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Article

Prospective Grandfathering: Anticipating the Energy Transition Problem

Christopher Serkin[†] & Michael P. Vandenberg^{††}

INTRODUCTION

Legal change poses familiar but difficult problems for the legal system.¹ New regulatory regimes can disrupt settled expectations and property rights.² The Takings Clause seeks to temper the most extreme costs of such legal change, and in the process can constrain governments' ability and willingness to adopt new laws and regulations.³ Even unsuccessful takings claims—or the threat of takings claims—can exert significant political pressure, to the extent they implicate commitments to fairness and freedom from government intrusion and reflect legitimate-seeming grievances by property owners.⁴

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1. See Louis Kaplow, *An Economic Analysis of Legal Transitions*, 99 HARV. L. REV. 509, 517 (1986); see also *infra* note 191 (citing and discussing “legal transitions” literature).

2. Laura S. Underkuffler, *Property and Change: The Constitutional Conundrum*, 91 TEX. L. REV. 2015, 2015 (2013).

3. U.S. CONST. amend. V (“[N]or shall private property be taken for public use, without just compensation.”).

4. See discussion *infra* Part II.

The interaction between property rights and legal transitions is frequently fraught and fiercely contested. In the typical situation, property owners object to newly imposed burdens following some change in the law.⁵ But what if the need for legal change can be anticipated far in advance—years, or even decades before new rules and regulations are adopted? Are there tools available to the government *ex ante* that will preserve regulatory flexibility in the future by forestalling regulatory takings claims and blunt the fairness concerns that fuel takings arguments in public debates? This Article identifies just such tools and argues for their adoption specifically in the context of natural gas regulation. Natural gas presents an urgent and fascinating example precisely because we can predict the need for strict new regulations in the future, while simultaneously embracing the trend towards expanding use of natural gas today. This Article therefore examines the problem of natural gas in detail, both because it is independently important and because it reveals the ways in which careful planning for the future can disarm property rights as a basis for objecting to necessary legal change in other regulatory contexts.

Power generation in the United States is undergoing profound changes as new methods of producing natural gas drive down costs while regulatory and other pressures on coal-fired power plants precipitate a shift away from coal-generated power. Generating a kilowatt of electricity by burning natural gas releases roughly half as much carbon dioxide (CO₂) as generating a kilowatt from coal, and a complete switch of electricity generation from coal to natural gas will prevent more than 700 million metric tons (MMT) of CO₂ emissions annually.⁶ In the face of this difference, many experts are advocating for the large-scale adoption of natural gas as quickly as possible.⁷

5. See, e.g., *infra* text accompanying notes 111–12 (discussing the coal industry's objection to the Obama Administration's Clean Power Plan).

6. Calculation based on data from U.S. ENERGY INFO. ADMIN., U.S. DEP'T OF ENERGY, *ELECTRIC POWER MONTHLY WITH DATA FOR OCTOBER 2016* tbl.1.1 (2016), <https://www.eia.gov/electricity/monthly/archive/december2016.pdf>; *Frequently Asked Questions: How Much Carbon Dioxide Is Produced per Kilowatt-Hour when Generating Electricity with Fossil Fuels?*, U.S. ENERGY INFO. ADMIN. [hereinafter *FAQ*], <https://www.eia.gov/tools/faqs/faq.php?id=74&t=11> (last reviewed June 8, 2017).

7. See, e.g., Jay Apt, *The Other Reason To Shift Away from Coal: Air Pollution That Kills Thousands Every Year*, *SCI. AM.: THE CONVERSATION* (June 7, 2017), <https://www.scientificamerican.com/article/the-other-reason-to-shift-away-from-coal-air-pollution-that-kills-thousands-every-year> (arguing that a shift to natural gas will, *inter alia*, improve public health).

The transition from coal is underway, and natural gas is ascendant. Although deregulatory efforts by the new administration may have an effect, the increased use of natural gas is expected to continue even if the federal government continues to back off of regulations designed to reduce coal-fired power generation over the next four to eight years.⁸ Deregulatory efforts directed at natural gas fracking will only accelerate the process by reducing the cost of natural gas. In addition, roughly one-third of all states, including California and New York, can be expected to continue to pursue climate-mitigation regulatory initiatives, which will combine with the declining cost of natural gas and renewables and the increasing pressure from major corporate buyers of renewable energy to reduce demand for coal-fired power regardless of the status of the so-called regulatory War on Coal.⁹

Natural gas is still a fossil fuel, however, and despite the carbon savings over coal, energy generated by natural gas is still expected to produce 1685 MMT of CO₂ in the year 2030, and 1835 MMT of CO₂ in 2040.¹⁰ Natural gas is therefore a bridge fuel.¹¹ It is a step along the path to a zero-carbon energy supply. But experts anticipate that substantially reducing the risk of catastrophic climate change will require meeting a target of no more than a two-degree-centigrade global temperature increase over preindustrial levels (the goal adopted in the Paris Agreement).¹²

8. U.S. ENERGY INFO. ADMIN., U.S. DEP'T OF ENERGY, ANNUAL ENERGY OUTLOOK 2017 WITH PROJECTIONS TO 2050, at 69 (2017), [https://www.eia.gov/outlooks/aeo/pdf/0383\(2017\).pdf](https://www.eia.gov/outlooks/aeo/pdf/0383(2017).pdf) (projecting that natural gas use for electricity generation over the 2016 to 2040 period would have increased more with implementation of the Clean Power Plan, as assumed by the Reference Case, but increased during this period even in the absence of the Clean Power Plan, as assumed in the No Clean Power Plan cases). Although certainly not a disinterested analyst, then-President Barack Obama published a policy forum essay in *Science* in which he projected that “[b]ecause the cost of new electricity generation using natural gas is projected to remain low relative to coal, it is unlikely that utilities will change course and choose to build coal-fired power plants, which would be more expensive than natural gas plants, regardless of any near-term changes in federal policy.” Barack Obama, *The Irreversible Momentum of Clean Energy*, 355 *SCIENCE* 126, 128 (2017).

9. See discussion *infra* Part I.B.

10. U.S. ENERGY INFO. ADMIN., U.S. DEP'T OF ENERGY, ANNUAL ENERGY OUTLOOK 2016 WITH PROJECTIONS TO 2040, at A-35 tbl.A18, [https://www.eia.gov/outlooks/aeo/pdf/0383\(2016\).pdf](https://www.eia.gov/outlooks/aeo/pdf/0383(2016).pdf).

11. See, e.g., Christopher Helman, *Energy Sec Chu Says Global Warming Is Real; Nat Gas Will Be Bridge Fuel*, *FORBES* (Mar. 9, 2010), <https://www.forbes.com/sites/energysource/2010/03/09/chu-global-warming-is-real>.

12. Paris Agreement to the United Nations Framework Convention on Climate Change, art. I, ¶ 1(a), 2015.

To meet this “2C climate goal,” the U.S. share of CO₂ emissions from the electricity sector will have to decline by over ninety percent by 2040 and shrink to zero by 2050.¹³

We can therefore predict today that there is a high likelihood that either a steep carbon tax or strict regulations limiting the use of natural gas will be adopted within the next thirty years.¹⁴ Although this is unlikely to occur in the next several years, nature bats last and near-term delay will only increase the magnitude of the emissions reductions necessary to address the problem over the following decades. And we can predict with equal certainty that owners and investors in natural-gas-fired electric plants and the associated infrastructure—which together we call the natural gas industry¹⁵—will object to those regulatory efforts. Other scholars and commenters have recognized the possibility that switching to natural gas might have lock-in effects, making it more difficult to move to zero-carbon sustainable sources of energy in the future.¹⁶ They have identified the path dependency that results from building out an energy infrastructure, and the economic and political pressures that make it difficult to change course.¹⁷ We identify and focus on a different source of policy lock-in: the legal protection for property entitlements, and the political pressures that accompany such protection.

A central objection to strict regulation of natural gas in the future—whatever the precise regulatory form—is likely to be that it amounts to an unconstitutional taking of vested property rights. There are measures we can take today, though, to forestall those claims thirty years from now. One is relatively easy:

13. See U.S. ENERGY INFO. ADMIN., *supra* note 10.

14. See discussion *infra* Part I.A.

15. In this Article, the term natural gas industry includes natural gas wells and pipelines that supply natural-gas-fired power plants, as well as the power plants themselves. We exclude other parts of the natural gas business more broadly construed—for example, home heating companies and others who rely on natural gas production for transport and other purposes.

16. See, e.g., Symposium, *Environmental and Social Implications of Hydraulic Fracturing and Gas Drilling in the United States: An Integrative Workshop for the Evaluation of the State of Science and Policy*, 22 DUKE ENVTL. L. & POL'Y F. 245, 249 (2012) (“Some viewed natural gas as a transition fuel between coal and renewables, while others expressed concern that investing in infrastructure to accommodate increased natural gas development would lock nations into natural gas dependence for decades.”).

17. See, e.g., MIT, THE FUTURE OF NATURAL GAS 67 (2011), <https://energy.mit.edu/wp-content/uploads/2011/06/MITEI-The-Future-of-Natural-Gas.pdf> (“Trade flows can be particularly sensitive to the development of transportation infrastructure and political considerations . . .”).

the Takings Clause protects only reasonable investment-backed expectations from significant adverse regulatory changes.¹⁸ By developing a record today about what constitute reasonable expectations for natural gas investments, we can constrain takings claims in the future. This can be done by public or private actors. Regulators decades from now will be able to point back to contemporaneous reports, studies, and writing demonstrating that investors knew or should have known that natural gas would have a climate-imposed lifespan of only roughly thirty years.

Defining the extent of reasonable expectations today will limit how investments in natural gas will be protected in the future. But it is no foolproof protection. We therefore also propose a stronger response in the form of a regulatory innovation that we label “prospective grandfathering.” According to current land use doctrine, a government can—in certain circumstances—regulate away an existing use of property so long as it allows the use to remain in place for some period after the new regulatory prohibition.¹⁹ For example, a zoning change prohibiting adult uses in a particular area might apply to a preexisting adult bookstore.²⁰ This bookstore, now a prior nonconforming use, can be given a prespecified amount of time to remain open, after which, in many states, the government can shut it down without paying compensation.²¹ This time-limited grandfathering, called amortization, makes permissible what would otherwise have been an unconstitutional regulatory taking, so long as the use is allowed to stay open long enough for the owners to recover a sufficient portion of their investment in the property.²²

We propose a modified version of this approach where the grandfathering happens *ex ante*, before the regulatory prohibition. By triggering an amortization period today, governments

18. See *Kaiser Aetna v. United States*, 444 U.S. 164, 175 (1979) (describing the Takings Clause as protecting “reasonable investment backed expectations”).

19. For an extended discussion and critique of this protection, see Christopher Serkin, *Existing Uses and the Limits of Land Use Regulations*, 84 N.Y.U. L. REV. 1222 (2009).

20. See *Pa. Nw. Distribs., Inc. v. Zoning Hearing Bd.*, 584 A.2d 1372, 1373 (Pa. 1991), for a case involving exactly this situation.

21. See generally Serkin, *supra* note 19, at 1236 (discussing amortization).

22. See *Red Roof Inns, Inc. v. City of Ridgeland*, 797 So. 2d 898, 903 (Miss. 2001) (upholding “fairly established amortization periods” for pre-existing nonconforming billboards). *But see Pa. Nw. Distribs., Inc.*, 584 A.2d at 1376 (invalidating amortization as a tool to eliminate prior nonconforming uses).

will be free to regulate in the future because investors will already have recovered the value of their investments.²³ Like the opposite of a sunset provision, we propose a kind of sunrise, where federal or state agencies announce regulations today that will become effective (or implemented) far in the future, and owners can recover the value of their investments in the interim.²⁴ This applies beyond the context of natural gas, and promises a new model for managing the costs of legal transitions.

The sunrise approach we propose is particularly appealing for natural gas, however, because it is politically expedient. It imposes few if any costs today, and states that support carbon mitigation (roughly a third of all states with more than half of the U.S. population) could adopt measures to implement this approach immediately. Over the longer run, this approach is a viable option for other states and the Federal Environmental Protection Agency (EPA). But it is also legally powerful. By preventing future regulatory takings claims, it preserves important policy flexibility for future governments facing an increasingly dire need to respond to the threat of climate change. It will also blunt political opposition to the inevitable regulations because it amounts to a kind of bargain for temporary regulatory forbearance that recalibrates what counts as fair treatment in the future. We recognize that recent political events make aggressive EPA or other federal action unlikely in the near term, even if costs are not borne until far into the future. After introducing the idea, we therefore focus specifically on ways in which state regulators could implement prospective grandfathering, particularly in conjunction with accelerated cost recovery in energy rates.

23. In energy policy, this resembles allowing recovery for stranded costs. For an excellent analysis of the problem in these terms, see Emily Hammond & Jim Rossi, *Stranded Costs and Grid Decarbonization*, 82 *BROOK. L. REV.* 645 (2017).

24. Sunrise provisions have previously been explored in the context of constitutional rules. See AKHIL REED AMAR, *AMERICA'S UNWRITTEN CONSTITUTION: THE PRECEDENTS AND PRINCIPLES WE LIVE BY* 476 (2012) ("A close look at the original Constitution and its amendments reveals clever, albeit too-rare, use of the sunrise device to overcome immediate entrenched interests and injustices and thereby achieve a more disinterested and just future state of affairs."); see also Daniel E. Herz-Roiphe & David Singh Grewal, *Make Me Democratic, but Not Yet: Sunrise Lawmaking and Democratic Constitutionalism*, 90 *N.Y.U. L. REV.* 1975 (2015) (analyzing sunrise provisions in the U.S. Constitution).

Legal scholars and political scientists voice a persistent worry about the entrenching effect of government actions.²⁵ Governments frequently act in ways that limit policy choices in the future, often imposing significant costs on subsequent generations.²⁶ This Article ultimately argues that we have a unique opportunity to do the opposite: to act today to preserve policy choices for future governments. And it argues that the stakes are so high when it comes to energy policy that even a small effect on future regulatory incentives may make the difference between a sustainable and unsustainable future.

Part I surveys the leading contemporary literature on climate change and the need for reducing carbon emissions. Part I also introduces the important role that natural gas can play in our energy infrastructure, but for a limited time. Part II then anticipates the takings challenges that the natural gas industry is likely to raise when faced with regulatory actions decades from now. It argues that takings liability is unlikely, but nevertheless concludes that there is, in fact, a chance that necessary regulations in the future may violate the Takings Clause—or at least that fear of takings claims will discourage policymakers from adopting such regulations. Part III then proposes several responses that public and private actors could implement today that would reduce, if not eliminate, that risk of takings liability in the future. These include setting reasonable expectations for the longevity of investments in natural gas and prospective grandfathering, possibly through accelerated cost recovery for natural gas infrastructure. Part III also explains how prospective grandfathering could usefully apply in other contexts.

25. See, e.g., Daryl Levinson & Benjamin I. Sachs, *Political Entrenchment and Public Law*, 125 YALE L.J. 400, 402–04 (2015) (describing the paralyzing effects of entrenchment on labor and Social Security policy); Christopher Serkin, *Public Entrenchment Through Private Law: Binding Local Governments*, 78 U. CHI. L. REV. 879, 882 (2011) (considering how private law entrenchment can upset a “carefully balanced equilibrium between stability and flexibility”).

26. See Julian N. Eule, *Temporal Limits on the Legislative Mandate: Entrenchment and Retroactivity*, 1987 AM. B. FOUND. RES. J. 379, 384–85 (describing various ways legislatures can restrict future legislative action); Eric A. Posner & Adrian Vermeule, *Legislative Entrenchment: A Reappraisal*, 111 YALE L.J. 1665, 1667 (2002) (defining entrenchment as “the enactment of either statutes or internal legislative rules that are binding against subsequent legislative action in the same form”).

I. NATURAL GAS AS A BRIDGE FUEL

The approaches we propose to address anticipated legal changes apply in any context where new regulations are foreseeable far into the future. But they are particularly appropriate and important for natural gas. This Part describes why natural gas is a bridge fuel and why regulations will be needed at the end of the bridge. This discussion is important because (1) it illustrates a context in which legal change is foreseeable and potentially problematic; and (2) as we argue in Part II, developing a record of reasonable expectations is one way of preventing regulatory takings claims in the future.

A. THE ROLE OF NATURAL GAS IN CLIMATE MITIGATION

Electricity generation accounts for over 30 percent of U.S. CO₂ emissions.²⁷ Coal-fired electricity generation accounts for 76 percent of electricity sector fossil fuel emissions,²⁸ even though it provides only 18.5 percent of the electricity generated.²⁹ Assuming leakage and other emissions are held to a minimum, an assumption we make in this Article (although we acknowledge that experts differ on these issues), natural-gas-fired electric generation yields roughly half the carbon emissions of coal per kilowatt-hour of electricity generated.³⁰ This difference arises because of a fundamental difference in the molecular structure of coal and natural gas; coal has only two hydrogen bonds, whereas natural gas has four. Since the energy release from combustion arises from breaking these bonds, half as much energy is released from each coal molecule as from each natural gas molecule.

27. EPA, EPA 430-R-16-002, INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS: 1990–2014, at 3-14 (2016), <https://www.epa.gov/sites/production/files/2017-04/documents/us-ghg-inventory-2016-main-text.pdf>.

28. *Id.* at 3-5. Fossil fuel combustion is the primary source of energy sector CO₂ emissions. *Id.* at 3-1.

29. *Id.* at 3-7.

