Planning for Failure: Pipelines, Risk, and the Energy Revolution

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In 2014, as production soared in North Dakota's oil fields, Energy Transfer Partners proposed a large pipeline to transport the oil to market. The very name of the project—Dakota Access—conveyed the company's optimistic vision of a needed link between the prolific oil fields and the rest of the country. The vast scale of the pipeline project was matched only by the intensity of the opposition to the route. A bitter controversy erupted at Standing Rock over the risk of a catastrophic oil spill. Tribal members and environmentalists from across the nation united to protest the company's decision to site the pipeline underneath a lake that serves as the sole source of drinking water for local tribes. The company defended the safety of its pipeline and ultimately prevailed. Dakota Access was completed in 2017. Since it began operation, it has leaked eight times.

One would expect risk governance to take a more preventative approach to risk, as the potential for catastrophic harm increases and the ability to predict an accident decreases. But projects such as Dakota Access raise troubling questions about the current system governing the risks of energy pipelines. Why are pipelines being sited in environmentally sensitive and densely populated areas? To what extent does the system address the long-term risks of spills and releases? These questions are more important than ever before, as the domestic revolution in oil and gas production fundamentally reshapes pipeline networks and the geographic and political landscape of risk.

This Article seeks answers by examining the laws governing energy pipelines through the lens of risk. The analysis reveals a critical flaw in risk governance: the risks associated with "siting" a pipeline are treated separately from the long-term "safety" of the pipeline. This formal legal distinction has a substantial practical effect on the risk landscape. By failing to consider the risks of an accident in the decision of where to locate a pipeline—that is, by failing to plan for failure—the system allows energy pipelines to be sited near people and sensitive ecosystems. This in turn leads to more accidents in vulnerable areas

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and a greater risk burden on landowners and surrounding communities. The result is a system that sites first—and cleans up later.

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"The Dakota Access Pipeline is built to be one of the safest, most technologically advanced pipelines in the world."[1]

"Just because oil is flowing today doesn't mean it won't leak in the future . . . . There's an uneasy feeling that any moment, this pipeline could pose a threat to our way of life. It's something you have to carry and be wary of all the time, and be ready for."[2]

I. INTRODUCTION

In 2014, Energy Transfer Partners announced it would construct a new pipeline, the Dakota Access pipeline, to transport crude oil from the Bakken shale play in North Dakota to markets in the Midwest and on the Gulf Coast.[3] The scale of the pipeline project reflected the bravado of the domestic revolution

[1] *The Dakota Access Pipeline Is Safe, Efficient, and Environmentally Sound*, DAKOTA ACCESS PIPELINE, https://daplpipelinefacts.com/Safety.html [https://perma.cc/6QVE-7HFQ] (statement of Energy Transfer Partners).

[2] Robinson Meyer, *Oil Is Flowing Through the Dakota Access Pipeline*, ATLANTIC (June 9, 2017), https://www.theatlantic.com/science/archive/2017/06/oil-is-flowing-through-the-dakota-access-pipeline/529707/ [https://perma.cc/Z7QA-RV93] (statement of David Archambault II, the chairman of the Standing Rock Sioux Tribe).

[3] Press Release, Energy Transfer Partners, Energy Transfer Announces Crude Oil Pipeline Project Connecting Bakken Supplies to Patoka, Illinois and to Gulf Coast Markets (June 25, 2014), https://ir.energytransfer.com/node/11911/pdf [https://perma.cc/92Z2-SU4Z].

in oil and gas production. The proposed pipeline was designed to transport up to 570,000 barrels of oil each day, approximately half of the daily production in the Bakken oil field.[4] The planned route was over a thousand miles long and crossed fifty counties in four states.[5] After receiving approval from each state, Energy Transfer Partners began to build the pipeline. But the company encountered significant resistance when it sought a federal easement to cross the Missouri River just above the Standing Rock reservation at Lake Oahe, the only source of drinking water for local tribes.[6] The risk of an oil spill ignited a protest that would last months.[7] Tribes and environmentalists challenged the company's decision to site the pipeline in such a sensitive area and the legal framework that would allow a company to use such a route.[8] After President Trump interceded and the U.S. Army Corps of Engineers (USACE) granted the easement, Energy Transfer Partners finally completed the project in 2017[9]—at a cost of $7.5 billion, almost double the project estimate.[10]

The opposition to the Dakota Access pipeline is part of a larger trend: communities are increasingly organizing to fight new energy pipelines. Residents of the densely populated Northeast,[11] farmers in Iowa,[12] and rural

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4 *See Moving America's Energy: The Dakota Access Pipeline*, DAKOTA ACCESS PIPELINE, https://www.daplpipelinefacts.com/ [https://perma.cc/8XU6-2YKW].

5 *Id.*; Alene Tchekmedyian & Melissa Etehad, *2 Years of Opposition, 1,172 Miles of Pipe, 1.3 Million Facebook Check-Ins. The Numbers to Know About the Standing Rock Protests*, L.A. TIMES (Nov. 1, 2016), https://www.latimes.com/nation/la-na-standing-rock-numbers-20161101-story.html [https://perma.cc/X439-D8XV].

6 Meyer, *supra* note 2. *See generally* Rebecca Hersher, *Key Moments in the Dakota Access Pipeline Fight*, NPR (Feb. 22, 2017), https://www.npr.org/sections/thetwo-way/2017/02/22/514988040/key-moments-in-the-dakota-access-pipeline-fight [https://perma.cc/2XNT-5HJM] (providing an overview of the easement controversy).

7 Meyer, *supra* note 2.

8 Phil McKenna, *Native American Pipeline Protest Halts Construction in N. Dakota*, INSIDE CLIMATE NEWS (Aug. 19, 2016), https://insideclimatenews.org/news/18082016/native-americans-sioux-tribe-protest-north-dakota-access-bakken-oil-pipeline-fossil-fuels [https://perma.cc/RQV5-XP2F].

9 *See* Meyer, *supra* note 2.

10 CARLA F. FREDERICKS ET AL., FIRST PEOPLES WORLDWIDE, SOCIAL COST AND MATERIAL LOST: THE DAKOTA ACCESS PIPELINE 41 (Nov. 2018), https://www.colorado.edu/program/fpw/sites/default/files/attached-files/social_cost_and_material_loss_0.pdf [https://perma.cc/TFV9-X96P].

11 *See* Phil McKenna, *Protesters Call for a Halt to Three Massachusetts Pipeline Projects*, INSIDE CLIMATE NEWS (July 19, 2016), https://insideclimatenews.org/news/19072016/natural-gas-pipeline-protests-boston-massachusetts-spectra-energy [https://perma.cc/EYH9-ML9U].

12 *See* Jen Fifield, *As Pipeline Projects Grow, So Do Protests*, PBS NEWSHOUR (Oct. 1, 2016), http://www.pbs.org/newshour/rundown/pipelines-proliferate-protests/ [https://perma.cc/UKZ4-9QR6].

homeowners in Georgia,[13] Virginia,[14] Kentucky,[15] and Pennsylvania[16] have sought to halt the construction of pipelines. Facing such public opposition, companies have cancelled or delayed several pipelines.[17] Protesters are painted as discontented, "not-in-my-backyard" property owners complaining about unwanted land uses,[18] or as fringe environmentalists who want to keep oil and natural gas in the ground.[19] But there is an alternative explanation: communities are increasingly concerned about the long-term risks of energy pipelines, including the impacts of spills and releases on the environment, human health, and public safety.[20]

The concern is justified. The legal frameworks governing energy pipelines impose unnecessary risks on communities and the environment by dividing approval of pipeline "siting"[21] from standards for pipeline "safety."[22] When government agencies review a proposed pipeline project, they primarily focus on the need for the pipeline and the negative effects of pipeline construction,

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[13] *See id.*

[14] *See* Jenna Portnoy, *A Dilemma of Development vs. the Prospect of Losing Peace and Quiet*, WASH. POST (Feb. 6, 2016), https://www.washingtonpost.com/local/virginia-politics/a-dilemma-of-development-vs-the-prospect-of-losing-peace-and-quiet/2016/02/06/dab301b8-c9b6-11e5-88ff-e2d1b4289c2f_story.html [https://perma.cc/XSM2-9DRB].

[15] *See* James Bruggers, *Kinder Morgan Cancels Fracked Liquids Pipeline Plan, and Pursues Another*, INSIDE CLIMATE NEWS (Oct. 19, 2018), https://insideclimatenews.org/news/18102018/natural-gas-pipeline-kinder-morgan-fracking-utica-marcellus [https://perma.cc/V2WJ-FRYP].

[16] *See* Eliza Griswold, *A Pipeline, a Protest, and the Battle for Pennsylvania's Political Soul*, NEW YORKER (Oct. 26, 2018), https://www.newyorker.com/news/dispatch/a-pipeline-a-protest-and-the-battle-for-pennsylvanias-political-soul [https://perma.cc/BW8G-DBY6].

[17] Zahra Hirji, *It's Not Just Dakota Access. Many Other Fossil Fuel Projects Delayed or Canceled, Too*, INSIDE CLIMATE NEWS (Dec. 5, 2016), https://insideclimatenews.org/news/06052016/fossil-fuel-projects-cancellations-keystone-xl-pipeline-oil-coal-natural-gas-climate-change-activists [https://perma.cc/8873-E9H5]; *see also* Ellen M. Gilmer et al., *The East Coast's Pipeline Wars: A Cheat Sheet*, E&E NEWS (Nov. 27, 2017), https://www.eenews.net/stories/1060067235 [https://perma.cc/EDC7-3GRL].

[18] *See* Fifield, *supra* note 12 (quoting Melissa Ruiz, spokeswoman for Kinder Morgan, as saying "[t]here are always going to be people who say not in my backyard").

[19] *See* Jordan Blum, *Protests, Arrests Pick Up as Environmentalists Target Pipelines*, HOUS. CHRON. (Oct. 19, 2016), http://www.houstonchronicle.com/business/energy/article/Protests-arrests-pick-up-as-environmentalists-9983690.php [https://perma.cc/3XWV-U4TZ] (stating that "environmentalists are targeting pipelines as the new public enemy number one" and "[w]ith the 'keep it [in] the ground' movement gaining support, the focus of efforts to slow the extraction of oil and gas has increasingly become pipelines").

[20] There are even longer-term risks of energy pipelines, notably the climate change enabled by fossil fuel infrastructure. Climate activists are increasingly focused on halting new pipelines to mitigate future greenhouse gas emissions. This Article considers the risks of spills and releases, leaving the issue of climate change risk to future work.

[21] *See, e.g.*, 15 U.S.C. § 717f(c) (2012) (requiring a federal certificate of public necessity and convenience for construction and extension of interstate natural gas pipelines).

[22] 49 U.S.C. § 60101; 49 C.F.R. §§ 192.1–.1015 (2019) (natural gas pipelines), 195.0–.589 (hazardous liquid pipelines).

rather than on the risks of operation.[23] Managing the risks of spills and releases to the surrounding area is left to the pipeline safety standards—which go into effect once the route is already established.[24] Combined with a compelled transfer of property rights through eminent domain, the result is a governance system that defers largely to the pipeline company and its chosen route.

The Standing Rock controversy is the exception that proves the rule. In addition to siting approval from each state, Energy Transfer Partners was required to obtain an easement from the USACE because the Dakota Access pipeline crossed a small area of a civil works project.[25] Under the National Environmental Policy Act (NEPA), the agency could not make a decision on the easement until it conducted an environmental assessment of the project to determine whether there were significant environmental impacts.[26] Relying on federal safety standards, the USACE assessed the risk of an oil spill as low and concluded that a leak during pipeline operation was an "unlikely event."[27] This assessment would prove incorrect for the pipeline as a whole. From 2017 to 2018, the Dakota Access pipeline has leaked eight times.[28] The leaks were relatively small, however, and none have affected Lake Oahe.[29]

The risk governance of oil and natural gas pipelines has never been more important. A revolution in domestic oil and gas production is occurring, as development companies extract the resources from shale and other "tight" rock

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[23] *See* discussion *infra* Part III.C.

[24] *See* discussion *infra* Part III.B.

[25] *See* 33 U.S.C. § 408a (2012). The crossing also required an easement under the Mineral Leasing Act. *See* 30 U.S.C. § 185 (2012).

[26] *See* 42 U.S.C. § 4332(2)(C) (2012); 40 C.F.R. § 1501.4(b).

[27] JOHN W. HENDERSON, U.S. ARMY CORPS OF ENG'RS, ENVIRONMENTAL ASSESSMENT: DAKOTA ACCESS PIPELINE PROJECT 88–94 (July 2016). Tribes and environmental organizations challenged the assessment, but the court deferred to the USACE and upheld the risk analysis. *See* Standing Rock Sioux Tribe v. U.S. Army Corps of Eng'rs, 255 F. Supp. 3d 101, 127 (D.D.C. 2017). The court remanded the assessment to the agency, however, to consider whether the project would be highly controversial in light of scientific critiques of the risk analysis and to analyze the effects of an oil spill on tribal hunting and fishing rights. *Id.* at 145–48. On remand, the USACE determined that the effects were not significant. JOHN L. HUDSON, U.S. ARMY CORPS OF ENG'RS, ANALYSIS OF THE ISSUES REMANDED BY THE U.S. DISTRICT COURT FOR THE DISTRICT OF COLUMBIA RELATED TO THE DAKOTA ACCESS PIPELINE CROSSING AT LAKE OAHE 41 (Aug. 2018). As this Article went to press, the court has once again remanded the assessment to the agency because the "[u]nrebutted expert critiques regarding [the risk of oil spills] mean that the easement approval remains 'highly controversial'" and the USACE must prepare an Environmental Impact Statement. Standing Rock Sioux Tribe v. U.S. Army Corps of Eng'rs, No. 16-1534 JEB, 2020 WL 1441923 (D.D.C. Mar. 25, 2020).

[28] *Distribution, Transmission & Gathering, LNG, and Liquid Accident and Incident Data*, PIPELINE & HAZARDOUS MATERIALS SAFETY ADMIN., https://www.phmsa.dot.gov/data-and-statistics/pipeline/distribution-transmission-gathering-lng-and-liquid-accident-and-incident-data [https://perma.cc/3H8B-N8GC] (follow "Hazardous Liquid Accident Data—January 2010 to present (ZIP)" hyperlink to download data and search for entries with DAPL-ETCO OPERATIONS MANAGEMENT, LLC and a DAPL pipeline segment).

[29] *Id.* One affected a drinking water source area in Patoka, Illinois.

formations in plays across the country.[30] The plays supply immense amounts of oil and gas, and production is growing.[31] Because of this revolution, the United States became a net exporter of natural gas in 2017[32] and the largest producer of crude oil in the world in 2018.[33] The rapid increase in oil and gas supply and changing demand are altering pipeline networks in profound ways. From 2004 to 2017, the pipeline industry constructed over 125,000 miles of pipelines to transport oil and gas from production areas in the United States and the border of Canada to areas where the commodities will be used or exported.[34] The industry expects to continue construction, with an additional 150,000 miles of new pipelines by 2035.[35]

The growing scholarly literature on energy pipelines has focused on the siting frameworks that govern natural gas pipelines, oil pipelines, and other energy transportation infrastructure.[36] Scholars have explored questions of

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[30] MICHAEL RATNER & MARY TIEMANN, CONG. RESEARCH SERV., R43148, AN OVERVIEW OF UNCONVENTIONAL OIL AND NATURAL GAS: RESOURCES AND FEDERAL ACTIONS 1–7 (2015).

[31] *EIA Adds New Play Production Data to Shale Gas and Tight Oil Reports*, U.S. ENERGY INFO. ADMIN. (Feb. 15, 2019), https://www.eia.gov/todayinenergy/detail.php?id=38372 [https://perma.cc/HR4H-NSEV].

[32] U.S. ENERGY INFO. ADMIN., ANNUAL ENERGY OUTLOOK 2019 WITH PROJECTIONS TO 2050, at 14 (Jan. 2019), https://www.eia.gov/outlooks/aeo/pdf/aeo2019.pdf [https://perma.cc/2A5S-RCCT] [hereinafter EIA, ANNUAL ENERGY OUTLOOK 2019]; *see also* IHS GLOBAL INC., OIL & NATURAL GAS TRANSPORTATION & STORAGE INFRASTRUCTURE: STATUS, TRENDS, & ECONOMIC BENEFITS 14 (Dec. 2013), https://www.api.org/~/media/Files/Policy/SOAE-2014/API-Infrastructure-Investment-Study.pdf [https://perma.cc/62GH-XJC7].

[33] *The United States Is Now the Largest Global Crude Oil Producer*, U.S. ENERGY INFO. ADMIN. (Sept. 12, 2018), https://www.eia.gov/todayinenergy/detail.php?id=37053 [https://perma.cc/SV6R-QHBJ].

[34] *See* discussion *infra* Part II.B.

[35] KEVEN PETAK ET AL., ICF, NORTH AMERICA MIDSTREAM INFRASTRUCTURE THROUGH 2035, at 88 (June 2018), https://www.ingaa.org/File.aspx?id=34703 [https://perma.cc/EKW6-WPY6] [hereinafter ICF, NORTH AMERICA] (reporting a total estimate of 149,128 miles of new pipelines by 2035 across the following three categories: 110,018 miles of new oil and gas gathering pipelines; 36,129 miles of oil, gas, and natural gas liquid pipelines; and 2,981 miles of oil product pipelines). Energy Transfer Partners has joined the fray again; it is proposing three new pump stations to increase the amount of oil the Dakota Access pipeline can transport. *See Growth Opportunity*, DAKOTA ACCESS PIPELINE, https://daplpipelinefacts.com/Updates.html [https://perma.cc/35BT-XRJN].

[36] *See generally, e.g.*, Alexandra B. Klass, *Future-Proofing Energy Transport Law*, 94 WASH. U. L. REV. 827 (2017) [hereinafter Klass, *Future-Proofing*] (considering how siting laws can encourage transportation infrastructure for clean energy); Alexandra B. Klass & Danielle Meinhardt, *Transporting Oil and Gas: U.S. Infrastructure Challenges*, 100 IOWA L. REV. 947 (2015) (assessing whether siting laws governing oil and gas pipeline networks are sufficient to facilitate new oil and gas pipelines); Tara K. Righetti, *Siting Carbon Dioxide Pipelines*, 3 OIL & GAS NAT. RESOURCES & ENERGY J. 907 (2017) (analyzing the current siting framework for carbon dioxide pipelines).

federalism,[37] the use of eminent domain,[38] the role of climate change,[39] and the criteria governing the siting of transboundary pipelines.[40] But the academy has paid less attention to the risks posed by pipeline accidents.[41] This Article builds on the author's previous work on pipeline safety and risk[42] to consider how pipeline siting laws and safety laws address the long-term risk of pipeline accidents. It presents the first comprehensive analysis of siting laws through the lens of risk. As described in the Article, the siting framework is certainly fragmented. Jurisdiction is scattered among the federal government and the states, and various agencies apply different criteria to pipeline proposals. These differences are largely cosmetic, however, when viewed through the lens of long-term risk. The overarching legal framework produces a surprisingly uniform result: This is a framework that sites first—and cleans up later.

The Article is divided into four parts. In Part II, I provide a detailed analysis of current data to describe the pipeline networks and explain the effect of the domestic energy revolution on those networks. In Part III, I explain the risks of energy pipelines and the ways in which the "safety" and "siting" legal frameworks address risk. This Part includes a fifty-state analysis of pipeline siting laws. In Part IV, I present a typology of risk policy approaches—a preventative approach, a management approach, and a remedial approach. While a preventative approach appears best suited to pipeline risk, I argue that the division between the siting and safety frameworks leads to less prevention. I contend that this creates several negative results, such as an increase in the

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37 *See, e.g.*, Alexandra B. Klass & Jim Rossi, *Reconstituting the Federalism Battle in Energy Transportation*, 41 HARV. ENVTL. L. REV. 423, 458–63 (2017) (exploring federalism tensions in energy transportation infrastructure, including in the siting of interstate gas pipelines); Amy L. Stein, *The Tipping Point of Federalism*, 45 CONN. L. REV. 217, 217, 237–38 (2012) (comparing state authority over siting of electricity generation facilities to federal control over the siting of other energy infrastructure, such as natural gas pipelines).

38 *See, e.g.*, James W. Coleman & Alexandra B. Klass, *Energy and Eminent Domain*, 104 MINN. L. REV. 659, 680–92, 724–38 (2019) (describing the growing opposition to the use of eminent domain for oil and gas pipelines and assessing potential reforms to address public concern).

39 *See generally, e.g.*, James W. Coleman, *Beyond the Pipeline Wars: Reforming Environmental Assessment of Energy Transport Infrastructure*, 2018 UTAH L. REV. 119.

40 *See, e.g.*, Sam Kalen, *Thirst for Oil and the Keystone XL Pipeline*, 46 CREIGHTON L. REV. 1, 10–25 (2012) (examining the presidential permit criteria for the transboundary Keystone XL pipeline).

41 *Cf.* Klass, *Future-Proofing*, *supra* note 36, at 887–96 (arguing that energy law should encourage transportation of oil by rail rather than by pipeline, in part because of the greater potential for rail safety improvements); Righetti, *supra* note 36, at 925–27 (describing the safety framework governing carbon dioxide pipelines); *see also* David B. Spence, *Regulation and the New Politics of (Energy) Market Entry*, 95 NOTRE DAME L. REV. 327, 357–75, 378–81 (2019) (presenting the results of an empirical study on nonprofit organizations that oppose energy infrastructure and arguing that opponents are misrepresenting the risk of projects).

