bankrupt

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581. *See* TEX. NAT. RES. CODE ANN. § 40.159(b)(1) (West 2017).

582. *See supra* section III.I.

583. *See, e.g.*, the Fishermen's Contingency Fund, *supra* section III.A, and the Texas Fund, *supra* section III.E.

584. 42 U.S.C. § 300aa-14.

585. 26 U.S.C. § 9509(c) (2015); 33 U.S.C. § 2712(a) (2015).

586. *See* TEX. NAT. RES. § 40.151(a).

587. *See id.* § 40.003(7)(A)(ii) (defining "damages" as compensation to state or local government for direct, documented losses of revenue).

588. *See* IND. CODE ANN. § 13-23-7-1 (West 2017).

589. *See* TEX. NAT. RES. § 40.152(a)(10).

590. *See, e.g.*, IND. CODE § 13-23-8-4(a).

591. *See, e.g.*, 33 U.S.C. § 2708(b) (2015).

592. *See* 1992 Convention, *supra* note 350, art. II(b); 1992 Fund, *supra* note 350, art. 3(b).

593. 26 U.S.C. § 9509(c) (2015) (covering government administrative costs in prevention efforts); 33 U.S.C. § 2712(a)(5) (2015) (same).

corporations. In that instance, the fund would serve as the "first and only resort" for claimants. However, other funds may offer a better blueprint if the purpose is to prevent additional firms from unnecessarily filing for bankruptcy: for instance, as will be discussed, by applying strict liability to a responsible company or companies, but limiting that liability and offering the fund as a secondary tier of compensation.[594] By tying fund payments to risk, or lifting liability caps where an operator violates a permit condition or is willfully negligent, the Model Fund could also drive safer behavior.[595]

Designing a fund to provide secondary compensation could also encourage insurance companies to enter the seismic liability market. This may be an important purpose, particularly given that the Oklahoma Insurance Commissioner has expressed doubts that the first-party insurance market is competitive.[596] The Model Fund might require any available (first-party or third-party) insurance to be applied first. Alternatively, the fund could require well operator insurance for a (capped) first tier of response, to encourage buyers and sellers to enter the insurance market.[597] At that stage, operators might enter into a private pooled liability arrangement, as in the tanker conventions.[598] Given that the insurance situation does not appear as dire as it was in the drug manufacturing context just before enactment of the National Vaccine Program,[599] or for drycleaners before the Illinois law went into effect,[600] the state would likely not have to create an insurance fund for well operators. However, this remains an option.

In addition to compensation, the Model Fund could serve other purposes. A state might use it to fund earthquake disaster response efforts, well inspections, or operator training in the more earthquake-prone areas of the state. A particularly interesting use of the Model Fund might be to underwrite earthquake prevention efforts, including state agency and smaller operator deployment of seismic arrays around wells. Decisions about funding non-compensation functions would turn on a number of factors, including the amount of funds collected and the possible alternative sources of funding for these response and oversight activities.

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594. *See infra* section IV.D.

595. *See infra* section IV.D.

596. *See* News Release, Okla. Ins. Comm'r, *supra* note 76.

597. A liability cap would induce private insurers to provide coverage. *See infra* section IV.D.

598. *See supra* section III.B.

599. *See* Beck, *supra* note 537.

600. *See, e.g.*, Sue McKenna, *'Mom & Pop' Dry Cleaning Market Hangs on Environmental Issues*, INS. J. (Aug. 7, 2006), http://www.insurancejournal.com/magazines/features/2006/08/07/72202.htm (noting that drycleaners were faced with high minimum premiums for environmental coverage in the 1990s); Robert M. Horkovich, Rene F. Hertzog & Peter A. Halprin, *Site Pollution Liability Insurance*, *in* ENVIRONMENTAL LIABILITY AND INSURANCE RECOVERY 513–15 (David Lee Guevara & Francis J. DeVeau eds., 2012) (summarizing the 1980s crash and subsequent 1990s reemergence of the environmental impairment liability insurance market).

C. DESIGN ELEMENT THREE: SOURCES OF REVENUE

Compensation funds are seeded and maintained in a number of ways. Many start with a fee on industry. Some are flat fees, others are graded based on the company's presence in the industry, or on risk factors. The federal LUST Fund,[601] the federal Oil Spill LTF,[602] and the Coastal Protection Fund[603] collect a flat fee per barrel of oil purchased. The 1971 Fund[604] and the 2003 Supplementary Fund[605] collect a small fee on oil receipts. The Oklahoma Revolving Fund assesses a tax on gross revenues for in-state fossil fuel production;[606] if companies wish, they may seek a refund from the tax office for some or all of the monies assessed.[607] Illinois requires drycleaners to be licensed,[608] and the license registration fees are deposited into that state's Trust Fund.[609] Illinois also applies a tax to drycleaners, based on the volume and toxicity of solvents used at each business.[610]

The Fishermen's Contingency Fund caps annual payments, but then allows the regulator to set annual fees under the cap.[611] Other funds, such as the Coastal Protection Fund,[612] suspend fee collection when the fund exceeds a certain level.