30. Ramón A. Alvarez et al., *Greater Focus Needed on Methane Leakage from Natural Gas Infrastructure*, 109 PROC. NAT. ACAD. SCI. 6435, 6438 tbl.1 (2012), <http://www.pnas.org/content/109/17/6435.full.pdf>; *FAQ*, *supra* note 6. International Energy Agency (IEA) figures indicate that, depending on the type of coal burned, coal-fired generation emits between 875 and 940 gCO₂ per kilowatt-hour (kWh), while natural gas emits 405 gCO₂ per kWh. INT'L ENERGY AGENCY, CO₂ EMISSIONS FROM FUEL COMBUSTION: HIGHLIGHTS 147 (2016), https://www.iea.org/publications/freepublications/publication/CO2EmissionsfromFuelCombustion_Highlights_2016.pdf.

As a result of its low CO₂ emissions as compared to coal, natural gas has been identified by researchers,³¹ government policy analysts,³² and regulators³³ as a bridge fuel that can provide a transition from the coal-dominated electric generation system of the last century to one that is dominated by renewable or non-carbon emitting sources. In other words, if natural-gas-fired electricity generation can substitute for coal-fired electricity generation over the next several decades, it can play a major role in reducing the contribution of the electric generation sector to U.S. emissions during this period. This trend has already begun to play out in the United States, where natural gas has steadily grown as a fuel for electricity generation; between 2005 and 2015, natural gas-fired generation almost doubled as a percentage of total U.S. electricity generation, growing from roughly 18 percent to more than 32 percent.³⁴ The increase in natural-gas-fired generation has been made possible by the prolific construction of new natural-gas-fired power plants, with even more in the pipeline.³⁵ Although the U.S. Energy Information Admin-

31. See MIT, *supra* note 17, at 2 *passim* (using the term bridge). The view that natural gas provides less carbon emissions, and thus can serve as a bridge to zero-carbon electricity generation is widely, but not universally, held. Some researchers have pointed out the substantial methane emissions from natural gas, and caution against its use as a bridge. *E.g.*, Robert W. Howarth, *A Bridge to Nowhere: Methane Emissions and the Greenhouse Gas Footprint of Natural Gas*, 2014 ENERGY SCI. & ENGINEERING 1.

32. See INT'L ENERGY AGENCY, WORLD ENERGY OUTLOOK 2011: ARE WE ENTERING A GOLDEN AGE OF GAS? 7 (2011), http://www.worldenergyoutlook.org/media/weowebiste/2011/WEO2011_GoldenAgeofGasReport.pdf (“[Natural gas] can provide the flexibility and back-up capacity needed as more variable capacity comes on-line in power generation.”).

33. See, *e.g.*, Helman, *supra* note 11. Prior to his appointment as U.S. Secretary of Energy in 2013, Ernest Moniz stated publicly that “natural gas is truly a bridge to a low-carbon future,” and that “in the very long run, very tight carbon constraints will likely phase out natural gas power generation in favor of zero-carbon or extremely low-carbon energy sources.” Steven Mufson, *Ernest Moniz, MIT Physicist, Nominated as Energy Secretary*, WASH. POST (Mar. 4, 2013), http://www.washingtonpost.com/business/economy/ernest-moniz-mit-physicist-is-to-be-nominated-as-energy-secretary/2013/03/04/e3fe68aa-808c-11e2-a350-49866afab584_story.html.

34. See U.S. ENERGY INFO. ADMIN., U.S. DEP'T OF ENERGY, ELECTRIC POWER ANNUAL 2015, at tbl.3.1.A (2016), <https://www.eia.gov/electricity/annual/archive/03482015.pdf>.

35. Industry data shows that over thirty-one gigawatts (GW) of natural gas electric power capacity was under construction in 2017. AM. PUB. POWER ASS'N, AMERICA'S ELECTRICITY GENERATION CAPACITY, 2017 UPDATE, at 6 tbl.2.1 (2017), http://appanet.files.cms-plus.com/PDFs/APPA_Generation_Capacity_2017.pdf. The EIA projects that 18.7 GW of new capacity is scheduled to come

istration (EIA) estimates that natural gas accounted for 27 percent of U.S. electricity production in 2015, this figure is predicted to increase to 37 percent by 2040 as natural gas grows, and coal and nuclear generation subside.³⁶

Natural gas is a bridge, however, not a complete response to the climate problem. If natural gas displaces coal for electricity generation, a net carbon reduction from the U.S. electricity sector will occur, but simply transitioning to a lower-emitting fossil fuel will be insufficient to meet the 2C climate goal articulated in the Paris Agreement, much less the aspiration of 1.5 °C.³⁷ The Obama Administration committed to reducing U.S. carbon dioxide emissions by 26 percent to 28 percent by 2025, and the transition to natural gas was expected to contribute the largest share of these emissions reductions.³⁸ The challenge for regulators is that the U.S. share of the global emissions reductions necessary to achieve the 2C goal increases steeply to roughly 70 percent to 80 percent reductions by 2050.³⁹ In addition, the required U.S. emissions reductions will become even more stringent after 2050; near-zero emissions will be required in the 2050–2070 period and net negative emissions will be required during the last third to quarter of this century.⁴⁰ The recently-announced Paris

on line between 2016 and 2018. Victoria Zaretskaya, *Many Natural Gas-Fired Power Plants Under Construction Are Near Major Shale Plays*, U.S. ENERGY INFO. ADMIN. (May 19, 2016), <https://www.eia.gov/todayinenergy/detail.php?id=26312>. Eighty-five GW are projected to be added through 2035. *Natural Gas and Renewable Shares of Electricity Generation To Grow, Coal Still Largest*, U.S. ENERGY INFO. ADMIN. (Feb. 10, 2012), <https://www.eia.gov/todayinenergy/detail.php?id=4950>.

36. See *Annual Energy Outlook 2016, Table: Electricity Supply, Disposition, Prices, and Emissions*, U.S. ENERGY INFO. ADMIN., <https://www.eia.gov/outlooks/aeo/data/browser/#/?id=8-AEO2016&sourcekey=0> (last reviewed Oct. 9, 2017).

37. Paris Agreement to the United Nations Framework Convention on Climate Change, art. I, ¶ 1(a), 2015.

38. See *Intended Nationally Determined Contribution Submitted by the United States of America to the United Nations Framework Convention on Climate Change* (Mar. 31, 2015), <http://www4.unfccc.int/Submissions/INDC/Published%20Documents/United%20States%20of%20America/1/U.S.%20Cover%20Note%20INDC%20and%20Accompanying%20Information.pdf>.

39. *Id.* Consistent with the 2C climate goal, the U.S. Department of State has announced a goal of reducing net emissions by 83 percent below 2005 levels in 2050. U.S. DEPT OF STATE, UNITED STATES CLIMATE ACTION REPORT 2010, at 3, 6 (2010), http://unfccc.int/resource/docs/natc/usa_nc5.pdf.

40. See INT'L ENERGY AGENCY, ANNUAL WORLD ENERGY OUTLOOK 150, 166 (2015), <https://www.iea.org/publications/freepublications/publication/WEO2015.pdf> (showing an increased use of natural gas in nearer years, followed by a decrease in later years to achieve a 450ppm atmospheric concentration of CO₂, which is often associated with the 2C goal).

Agreement withdrawal⁴¹ and various domestic deregulatory efforts may take some of the legal pressure off at times over the next decade, but these deregulatory efforts will only increase the need to transition away from natural gas by 2050, since even greater emissions reductions will be necessary over the 2030–2050 period if these deregulatory efforts increase U.S. emissions in the interim.

These estimates of future U.S. emissions reductions thus suggest that it will be necessary to phase out even natural-gas-based carbon emissions by the 2040–2050 period.⁴² Similar transitions away from natural gas will be required in many other countries.⁴³ Although steep emissions reductions from other sectors of the economy could reduce the pressure on natural-gas fired power plants, studies suggest that efforts to decarbonize other sectors will face higher costs and other hurdles. For example, a 2014 study by two leading laboratories notes that cutting emissions from sectors that rely heavily on gas and oil (for example, motor vehicle use and air transport) would require replacing natural gas with biofuel and offsetting the remaining emissions with carbon capture and storage (CCS).⁴⁴ We note, however, that “commercial or near-commercial technologies and limits on biomass availability and [CCS] deployment” make it “difficult to decarbonize both gas and liquid fuel supplies.”⁴⁵ The electricity sector thus is likely to shoulder a greater load of emissions reductions, and this research suggests that power-sector emissions ultimately would need to fall to zero.⁴⁶

If even natural-gas-fired power generation will need to be phased out by 2050, the bridge for natural gas should begin to slope down within two decades and should not extend for more

41. See Robinson Meyer, *Trump and the Paris Agreement: What Just Happened?*, ATLANTIC (Aug. 4, 2017), <https://www.theatlantic.com/science/archive/2017/08/trump-and-the-paris-agreement-what-just-happened/536040>.

42. See, e.g., JAMES H. WILLIAMS ET AL., PATHWAYS TO DEEP CARBONIZATION IN THE UNITED STATES, at xi (2014), <http://unsdsn.org/wp-content/uploads/2014/09/US-Deep-Decarbonization-Report.pdf> (predicting the attainment of “deep decarbonization” by phasing out natural gas-fired electricity generation).

43. See MICHAEL P. VANDENBERGH & JONATHAN M. GILLIGAN, BEYOND POLITICS: THE PRIVATE GOVERNANCE RESPONSE TO CLIMATE CHANGE (forthcoming Dec. 2017) (examining carbon emissions pathways and concluding that even if all of the countries that made commitments in the Paris Agreement fulfill all of their commitments, the resulting pathway has a low probability of achieving the 2C goal).

44. WILLIAMS ET AL., *supra* note 42, at 17.

45. *Id.* at xiii.

46. *Id.* at xiii, 14.

than roughly thirty years. The rapid installation of new natural-gas-fired capacity, combined with the expected life of natural-gas-fired power plants, however, could make this difficult. Utilities will resist shuttering newly built power plants during their useful lifetime, which according to a survey of plants retired from 2000 to 2010, is an average of roughly fifty years.⁴⁷ Assuming that plants built today have a similar or even longer lifespan, this figure suggests that decarbonizing the electricity sector by 2050 will necessitate the early closure of otherwise functional plants.

Plants built before 2000 will be at the end of their useful lives as we approach the 2040–2050 period, but the decades-long controversy over the Clean Air Act new source review (NSR) process for coal-fired power plants demonstrates that utilities have incentives to lobby and litigate aggressively to resist efforts to shutter plants that at least arguably were expected to close at the end of their useful lives.⁴⁸ The Clean Air Act Amendments of 1970 and 1977 grandfathered existing power plants.⁴⁹ The expectation of many at the time, and arguably the intent of Congress, was that the power plants would become obsolete and eventually would be replaced by more efficient and cleaner ones.⁵⁰ These newer plants were subject to more stringent emissions standards, and substantial upgrades to existing plants also

47. Melissa C. Lott, *Natural Gas—Leading Retirements, New Capacity*, SCI. AM.: PLUGGED IN (Dec. 14, 2011), <https://blogs.scientificamerican.com/plugged-in/natural-gas-leading-the-retirements-board> (“[T]he average age of these recently retired natural gas power plants was 48 years . . .”).

48. For an overview, see RICHARD L. REVESZ & JACK LIENKE, *STRUGGLING FOR AIR: POWER PLANTS AND THE “WAR ON COAL”* (2016). Revesz and Lienke note that the regulatory standards included in the 1970 and 1977 amendments to the Clean Air Act applied only to new power plants and grandfathered in preexisting plants. They conclude that the effect was to make new facilities more costly to run whereas old facilities—which Congress had assumed would retire after their thirty-year estimated useful lifespan—became more valuable precisely because of their regulatory advantage. *Id.* at 33. As a result, Congress grossly underestimated the effect of exempting existing facilities, and by 2012, over seventy-five percent of the grandfathered coal-fired plants had exceeded their expected lifespan, some by double. *Id.* at 33, 54.

49. Clean Air Act § 111(a)(2), 42 U.S.C. § 7411(a)(2) (2012) (applying the Clean Air Act to sources of which “the construction or modification . . . is commenced after the publication of regulations”).

50. See NAT’L ACAD. OF PUB. ADMIN., *A BREATH OF FRESH AIR: REVIVING THE NEW SOURCE REVIEW PROGRAM* 14 (2003), https://napa.primedev.build/uploads/Academy_Studies/03_02AbreathofFreshAirRevivingtheNewSourceReviewProgram.pdf (“Congress intended NSR to assure that new sources would

triggered the new, stricter standards.⁵¹ In fact, however, the ability of older plants to continue producing power without meeting higher emission standards made them particularly valuable. Instead of slow obsolescence, the plants continued to operate far beyond what would have been their normal operating life.⁵²

Decades later, the Clinton EPA brought enforcement actions against heavily upgraded existing plants that did not comply with new plant standards. The enforcement actions asserted that the industry had made major modifications to existing plants without installing the required upgrades.⁵³ These enforcement actions triggered a long, partially successful battle by electric utilities, which litigated against the enforcement actions and lobbied EPA and Congress to allow the plants to continue operating.⁵⁴ The Bush administration later adopted policies that allowed the power plants to be improved without meeting the higher emissions standards, reasoning that the incremental improvement was better than nothing.⁵⁵

be clean, existing sources would become cleaner over time, and a moving frontier of improved technology would be the benchmark against which 'clean' is measured . . .").

51. See *New York v. EPA*, 413 F.3d 3, 10 (D.C. Cir. 2005) (upholding EPA regulations requiring construction permits for plant modifications that substantially increase emissions).

52. See Richard L. Revesz & Jack Lienke, *The Tragic Flaw of the Clean Air Act*, REG. REV. (May 17, 2016), <https://www.theregreview.org/2016/05/17/revesz-lienke-tragic-flaw-clean-air-act> ("[T]he economically useful life of a coal plant [when the CAA was drafted] was thought to be about 30 years. But by 2012, more than three-quarters of the nation's coal-fired generation capacity had been in service for longer than that. . . . [A]lmost 40 percent of . . . coal-fired infrastructure was more than 40 years old, and close to 20 percent was more than 50 years old.").

53. Richard Revesz & Jonathan Remy Nash, *Grandfathering and Environmental Regulation: The Law and Economics of New Source Review*, 101 NW. U. L. REV. 1677, 1693 (2007).

54. See, e.g., *id.* at 1687–89 (2007) (noting the response of the industry to EPA regulations).

55. See *EPA: New Source Review Is Hurting Power Projects That Would Improve Reliability*, POWER ENG'G INT'L (June 17, 2002), <http://www.powerengineeringint.com/articles/2002/06/epa-new-source-review-is-hurting-power-projects-that-would-improve-reliability.html> (statement of then-EPA Administrator Christie Whitman) (arguing the Bush reforms would "promote energy efficiency . . . and modernization" and create "opportunities for pollution prevention and energy efficiency"); see also Dana Joel Gattuso, *Why the New Source Review Program Needs Reform: A Primer on NSR*, BACKGROUNDERS (The Heritage Found., Washington, D.C.), Feb. 21, 2002, at 1, 2, <http://www.heritage.org/environment/report/why-the-new-source-review-program-needs-reform-primer-nsr> (describing the Bush reforms as "much-needed" and "not expected to roll back regulations on industrial air emissions").

Assuming an average lifespan, a large number of natural-gas plants built after 2000 will need to be shut down while they are still in the midst of their useful life. Between 2001 and 2015, the United States added 3213 natural-gas-fired generators⁵⁶ at 203 plants,⁵⁷ representing roughly \$130 billion in capital investments.⁵⁸ Likewise, an additional 195 natural-gas-fired generators, representing roughly \$31 billion in capital investments are expected to be built between 2018 and 2020.⁵⁹ As the NSR battles of the 1990s and early 2000s suggest, these valuable assets will not be abandoned lightly.⁶⁰

Perhaps in an early signal of the conflict just over the horizon, natural gas industry officials have described natural gas as a foundation fuel, rather than a bridge fuel.⁶¹ Furthermore, natural gas infrastructure includes more than just the power plants

56. See U.S. ENERGY INFO. ADMIN., U.S. DEP'T OF ENERGY, ELECTRIC POWER ANNUAL 2015, at tbl.4.3 (2016) <https://www.eia.gov/electricity/annual/archive/03482015.pdf> (providing count of generators); U.S. ENERGY INFO. ADMIN., U.S. DEP'T OF ENERGY, DOE/EIA-0348(2001), ELECTRIC POWER ANNUAL 2001, at 18 tbl.2.2 (2003), <http://www.eia.gov/electricity/annual/archive/03482001.pdf>.

57. See U.S. ENERGY INFO. ADMIN., U.S. DEP'T OF ENERGY, ELECTRIC POWER ANNUAL 2015, at tbl.4.1 (2016), <https://www.eia.gov/electricity/annual/archive/03482015.pdf>; U.S. ENERGY INFO. ADMIN., U.S. DEP'T OF ENERGY, DOE/EIA-0348(2008), ELECTRIC POWER ANNUAL 2008, at tbl.5.1 (2010), <https://www.eia.gov/electricity/annual/archive/03482008.pdf> (providing count of natural gas plants).

58. Estimations for capital costs calculated by multiplying the most recent (2015) EIA estimates of cost per kW of natural-gas generator construction by net addition in summer generation capacity between 2001 and 2015. See U.S. ENERGY INFO. ADMIN., U.S. DEP'T OF ENERGY, ELECTRIC POWER ANNUAL 2015 tbl.4.2.A (2016), <https://www.eia.gov/electricity/annual/archive/03482015.pdf>; U.S. ENERGY INFO. ADMIN., U.S. DEP'T OF ENERGY, DOE/EIA-0348(2008), ELECTRIC POWER ANNUAL 2008, at 16 tbl.1.1 (2010), <http://www.eia.gov/electricity/annual/archive/03482008.pdf>; *Construction Cost Data for Electric Generators Installed in 2013*, U.S. ENERGY INFO. ADMIN. (June 3, 2016), <https://www.eia.gov/electricity/generatorcosts/archive/2013>.