42 *See generally* Sara Gosman, *Justifying Safety: The Paradox of Rationality*, 90 TEMP. L. REV. 155 (2018) (examining the legal framework governing pipeline safety and criticizing the federal law's rationalist approach to risk).

number and catastrophic harm of pipeline incidents. Finally, I identify a policy solution that would combine the siting and safety frameworks into one risk governance system.

II. RECONSTRUCTING THE ENERGY SYSTEM

Today's energy system depends on vast networks of underground pipelines that transport petroleum to users, in order to heat buildings, generate electricity, fuel cars, and manufacture thousands of products.[43] Approximately three million miles of pipelines[44] lie underneath cities and rural areas, coastal waters and inland streams, forests and grasslands, in almost every part of the United States.[45] The pipelines transport 28 trillion cubic feet of natural gas,[46] 11.38 billion barrels of crude oil,[47] and 10.19 billion barrels of petroleum products[48] per year. No other transportation mode for commodities—including railways,[49] inland waterways,[50] and paved roadways[51]—stretches as far to connect

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[43] *General Pipeline FAQs*, PIPELINE & HAZARDOUS MATERIALS SAFETY ADMIN., https://www.phmsa.dot.gov/faqs/general-pipeline-faqs [https://perma.cc/P4VK-L29M] (last updated Feb. 26, 2019); *Products Made from Petroleum*, RANKEN ENERGY CORP., https://www.ranken-energy.com/index.php/products-made-from-petroleum/ [https://perma.cc/53PX-LJZL] (including a partial list of 144 common products such as clothes, refrigerators, and eyeglasses).

[44] PAUL W. PARFOMAK, CONG. RESEARCH SERV., R44201, DOT'S FEDERAL PIPELINE SAFETY PROGRAM 1 (Mar. 2019).

[45] *Id.* (describing pipelines as "geographically widespread, running alternately through remote and densely populated regions—from Arctic Alaska to the Gulf of Mexico and nearly everywhere in between"); *Where Are Pipelines Located?*, PIPELINE 101, https://pipeline101.org/Where-Are-Pipelines-Located [https://perma.cc/SF3Z-V57B].

[46] *Natural Gas Explained: Natural Gas Pipelines*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/energyexplained/index.php?page=natural_gas_pipelines [https://perma.cc/Q2HN-VZHQ] (last updated Dec. 5, 2019).

[47] AM. PETROLEUM INST. & ASS'N OF OIL PIPE LINES, PIPELINE SAFETY EXCELLENCE PERFORMANCE: 2019 ANNUAL LIQUIDS REPORT 43 (2019), https://www.aopl.org/documents/en-us/d904059a-c130-41f9-b8da-3ca7e100ad4a/1 [https://perma.cc/3JUG-7QE8] (providing 2017 data).

[48] *Id.*

[49] *See System Mileage within the United States*, BUREAU OF TRANSP. STATISTICS, https://www.bts.gov/content/system-mileage-within-united-states [https://perma.cc/DU37-8HYJ] (reporting 92,837 miles of Class 1 rail and 21,407 miles of Amtrak rail in 2018, and 11,498 miles of transit rail in 2017).

[50] *See id.* (reporting an estimated 25,000 miles of navigable channels, "which include rivers, bays, channels, and the inner route of the Southeast Alaskan Islands, but does not include the Great Lakes or deep ocean traffic").

[51] *See Highway Statistics 2018: Public Road Length*, U.S. DEP'T OF TRANSP., FED. HIGHWAY ADMIN., https://www.fhwa.dot.gov/policyinformation/statistics/2018/hm12.cfm [https://perma.cc/3PBS-KVZZ] (last updated Oct. 29, 2019) (reporting 2,844,126 miles of paved public roads and streets in 2018). If unpaved roads are included, however, the length of the road transportation network exceeds that of energy pipelines. *Id.* (reporting 4,160,800 miles of total roads and streets).

production and use. The sheer size of these pipeline networks is rivaled only by the transmission and distribution system for electricity.[52] Unlike most electric wires, pipelines are hidden from public view until an operator constructs a new pipeline or an accident occurs, bringing the networks to the surface. A dramatic increase in domestic oil and natural gas production has spurred pipeline construction across the country—and reshaped the energy system.

A. *Energy Pipeline Networks*

There are two primary energy pipeline networks in the United States: a network that transports natural gas, and a network that transports liquid petroleum.[53] In general, both networks carry domestically produced and imported fossil fuels to users and export facilities. But it is important to understand the specific features of the networks, both to appreciate the effects of the energy revolution and to evaluate the laws governing pipeline risk.

The natural gas pipeline network consists of three interconnected types of systems: gathering systems, transmission systems, and distribution systems.[54] Operators of gathering pipeline systems collect raw natural gas from production fields.[55] Depending on the constituents in the raw gas, the pipelines may carry the gas to a central processing facility or directly to the transmission pipeline system.[56] Operators of transmission pipeline systems transport methane from gathering systems and import facilities to areas where the gas will be consumed or to terminals for export.[57] Some large users—like power plants or manufacturing facilities—take delivery of the gas from transmission systems.[58]

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52 *See* W.M. WARWICK ET AL., PACIFIC NORTHWEST NAT'L LAB., ELECTRICITY DISTRIBUTION SYSTEM BASELINE REPORT 11 tbl.2.2 (July 2016), https://www.energy.gov/sites/prod/files/2017/01/f34/Electricity%20Distribution%20System%20Baseline%20Report.pdf [https://perma.cc/8WBS-E3WL] (reporting 476,398 miles of electric transmission lines and 6,322,236 miles of distribution lines).

53 *See How Do Pipelines Work?*, PIPELINE 101, https://pipeline101.org/How-Do-Pipelines-Work [https://perma.cc/3L4Y-N9UZ]. Liquid pipelines also transport liquefied gases, such as carbon dioxide, and liquefied hydrocarbons associated with natural gas production, such as ethane, propane, and butane. *Id.*

54 *See* THOMAS O. MIESNER & WILLIAM L. LEFFLER, OIL AND GAS PIPELINES IN NONTECHNICAL LANGUAGE 2 (2006).

55 In many cases, the gas extracted from the underground rock formation must be separated from water, solids, and crude oil. *Id.* at 89. The oil and heavier hydrocarbons, or lease condensate, are sent to a crude oil pipeline system. *Id.* The raw gas enters the gathering system at the separator outlet. *Id.*

56 *Id.* at 5. At a processing facility, methane is separated from impurities and other hydrocarbons. *Id.*

57 *Id.* at 6. The United States imports and exports natural gas by cross-border transmission pipelines and by tanker vessel. *Id.* at 92. To efficiently transport natural gas across the ocean, operators of export facilities must cool the gas until it liquefies. *Id.* Import terminals then re-gasify the methane before piping it to the transmission pipeline system. *Id.*

58 *Id.* at 6.

Transmission operators also deliver to local distribution companies, which transport the gas to customers through distribution pipelines.[59]

There is very little information available on gas gathering systems because the vast majority are unregulated.[60] An estimated 3500 private companies operate 356,000 to 400,000 miles of pipelines.[61] In production areas where there are many wells and where operators have built processing and transmission infrastructure, the gathering systems are compact; short branch lines funnel gas from wells into larger pipelines that carry the gas to central facilities.[62] In areas with fewer wells and less infrastructure development, the systems consist of longer pipelines that connect distant production fields.[63] Traditionally, gathering systems are composed of small-diameter steel pipes that operate at low pressure.[64] Operators utilize plastic and composite piping as cheaper alternatives to steel, but to what extent is unclear.[65]

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59 *Id.* at 99.

60 *See* PIPELINE & HAZARDOUS MATERIALS SAFETY ADMIN., PRELIMINARY REGULATORY IMPACT ASSESSMENT: NOTICE OF PROPOSED RULEMAKING—PIPELINE SAFETY: SAFETY OF GAS TRANSMISSION AND GATHERING PIPELINES 144 (Mar. 2016) [hereinafter PHMSA, PRELIMINARY REGULATORY IMPACT ASSESSMENT] (estimating that PHMSA regulates 3% of onshore gathering pipelines and contending that data should be collected on all gathering systems); U.S. GOV'T ACCOUNTABILITY OFFICE, GAO-12-388, COLLECTING DATA AND SHARING INFORMATION ON FEDERALLY UNREGULATED GATHERING PIPELINES COULD HELP ENHANCE SAFETY 7 (Mar. 2012) [hereinafter GAO, COLLECTING DATA AND SHARING INFORMATION].

61 *Compare* PHMSA, PRELIMINARY REGULATORY IMPACT ASSESSMENT, *supra* note 60, at 144 (estimating 356,000 miles of gas gathering pipelines), *with* ICF INT'L, COST AND BENEFIT IMPACT ANALYSIS OF THE PHMSA NATURAL GAS GATHERING AND TRANSMISSION SAFETY REGULATION PROPOSAL 11 (July 2016), https://www.api.org/~/media/Files/Oil-and-Natural-Gas/pipeline/2016-ICF/ICF-PHMSA-Proposed-Regulation-RIA-Analysis-070516.pdf [https://perma.cc/23GN-YBZ3] (estimating 399,579 miles of gas gathering pipelines).

62 *See* ACCUFACTS INC. & PIPELINE SAFETY TR., THE STATE OF NATURAL GAS PIPELINES IN FORT WORTH 25 (Oct. 2010), https://pstrust.org/docs/FWFinal.pdf [https://perma.cc/J78Y-CVFA] (showing a map of gas gathering pipelines around Fort Worth, Texas).

63 *See* PIPELINE & HAZARDOUS MATERIALS SAFETY ADMIN., ONSHORE GAS GATHERING FAQS 6–9 (July 2007), https://www.phmsa.dot.gov/sites/phmsa.dot.gov/files/docs/about-phmsa/grants/pipeline/57056/gathering-faqs-7112007.pdf [https://perma.cc/47JJ-V9UD] (describing different configurations of gathering systems).

64 Pipeline Safety: Safety of Gas Transmission and Gathering Pipelines, 81 Fed. Reg. 20,722, 20,724 (proposed Apr. 8, 2016) (to be codified at 49 C.F.R. pts. 191, 192); *Natural Gas Explained: Natural Gas Pipelines*, *supra* note 46.

65 *See* U.S. GOV'T ACCOUNTABILITY OFFICE, GAO-17-639, PIPELINE SAFETY: ADDITIONAL ACTIONS COULD IMPROVE FEDERAL USE OF DATA ON PIPELINE MATERIALS AND CORROSION 13–14, 16 (Aug. 2017) [hereinafter GAO, PIPELINE MATERIALS AND CORROSION].

In contrast to localized gathering systems tied to production fields, gas transmission pipeline systems crisscross the nation.[66] More than 210 systems form an integrated transmission grid of 300,000 miles of line pipe.[67] The industry is very concentrated: just twenty-seven private companies operate almost two-thirds of these miles.[68] Interstate "trunkline" systems, which transport gas over long distances between a few collection and distribution points, make up most of the grid.[69] The rest of the systems generally operate within a major market and serve that region; unlike trunkline systems, the main pipelines have many interconnections and branch lines where gas can enter and exit the system.[70] Because transmission systems transport large volumes of gas, the pipes are generally wide—trunklines can be greater than three feet in diameter[71]—and are constructed of steel that can withstand the high operating pressures.[72] Mechanical devices compress gas from gathering systems to boost its pressure before the gas enters the transmission system, and compress gas once it is in the system to maintain pressure and counteract friction.[73] There are more than 1400 compressor stations along the transmission grid.[74]

Of the three types of natural gas pipeline systems, distribution systems are by far the most ubiquitous. Approximately 1400 local gas utilities distribute gas through 2.2 million miles of pipelines to 69.3 million customers in communities across the nation.[75] The distribution systems begin at city gates, where operators

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[66] *See Natural Gas Explained: Natural Gas Pipelines*, *supra* note 46 ("The U.S. natural gas pipeline network is a highly integrated network that moves natural gas throughout the continental United States.").

[67] *About U.S. Natural Gas Pipelines—Transporting Natural Gas*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/naturalgas/archive/analysis_publications/ngpipeline/index.html [https://perma.cc/5EKP-EHTF] (based on 2007/2008 data with selected updates); *Pipeline Mileage and Facilities*, PIPELINE & HAZARDOUS MATERIALS SAFETY ADMIN., https://www.phmsa.dot.gov/data-and-statistics/pipeline/pipeline-mileage-and-facilities [https://perma.cc/QX57-MJCE] (follow "2010+ Pipeline Miles and Facilities" hyperlink) (reporting 298,401.7 onshore miles and 3171.6 offshore miles of gas transmission pipelines in 2018).

[68] *See About*, INTERSTATE NAT. GAS ASS'N OF AM., https://www.ingaa.org/about.aspx [https://perma.cc/6SMH-DR4W] ("INGAA members operate almost 200,000 miles of pipeline.").

[69] *Interstate Natural Gas Pipeline Segment*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/naturalgas/archive/analysis_publications/ngpipeline/interstate.html [https://perma.cc/PKH4-XHC4]; *Transportation Process and Flow*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/naturalgas/archive/analysis_publications/ngpipeline/process.html [https://perma.cc/Z7D3-ZDJJ].

[70] *Transportation Process and Flow*, *supra* note 69.

[71] *Interstate Natural Gas Pipeline Segment*, *supra* note 69; *Natural Gas Pipeline Systems*, PIPELINE & HAZARDOUS MATERIALS SAFETY ADMIN, https://primis.phmsa.dot.gov/comm/NaturalGasPipelineSystems.htm [https://perma.cc/5HH8-7YQA].

[72] GAO, PIPELINE MATERIALS AND CORROSION, *supra* note 65, at 12–13.

[73] *See* MIESNER & LEFFLER, *supra* note 54, at 5–6, 51, 105.

[74] *About U.S. Natural Gas Pipelines—Transporting Natural Gas*, *supra* note 67.

[75] *Pipeline Mileage and Facilities*, *supra* note 67 (follow "2010+ Pipeline Miles and Facilities" hyperlink) (reporting 1372 operators, 1,307,826.6 miles of main pipelines, and

receive gas from transmission pipelines and add an odorant to give methane its distinctive smell.[76] Gas is delivered to residences and businesses through main pipelines and small service lines that branch off the "mains."[77] These pipes—particularly service lines—are generally smaller in diameter and operate at lower pressure.[78] Beyond the basic function, the systems are remarkably heterogenous: they vary from small municipal systems of less than 1000 customers to large investor-owned systems that service over 100,000 customers.[79] They also vary in materials. Systems may contain piping constructed of steel, plastic, cast iron, or copper.[80] Most mains and service lines are now plastic because the material is flexible and resistant to corrosion.[81]

The liquid petroleum pipeline network also consists of three types of systems: crude oil gathering systems, crude oil transmission systems, and product transmission systems.[82] The gathering pipeline systems, like their counterparts in the natural gas network, connect production fields to the transmission systems that provide long-distance transport.[83] But crude oil is processed at refineries that can be hundreds of miles away from production areas.[84] The crude oil transmission systems transport raw crude from domestic gathering systems to refineries,[85] while separate transmission systems carry

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930,880 miles of service pipelines in 2018); *Annual Report Mileage for Gas Distribution Systems*, PIPELINE & HAZARDOUS MATERIALS SAFETY ADMIN., https://www.phmsa.dot.gov/data-and-statistics/pipeline/annual-report-mileage-gas-distribution-systems [https://perma.cc/G2WW-WEM3] (last updated Feb. 6, 2020) (reporting 69,349,129 services in 2018).

[76] *See Fact Sheet: Distribution Pipelines*, PIPELINE & HAZARDOUS MATERIALS SAFETY ADMIN., https://primis.phmsa.dot.gov/comm/FactSheets/FSDistributionPipelines.htm [https://perma.cc/KC8N-A9GX] (last updated Feb. 26, 2018).

[77] *Natural Gas Pipeline Systems*, *supra* note 71.

[78] *See Fact Sheet: Distribution Pipelines*, *supra* note 76.

[79] OFFICE OF PIPELINE SAFETY, PIPELINE & HAZARDOUS MATERIALS SAFETY ADMIN., ASSURING THE INTEGRITY OF GAS DISTRIBUTION PIPELINE SYSTEMS: A REPORT TO CONGRESS 5–6 (May 2005), https://www.phmsa.dot.gov/sites/phmsa.dot.gov/files/docs/technical-resources/pipeline/gas-distribution-integrity-management/61721/assuringintegrityofgasdistributionpipelinesystemsreporttocongressmay2005.pdf [https://perma.cc/9DCM-4878].

[80] *Pipeline Mileage and Facilities*, *supra* note 67; *Pipeline Replacement Background*, PIPELINE & HAZARDOUS MATERIALS SAFETY ADMIN., https://opsweb.phmsa.dot.gov/pipeline_replacement/ [https://perma.cc/LS58-35FU] (last updated Sept. 20, 2019) (noting that although cast and wrought iron pipelines are some of the oldest pipeline materials in the United States, operators have made progress in replacing these high-risk pipelines).

[81] *See* GAO, PIPELINE MATERIALS AND CORROSION, *supra* note 65, at 14–16.

[82] *See Petroleum Pipeline Systems*, PIPELINE & HAZARDOUS MATERIALS SAFETY ADMIN., https://primis.phmsa.dot.gov/comm/PetroleumPipelineSystems.htm [https://perma.cc/V3X6-7SFX].

[83] *See* MIESNER & LEFFLER, *supra* note 54, at 2–3.

[84] CHERYL J. TRENCH & THOMAS O. MIESNER, THE ROLE OF ENERGY PIPELINES AND RESEARCH IN THE UNITED STATES 17 (May 2006), https://www.ingaa.org/File.aspx?id=4857&v=7ac32bf8 [https://perma.cc/38R4-TQ3M].

[85] MIESNER & LEFFLER, *supra* note 54, at 3–4.

petroleum products and hydrocarbon gas liquids to direct users and distribution terminals.[86] Both types of transmission systems also serve import and export markets.[87] There are no distribution pipeline systems similar to the ones for natural gas; instead, trucks generally transport products to end users.[88]

Like gas gathering systems, crude oil gathering systems operate largely without regulation and so data on the systems is sparse.[89] There are an estimated 30,000 to 40,000 miles of gathering pipelines;[90] the number of operators is unknown. Gathering pipelines collect crude oil from storage tanks on well sites and carry it to oil terminals, where oil is aggregated in large tanks to await further transportation by transmission pipeline, rail, or truck.[91] A system may also transport oil from several well sites to an interim central tank battery, before carrying the oil to an oil terminal.[92] Depending on the location of the oil terminal and tank batteries, small pipelines may feed oil from production sites into main pipelines, or pipelines may connect one site to another in a more haphazard fashion.[93] The pipes are traditionally smaller in diameter, constructed of steel, and operated at lower pressures.[94]

Crude oil transmission pipeline systems connect domestic and foreign producers with U.S. refineries while also bringing domestically produced crude to the coast for export.[95] Over 250 companies operate a loose grid of over 80,000 miles of crude oil transmission pipelines, which extends across much of the nation.[96] The systems share many features with gas transmission systems. The largest crude oil systems use long-distance trunklines with only a few receipt

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86 *Id.* at 4.

87 *Id.*; TRENCH & MIESNER, *supra* note 84, at 17–18.

88 *How Do Pipelines Work?*, *supra* note 53.

89 Pipeline Safety: Safety of Hazardous Liquid Pipelines, 80 Fed. Reg. 61,610, 61,612 (proposed Oct. 13, 2015) (to be codified at 49 C.F.R. pt. 195) ("Recent data indicates . . . that PHMSA regulates less than 4,000 miles of the approximately 30,000 to 40,000 miles of onshore hazardous liquid gathering lines in the United States.").

90 GAO, COLLECTING DATA AND SHARING INFORMATION, *supra* note 60, at 3; TRENCH & MIESNER, *supra* note 84, at 13; Pipeline Safety: Safety of Hazardous Liquid Pipelines, 80 Fed. Reg. at 61,612.

91 MIESNER & LEFFLER, *supra* note 54, at 3; ENERGY & ENVTL. RESEARCH CTR., UNIV. OF N.D., LIQUIDS GATHERING PIPELINES: A COMPREHENSIVE ANALYSIS 11 (Dec. 2015), https://undeerc.org/bakken/pdfs/EERC%20Gathering%20Pipeline%20Study%20Final%20Dec15.pdf [https://perma.cc/DJ7G-5J6D]. The fluid mixture extracted through the production well is treated on site to separate crude oil from water, gases, and impurities. *Id.*

92 ENERGY & ENVTL. RESEARCH CTR., *supra* note 91, at 11.

93 *See id.* at 15–16 (showing maps of gathering systems).

94 *Id.* at 79, 122, 128.

95 *See generally Oil: Crude and Petroleum Products Explained*, ENERGY INFO. ADMIN., https://www.eia.gov/energyexplained/oil-and-petroleum-products/imports-and-exports.php [https://perma.cc/SDA3-YGUV] (last updated May 29, 2019) (explaining that the United States imports and exports crude oil).

96 *Pipeline Mileage and Facilities*, *supra* note 67 (follow "2010+ Pipeline Miles and Facilities" hyperlink) (reporting 80,748 miles of crude oil transmission pipelines and 267 operators in 2018, not including those who operate only tanks).

and delivery points.[97] The piping is constructed of steel,[98] is wider in diameter, and is operated at higher pressures.[99] Operators also use mechanical devices—pumps—to increase the pressure of oil before it enters the transmission system and to ensure continued flow.[100] But there is one significant difference between the two: while gas systems carry one commodity, crude oil transmission systems generally transport multiple grades of oil.[101] Based on the demands of refineries, operators "batch" the grades by sequentially injecting the fluids into the transmission pipeline and removing the batches once they reach their destinations.[102]

Other liquid transmission systems transport two categories of commodities—refined products and hydrocarbon gas liquids—for both the domestic and import-export markets. Refined product pipeline transmission systems deliver the petroleum products made from crude oil at refineries to large users and fuel terminals.[103] These products include jet fuel, diesel fuel, gasoline, and heating oil.[104] Liquefied gas transmission systems transport hydrocarbon gas liquids—the natural gas liquids separated from methane at natural gas processing plants and the liquefied gases produced by refineries—to manufacturers and distributors.[105] The grids are similar in size: 188 companies operate approximately 62,000 miles of refined product pipelines, while 192 companies operate approximately 70,000 miles of liquefied gas pipelines.[106] Like crude oil transmission systems, these liquid systems generally transport or

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[97] *See* TRENCH & MIESNER, *supra* note 84, at 17–18. Shorter transmission pipelines transport crude oil to nearby refineries or receiving points for trunklines. *Id.* at 17.