The federal Oil Spill LTF also collects penalties for violations of environmental law.[613] This fund,[614]—as well as the Coastal Protection Fund[615] and the National Vaccine Fund[616]—assumes all legal rights of claimants and deposits recovered costs into the fund. Several funds receive appropriations from the legislature, such as the federal LUST Fund[617] and National Vaccine Fund.[618] The Illinois insurance account collects premiums from participating drycleaners.[619]

Some compensation regimes collect from different actors in the supply chain, to align incentives and prevent the type of risk shifting that might raise the overall risk profile. For instance, in the tanker conventions space, the 1969 Convention

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601. 26 U.S.C. § 4041(d) (2015).
602. *Id.* § 9509(b)(1); *id.* § 4611(c)(2)(B).
603. *See* TEX. NAT. RES. CODE ANN. § 40.155(a) (West 2017).
604. 1971 Fund, *supra* note 319, art. 10.
605. 2003 Protocol, *supra* note 344, art. 10.
606. *See* OKLA. STAT. ANN. tit. 52, § 288.8A(A).
607. *See id.* § 288.5E(A).
608. 415 ILL. COMP. STAT. ANN. 135/60 (West 2017).
609. *Id.* § 135/70.
610. *Id.* § 135/65(a); ILL. ADMIN. CODE tit. 35, § 1500.55(a) (West 2017).
611. 43 U.S.C. § 1842(b)(1) (2015).
612. *See* TEX. NAT. RES. CODE ANN. § 40.155(a) (West 2017).
613. 26 U.S.C. § 9509(b) (2015).
614. 33 U.S.C. § 2712(f) (2015); 33 C.F.R. § 136.115(a) (2016).
615. *See* TEX. NAT. RES. §§ 40.160(d), 40.153.
616. 42 U.S.C. § 300aa-17 (2015).
617. *Id.* § 6991m.
618. *Id.* § 300aa-15(j).
619. 415 ILL. COMP. STAT. ANN. 135/45(b).

only holds tanker owners liable and makes them carry financial assurance.[620] However, the 1971 Fund[621] and the 2003 Supplemental Fund[622] are paid for through an assessment on the owners of the oil, to make them more careful about the tankers they secure for transportation of their product.

Once funds are in place, they may be invested. Usually, the interest earned is then credited to the fund. The Fishermen's Contingency Fund[623] and the Illinois Drycleaner Fund[624] operate in this way.

Given today's political climate and budget realities, legislators may not be able to appropriate funds to a new program.[625] Therefore, the Model Fund would likely require a showing of financial responsibility (including insurance) up to a liability cap, a fee assessment, or some combination of the two. One interesting question will be how broadly these requirements should apply among well operators. One distinction could be geography—perhaps only those wells operating in the earthquake-prone Mississippi Lime play of Oklahoma, for instance, would pay into that state's fund, or need to show financial responsibility. However, in the Mississippi Lime, larger companies including Devon, Chesapeake, and Sandridge have sold their assets or filed for bankruptcy,[626] leaving well operators in the rest of the state concerned about the fallout of a catastrophic earthquake, but unable to directly mitigate that risk.[627] In this environment, it may make more sense to assess a fee on all wells regardless of location; though wells in the Mississippi Lime might still pay more. Another distinction could be the presence of risk factors, as in the Illinois Drycleaner Fund.[628] For instance, wells operating near or injecting into a fault, wells drilled into basement rock (or unable to establish that they do not extend into that formation), or wells with a history of permit violations might need to pay more or carry more insurance. Another interesting question is whether to extend the regime to cover production

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620. 1969 Convention, *supra* note 317, art. VII(1).

621. 1971 Fund, *supra* note 319, art. 10.

622. 2003 Protocol, *supra* note 344, art. 10.

623. 43 U.S.C. § 1842(a)(1)(A) (2015); 50 C.F.R. § 296.3(d) (2016).

624. 415 ILL. COMP. STAT. ANN. 135/10(a).

625. *See, e.g.*, CQ ROLL CALL, 50 STATE PROJECT: A REPORT ON THE TOP STATE ISSUES OF 2016 BY THE REPORTERS WHO COVER THEM (2016), http://info.cqrollcall.com/rs/764-XAC-282/images/50StateP-Spring2016.pdf (reporting that budget cuts and budget shortfalls remain the top priority across all states).

626. *See* Joe Wertz, *Why Quakes and Shaky Finances Could Crumble an Oklahoma Energy Company*, STATEIMPACT OKLA. (Nov. 10, 2015, 4:08 PM), https://stateimpact.npr.org/oklahoma/2015/11/10/why-quakes-and-shaky-finances-could-crumble-an-oklahoma-energy-company/; Adam Wilmoth, *Earthquake Rates Fall, but Oklahoma Regulators Prepare for Increased Energy Industry Activity*, THE OKLAHOMAN (Aug. 12, 2016, 12:00 AM), http://newsok.com/article/5514674 (reporting that companies are moving out of the Mississippi Lime into the SCOOP and the STACK, where there is less produced water and therefore lower disposal volumes); *see also* Interview with Chad Warmington, *supra* note 438.

627. Interview with Chad Warmington, *supra* note 438.

628. ILL. ADMIN. CODE tit. 35, § 1500.50(d)(5) (assessing fees based on the volume and toxicity of dry cleaning chemicals used at the facility).

wells, either because they are linked directly to earthquakes, or based on the volume of waste water they send to state disposal wells.

Fees could be set by the legislature, with some flexibility given to the regulators to adjust based on the solvency of the fund (as in the Coastal Protection Fund). Fees and awards should be invested, with interest deposited in the fund.