59. See U.S. ENERGY INFO. ADMIN., U.S. DEP'T OF ENERGY, ELECTRIC POWER ANNUAL 2015, at tbl.4.5 (2016), <https://www.eia.gov/electricity/annual/archive/03482015.pdf>; *Construction Cost Data for Electric Generators Installed in 2013*, U.S. ENERGY INFO. ADMIN. (June 3, 2016), <https://www.eia.gov/electricity/generatorcosts/archive/2013>.

60. The NSR controversy is ongoing. See, e.g., Art Fraas et al., *EPA's New Source Review Program: Time for Reform?*, 47 ENVTL. L. REP. 10026, 10031-32 (2017) (examining history of ongoing regulation and litigation surrounding NSR).

61. We have not located any official statement from a natural gas interest identifying natural gas as a bridge fuel. Instead, the industry stance seems to be that it is a foundation fuel that should support the U.S. economy far into the future. See, e.g., AM. PETROLEUM INST., 2016 STATE OF AMERICAN ENERGY 46

themselves. Natural gas transmission pipelines also represent significant investments that will have a physical lifespan that exceeds the critical period from 2040–2050.⁶² If natural gas is no longer usable, these pipelines will also lose their utility. The same is true of wells, although they typically have a shorter lifespan.⁶³ Nevertheless, we can anticipate that at least some wells could remain active and productive beyond the viability of natural gas as a source of power. In sum, policymakers today are on notice that the owners and operators of natural gas power plants and related infrastructure will fight vigorously to extend the bridge far beyond what is needed for climate policy.

B. THE REGULATORY RESPONSE TO NATURAL GAS

Policymakers will have several options to induce the phase-out of natural-gas-fired power plants by 2050, actions that would

(2016), <http://www.api.org/~media/Files/Policy/SOAE-2016/API-2016-SOAE-Report.pdf> (“[T]he long-term trend is clear: We will need more energy, specifically oil and natural gas, for decades to come.”); *Natural Gas Emissions*, AM. GAS ASS’N, <https://www.aga.org/policy/environment/natural-gas-emissions> (last visited Jan. 31, 2018) (“AGA believes that natural gas is poised to serve as a foundation fuel for the U.S. economy for years to come.”). Marty Durbin, the head of America’s Natural Gas Alliance, stated publicly in 2015 that natural gas “is no longer a bridge; it’s a foundation for the economy and will be for a long time.” *ANGA’s Durbin Discusses Merger Talks, Future of Natural Gas Under Power Plan and Methane Rules*, E&ETV: ONPOINT (Sept. 10, 2015), <http://www.eenews.net/tv/videos/2027/transcript>.

62. JOHN F. KIEFNER & MICHAEL J. ROSENFELD, INTERSTATE NAT. GAS ASS’N OF AM., *THE ROLE OF PIPELINE AGE IN PIPELINE SAFETY* 12–15, 25–30 (2012), <http://www.ingaa.org/file.aspx?id=19307> (discussing pipeline age and various factors that contribute to pipeline operation and safety).

63. Although the productive lifetime of natural gas wells varies across different plays, a conservative estimate is that most wells experience a decline in production of 40 to 60 percent over their first year, implying a productive lifetime of thirty to forty years. See J. D. HUGHES, *POST CARBON INST., DRILL, BABY, DRILL: CAN UNCONVENTIONAL FUELS USHER IN A NEW ERA OF ENERGY ABUNDANCE?* 54 (2011), http://liege.mpoc.be/doc/energie/carbonefossile/~En-anglais/Hughes-David_Drill-Baby-Drill_178pages-31Mo_fevrier2013.pdf (showing production life estimates for Haynesville shale); U.S. ENERGY INFO. ADMIN., U.S. DEP’T OF ENERGY, *DOE/EIA-0383(2012), ANNUAL ENERGY OUTLOOK 2012 WITH PROJECTIONS TO 2035*, at 59 fig.54 (2012), [https://www.eia.gov/outlooks/aeo/pdf/0383\(2012\).pdf](https://www.eia.gov/outlooks/aeo/pdf/0383(2012).pdf) (demonstrating rapid decline of production in early part of shale lives). Production from some wells declines up to 80 percent over the first year, suggesting a shorter productive lifespan. See James R. Ladlee, *Natural Gas Production Decline Curve and Royalty Estimation*, PA. STATE UNIV. EXTENSION, <https://extension.psu.edu/natural-gas-production-decline-curve-and-royalty-estimation> (last updated Aug. 8, 2017) (“The average first year decline rates across Pennsylvania appear to range from approximately 60% to 80%.”).

also affect transmission pipelines and wells. For instance, pricing carbon via a carbon tax or cap-and-trade system could undermine the economic viability of these plants. Direct federal regulatory requirements could include a ban on carbon emissions from power plants or emissions standards that cannot be achieved through natural-gas-fired generation. EPA also could set the standards at a level that natural-gas-fired power plants could meet, but only with carbon capture and storage equipment that renders the plants more costly than competing forms of generation. Some have argued that the standard included in EPA's Clean Power Plan for existing coal-fired power plants and New Source Performance Standards for new coal-fired power plants adopted this approach.⁶⁴

Although the 2016 presidential election has resulted in the withdrawal or suspension of several climate measures and thrown federal climate policy into a period of uncertainty, the climate problem is not going away, and over the longer term the federal government is likely to return to the regulation of greenhouse gas emissions from power plants. In addition, the governments of roughly one-third of the states are likely to take additional steps to reduce greenhouse gas emissions.⁶⁵ States in this group, including California, New York, and Massachusetts, (1) are responsible for a large share of U.S. power consumption; (2) have state climate laws that are unlikely to be preempted by Congress; and (3) are likely to continue to create regulatory incentives for shifting from coal to natural gas for electric power plants and ultimately to renewable sources.⁶⁶ Many local governments also have adopted carbon goals and some operate their own electric power plants.⁶⁷

64. See, e.g., Nicolas D. Loris, *The Many Problems of the EPA's Clean Power Plan and Climate Regulations: A Primer*, BACKGROUND (The Heritage Found., Washington, D.C.), July 7, 2015, <http://www.heritage.org/environment/report/the-many-problems-the-epas-clean-power-plan-and-climate-regulations-primer> (criticizing the Clean Power Plan).

65. See GEORGETOWN CLIMATE CTR., STATE LEADERSHIP DRIVING THE SHIFT TO CLEAN ENERGY: 2016 UPDATE (2016), http://www.georgetownclimate.org/files/report/Final_GCC_State_Leadership_Driving_the_Shift_to_Clean_Energy_11Nov2016v2_1.pdf (reporting the status of various states' efforts to shift to cleaner energy).

66. *Id.* at 4–5, 17–19, 28–29.

67. See, e.g., U.S. CONFERENCE OF MAYORS, U.S. MAYORS CLIMATE PROTECTION AGREEMENT 1 (2005), <http://www.mayors.org/climateprotection/documents/mcpAgreement.pdf> (listing steps municipalities will take to limit climate change). An example of a municipality that owns power plants is Austin, Texas. See *Company Profile: Power Plants*, AUSTIN ENERGY, <https://z.umn.edu/AustinEnergy> (last visited Jan. 31, 2018).

These government regulatory moves are likely to be supported by the increasing demand for renewable power from large corporations. Many leading corporate electricity users, such as Microsoft, Google, and Facebook, have set stringent corporate carbon goals, and over 400 large corporations have adopted internal corporate carbon prices to steer internal corporate decision-making.⁶⁸ These large buyers are creating demand for a shift from fossil-fuel-based electricity to renewables in many states, including states that have opposed the federal climate regulatory efforts, and this demand for renewables may expand to include smaller firms.⁶⁹ Private climate-governance initiatives such as these will not force a transition away from natural gas on their own, but they may contribute to the long-term transition, as politicians take note and as utilities seek not only to respond to government regulators, but also to serve their largest customers.

Regardless of the success of interim public and private efforts, and regardless of the regulatory instrument selected and the level of government that acts, future government action may have the effect of eliminating billions of dollars of investments in natural gas power plants. We know today that these plants must cease emitting carbon by roughly 2040–2050,⁷⁰ but if investors have expectations about extracting value from these investments they are likely to lobby heavily against these new policies. In this process, regulators and Congress may have

68. See Michael P. Vandenbergh & Jonathan A. Gilligan, *Beyond Gridlock*, 40 COLUM. J. ENVTL. L. 217, 260 (2015); see also CDP, PUTTING A PRICE ON RISK: CARBON PRICING IN THE CORPORATE WORLD (2015), <https://www.oceanfdn.org/sites/default/files/CDP%20Carbon%20Pricing%20in%20the%20corporate%20world.compressed.pdf>; Sarah E. Light, *The New Insider Trading: Environmental Markets Within the Firm*, 34 STAN. ENVTL. L.J. 3, 41–50 (2015); David Ferris, *Tech Giants Lead Campaign To Bring Renewables to Reluctant States*, E&E NEWS (May 23, 2016), <https://www.eenews.net/stories/1060037674>.

69. See David Ferris & Kristi E. Swartz, *Southern Utilities Stand in the Way of Making the Internet Greener—Report*, E&E NEWS (May 12, 2015), <https://www.eenews.net/stories/1060018386> (noting that “[b]ig tech companies like Google and Facebook are on the way to powering their data centers with renewable energy, but an obstacle stands in their path: the biggest utilities in Virginia and North Carolina”); Ferris, *supra* note 68 (discussing corporate membership in Renewable Energy Buyers Alliance).

70. Jeff Spross, *At This Rate, The World Will Have To Cease All Carbon Emissions in 2040 To Stay Under 2°C*, THINKPROGRESS (Nov. 17, 2014), <https://www.thinkprogress.org/at-this-rate-the-world-will-have-to-cess-all-carbon-emissions-in-2040-to-stay-under-2-c> (arguing that to limit climate change, carbon emissions must cease by 2040).

concerns about takings claims by the affected utilities. Regardless of the success of actual takings cases, the perceived threat of takings claims may be the greatest impediment to regulatory change. This perception has affected policymakers at the local, state and federal levels across many issues and is likely to be influential in the coming end-of-bridge debates.⁷¹

Thus we are in the unusual position of being able to anticipate the end of the bridge even as we are building it. Are we smart enough to put policies in place that will allow it to end? Or will we lose the opportunity to construct an end to the bridge, leading to protracted conflicts and an increased chance of exceeding climate emissions reduction goals? The problem is a temporal one: Can we anticipate today the legal and political challenges to phasing out natural gas in the future? It turns out we can, and identifying these challenges also suggests important steps that we can take to ensure regulatory flexibility in the future.

II. LEGAL PROTECTION FOR THE NATURAL GAS INFRASTRUCTURE

It is easy to imagine the legal landscape thirty to forty years from now. If current predictions are correct, the world will have nearly tapped out its carbon budget to keep climate change from reaching catastrophic levels. However, the American electrical grid will be dependent in large measure on natural gas. Renewables will supply a larger share of electric generation, but a robust natural gas infrastructure will have been in place for decades, from wells to pipelines to power plants. Each will represent substantial investments, the returns from which will be dependent upon the ongoing production of power through natural gas. If a regulator were to seek to eliminate those natural gas resources, either outright, through the imposition of restrictive emissions rules, or through a carbon price, owners would almost certainly object.⁷² Everyone involved in the production, transportation, and use of natural gas would likely try to protect their

71. See, e.g., Kirsten H. Engel, *State Environmental Standard-Setting: Is There a "Race" and Is It "To the Bottom"?*, 48 HASTINGS L.J. 271, 321–37 (noting the importance of perceptions by government officials that industry will relocate if more stringent regulations are adopted); James L. Huffman, *Why Liberating the Public Trust Doctrine Is Bad for the Public*, 45 ENVTL. L. 337, 359–60 (2015) (quoting Mary Christina Wood, *Nature's Trust: Reclaiming an Environmental Discourse*, 25 VA. ENVTL. L.J. 243, 257 (2007) ("This private property rights rhetoric has cowered officials at every level of government . . .")).

72. See, e.g., Petition for Review, *West Virginia v. EPA*, No. 16-1264 (D.C.

investments. And they would have at least some law on their side.

The primary source of constitutional protection for property comes from the Takings Clause.⁷³ Indeed, the natural gas industry is likely to invoke the Takings Clause to try to shield itself from regulations that substantially interfere with its investments. A close look at the doctrine reveals that the Constitution should not, and probably will not, constrain future regulators. Nevertheless, this conclusion remains speculative. In the face of uncertainty, it is important to consider how the Takings Clause might operate to constrain what we view as the inevitable regulation of natural gas. The discussion that follows serves an additional purpose, as well. By examining how the Takings Clause might apply to the future regulation of natural gas, it sets the stage for Part III and our proposals preventing takings liability.

A. THE TAKINGS PROBLEM IN ENERGY TRANSITIONS

There are two potentially relevant bases for takings liability that could apply to in-place natural gas infrastructure.⁷⁴ The first is the *per se* takings rule from *Lucas v. South Carolina Coastal Council*.⁷⁵ According to *Lucas*, a total wipeout of all economically valuable use of property is always a taking.⁷⁶ These

Cir. Aug. 2, 2016) (featuring challenges to EPA's coal-fired power plant rules). A carbon tax is the least likely to implicate property protection because the Takings Clause traditionally, if controversially, does not apply to taxes. See Eduardo Moisés Peñalver, *Regulatory Taxings*, 104 COLUM. L. REV. 2182, 2183–93 (2004).

73. U.S. CONST. amend. V.

74. We are confident that substantive due process protections will not apply to protect natural gas infrastructure from future regulations. See, e.g., Serkin, *supra* note 19, at 1256–58 (“After [*Lochner*] was overruled, substantive due process protection for most economic rights all but ended.”); Mark Tunick, *Constitutional Protections of Private Property: Decoupling the Takings and Due Process Clauses*, 3 U. PA. J. CONST. L. 885, 899 n.59 (2001) (“Since the demise of *Lochner*, the Court has been reluctant to strike down economic legislation on due process grounds . . .”). While modern courts have occasionally invalidated zoning regulations on this basis, the usual approach is still highly deferential to the government. For a summary and discussion of these cases, see, for example, ROBERT C. ELLICKSON ET AL., *LAND USE CONTROLS* 110 (4th ed. 2013); see also DENNIS J. COYLE, *PROPERTY RIGHTS AND THE CONSTITUTION: SHAPING SOCIETY THROUGH LAND USE REGULATION* 10–11 (1993) (describing the spectrum in state court deference under the Due Process Clause).

75. 505 U.S. 1003 (1992).

76. See *id.* at 1027 (“Where the State seeks to sustain regulation that deprives land of all economically beneficial use, we think it may resist compensation only if the logically antecedent inquiry into the nature of the owner’s estate shows that the proscribed use interests were not part of his title to begin with.”).

total wipeouts are vanishingly rare. In *Lucas* itself, the Supreme Court reached its result only because the government had stipulated to the fact of the total wipeout.⁷⁷ Since then, governments have refused to make such concessions, and courts have almost always found that regulated property retains sufficient residual value to prevent application of the rule.⁷⁸ We are aware of only one recent case in which the Federal Circuit upheld the determination of a total wipeout, and it was on an unusual set of facts.⁷⁹

Regulations that merely make natural gas more expensive—even significantly so—will not trigger the total wipeout rule.⁸⁰ Regulatory requirements like carbon capture and sequestration or a carbon tax might well make natural gas facilities less valuable, but will not rise to the level of a total wipeout under current law.⁸¹

Even outright bans on natural gas are unlikely to rise to the level of a *Lucas* total wipeout. Factually, it may be that natural gas facilities could be put to some entirely alternative use. If a plant could be converted to run on an alternative fuel, or the land itself turned into a factory or other use, then even a regulation eliminating a natural gas plant might not be a total wipeout.⁸² Something along these lines occurred recently when Google located a data center at the site of the former Widows Creek coal-fired power plant in Alabama.⁸³ Admittedly, though, such alternatives seem unlikely to be the norm. We presume—at least for

77. See CHRISTOPHER SERKIN, *THE LAW OF PROPERTY* 266 (2d ed. 2013).

78. See, e.g., *Pallazzolo v. Rhode Island*, 533 U.S. 606, 630–32 (2001) (concluding that \$200,000 in retained development value constituted more than “a few crumbs of value” and so the regulation at issue did not rise to the level of a taking under *Lucas*).

79. See *Lost Tree Vill. Corp. v. United States*, 787 F.3d 1111, 1116–17 (Fed. Cir. 2015) (finding the denial of a permit to fill a wetland, which the trial court had concluded deprived the parcel of 99.4 percent of its value, to be a per se taking under *Lucas*).

80. See *supra* text accompanying notes 77–79 (describing limited applicability of total wipeout rule).

81. See, e.g., *Tahoe-Sierra Pres. Council, Inc. v. Tahoe Reg'l Planning Agency*, 535 U.S. 302, 331–32 (2002) (holding that a thirty-two-month moratorium on development was not a total wipeout under *Lucas*); see also *Walcek v. United States*, 303 F.3d 1349, 1355 (Fed. Cir. 2002) (finding no taking under *Lucas* when a wetlands permit allowed development on 2.2 acres of a 13.2-acre parcel).

82. See, e.g., Serkin, *supra* note 19, at 1229–30 (examining how the availability of alternative uses relates to the elimination of an existing use).