[98] *Fact Sheet: Pipeline Materials*, PIPELINE & HAZARDOUS MATERIALS SAFETY ADMIN., https://primis.phmsa.dot.gov/comm/FactSheets/FSPipelineMaterials.htm [https://perma.cc/T6SR-SF8M] (last updated Oct. 9, 2015). Since 1970, operators of hazardous liquid pipelines—which include crude oil pipelines—have been required to notify PHMSA of any pipe constructed of materials other than steel. 49 C.F.R. § 195.8 (2019).

[99] *How Do Pipelines Work?*, *supra* note 53 (stating that most crude oil transmission pipelines are 8 to 24 inches and a few are 48 inches in diameter).

[100] *See* MIESNER & LEFFLER, *supra* note 54, at 3, 70, 247.

[101] *See* TRENCH & MIESNER, *supra* note 84, at 12–15.

[102] *Id.* at 15.

[103] *Petroleum Pipeline Systems*, *supra* note 82; *How Do Pipelines Work?*, *supra* note 53.

[104] *How Do Pipelines Work?*, *supra* note 53.

[105] *See Hydrocarbon Liquids Explained*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/energyexplained/index.php?page=hgls_home [https://perma.cc/85TG-RQ2H] (last updated Oct. 31, 2019). For example, ethane is a natural gas liquid used as feedstock for plastics and chemicals, while propane is a liquefied petroleum gas used as fuel for heating and cooking. *Id.*

[106] *Pipeline Mileage and Facilities*, *supra* note 67 (follow "2010+ Pipeline Miles and Facilities" hyperlink) (reporting 188 operators and 62,714.4 miles of refined products pipelines, and 192 operators and 70,268.6 miles of pipelines transporting "Highly Volatile Liquids (HVL), flammable, and toxic liquids," which are generally liquefied hydrocarbon gases).

"batch" multiple commodities.[107] But unlike the trunkline systems that carry oil over large distances, they are typically shorter in length and serve a region.[108] The steel piping is also smaller in diameter,[109] though operated at high pressure.

B. *The Energy Revolution*

Over the last fifteen years, a revolution in oil and gas production has reshaped the energy system of the United States. Development companies have combined two techniques—high-volume hydraulic fracturing and horizontal drilling—to extract large volumes of oil and natural gas from shale and other "tight" rock formations.[110] These unconventional reservoirs underlie vast swaths of the country, including areas that have not traditionally produced oil and gas.[111] The results are dramatic. From 2004 to 2018, the nation's annual domestic gas production has increased by 64%, from 18.6 to 30.6 trillion cubic feet.[112] In 2017, the United States produced so much natural gas that it became a net exporter, a feat that would have seemed impossible at the beginning of this century.[113] Over the same period, annual domestic crude oil production rose from 2.0 to 4.0 billion barrels, an increase of 100%.[114] In 2018, the nation became the top crude oil producer in the world and a net exporter of petroleum liquids—reclaiming energy independence for the first time in seventy-five years.[115]

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[107] TRENCH & MIESNER, *supra* note 84, at 15.

[108] *Id.* at 18–19.

[109] *Id.* at 19.

[110] RATNER & TIEMANN, *supra* note 30, at 1–7. In this type of development, a company drills vertically down to the target rock formation and then horizontally within the formation. GROUND WATER PROT. COUNCIL & ALL CONSULTING, MODERN SHALE GAS DEVELOPMENT IN THE UNITED STATES: A PRIMER ES-3 (Apr. 2009), https://www.energy.gov/sites/prod/files/2013/03/f0/ShaleGasPrimer_Online_4-2009.pdf [https://perma.cc/T8GY-H3G8]. The horizontal leg can extend two or more miles, which increases the surface area in contact with the well. *Id.* To stimulate production, the company then hydraulically fractures the rock by injecting large volumes of fluid and sand into the well under high pressure. *Id.* at ES-4. The fractures allow the oil or gas to flow out of the formation and up to the surface. *Id.* Several of these wells can be drilled on one well site, the horizontal legs spreading out in different directions to efficiently drain the reservoir. *Id.* at ES-3, ES-5.

[111] *See* IHS GLOBAL INC., *supra* note 32, at 15–16.

[112] *Open Data: U.S. Dry Natural Gas Production, Annual*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/opendata/qb.php?sdid=NG.N9070US2.A [https://perma.cc/N5FZ-RJBG].

[113] IHS GLOBAL INC., *supra* note 32, at 14; EIA, ANNUAL ENERGY OUTLOOK 2019, *supra* note 32, at 14.

[114] *Crude Oil Production*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/dnav/pet/pet_crd_crpdn_adc_mbbl_m.htm [https://perma.cc/E68V-2EC2].

[115] *See The United States Is Now the Largest Global Crude Oil Producer*, *supra* note 33; *Petroleum & Other Liquid: Weekly Imports and Exports*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/petroleum/supply/weekly/ [https://perma.cc/AL8Y-FXQH]. *But see* Robert Rapier, *No, the U.S. Is Not a Net Exporter of Crude Oil*, FORBES (Dec. 9, 2018),

As production increased, so did the need for transport. The nation's energy pipeline networks were originally built to carry oil and gas from conventional production areas to nearby users.[116] When the reservoirs began to empty and it seemed that the United States would be ever more dependent on oil and gas from other countries, energy companies responded by investing in new infrastructure that would bring imports to processing facilities and consumers.[117] Starting in the late 1970s, companies built large crude oil transmission pipelines to transport imported oil from Gulf Coast ports to the north and expanded the Canadian oil pipeline system to bring oil from Alberta to the south.[118] U.S. oil refineries invested in technologies to process these imported heavy crude oils.[119] Even at the beginning of this century, companies were constructing or restarting large import terminals on the East and Gulf coasts to accept liquefied natural gas by tanker vessel from countries as distant as Australia.[120] The terminals were connected to interstate transmission pipelines to bring the gas to local distribution companies and large users.[121]

But once the energy revolution began, pipeline companies that had pivoted away from domestic production towards imports suddenly faced new demands for transportation.[122] Producers needed gathering pipelines to transport the oil and gas from thousands of wells in prolific shale plays to processing facilities and interstate transmission pipeline systems.[123] This need was particularly acute in nontraditional production areas—such as the Marcellus and Utica shale gas plays in the Appalachian region—which contained little to no existing pipeline infrastructure.[124] The gathering pipeline industry struggled to keep up with the number of wells drilled in these regions, frustrating development companies and

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https://www.forbes.com/sites/rrapier/2018/12/09/no-the-u-s-is-not-a-net-exporter-of-crude-oil/ [https://perma.cc/6WX2-2HML] (concluding that the nation still consumes more crude oil than it produces).

[116] *See* MIESNER & LEFFLER, *supra* note 54, at 9–15 (chronicling the early history of oil and gas pipelining).

[117] *See* IHS GLOBAL INC., *supra* note 32, at 12.

[118] *See id.* at 13; JOHN F. KIEFNER & CHERYL J. TRENCH, OIL PIPELINE CHARACTERISTICS AND RISK FACTORS: ILLUSTRATIONS FROM THE DECADE OF CONSTRUCTION 25 (Dec. 2001), https://www.api.org/~/media/files/oil-and-natural-gas/ppts/other-files/decadefinal.pdf?la=en [https://perma.cc/Q7WH-XRJM] .

[119] ANTHONY ANDREWS ET AL., CONG. RESEARCH SERV., R41478, THE U.S. OIL REFINING INDUSTRY: BACKGROUND IN CHANGING MARKETS AND FUEL POLICIES 16 (2010).

[120] IHS GLOBAL INC., *supra* note 32, at 14.

[121] *See id. See generally* MIESNER & LEFFLER, *supra* note 54, at 5–6 (describing natural gas pipeline value chain).

[122] *See* IHS GLOBAL INC., *supra* note 32, at 15–19 (discussing the U.S. shale oil and gas revolution and the corresponding increase of capital investment in pipeline infrastructure).

[123] *See id.*

[124] *See Spot Natural Gas Prices at Marcellus Trading Point Reflect Pipeline Constraints*, U.S. ENERGY INFO. ADMIN. (July 23, 2012), https://www.eia.gov/todayinenergy/detail.php?id=7210 [https://perma.cc/XZ64-BFK2].

slowing production.[125] Yet even plays in more traditional production areas, such as the Bakken shale play in North Dakota, required significant expansions in gathering systems: one to transport the produced oil to oil terminals,[126] and another to transport the gas that flowed to the surface with the oil to the rest of the gas pipeline network.[127] By one estimate, approximately 28,000 miles of gas gathering pipelines and 20,000 miles of oil gathering pipelines were built between 2013 and 2017 alone.[128]

Meanwhile, producers needed transmission pipelines to transport oil, gas, and hydrocarbon liquids from shale play regions to shifting markets. When production increased and prices dropped, domestic demand rose as well. The electric power sector turned more and more towards natural gas to generate electricity, encouraged by federal and state environmental policies and the retirement of aging coal-fired power plants.[129] Residential, commercial, and industrial users consumed more natural gas—and distribution systems grew.[130] Demand for hydrocarbon liquids—notably chemical feedstocks—increased.[131] Producers also responded to declining prices by seeking to export oil and gas to markets abroad.[132] Owners of liquefied natural gas import terminals proposed export facilities.[133] Because domestic oil refineries had invested in processing equipment for imported heavy crude oil before the energy revolution, they had limited capacity to refine the light crude oil extracted from shale plays.[134] After intense lobbying by producers, Congress cemented the shift in energy transport

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125 *See id.* (stating that, at the time, over 1000 wells in northern Pennsylvania had been drilled but were unable to produce because of a lack of pipeline infrastructure).

126 *See* CONG. RESEARCH SERV., R42032, THE BAKKEN FORMATION: LEADING UNCONVENTIONAL OIL DEVELOPMENT 6 (2012).

127 *See Over One-Third of Natural Gas Produced in North Dakota Is Flared or Otherwise Not Marketed*, U.S. ENERGY INFO. ADMIN. (Nov. 23, 2011), https://www.eia.gov/todayinenergy/detail.php?id=4030 [https://perma.cc/F7ZH-9ZBM].

128 ICF, NORTH AMERICA, *supra* note 35, at 88.

129 *See id.* at 3; *see also Natural Gas Consumption by End Use*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/naturalgas/data.php [https://perma.cc/GGK8-AYTX] (select "Consumption," then "Total consumption") (reporting that U.S. natural gas deliveries to the electric power sector roughly doubled between 2004 and 2018).

130 *See Natural Gas Consumption by End Use*, *supra* note 129; *see also Both Natural Gas Supply and Demand Have Increased from Year-Ago Levels*, U.S. ENERGY INFO. ADMIN. (Oct. 4, 2018), https://www.eia.gov/todayinenergy/detail.php?id=37193 [https://perma.cc/22MU-ABQH].

131 *Petroleum & Other Liquids*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/petroleum/data.php [https://perma.cc/J8WM-HD3Z] (select "Consumption/sales," then "Product supplied") (showing increases in consumption of ethane, a chemical feedstock, since 2010).

132 *See* MICHAEL RATNER ET AL., CONG. RESEARCH SERV., R42074, U.S. NATURAL GAS EXPORTS: NEW OPPORTUNITIES, UNCERTAIN OUTCOMES 3 (2015); PHILLIP BROWN ET AL., CONG. RESEARCH SERV., R43442, U.S. CRUDE OIL EXPORT POLICY: BACKGROUND AND CONSIDERATIONS 10–12 (2014).

133 RATNER ET AL., *supra* note 132, at 3.

134 BROWN ET AL., *supra* note 132, at 5, 20; IHS GLOBAL INC., *supra* note 32, at 30.

from imports to exports in 2015 by lifting the ban on exports of crude oil that had been enacted forty years earlier in the wake of the Arab oil embargo.[135]

Transmission pipeline companies responded to these significant changes in supply and demand in three ways. First, they sought to expand the footprint of transmission systems to connect new delivery and receipt points and to increase transportation capacity.[136] Some projects were designed to lengthen existing pipeline systems,[137] and others to construct new interstate pipelines.[138] Second, they sought to transport the large volumes of oil and gas produced in shale plays by increasing the capacity of existing routes.[139] Projects ranged from adding compression or pump stations to boost operating pressures,[140] to constructing new pipelines parallel to older pipelines,[141] to replacing older pipelines with new, higher capacity pipelines.[142] Third, they sought to alter the purpose of existing transmission systems so the systems could carry products in the right

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135 Consolidated Appropriations Act of 2016, Pub. L. No. 114-113, § 101(a), 129 Stat. 2242, 2987 (2015) (codified as amended at 42 U.S.C. § 6212(a)); Energy Policy and Conservation Act of 1975, Pub. L. No. 94-163, 89 Stat. 871, 871, 877–78 (1975).

136 *See New Infrastructure Aims to Increase Takeaway Capacity of Natural Gas from Utica Region*, U.S. ENERGY INFO. ADMIN. (Nov. 22, 2016), https://www.eia.gov/todayinenergy/detail.php?id=28872 [https://perma.cc/5LWK-MPBA].

137 *See id.* (describing two projects, the Leach Xpress and Rayne Xpress, to expand the Columbia Pipeline natural gas transmission system).

138 *See* BROWN ET AL., *supra* note 132, at 17–18; *see also id.* at 17 n.80 (noting Enbridge's proposed Sandpiper project, a new crude oil pipeline, which was not built after public opposition).

139 *See* Christopher M. Matthews & Lynn Cook, *Pipeline Builders Try New Growth Strategy: Bigger Pipes*, WALL ST. J. (Jan. 17, 2018), https://www.wsj.com/articles/pipeline-builders-outflank-opposition-with-expansions-1516185001 [https://perma.cc/9SNU-KFHY].

140 *See* Pipeline Safety: Safety of Gas Transmission and Gathering Pipelines, 81 Fed. Reg. 20,722, 20,726–27 (proposed Apr. 8, 2016) (to be codified at 49 C.F.R. pts. 191, 192); *Broad Run Expansion Project*, KINDER MORGAN, https://www.kindermorgan.com/pages/business/gas_pipelines/east/broadrun/ [https://perma.cc/F532-HG7F] (describing project to add compression to existing natural gas transmission pipeline).

141 *See Overview*, ENERGY TRANSFER, https://marinerpipelinefacts.com/overview/ [https://perma.cc/V4R5-KRKA] (describing project to build two hydrocarbon liquids pipelines, primarily along the route of an existing pipeline).

142 *See, e.g.*, *Line 3 Replacement Project*, ENBRIDGE, https://www.enbridge.com/projects-and-infrastructure/public-awareness/minnesota-projects/line-3-replacement-project [https://perma.cc/82YK-SHT2] (describing project to replace existing oil pipeline with a larger pipeline).

direction.[143] These projects included reversing the flow of commodities[144] and converting pipelines to transport new products.[145]

The result is a pipeline transportation system that is remaking itself, one project at a time. Oil and hydrocarbon liquids transmission companies have steadily expanded the systems' footprint by building new, large pipelines that carry the commodities to export terminals or to be refined or processed. From 2004 to 2018, the total length of oil systems increased by almost 30,000 miles or 64%.[146] One of these pipelines was the Dakota Access pipeline.[147] Hydrocarbon liquids systems grew by approximately 18,000 miles or 36% during the same time period.[148] Natural gas transmission systems added approximately 34,000 miles of new pipeline during this time, but the size of the gas transmission footprint declined slightly because the industry decommissioned older pipelines.[149] In the last few years, the pace of new gas transmission pipeline construction has skyrocketed.[150] In 2017 alone,

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[143] *See* Mike Kirkwood, *Pipeline Reversals and Conversions: Case Studies and Best Practices*, 242 PIPELINE & GAS J. 26, 26 (2015) (discussing the increase in pipeline flow-reversals caused by the boom in U.S. shale plays).

[144] *See* BROWN ET AL., *supra* note 132, at 17 n.79 (noting the Seaway oil pipeline reversal project, which was completed in 2012).

[145] *See, e.g.*, *Enbridge and Energy Transfer Join to Provide Crude Oil Pipeline Access to Eastern Gulf Coast Market*, ENBRIDGE (Feb. 15, 2013), https://www.enbridge.com/media-center/news/details?lang=en&year=2013&id=1687747 [https://perma.cc/S6YS-ZKSN] (describing project to convert a natural gas transmission pipeline to a crude oil pipeline).

[146] *Annual Report Mileage for Hazardous Liquid or Carbon Dioxide Systems*, PIPELINE & HAZARDOUS MATERIALS SAFETY ADMIN., https://www.phmsa.dot.gov/data-and-statistics/pipeline/annual-report-mileage-hazardous-liquid-or-carbon-dioxide-systems [https://perma.cc/9LR8-HL3Z] (last updated Feb. 6, 2020) (showing that annual reported mileage grew from 49,264 to 80,719 miles for crude oil systems).

[147] *Addressing Misconceptions About the Dakota Access Pipeline*, DAKOTA ACCESS PIPELINE, https://daplpipelinefacts.com/The-Facts.html [https://perma.cc/QNY8-TLHL].

[148] *Annual Report Mileage for Hazardous Liquid or Carbon Dioxide Systems*, *supra* note 146 (showing that annual reported mileage grew from 51,794 to 70,267 miles for highly volatile liquid systems).

[149] *See Gas Distribution, Gas Gathering, Gas Transmission, Hazardous Liquids, Liquefied Natural Gas (LNG), and Underground Natural Gas Storage (UNGS) Annual Report Data*, PIPELINE & HAZARDOUS MATERIALS SAFETY ADMIN., https://www.phmsa.dot.gov/data-and-statistics/pipeline/gas-distribution-gas-gathering-gas-transmission-hazardous-liquids [https://perma.cc/K4AA-JRG7] (last updated Mar. 9, 2020) (follow "Gas Transmission & Gathering Annual Data" hyperlinks to download data for 2004 and 2018); *Annual Report Mileage for Natural Gas Transmission & Gathering Systems*, PIPELINE & HAZARDOUS MATERIALS SAFETY ADMIN., https://www.phmsa.dot.gov/data-and-statistics/pipeline/annual-report-mileage-natural-gas-transmission-gathering-systems [https://perma.cc/ZP77-7BHY] (last updated Feb. 6, 2020) (showing that annual reported mileage of gas transmission pipelines fell from 303,001 miles to 301,578 miles).

[150] *See Northeast Region Slated for Record Natural Gas Pipeline Capacity Buildout in 2018*, U.S. ENERGY INFO. ADMIN. (May 18, 2018), https://www.eia.gov/todayinenergy/detail.php?id=36272 [https://perma.cc/DN7T-59K8].

companies built 773 miles of new pipeline, most of which were designed to carry natural gas from the Marcellus and Utica shale plays to the Midwest.[151] That same year, the federal government approved forty-nine more projects to construct 2739 miles of pipeline.[152] The projects included largest-capacity gas pipeline ever approved: the 713-mile Rover pipeline, which transports gas from the Marcellus and Utica plays to Michigan and to market hubs in Canada.[153]

All predictions are that the domestic energy revolution is not over. Vast potential drilling areas and improving technology will likely spur more development.[154] Annual natural gas production is expected to rise from 29.5 trillion cubic feet in 2018 to 43.4 trillion cubic feet in 2050, driven by production from the Marcellus and Utica shale plays in the northeast and the Eagle Ford and Haynesville shale plays in the Gulf Coast region.[155] Development of unconventional resources is also expected to drive an increase in annual oil production, from 4.0 billion barrels in 2018 to a peak of 5.3 billion barrels in 2031, before production falls to 4.3 billion barrels in 2050.[156] Production in the Permian Basin play in west Texas and eastern New Mexico is predicted to rapidly rise, while the Bakken shale play and plays in the Gulf Coast region will contribute smaller amounts.[157]

In this energy future, the pipeline industry will reshape itself even more to carry oil, gas, and petroleum products to consumers and export markets. From 2018 to 2035, the industry expects to invest $266 to $336 billion and build approximately 150,000 miles of new pipelines in the United States.[158] This predicted buildout would be greater than the one that has already taken place.

The majority of the pipeline construction is expected to occur in the natural gas pipeline network.[159] The industry predicts that gathering pipeline companies will add 73,500 miles of new gas gathering pipelines to the current network

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151 FED. ENERGY REGULATORY COMM'N, 2017 STATE OF THE MARKETS REPORT 4 (Apr. 2018), https://www.ferc.gov/market-assessments/reports-analyses/st-mkt-ovr/2017-som-A-3-full.pdf [https://perma.cc/FL5W-MTVF].

152 *Id.*

153 *Id.*; Rover Pipeline LLC, 158 FERC ¶ 61,109 (2017); *Rover Pipeline Project*, ROVER PIPELINE, https://www.roverpipelinefacts.com/ [https://perma.cc/FU7N-FAFJ].

154 EIA, ANNUAL ENERGY OUTLOOK 2019, *supra* note 32, at 76 (stating that there are roughly 500,000 square miles of oil and gas resources in the United States).