D. DESIGN ELEMENT FOUR: LIABILITY OF THE TARGET INDUSTRY/ACTIVITY

In many instances, existing funds hold the industry or responsible members of the industry strictly liable for harms, but then cap that liability. The tanker conventions,[629] the federal Oil Spill LTF,[630] and the Coastal Protection Fund[631] operate in this way. Strict liability with a cap expedites the claims process by making clear who will be on the hook for payment, while managing exposure so that companies can secure insurance and meet their obligations following the incident, rather than file for bankruptcy. Even private funds use this combination of tools, at least for purposes of apportioning responsibility among private actors. For instance, an OPOL party responsible for a spill is strictly liable up to a certain amount.[632] But if that party fails to meet its obligation, OPOL acts as a guarantee.[633] In the event OPOL is tapped, each member is responsible for a pro rata share of the costs, based on the number of wells they are operating in the area at the time of the incident.[634]

Liability caps may be lifted where actual fault is shown, as in the tanker conventions,[635] or where a company displayed gross negligence or willful misconduct, as under the Coastal Protection Fund.[636] In a related design feature, some companies are barred from recovering for response costs based on behavior. In Illinois, drycleaners are eligible for recovery only if they timely report a release, and demonstrate compliance with all applicable laws.[637] Until last year, Indiana would only reimburse response costs if the tank owner had paid all registration fees, complied with the regulatory regime, and submitted a corrective action plan.[638] As of July 1, 2016, Indiana will reimburse response costs regardless of compliance status, even if the tank owner has outstanding registration fees; however, the payment will be reduced by the sum of the outstanding

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629. *See supra* section III.B.

630. *See supra* section III.D.

631. *See supra* section III.E.

632. OPOL Agreement, *supra* note 354, cl. IV(A).

633. *Id.* cl. II(C)(4), cl. III(2).

634. *See* OPOL Articles, *supra* note 361, at art. 43., app. ¶ 3.

635. 1969 Convention, *supra* note 317, art. V(2).

636. *See* TEX. NAT. RES. CODE ANN. §§ 40.202(c)(1), 40.203(f) (West 2017). Similarly, the federal Oil Spill LTF removes caps for willful negligence or willful misconduct. 33 U.S.C. § 2704(c)(1)(A) (2015).

637. *See supra* section III.I.

638. *See* IND. CODE ANN. § 13-23-8-4 (amended 2016 by An Act to Amend the Indiana Code Concerning Environmental Law, 2016 Ind. Legis. Serv. 96-2016 (West)).

fees and an added penalty for each unpaid annual fee.[639]

Some funds make no mention of liability caps and likewise do not limit a company's exposure in any venue, as in the Indiana ELT Fund[640] and the Fishermen's Contingency Fund.[641]

Some funds take the place of the would-be defendant or defendants, who are no longer directly responsible for the harms.[642] The Oklahoma Revolving Fund, for instance, assumes responsibility for environmental cleanup and remediation related to oil and gas activity.[643] As noted in the previous section, other funds initially pay for response costs or claims, but then assume all legal rights from the claimant and may use those to seek recovery from the responsible parties. The Oil Spill LTF,[644] the Coastal Protection Fund,[645] and the National Vaccine Fund[646] operate in this way. The federal LUST fund acts as a hybrid—it may pay for emergency responses and then seek restitution from the responsible party or parties, but it also pays for responses where a responsible party is defunct or insolvent and therefore not available to make restitution.[647]

Most funds block further recovery once a claim has been paid.[648] Or they bar use of the claim in subsequent court proceedings. For instance, under Illinois law, remedial actions taken by owners or the subsequent submittal of receipts to the Drycleaner Trust Fund may not be used as evidence of liability.[649] However, litigation before or instead of making a claim against the fund is handled a number of different ways. As noted, OPOL as a private agreement cannot block legal action; claimants may opt to recover subject to caps from the fund based on an easier burden of proof, or proceed to court for a higher risk process that carries a higher possible reward.[650] Often, the inherent uncertainty posed by litigation is enough to make a compensation fund more enticing to would-be litigants. However, in addition, many funds are designed to further discourage the filing of lawsuits. In an extreme example, under the National Vaccine Fund, if victims file in federal court first, their award is capped at $1000; if they file after going through the streamlined claims process, some claims are barred and victims must

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639. *Id.* § 13-23-9-1.3.

640. 328 IND. ADMIN. CODE 1-3-6 (West 2017).

641. *See supra* section III.A.

642. This protection is stripped in some instances. *See supra* section IV.C. It is important to have an indemnity "off-ramp" for actions that violate law or industry norms, or otherwise reflect wanton disregard for risk.

643. *See* OKLA. STAT. ANN. tit. 52, § 288.7(B).

644. 33 U.S.C. § 2712(f) (2015); 33 C.F.R. § 136.115(a) (2016).

645. *See* TEX. NAT. RES. CODE ANN. § 40.160(d) (West 2017).

646. 42 U.S.C. § 300aa-17(a) (2015).

647. *See supra* section III.G.

648. *See, e.g.*, 33 C.F.R. § 136.115(a) (OSLT Fund); 415 ILL. COMP. STAT. ANN. 135/50(e) (West 2017) (Illinois Drycleaner Fund).

649. 415 ILL. COMP. STAT. ANN. 135/55(b).

650. *See also* Klass & Wilson, *supra* note 280, at 169 (describing this type of dual recovery system, and illustrating with the Trans-Alaska Pipeline Authorization Act of 1973).

begin from the presumption that the vaccine manufacturer did no wrong.[651]

Some funds also introduce the concept of contributory negligence. A fisherman may not recover from the Fishermen's Contingency Fund if the fisherman was negligent or at fault.[652] Anyone who displayed gross negligence or willful misconduct in helping respond to a spill is barred from recovery from the Oil Spill LTF.[653] On the other hand, the OPOL fund makes clear that sub-contracting work at the well will not absolve the operator from liability.[654]

For the Model Induced Seismicity Compensation Fund, imposition of strict liability with a cap makes sense, rather than requiring a showing of fault. Moreover, the issue of causation in the induced seismicity context remains murky, raising the question of liability for one or more companies for any particular seismic event. A state might consider having all companies operating disposal and production wells—or just disposal wells—in the state pay into a Model Fund, and then using the fund to compensate damages from an earthquake, solely with the fund or in combination with insurance. The fund could assume all rights of claimants and then pursue recovery from companies where clear fault and causation are established. Alternatively, a fund might hold all wells within a certain distance of the epicenter of an earthquake—or wells drilled to a particular geologic strata—strictly liable up to a pro rata cap, and then use the fund as a back-up/guarantee or as a second tier of compensation. A fund also might hold "high risk" wells strictly liable: for instance, wells drilled within a certain distance from a fault, or wells drilled into basement rock. In any event, identifying a clear universe of liable parties or a hierarchy of compensation before an earthquake occurs will streamline the claims process. Meanwhile, by capping liability, each well operator is in a better position to measure and manage risk prospectively, rather than throw up its hands in the face of an uncertain prospect of catastrophic losses that, if it occurred, would likely just drive the firm to bankruptcy.