83. See Press Release, Google, A Power Plant for the Internet: Our Newest Data Center in Alabama (June 24, 2015), <https://googleblog.blogspot.com/2015/06/a-power-plant-for-internet-our-newest.html>; Press Release, TVA, Google Chooses TVA Site for Next Data Center (June 24, 2015), <https://www>

the sake of argument today—that natural gas plants are useful only for generating power from natural gas. Moreover, it is implausible to think that the property could be converted to many nonindustrial uses.⁸⁴ Even an alternative industrial development might require such extensive remediation and retrofitting as to be effectively impossible.

Natural gas infrastructure includes more than just power plants. Pipelines also cannot be easily converted to transport other materials. The obvious hurdles are physical, but the legal ones may be equally important. Many pipeline companies do not own fee simple title to the property under their pipelines, but instead only easements over land held in fee simple by someone else.⁸⁵ Where that is true, depending on how the easement is worded, the pipeline cannot be converted to different purposes without impermissibly expanding the scope of the easement.⁸⁶ For the same reason, the pipeline cannot be removed and replaced with another kind of transmission line, let alone a bike trail, walking path, or other kind of right-of-way.⁸⁷ Therefore, if

.tva.gov/Newsroom/Press-Releases/Google-Chooses-TVA-Site-for-Next-Data-Center.

84. See Sarah K. Adair et al., *Considering Shale Gas Extraction in North Carolina: Lessons from Other States*, 22 DUKE ENVTL. L. & POL'Y F. 257, 280–87, 291–99 (2012) (discussing the various environmental concerns that arise at shale gas extraction sites); Terry W. Roberson, *Environmental Concerns of Hydraulically Fracturing a Natural Gas Well*, 32 UTAH ENVTL. L. REV. 67, 115–35 (2012) (exploring the environmental issues with hydraulic fracking); Hannah Wiseman, *Regulatory Adaptation in Fractured Appalachia*, 21 VILL. ENVTL. L.J. 229, 242 (2010) (“[A]ny oil or gas producer that contaminates a site with wastes other than petroleum or natural gas may be subject to future liability for clean-up costs under the Comprehensive Environmental Response, Compensation, and Liability Act . . .”).

85. See, e.g., Alejandro Davila Fragoso, *For-Profit Pipelines Are Growing and So Are Eminent Domain Battles*, THINKPROGRESS (June 7, 2016), <https://thinkprogress.org/for-profit-pipelines-are-growing-and-so-are-eminent-domain-battles> (quoting a pipeline company's statement that ninety-six percent of the route for the controversial Dakota Access Pipeline was secured with easements); cf. INGAA FOUND., INC., BUILDING INTERSTATE NATURAL GAS TRANSMISSION PIPELINES: A PRIMER 19–23, 30–31 (2013), <http://www.ingaa.org/file.aspx?id=19618> (detailing the process of easement acquisition for natural gas pipelines).

86. See *Stew-Mc Dev., Inc. v. Fischer*, 770 N.W.2d 839, 846–48 (Iowa 2009) (concluding that an easement originally granted for farm access could not be used for access to a residential development); *Brown v. Voss*, 715 P.2d 514, 517 (Wash. 1986) (“As a general rule, an easement appurtenant to one parcel of land may not be extended by the owner of the dominant estate to other parcels owned by him . . . to which the easement is not appurtenant.”).

87. Cf. *Toews v. United States*, 376 F.3d 1371, 1376 (Fed. Cir. 2004) (“It is elementary law that if the Government uses . . . an existing railroad easement

natural gas is regulated out of existence as an energy supply, the pipeline transmission infrastructure may become valueless.⁸⁸

Even assuming for the sake of argument that government regulations in the future might effectuate a total wipeout of all economically valuable use of natural gas facilities, that wipeout may still not be a taking. The imposition of such a regulatory regime is actually quite similar to alcohol prohibition in the late nineteenth century.⁸⁹ There, investments made in distilleries were suddenly rendered valueless when alcohol was banned. When one distillery owner in Kansas sued, claiming that the state's prohibition on alcohol amounted to a taking of his property, the Supreme Court rejected the argument in *Mugler v. Kansas*.⁹⁰ The Court held: "A prohibition simply upon the use of

for purposes and in a manner not allowed by the terms of the grant of the easement, the Government has taken the landowner's property for the new use. . . . And it appears beyond cavil that use of these easements for a recreational trail . . . is not the same use made by a railroad. . . ."; *Preseault v. United States*, 100 F.3d 1525, 1541–44 (Fed. Cir. 1996) (holding that a railroad right-of-way could not be converted to a public recreational trail); *Marcus Cable Assocs., L.P. v. Krohn*, 90 S.W.3d 697, 703–06 (Tex. 2002) (holding that an easement for "electric transmission or distribution line or system" did not permit use for cable-television lines).

88. Those individual property interests are not necessarily the correct denominator for takings purposes. Severing the easement or the lease from the underlying land does not necessarily mean that these smaller interests are the relevant constitutional property. See Steven J. Eagle, *The Parcel and Then Some: Unity of Ownership and the Parcel as a Whole*, 36 VT. L. REV. 549, 562–63 (2012) ("[T]he baseline for 'parcel as a whole' remains the deeded parcel."); Marc R. Lisker, *Regulatory Takings and the Denominator Problem*, 27 RUTGERS L.J. 663, 694–706 (1996) (exploring the various dimensions of the denominator problem under Supreme Court doctrine); see also *Murr v. State*, No. 2013AP2828, 2014 WL7271581, at *4–5 (Wis. Ct. App. Dec. 23, 2014) (characterizing two separate but contiguous parcels owned by the plaintiffs as the relevant property interest and therefore rejecting the regulatory takings claim), *rev. denied*, 862 N.W.2d 899 (Wis. 2015), *aff'd*, 137 S. Ct. 1933 (2017); Frank I. Michelman, *Property, Utility, and Fairness: Comments on the Ethical Foundations of "Just Compensation" Law*, 80 HARV. L. REV. 1165, 1192–93 (1967) (discussing the difficulty of defining the relevant property interest for a takings determination); Danaya C. Wright, *A New Time for Denominators: Toward a Dynamic Theory of Property in the Regulatory Takings Relevant Parcel Analysis*, 34 ENVTL. L. 175, 190–93 (2004) (highlighting the "intractable" problems with "identifying the bundle from which a particular property right has been taken").

89. See Lloyd C. Anderson, *Direct Shipment of Wine, the Commerce Clause and the Twenty-First Amendment: A Call for Legislative Reform*, 37 AKRON L. REV. 1, 5–6 (2004) (describing the nineteenth-century prohibition adopted in some states); Kenneth M. Murchison, *Prohibition and the Fourth Amendment: A New Look at Some Old Cases*, 73 J. CRIM. L. & CRIMINOLOGY 471, 473–74 (1982) (reviewing the historical context of the nineteenth-century prohibition movement).

90. 123 U.S. 623, 668–69 (1887).

property for purposes that are declared, by valid legislation, to be injurious to the health, morals, or safety of the community, cannot, in any just sense, be deemed a taking or an appropriation of property for the public benefit.”⁹¹

The *Mugler* principle, repeated in subsequent cases, is that valid regulations designed to protect the public from harm do not violate the Takings Clause.⁹² As the public harm of carbon emissions comes more clearly into view, the “evils” of liquor seem but a trifling delight in comparison. If Kansas could eliminate distilleries on grounds that it was protecting the public from alcohol, surely the federal government in the future can eliminate natural gas facilities to protect the planet from catastrophic climate change. While *Lucas* casts that sensible-seeming conclusion into some doubt, we are hopeful that a court decades from now would defer to a legislative determination that carbon is harmful and refuse to find a taking on that basis.⁹³ But given the state of the law today, we cannot predict that outcome with certainty.⁹⁴

Assuming *Lucas* will not apply, any regulation of natural gas facilities in the future will be judged under *Penn Central’s*

91. *Id.*

92. *See, e.g., Zeman v. City of Minneapolis*, 552 N.W.2d 548, 554 (Minn. 1996) (“If the state regulation appears genuinely designed to prevent harm to the public and is likely to achieve that goal and the harm suffered by the property owner does not appear to be one that should be borne by the entire community, we will not find a taking.” (citing *Mugler*, 123 U.S. at 661–62)). *Zeman* went on to uphold an ordinance allowing the revocation of rental licenses for dwellings involved in three “disorderly use” incidents, stating that the ordinance “serves a public harm prevention purpose and, properly implemented, it will likely be advantageous to all involved. Accordingly, we see no taking here.” *Id.* at 555; *see also Hadacheck v. Sebastian*, 239 U.S. 394, 410–14 (1915) (denying a takings claim concerning an ordinance that prohibited brick yards within a city’s limits); Frederic Bloom & Christopher Serkin, *Suing Courts*, 79 U. CHI. L. REV. 553, 573 (2012) (“Courts have long held that a government can prevent public harms without violating the Takings Clause.”).

93. Writing for the majority in *Lucas*, Justice Scalia sharply criticized the traditional “harm-prevent[ion]” defense from *Mugler* and its progeny. Reasoning that the difference between a harm and a benefit is “often in the eye of the beholder,” he concluded that the only defense to a total wipeout of all economically beneficial uses of land is that the regulation is consistent with “background principles of . . . property and nuisance” law. *Lucas v. S.C. Coastal Council*, 505 U.S. 1003, 1023–30 (1992).

94. *Cf. Am. Elec. Power Co. v. Connecticut*, 564 U.S. 410 (2011) (concluding that the Clean Air Act displaces federal common law tort actions by states against major utilities for greenhouse gas emissions, revealing unpredictability in courts’ attitudes towards climate change).

three-factor ad hoc balancing test, which focuses on (1) the character of the regulation; (2) the extent to which the regulation interferes with investment-backed expectations; and (3) the resulting diminution in value.⁹⁵ This test is notoriously difficult to apply.⁹⁶ Each factor in the *Penn Central* test is contested, but the second prong—the extent to which the regulation interferes with property owners' expectations—is particularly so.⁹⁷ As originally articulated by the Supreme Court, the focus of the inquiry is on a property owner's "distinct investment-backed expectations."⁹⁸ Its purpose is to distinguish between those expectations that are particularly well crystalized (which should be protected), and those that are more speculative (which should not).⁹⁹ The dividing line for constitutional protection is not necessarily between existing uses and prospective future uses of property; the formulation implicitly acknowledges that some prospective uses could still be sufficiently distinct as to deserve takings protection. But it clearly anticipates strong protection for uses already in place, like a developed natural gas infrastructure.¹⁰⁰

However, just one year after *Penn Central*, in *Kaiser Aetna*

95. *Penn Cent. Transp. Co. v. New York City*, 438 U.S. 104, 124 (1978); see also Robert Meltz, *Takings Law Today: A Primer for the Perplexed*, 34 *ECOLOGY L.Q.* 307, 333–46 (2007) (expounding on each of these three factors).

96. See Christopher Serkin, *The Meaning of Value: Assessing Just Compensation for Regulatory Takings*, 99 *Nw. U. L. REV.* 677, 741 (2005) ("Looking for consistency in takings cases is a little bit like finding shapes in the clouds: you can see them if you look hard enough, but they say more about the observer than [about] the clouds themselves.").

97. See *Agins v. City of Tiburon*, 447 U.S. 255, 262–63 (1980) (holding that an ordinance only permitting single-family housing did not unduly interfere with the expectations of a developer who desired to build multifamily housing), abrogated by *Lingle v. Chevron U.S.A., Inc.*, 544 U.S. 528 (2005); see also Daniel R. Mandelker, *Investment-Backed Expectations in Taking Law*, 27 *URB. LAW.* 215, 225–37 (1995) (critiquing *Penn Central*'s second prong).

98. *Penn Cent.*, 438 U.S. at 124.

99. See Michelman, *supra* note 88, at 1233 ("The [reasoning behind this factor] seems to be that actual establishment of the use demonstrates that the prospect of continuing it is a discrete twig out of his fee simple bundle to which the owner makes explicit reference in his own thinking, so that enforcement of the restriction would, as he looks at the matter, totally defeat a distinctly crystallized expectation.").

100. According to Professor Frank Michelman's famous formulation of this test, interference with existing uses of property tend to come with high demoralization costs and relatively low settlement costs. See *id.* at 1234 (stating that restrictions of existing uses generate "pain of a . . . demoralizing kind" that can be "identified by compensation tribunals with relative ease").

v. United States,¹⁰¹ the Supreme Court restated the *Penn Central* factors but with a subtle and unacknowledged change: it replaced “distinct” with “reasonable” investment-backed expectations.¹⁰² This alternative formulation allows governments to argue that even distinct plans are unreasonable. The focus on “reasonable” expectations principally serves to limit takings protection for unreasonable expectations regarding some future uses of property, like a property owner buying property in the middle of a residential area with firm plans to build a gas station.¹⁰³ Even if such plans or expectations are *distinct*—the property owner knows precisely what he wants to build and has maybe even undertaken preliminary site preparation—they might nevertheless be *unreasonable*.

An existing use is presumptively reasonable.¹⁰⁴ Conceptually, however, a use that was reasonable when developed—whether a tannery or natural gas facility—can become unreasonable over time.¹⁰⁵ This has long been true in the law of nuisance, where a benign use can turn into a nuisance as conditions in the world change.¹⁰⁶ It should be true of the law of takings as

101. 444 U.S. 164 (1979).

102. See J. David Breemer, *Playing the Expectations Game: When Are Investment-Backed Land Use Expectations (Un)reasonable in State Courts?*, 38 URB. LAW. 81, 85–86 (2006).

103. See, e.g., *Appollo Fuels, Inc. v. United States*, 381 F.3d 1338, 1349–50 (Fed. Cir. 2004) (providing a framework to assess the reasonableness of an owner’s expectations, based largely on the probability of regulation); *Mock v. Dep’t of Env’tl. Res.*, 623 A.2d 940, 949 (Pa. Commw. Ct. 1993) (“As to the Mocks’ future plans, we further agree . . . that the Mocks could not reasonably expect to develop their land free from government regulation because it is riparian land, which has been subject to regulation for centuries.”); see also John D. Echeverria, *Making Sense of Penn Central*, 23 UCLA J. ENVTL. L. & POL’Y 171, 183–86 (2005) (analyzing this reasonableness aspect of the *Penn Central* test).

104. In upholding the historic landmarking of Grand Central terminal in *Penn Central*, the Court noted that the regulation did not interfere with the use of the property as a railroad terminal—the existing use and therefore the primary investment-backed expectation of its owners. See *Penn Cent. Transp. Co. v. New York City*, 438 U.S. 104, 136 (1978) (“[T]he New York City law does not interfere in any way with the present uses of the Terminal. Its designation as a landmark not only permits but contemplates that appellants may continue to use the property precisely as it has been used for the past 65 years: as a railroad terminal containing office space and concessions. So the law does not interfere with what must be regarded as Penn Central’s primary expectation concerning the use of the parcel.”).

105. Cf. *Spur Indus., Inc. v. Del E. Webb Dev. Co.*, 494 P.2d 700, 705–08 (Ariz. 1972) (finding a cattle feedlot, the location of which was not originally unreasonable, to be a nuisance given the development of a new community nearby).

106. See *id.*; see also RESTATEMENT (SECOND) OF TORTS § 840D, cmt. b (AM.

well, which increasingly incorporates a dynamic approach to defining expectations.¹⁰⁷ Under the *Kaiser Aetna* version of the *Penn Central* test, natural gas infrastructure should then receive less takings protection as the investments become unreasonable over time.

Despite these arguments, tremendous uncertainty remains. The specter of property protection indeed hangs over many current regulatory responses to climate change, even though our arguments about reasonable expectations should apply today as in the future.¹⁰⁸ Moreover, the diminution in value prong from *Penn Central* will continue to weigh heavily against the government.¹⁰⁹ Although regulations of natural gas facilities should not cause a total wipeout under *Lucas*, they will almost certainly result in a significant diminution in value. There is no automatic cutoff or trigger in the percentage diminution in value that will result in takings liability, but the greater the regulatory impact, the more likely it is to be a taking.¹¹⁰ The kinds of regulatory

LAW INST. 1979) (“The defendant is required to contemplate and expect the possibility that the adjoining land may be settled, sold or otherwise transferred and that a condition originally harmless may result in an actionable nuisance when there is later development.”).

107. See Christopher Serkin, *Passive Takings: The State’s Affirmative Duty To Protect Property*, 113 MICH. L. REV. 345, 377–78 (identifying governments’ obligation to act in the face of changes in the world); see also *District Intown Props. Ltd. P’ship v. District of Columbia*, 198 F.3d 874, 883 (D.C. Cir. 1999) (“[A]t the time District Intown subdivided the property, it knew, or should have known, that the property was potentially subject to regulation under the landmark laws.”); *Good v. United States*, 189 F.3d 1355, 1363 (Fed. Cir. 1999) (finding the plaintiff’s expectations of developing wetlands to be unreasonable “[i]n light of the growing consciousness of and sensitivity toward environmental issues”).

108. See Laurence H. Tribe & Peabody Energy Corp., Comment Letter on Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, 79 Fed. Reg. 34830 (June 18, 2014), 11–15 (Dec. 1, 2014), <https://www.regulations.gov/document?D=EPA-HQ-OAR-2013-0602-23587> (contending the Clean Power Plan effectuates a taking); see also Andrew W. Schwartz, *No Competing Theory of Constitutional Interpretation Justifies Regulatory Takings Ideology*, 34 STAN. ENVTL. L.J. 247, 251 (2015) (“[T]he dramatic expansion of regulatory programs necessary to avoid environmental harms and other social problems, in addition to facing formidable political obstacles, risks running headlong into a regulatory takings doctrine.”); Jeffrey Dintzer & Nathaniel Johnson, *Legal Risks of Fracking Bans Are Real*, L.A. DAILY J. (June 24, 2014), <https://www.gibsondunn.com/publications/Documents/LegalRisksFrackingBans.pdf> (examining the takings implications of restrictions on fracking).