155 *Id.* at 78; *Annual Energy Outlook 2019: Oil and Gas Supply*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/outlooks/aeo/data/browser/#/?id=14-AEO2019&cases=ref2019&sourcekey=0 [https://perma.cc/75MC-DGM7].

156 *Annual Energy Outlook 2019: Oil and Gas Supply*, *supra* note 155.

157 EIA, ANNUAL ENERGY OUTLOOK 2019, *supra* note 32, at 57–58.

158 ICF, NORTH AMERICA, *supra* note 35, at 88, 146, 151, 153–54, 158, 160–61 (predicting capital investment of $220.3–$280.2 billion for U.S. natural gas pipeline systems, $13.8–$15.6 billion for U.S. natural gas liquid pipeline systems, $4.7–$6.5 billion for U.S. crude oil gathering pipeline systems, and $27.2–$33.2 billion for U.S. crude oil transmission pipeline systems).

159 *See id.* at 80, 88.

between 2018 and 2035—an increase of 20%.[160] About half of this new construction is expected to occur in Gulf Coast plays, in conjunction with a rapid rise in production.[161] During the same period, the industry predicts that the transmission grid will transport an additional 50 billion cubic feet per day of natural gas, half of which will be from the Marcellus and Utica shale plays.[162] To carry this amount of gas, transmission companies will build 24,000 miles of new pipeline, an increase of 8%.[163] There are different predictions as to where the pipelines will be constructed. The industry expects to build pipelines in the Northeast, South, and Gulf Coast regions, where the added capacity will primarily serve gas-fired power plants and export facilities.[164] The federal government also predicts that the natural gas transmission grid will expand to transport increasing supplies from the Marcellus and Utica shale plays.[165] But it expects that the buildout will occur in the Midwest, which will serve as a throughway for gas from the shale plays to the South and Gulf Coast.[166]

The oil and hydrocarbon liquids pipeline network is expected to grow less overall because the industry has already invested in several large pipelines.[167] But the Permian Basin is experiencing dramatic growth and will need many more gathering pipelines.[168] The industry predicts that gathering pipeline systems will double between 2018 and 2035, as 36,000 miles of new pipelines are built in the Permian Basin and Gulf Coast plays.[169] Oil transmission pipeline systems will expand by 6400 miles, or 8% of the current grid, during the same time period.[170] These new pipelines will transport an additional 2.1 billion barrels of oil, primarily from the Permian Basin to refineries along the Gulf Coast.[171] Pipeline capacity is also needed to transport imports of Canadian heavy crude oil and domestic oil from the Bakken shale through a central corridor to U.S. refineries.[172] Construction on most of these projects is expected to occur between 2023 and 2028.[173] Finally, the industry predicts that 8600 miles of hydrocarbon liquids pipeline will be built, primarily to transport liquids from production areas to manufacturers and the coast for export.[174]

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160 *Id.* at 88.
161 *See id.* at 146.
162 *Id.* at 37–38.
163 *Id.* at 88.
164 ICF, NORTH AMERICA, *supra* note 35, at 4–5, 125–26.
165 EIA, ANNUAL ENERGY OUTLOOK 2019, *supra* note 32, at 80.
166 *Id.*
167 ICF, NORTH AMERICA, *supra* note 35, at 156, 159.
168 *Id.* at 6.
169 *Id.* at 80, 85, 88.
170 *Id.* at 88.
171 *Id.* at 36–37.
172 *Id.* at 34, 36–37; IHS GLOBAL INC., *supra* note 32, at 28.
173 ICF, NORTH AMERICA, *supra* note 35, at 6.
174 *Id.* at 88.

III. THE LEGAL FRAMEWORKS GOVERNING RISK

Energy pipelines pose risks to the environment, health, and public safety.[175] When a pipeline system releases gases or liquids, it can damage natural resources, harm human health, and injure or kill members of the public. Regulation of these risks is divided between decisions about the "safety" of a pipeline and decisions about the "siting" of a pipeline. The safety framework focuses on preventing and managing accidents from the sited pipeline. The framework is concentrated in federal law and consists of minimum standards for most types of pipelines. In contrast, the siting framework focuses on whether the pipeline should be built, the location of the pipeline, and the acquisition of property rights. The framework is fragmented by type of pipeline and decision-maker, resulting in a patchwork of policy approaches. The two frameworks are formally separate, leaving the relationship between the location of a pipeline and the long-term risk of a spill or release unaddressed.

A. *The Risk of Energy Pipelines*

The risk posed by energy pipelines is a function of two elements: (1) the probability—or likelihood—of a failure of the integrity of a pipeline system, and (2) the magnitude of the consequences of a release or spill of product to public safety, human health, and the environment.[176] Energy pipelines pose a low-frequency, high-consequence risk. Accidents are relatively infrequent given how vast the networks are. Each year, energy pipelines cause an average of 295 significant accidents.[177] Onshore accidents are distributed roughly evenly among the pipeline systems; the annual average ranges from sixty-eight accidents on gas transmission pipelines to eighty-four accidents on hydrocarbon

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175 "Risk" is defined in different ways. At its most general, risk "refers to uncertainty about and severity of the events and consequences (or outcomes) of an activity with respect to something that humans value." Terje Aven & Ortwin Renn, *On Risk Defined as an Event Where the Outcome Is Uncertain*, 12 J. RISK RES. 1, 6 (2009).

176 PIPELINE & HAZARDOUS MATERIALS SAFETY ADMIN., PIPELINE RISK MODELING: OVERVIEW OF METHODS AND TOOLS FOR IMPROVED IMPLEMENTATION 17–18 (May 2018), https://primis.phmsa.dot.gov/rmwg/docs/Pipeline_Risk_Modeling_Technical_Information_Document_05-09-2018_Draft_1.pdf [https://perma.cc/7MLH-2DW8] [hereinafter PHMSA, PIPELINE RISK MODELING].

177 *National Pipeline Performance Measures*, PIPELINE & HAZARDOUS MATERIALS SAFETY ADMIN., https://www.phmsa.dot.gov/data-and-statistics/pipeline/national-pipeline-performance-measures [https://perma.cc/2BF8-EE66] (follow "Significant Incidents" hyperlink) (reporting the annual average over the past ten years) (last updated Mar. 4, 2020). A significant incident is an accident that causes a "[f]atality or injury requiring in-patient hospitalization[;] $50,000 or more in total costs, measured in 1984 dollars[;] [h]ighly volatile liquid releases of 5 barrels or more or other liquid releases of 50 barrels or more; [or] [l]iquid releases resulting in an unintentional fire or explosion." *Id.*

liquid transmission pipelines.[178] By mile of pipeline, gas distribution pipelines are by far the safest.[179] Energy pipeline accidents cause twelve deaths, seriously injure sixty-three people, and result in $671.6 million of property damage on average per year.[180] But when a pipeline accident happens, catastrophic consequences are more likely to occur than would be predicted by a normal distribution of harm.[181] In 2010, for example, a PG&E gas transmission pipeline exploded in a residential neighborhood of San Bruno, California, killing eight people, injuring fifty-eight, and causing $558 million in property damage.[182] That same year, an oil transmission pipeline operated by Enbridge spilled over one million gallons of heavy crude oil into a creek near Marshall, Michigan.[183] The oil flowed almost forty miles down the Kalamazoo River, causing more than $840 million in damage; cleanup took over four years.[184]

There are many threats that could cause a pipeline to fail, including defects in the manufacturing of system components, incorrect construction or installation of the system, degradation of materials over time, mistakes in operation, or external human or natural forces.[185] Over the last twenty years, the leading cause of accidents in the few regulated natural gas gathering pipelines

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178 *Id.* (on average over the last ten years, onshore hydrocarbon liquids pipelines caused 84 accidents, gas distribution pipelines caused 65 accidents, crude oil transmission pipelines caused 65 accidents, gas transmission pipelines caused 58 accidents, and regulated gas gathering pipelines caused 2 accidents). But note that only a small percentage of gas gathering pipelines are regulated and thus required to report accidents.

179 *Id.*; *Pipeline Mileage and Facilities*, *supra* note 67.

180 *National Pipeline Performance Measures*, *supra* note 177 (reporting the average over the last ten years).

181 Kyle Siler-Evans et al., *Analysis of Pipeline Accidents in the United States from 1968 to 2009*, 7 INT'L J. CRITICAL INFRASTRUCTURE PROTECTION 257, 264 (2014).

182 NAT'L TRANSP. SAFETY BD., NTSB/PAR-11/01, PIPELINE ACCIDENT REPORT: PACIFIC GAS AND ELECTRIC COMPANY NATURAL GAS TRANSMISSION PIPELINE RUPTURE AND FIRE, SAN BRUNO, CALIFORNIA 18 (Aug. 2011), https://www.aga.org/sites/default/files/legacy-assets/our-issues/safety/pipleinesafety/Technicalreports/Documents/Final%20Report%20of%20NTSB%20San%20Bruno%20Accident%20Investigation.pdf [https://perma.cc/JJ6W-6P9R] [hereinafter NAT'L TRANSP. SAFETY BD., SAN BRUNO REPORT]; *National Pipeline Performance Measures*, *supra* note 177.

183 *EPA Response to Enbridge Spill in Michigan*, ENVTL. PROTECTION AGENCY, https://www.epa.gov/enbridge-spill-michigan [https://perma.cc/DGZ2-472G] (last updated Dec. 12, 2018).

184 NAT'L TRANSP. SAFETY BD., NTSB/PAR-12/01, PIPELINE ACCIDENT REPORT: ENBRIDGE INCORPORATED HAZARDOUS LIQUID PIPELINE RUPTURE AND RELEASE, MARSHALL, MICHIGAN 57 (July 2012), https://www.ntsb.gov/investigations/AccidentReports/Reports/PAR1201.pdf [https://perma.cc/S8DK-U2US] [hereinafter NAT'L TRANSP. SAFETY BD., ENBRIDGE REPORT]; *Enbridge Spill Response Timeline*, ENVTL. PROTECTION AGENCY, https://www.epa.gov/enbridge-spill-michigan/enbridge-spill-response-timeline [https://perma.cc/K7SJ-KB3S] (last updated Mar. 19, 2019); *National Pipeline Performance Measures*, *supra* note 177 (reporting a total cost of $840,526,118).

185 PHMSA, PIPELINE RISK MODELING, *supra* note 176, at 32–33.

is internal corrosion of the metal piping.[186] These pipelines carry raw gas, which is more likely to contain contaminants that react with metal.[187] In contrast, the primary cause of accidents in natural gas and liquid transmission pipelines is a failure in the physical components of the pipeline system—flaws in the construction or installation of a pipeline, cracks in the pipe, or malfunction of control equipment.[188] These failures can occur in any pipeline system, but they are more likely to lead to accidents in transmission pipelines because the systems are complex and transport large volumes of commodities at high pressures. Finally, the leading cause of accidents in gas distribution pipelines is excavation damage, usually by third parties engaged in construction activities.[189] This is because gas distribution pipelines run underneath streets and commercial and residential property in developed areas.[190]

The consequences of an accident depend on the commodity the pipeline is carrying, the volume of the product released, the rate at which the product disperses, and the people and environment in the affected area.[191] Natural gas and some hydrocarbon liquids are flammable, so a rupture in a pipeline transporting one of these substances can result in an immediate explosion and fire, killing or injuring people and destroying property.[192] If the hydrocarbon liquids are volatile but dense, the heavy gas can move along the surface of the ground and suffocate people before exploding.[193] A liquid spill—whether of crude oil or other hydrocarbon liquids that remain liquefied—can flow over the ground, polluting surface waters, harming natural resources, and damaging property.[194] Depending on the permeability of the soil, the spill can seep through

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[186] *National Pipeline Performance Measures*, *supra* note 177 (select "Gas Gathering" from the drop-down menu) (reporting that 47.5% of forty total incidents were caused by internal corrosion).

[187] *See Fact Sheet: Internal Corrosion*, PIPELINE & HAZARDOUS MATERIALS SAFETY ADMIN., https://primis.phmsa.dot.gov/comm/FactSheets/FSInternalCorrosion.htm [https://perma.cc/HX5M-NFTT] (last updated Sept. 24, 2018).

[188] *National Pipeline Performance Measures*, *supra* note 177 (select "Gas Transmission" from the drop-down menu) (reporting that 36% of 1,098 total onshore incidents were caused by such failures); *id.* (select "Hazardous Liquid" from the drop-down menu) (36.9% of 2683 onshore incidents were caused by such failures).

[189] *Id.* (select "Gas Distribution" from the drop-down menu) (reporting that 35% of 1439 total incidents were caused by excavation damage).

[190] PIPELINE & HAZARDOUS MATERIALS SAFETY ADMIN., INTEGRITY MANAGEMENT FOR GAS DISTRIBUTION: REPORT OF PHASE 1 INVESTIGATIONS 4 (Dec. 2005), https://www.phmsa.dot.gov/sites/phmsa.dot.gov/files/docs/DIMP%20Phase%201%20Report.pdf [https://perma.cc/SP6P-8D2V].

[191] PHMSA, PIPELINE RISK MODELING, *supra* note 176, at 46–48.

[192] U.S. DEP'T OF TRANSP., THE STATE OF THE NATIONAL PIPELINE INFRASTRUCTURE 1–2 (2016), https://www.hsdl.org/?abstract&did=804318 [https://perma.cc/JR5T-HTHQ].

[193] *Id.* at 2.

[194] *Id.*

the ground and contaminate groundwater.[195] Exposure to compounds in crude oil can also harm human health.[196]

Just as the domestic energy revolution has fundamentally changed oil and gas pipeline networks, so has it changed the landscape of risk. Each time a new pipeline is installed, more communities and natural resources are put at risk. In a commonly recognized phenomenon known as the "bathtub curve," newer pipelines generally experience a higher accident rate than older pipelines because material and construction defects are likely to surface when pipelines first begin operation.[197] But the risk profile of the pipelines themselves is also changing. To accommodate the increased flow of oil, gas, and hydrocarbon liquids, companies are building pipelines with wider diameters and operating them at higher pressures. Some natural gas gathering pipelines in shale plays are so large that they function similarly to gas transmission lines.[198] In the future, the industry expects to build larger gathering and transmission pipelines than it is building today—across every type of system.[199] The size of transmission pipelines, which are already wider than other types of pipelines, will increase the most.[200]

B. *The Safety Framework*

The federal Pipeline Safety Act is the primary legal framework governing the risk of accidents from gathering, transmission, and distribution energy pipelines.[201] The Act grants the Pipeline and Hazardous Materials Safety Administration (PHMSA) broad authority to prescribe minimum safety

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[195] *Id.*

[196] *See, e.g.*, Mark D'Andrea & G. Kesava Reddy, *Crude Oil Spill Exposure and Human Health Risks*, 56 J. OCCUPATIONAL & ENVTL. MED. 1029, 1029 (2014).

[197] *See, e.g.*, BUREAU OF SAFETY & ENVTL. ENF'T, OVERVIEW OF RISK ASSESSMENT AND MANAGEMENT FOR OFFSHORE PIPELINES 6–7, https://www.bsee.gov/sites/bsee.gov/files/tap-technical-assessment-program//223aj.pdf [https://perma.cc/TQ8W-LKEY]; PIPELINE SAFETY TR., HOW OLD IS TOO OLD? A LOOK AT AGING TRANSMISSION PIPELINE INFRASTRUCTURE ISSUES (2015), http://pstrust.org/wp-content/uploads/2015/12/Weimer-Old-Pipes.pdf [https://perma.cc/PA9J-LUAQ].

[198] Pipeline Safety: Safety of Gas Transmission and Gathering Pipelines, 81 Fed. Reg. 20,722, 20,728 (proposed Apr. 8, 2016) (to be codified at 49 C.F.R. pts. 191, 192) (stating that "[p]roducers are employing gathering lines with diameters as large as 36 inches and maximum operating pressures up to 1480 psig").

[199] ICF, NORTH AMERICA, *supra* note 35, at 8.

[200] *Id.* at 8, 48 (predicting that the average size of oil, gas, and hydrocarbon liquids transmission pipelines will increase from 20.4 to 26.9 inches). "[M]ost pipeline capacity added in each of the scenarios is large pipe . . . . Some of the projects, particularly the oil projects transporting heavy crude oil from Western Canada into the U.S. and toward the Gulf Coast require very large pipe, each of which is upwards of 32-inches in diameter." *Id*.

[201] 49 U.S.C. §§ 60101–41 (2012). As described in *supra* Part II.A, only a small fraction of oil and gas gathering pipelines are regulated. *See* 49 C.F.R. §§ 192.8–.9, 195.11 (2019).

standards for the transportation of gases and hazardous liquids by pipeline.[202] These standards, which are adopted by rule, must be "practicable" and "designed to meet the need for . . . pipeline safety . . . and protecting the environment."[203] But the statute's concept of "safety" is limited to the pipeline system: the design, installation, and construction of the new pipeline; the operation and maintenance of the pipeline once it is in the ground; the plans and procedures for a pipeline emergency; and the eventual replacement or abandonment of the pipeline.[204]

The Act draws a bright line between "safety" and "siting" by specifically providing that it "does not authorize [PHMSA] to prescribe the location or routing of a pipeline facility."[205] The standards contain only one modest restriction on siting—an admonition that a right-of-way for a hazardous liquid pipeline "must be selected to avoid, as far as practicable, areas containing private dwellings, industrial buildings, and places of public assembly."[206] In recognition that this restriction will not prevent operators from continuing to locate pipelines near buildings, the standard also provides that the operator must bury the liquid pipeline more deeply if it is located within fifty feet of a private dwelling or an industrial building or place of public assembly "in which persons work, congregate, or assemble."[207]

As the domestic energy revolution has radically reshaped the pipeline networks during the last fifteen years, the approach to risk has remained the same: to "keep the product in the pipe." Rather than limit where pipelines can be sited, the safety framework focuses on protecting the area around the pipeline after the fact. PHMSA does not approve new pipeline projects or expansions in a pipeline system.[208] Instead, the materials, design, and construction of a new pipeline and its components are governed by technical engineering standards.[209] The standards include specific prescriptive requirements, such as a design

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[202] 49 U.S.C. §§ 60101(a)(18)–(19), 60102 (2012). A "hazardous liquid" includes all petroleum products, such as crude oil and hydrocarbon liquids, as well as "nonpetroleum fuel" and liquid substances that "may pose an unreasonable risk to life or property" when transported in pipelines. *Id.* § 60101(a)(4). While the safety standards for gas and hazardous liquid pipelines are separate, they have many similarities.

[203] *Id.* § 60102(b)(1).

[204] *Id.* § 60102(a)(2)(B).

[205] *Id.* § 60104(e).

[206] 49 C.F.R. § 195.210(a) (2019).

[207] *Id.* § 195.210(b).

[208] The operator may apply for a special permit if it would like an exception or modification to the rules. 49 U.S.C. § 60118(c) (2012); 49 C.F.R. § 190.341 (2019). In 2017, PHMSA responded to the energy revolution by requiring companies to notify it of pipeline construction projects or other operational changes such as a change in product or reversal of the flow of a product. Pipeline Safety: Operator Qualification, Cost Recovery, Accident and Incident Notification, and Other Pipeline Safety Changes, 82 Fed. Reg. 7972, 7973 (Jan. 23, 2017) (to be codified at 49 C.F.R. pts. 190–92, 195, 199).

[209] *See, e.g.*, 49 C.F.R. §§ 192.51–.329, 195.100–.264 (2019).

formula for steel pipe that determines the maximum safe operating pressure.[210] They also include general standards of performance—such as requiring the pipe to be sufficiently thick to withstand the internal and external pressures on the pipeline system.[211]

Once the pipeline is in the ground, PHMSA is prohibited from applying design, installation, and construction standards to existing pipelines—thus ensuring that a company need not reconstruct pipelines in the ground to current standards.[212] The operation and maintenance of the pipeline is primarily governed by management directives.[213] The standards require operators to create and follow a written manual of procedures for each task,[214] as well as to develop programs to address particular issues, such as training of employees and monitoring of pipelines in control centers.[215] To address the risk of third-party excavation damage, the standards require pipeline operators to mark the location of their pipelines as part of "call-before-you-dig" programs.[216] If the technical and management standards fail to keep the product in the pipe, the safety framework relies on operators' emergency response planning to mitigate the damage. Operators must have emergency procedures that include a "[p]rompt and effective response" to notice of the accident and the necessary actions to minimize the spill or release and public exposure to injury.[217]

The safety framework responds to the risks associated with siting a pipeline in a certain location by focusing more attention on "high-consequence" areas. These areas are limited to ones where an accident could cause catastrophic harm. For gas pipelines, the standards focus on densely settled areas near the pipeline, where an explosion would cause the most fatalities and injuries.[218] The definition is so narrow that it only captures 6.9% of the gas transmission pipeline grid.[219] For hazardous liquid pipelines, the standards focus on municipal census tracts, commercially navigable waterways, and "unusually sensitive areas"—drinking water sources and certain habitats of imperiled, threatened, or

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210 *Id.* §§ 192.105, .619, 195.106, .406.

211 *Id.* §§ 192.103, 195.112(a).

212 49 U.S.C. § 60104(b) (2012).

213 *See, e.g.*, 49 C.F.R. §§ 192.605, .614–.16, .631, 195.402, .440–.46.

214 *Id.* §§ 192.605, .615, 195.402–.403.

215 *Id.* §§ 192.801–.809, 195.501–.509.

216 *Id.* §§ 192.614, 195.442.

217 *Id.* §§ 192.605(a), (e), .615, 195.402(a), (e).

218 *Id.* § 192.903 (defining "high-consequence area[s]" to include areas near the pipeline where multi-story buildings are prevalent or there are forty-six or more buildings; or where the potential impact circle contains twenty or more buildings or a regularly occupied structure such as a playground, church, or hospital). The standards use different terms for protected areas: class locations and high-consequence areas. *See id.* §§ 192.5, .903. The approach to risk, however, is the same.