It is imperative for caps to be lifted in the event of an operator's gross negligence. It may not always be possible to identify the offending well to determine its compliance status, but having the possibility of limitless liability should induce well operators to comply with the law and industry standards. It also incentivizes insurance companies to drive safer behavior among its customers.

The Model Fund should prohibit anyone who receives payment from then filing a lawsuit on the same claims. Further, thought should be given to the issue of prohibiting lawsuits to be filed initially, or instead of resorting to the fund. A healthy compromise might be to prohibit lawsuits except in those instances

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651. *See supra* section III.J.
652. 43 U.S.C. § 1843(c)(2)(A) (2015).
653. 33 U.S.C. § 2712(b) (2015).
654. OPOL Agreement, *supra* note 354, cl. I(10).

where a regulator has identified that a well operator violated the law or was grossly negligent.

A state may assess fees on production wells because of their direct—although relatively small—role in inducing earthquakes. For instance, recent Oklahoma guidance suggests that hydraulic fracturing in two new plays—the SCOOP and the STACK—may be tied to induced seismicity.[655] A state may also assess fees on production wells based on the volume of wastewater they send to disposal wells in the state. As noted in Design Element Three (Sources of Revenue), the tanker conventions decided over time to bring the owners of the oil into the compensation regime to enlist them in driving safer practices in the tanker industry.

E. DESIGN ELEMENT FIVE: METHODS FOR ENSURING SOLVENCY

A compensation fund must have mechanisms in place to ensure solvency, or a contingency plan if claims exceed what the fund can distribute. The funds discussed in Part III address this issue a number of ways. First, a fund may set incident caps or annual caps on expenditures. Sometimes these caps match the liability limit of the responsible parties. The National Vaccine Fund sets limits on compensation for death or listed injuries,[656] and then may seek to recover up to those limits from the drug manufacturer.[657] In other instances, they are separate caps: for instance, the 1971 Fund sets an incident limit that is a combination of the tanker's initial liability limit (as set forth in the 1969 Convention), plus headroom provided by the 1971 Fund.[658]

Second, a fund may prevent expenditures that would exceed its balance. This may be particularly important when a fund caps the liability of responsible parties, but not of per-incident payouts.[659] The Illinois remedial action account in the Drycleaner Trust Fund will not pay a claim if it would wipe out the account.[660] This fund will also prevent a payout for an incident when it would reduce the amount available for a high-priority site.[661] The federal Oil Spill LTF will not pay a claim if it would cause the balance in the fund to drop below $30 million.[662] The Indiana ELT Fund sets incident and annual caps on expenditures,[663] and prioritizes cleanups when funds are limited.[664] By contrast, the Coastal Protection Fund allows payments to be made against future revenue in

655. *See* Okla. Corp. Comm'n, *supra* note 46, at 1.
656. 42 U.S.C. § 300aa-15(a) (2015).
657. *Id.* § 300aa-17(a).
658. 1971 Fund, *supra* note 319, art. 4.
659. *See, e.g.*, the Federal Oil Spill LTF, *supra* section III.D.
660. 415 ILL. COMP. STAT. ANN. 135/10(d), 135/25(c).
661. ILL. ADMIN. CODE tit. 35, § 1500.40(g).
662. 26 U.S.C. § 9509(c)(2)(B) (2015).
663. IND. CODE ANN. § 13-23-8-8 (West 2017).
664. *Id.* § 13-23-8-6.

the fund;[665] however, the same fund authorizes fund administrators to raise fees when the balance is low.

Third, a legislature may require periodic audits of the fund. The federal Oil Spill LTF,[666] the Illinois Drycleaner Fund,[667] and the Indiana ELT Fund[668] are subject to auditing requirements. In addition, Indiana has established a financial assurance board to oversee investment and management of the ELT Fund.[669]

Fourth, a fund may increase fee assessments when solvency is at risk. For instance, not only does the Coastal Protection Fund suspend fees when the fund's balance exceeds a certain level,[670] but the fund may reinstate the fee,[671] or triple the fee assessment when funds are low and an oil spill threatens to wipe out the balance.[672]

Measures to ensure solvency will be important to assure the public that the Model Induced Seismicity Compensation Fund intends to stand the test of time and provide a meaningful substitute for litigation. A state might consider any combination of tools discussed here. Indiana's ELT Fund provides a particularly robust model. The Model Fund might set incident caps (making clear whether aftershocks are considered part of the same incident, or separate incidents) or annual caps on overall expenditures. It might cap damages that any one claimant could receive for different types of harm; these damage caps might exist all the time or only when the fund's balance drops below a "safe" threshold. The Model Fund might establish a financial assurance board, or require audits of the fund. And finally, as in the Coastal Protection Fund, the state regulator might be empowered to shift the fee structure upward when solvency is threatened. Being able to do this within a reasonable range, without having to go back to a state legislature, will make the fund more nimble and responsive to needs over time.