109. *Penn Cent. Transp. Co. v. New York City*, 438 U.S. 104, 105–06 (1978).

110. See Mark W. Cordes, *Takings Jurisprudence as Three-Tiered Review*, 20 J. NAT. RESOURCES & ENVTL. L. 1, 39 (2005) (analyzing the general percentage of diminution in value required by courts applying the *Penn Central* test);

burdens we anticipate becoming necessary in the future would significantly diminish the value of all natural gas infrastructure.

A prelude to these anticipated takings challenges can be found in initial reactions to EPA's Clean Power Plan, which is now in the process of being replaced, but was directed at coal-fired plants. Although less sweeping in scope than the kinds of regulations that are likely in the future, industry was nevertheless quick to raise regulatory takings objections. In formal comments to EPA on behalf of Peabody Energy Corporation, Professor Laurence Tribe argued that the regulation effected an impermissible taking.¹¹¹ He pointed to the significant economic impact of the regulation, as well as the long tradition of federal support for coal as informing the industry's reasonable expectations.¹¹² Tribe's comments evoked furious responses, and were pilloried by other academics. In a comprehensive reply, Professors Jody Freeman and Richard Lazarus—Tribe's colleagues at Harvard Law School—called the argument “wholly without merit.”¹¹³ They argued that “there is simply no reasonable expectation to profit forever from activities that are proven to harm public health and welfare.”¹¹⁴ Even Professor Richard Epstein, famous for his maximalist view of the Takings Clause, found Tribe's argument “wholly unconvincing” because “control of pollution lies at the heart of the government's power to regulate under even the narrowest view of the takings clause.”¹¹⁵

The invocation of the Takings Clause in the context of comparatively modest changes to the regulation of coal-fired power plants presages the fights to come, however. Change the facts to make new regulations much more restrictive and the economic

Mark W. Cordes, *The Effect of Palazzolo v. Rhode Island on Takings and Environmental Land Use Regulation*, 43 SANTA CLARA L. REV. 337, 383 (2003) (“Yet, all else being equal, a substantial diminution in value might bring a regulation closer to a *Penn Central* taking . . .”); Michelman, *supra* note 88, at 1190–93 (“[T]he claim to compensation must grow more compelling as the disproportionate harm increases towards immensity.”).

111. See Tribe & Peabody Energy Corp., *supra* note 108.

112. *Id.* at 13–15. Tribe also argued that the rules were discriminatory in the sense that they unfairly burdened power plants that were reliant on coal more than those that were not. *Id.*

113. Jody Freeman & Richard Lazarus, *Is the President's Climate Plan Unconstitutional?*, HARV. L. TODAY (Mar. 18, 2015), <https://today.law.harvard.edu/is-the-presidents-climate-plan-unconstitutional>.

114. *Id.*

115. Richard A. Epstein, *The EPA's Clean Coal Dust-Up*, HOOVER INST.: DEFINING IDEAS (Apr. 27, 2015), <https://www.hoover.org/research/epas-clean-coal-dust>.

impact much greater, and the Tribe of the future may well find himself with more allies, including judicial ones. We agree with the critiques of Tribe's particular application of the Takings Clause, but we also suspect that the ferocity of the responses reflects an awareness of the risk of takings liability for carbon regulations. As unlikely as takings liability may be, the risk is real.

The only certainty in the constitutional protection of property is a significant measure of unpredictability. The outcome of any takings analysis is difficult to predict, and the resolution of the particular claims we envision here is even more so.¹¹⁶ Even though governments usually win, the nature of the ad hoc takings inquiry provides little certainty in any particular dispute.¹¹⁷ Moreover, the takings analysis here is fundamentally a predictive exercise, only slightly more reliable than gazing into a crystal ball. The last fifty years have demonstrated that the substantive content of property protection can change drastically over time.¹¹⁸ What counts as a taking today may not be one tomorrow. Or, more problematically, what would count as a regulatory safe harbor today may be eliminated by the time that our reliance on natural gas must come to an end.¹¹⁹ So long as the possibility of constitutional protection exists, governments in the future may well find themselves constrained from completing the process of decarbonizing our energy supply. This is as likely to be true for political reasons as doctrinal ones; so long as property owners have a colorable claim—whether or not it should win—they may

116. See J. Peter Byrne, *Ten Arguments for the Abolition of the Regulatory Takings Doctrine*, 22 *ECOLOGY L.Q.* 89, 90–91 (1995) (“The regulatory takings doctrine is a pernicious mess.”); Andrea L. Peterson, *The Takings Clause: In Search of Underlying Principles Part I—A Critique of Current Takings Clause Doctrine*, 77 *CAL. L. REV.* 1299, 1316–17 (1989) (declaring that it is not only “difficult to discern . . . which test the Court [will] apply in any given case,” but that there is also “considerable uncertainty as to what each test means”); Susan Rose-Ackerman, *Against Ad Hocery: A Comment on Michelman*, 88 *COLUM. L. REV.* 1697, 1700–02 (1988) (criticizing takings jurisprudence as “judicially created uncertainty”).

117. See James E. Krier & Stewart E. Sterk, *An Empirical Study of Implicit Takings*, 58 *WM. & MARY L. REV.* 35, 62–68 (2016) (“[Under *Penn Central*,] [e]ach case is to be examined in light of all its facts and circumstances. Essentially, ad hoc review doctrine empowers state courts to reach whatever result they like.”).

118. *Penn Central* was decided in 1978. The common law nuisance exception was created in 1992. See *Lucas v. S.C. Coastal Council*, 505 U.S. 1003, 1029–30 (1992) (establishing the common law nuisance exception); *Penn Cent. Transp. Co. v. New York City*, 438 U.S. 104 (1978).

119. *ELICKSON ET AL.*, *supra* note 74; see also *Lucas*, 505 U.S. at 1024 (curtailing the harm-prevention defense “since the distinction between ‘harm-preventing’ and ‘benefit-conferring’ regulation is often in the eye of the beholder”).

well be able to invoke considerations of justice and fairness to influence a skittish and politically responsive government. As a result, there are nontrivial reasons to worry that the development of natural gas infrastructure today may well lock in those investments and make subsequent regulation more difficult, more expensive, and potentially even impermissible.¹²⁰ Natural gas may well turn into a bridge to nowhere if building out the infrastructure generates property protections that discourage adoption of adequate climate measures in the future.

B. PRESERVING FLEXIBILITY

The path that we are currently on—doing nothing today and risking paying compensation in the future—represents an implicit bet about the need for regulatory change in the future, and also about how courts will apply the Takings Clause to those changes. Many political actors today appear to be betting that future regulations will not be necessary. This attitude is consistent with a denial of the basic science of climate change, a political (or normative) calculus that costs can and should be shifted into the future, a choice to ignore the problem altogether, or a gamble that some technological innovation or changed understanding of the climate system will forestall the need for future regulatory intervention. We reject the first three of these “reasons” to do nothing. We accept the basic science of climate change, object to ignoring intergenerational concerns, and believe the need to focus on the problem is urgent. These positions are, in fact, embedded in our assumptions in this project, and they have received ample treatment in other work.¹²¹

120. The typical remedy for a regulatory takings violation is damages, while the remedy for a due process violation is injunctive relief. See *Lingle v. Chevron U.S.A. Inc.*, 544 U.S. 528, 543 (2005) (contrasting the remedies for takings violations and due process violations); see also Eduardo M. Peñalver & Lior Jacob Strahilevitz, *Judicial Takings or Due Process*, 97 CORNELL L. REV. 305, 309–10 (2012) (“[W]here the government violates the Takings Clause, the remedy is compensation for the period the violation is in place, but when its action deprives an owner of property without due process, compensation is not sufficient and the government action must be invalidated.” (footnote omitted)).

121. See, e.g., Elizabeth Burleson, *Climate Change and Natural Gas Dynamic Governance*, 63 CASE W. RES. L. REV. 1217, 1225–31 (2013) (discussing the potential for “path dependency” and the need for “breakout solutions”); Lincoln L. Davies & Victoria Luman, *The Role of Natural Gas in the Clean Power Plan*, 49 J. MARSHALL L. REV. 325, 371–73 (2015) (exploring the view that reliance on natural gas could be a “dead end” rather than a bridge fuel); Patrick Parenteau & Abigail Barnes, *A Bridge Too Far: Building Off-Ramps on the Shale Gas Superhighway*, 49 IDAHO L. REV. 325, 326–29 (2013) (emphasizing that present steps must be taken to offset the “path dependency” associated with

We nevertheless recognize the fourth possibility: that no dramatic regulatory interventions will be needed in the future to decarbonize our energy supply. It is possible, for example, that market forces will propel adoption of renewable energy, either because costs of solar and wind energy continue to decrease substantially, or because the costs of natural gas extraction and use go up.¹²² It is also possible that technological innovations, like CCS, will turn out to be both efficacious and inexpensive, and that regulatory burdens associated with them will not be too onerous.¹²³ But these possibilities, while conceivable, seem unlikely. Markets are difficult to predict, but, as we argued above, the economics of natural gas make it likely to remain relatively inexpensive and therefore ubiquitous for a long time—even if adoption of renewable energy increases dramatically.¹²⁴ Furthermore, planet scientists characterize technological solutions like CCS as a kind of Hail Mary pass, posing enormous risks and viewed as a last-ditch effort at best.¹²⁵

natural gas).

122. See, e.g., Joseph E. Aldy & Robert N. Stavins, *Using the Market To Address Climate Change: Insights from Theory & Experience*, DAEDALUS, Spring 2012, at 45, 46–47 (“[R]eal-world experience demonstrates the power of markets to drive changes in the investment and use of emission-intensive technologies.”); Jim Murphy, *Tipping Points: Carbon Rule Can Spur Clean Energy*, NAT. RESOURCES & ENV’T, Winter 2015, at 52, 53 (“[A] shift is clearly occurring as market forces and more competitive prices are leading to a rapid increase in renewable energy growth.”). But see Thomas Joo, *Global Warming and the Management-Centered Corporation*, 44 WAKE FOREST L. REV. 671, 693 (2009) (“Market forces and shareholder empowerment will . . . be woefully insufficient to make corporations reduce carbon emissions unless regulation reduces the profitability of carbon-intensive business activity through taxes, fines, and the like, and/or by reducing the relative costs of cleaner technology through tax breaks or direct subsidies.”); Lonnie G. Thompson, *Abrupt Climate Changes: Past, Present and Future*, J. LAND RESOURCES & ENVTL. L. 101, 105–06 (2007) (“Market forces alone will not produce the big switch in energy resources that is required if we are going to significantly reduce our carbon dioxide emissions.”).

123. See Howard Herzog et al., *Cost and Economic Potential*, in IPCC SPECIAL REPORT ON CARBON DIOXIDE CAPTURE AND STORAGE 339, 339–62 (Bert Metz et al. eds., 2005) (studying the potential for CCS to cost-effectively reduce greenhouse gas emissions). See generally Victor B. Flatt, *Paving the Legal Path for Carbon Sequestration from Coal*, 19 DUKE ENVTL. L. & POLY F. 211 (2009) (examining legal obstacles to CCS); Alexandra B. Klass & Elizabeth J. Wilson, *Climate Change and Carbon Sequestration: Assessing a Liability for Long-Term Storage of Carbon Dioxide*, 58 EMORY L.J. 103 (2008) (addressing potential liability from storing sequestered carbon dioxide and considering various liability options moving forward).

124. See *supra* Part I.A.

125. See, e.g., Christine Ehlig-Economides & Michael J. Economides, *Sequestering Carbon Dioxide in a Closed Underground Volume*, 70 J. PETROLEUM SCI.

If regulatory responses are required, courts in the future may give broad constitutional latitude to new regulations, as described in the previous section.¹²⁶ Notice, however, that there are parties on either side of that bet. The government may be gambling that it will be free to act in the future, while the natural gas industry will be gambling on the opposite. Or, more precisely, the natural gas industry may be gambling that it will have sufficient political power in the future to prevent regulatory change in the first place, with the prospect of takings-based compensation serving as a kind of alternative safety net in the event of new regulations.

This is a complex calculus on both sides, and small shifts in the ex ante probability of losing a takings claim will have a significant impact on the expected cost of a regulation.¹²⁷ Where the economic stakes are in the billions of dollars, a change of even a few percentage points in the likelihood of liability will have an impact in the hundreds of millions of dollars, and make regulation either more or less likely. Moreover, government actors are sensitive—perhaps overly so—to legitimate-seeming claims of property owners.¹²⁸ Whether or not takings protection would ultimately apply, perceptions of fairness and illegality affect the political calculus.¹²⁹ The presence of serious constitutional

& ENGINEERING 123 (2009) (reporting on the impractically vast space necessary to store sequestered carbon dioxide); Gary Shaffer, *Long-Term Effectiveness and Consequences of Carbon Dioxide Sequestration*, 3 NATURE GEOSCIENCE 464 (2010) (questioning the long-term efficacy of CCS).

126. See *supra* Part II.A.

127. See Christopher Serkin, *Insuring Takings Claims*, 111 NW. U. L. REV. 75, 78–79 (2016) (“[A] risk averse government may choose not to enact beneficial land use regulations . . . that create a risk of litigation, even if the likelihood of liability is remote, and even if the expected value of the regulation is strongly positive.”).

128. Cf. David Dana, *Incentivizing Municipalities To Adapt to Climate Change: Takings Liability and FEMA Reform as Possible Solutions*, 43 B.C. ENVTL. AFF. L. REV. 281, 295 (2016) (“It is . . . arguable that local governments are not only sensitive to potential Takings Clause liabilities, but risk averse with respect to such potential liabilities.”); Serkin, *supra* note 127, at 110–14 (contemplating the effects of takings claims on risk-averse government actors); Christopher Serkin, *Big Differences for Small Governments: Local Governments and the Takings Clause*, 81 N.Y.U. L. REV. 1624, 1666–70 (2006) (discussing the risk aversion of local governments).

129. Fairness considerations also affect the doctrinal analysis. See *Armstrong v. United States*, 364 U.S. 40, 46–49 (1960) (“The Fifth Amendment’s guarantee that private property shall not be taken for a public use without just compensation was designed to bar Government from forcing some people alone to bear public burdens which, in all fairness and justice, should be borne by the public as a whole.”).

claims makes the government less likely to regulate. Actions today that (1) reduce the likelihood of valid takings claims; and (2) that defang claims that regulations are unfair and unconstitutional will therefore have an impact on future regulatory incentives, both by affecting the anticipated costs of takings litigation and liability and by changing the politics.

Continuing on the current path therefore comes with significant risks. It raises the distinct possibility that the natural gas infrastructure will become entrenched against adverse regulatory changes, either legally or politically, even though there is widespread acknowledgement today that those regulatory changes will be necessary in several decades. Ultimately, we remain concerned that regulations will be necessary in the future and that the threat of legal protections will overly constrain regulatory responses. In the face of uncertainty, it is important to lay the legal groundwork to preserve policy flexibility in the future.

III. PREVENTING TAKINGS CLAIMS

When the legal system looks backwards, it sees the investments people have already made in reliance on legal rules, and generally seeks to protect those settled expectations.¹³⁰ What we propose, however, is a set of tools to require the legal system to look forward. By building limitations into legal entitlements *ex ante*, it will be easier *ex post* to find that any additional reliance was unreasonable. The challenge, at the most general level, is to shift the temporal perspective of property rights and regulation, and to act now to preserve policy flexibility in the future.¹³¹ We argue that developing a record establishing the reasonable expectations regarding the lifespan of the natural gas industry will limit or eliminate takings liability. This should be relatively easy to accomplish today and requires little or no political intervention. We advocate for that approach as low-hanging fruit. But, in addition, we also propose a new regulatory tool to accomplish

130. See Jill E. Fisch, *Retroactivity and Legal Change: An Equilibrium Approach*, 110 HARV. L. REV. 1055, 1084–87 (1997) (describing the relevance of settled expectations and reliance interests in assessing the desirability of retroactive laws).

131. By some measure, we are accepting the challenge to focus ahead of time on regulatory exit when designing current regulatory strategy. See J.B. Ruhl & James Salzman, *Regulatory Exit*, 68 VAND. L. REV. 1295, 1296–99 (2015) (“Government should also ask how it will *exit* when it realizes it (1) has accomplished Goal X, (2) is not achieving Goal X, or (3) has regulated more than necessary to achieve Goal X.”).

this temporal shift: prospective grandfathering. It relies, fundamentally, on important limits on the legal protection of existing uses found in land use law. We consider these in turn.

A. SETTING REASONABLE EXPECTATIONS

As we described above, the Takings Clause does not protect all expectations that a property owner might have, nor even all investment-backed expectations. Instead, the Takings Clause protects only reasonable investment-backed expectations.¹³² That is a substantial limitation when it comes to natural gas. Although it is reasonable to invest in natural gas infrastructure today—indeed, it is imperative—expectations regarding those investments should be temporally limited. Natural gas companies and their investors should expect future regulatory action, and those expectations should inform any subsequent takings litigation.