219 *GT IM Performance Measures*, PIPELINE & HAZARDOUS MATERIALS SAFETY ADMIN., https://www.phmsa.dot.gov/pipeline/gas-transmission-integrity-management/gt-im-performance-measures [https://perma.cc/E4BM-DPM2] (last updated Feb. 6, 2020) (follow "GT IM Assessment" hyperlink).

endangered species.[220] This definition is more expansive than the one for gas pipelines; approximately 42% of the total hazardous liquid transmission pipeline grid lies within these areas or is near enough that a spill could affect the areas.[221] The difference can largely be explained by the use of census tracts, not by the inclusion of natural resource areas.[222] The standards focus on a remarkably narrow list of environmental features.[223]

The framework seeks to protect high-consequence areas in three different ways. First, it regulates more pipelines in these areas. The safety standards apply to gathering pipelines only if the pipelines are in or could affect the protected areas.[224] In practice, this threshold is quite high. The vast majority of gathering pipelines built during the domestic energy revolution are unregulated because they are located in rural areas where the oil and gas wells are located.[225] Second, when companies site new gas transmission pipelines in protected areas, they must comply with additional construction and operation requirements. As the number of buildings in the area around a gas transmission pipeline increases, for example, the pipeline must be able to withstand more pressure and use more closely spaced safety valves.[226] Pipelines in navigable rivers, streams, and harbors must be buried at least forty-eight inches in soil or twenty-four inches in consolidated rock.[227] And third, the framework requires operators of pipelines in protected areas to improve their risk management through special integrity management programs.[228] In these programs, operators must assess the condition of the pipelines, identify threats to the lines, analyze the risks, and take "prompt action" to address defects and other anomalous conditions.[229]

The states may choose to impose additional "compatible" safety requirements on intrastate pipelines, if they have a pipeline safety program

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[220] 49 C.F.R. §§ 195.6, .450 (2019).

[221] *HL IM Performance Measures*, PIPELINE & HAZARDOUS MATERIALS SAFETY ADMIN., https://www.phmsa.dot.gov/pipeline/hazardous-liquid-integrity-management/hl-im-performance-measures [https://perma.cc/ZSC7-B46X] (last visited Mar. 1, 2020) (follow "HL IM reporting data" hyperlink).

[222] *See* Pipeline Safety: Areas Unusually Sensitive to Environmental Damage, 65 Fed. Reg. 80530, 80534 (Dec. 21, 2000) (explaining that the agency chose not to include many natural resources in its definition of "unusually sensitive areas" and that the definition would concentrate on "areas that are most susceptible to permanent or long-term damage").

[223] *See* 49 C.F.R. §§ 195.2, .6 (2019).

[224] *Id.* §§ 192.9, 195.1–.2, .11.

[225] *See* Pipeline Safety: Safety of Gas Transmission and Gathering Pipelines, 81 Fed. Reg. 20,722, 20,724 (proposed Apr. 8, 2016) (to be codified at 49 C.F.R. pts. 191, 192); Pipeline Safety: Safety of Hazardous Liquid Pipelines, 80 Fed. Reg. 61,610, 61,612 (proposed Oct. 13, 2015) (to be codified at 49 C.F.R. pt. 195).

[226] 49 C.F.R. §§ 192.111, .179 (2019).

[227] *Id.* § 192.327(e).

[228] *Id.* §§ 192.901–.951, 195.452. Operators of gas distribution pipeline systems are also required to create integrity management programs; the programs apply to the entire system because all of the pipelines are generally in populated areas. *Id.* §§ 192.1001–.1015.

[229] *Id.* §§ 192.911, 195.452.

certified by PHMSA.[230] All states except Alaska and Hawaii regulate the safety of intrastate gas pipelines.[231] Just one-third of the states regulate the safety of intrastate hazardous liquid pipelines; this group includes some states with productive oil plays—but not, it must be noted, North Dakota.[232] States generally retain the bright-line distinction between safety and siting in their delegated programs; indeed, several state legislatures have enacted an identically worded provision that prevents the delegated agency from prescribing the route of a pipeline.[233] While the states have adopted numerous requirements that exceed the federal minimum standards—by one report there are over 1300 such requirements—the scope of the standards is largely limited to enhanced reporting, recordkeeping, and testing.[234] Many states, for example, require operators to prepare more detailed maps of their systems than is mandated by PHMSA.[235] Texas requires pipeline operators to obtain a permit from the state and to submit maps of systems in digital shape files.[236] The states that do regulate the location of pipelines through their safety programs impose relatively minor restrictions.[237]

C. *The Siting Framework*

The legal framework governing the siting of new energy pipelines or the expansion of existing pipeline systems is a scattered collection of policy

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230 49 U.S.C. §§ 60104(c), 60105 (2012).

231 PIPELINE & HAZARDOUS MATERIALS SAFETY ADMIN., STATE PROGRAM CERTIFICATION/AGREEMENT STATUS 1 (2017), https://www.phmsa.dot.gov/sites/phmsa.dot.gov/files/docs/about-phmsa/working-phmsa/state-programs/56591/2017-appendix-f-state-program-certification-agreement-status.pdf [https://perma.cc/S657-5PSS].

232 The states that regulate intrastate hazardous liquid pipelines are Alabama, Arizona, California, Indiana, Louisiana, Maryland, Minnesota, New York, New Mexico, Oklahoma, Pennsylvania, Texas, Virginia, Washington, and West Virginia. *See id.* at 2.

233 *See* ALA. CODE § 37-4-80 (1992); ARK. CODE ANN. § 23-15-203(7) (2015); NEB. REV. STAT. ANN. § 81-542(6) (LexisNexis 2011); N.M. STAT. ANN. § 70-3-13(E) (LexisNexis 2017); S.C. CODE ANN. § 58-5-920(h) (2015); TENN. CODE ANN. § 65-28-104(5) (2015); W. VA. CODE § 24B-1-2(6) (2013).

234 *Cf.* NAT'L ASS'N PIPELINE SAFETY REPRESENTATIVES & NAT'L ASS'N REGULATORY UTIL. COMM'RS, PROVIDING INCREASED PUBLIC SAFETY LEVELS: EXECUTIVE SUMMARY 2 (2d ed. 2013), https://www.puc.nh.gov/Safety/Compendium/State%20Initiative%20Exec%20Summary_Final%20091813.pdf [https://perma.cc/MPV9-SD7U].

235 *See, e.g.*, ARK. CODE R. § 192.615(d) (2015); CAL. PUB. UTIL. CODE § 4354.5(a)(1) (West 2010) (mobile home park operators); FLA. ADMIN. CODE ANN. r. 25-12.061 (2019); IDAHO ADMIN. CODE r. 31.31.01.101.01 (2019).

236 16 TEX. ADMIN. CODE §§ 3.70, 8.1 (2017); *Mapping*, RAILROAD COMM'N TEX., https://www.rrc.state.tx.us/pipeline-safety/mapping/ [https://perma.cc/Z8B5-XWQ3] (last updated Oct. 9, 2018).

237 *See, e.g.*, ARIZ. ADMIN. CODE § 14-5-202(f) (2019) (prohibiting operators from constructing pipelines under buildings); MICH. ADMIN. CODE r. 460-20415 (2003) (limiting the location of sour gas pipelines); N.J. ADMIN. CODE § 14:7-1.4 (2009) (requiring approval for high-pressure natural gas pipelines within 100 feet of a building).

decisions, divided across jurisdictions and fragmented by the type of pipeline, the product being transported, and whether the pipeline crosses state borders. States have authority under their police powers to regulate the route of gathering pipelines and gas distribution pipelines, but few states have chosen to do so. In effect, the decisions about the location of these pipelines—and the risks that a pipeline accident poses to communities and the environment—are left to the companies who will operate the lines. In contrast, the Federal Energy Regulatory Commission (FERC) approves the siting of interstate natural gas transmission pipelines,[238] and some states have chosen to regulate the siting of other types of transmission pipelines.

Given PHMSA's authority over the safety of pipelines, the issue of whether other federal or state entities have the authority to consider the risks of an accident in their siting decisions is contested. At the federal level, FERC acknowledges PHMSA's exclusive authority to set safety standards but claims the authority to impose conditions on interstate natural gas pipelines that "mitigate the impact of construction or operation on the environment."[239] As to states, the Pipeline Safety Act provides that states "may not adopt or continue in force safety standards" for interstate pipelines and certified states may only adopt additional or more stringent safety standards if they are "compatible" with federal minimum standards.[240] There are no court decisions directly on point, but a state likely has the authority to regulate the siting of an interstate or intrastate pipeline based on the risk of an accident. Federal "safety standards" only apply to aspects such as design, construction, and operation—and PHMSA is not authorized to prescribe the location or route of a pipeline.[241] But a state is likely preempted from imposing "safety standards" on the construction or operation of an interstate pipeline as a condition of siting approval,[242] and may

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[238] 15 U.S.C. § 717f (c) (2012).

[239] Memorandum of Understanding between the Dep't of Transp. and the Fed. Energy Regulatory Comm'n Regarding Natural Gas Transportation Facilities 2 (Jan. 15, 1993) (on file with *Ohio State Law Journal*).

[240] 49 U.S.C. § 60104(c) (2012).

[241] *See* Wash. Gas Light Co. v. Prince George's Cty. Council, 711 F.3d 412, 422 (4th Cir. 2013) ("Even if we were to find that the [Pipeline Safety Act] has preemptive effect beyond the express preemption provision . . . we would not conclude that Congress intended the [law] to occupy the field of natural gas facility siting."); ANR Pipeline Co. v. Iowa State Commerce Comm'n, 828 F.2d 465, 473 (8th Cir. 1987) (noting that the state "may be able to enact legislation to protect its valuable topsoil and other aspects of the environment" but that the issue was not before the court); Portland Pipe Line Corp. v. South Portland, 288 F. Supp. 3d 321, 430–31 (D. Me. 2017) (stating that "Congress did not intend the [Pipeline Safety Act] to preempt state and local authority 'to prescribe the location or routing of a pipeline facility,'" that "[u]nder their police power, states and localities retain their ability to prohibit pipelines altogether in certain locations," and that "it is unlikely Congress intended to remove [a lesser restriction than a ban]").

[242] *See* Kinley Corp. v. Iowa Util. Bd., 999 F.2d 354, 359 (8th Cir. 1993) (stating that "[t]his Congressional grant of exclusive federal regulatory authority [over interstate pipelines] precludes state decision-making in this area altogether and leaves no regulatory

be preempted from doing so as to intrastate pipelines if it is not certified to regulate the safety of those lines.[243]

The siting of gathering pipelines, like the safety of the lines, is almost entirely unregulated. In oil and gas producing states, state commissions generally oversee gathering pipelines as part of their well permitting programs.[244] This oversight does not extend to siting, however. Twenty-eight of the thirty states that assert jurisdiction over gathering pipelines do not require companies to obtain approval from the state commission to site gathering pipeline systems.[245] These states accept the risks of the pipelines without regard to their location—presumably because they deem the risks of gathering pipelines to be so low that the location does not matter. Even the two states that require gathering pipeline companies to seek approval before constructing projects do not include a standard on risk in their siting criteria.[246]

As companies have installed larger gathering pipelines and operated them at higher pressures, the states' approach to risk has remained the same. The location of gathering systems is not regulated in states where much of the rapid build out has occurred during the domestic energy revolution, such as North Dakota, Ohio, Pennsylvania, and West Virginia. Neither is the siting of systems in states where companies are expected to build many more gathering pipelines in the future: Louisiana, New Mexico, and Texas.[247] The states' only concession

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room for the state to either establish its own safety standards or supplement the federal safety standards").

[243] *See* Olympic Pipe Line Co. v. Seattle, 437 F.3d 872, 880 (9th Cir. 2006) (holding that only certified state or local government agencies may regulate the safety of intrastate pipelines); United Steelworkers of Am. v. Skinner, 768 F. Supp. 30, 35 (D.R.I. 1991) (same).

[244] *See generally* OAK RIDGE NAT'L LAB., U.S. DEP'T OF ENERGY, ORNL/TM-2013/133, REVIEW OF EXISTING FEDERAL AND STATE REGULATIONS FOR GAS AND HAZARDOUS LIQUID GATHERING LINES (Sept. 2013), https://www.phmsa.dot.gov/sites/phmsa.dot.gov/files/docs/Review%20of%20Existing%20Federal%20and%20State%20Regulations%20for%20Gas%20and%20Hazardous%20Liquid%20Gathering%20Lines%20-%20May%202015.pdf [https://perma.cc/UW32-UEEB].

[245] The states are Alaska, Arkansas, California, Colorado, Delaware, Illinois, Indiana, Kansas, Louisiana, Maryland, Michigan, Mississippi, Montana, Nebraska, Nevada, New Mexico, New York, North Dakota, Ohio, Oklahoma, Pennsylvania, South Dakota, Tennessee, Texas (unregulated pipelines), Utah, Virginia, West Virginia, and Wyoming. *See id.* app. A at A-3 to -227 (providing the oil and gas gathering line rules and regulations for each state).

[246] *See* ALA. ADMIN. CODE r. 400-1-8-.03 (2000) (requiring operators to obtain approval for "[a]ll intrastate gathering lines, located in a rural location" and specifying that information on the "[l]ocation, route and length of line" must be provided); 805 KY. ADMIN. REGS. 1:190 (2019) (requiring operators to obtain approval for all oil and gas gathering lines that are not federally regulated and specifying that the "approximate locations of property lines, dwellings, environmentally sensitive features and road and stream crossings along the path of the gathering line" must be provided).

[247] As part of the state's pipeline safety program, Texas requires regulated gathering pipelines to obtain a permit. 16 TEX. ADMIN. CODE §§ 3.70(a), 8.1(a)(1)(B), 8.1(b)(4) (2017). The state does not, however, approve the route of the pipelines.

to risk is to require operators to report the location of the systems.[248] Ironically, the two states that require approval for gathering line projects—Alabama and Kentucky—do not have productive shale plays.[249]

The siting of natural gas distribution pipelines is also generally not regulated. Investor-owned local distribution companies are governed by state public utility laws.[250] As public utilities, the companies are expected to provide safe and adequate service at reasonable rates.[251] Several states specifically require utilities to obtain a "certificate of convenience and public necessity" before construction of any facilities.[252] Even so, the focus of certification is on the need for the service, the adequacy of the service, and the reasonableness of the cost of infrastructure—not on the location of pipelines.[253] And states do not require utilities to obtain a certificate for expansions of existing systems within a service area;[254] at most, a company might be required to obtain a city's consent to construct pipelines under its public roads.[255] Municipally owned utilities, meanwhile, oversee their own pipeline systems and routes.[256] Leaving decisions about the risk of a route to distribution utilities presumes that the utility is best able to design its system, the possible routes are limited by the need to service customers, and distribution pipelines are operated at low pressures. Once again, the domestic energy revolution has not altered this perception of the risk—even as distribution utilities build more pipelines and transport more gas.

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[248] *See, e.g.*, N.D. CENT. CODE § 38-08-26 (2014) (requiring all operators of underground gas and liquid gathering lines to submit geographic information system (GIS) data to the state within 180 days of putting the pipeline into service); OHIO ADMIN. CODE 4901:1-16-15 (2019) (requiring operators of gas gathering pipelines to notify the state prior to construction and after construction of the pipeline route); *see also* N.Y. COMP. CODES R. & REGS. tit. 16, § 255.9(c) (2019) (requiring operators of gas gathering pipelines to notify the state prior to construction).

[249] *See U.S. States: State Profiles and Energy Estimates*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/state/ [https://perma.cc/E6U6-QTKA] (select "Rankings" from top menu, then "Crude Oil" or "Natural Gas").

[250] CHARLES F. PHILLIPS, JR., THE REGULATION OF PUBLIC UTILITIES 5 (3d ed. 1993).

[251] *Id.*

[252] *See, e.g.*, ARIZ. REV. STAT. ANN. § 40-281(A) (2011) ("A public service corporation . . . shall not begin construction of . . . plant, service or system, or any extension thereof, without first having obtained from the commission a certificate of public convenience and necessity.").

[253] *See, e.g.*, GA. CODE ANN. § 46-4-25(a) (2004) (listing criteria for a certificate that include the demand for the natural gas, the economic feasibility of the system, the propriety of the costs, and the effects on other distribution systems).

[254] *See, e.g.*, ARIZ. REV. STAT. ANN. § 40-281(B) (2011) ("This section shall not require such corporation to secure a certificate for an extension within a city, county or town within which it has lawfully commenced operations, or for an extension into territory either within or without a city, county or town, contiguous to its . . . plant or system, and not served by a public service corporation of like character, or for an extension within or to territory already served by it, necessary in the ordinary course of its business.").

[255] *See, e.g.*, MD. CODE ANN., PUB. UTIL. § 7-102(b) (LexisNexis 2010).

[256] *See, e.g.*, ARIZ. CONST. art. 15, § 2 (defining "public service corporations" as "[a]ll corporations other than municipal engaged in furnishing gas . . . for . . . fuel").

In comparison to gathering and distribution pipelines, the location of transmission pipelines is more likely to be regulated. Authority over the siting of transmission pipelines is divided between the federal government and the states. At the federal level, the location of all interstate natural gas transmission pipeline projects must be approved by FERC.[257] Jurisdiction over the location of other types of transmission lines—intrastate gas transmission lines and both interstate and intrastate crude oil and hydrocarbon liquid lines—is left to the states.[258] Most of the siting laws were enacted well before the domestic energy revolution. FERC has exercised authority over interstate natural gas transmission projects since 1938.[259] In the following decades, some states expanded their traditional authority over public utilities or common carriers to include the location of transmission pipelines.[260] Others began to regulate transmission pipelines as "energy facilities" under general siting acts.[261]

The states have split evenly on whether to approve transmission pipeline projects. Half of the states do not require pipeline companies to obtain approval for any type of transmission project;[262] half require approval of at least one type of transmission pipeline system.[263] More states regulate intrastate gas transmission projects than liquid transmission projects: twenty-three states require companies to obtain permission for intrastate gas transmission

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[257] 15 U.S.C. § 717f(c) (2012).

[258] FERC's authority over interstate crude oil and hydrocarbon liquid pipelines is limited to economic regulation, which allows states to regulate the siting of these pipelines. *See* Interstate Commerce Act, 49 U.S.C. app. § 6 (1988).

[259] Natural Gas Act, § 1(b), 52 Stat. 821, 821 (1938).

[260] *See, e.g.*, ALASKA STAT. § 42.06.240(a) (2018) (requiring oil and gas pipeline carriers to obtain approval for pipeline construction as of January 1, 1974).

[261] *See* THOMAS E. EBZERY & BRENT R. KUNZ, ROCKY MOUNTAIN MINERAL LAW FOUND., PAPER 5: FACILITY SITING 5-1 (1981) (on file with *Ohio State Law Journal*) (describing history of energy facility acts).

[262] Twenty-five states do not specifically require approval for transmission pipeline projects, although public utility commissions may decide to review such projects if they are constructed by local distribution companies. The states are Alabama, Arizona, Colorado, Delaware, Hawaii, Idaho, Indiana, Kansas, Kentucky, Louisiana, Maine, Maryland, Mississippi, Missouri, New Jersey, New Mexico, North Carolina, Oklahoma, Pennsylvania, South Carolina, Tennessee, Texas, Utah, West Virginia, and Wisconsin. The District of Columbia also does not require approval. In Colorado, county governments may choose to designate certain gas transmission pipeline projects as an "activity of state interest" and require approval before construction. COLO. REV. STAT. §§ 24-65.1-104, -201 (2019). In Texas, transmission pipelines are required to obtain a permit from the state under the safety program but there is no siting review. 16 TEX. ADMIN. CODE §§ 3.70, 8.1 (2017).

[263] Fourteen states require approval for intrastate gas, interstate liquid, and intrastate liquid transmission pipelines: Alaska, Illinois, Iowa, Massachusetts, Michigan, Minnesota, Montana, New Hampshire, North Dakota, Oregon, Rhode Island, South Dakota, Washington, and Wyoming. Nine states only require approval for intrastate gas transmission pipelines: Arkansas, California, Connecticut, Florida, Nevada, New York, Ohio, Vermont, and Virginia. Two states—Nebraska and Georgia— only require approval for liquid transmission pipelines.

projects,[264] while sixteen states require the same for interstate and intrastate liquid transmission projects.[265] Only two states—Georgia and Nebraska—have passed new siting laws to respond to the expansion in pipeline networks caused by the domestic energy revolution; both laws govern liquid transmission pipelines.[266]

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264 ALASKA STAT. §§ 42.06.240(a), .630 (2018); ARK. CODE ANN. §§ 23-18-503(6)(C), -510(a) (2015) (greater than one mile and at least 125 psi); CAL. PUB. UTIL. CODE §§ 1001, 1002.5 (West 2010) (public utilities that add new natural gas capacity to the state); CONN. GEN. STAT. §§ 16-50i, -50k (2013) (at least 200 psi and design capacity of 20% of specified minimum yield strength); FLA. STAT. § 403.9405 (2015) (at least 15 miles in length and crosses a county line); 220 ILL. COMP. STAT. 5/15-401 (2013); IOWA CODE ANN. § 479.5 (West 2019) (at least 5 miles in length and more than 150 psi); MASS. GEN. LAWS ch. 164, §§ 69G, 69J (2015) (more than 1 mile in length and 100 psi); MICH. COMP. LAWS ANN. § 483.109 (West 2008); MINN. STAT. ANN. § 216G.02 (West 2010) (more than 275 psi); MONT. CODE ANN. §§ 75-20-104(9)(b), -201 (2019) (greater than 50 miles in length and 25" in diameter); NEV. REV. STAT. §§ 704.860, .865 (2014) (outside incorporated city); N.H. REV. STAT. ANN. §§ 162-H:2(VII)(a), :5(I), :10-b (2014); N.Y. PUB. SERV. LAW §§ 120(2), 121 (McKinney 2019) (more than 1000 feet in length and more than 125 psi); N.D. CENT. CODE § 49-22.1-01(7)(a), -04 (2014) (at least one mile and more than 4.5" in diameter); OHIO REV. CODE ANN. §§ 4906.01(B)(1)(c), .04 (West Supp. 2019) (more than 500 feet in length, 9" in diameter, and 125 psi); OR. REV. STAT. §§ 469.300(11)(a)(E)(ii), 320 (2017) (at least five miles in length and 16" in diameter); 42 R.I. GEN. LAWS §§ 42-98-3, -4 (2006); S.D. CODIFIED LAWS §§ 49-41B-2.1(2), -4 (2004) (design capacity of at least 20% of specified minimum yield strength, exception for pipes less than 4" diameter, and one mile or less is constructed outside of public right-of-way); VT. STAT. ANN. tit. 30, § 248(a)(3) (2017); VA. CODE ANN. § 56-265.2−.2:1 (2012) (owned by public utility); WASH. REV. CODE ANN. §§ 80.50.020(21)(b), .060 (West 2001) (at least 15 miles in length and greater than 14" in diameter that delivers to distribution facility); WYO. STAT. ANN. §§ 37-1-101(a)(vi)(G), -2-205 (2019).