F. DESIGN ELEMENT SIX: LIMITS ON USE OF THE FUND

This design element overlaps heavily with the fifth design element, in that limits on the use of the fund may also protect its solvency. However, the focus of the design attributes discussed here is less about the health of the fund and more about shaping behavior of claimants and responsible parties.

There are several ways that fund design can shape the behavior of claimants. Some of these elements relate to actions taken once damage has taken place. Most commonly, these take the form of time limits to file a claim. Of the funds

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665. *See* TEX. NAT. RES. CODE ANN. § 40.162 (West 2017).
666. 33 U.S.C. § 2712(g) (2015).
667. 415 ILL. COMP. STAT. ANN. 135/80.
668. *See* IND. CODE § 13-23-7-7.
669. *Id.* §§ 13-23-11-1, 13-23-11-7.
670. *See* TEX. NAT. RES. § 40.155(a).
671. *See id.* § 40.155(b).
672. *See id.* § 40.155(c).

discussed in Part III, these time limits range from the Fishermen's Contingency Fund, requiring a fisherman to file a claim within ninety days,[673] to the tanker regime[674] and the federal Oil Spill LTF,[675] which require claims to be filed within three years from discovery of damage and in no case more than six years from the date of the incident. These timelines seek to give adequate time for victims to file, given the circumstances, while managing incident liability for the fund by receiving all claims within a reasonable period of time.

Several funds also limit recovery to claimants who can provide a threshold amount of documentation. OPOL, for instance, indicates that a claimant should be prepared to provide evidence reasonably requested by a responsible party—a somewhat vague standard.[676] The federal Oil Spill LTF provides more specific guidance: claimants must demonstrate, for instance, that property damage occurred, that they owned or leased the property at the time of the damage, and that an oil spill caused the damage.[677] A few funds—including the Fishermen's Fund,[678] the federal Oil Spill LTF,[679] and the Indiana ELT Fund[680]—may prosecute persons who file false claims.

Another category of limits on the use of a fund relate to the types of damages compensated. This line-drawing exercise allocates risk between parties, and could help deter risky behavior before an incident occurs. By excluding certain claims, a fund may also serve to place the risk of truly catastrophic damages on the responsible party, who might remain liable under tort claims and other statutory hooks. For instance, the tanker conventions only cover environmental damages to the extent that a government or private party can demonstrate it has taken or will undertake specific restoration actions.[681] Harms to the environment that exceed what public and private actors can hope to restore might still be litigated elsewhere. A responsible party, knowing that this liability lies outside of the fund regime and therefore may not be limited, might be more careful in preventing such an outcome. However, this deterrent role is far from guaranteed. When the fund only compensates "direct" and "documented" damages (as in the Coastal Protection Fund),[682] it accepts risk for the most obvious harms and makes it unlikely a claimant would be able to recover additional damages in a court of law.

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673. 43 U.S.C. § 1843(a)(1) (2015); 50 C.F.R. § 296.5(c) (2016).

674. 1969 Convention, *supra* note 317, art. VIII.

675. 33 U.S.C. § 2712(h) (2015); 33 C.F.R. § 136.101(a) (2015); *see also* TEX. NAT. RES. § 40.159(c) (six months); OPOL Agreement, *supra* note 354, cl. VI (one year).

676. OPOL Agreement, *supra* note 354, cl. V(1).

677. *See supra* section III.D; *see also* 33 C.F.R. § 136.105.

678. 50 C.F.R. § 296.6(e)(4).

679. 33 C.F.R. § 136.9.

680. IND. CODE ANN. § 13-23-9-6 (West 2017).

681. 1969 Convention, *supra* note 317, art. II.

682. *See supra* section III.E.

Finally, funds have geographic limits. State funds in the United States are limited to the state and its territorial waters.[683] The tanker conventions initially covered spills in the territorial waters of member countries, but then expanded over time to include each member's EEZ.[684]

Time limitations for filing earthquake damage claims make sense. The triggering incident—an earthquake—will be fairly clear to all would-be claimants, just as a patient will know when they receive a vaccine. In fact, it may be more obvious when an earthquake occurs than when oil is spilled far from shore, or when fishing gear gets entangled beneath the surface. Similarly, harms from an earthquake should manifest fairly quickly; whereas it might take weeks or in some conditions months for an offshore oil spill to impact coastal ecosystems and communities, a building will likely sustain damage from an earthquake the same day or soon thereafter. Therefore, it will not disadvantage earthquake victims to set a reasonable time line for filing claims against a fund. Time should be allowed to respond to the immediate threat before seeking compensation; for instance, in the event a family loses its home, finding shelter would understandably take precedence over writing out a claim. However, a time limit between six months and two years should suffice.

The Model Fund should require some documentation for a claim. The more specific the fund can be about the evidence necessary to make out a claim, the clearer the process will be for the fund and for would-be claimants. It would not make sense to require a claimant to prove that a particular well or disposal activity caused a damaging earthquake, as this would put the claimant in the very same position induced-earthquake victims find themselves in today. The fund could, however, require claimants to demonstrate that damage to property they owned at the time was caused by an earthquake and not by another phenomenon.[685] The Model Fund could also require documentation of the cost of any repairs, or the change in value of property before and after an earthquake.

As suggested by the tanker conventions, an induced seismicity fund could begin by covering a smaller geographic footprint and then grow over time; for instance, as new faults are discovered.

G. DESIGN ELEMENT SEVEN: MODIFICATION/TERMINATION

Many of the funds discussed in Part III do not contain modification provisions. However, some provisions explicitly or implicitly afford some flexibility in fund

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683. *See* TEX. NAT. RES. CODE ANN. § 40.003(2) (West 2017).