Doctrinally, the reasonableness of expectations can be affected by the foreseeability of future adverse regulatory changes. In *Kafka v. Montana Department of Fish, Wildlife & Parks*, the Montana Supreme Court rejected a takings claim arising out of Montana's decision to prohibit game-farm operators from charging a fee to shoot exotic big game species.¹³³ Plaintiffs owned a game-farm ranch where the business model involved raising exotic animals for hunters to pay to shoot.¹³⁴ They alleged that the new regulation was a taking of their property. In rejecting the challenge, the Montana Supreme Court reasoned that plaintiffs should have known their industry was controversial and there was a likelihood it would be significantly regulated.¹³⁵ Therefore, the plaintiffs could not have reasonable investment-backed expectations in their ongoing use of their property as a game farm.¹³⁶ Not every regulatory change is reasonably foreseeable,

132. See *supra* text accompanying notes 102–07.

133. *Kafka v. Mont. Dep't of Fish, Wildlife & Parks*, 201 P.3d 8, 12–13 (Mont. 2008).

134. *Id.*

135. See *id.* at 32 (“[S]ince appellants could have reasonably anticipated the complete elimination of Game Farms by the State or regulations that would make participation in the field unprofitable, they should have also anticipated that the State could make the operations less profitable by eliminating the in-state market for fee-shooting.”).

136. See *id.* (“[A]ppellants could not maintain a reasonable investment-backed expectation that they would be permanently insulated against the possibility that the Game Farm industry would be either regulated so as to eliminate its profitability, or completely abolished.”).

of course. And “the mere fact that a business operates in even a highly-regulated industry does not mean that all regulatory changes are reasonably foreseeable nor that the business cannot have reasonable investment-backed expectations.”¹³⁷ Nevertheless, courts generally examine whether future regulations were foreseeable when evaluating the extent of investment-backed expectations, and do not focus exclusively on the existing regulatory regime.¹³⁸

In light of this attention to property owners’ objective expectations *ex ante*, it is possible to preserve future regulatory authority by establishing an adequate record today of the regulatory lifespan of the natural gas industry. Information can have powerful legal consequences, an insight that has not been lost on public and private environmental policymakers over the last several decades. Consider, for example, the use of deed notices and deed restrictions. This approach has been used to limit future uses of contaminated sites under both the federal Superfund statute and its state analogues.¹³⁹ A site that will only be used as a landfill or a factory may not need to be cleaned up to the level that would be necessary if the site could be used as a school. Federal and state policymakers have responded by adopting policies that allow the cleanup standards to be determined based on the likely uses of the property, and to constrain those uses by placing information and restrictions in the property record regarding the site.¹⁴⁰

137. *Res. Invs., Inc. v. United States*, 85 Fed. Cl. 447, 514 (2009) (citing *Cienega Gardens v. United States*, 331 F.3d 1319, 1350 (Fed. Cir. 2003)).

138. *See, e.g., Arctic King Fisheries, Inc. v. United States*, 59 Fed. Cl. 360, 385 (2004) (“[K]nowing that Congress likely would eventually address the over-capitalization problem [in the fishing industry], plaintiff risked that it could cease actively participating in the fishery and yet still receive [a benefit] under whatever regulatory regime was ultimately adopted to effectuate a decapitalization. Things did not work as planned and plaintiff was excluded . . . not because the Congress failed to act in a reasonably foreseeable fashion, but because plaintiff miscalculated.”); *Walcek v. United States*, 49 Fed. Cl. 248, 268 (2001) (“Because the market can anticipate regulatory developments, it follows that reasonable expectations may extend beyond legal restrictions already in place and encompass the foreseeable creation of a new regulatory program or the expansion of an existing program.”), *aff’d*, 303 F.3d 1349 (Fed. Cir. 2002).

139. *See Comprehensive Environmental Response, Compensation, and Liability Act*, 42 U.S.C. § 9620 (2012) (imposing deed notice and restriction requirements when federally owned sites are transferred); *Industrial Site Recovery Act*, N.J. STAT. ANN. § 58:10B-13a(2) (West 2015) (instituting deed notice requirements in certain situations).

140. *See, e.g., EPA*, EPA-540-R-09-001, INSTITUTIONAL CONTROLS: A GUIDE TO PLANNING, IMPLEMENTING, MAINTAINING AND ENFORCING INSTITUTIONAL CONTROLS AT CONTAMINATED SITES 17 (2012), <https://www.epa.gov/sites/>

Many types of public actions along these lines are possible. Regulators and other scientific bodies have already developed the research base necessary to create a reasonable expectation that the end of the natural gas bridge will occur by 2050. The five assessment reports of the Intergovernmental Panel on Climate Change (IPCC), promulgated over the last twenty-five years, present ever starker warnings about anthropogenic climate change and the need for carbon limits.¹⁴¹ Domestic regulatory agencies also have produced reports that provide information about climate change and carbon limits.¹⁴² To reduce uncertainty in the record, regulators could draw from options such as a clear statement of long-term prospective regulatory actions in annual regulatory agendas, preambles to legislation and regulations, permits, and deed notices for the land on which natural gas facilities are built. These are just examples of available options.

Although public policymakers may not have the legal or political support necessary to act, private actors also have used information in ways that could address the end-of-bridge problem. For instance, in 1987, the Environmental Defense Fund used information to change the incentives and legal risks facing municipal waste incinerator operators.¹⁴³ At the time, municipal waste incinerator operators were treating incinerator ash as nonhazardous, based on a federal regulatory provision that allowed

production/files/documents/final_pime_guidance_december_2012.pdf (providing guidance on use of deed notices and restrictions). Of course, like all regulatory instruments, these are imperfect. The deed transferring what became the Love Canal Superfund site from Hooker Chemicals to the Niagara School District stated that “[p]rior to the delivery of this instrument of conveyance, the grantee herein has been advised by the grantor that the premises above described have been filled, in whole or in part, to the present grade level thereof with waste products resulting from the manufacturing of chemicals by the grantor at its plant . . . and the grantee assumes all risk and liability incident to the use thereof.” *United States v. Hooker Chems. & Plastics Corp.*, 722 F. Supp. 960, 962 (W.D.N.Y. 1989).

141. See generally INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2013: THE PHYSICAL SCIENCE BASIS (Thomas F. Stocker et al. eds., 2013), https://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WGIAR5_SPM_brochure_en.pdf.

142. See, e.g., EXEC. OFFICE OF THE PRESIDENT, THE PRESIDENT’S CLIMATE ACTION PLAN (2013), <https://obamawhitehouse.archives.gov/sites/default/files/image/president27sclimateactionplan.pdf> (advancing various policy initiatives related to climate change adaptation and mitigation).

143. The municipal incinerator waste litigation ended with *City of Chicago v. Environmental Defense Fund*, 511 U.S. 328 (1994), and is discussed in ROBERT V. PERCIVAL ET AL., ENVIRONMENTAL REGULATION: LAW, SCIENCE, AND POLICY 389–91 (7th ed. 2013).

them, in the absence of data, to “apply[] knowledge” of a waste stream “in light of the materials or the processes used” to determine whether it must be treated as hazardous.¹⁴⁴ To reduce treatment costs, operators were assuming the waste was not hazardous and were sending it to landfills. Combined with lobbying and litigation efforts, the Environmental Defense Fund took the novel step of testing some waste streams, finding them to be hazardous, and sending that information, by registered mail, to waste incinerator operators nationwide.¹⁴⁵ By destroying the ability to rely on a lack of knowledge about the potentially hazardous nature of the waste, the information shifted the incentives of the incinerator operators even in the absence of statutory or regulatory change.

An initiative that distributes information about the expected lifespan of natural-gas-fired electric plants could have a similar effect here. Environmental groups could play a leading role by collecting and disseminating studies and authoring reports detailing the limits of long-term reliance on natural gas. Broad dissemination to corporate managers, investors, regulators, and the public will make it difficult for industry in the future to disclaim knowledge. At the very least, the expert studies cited in this Article and other studies discussing the need to treat natural gas as a bridge fuel will create a record of the reasonableness of investment-backed expectations that can be used in takings litigation in the future.¹⁴⁶ Regulators will be able to point back to this record evidence that investors in natural gas knew, or should have known, that their investments would only pay out for approximately thirty years, at which point the regulatory environment would be likely to change.

In addition to the advocacy group initiatives we discussed above, several other private options are available to address this problem.¹⁴⁷ For one, banks and other institutional investors have an important role to play. Already, many forward-looking financial institutions recognize the disruptive potential of future

144. 40 C.F.R. § 262.11 (c)(2) (2017).

145. For a discussion of the Environmental Defense Fund’s letter to municipal incinerator operators, see Elmer W. Lammi, *Environmental Group Warns Trash Being Turned into Toxic Waste*, UNITED PRESS INT’L (Mar. 12, 1987), <https://www.upi.com/Archives/1987/03/12/Environmental-group-warns-trash-being-turned-into-toxic-waste/7669542523600>.

146. See *supra* notes 31–33 and accompanying text (citing articles discussing natural gas as a bridge fuel).

147. For a discussion of private regulatory instruments, see Michael P. Vandenbergh, *Private Environmental Governance*, 99 CORNELL L. REV. 129 (2013).

carbon regulations and require borrowers to analyze and disclose how their investments will fare under a different regulatory regime.¹⁴⁸ In fact, in 2008, a group of major banks signaled the expectations of the leaders in the financial sector by adopting the carbon principles, a set of private guidelines that require prospective borrowers for fossil-fuel-fired power plants to account for climate change regulations when conducting due diligence.¹⁴⁹ The carbon principles signaled to potential borrowers the need to account for regulatory limits on fossil fuel carbon emissions when applying for loans to finance new fossil-fuel-fired electric plants, and the principles could be updated to require borrowers to commit not to run plants after 2040 or 2050. If the banks and investors financing natural gas electric generating infrastructure are assuming some significant risk of regulation—which the studies discussed in Part I.A suggest may result in the nonviability of carbon-emitting energy by 2050—then those assumptions should again inform takings analysis in the future. The challenge today is to build and maintain an adequate record—such as those developed through the enhanced diligence and disclosure required by the carbon principles—and to understand how those financial assumptions may be an important tool to preserve regulatory flexibility.

Admittedly, there is a circularity to this claim. It implies that investors could help to immunize their investments in natural gas infrastructure by willfully ignoring the risk of future regulation. That circularity is actually inherent in the focus on investment-backed expectations and in takings analysis today.¹⁵⁰ Other scholars have identified the possibility that a property owner can bootstrap a regulatory takings claim by overpaying for property subject to regulation, because the purchase price

148. See MORGAN STANLEY, THE CARBON PRINCIPLES: FOSSIL FUEL GENERATION FINANCING ENHANCED ENVIRONMENTAL DILIGENCE PROCESS 6–7 (n.d.), https://www.morganstanley.com/about/press/files//1500519_carbon_principles_diligence_2.pdf.

149. See Vandenberg & Gilligan, *supra* note 68, at 266–67 (discussing the carbon principles).

150. This same dynamic arises in the very different context of the Fourth Amendment, which focuses on the “reasonable expectation of privacy,” but with more equivocal results. See, e.g., *Smith v. Maryland*, 442 U.S. 735, 740–41 n.5 (1979) (“[I]f the Government were suddenly to announce on nationwide television that all homes henceforth would be subject to warrantless entry, individuals thereafter might not in fact entertain any actual expectation of privacy regarding their homes In such circumstances . . . those subjective expectations obviously could play no meaningful role in ascertaining what the scope of Fourth Amendment protection was.”). We thank Christopher Slobogin for bringing this issue to our attention.

is evidence of investment-backed expectations.¹⁵¹ Precisely the same problem arises here. This is a problem in theory, but not in practice. Investors will not ignore genuine risks so as to marginally increase the merits of regulatory takings claims if those risks come to pass. Takings liability remains unlikely, and will not fully protect investors in any case. And, fundamentally, the Takings Clause only protects *reasonable* expectations. Ignoring foreseeable risks does not make an investment reasonable.

Our argument is that courts in the future will look back at the information that was readily available to power plant and other investors today when the courts evaluate the reasonableness of expectations for investments in natural-gas-fired electricity plants and related infrastructure, and public and private policymakers today have an opportunity to reduce the uncertainty in the record. Decades from now, faced with a takings claim, governments will be able to point back to this record as evidence that it was unreasonable to expect that natural gas would remain viable indefinitely. And the more attention this issue receives, the greater the impact on reasonable expectations.

B. PROSPECTIVE GRANDFATHERING

The advantage of information disclosure to establish reasonable investment-backed expectations is its relative ease. Given the public and private options, it also requires little or no political will, or even government action, to build a record that will help to immunize future regulators from regulatory takings claims. But information disclosure is not particularly strong medicine. The NSR debate discussed above demonstrates the difficulty of establishing the state of knowledge that prevailed several decades earlier, particularly when creating ambiguity about that state of knowledge can affect billions of dollars.¹⁵²

It is therefore important to consider a stronger approach available to government actors today to preserve regulatory flexibility in the future—what we dub prospective grandfathering.

151. See, e.g., Mandelker, *supra* note 97, at 247 n.126 (“A landowner may overpay for land knowing he has a chance at compensation if his expectations for development of the land are not realized.”); Lynda J. Oswald, *Concerning the Quark: Investment-Backed Expectations and Economically Viable Uses in Takings Analysis*, 70 WASH. L. REV. 91, 121 (1995) (objecting to use of the purchase price to evaluate landowner expectations on account of this concern).

152. See *supra* Part I.A.

Understanding how it works, and the extent of its promise, requires first examining an important tool in land use law for eliminating in-place investments: amortization of prior existing uses of property.

1. Amortization

Both the Constitution and statutory law provide extremely robust protection for existing uses of property.¹⁵³ It is not surprising, then, that zoning and land use regulations are usually prospective only; they grandfather developed property as prior nonconforming uses.¹⁵⁴ The persistence of prior nonconforming uses can interfere with rational land use objectives, however, leading governments to adopt a variety of responses to address them. At one end of the spectrum, governments sometimes use eminent domain to take title to problematic nonconforming uses.¹⁵⁵ At the opposite end of the spectrum—following the lead of the Standard Zoning Enabling Act—governments adopt what amounts to a natural-death approach; they constrain the extent to which prior nonconforming uses can be improved or rebuilt (and sometimes even maintained), but otherwise wait for them to die out.¹⁵⁶

Some states and local governments have adopted an intermediate alternative for eliminating prior nonconforming land uses. Instead of relying on either condemnation or on natural obsolescence, they have instead opted for the land use tool of amortization. Amortization in this context amounts to allowing a prior nonconforming use to remain in place for some predetermined amount of time before having to conform to the regulatory

153. See Serkin, *supra* note 19, at 1232, 1242 (referring to statutory and constitutional protections, respectively).

154. Indeed, in the context of land use controls, the original 1926 Standard State Zoning Enabling Act (SZA) recognized that “the almost universal practice is to make zoning ordinances nonretroactive.” U.S. DEPT OF COMMERCE, ADVISORY COMM. ON ZONING, STANDARD STATE ZONING ENABLING ACT 2 (1926). The difference between prospective and retroactive regulations in the context of land use regulations is surprisingly fraught. See Fisch, *supra* note 130, at 1067–69; Serkin, *supra* note 19, at 1263.

155. See, e.g., *Kelo v. City of New London*, 545 U.S. 469, 476 (2005) (taking developed land by eminent domain is acceptable when it serves a public purpose).

156. See Serkin, *supra* note 19, at 1235–36 (citing Eunice A. Eichelberger, *Alteration, Extension, Reconstruction, or Repair of Nonconforming Structure or Structure Devoted to Nonconforming Use as Violation of Zoning Ordinance*, 63 A.L.R. 4th 275 (1988)) (noting the variety of rules governments have implemented to encourage the demise of non-conforming uses).

change.¹⁵⁷ For example, when enacting new zoning prohibitions on adult uses or billboards (two common targets of amortization), the zoning ordinance may require property owners to come into compliance with new zoning regulations after, say, two years.¹⁵⁸ By giving this limited period of grandfathering, the government can then compel removal of the preexisting use without paying any explicit compensation.

Both the use of amortization and the duration of the amortization period are subject to constitutional limits. Although the source of protection is contested, courts typically review amortization under the Takings Clause.¹⁵⁹ Courts in some states have prohibited the practice outright. They have reasoned that if a regulation would be a taking today, it would still be a taking at the end of the amortization period.¹⁶⁰ Most courts, however, have upheld amortization under the Takings Clause. Of those, some have reasoned that the amortization provision is itself a kind of implicit compensation that satisfies the Fifth Amendment's just compensation requirement.¹⁶¹ In other words, prohibiting the

157. See Serkin, *supra* note 19, at 1236–37 (describing amortization).

158. See, e.g., *Indep. News, Inc. v. City of Charlotte*, 568 F.3d 148, 151 (4th Cir. 2009) (zoning ordinance compliance for adult use for eight years); *World Wide Video of Wash., Inc. v. City of Spokane*, 368 F.3d 1186, 1189 (9th Cir. 2004) (zoning ordinance compliance for adult use for one year); *David Vincent, Inc. v. Broward Cty.*, 200 F.3d 1325, 1328 (11th Cir. 2000) (zoning ordinance compliance for adult use for five years); *Adams Outdoor Advert., LP. v. Zoning Hearing Bd.*, 909 A.2d 469, 473 (Pa. Commw. Ct. 2006) (zoning ordinance compliance for billboards for thirty days); cf. *PA Nw. Distribs., Inc. v. Zoning Hearing Bd.*, 584 A.2d 1372, 1378 (Pa. 1991) (finding ninety days too short for an adult book store).