265 ALASKA STAT. § 42.06.240(a) (2018); GA. CODE ANN. §§ 12-17-2, 22-3-83 (2019); 220 ILL. COMP. STAT. 5/15-401 (2013); IOWA CODE ANN. §§ 479.5, 479B.4 (West 2009) (at least 5 miles in length and more than 150 psi); MASS. GEN. LAWS ch. 164, §§ 69G, 69J (2015) (more than 1 mile in length); MICH. ADMIN. CODE r. 792.10447(1)(c) (2010); MINN. STAT. ANN. § 216G.02 (West 2010) (at least 6" diameter); MONT. CODE ANN. §§ 75-20-104(9)(b)(i), -201 (2019) (greater than 50 miles in length and 25" in diameter); NEB. REV. STAT. ANN. § 57-1404(2), -1405(1) (LexisNexis 2014) (greater than 6" diameter); N.H. REV. STAT. ANN. §§ 162-H:2(VII)(a), :5(I) (2014); N.D. CENT. CODE § 49-22.1-01(7)(a), -04 (2014) (at least one mile and more than 4.5" in diameter); OR. REV. STAT. §§ 469.300(11)(a)(E)(i), 320 (2017) (at least five miles in length and 6" in diameter); 42 R.I. GEN. LAWS §§ 42-98-3(d), -4 (2006) ("facilities associated with the transfer of oil . . . via pipeline"); S.D. CODIFIED LAWS §§ 49-41B-2.1(2), -4 (2004) (design capacity of at least 20% of specified minimum yield strength, exception for pipes less than 4" diameter, and one mile or less is constructed outside of public right-of-way); WASH. REV. CODE ANN. §§ 80.50.020(21)(a), .060 (West 2001) (at least 15 miles in length and greater than 6" diameter); WYO. STAT. ANN. §§ 37-1-101(a)(vi)(G), -2-205 (2019). In Oklahoma, companies may choose to apply to the state commission for an order authorizing "the siting, construction, expansion, or operation of a crude oil or refined petroleum product pipeline facility." OKLA. STAT. ANN. tit. 52, § 67(D) (2011).

266 Phil McKenna, *Property Rights Outcry Stops Billion-Dollar Pipeline Project in Georgia*, INSIDE CLIMATE NEWS (Apr. 1, 2016), https://insideclimatenews.org/news/

This comprehensive analysis of federal and state siting laws reveals that pipeline siting laws take two different approaches to risk: (1) a public utility approach that views risk as one factor in a broad inquiry to determine whether the pipeline is in the public interest, or (2) a facility approach that views risk as an issue of the acceptability of the pipeline, separate from the question of public need. These approaches in turn reveal two different conceptions of energy infrastructure: in the first, energy infrastructure is a conduit for the beneficial provision of energy with inherent risks; in the second, it is a large land use that provides benefits but also has significant side effects that can be minimized.

The first type of siting law draws on public utility concepts to holistically evaluate whether the project is in the public interest. The risk of pipeline accidents to communities and the environment is treated as a factor in a larger determination of public good. FERC uses this approach to determine whether to approve an interstate natural gas transmission pipeline project. In deciding whether the project "is or will be required by the present or future public convenience and necessity,"[267] FERC must weigh the public benefits against the adverse effects of the project.[268] The balancing test includes the effects of the pipeline on the surrounding community and potential disruption of the environment—both factors that could include the risk of accidents.[269] FERC may also set "reasonable terms and conditions" on its approval.[270]

Of the twenty-five states that approve pipeline projects, eight use a similar public utility approach.[271] Like FERC, the states apply a balancing test to determine whether a pipeline is required by the "public convenience and necessity" or the "public interest."[272] Some states explicitly include negative

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01042016/palmetto-pipeline-kinder-morgan-georgia-eminent-domain-oil-gas-republicans [https://perma.cc/7W9F-DR2G]; Kevin O'Hanlon, *Governor Signs Two Pipeline Bills into Law*, LINCOLN J. STAR (Nov. 22, 2011), https://journalstar.com/news/unicameral/governor-signs-two-oil-pipeline-bills-into-law/article_81853373-b52c-537b-9a7d-e84b813faa9c.html [https://perma.cc/BB2X-M3N5]. Nebraska created a special siting process for the Keystone XL pipeline. 2012 Neb. Laws L.B. 1161 (codified at NEB. REV. STAT. ANN. § 57-1101). While landowners challenged the law as unconstitutional, the state supreme court upheld it. *See* Sandra Zellmer, *Keystone XL Pipeline Route through Nebraska Upheld on Constitutional Technicality—For Now*, CPRBLOG (Jan. 15, 2015), http://www.progressivereform.org/CPRBlog.cfm?idBlog=EEC8FFCB-942B-4764-55172CC3E973EEF8 [https://perma.cc/Q45G-K6HJ].

[267] 15 U.S.C. § 717f(e) (2012).

[268] Certification of New Interstate Natural Gas Pipeline Facilities, 88 FERC ¶ 61,227 (1999), *clarified*, 90 FERC ¶ 61,128, *further clarified*, 92 FERC ¶ 61,094 (2000) (Policy Statement).

[269] *Id.*

[270] 15 U.S.C. § 717f(e) (2012).

[271] The states are Alaska, California, Illinois, Iowa, Michigan, Nebraska, Virginia, and Wyoming. *See infra* note 272.

[272] ALASKA STAT. § 42.06.270(a) (2018); CAL. PUB. UTIL. CODE §§ 1001, 1002.5 (West 2010); 220 ILL. COMP. STAT. 5/15-401 (2013); IOWA CODE ANN. § 479.12 (West 2009); MICH. COMP. LAWS ANN. § 483.109 (West 2015); NEB. REV. STAT. ANN. § 57-1407(4)

effects on the environment and "public safety" among the balancing factors.[273] In Illinois, for example, the law directs the commission to consider the environmental impact, the impact on natural resources, and the impact on public safety of the project.[274] Other states grant decision-makers the authority to impose conditions to address negative effects, thereby implicitly including these effects in the balancing test.[275] In Iowa, the board has authority to impose conditions on intrastate pipelines as to "safety requirements" that are "determined by it to be just and proper."[276] But the only state that directly addresses the risk of an accident in its siting law—Nebraska—prohibits its commission from considering the "risk or impact of spills or leaks" in its determination that the route is in "the public interest."[277]

While the public utility approach considers environmental effects and public safety, it presumes that the risk of an accident is a generic factor inherent to the project—that is, an issue of whether the product will remain in the pipe—rather than an issue that can be proactively solved through a land use decision. FERC and the states that use this approach view the risk of accidents across the entire pipeline as acceptable and rely on the safety framework, rather than the location of the pipeline, to protect vulnerable areas. For example, FERC responded to a landowner's concern about the safety of the Rover Pipeline, the largest-capacity natural gas pipeline ever considered by the Commission, by stating that the "minimal number of incidents distributed over more than 300,000 miles of natural gas transmission pipelines indicates a low risk for an incident at any given location."[278] FERC requires pipeline operators to certify that the project complies with PHMSA's safety standards but does not otherwise seek to reduce the risk of accidents.[279] Similarly, states that weigh public safety

(LexisNexis 2014); VA. CODE ANN. § 56-265.2(A)(1) (2012); WYO. STAT. ANN. § 37-2-205 (2019).

[273] CAL. PUB. UTIL. CODE § 1002(a)(4) (West 2010); 220 ILL. COMP. STAT. 5/15-401(c) (2013); NEB. REV. STAT. ANN. § 57-1407(4) (LexisNexis 2014); VA. CODE ANN. § 56-265.2:1(A) (2012). In Wyoming, the statute is unclear, but the rules require applicants to provide information on the facility and site. 2-3 WYO. CODE R. § 21 (LexisNexis 2019).

[274] 220 ILL. COMP. STAT. 5/15-401(b)(1), (3), (4) (2013).

[275] IOWA CODE ANN. § 479.12 (West 2009); VA. CODE ANN. § 56-265.2:1(A) (2012); *see also* ALASKA STAT. § 42.06.240(d) (2018) (the state commission may impose conditions "necessary for the protection of the environment" and for the "best interest" of the oil or gas pipeline and the general public).

[276] IOWA CODE ANN. § 479.12 (West 2009); *cf. id.* § 479B.9 (authorizing conditions on interstate hazardous liquid transmission pipelines only "as to location and route").

[277] NEB. REV. STAT. ANN. § 57-1407(4) (LexisNexis 2014). According to the state's law, the purpose of this provision is to "acknowledge[] and respect[] the exclusive federal authority over safety issues established by the federal . . . Pipeline Safety Act . . . and the express preemption provision stated in that act." *Id.* § 57-1402(2) (2014). As discussed *supra* notes 239–43 and accompanying text, this is an overly restrictive interpretation of the state's authority.

[278] Rover Pipeline LLC, 158 FERC ¶ 61,109, at 85 (2017).

[279] 18 C.F.R. § 157.14(a)(10)(vi) (2019) (requiring an applicant to "certify that it will design, install, inspect, test, construct, operate, replace, and maintain the facilities for which

in a siting decision view the risk as negligible and defer to federal safety standards rather than address the potential harm through the route. Illinois[280] and Iowa,[281] for example, compared the generic risks of pipeline transportation of crude oil against rail transportation and determined that the Dakota Access Pipeline was much safer. The states ultimately relied on PHMSA's standards and the pipeline operator's private commitments to protect the public and the environment.[282]

The second type of siting law draws on land use planning concepts to recognize the significant impacts of locating and operating energy facilities on communities and the environment. In this approach, the risk of a pipeline is treated as a distinct issue that must be addressed before siting, separate from the benefits of the pipeline. The decision-maker—which may be a public utility commission or a designated siting board or council[283]—must consider the public need for and the effects of the project. But rather than weigh the benefits against the risks, the decision-maker must determine that the pipeline fulfills a public need *and* that the negative effects of the pipeline are acceptable. Seventeen states utilize the facility approach for the pipelines they regulate, making this approach the more popular of the two approaches to risk. Most of the states adopted general energy facility siting acts in the 1970s and included

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a certificate is requested in accordance with Federal safety standards and plans for maintenance and inspection or shall certify that it has been granted a waiver of the requirements of the safety standards by the Department of Transportation"). As noted *supra* in note 239 and accompanying text, FERC has agreed to defer to PHMSA on the safety of interstate natural gas pipelines.

280 Dakota Access, LLC, Ill. Commerce Comm'n, 14-0754, at 17 (Dec. 16, 2015) (citing testimony by a representative of Dakota Access).

281 Dakota Access, LLC, Iowa Utils. Bd., HLP-2014-0001, at 32 (Mar. 10, 2016), *aff'd*, Puntenney v. Iowa Utils. Bd., 928 N.W.2d 829, 842 (Iowa 2019) (holding that data supported the conclusion that pipeline transportation is safer than rail transportation).

282 *See Dakota Access, LLC*, 14-0754 at 27 (concluding that the evidence of PHMSA safety standards in the record was sufficient to determine that the public convenience and necessity required the pipeline); *Dakota Access, LLC*, HLP-2014-0001 at 54–58 (asserting authority to "consider the future safety of the proposed pipeline in connection with the decision of whether to issue a permit for the construction of the pipeline" but determining that PHMSA's safety standards and additional industry commitments were "reasonable steps to reduce the safety risks").

283 *See, e.g.*, CONN. GEN. STAT. § 16-50j (2013); WASH. REV. CODE ANN. § 80.50.030 (West 2001).

at least some transmission pipelines in the definition of a facility.[284] A few states apply the approach only to transmission pipelines.[285]

The siting laws that take this approach vary in their phrasing of the acceptability determination. In some states, the decision-maker must find that the facility "represents the minimum adverse" or "acceptable" environmental impact considering "available technology" and "the nature and economics of the various alternatives."[286] In others, the requirement is phrased in the negative—the facility may not create an "unacceptable," "unreasonable," "serious," or "undue" adverse environmental effect.[287] Several of the states include safety as a criterion that must be acceptable,[288] and some prohibit the siting of transmission pipelines that pose an "undue hazard to persons or property along the area traversed by the line."[289]

While the facility approach views a pipeline as a large land use and focuses the decision-maker on the risk of that pipeline, the laws still treat the risk of the project as a single determination. This is likely because the prototypical energy facility is a power plant, which is sited in one location. Even the references to

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[284] ARK. CODE ANN. § 23-18-503(6)(C) (2015); CONN. GEN. STAT. § 16-50i(a)(2) (2013); MASS. GEN. LAWS ch. 164, § 69G (2015); MONT. CODE ANN. § 75-20-104(9)(b) (2019); NEV. REV. STAT. § 704.860(3) (2014); N.H. REV. STAT. ANN. § 162-H:2(VII)(a) (2014); N.Y. PUB. SERV. LAW § 120(2) (McKinney 2019); N.D. CENT. CODE § 49-22.1-01(7)(a) (2014); OHIO REV. CODE ANN. § 4906.01(B)(1)(c) (West Supp. 2019); OR. REV. STAT. § 469.300(11)(a)(E) (2017); 42 R.I. GEN. LAWS § 42-98-3(d) (2006); S.D. CODIFIED LAWS §§ 49-41B-2(7), -2.1(2) (2004); WASH. REV. CODE ANN. §§ 80.50.020(11), (21) (West 2001).

[285] FLA. STAT. § 403.9405(1) (2015); GA. CODE ANN. § 12-17-1(10), -2 (2012); MINN. STAT. ANN. § 216G.02 (West 2010); VT. STAT. ANN. tit. 30, § 248(a)(3) (2017). Minnesota also has a general energy facility siting law that includes some transmission pipelines, but it focuses on need. MINN. STAT. ANN. § 216B.43 (West 2010).

[286] ARK. CODE ANN. § 23-18-519(b)(4) (2015); MONT. CODE ANN. § 75-20-301(1)(c) (2019); NEV. REV. STAT. § 704.890(1)(d) (2014); N.Y. PUB. SERV. LAW § 126(1)(c) (McKinney 2019); OHIO REV. CODE ANN. § 4906.10(A)(3) (West Supp. 2019); *see also* WASH. ADMIN. CODE § 463-14-020 (2004) ("Ensuring through available and reasonable methods that the location and operation of such facilities will produce minimal adverse effects on the environment . . . .").

[287] N.H. REV. STAT. ANN. § 162-H:16(IV)(c) (2014); 42 R.I. GEN. LAWS § 42-98-11(b)(3) (2006); S.D. CODIFIED LAWS § 49-41B-22(2) (2004); VT. STAT. ANN. tit. 30, § 248(b)(5) (2017).

[288] CONN. GEN. STAT. § 16-50p(a)(3)(B) (2013); FLA. STAT. § 403.9415(4)(e) (2015); MASS. GEN. LAWS ch. 164, § 69O(2) (2015); MONT. CODE ANN. § 75-20-301(2)(d) (2019); N.H. REV. STAT. ANN. § 162-H:16(IV)(c) (2014); OR. REV. STAT. § 469.501(1)(g) (2017); S.D. CODIFIED LAWS § 49-41B-22(3) (2004); VT. STAT. ANN. tit. 30, § 248(b)(5) (2017); *see also* 42 R.I. GEN. LAWS § 42-98-8(a)(5)-(6) (2006) (requiring information on estimated costs to the community on safety issues and measures to protect public safety as part of the application).

[289] ARK. CODE ANN. § 23-18-519(b)(8) (2015); CONN. GEN. STAT. § 16-50p(a)(3)(E) (2013); N.Y. PUB. SERV. LAW § 126(1)(f) (McKinney 2019); *see also* GA. CODE ANN. § 12-17-4(a) (2012) (prohibiting the siting of transmission pipelines that create "an undue hazard to the environment and natural resources of this state").

the "hazard" of a potential pipeline presume that the line either poses an undue hazard or it does not. Thus, the facility approach does not encourage decision-makers to consider the siting of linear infrastructure as a series of risk decisions that shift based on the potential consequences of an accident. Nor does the approach necessarily create a proactive response to risk by empowering the decision-maker to choose the best route. South Dakota's law, for example, prohibits its commission from establishing a route.[290]

A few states that utilize the approach seek to protect vulnerable areas from the consequences of a pipeline accident. In Florida, the state board certifies a corridor for a gas transmission pipeline after considering whether the pipeline "[a]void[s] densely populated areas to the maximum extent feasible."[291] Similarly, in Minnesota, the commission considers criteria such as the "existence of populated areas" in designating a pipeline route.[292] North Dakota is the only state to explicitly protect certain areas. The route of a pipeline may not traverse any "exclusion" areas such as national and state parks, historic sites, and wilderness areas.[293] The company must also avoid other sensitive areas, such as drinking water sources, unless there is no reasonable alternative.[294] In determining whether there is a reasonable alternative, the commission can weigh the management of adverse impacts, orderly siting, system reliability and integrity, and efficient use of resources.[295]

South Dakota's and North Dakota's reviews of the Dakota Access Pipeline demonstrate the limitations of the facility approach to risk. South Dakota's siting law requires the operator to demonstrate that the pipeline will not "pose a threat of serious injury to the environment" or "substantially impair the health, safety or welfare of the inhabitants."[296] But the commission concluded that the operator met these requirements by complying with PHMSA's safety standards.[297] The commission also concluded that it could not "compel the [a]pplicant to select an alternative route" or base its decision "on whether . . . the selected route is the route [the state] might itself select."[298]

North Dakota's siting law protects vulnerable areas, yet the state commission's application of the law is much less demanding than the text would seem to require. The law prohibits a pipeline from being routed through an "exclusion" area, which includes critical habitat for endangered and threatened

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290 S.D. CODIFIED LAWS § 49-41B-36 (2004).

291 FLA. STAT. ANN. § 403.9415(4)(g) (West 2010).

292 MINN. STAT. ANN. § 216G.02, subdiv. 3(b)(4) (West 2010). Recognizing the issue of preemption, Minnesota prohibits the commission from "set[ting] safety standards for the construction of pipelines." *Id.* § 216G.02, subdiv. 3(a).

293 N.D. CENT. CODE § 49-22.1-03 (2014); N.D. ADMIN. CODE 69-06-08-02(1) (2019).

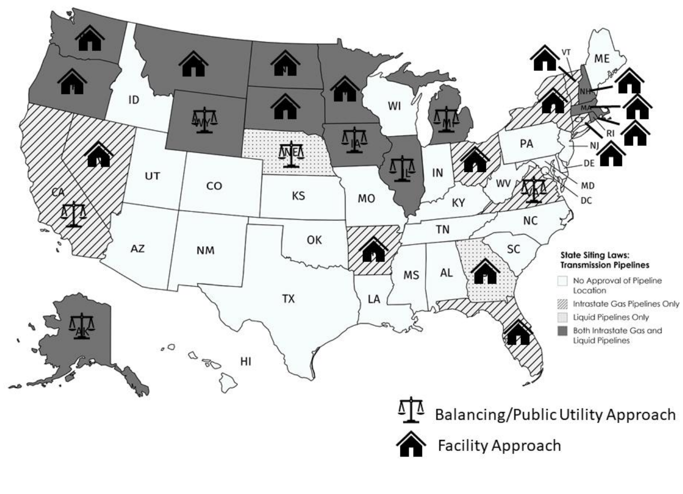
294 N.D. CENT. CODE § 49-22.1-03 (2014); N.D. ADMIN. CODE 69-06-08-02(2) (2019).

295 N.D. ADMIN. CODE 69-06-08-02(2).

296 S.D. CODIFIED LAWS § 49-41B-22(2)–(3) (2004).

297 Dakota Access, LLC, HP14-002, at 13 (S.D. Pub. Util. Comm'n, Dec. 14, 2015).

298 *Id.* at 24–25.



species.[299] The commission, however, interpreted this as a prohibition on surface impacts and allowed the Dakota Access Pipeline to be bored underneath critical habitat in the Missouri River.[300] When Energy Transfer Partners proposed a tank terminal on the other side of a city's groundwater supply protection area, the commission concluded that there was no reasonable alternative to routing the pipeline through the area even though the operator had created the dilemma.[301]

The figure below shows which states have adopted transmission pipeline siting laws and the approaches they use to assess risk. Most of the states that regulate pipeline siting are in the North and along the West and East Coasts. The author's future research will explore relationships between the states' policy choices and pipeline risk characteristics, but it is interesting to note that states with extensive transmission pipeline systems, such as Texas and Louisiana, have not adopted siting laws. There is also no obvious correlation between the type of pipeline and the type of policy approach. The two states that adopted pipeline siting laws in response to the domestic energy revolution—Georgia and Nebraska—chose different policy approaches to address the same type of pipeline. Instead, it appears that certain geographic regions prefer one approach, perhaps because the states in that region look to each other for policy models. The Northeast and the northern states in the Mountain West use the facility approach, while states in the Midwest and the Plains are more likely to use the public utility approach.