684. The EEZ extends up to 200 miles from a coastal state. *See* United Nations Convention on the Law of the Sea, art. 57, Dec. 10, 1982, 1883 U.N.T.S. 3.

685. For instance, in Texas, drought has caused foundations to crack. *See* Gail Burkhardt, *Building Foundations Crack as Texas Drought Shifts Soil*, THE MONITOR (Nov. 6, 2011), http://www.themonitor.com/building-foundations-crack-as-texas-drought-shifts-soil/article_65b7af4d-eead-5154-9edc-e69db453b451.html.

implementation. The Coastal Protection Fund directs the suspension, reinstatement, and increase of fees upon some triggering event in the statute.[686] For the Fishermen's Contingency Fund, Congress set statutory fees, but then enabled the administering agency to change those fees as necessary, without new statutory authority.[687] Some statutes leave the details of a compensation process to the implementing agency, which allows for some flexibility as well. The National Vaccine Fund sets a specific cap for death damages, but provides only guidance for determining the compensation for other injuries and loss of earnings.[688] The U.S. Coast Guard regulations specify what documentation is necessary to file a successful claim against the Oil Spill LTF.[689]

Only one of the funds, the Oklahoma Revolving Fund, contains an explicit termination clause.[690] A legislative committee may authorize the Fund to continue if it can demonstrate its effectiveness. Oklahoma requires this on a case-by-case basis; its Sunset Law lists specific funds and programs that must expire or seek re-authorization every few years.[691]

The ability to modify some aspects of the Model Induced Seismicity Compensation Fund could be important, to ensure that the fund can operate in such a dynamic environment and respond to changing circumstances. For instance, a legislature might authorize a fund to begin operating within a smaller geographic context, but then enable the implementing agency to expand the fund's geographic footprint if new faults or problem wells are identified. Or, a legislature might set a range of fees to be paid into the fund and describe when an agency can raise or lower the fees within this range. Or, the fund might not require insurance coverage as a first tier of compensation, unless and until the state insurance commissioner determines that a competitive insurance market exists.

The inclusion of a termination clause may depend on existing sunset laws in a state, or the politics surrounding the fund. A fund may be able to pick up skeptics with a termination clause; they can test a compensation regime but easily pull the plug five or ten years down the road if it falls short of expectations. A fund could also terminate upon a particular set of conditions in the marketplace—for instance, the creation of robust first-party and third-party insurance markets for induced seismicity, or the end of the use of disposal wells for oil and gas wastewater.

V. ENCOURAGING DATA SHARING THROUGH A COMPENSATION FUND

Data collection was not included as a design element in Part IV because it is not a common part of existing funds. And yet, this element could play a crucial

686. *See supra* section III.E.
687. *See supra* section III.A.
688. 42 U.S.C. § 300aa-15(a) (2015).
689. *See* 33 C.F.R. § 136.105 (2016).
690. OKLA. STAT. ANN. tit. 74, § 3908(5).
691. *See id.* § 3908.

role in a successful Model Induced Seismicity Compensation Fund, given how central information gathering is to addressing induced seismicity.

Today, we have an incomplete picture of induced seismicity in oil and natural-gas producing regions of the country.[692] Seismic information is either not collected, or if it is, is often siloed away in separate firms and institutions. This situation risks three potentially bad outcomes: (1) a lost opportunity to reduce the risk of earthquakes, (2) a failure to prevent or mitigate losses when earthquakes do occur, or at least to effectively insure against them, and (3) a signal to the public that the problem is not being taken seriously or may not be adequately addressed.[693]

By contrast, collected and shared data can improve the induced seismicity situation by increasing scientific knowledge and using it to mitigate the risks of induced seismicity. This gives actors the information they need to allocate risk effectively, and builds public confidence.

"Open sharing of data can benefit all stakeholders, including industry, by enabling the research needed to develop more effective techniques for reducing the seismic hazard."[694] Generally, industry, researchers, and regulators know what information we need to better identify seismic risk factors. As one Oklahoma state representative put it at a 2016 public hearing, "[y]ou're injecting two Lake Hefners a year underground with really no pressure map of where it's going, that's the problem."[695] Researchers and regulators agree that regular measurements of reservoir pressure are critical.[696] Researchers also express a need for injection rate data and directional surveys of high-rate disposal wells, to help establish causal links between wastewater injection and induced seismicity.[697] In comments on induced seismicity rules proposed by the Texas Railroad Commission, seismologists recommended that the agency collect bottom-hole pressure data.[698] EPA's UIC National Technical Workgroup noted that injection volumes and pressures and pressure gradients could "highlight significant changes in disposal well behavior," and suggested conducting step rate tests, pressure falloff tests, production logs, and static reservoir pressure measurements.[699] Standardizing the collection and dissemination of this data would advance

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692. *See, e.g.*, Langenbruch & Zobach, *supra* note 29, at 7 (explaining the need for an earthquake catalog in Oklahoma and other "parts of the central and eastern United States," including records of quakes below 3 M).

693. *See* BARBARA REYNOLDS & MATTHEW SEEGER, CTRS. FOR DISEASE CONTROL & PREVENTION, CRISIS & EMERGENCY RISK COMMUNICATION 315 (2012), https://emergency.cdc.gov/cerc/resources/pdf/cerc_2012edition.pdf (emphasizing importance of having and sharing information to build public confidence).

694. McGarr et al., *supra* note 56, at 831.

695. Broyles, *supra* note 75 (quoting Rep. Cory Williams, D-District 34).

696. *See, e.g.*, Keranen et al., *supra* note 27; R.R. COMM'N OF TEX., *supra* note 45, at 9–10 (noting that "[n]o one knows where all faults are, whether they are under stress, or how much of an increased reservoir pressure would trigger movement of an existing stressed fault").