159. See Serkin, *supra* note 19, at 1244–45 (noting that the majority of courts uphold amortization statutes through a takings analysis). Some courts view amortization through the lens of due process, asking, in essence, whether the benefits of amortization to the public outweigh the costs to the property owner. *Id.* at 1243–44. Courts in many states have upheld the use of amortization, at least in principle. But the sufficiency of the amortization period is then subject to its own due process review. The greater the capital investments, the longer the amortization period needs to be. See Margaret Collins, *Methods of Determining Amortization Periods for Non-Conforming Uses*, 3 WASH U. J.L. & POL'Y 215, 218–20 (2000) (describing how to calculate amortization periods for recoverable costs).

160. See, e.g., *Hoffmann v. Kinealy*, 389 S.W.2d 745, 753 (Mo. 1965) (“[I]t would be a strange . . . doctrine indeed [to approve a taking simply if it] was not too soon.”); see also John H. Clifton, Comment, *Amortization of Nonconforming Uses in Pennsylvania: A Possible Remedy for a Zoning Headache*, 79 DICK. L. REV. 235, 244 (1975) (characterizing *Hoffman* as holding that “[a] delayed taking of private property for public use without just compensation was still unconstitutional”).

161. Serkin, *supra* note 19, at 1244.

existing use is, in fact, a taking that requires compensation, but the form of payment is the permission to remain in place for long enough to obtain a reasonable return on the investment.

Other courts, however, have viewed the amortization period as a kind of reciprocal benefit analogous to the transferable development rights (TDRs) in *Penn Central*; amortization blunts the impact of the regulatory burden by enough to prevent the regulation from effecting a taking in the first place.¹⁶² As the time horizon for regulatory compliance increases, the present value of the regulatory impact decreases. A regulation that grandfathers an existing use for a hundred years, for example, will have very little impact on the value of the property today, while a two-year amortization period will have a much more significant effect. In other words, requiring regulatory compliance in the future will affect the value of the resource today, but the extent of the diminution in the present value of the property will depend on the duration of the amortization period. Applying traditional *Penn Central* takings analysis, amortization should be permissible so long as the amortization period is long enough that the regulation neither (1) reduces the present value of the property by too much; nor (2) interferes too much with reasonable investment-backed expectations. If a property owner is given long enough before coming into compliance, the regulation will have no meaningful impact on present value or on reasonable expectations.

Of course, zoning and land use regulations will not be the specific regulatory tools used to eliminate natural gas infrastructure in the future. Nevertheless, the same dynamics are at play. In-place investments—whether billboards or pipelines—represent crystalized expectations about the use of property. If courts find that they cannot be eliminated outright without violating the Takings Clause, the same range of regulatory options should be available.

Both eminent domain and natural obsolescence are problematic in the context of natural gas. Eminent domain is very expensive. If the federal government were to seek to condemn natural gas facilities, the price tag would likely run into the billions of dollars.¹⁶³ Indeed, our effort here to avoid regulatory takings liability is based on the assumption that governments in the

162. For discussion of the TDRs in *Penn Central*, and how they prevented the landmarking of Grand Central from effecting a taking, see generally Christopher Serkin, *Penn Central Take Two*, 92 NOTRE DAME L. REV. 913 (2016).

163. See U.S. DEP'T OF ENERGY, *Appendix B: Natural Gas*, in QUADRENNIAL

future will underregulate carbon emissions if forced to pay compensation. Natural obsolescence has its own well-known problems: many prior nonconforming uses are especially valuable precisely because they are nonconforming.¹⁶⁴ They will not die a natural death because the regulatory regime has granted them a kind of minimonopoly—the only bodega in a residential area, the only gas station in a retail area, and so forth.¹⁶⁵ The same is true in the context of power plants, as the Clean Air Act NSR debate demonstrated.¹⁶⁶ As we discussed in Part I.A, the end of the natural gas bridge has strong parallels with the Clean Air Act NSR experience regarding coal-fired power plants and other large sources of air pollution. Disagreements remain about how EPA should have treated modifications to grandfathered coal-fired power plants that enabled them to run for decades after non-modified plants would have closed. Whether the Clinton or Bush Administrations took the appropriate regulatory response, the dynamic is clear enough: uses that are exempt from new regulations can become especially valuable precisely because of their grandfathered status.¹⁶⁷ We predict that the same will be true of natural gas facilities.

Amortization is a more promising middle path. It would accelerate the obsolescence of natural gas infrastructure without

ENERGY REVIEW: ENERGY TRANSMISSION, STORAGE, AND DISTRIBUTION INFRASTRUCTURE, at NG-5 (2015), https://energy.gov/sites/prod/files/2015/07/f24/QR_Appendix%20B_NaturalGas.pdf (stating that “[f]rom 2004 to 2014, companies made \$10 billion in average annual investments in midstream natural gas infrastructure, including major pipeline projects,” to support increasing demand); see also *supra* notes 58–59 and accompanying text.

164. See *City of Los Angeles v. A.I. Gage*, 274 P.2d 34, 40 (Cal. Dist. Ct. App. 1954) (“Until recently zoning ordinances have made no provision for any systematic and comprehensive elimination of the nonconforming use. The expectation seems to have been that existing nonconforming uses would be of little consequence and that they would eventually disappear. The contrary appears to be the case.” (internal citations omitted)); Osborne M. Reynolds, Jr., *The Reasonableness of Amortization Periods for Nonconforming Uses—Balancing the Private Interest and the Public Welfare*, 34 WASH. U. J. URB. & CONTEMP. L. 99, 109 (1988) (“[N]onconforming uses thrived due to the protection from new competition given them by the zoning laws.”).

165. See Eric J. Strauss & Mary M. Giese, *Elimination of Nonconformities: The Case of Voluntary Discontinuance*, 25 URB. LAW. 159, 163 (1993) (“Unfortunately, nonconforming uses were not phased out because the restriction on the development of similar uses in the area created a virtual monopoly, which allowed the nonconforming use to flourish.”).

166. See *supra* Part I.A.

167. See REVESZ & LIENKE, *supra* note 48, at 5 (“Once grandfathered, [as with the Clean Air Act,] lobbyists . . . work to preserve and enhance their legally created advantage.”).

forcing the government to pay monetary compensation. Amortization is traditionally a forward-looking doctrine, however, and is triggered by the date of the new regulation and not by the date the offending use was originally developed. The necessary amortization period for adult uses in a zoning ordinance will be the same whether the targeted business had been in place for six months, six years, or six decades before the zoning change.¹⁶⁸ Regulators of natural gas in the future will not be able to point to the previous decades as an amortization period unless something is done today—or soon—to start the period running. What we propose, then, is a kind of prospective grandfathering, where utilities are put on notice that they will need to come into compliance with anticipated future regulations and that the decades in the interim will count for purposes of amortization. Specifically, we advocate for a form of advance notice of future regulation—what has been dubbed a sunrise law or regulation in other contexts¹⁶⁹—implemented through a prospective ban or, perhaps, through expedited cost recovery by state regulators.

2. Sunrise Provisions and Prospective Grandfathering for Natural Gas

In land use and zoning law, the mechanism for triggering an amortization period is to prohibit the use prospectively while allowing some amount of time for existing uses to come into compliance with the prohibition. This is entirely inappropriate for natural gas. Instead of encouraging the rapid deployment of natural gas, this approach would bring it to a screeching halt. As we said at the outset, it is important to embrace the conversion to natural gas, at least in the short and medium term.¹⁷⁰ There is no reason, however, that the doctrine of amortization needs to be coupled with a prospective prohibition. Instead, the delayed implementation of a prohibition will have the same effect.¹⁷¹ What

168. See Serkin, *supra* note 19, at 1237 (explaining that courts weigh present harm to property owners against public benefit to determine the amortization period).

169. See Jacob E. Gersen & Eric A. Posner, *Timing Rules and Legal Institutions*, 121 HARV. L. REV. 543, 561 (2007) (describing anticipatory legislation); see also Herz-Roiphe & Grewal, *supra* note 24 (suggesting a framework for sunrise legislation).

170. See *supra* notes 27–36 and accompanying text.

171. There is one important limitation to our proposal. We envision that investments in natural gas will continue to be made, and should continue to be made, for at least another two decades. After that, however, additional investments might not be sufficiently amortized before new regulations need to be imposed. As a result, for the proposals considered below, we imagine a staged

we therefore propose is, in effect, a ban on natural-gas-fired electric generating plants that is adopted now, but that does not apply until approximately 2050.

This is not as unorthodox as it might seem. Many laws and regulations come with timing rules.¹⁷² Most familiar, of course, are sunset provisions that cause the subject legislation or regulation “to expire by its own terms.”¹⁷³ From tax rules, to the federal assault weapon ban, Congress frequently relies on sunset provisions to control the temporal reach of its laws.¹⁷⁴ What we propose is, in a sense, the inverse. Previously explored in the context of constitution-making, a sunrise rule is the formal announcement of future legislation or regulation, following the absence of one.¹⁷⁵

In fact, such sunrise rulemaking is consistent with the oldest forms of congressional delegations of regulatory authority. In exploring the nondelegation principle in administrative law, Professor Kevin Stack has identified its origins in a “contingency theory of delegation.”¹⁷⁶ Early examples from the end of the nineteenth century involved congressional delegations to the executive “on a finding that a ‘named contingency’ had occurred.”¹⁷⁷ These included, for example, the power to impose tariffs if the President determined that “tariff-free trade with [a] country would be ‘reciprocally unequal and unreasonable.’”¹⁷⁸ In other words, early congressional delegations of authority to the executive were often framed as advance notice of executive action in the event that certain contingencies were met.

Contemporary examples of sunrise provisions are easy to

adoption, where the prospective grandfathering is announced at T1, a prospective ban is announced at T2, and new regulations are enforced against all natural gas facilities at T3. So long as the time between T2 and T3 is adequate for amortization purposes, there should be no takings problem at T3.

172. Professors Gersen and Posner explored a variety of timing issues in both statutory and constitutional contexts, and labeled rules with deferred implementation “delay rules.” Gersen & Posner, *supra* note 169, at 565.

173. Rebecca M. Kysar, *Lasting Legislation*, 159 U. PA. L. REV. 1007, 1009 n.4 (2011). For a useful catalogue of the history of sunset rules, see Gersen & Posner, *supra* note 169, at 562 n.78.

174. See Herz-Roiphe & Grewal, *supra* note 24, at 1982 (collecting examples of sunset provisions).

175. See AMAR, *supra* note 24, at 474–75 (discussing sunrise provisions as a way to effect constitutional change); Herz-Roiphe & Grewal, *supra* note 24, at 1979 (noting, further, the utility of sunrise provisions); see also *supra* note 172.

176. Kevin M. Stack, *The Constitutional Foundations of Chenery*, 116 YALE L.J. 952, 983 (2007).

177. *Id.*

178. *Id.* (quoting *Field v. Clark*, 143 U.S. 649, 680 (1892)).

find. In fact, they are much more common than their more discussed inverse, sunset provisions. Whenever a rule contains a future implementation or phase-in date, it contains a kind of sunrise.¹⁷⁹ Perhaps the best-known example is EPA's phase-down of lead in gasoline, which the agency implemented in a series of steps during the 1980s.¹⁸⁰ But there are many other examples, as well.

Corporate Average Fuel Economy (CAFE) standards currently include some of the longest prospective rules in the United States.¹⁸¹ The National Highway Traffic Safety Administration (NHTSA) and EPA set the standards for vehicle fuel efficiency and emissions, respectively.¹⁸² The agencies gather input from various stakeholders to create the National Program for implementing the standards, which are announced many years in advance.¹⁸³ For example, Phase I of the National Program applied to model years 2012 through 2016, while Phase II applies to

179. See, e.g., 16 C.F.R. § 305.13 (2017) (phasing in a ceiling fan labeling regulation over the course of two years); Prepaid Accounts under the Electronic Fund Transfer Act (Regulation E) and the Truth in Lending Act (Regulation Z), CFPB No. 2014-CFPB-0031, http://files.consumerfinance.gov/f/documents/20161005_cfpb_Final_Rule_Prepaid_Accounts.pdf (delaying regulatory requirements for two years).

180. See *EPA History: Lead*, EPA <https://www.epa.gov/history/epa-history-lead> (last visited Jan. 31, 2018) (listing the press releases associated with the phases).

181. See *A Brief History of U.S. Fuel Efficiency Standards*, UNION OF CONCERNED SCIENTISTS [hereinafter *CAFE History*], <http://www.ucsusa.org/clean-vehicles/fuel-efficiency/fuel-economy-basics.html> (last visited Jan. 31, 2018) (explaining that 1975 legislation set standards for ten years and the 2007 legislation proscribed standards through 2030). Most agencies enact rules with effective dates within mere months, and even those rules with a longer timeframe tend to fall within the two-year range. See, e.g., 16 C.F.R. § 305.13 (2017) (allowing two years to comply with the Federal Trade Commission's labeling rules); 31 C.F.R. §§ 1010, 1020, 1023, 1024, 1026 (2017) (allowing two years to comply with the Financial Crimes Enforcement Network's due diligence rules).

182. See 49 C.F.R. § 533.5 tbl.IV (2003) (setting mpg standards for light truck model years 2005 (21.0 mpg), 2006 (21.6 mpg) and 2007 (22.2)). See generally 2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards, 76 Fed. Reg. 74,854 (proposed Dec. 1, 2011) (to be codified at 40 C.F.R. §§ 85, 86, 600; 49 C.F.R. §§ 523, 531, 533, 536, 537) [hereinafter *Proposed Phase II*] (containing the NHTSA's and EPA's joint proposed National Program for model years 2017 through 2025 of cars, trucks, SUVs, and other vehicles).

183. *CAFE History*, *supra* note 181 (relating how "the Federal Government, state regulators, and the auto industry established a national program to implement [the] first meaningful fuel efficiency improvements in over 30 years"); see also *Proposed Phase II*, *supra* note 182, at 74,854–56, 74,862–65 (inviting comments from industry stakeholders and discussing stakeholder involvement in developing the program).

model years 2017 and beyond.¹⁸⁴ The fleet standards generally increase steadily, but leave room for changes in later years.¹⁸⁵ Similarly, the Financial Accounting Standards Board consistently and intentionally enacts rules with long compliance timeframes.¹⁸⁶ And other agencies have delayed implementation of new rules in one-off situations to address specific challenges. For example, the phasing out of incandescent light bulbs and the conversion to high-definition television broadcasts both came with significant lead time.¹⁸⁷ In both cases, Congress ended up delaying implementation of the law even further in the face of industry resistance, but the changes did ultimately occur.¹⁸⁸ Internationally, too, Germany enacted a ban on the internal combustion engine in cars, effective in 2030.¹⁸⁹

184. *Corporate Average Fuel Economy*, NHTSA, <http://www.nhtsa.gov/laws-regulations/corporate-average-fuel-economy> (last visited Jan. 31, 2018). The statutes guide the contents and timing of the rules implemented by the agency; NHTSA, for example, must consider “technological feasibility, economic practicability, the effect of other standards of the Government on fuel economy, and the need of the nation to conserve energy” in its rulemaking. *Proposed Phase II*, *supra* note 182, at 74,897.

185. See 49 U.S.C. 32902(b)(2)(B)–(C) (2012) (explaining that the CAFE standards should increase ratably through 2020 and then should be set at the maximum feasible standards); *Proposed Phase II*, *supra* note 182, at 74,861 (“NHTSA has a statutory obligation to conduct a separate de novo rulemaking in order to establish final standards for vehicles for the 2022–2025 model years.”).

186. See *Accounting Standards Updates—Effective Dates*, FIN. ACCOUNTING STANDARDS BD., <http://www.fasb.org/jsp/FASB/Page/SectionPage&cid=1218220137102> (last updated Aug. 2017) (listing effective dates up to five years); see also Mary Clare Jalonik, *FDA Punts Calorie Labels on Menus for Another Year—Again*, U.S. NEWS (Mar. 28, 2016), <https://www.usnews.com/news/politics/articles/2016-03-28/looking-for-calorie-labels-on-menus-not-until-2017> (noting that despite issuance in 2014, the FDA continues to delay enforcement of menu guidelines due to industry pushback).

187. See Energy Independence and Security Act of 2007, Pub. L. No. 110-140, 121 Stat. 1492, 1580 (2007) (setting a deadline for rulemaking for incandescent lamp wattage by 2020); Carriage of Dig. Television Broad. Signals: Amendment to Part 76 of the Comm’n’s Rules, 27 FCC Rcd. 1713, 1713 (2012) [hereinafter *HDTV Carriage Rulemaking*] (explaining the initial three-year exemption period).

188. See Better Use of Light Bulbs Act, H.R. 2417, 112th Cong. (2011) (attempting to repeal parts of the 2007 act); *HDTV Carriage Rulemaking*, *supra* note 187, at 1734 (describing steps taken to accommodate the economic impact on small businesses).

189. See Bertel Schmitt, *Germany’s Bundesrat Resolves End of Internal Combustion Engine*, FORBES (Oct. 8, 2016), <https://www.forbes.com/sites/bertelschmitt/2016/10/08/germanys-bundesrat-resolves-end-of-internal-combustion-engine>. Similarly, France has announced a similar ban, to take effect in 2040. See Angélique Chrisafis & Adam Vaughan, *France To Ban Sales of Petrol and Diesel Cars by 2040*, GUARDIAN (July 6, 2017), <https://www>

These kinds of sunrise provisions are routine. There has been little scholarly work describing or characterizing them, and the justifications seem self-evident. By and large, regulators delay implementation of rules to allow industry time to develop and deploy the technology necessary to meet the new standards. But our proposal is different. Our goal is not to give industry time to catch up, but rather to give it time to wind down. We offer sunrise rules as a way of easing the legal transition between the current policy encouraging natural gas, and our expectation of an eventual ban.