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[299] N.D. CENT. CODE § 49-22.1-03 (2014); N.D. ADMIN. CODE 69-06-08-02(1) (2019).
[300] Dakota Access, LLC, PU-14-842, at 7 (N.D. Pub. Serv. Comm'n, Jan. 20, 2016).
[301] *Id.* at 8.

IV. EVALUATING THE RISK FRAMEWORKS

These regulatory frameworks raise descriptive and normative questions of risk governance—how society makes collective decisions about the acceptability of risk, and how it should make such decisions.[302] A common governance approach to environmental, health, and safety risks is to separate the decision on siting from the decision on the ongoing risk of the industrial activity.[303] This approach presumes that the decision about the location of a source of risk can be divorced from a decision about the acceptable level of risk—or that the distinction is not important because the risk can be managed regardless of its geographic location. Both presumptions can be questioned.[304] But even if the distinction is valid, one would expect risk governance to adopt a more cautious approach when the potential for catastrophic harm increases and the ability to predict the consequences of the next accident decreases.

A. *The Risk Policy Approaches*

In risk governance, there are three primary policy approaches: a preventative approach, a management approach, and a remedial approach.[305]

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302 *See* ORTWIN RENN, RISK GOVERNANCE: COPING WITH UNCERTAINTY IN A COMPLEX WORLD 8–9 (2008) (describing risk governance as "structures and processes for collective decision-making involving governmental and non-governmental actors" as applied to the "context of risk and risk-related decision-making," which includes the "complex web of actors, rules, conventions, processes and mechanisms concerned with how relevant risk information is collected, analysed and communicated, and how management decisions are taken"); Timothy F. Malloy, *Disrupting Conventional Policy: The Three Faces of Nanotechnology*, 28 UCLA J. ENVTL. L. & POL'Y 1, 3 (2010) (defining risk governance as "the social, legal and institutional decision-making processes used in identifying and responding to risks facing society").

303 Major environmental laws such as the Clean Water Act and the Clean Air Act do not directly address siting by specifying the best location for a facility. *See* Rodger C. Field, *Siting, Justice, and the Environmental Laws*, 16 N. ILL. U. L. REV. 639, 645–46 (1996). Instead, the laws accept the proposed site as a given and set pollution standards based on the environmental characteristics of the area. *See id.* at 645.

304 For example, environmental justice advocates have criticized environmental law on the grounds that polluting facilities are sited more often in communities of color and poor communities, and general environmental standards do not adequately protect these communities. *See, e.g.*, Alice Kaswan, *Environmental Justice: Bridging the Gap Between Environmental Laws and "Justice,"* 47 AM. U. L. REV. 221, 268–75 (1997). For a specific critique of risk, see Robert R. Kuehn, *The Environmental Justice Implications of Quantitative Risk Assessment*, 1996 U. ILL. L. REV. 103, 119 (1996).

305 This typology builds off my earlier work on hydraulic fracturing policy. *See* Sara Gosman et al., *Chemical Use*, *in* HIGH VOLUME HYDRAULIC FRACTURING IN MICHIGAN: INTEGRATED ASSESSMENT FINAL REPORT 85, 85–86 (Sept. 2015), http://graham.umich.edu/media/pubs/HF-IA-Final-Report.pdf [https://perma.cc/X3XH-RZPW]. Risk scholars classify policies in different ways. *See, e.g.*, Andreas Klinke & Ortwin Renn, *A New Approach to Risk Evaluation and Management: Risk-Based, Precaution-Based, and Discourse-Based Strategies*, 22 RISK ANALYSIS 1071, 1071 (2002) (proposing three

Each policy approach chooses to intercede at a different point in the risk timeline, from before the risk-creating activity begins to after harm occurs. Underlying this choice are distinct risk philosophies—from policies that focus primarily on protecting the public and the environment to those that consciously allow some harm. Each approach is thus built on a particular characterization of risk, a judgment about the acceptability of risk, and an assumption about the efficacy of policy measures to respond to risk. While the approaches are conceptually independent, they are not mutually exclusive. A policymaker can apply multiple approaches to the same risk activity.

In the preventative approach, policymakers respond to risk through measures that avert harm.[306] At the extreme, a preventative policy embraces the strong version of the precautionary principle and prohibits an activity unless the risk creator can demonstrate that the activity would be safe.[307] More pragmatically, a preventative policy protects communities and the environment from the worst harms.[308] By seeking to prevent harm, the policy approach treats negative consequences as unacceptable—either because from a technocratic perspective the benefits of the activity do not justify the risks, or because the public perceives the risks to be intolerable regardless of the benefits. From a democratic governance perspective, the policy approach is particularly suited to "dread" risks that evoke significant public concern because they cause fatalities, create the potential for catastrophic outcomes, are not controllable, and do not equally distribute the risks and benefits.[309] The policy approach is also suited to

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strategies). The typology in this Article most closely resembles one by Professor Malloy, who divides chemical risk policies into "prevention based" and "conventional risk management," but I categorize certain policy measures differently and add a category of remedial approaches. *See generally* Timothy F. Malloy, *Principled Prevention*, 46 ARIZ. ST. L.J. 105 (2014) (identifying and evaluating structural approaches to risk policy).

[306] *See* NICOLAS DE SADELEER, ENVIRONMENTAL PRINCIPLES: FROM POLITICAL SLOGANS TO LEGAL RULES 61–90 (2002) (describing "the principle of prevention"); Malloy, *supra* note 305, at 109. Here, I use "prevention" to mean hazard avoidance. *See* John S. Applegate, *The Taming of the Precautionary Principle*, 27 WM. & MARY ENVTL. L. & POL'Y REV. 13, 36–39 (2002) (describing the hazard paradigm).

[307] *See* Jonathan B. Wiener, *Precaution in a Multi-Risk World*, *in* HUMAN AND ECOLOGICAL RISK: THEORY AND PRACTICE 1509, 1513–16 (Dennis J. Paustenbach ed., 2002) (describing different precaution models). For a discussion of the difference between prevention and precaution, see ARIE TROUWBORST, EVOLUTION AND STATUS OF THE PRECAUTIONARY PRINCIPLE IN INTERNATIONAL LAW 36–43 (Daniel Bodansky & David Freestone eds., 2002).

[308] *See* Malloy, *supra* note 305, at 149 (stating that "one can adopt a prevention-based approach without embracing the precautionary principle"); Robert V. Percival, *Who's Afraid of the Precautionary Principle?*, 23 PACE ENVTL. L. REV. 21, 36–75 (2005) (describing range of preventative or precautionary actions in U.S. environmental law).

[309] *See* Paul Slovic, *Perception of Risk*, 236 SCIENCE 280, 282–83 (1987); *cf.* CASS R. SUNSTEIN, LAWS OF FEAR: BEYOND THE PRECAUTIONARY PRINCIPLE 126–28 (2005) (arguing that policymakers should not necessarily respond to public fear of certain risks).

risks that are uncertain, in the sense that the probability cannot be calculated or the consequences are unknown.[310]

In the management approach, policymakers respond to risk through measures that limit the risk of harm. A management policy permits an activity to occur while imposing controls that reduce—but do not prevent—risk.[311] While the activity still has the potential to create harm, the risk is acceptable because the benefits of the activity outweigh the risks or the public perceives the risks to be tolerable. In a technocratic paradigm in which risks are just another policy problem to be competently managed, policymakers can adopt this approach to address a range of risks with different characteristics.[312] But because management depends on the presumption that policy measures can reliably reduce risk to an acceptable level,[313] the approach is best suited to regulating risk-creating activities with more familiar characteristics. From a democratic governance perspective, management is also appropriate for risks that do not evoke the same level of public concern—that is, they are controllable; voluntary; known to the public; have immediate, observable effects; or are more equitable in the distribution of risks and benefits.[314]

In the remedial approach, policymakers respond to risk through measures that reduce the harm after an accident. A remedial policy allows an activity but requires the risk creator to plan for emergencies and to take immediate action when harm occurs.[315] The approach accepts not only the presence of risk, but also the inevitability of some damage—because it presumes that remedial measures can lessen the consequences to an acceptable level.[316] It is best suited to respond to risks that create large benefits and cause the type of harm that can

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[310] The traditional formulation of the precautionary principle provides that policymakers should take action to prevent threats of serious or irreversible harm even in the face of scientific uncertainty. *See* Percival, *supra* note 308, at 22–36; *see also* Slovic, *supra* note 309, at 282–83 (describing the public's concern about "unknown" risks that are new, latent, or not observable).

[311] *See* Malloy, *supra* note 305, at 112 (describing conventional risk management as "setting 'acceptable' exposure levels and relying on engineering controls to achieve such levels").

[312] For descriptions of the acceptability of risk in the "risk paradigm," see SIDNEY A. SHAPIRO & ROBERT L. GLICKSMAN, RISK REGULATION AT RISK: RESTORING A PRAGMATIC APPROACH 3–13 (2003); John S. Applegate, *The Perils of Unreasonable Risk: Information, Regulatory Policy, and Toxic Substances Control*, 91 COLUM. L. REV. 261, 264–66 (1991).

[313] *Cf.* Malloy, *supra* note 305, at 134–35 (discussing potential ineffectiveness of control measures).

[314] *See* Slovic, *supra* note 309, at 282–83.

[315] *Cf.* Gary E. Marchant & Yvonne A. Stevens, *Resilience: A New Tool in the Risk Governance Toolbox for Emerging Technologies*, 51 U.C. DAVIS L. REV. 233, 235–36 (2017) (describing ex post governance tools such as liability and resilience as "attempting to mitigate or minimize, sometimes inevitable, harm after it occurs"); *see also* David B. Graham & Thomas D. Johns, *Emergency Response Planning: A Critical Investment*, 20 NAT. RESOURCES & ENV'T 49, 49–50 (2006).

[316] *Cf.* John Wyeth Griggs, *BP Gulf of Mexico Oil Spill*, 32 ENERGY L.J. 57, 63–68 (2011) (describing weaknesses in BP's spill response planning).

be easily controlled.[317] This approach can be combined with a management approach, since it addresses the remaining potential for harm. To the extent the approach is used by itself, it is suited to risks that create less significant consequences, such as activities that do not cause catastrophic harm, many fatalities, or widespread property damage.[318]

Energy pipelines benefit consumers and the economy, but they also pose catastrophic risks to populated and environmentally sensitive areas. Because a pipeline accident is more likely to cause extreme consequences than would be expected, the scale of a future accident is difficult to predict based on past events.[319] As companies build ever more pipelines across the United States, a preventative policy approach would seem best suited to addressing the risks to the areas where the consequences of an accident would be most severe.

But when the safety and siting frameworks are combined, they take a markedly constrained approach to prevention. The safety framework seeks to prevent risk using engineering standards that regulate the design, installation, and construction of pipelines.[320] Once the pipelines are constructed, the safety framework works backward to reduce the risks to a limited number of vulnerable areas through special requirements such as risk management programs.[321] The siting framework largely defers to the engineering and management standards in safety regulation, rather than take its own preventative approach. To address the inevitable accidents that follow management policies, the safety framework takes a remedial approach and requires pipeline operators to plan for emergencies and respond promptly.[322]

The frameworks treat risk as a technical problem in the physical pipeline systems and as a management problem in the organizations that operate those systems, not as a problem of incompatible land uses. This vision of risk reifies pipelines and organizations, extracting the problem from the particulars of the surrounding communities and environment. It frames the risk as controllable rather than catastrophic, and places decision-making in the hands of experts instead of land use planners. Finally, it presumes that the policy measures can effectively reduce risk to an acceptable level, putting faith in the engineering standards and technologies that prevent and reduce risk—as well as in remedial measures to minimize the effects of a spill or release.

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[317] *See* Marchant & Stevens, *supra* note 315, at 246 (arguing that ex post governance is appropriate for technologies that have major net safety benefits but also cause accidents).

[318] *See* Slovic, *supra* note 309, at 282–83.

[319] *Cf.* W. Kip Viscusi & Richard J. Zeckhauser, *Deterring and Compensating Oil-Spill Catastrophes: The Need for Strict and Two-Tier Liability*, 64 VAND. L. REV. 1717, 1734 (2011) ("There are two implications of catastrophes being characterized by fat-tailed distributions. First, where disasters are concerned, the past may not be prologue. A future disaster could easily be many times worse. Second, a single extreme outcome may readily account for most of the losses from a particular type of catastrophe.").

[320] *See, e.g.*, 49 C.F.R. §§ 192.51–329, 195.100–.264.

[321] *Id.* §§ 192.901–.951, .1001–.1015, 195.452.

[322] *Id.* §§ 192.605(a), (e), .615, 195.402(a), (e).

In viewing the risk problem as a pipeline problem or an operator management problem, the frameworks follow an approach that emerged from the pipeline industry. The division between "safety" and "siting" began in the industry's safety codes. Originally, the pipeline industry regulated safety itself, using standards developed by private standard-setting organizations.[323] The codes viewed risk as a private engineering decision, not as a public decision about land use. They assumed that an operator had already selected a route and addressed the risk through technical and operational requirements.[324] In the 1950s, the states began adopting the codes as safety regulations for public utilities.[325] Congress accepted this narrow vision of safety and gave the new Department of Transportation authority to set standards for natural gas pipelines,[326] then adopted the same approach for liquid pipelines.[327]

Siting laws, where they exist, primarily treat pipelines as inert construction projects. They seek to prevent and mitigate short-term "effects" more than long-term risk. Indeed, states that regulate the siting of both gas and liquid transmission pipelines use the same criteria, indicating that the focus of the laws is on the pipeline more than on the product it transports. Only one state—North Dakota—has adopted a completely preventative approach to ensure that transmission pipelines will not harm protected areas. But even this siting law takes a relatively narrow approach to prevention that appears to be focused on construction effects. The excluded areas are lands that have already been protected for their recreational or historical value by the federal government or state: national and state parks, historic sites, and wilderness areas.[328] The only private lands that are excluded are those that serve as habitat for threatened, endangered, unique, or rare species.[329]

In theory, laws that require agencies to analyze alternatives to the route of a pipeline should lead to pipelines that are sited away from vulnerable areas. Under NEPA and similar "stop and think" state laws, agencies must compare the environmental effects of the proposal against the alternatives.[330] Several of the pipeline siting laws also require the decision-maker to consider alternate routes.[331] Even if the laws do not mandate approval of the route with the least

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323 *See* FED. POWER COMM'N, 89TH CONG., SAFETY OF INTERSTATE NATURAL GAS PIPELINES 5–6 (Comm. Print 1966).

324 *See id.* at 5 (describing the industry code for natural gas pipelines as a "consensus of informed engineering judgment as to minimum construction requirements for safety").

325 *Id.* at 126–27 tbls.3 & 4.

326 Natural Gas Pipeline Safety Act of 1968, Pub. L. No. 90-481, 82 Stat. 720.

327 Pipeline Safety Act of 1979, Pub. L. No. 96-129, 93 Stat. 989.

328 N.D. ADMIN. CODE 69-06-08-02(1) (2019).

329 *Id.*

330 *See* 42 U.S.C. § 4332(C) (2012); Sierra Club v. FERC, 867 F.3d 1357, 1367 (D.C. Cir. 2017). State laws include the California Environmental Quality Act, CAL. PUB. RES. CODE §§ 21000 *et seq.* (West 2016).

331 *See, e.g.*, CONN. GEN. STAT. § 16-50*l*(a)(1)(D) (Supp. 2019); FLA. STAT. ANN. § 403.9412 (West 2015); IOWA CODE ANN. § 479.6(8) (West 2009); N.H. REV. STAT. ANN. § 162-H:7(V)(b) (2014).

impacts, the analysis should create external and internal pressure on the agency to make the best decision.[332] In practice, however, the evaluation of alternatives is limited by the same divide between siting and safety. In FERC's environmental analysis of the Rover pipeline, for example, the commission compared the surface environmental impacts of the alternative routes but not the consequences of an accident.[333] When FERC evaluated the safety of the pipeline, it took the location of the pipeline as a given and relied on PHMSA's more stringent design and management standards to control the risk of accidents in more densely populated areas.[334] FERC ultimately concluded "that [the pipeline] would represent a slight increase in risk to the nearby public."[335] This conclusion points to a deeper concern about using laws such as NEPA to compare risks. It is particularly difficult for agencies to predict low-probability, high-consequence events in a changing risk landscape because the frequency and consequences of accidents in the past do not necessarily predict the future.[336]

B. *The Results*

The failure of risk governance to take a robust preventative policy approach to the catastrophic risks posed by energy pipelines to vulnerable areas creates four negative effects: (1) it leads to more pipeline accidents that cause the worst harms; (2) it places a significant burden on the public and local governments to manage risk; (3) it relies disproportionately on emergency response measures to mitigate harm; and (4) it encourages pipeline operators to build more pipelines than is efficient.

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[332] *See* Robertson v. Methow Valley Citizens Council, 490 U.S. 332, 349 (1989) (explaining that environmental analysis forces action by "ensur[ing] that the agency . . . will . . . carefully consider . . . detailed information concerning significant environmental impacts . . . [and] guarantee[ing] that the relevant information will be made available to the larger audience that may also play a role in both the decisionmaking process and the implementation of that decision").

[333] FED. ENERGY REGULATORY COMM'N, FERC/FEIS-0267F, ROVER PIPELINE, PANHANDLE BACKHAUL, AND TRUNKLINE BACKHAUL PROJECTS: FINAL ENVIRONMENTAL IMPACT STATEMENT 3-10 to -35 (July 2016), https://www.ferc.gov/industries/gas/enviro/eis/2016/07-29-16-rover-pipeline/impact-statement.pdf [https://perma.cc/YV7V-87SV] [hereinafter FERC, ROVER PIPELINE FINAL EIS]. The criteria included residences within 50 feet, but this criterion must have measured nuisance impacts; the potential impact radius of an explosion is 628 to 1100 feet. *Id.* at 4-270.

[334] *Id.* at 4-258 to -267.

[335] *Id.* at 4-264 to -266, -271. The Commission also presented a risk ladder that showed that the annual number of deaths from tractor turnovers was higher than the deaths from natural gas pipelines, a statistic unlikely to sway anyone concerned about the involuntary risks of pipelines. *Id.* at 4-271.

[336] *See* Jamison E. Colburn, *Necessarily Unpredictable? Oil Spill Risks Beyond the Horizon*, 30 MISS. C. L. REV. 307, 328 (2011) (explaining the challenges of assessing low-probability, high-consequence risks under NEPA and contending that frequentist data from past accidents fails to predict unprecedented events like Deepwater Horizon).

First, the lack of a preventative approach leads to more pipeline accidents and to more catastrophic harm to the environment and the public from pipeline accidents. Because the regulatory frameworks do not require the risk of an accident to be taken into account when a pipeline is sited, it is not surprising that operators continue to build energy pipelines in or near highly populated and environmentally sensitive areas when it makes economic sense to do so.[337] Approximately 7% of natural gas transmission pipelines and 42% of hazardous liquid transmission pipelines are located in areas where PHMSA has determined that an accident could have significant consequences.[338] And during the energy revolution, companies have continued to build transmission pipelines—particularly the interstate pipelines that are more likely to pose significant risks—in high-consequence areas at the same pace as pipelines in other areas.[339] Of course, pipelines must sometimes be built in a specific location.[340] But operators appear to have significant latitude to choose the path from one point to another, particularly when they construct new "greenfield" projects.[341] For large projects such as the Keystone XL pipeline, operators have proposed

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[337] Operators contend that they select routes to avoid vulnerable areas. *See, e.g.*, INGAA FOUND., BUILDING INTERSTATE NATURAL GAS TRANSMISSION PIPELINES: A PRIMER 8–9 (Jan. 2013), https://www.ingaa.org/file.aspx?id=19618 [https://perma.cc/3RL5-GFL5]. Operators would have a strong incentive to take preventative actions to protect areas such as wetlands that are subject to environmental regulation. From an economic perspective, operators would use private risk governance to protect other areas when the social or expected liability costs of siting the pipeline in that location outweigh the economic benefits. Judging from the data, these costs are not high enough to encourage operators to avoid high-consequence areas.

[338] As described *supra* in Part III.B., a "high-consequence area" is an imperfect measure of potential harm. For natural gas pipelines, the measure likely understates the risk of catastrophic harm because the definition only includes very densely populated areas. For hazardous liquid pipelines, the measure is both over- and under-inclusive. The definition currently includes a pipeline if an accident could affect a municipal census tract but not if it could affect the Great Lakes. *See* Pipeline Safety: Public Meeting on Unusually Sensitive Area Definitions and Pipeline Awareness and Engagement, 84 Fed. Reg. 24,593, 24,593 (May 28, 2019) (stating that PHMSA is considering how to include the Great Lakes, coastal beaches, and marine coastal waters in its definition in order to meet a 2016 statutory requirement).