697. *See, e.g.*, Keranen et al., *supra* note 27.

698. R.R. COMM'N OF TEX., *supra* note 45, at 6.

699. UIC NAT'L TECH. WORKGRP., *supra* note 37, at 12–13.

induced seismic research. Moreover, engaging the public to report tremors of earthquake damages can supplement or calibrate seismic networks and result in a more accurate understanding of a quake's effects.[700]

In turn, information empowers actors to allocate risk and resources in a conscious and sensible way. For instance, a homeowner who reviews data indicating recent seismic activity in the area may be more motivated to purchase earthquake insurance. A city manager noting earthquake trends may launch a voluntary seismic retrofit program to shore up existing buildings in anticipation of future quakes. Or, taking a step back to the data collection stage: if states know where company monitors are located—either because the state requires this monitoring or the reporting of any voluntary monitoring—states can be smarter about when to purchase and where to place seismometers, to leverage existing monitoring resources[701] and learn more about induced seismic events on the same dollar.

Meanwhile, sharing seismic data or event information can put the public at ease. Emphatic public denials and a lack of transparency about response strategies can undermine the public trust and erode the credibility of findings later publicized. Open communication, on the other hand, builds trust.[702] Part of the public's concern about induced seismicity is the lack of information about the process, or a sense that information is being hidden or manipulated.[703]

Investors and scientists have called for increasing data availability in the induced seismicity context,[704] but more could be done to facilitate, incentivize, or require seismic data sharing between the public and private sectors. Of the existing risk management tools, statutes and regulations hold the greatest potential for improving information collection and reporting. Insurance companies may collect data or require reporting by policyholders, but the information will not likely be made public. Data might also be released through discovery in litigation, but this would be piecemeal and in any event, most lawsuits have been

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700. *See Did You Feel It? (DYFI) Scientific Background*, U.S. GEOLOGICAL SURVEY, http://earthquake.usgs.gov/data/dyfi/background.php (last visited Apr. 7, 2017) (explaining that public reports "make a contribution to the scientific body of information about each earthquake"); JASON C. YOUNG ET AL., WOODROW WILSON CTR. COMMONS LAB, TRANSFORMING EARTHQUAKE DETECTION AND SCIENCE THROUGH CITIZEN SEISMOLOGY 5 (2013), https://www.wilsoncenter.org/sites/default/files/CitizenSeismology_FINAL.pdf (describing how "citizen seismology" can supplement the scientific data "where sensors are sparse or even absent altogether").

701. GROUND WATER PROTECTION COUNCIL & INTERSTATE OIL AND GAS COMPACT COMMISSION, POTENTIAL INJECTION-INDUCED SEISMICITY ASSOCIATED WITH OIL & GAS DEVELOPMENT: A PRIMER ON TECHNICAL AND REGULATORY CONSIDERATIONS INFORMING RISK MANAGEMENT AND MITIGATION 4 (2015).

702. *See* REYNOLDS & SEEGER, *supra* note 693, at 33.

703. *See, e.g.*, Kyle J. Ferrar, Jill Kriesky, Charles L. Christen, Lynne P. Marshall, Samantha L. Malone, Ravi K. Sharma, Drew R. Michanowicz & Bernard D. Goldstein, *Assessment and Longitudinal Analysis of Health Impacts and Stressors Perceived to Result from Unconventional Shale Gas Development in the Marcellus Shale Region*, 19 INT'L J. OCCUPATIONAL & ENVTL. HEALTH 104, 110 (2013).

704. *See, e.g.*, RICHARD LIROFF ET AL., DISCLOSING THE FACTS 2015: TRANSPARENCY AND RISK IN HYDRAULIC FRACTURING 7 (2015), http://disclosingthefacts.org/2015/DisclosingTheFacts_2015.pdf; McGarr et al., *supra* note 56, at 831.

settled before discovery begins.[705]

Despite good reasons to collect and share data, the uncertainty of risk exposure motivates operators against it. One of the great benefits of a compensation fund is that it could manage exposure, and thus promote more openness.

Beyond risk management, the Model Induced Seismicity Compensation Fund could contribute even more proactively to the data available on induced seismicity. Here, a design element of the Fishermen's Contingency Fund might serve as a useful model. When a fisherman files a report of damage from oil and gas infrastructure, the government sends the reported location of the obstruction to the National Ocean Survey for inclusion on nautical maps.[706] In the same way, reports of damage from quakes could be collected and mapped to add to the seismic event data.

The National Vaccine Program also provides a useful blueprint. Medical professionals are required to maintain vaccine records[707] and report incidents that match those on the Injury Table used to determine if an injury or death is compensable under the program.[708] This information is released to the public with specific patient information removed.[709] An advisory committee reviews the medical reports as well as current medical literature and uses this information to recommend additions and changes to the Injury List.[710] Meanwhile, drug companies must collect certain information about vaccine production, and provide that information upon request.[711] This regime helps government, industry, and the general public learn more about vaccine risks. Not only does this ensure that the compensation regime is compensating damages for injuries likely to be caused by vaccines, but the information could reduce risks going forward as links between drug manufacturing and poor medical outcomes are understood better.