[339] *HL IM Performance Measures*, *supra* note 221 (follow "HL IM reporting data" hyperlink, then select "Interstate" from drop-down menu) (reporting that interstate hazardous liquid pipelines in or near high-consequence areas grew from 53,491.33 miles in 2010 to 66,101.81 miles in 2018); *GT IM Performance Measures*, *supra* note 219 (follow "GT IM Assessment" hyperlink, then select "Interstate" from drop-down menu) (reporting that interstate gas transmission pipelines in high-consequence areas grew from 8035.28 miles in 2010 to 9258.86 miles in 2018). The proportion of interstate pipelines that could affect high-consequence areas to total pipelines has remained roughly the same.

[340] For example, natural gas distribution pipelines, which provide natural gas to residences and businesses, will by necessity be located in densely populated areas. But the same is not generally true of transmission pipelines.

[341] *Cf.* INGAA FOUND., *supra* note 337, at 10 ("'[G]reenfield,' or new, projects may have more routing flexibility when the pipelines cover long distances.").

substantial changes to the pipeline route when required to submit route alternatives to a federal or state agency.[342]

According to PHMSA's accident data, pipelines located in high-consequence areas are more likely to have spills or releases than pipelines located in other, "low-consequence" areas.[343] This is in part because the external threats to pipelines are greater in such areas.[344] But even if the likelihood of an accident were the same in both types of areas, the siting of a pipeline in a high-consequence area instead of a low-consequence area would result in greater harm over the long term. A spill or release from a pipeline in a high-consequence area is, by definition, more likely to cause severe effects than the same accident in a low-consequence area.[345]

PHMSA has tried to reduce the risk of accidents in high-consequence areas by requiring operators to develop integrity management programs to identify, assess, and manage threats to the integrity of their pipelines.[346] Even putting aside the limited number of communities and natural resources protected by these programs, the effectiveness of the approach to risk is debatable. If the programs were designed to deter operators from siting new pipelines in high-consequence areas, the additional cost of the requirements does not appear to have altered the operators' decisions. Nor have these risk management programs been successful in lowering the number of accidents or the total amount of damage; the rate of transmission pipeline accidents in high-consequence areas has stayed the same or increased since the programs went into effect.[347] Indeed, the incidents that have caused the greatest harm have occurred recently and in high-consequence areas.[348]

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342 *See, e.g.*, Application, Transcanada Keystone Pipeline, L.P., Neb. Pub. Serv. Comm'n, No. OP-0003, at 2–8 (2017) (describing alternative routes).

343 *See HL IM Performance Measures*, *supra* note 221 (follow "HL IM reporting data" hyperlink); *National Pipeline Performance Measures*, *supra* note 177 (follow "Onshore Significant Incident HCA" hyperlink).

344 *See National Pipeline Performance Measures*, *supra* note 177 (follow "Onshore Significant Incident HCA" hyperlink) (noting that "[s]ince [high-consequence areas] are typically developed areas, [natural gas transmission] pipelines have increased integrity risks from excavation and outside force damage").

345 *See* Pipeline Safety: Pipeline Integrity Management in High Consequence Areas, 65 Fed. Reg. 21,695, 21,699 (proposed Apr. 24, 2000) (to be codified at 49 C.F.R. pt. 195) (describing "high consequence areas" as areas where "a pipeline failure could pose the greatest threat to public safety, the environment, and water commerce").

346 49 C.F.R. §§ 192.901–.951 (natural gas transmission pipelines), .1001–.1015 (natural gas distribution pipelines), 195.450, .452 (hazardous liquid pipelines) (2019).

347 RICK KOWALEWSKI, PIPELINE INTEGRITY MANAGEMENT: A REPORT TO THE SECRETARY OF TRANSPORTATION 24–25 (Oct. 2013), http://pstrust.org/wp-content/uploads/2015/10/Kowalewski-IM-PE_Report.pdf [https://perma.cc/5W8J-3SDW]; NAT'L TRANSP. SAFETY BD., NTSB/SS-15/01, SAFETY STUDY: INTEGRITY MANAGEMENT OF GAS TRANSMISSION PIPELINES IN HIGH CONSEQUENCE AREAS 65 (Jan. 2015), https://www.ntsb.gov/safety/safety-studies/Documents/SS1501.pdf [https://perma.cc/7GH9-5LYE].

348 KOWALEWSKI, *supra* note 347, at 25–27.

Second, the lack of a preventative approach to siting shifts the responsibility for preventing pipeline accidents from pipeline operators to landowners, nearby residents, and local governments. Rather than requiring operators to site pipelines away from people, the regulatory system relies heavily on the people exposed to risk to protect pipelines. This includes landowners who involuntarily encounter the risk because their property has been taken through eminent domain.[349] PHMSA supports this shift by requiring pipeline operators to develop "public awareness" programs.[350] The purpose of these programs is to educate residents about the hazards associated with pipelines and to enlist them as partners in safety so they will refrain from activities that damage the pipeline and monitor the right-of-way for any threats.[351] The effectiveness of the operators' programs is questionable.[352] Local governments are also expected to manage the risks of existing pipelines through zoning and planning requirements. PHMSA recommends that local governments require developers to consult with pipeline operators and restrict land uses that could interfere with pipelines.[353] The burden of reducing risk is thus on the community surrounding the pipeline. In practice, localities often do not curb incompatible land uses, because officials are not aware of the risk or because such restrictions are politically unpopular.[354]

Third, the lack of a preventative approach puts extraordinary pressure on mitigation strategies to address the effects of accidents. PHMSA requires

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[349] As other scholars have explored, pipeline companies generally have the authority to exercise eminent domain to site pipelines under either federal or state law. *See* Klass & Meinhardt, *supra* note 36, at 951.

[350] 49 C.F.R. §§ 192.616, 195.440 (2019).

[351] AM. PETROLEUM INST., API RECOMMENDED PRACTICE 1162: PUBLIC AWARENESS OF PROGRAMS FOR PIPELINE OPERATORS 3–4 (Dec. 2003), https://law.resource.org/pub/us/cfr/ibr/002/api.1162.2003.pdf [https://perma.cc/RQX3-Q64P] (incorporated by reference in 49 C.F.R. §§ 192.616, 195.440).

[352] *See* NAT'L TRANSP. SAFETY BD., ENBRIDGE REPORT, *supra* note 184, at 43 tbl.1 (noting the results of a survey measuring the effectiveness of the public awareness program, in which only 23% of the affected public, 39% of public officials, and 47% of emergency officials said that they were "very well informed" about pipelines in their community); NAT'L TRANSP. SAFETY BD., SAN BRUNO REPORT, *supra* note 182, at 59 (noting the results of a survey measuring the effectiveness of the public awareness program, in which "the affected public was [the operator's] least informed audience," with 89% reporting that "they did not recall receiving information" from the operator and 34% reporting that they considered themselves "somewhat or very well informed").

[353] *See, e.g.*, *PIPA Audience: Local Government*, PIPELINE & HAZARDOUS MATERIALS SAFETY ADMIN., http://primis.phmsa.dot.gov/comm/PIPA/pipa_audience_local_government.htm [https://perma.cc/L2U3-79PK].

[354] *See, e.g.*, COMM. FOR PIPELINES & PUB. SAFETY, TRANSP. RESEARCH BD. OF THE NAT'L ACADS., TRANSMISSION PIPELINES AND LAND USE: A RISK-INFORMED APPROACH 36 (2004), http://onlinepubs.trb.org/onlinepubs/sr/sr281.pdf [https://perma.cc/MF4L-J4CY] ("[A]necdotal evidence of building development, including schools, adjacent to transmission pipelines suggests that managing the risks to the public near pipelines has not been considered by many local governments.").

pipeline operators to develop emergency plans with written procedures that detail how the operators will respond to an emergency.[355] The operator must train its employees to follow the procedures.[356] It must also establish a liaison with local emergency responders so that they can coordinate efforts when there is an incident.[357] In addition, operators of oil pipelines must prepare a plan that identifies the resources that are available to clean up a "worst case discharge."[358] In practice, operators have found it difficult to put the procedures into action and respond quickly to incidents.[359] Overburdened fire departments and other emergency officials often do not understand the hazards of pipelines and how to respond to emergencies, either because the operator has failed to adequately train them or because the officials did not take the time to attend trainings.[360] And even if the system worked perfectly, there is a limit to mitigation as policy approach. Natural gas explosions, for example, will immediately destroy the buildings within the zone of impact.[361]

Fourth, the lack of a preventative approach results in a greater number of pipelines than is economically efficient. When the operator is deemed a common carrier and there is no review of the need for the pipeline or alternative routes, the absence of a governance mechanism to consider long-term risks will lead to overbuilding. An efficient system of risk governance would require a pipeline operator to fully weigh the cost of the risk of a spill or release against the benefits in deciding whether to build a pipeline in a particular location.[362] Pipeline operators may have at least some incentive to site their pipelines in a way that minimizes their liability for future damages.[363] But given the difficulty

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[355] 49 C.F.R. §§ 192.615, 195.402–.403.

[356] *Id.* § 192.615(b)(2).

[357] *Id.* §§ 192.615(c), 195.402(c)(12).

[358] *Id.* §§ 194.101, .105.

[359] *See* NAT'L TRANSP. SAFETY BD., ENBRIDGE REPORT, *supra* note 184, at 8–18; NAT'L TRANSP. SAFETY BD., SAN BRUNO REPORT, *supra* note 182, at 98–99.

[360] *See* NAT'L TRANSP. SAFETY BD., ENBRIDGE REPORT, *supra* note 184, at 105; NAT'L TRANSP. SAFETY BD., SAN BRUNO REPORT, *supra* note 182, at 77 (noting that the fire chief of the city did not know there was a pipeline in that location).

[361] *See, e.g.*, NAT'L TRANSP. SAFETY BD., NTSB/PAR-14/01, PIPELINE ACCIDENT REPORT: COLUMBIA GAS TRANSMISSION CORPORATION PIPELINE RUPTURE, SISSONVILLE, WEST VIRGINIA 3 (Feb. 2014), https://www.ntsb.gov/investigations/AccidentReports/Reports/PAR1401.pdf [https://perma.cc/AKJ3-WC9T] (describing a natural gas transmission pipeline accident, which burned an area 820 feet wide and nearly 1100 feet long and destroyed three houses).

[362] *Cf.* Russell S. Jutlah, *Economic Theory and the Environment*, 12 VILL. ENVTL. L.J. 1, 14 (2001) (stating that "the objective [of environmental economics] is to achieve a socially optimal allocation of resources by ensuring that polluters, and others whose activities may adversely affect environmental quality, bear the full costs that their activities may impose").

[363] *Cf.* Viscusi & Zeckhauser, *supra* note 319, at 1737–38 (describing the "conventional retrospective liability approach," in which "payment for all damages leads the injurer to internalize costs and to take appropriate levels of care").

in predicting the consequences of an accident, it seems unlikely that liability results in full internalization of the cost of risk.[364]

Even when the operator is required to obtain approval for a route from FERC or state governments, there will still be too many pipelines. This is because decision-makers do not consider the risks of an accident to be a part of economic regulation. For example, FERC frames the economic inquiry as whether existing customers will subsidize the pipeline project and the extent to which customers and property owners will bear additional financial costs.[365] The risk of long-term spills and releases should affect the economic calculus and thus the public need for the pipeline. FERC is already criticized for approving too many projects,[366] but critics have not focused on the treatment of risk as a cause.[367]

C. *Three Potential Solutions*

To avoid these results, the siting and safety frameworks should adopt a more preventative approach to the risks of energy pipelines. This Article sketches three potential policy solutions: a policy that sets aside protected areas, a policy that returns decision-making to landowners and municipal governments, and a policy that combines safety and siting decisions. It concludes that the third solution provides the greatest benefits to communities and the environment. At the very least, this policy should apply to gas and hazardous liquid transmission pipelines as well as larger gas and oil gathering pipelines that effectively create the same risks as transmission lines. This would capture most of the projects that will be built in the next few decades, as well as the types of pipelines that are most likely to have a flexible route.

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[364] *Cf. id.* at 1738 (arguing that it is difficult to determine the magnitude of harm when there is a catastrophic accident).

[365] Certification of New Interstate Natural Gas Pipeline Facilities, 88 FERC ¶ 61,227, at 19 (1999) (describing the initial assessment of adverse effects as "essentially an economic test" and explaining that "[o]nly when the benefits outweigh the adverse effects on economic interests will the Commission then proceed to complete the environmental analysis where other interests are considered").

[366] Since 1999, FERC has denied only two applications under Section 7 of the Natural Gas Act. SUSAN TIERNEY, ANALYSIS GRP., NATURAL GAS PIPELINE CERTIFICATION: POLICY CONSIDERATIONS FOR A CHANGING INDUSTRY 12–13 (Nov. 2017), https://www.analysisgroup.com/uploadedfiles/content/insights/publishing/ag_ferc_natural_gas_pipeline_certification.pdf [https://perma.cc/H6T5-PCMY].

[367] *See, e.g.*, CATHY KUNKEL & TOM SANZILLO, INST. FOR ENERGY ECONS. & FIN. ANALYSIS, RISKS ASSOCIATED WITH NATURAL GAS PIPELINE EXPANSION IN APPALACHIA 1 (Apr. 2016), http://ieefa.org/wp-content/uploads/2016/04/Risks-Associated-With-Natural-Gas-Pipeline-Expansion-in-Appalachia-_April-2016.pdf [https://perma.cc/H2K6-93LM] (arguing that FERC's allowed rate of return on equity and a lack of comprehensive planning encourage overbuilding, and concluding that so many new pipelines create a significant safety issue for landowners).

One policy solution is to follow the North Dakota model and create exclusion and avoidance areas. Under this policy, FERC and the states that choose to regulate siting would prohibit companies from siting pipelines in certain exclusion areas that are vulnerable to significant harm in an accident. Companies would also be required to avoid areas that were vulnerable to moderate harm unless there were no reasonable alternative. Because the policy would specifically focus on the risk of spills and releases, it would encompass pipelines sited outside of vulnerable areas if a worst-case release could impact the areas. This expansion would prevent companies from manipulating the system by building pipelines that skirt sensitive features yet still pose risks.

Each jurisdiction could choose the areas it would protect. Alternatively, federal and state environmental, natural resource, and public health agencies could work together to establish risk-based criteria for designating vulnerable areas, taking into account the type of pipeline and the risks posed by different products. Each decision-maker would then apply the criteria to the areas within its jurisdiction. The policy could also draw on local knowledge by allowing local governments to nominate areas within their jurisdictions for consideration. If the governance process limits exclusions to locations where an accident would cause the most significant consequences, any exception to the prohibition should be narrow. For example, it could allow only those projects that have a demonstrated need to be in the area or that would pose greater risks to communities and the environment if they were required to use alternative routes.

The benefits of this policy solution are that it would fit easily into the current regulatory frameworks, and it would take a completely preventative approach to risk by protecting sensitive areas from potential harm. This would reduce the number of accidents with significant consequences and free landowners and communities from the burdens of managing the risk and responding to accidents. But the policy would treat the safety of pipelines as a dichotomous choice between no harm and the risk of an accident. And the larger the protected area, the greater the pressure would be to make exceptions to the policy. Based on the North Dakota Public Service Commission's implementation of the law, the decision-maker may find it challenging to protect areas when companies contend that it is necessary to site the pipeline in that location. This is particularly true because the decision-maker is likely to be hampered by information asymmetry; the pipeline company would have much more information about the need for the route and the characteristics of alternative routes than would the agency.

Another solution would be to transfer the governance of siting to landowners and local governments. This policy would remove the power of condemnation from pipeline companies and give local governments the authority to regulate pipelines like any other land use under their zoning and planning laws. Federal and state agencies would retain jurisdiction over pipeline safety and public lands, but landowners and local governments would exert primary decision-making power over the pipeline route. The result would be a siting framework in which private landowners would decide the level of acceptable risk, subject to local land use requirements. A version of this policy solution is already being implemented by Indian tribes, who have sovereign authority to decide whether to grant rights-of-way to pipeline companies and who may set conditions or restrictions on the approval.[368]

The benefits of this policy solution are that it would internalize the social costs of a pipeline project by requiring companies to pay for the use of property and for the imposition of risk. Agreements could be structured to include yearly risk payments, which would more accurately reflect the cost of the pipeline operation.[369] This would result in an efficient number of pipelines. But the effectiveness of the policy solution depends on whether individuals and local governments have enough information to make a decision on the acceptability of the risk. It is also possible that important pipeline projects that serve a public need would not be built because companies would be unable to obtain easements from holdouts.[370] This is a potential problem, but it is not clear that it would be an insuperable hurdle for projects. Pipeline companies are currently siting projects in a few states without the power of eminent domain, presumably by paying more for the privilege.[371]

This policy solution would not necessarily reduce the number of accidents or the burden of accidents on communities. Some individual property owners may choose not to allow pipelines in vulnerable areas or may be more likely to detect a problem because they appreciated the risk. In the absence of these private actions, it would be up to local governments to protect the community by adopting planning and zoning requirements. For example, local governments could adopt a minimum setback requirement for new pipelines and require that any developments in the area around the pipeline obtain prior approval from the zoning authority. But these actions would be dependent on the capacity of local

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[368] *See* 25 C.F.R. § 169.107(a) (2019) (acknowledging that applicants for rights-of-way must obtain consent from tribes if the project is on tribal land).

[369] In Wyoming, courts may award yearly payments to landowners for the taking of an easement under the state's eminent domain statute. *See* Barlow Ranch, Ltd. P'ship v. Greencore Pipeline Co., 301 P.3d 75, 103 (Wyo. 2013); *see also* Kelianne Chamberlain, *Unjust Compensation: Allowing a Revenue-Based Approach to Pipeline Takings*, 14 WYO. L. REV. 77, 95–98 (2014) (arguing that landowners should receive annual payments tied to revenue as compensation).

[370] *See* Coleman & Klass, *supra* note 38, at 717.

[371] For example, in 2012, the Colorado Supreme Court held that companies may not exercise eminent domain authority to site oil pipelines in the state. Larson v. Sinclair Transp. Co., 284 P.3d 42, 46 (Colo. 2012) (en banc); *see also* Klass & Meinhardt, *supra* note 36, at 987. Yet operators have built 1157 miles of oil pipeline in Colorado since 2012. *Pipeline Mileage and Facilities*, *supra* note 67. In Pennsylvania, companies have sited thousands of miles of gathering pipelines without eminent domain. *See* 66 PA. CONS. STAT. § 1104 (2000) (requiring a public utility to obtain a certificate of public convenience before exercising the power of eminent domain). *But see* Press Release, Penn. Pub. Util. Comm'n, PUC Continues Consideration of Laser Northeast Gathering Co. Application (May 19, 2011), http://www.puc.state.pa.us/about_puc/press_releases.aspx?ShowPR=2759 [https://perma.cc/MGD7-6459] (describing 3-2 decision to grant a certificate to a gathering pipeline company).

governments to understand the risk and to make informed decisions that protect the public and environment.

A final policy solution would be to combine the safety and siting frameworks into one risk governance system. Unlike the other solutions, this policy would grant a single agency the authority to review all of the risks of a pipeline project—from the risks of harm to the environment caused by construction, to the risks of operation, to the risks of an accident to individuals and property. The agency would then approve the pipeline if the location and the safety measures together made the risk acceptable. PHMSA would be the best agency to regulate the route and safety of gas and liquid interstate transmission pipelines because of its expertise on pipeline risk, while the states could regulate intrastate transmission lines.

The primary benefit of this policy is that the agency would make more knowledgeable and comprehensive decisions about pipeline risk. In contrast to the current system and the other policy solutions, the decision-maker would be able to consider the entire life cycle of risk at the beginning of the project, from the location to the operation to the consequences of accidents. This comprehensive review would result in pipelines that have fewer accidents with less significant consequences, create less of a burden on communities and landowners to manage risk, and required fewer emergency response measures. The policy would also improve economic efficiency by ensuring that only those pipelines that create an acceptable risk would be built.

One potential criticism is that the comprehensiveness of the review may delay the approval of worthy projects. FERC addresses this issue by offering the option of pre-filing procedures.[372] PHMSA and the states could also look to the Nuclear Regulatory Commission's (NRC's) regulation of nuclear power plants as a model.[373] The NRC regulates all risks associated with the plants, from siting, to design, to operation, to the final stage of decommissioning.[374] To streamline the process, however, the NRC allows operators to apply for an early site permit. The commission weighs safety issues related to the location, effects on the environment, and emergency planning in the permitting decision.[375] The risks posed solely by the design and operation of the plant are then evaluated in separate proceedings.[376]

This solution would no doubt face political hurdles. The states would likely oppose any attempt to give jurisdiction over the siting of interstate oil and hydrocarbon liquid pipelines to the federal government, even if the states were given more authority over the risks of siting intrastate pipelines in return. FERC may not be any more amenable to relinquishing its authority over the siting of natural gas pipelines, though it could retain economic regulation of the lines. But the second option would transfer even more authority from state and federal

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[372] 18 CFR § 157.21 (2018).
[373] 42 U.S.C. §§ 2011–2296b (2016).
[374] *Id.* §§ 2133, 2137.
[375] 10 C.F.R. §§ 52.12–.39 (2019).
[376] *Id.* §§ 52.41–.63 (design certification), .71–.110 (combined licenses).

agencies to local governments and individuals. And setting aside their parochial interests, all of the government agencies must recognize that the current system is not successful.

V. Conclusion

The United States is in the midst of a radical reshaping of energy pipeline networks that will create a new landscape of risk for decades to come. The recent controversies surrounding pipelines demonstrate that the public is deeply skeptical of risk decisions made by government agencies and pipeline companies. Yet the legal frameworks governing the siting and safety of these pipelines fail to use the one tool that would prevent the worst harms to communities and the environment—preventative land-use planning. This failure is based on a shuttered vision of pipelines as self-contained systems that can be placed in almost any location with the right safety devices. It is time for risk governance to expand its remit, thus matching the geographic scope and optimism of the domestic energy revolution.