In the induced seismicity context, the Model Fund should be linked to the state geological survey and receive alerts of any earthquakes, to prepare for claims processing. The fund might require participating companies to collect seismic and well-operation data as a condition of participation. Or, if the fund required companies to acquire third-party coverage, insurance firms might offer premium discounts for operators that install electronic sensors to provide real-time pressure and micro-seismic readouts.[712] Finally, as noted above, the fund might defray the costs of seismic monitoring as a prevention expenditure, to further

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705. Shahar & Logue, *supra* note 65, at 198–99.
706. 50 C.F.R. § 296.6(a)(2) (2016).
707. 42 U.S.C. § 300aa-25(a) (2015).
708. *Id.* § 300aa-25(b).
709. *Id.* § 300aa-25(c).
710. *Id.* § 300aa-19.
711. *Id.* § 300aa-28(a).
712. Dana & Wiseman, *supra* note 64, at 1566.

facilitate collection of data.[713]

Companies might report the data to regulators as a matter of course, or upon request. Legislators creating the fund could debate whether such data could or should be aggregated so as not to be attributable to a particular well or operator; this might depend on the fund's design.[714] If harms are compensated equally by all operators (or based on the number of wells they have in operation at the time), knowing which well or wells contributed to an earthquake would not be necessary. On the other hand, if the fund seeks recovery from responsible parties up to a limit for any compensation disbursed, fund administrators will need well-specific and operator-specific data to make an evidence-based finding of fault.

The fund might benefit from an advisory committee made up of scientists from industry, academia, and the non-governmental organization community, who would review the latest scientific literature about seismicity induced by oil and gas activity, provide expert opinions to a state agency about the cause of a particular earthquake, and share collected seismic and well-operating data with researchers. This information could improve our understanding of the risk drivers of earthquakes and help insurers better gauge risk when providing induced-earthquake coverage. The information might also drive more effective and better calibrated regulatory regimes. These tools could continue to operate alongside an induced seismicity compensation fund.

Policymakers would likely spend considerable time debating how a tort liability regime should interact with the compensation fund, and how information gathered by the fund would be used. If claimants may opt to submit claims against the fund, or file a lawsuit in a court of law, industry may strongly oppose publication of well-specific or operator-specific data that might be used in litigation. However, if tort liability is foreclosed, or limited to cases where an operator has displayed gross negligence or willful violation of a permit limitation, data sharing might be seen by industry as effective deterrent to risky behavior. This is particularly the case if the Model Fund is set up in a way that pools liability—model industry actors will not want to pay for risk-prone operators and activities.

CONCLUSION

Since 2009, oil and natural-gas producing regions in the central and eastern United States have noted a dramatic uptick in seismic activity. Scientists have established a general correlation between these earthquakes and the underground

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713. *See supra* section IV.B.

714. State legislation could designate a university or other third party to collect and aggregate the data. There may be a model for this at the federal level. *See* Confidential Information Protection and Statistical Efficiency Act of 2002 ("CIPSEA"), Pub. L. No. 107-347, 116 Stat. 2962.

injection of wastewater, and—to a lesser extent—hydraulic fracturing to stimulate fossil fuel production. The situation has caused unease in communities, and challenged conventional risk allocation and risk management tools. Well operators and property owners face a lack of affordable insurance options and uncertainty of coverage. Regulation has been piecemeal and hesitant, which may frustrate some homeowners living in the earthquake zone. Meanwhile, the possibility of a cataclysmic event raises the specter of aggressive regulation and the end of disposal wells, which would serve a serious blow to the industry.[715] When damage is sustained from an earthquake, a homeowner may find that she needs to hire experts to make the connection between a disposal or production activity and the earthquake that knocked all the brickwork off of her façade. At the same time, well operators may worry about juries who are increasingly aware of and concerned about earthquakes—and willing to find fault in the case before them, even on contestable causation evidence. And should someone lose their life, or should massive property and environmental damage be sustained—say, if a quake damaged interstate oil and gas pipelines in Cushing, Oklahoma[716]—the industry will realize that it could face enormous potential liability.

After evaluating the utility of these existing tools and determining that they fail to provide sufficient certainty or incentive to reduce the risk of induced seismicity, this Article has proposed the creation of a state Model Induced Seismicity Compensation Fund. The Model Fund need not completely displace existing tools, but instead could be designed to complement their strengths and supplement their effectiveness. The Model Fund could build on components of existing compensation and liability funds, adapted to meet the specific challenges of induced seismicity from oil and gas production and disposal activities. The Article reviews ten compensation regimes currently in use around the world, including private arrangements and public regimes at the international, national, and state level. The Article then describes seven fundamental design elements for a compensation fund: how the Model Fund is created and managed, its purpose, sources of revenue, liability of the target industry or activity, methods for ensuring the Model Fund's solvency, limits on use of the fund—with an eye toward shaping behavior of firms seeking to rely on the Model Fund, as well as would-be victims of seismicity—and, finally, how the Model Fund is modified or terminated. For each design element, the Article pulls examples from the existing funds studied, and then determines a range of options for policymakers designing a Model Induced Seismicity Compensation Fund based on the particulars of this challenge.

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715. *See* Erin Ailworth, *Oklahoma Oil Firm Resists Call to Shut Down Wells Amid Earthquake Concerns*, WALL ST. J. (Jan. 6, 2016), http://www.wsj.com/articles/oklahoma-oil-firm-resists-call-to-shut-down-wells-amid-earthquake-concerns-1451989802 (noting that Sandridge would have to stop crude production if it halted use of its waste water disposal wells).

716. *See* Philips, *supra* note 102.

Additional seismic and geological data is needed to understand the mechanics behind induced seismicity in different regions. In turn, that information could be used to lower the risk of non-tectonic earthquakes. Critically, the Model Induced Seismicity Compensation Fund could be used as a vehicle for information gathering and data sharing. The Article describes some of the data the fund might help to collect, and suggests ways that the fund could require or induce collection and data sharing.

Across all risk management tools in this space, the goal should be to fairly allocate risk today while reducing risk tomorrow.