Conceptually, adopting new carbon limits for natural-gas-fired power plants to be implemented at a date far in the future should create immunity from takings liability. Ideally, the rule we propose would include a specific provision setting forth the amortization schedule for natural gas investments, a schedule that could even be implemented through expedited cost recovery and accelerated depreciation by ratemakers, described below.¹⁹⁰ The interim period—the years before the new regulations come into effect—will then count as an explicit amortization period. Investors will be on notice that they have approximately thirty years to recoup their investments, and cannot complain when new carbon limits are ultimately implemented.

Even in the absence of an explicit trigger, sunrise rules should create *de facto* amortization. Whether grandfathering happens retroactively, as is typical, or prospectively, as we propose, the effect on investors is precisely the same. It should not matter whether the amortization period is triggered by a new prohibition coupled with a temporary reprieve to come into compliance, or by advanced notice of a future prohibition coupled with a reprieve in the interim. In either case, investors are given advance notice that their investments will come to an end at a prespecified time, and that the time between enactment and implementation is intended to smooth the costs of the eventual prohibition. In the language of the Takings Clause, the prospective grandfathering we propose eases the costs of the legal transition by leveling it out over a long period.¹⁹¹

.theguardian.com/business/2017/jul/06/france-ban-petrol-diesel-cars-2040-emmanuel-macron-volvo.

190. See *infra* Part III.B.3.

191. See Holly Doremus, *Takings and Transitions*, 19 J. LAND USE & ENVTL. L. 1, 3 (2003) (“Regulatory takings claims are fundamentally conflicts over legal transitions.”); Kyle D. Logue, *Legal Transitions, Rational Expectations, and Legal Progress*, 13 J. CONTEMP. LEGAL ISSUES 211, 216–18 (2003) (arguing for

Indeed, the complex interaction of discount rates and statutes of limitations may even preclude takings challenges. Delayed implementation of a legal change blunts the economic impact of that change. If the natural gas industry were to challenge our proposed sunrise rule on the date of enactment, it would almost certainly fail the *Penn Central* test because the resulting diminution in value, and the extent of interference with investment-backed expectations, would be discounted to present value. This is precisely the same reasoning used to uphold amortization provisions generally. The effect of the new rule thirty years from now will be small enough to survive *Penn Central* analysis.¹⁹² Importantly, however, the natural gas industry also would not be able to wait until the date of implementation to sue because of statute of limitations problems. The statute of limitations for takings claims is generally six years from the date the claim accrues.¹⁹³ For facial takings claims, and the kind of clear-cut rule we propose, that accrual date should be the date of enactment and not the date of implementation.¹⁹⁴

transition policies for regulatory takings of private property as a type of "government-provided insurance"); Edan Rotenberg, *Ending Both Forms of Grandfathering in Environmental Law*, 37 ENVTL. L. REP. 10717, 10719 (2007) (explaining that grandfathering compensates property owners for legal transitions).

192. Imagine that the financial impact thirty years from now will be in the billions of dollars. That loss might not result in a significant diminution in value *today*. The discounted present value of a billion dollars thirty years in the future is approximately \$170 million (using a six percent interest rate). Although this is a lot of money, it represents a small fraction (less than one-fifth) of the eventual loss. The value of the entire natural gas industry that would be affected by the end of the natural gas bridge, if discounted in this way, would represent a loss today of less than twenty percent, which should not rise to the level of a taking under *Penn Central*.

193. 28 U.S.C. § 2501 (2012). In *John R. Sand & Gravel Co. v. United States*, the Supreme Court held that the statute of limitations of any action in the Court of Claims is jurisdictional; thus, it may not be tolled, and it must be considered by the court *sua sponte*. 522 U.S. 130, 134–35 (2008) (citing *Finn v. United States*, 123 U.S. 227, 232 (1887)). Due to the fact-sensitive nature of takings claims, however, courts will dismiss a case based on the statute of limitations only if more than six years has passed since the taking could not have been in controversy. *Ewald v. United States*, 14 Cl. Ct. 378, 382 (1988).

194. See, e.g., *Levald, Inc. v. City of Palm Desert*, 998 F.2d 680, 687–88 (9th Cir. 1993) (finding that a statute's enactment triggered the statute of limitations); see also Gregory M. Stein, *Regulatory Takings and Ripeness in the Federal Courts*, 48 VAND. L. REV. 1, 27 n.112 (1995); cf. Richard A. Epstein, *Takings: Descent and Resurrection*, 1987 SUP. CT. REV. 1, 28 ("The taking therefore occurs not at the time of the final judicial determination, but at the earlier moment when the regulation was first placed into effect."); Gregory M. Stein, *Pinpointing the Beginning and Ending of a Temporary Regulatory Taking*, 70 WASH. L. REV. 953 (1995) (discussing when statutes of limitations begin to

In short, where the implementation date is pushed off far into the future, sunrise lawmaking will not have a significant enough impact when discounted to present value to violate the Takings Clause, and by the time it would have such an impact, the statute of limitations will have run. This outcome is not some kind of perverse trap for the natural gas industry, but instead follows naturally from substantive takings law. Where legal transitions occur over a long enough period of time so that property owners can adjust to legal changes, there should be no takings protection.¹⁹⁵

It is not surprising that the relationship between timing rules and the Takings Clause has not been explored before. None of the sunrise provisions we have identified even implicate the Takings Clause. If the underlying regulation would not create a takings claim, there is no reason to consider how delaying implementation would change the takings calculus. Moreover, most sunrise provisions are too short to provide the kind of immunity that our proposal would create because they do not provide for adequate amortization. The duration we envision is extremely unusual. Most implementation dates are measured by months or maybe years from the adoption of a rule.¹⁹⁶ Ours is measured in decades.

Nevertheless, there are informative analogies. Our proposal bears a surprising resemblance to municipal street mapping. Many municipalities identify the location for future streets well in advance of building them. In fact, in some instances, streets are mapped decades before they are actually built—if they are ever built at all. But the act of mapping the streets is important because it puts property owners on notice that the streets *may* be built, and so can remove the need to pay compensation for any structures built where a street was already mapped.¹⁹⁷ If and

run).

195. This is contrary to an assumption by Professors Gersen and Posner, who argued in their theoretical discussion of timing rules for legislation that delaying implementation of a rule does not constitute compensation. Gersen & Posner, *supra* note 169, at 584. In fact, it should. As prospective grandfathering, if the delay is long enough to constitute adequate amortization, it should prevent the ultimate implementation of a law or regulation from effecting a taking.

196. It is interesting to note that the EPA's lead phase-down continued for roughly a decade, and Article I, Section 9 of the U. S. Constitution prohibited congressional interference with the slave trade for twenty years after ratification. See U.S. CONST. art. I, § 9; see also Herz-Roiphe & Grewal, *supra* note 24, at 2015, 2018–19 (discussing this example as a sunrise provision).

197. See *In re Furman St.*, 17 Wend. 649, 655–56 (N.Y. Sup. Ct. 1836) (finding that the street plan provided notice to residents and landowners were not

when the municipality actually builds the street, it will have to pay compensation for the underlying land, but not for improvements on the land.¹⁹⁸ Advance notice of the possibility of regulations in the future has a similar effect.

3. Implementing Prospective Grandfathering: Accelerated Depreciation

In theory, the most straightforward way to implement prospective grandfathering is for Congress to enact a statute that imposes new regulations on natural gas with an implementation date three decades from now, coupled with an explicit provision that the interim period counts as amortization. For instance, Congress could mandate that EPA adopt regulations to be implemented by some date certain, either specifying the carbon emission limits itself or, more plausibly, instructing EPA to adopt significant carbon limits by 2040 or 2050. Unfortunately, this seems wholly implausible. Congress had shown little willingness to regulate carbon in any meaningful way before the 2016 election, and any hope of near-term congressional action seems unrealistic.

Only slightly more likely would be for EPA to adopt a sunrise rule prohibiting natural gas in the future under its existing Clean Air Act authority. Before the 2016 election, the agency promulgated new source performance standards for fossil-fuel-fired power plants, and before the recent EPA regulatory shifts our approach would simply have required EPA to add the steeper future emissions reduction requirements to its current regulations.¹⁹⁹ This would raise questions about the authority to do so under the Clean Air Act, the calculation of costs and benefits under the executive orders on regulatory reviews and other issues, but these are beyond the scope of this Article. Our point is that a regulatory option is conceptually a plausible approach to prospective grandfathering.

owed compensation for erecting structures that failed to comply with the public plan). *But see* Trent Andrews, Comment, *Official Maps and the Regulatory Takings Problem: A Legislative Solution*, 2011 B.Y.U. L. REV. 2251, 2253–58 (describing unpredictability of cases, and some that found the act of adopting an official map to be regulatory takings because of the immediate impact of the map on property values).

198. *See In re Furman St.*, 17 Wend. at 657, 660 (noting that while landowners could be compensated for the reasonable value of their land, they could not extract exorbitant sums from the public by building extravagant structures).

199. *See* Standards of Performance for Greenhouse Gas Emissions, 80 Fed. Reg. 64,510 (Oct. 23, 2015) (establishing standards for fossil-fuel-fired units).

Of course, any near-term EPA carbon regulations became extremely unlikely following the 2016 presidential election. Even with the political benefits of our approach—discussed below²⁰⁰—we do not expect EPA to adopt new regulations of carbon emissions anytime in the near future. That puts increasing pressure on the states, which do, in fact, have a number of paths for implementing prospective grandfathering.²⁰¹

Most obviously, state utility regulators could introduce the same kind of sunrise rulemaking that is available to EPA. The mechanics will vary state by state, and not every agency has an obvious way to phase out natural gas power plants far in the future. Just as problematically, the politics surrounding state utility regulation may prove difficult to overcome. That political landscape changes, however, if states can offer the natural gas industry a short-term or medium-term benefit in exchange for losing property protection far in the future. Regulators could therefore also create prospective grandfathering by providing additional money *ex ante* as a way of accelerating amortization.

Importantly, this is not the compensation that would be required if the regulation effected a taking. Following the logic of amortization, it is a kind of *ex ante* payment that is then included for purposes of assessing diminution in value; it prevents a future regulation from being a taking at all.²⁰² This reasoning mirrors the justifications for upholding amortization, and it should insulate any regulator from future takings liability.

There are also any number of ways of providing an *ex ante* payment. Outright tax benefits would be the most straightforward. Indeed, it is arguably the case that the enormous tax benefits currently provided to the natural gas industry—and the energy sector as a whole—should make compensation unnecessary for any future regulation already.²⁰³ Doctrinally, however, courts have kept takings and taxing in conceptually separate catego-

200. See *infra* Part III.C.

201. It also puts increasing pressure on private governance, as one of us has recently been arguing. See generally Vandenberg, *supra* note 147 (suggesting that private governance is an increasingly important component of modern environmental governance).

202. This is the same logic that applies to transferable development rights. See generally Serkin, *supra* note 162 (discussing TDRs).

203. See generally Tracey M. Roberts, *Picking Winners and Losers: A Structural Examination of Tax Subsidies to the Energy Industry*, 41 COLUM. J. ENVTL. L. 63 (2016) (identifying the extent of tax subsidies to fossil fuel companies).

ries; they are likely to be reluctant to count favorable tax treatment as an offsetting benefit for purposes of takings analysis.²⁰⁴ Nor are tax credits or other tax benefits conditioned on relinquishing takings claims in the future. The mere fact of favorable tax treatment should be enough to trigger prospective grandfathering, but doctrinally may not be.

Prospective grandfathering can be triggered in other ways that are more closely tied to the underlying rationale of amortization and that are therefore more promising. The most intriguing, and therefore the one we explore in depth below, is for state utility regulators to exercise their ratemaking authority to trigger prospective grandfathering. This is primarily by way of example; other approaches would work as well. But ratemaking is a particularly effective and appropriate approach in this setting.

Ratemaking by utility regulators is a complex topic. The details fill volumes and go far beyond what we can address here.²⁰⁵ But in broad form, utility regulators set rates by identifying the total revenue that the utility will require and spreading that revenue over the customer base.²⁰⁶ The total revenue required will include the marginal cost of the power itself, as well as a reasonable rate of return on the costs of capital improvements, like the development of infrastructure or a new plant. Capital costs can be included in the base rate for customers, and will be spread out over the projected useful life of the capital asset.²⁰⁷ So, for example, the marginal cost (that is, the production cost) of each kWh

204. Cf. generally Peñalver, *supra* note 72 (discussing relationship between taxes and the Takings Clause).

205. See, e.g., Jeremy Knee, *Rational Electricity Regulation: Environmental Impacts and the "Public Interest"*, 113 W. VA. L. REV. 739, 747–51 (2011) (detailing the history of ratemaking); Ari Peskoe, *Unjust, Unreasonable, and Unduly Discriminatory: Electric Utility Rates and the Campaign Against Rooftop Solar*, 11 TEX. J. OIL, GAS, & ENERGY L. 211, 263–74 (2016) (summarizing recent rate-making proceedings concerning ratemaking subsidies); Jim Rossi, *The Political Economy of Energy and Its Implications for Climate Change Legislation*, 84 TUL. L. REV. 379, 390–93 (2009) (exploring the ratemaking process).

206. See, e.g., Lino Mendiola, *The Erosion of Traditional Ratemaking Through the Use of Special Rates, Riders, and Other Mechanisms*, 10 TEX. TECH ADMIN. L.J. 173, 173 (2008) (“In a traditional model of ratemaking, regulators establish rates after a review and approval of the utility’s total revenue requirement measured during a historical ‘test year.’”).

207. See, e.g., MARK COOPER, *ADVANCED COST RECOVERY FOR NUCLEAR REACTORS: A BAD IDEA THAT GETS WORSE BY THE MINUTE* 3–4 (2011), <http://www.iaumc.org/files/fileslibrary/2011NuclearPower-CooperIssueBrief.pdf> (describing how capital investments must be “used and useful” and “just, reasonable, and prudent” before they can be passed on to customers).

of electricity may be \$0.05, but the actual “levelized” cost to consumers might be \$0.10 per kWh, to incorporate cost recovery for the fixed capital investments.²⁰⁸ The depreciation rates for capital assets will determine how they are built into the base rate, and this can be an important policy lever. By accelerating depreciation rates, rate-makers can, in effect, expedite cost recovery, and so allow utilities to amortize their investments more quickly.

To be explicit, we propose that state regulators allow natural gas utilities to recover their investments from consumers more quickly in exchange for losing the right to sue for a regulatory taking in the future.²⁰⁹ An aggressive form of cost recovery is currently being used—controversially, it is true—to stimulate investments in nuclear power. No new nuclear power plants have been built in this country for over thirty years. The reason is as much financial as it is technological. New plants take a long time to build, often struggle to meet regulatory requirements, and are beset by cost overruns. The problem for a public utility, then, is that the substantial costs of developing a nuclear power plant are not typically passed on to consumers until the plant actually comes online.²¹⁰ As a result, some utility regulators have adopted accelerated cost recovery, allowing the costs of nuclear plants to be built into base rate before the plant actually starts producing power.²¹¹ The effect is to lower the financial risks for the utility, to provide access to less expensive financing mechanisms, and thereby to incentivize the construction of new plants. The strategy is controversial because it increases costs to consumers in the short run, and it folds in costs of nuclear facilities that may not actually benefit consumers for decades, if ever.²¹²

208. See, e.g., *Electric Generating Costs: A Primer*, INST. FOR ENERGY RES. (Aug. 22, 2012), <http://www.instituteforenergyresearch.org/analysis/electric-generating-costs-a-primer>.

209. In effect, this addresses the more familiar problem of stranded costs from a different temporal perspective, ex ante instead of ex post. See Hammond & Rossi, *supra* note 23, at 652–55 (noting the importance of cost recovery).

210. See, e.g., COOPER, *supra* note 207, at 3–4 (explaining the relationship between ratemaking and cost recovery).

211. See 26 U.S.C. § 168 (2012) (providing for accelerated cost recovery); 26 C.F.R. 1.168(a)-1 (2017) (providing for modified accelerated cost recovery); THE CSIS COMM'N ON NUCLEAR ENERGY POLICY IN THE U.S., RESTORING U.S. LEADERSHIP IN NUCLEAR ENERGY: A NATIONAL SECURITY IMPERATIVE 37 (2013) (noting that nuclear power is typically eligible for fifteen-year cost recovery).

212. See Sony Ben-Moshe et al., *Financing the Nuclear Renaissance: The*

The accelerated depreciation we propose for natural gas avoids some of the pitfalls of accelerated cost recovery for nuclear plants by ensuring that natural gas facilities are actually online and producing power before being added to base rate. Accelerated depreciation will still force consumers to bear some or, potentially, all of the risk of regulatory change by paying for the costs of natural gas infrastructure early. If our predictions are correct, they will be buying facilities with shortened lifespans resulting from regulatory, rather than physical, limits. But to the extent we are right, this accelerated repayment also reflects reality and provides a more realistic price signal about the true cost of power generation. In other words, consumers should pay for this risk because it provides a more accurate pricing mechanism for the true cost of natural gas. In effect, it forces consumers to internalize at least some of the intertemporal costs of energy consumption today.

This approach might also blunt utilities' opposition to our sunrise proposals and might indeed make them supporters. For a utility, the ability to recover capital expenditures on an accelerated basis is a substantial economic benefit. More importantly, it is a benefit in the short term in exchange for eliminating takings protection in the long term. While pricing and individual risk preferences matter, we expect that this is an exchange many, if not most, utilities would willingly undertake. In other words, this is a better outcome than the do-nothing path we are currently on. Utilities know there is a chance that natural gas will be subject to significant new carbon regulations in the future and that the Takings Clause may not provide them with compensation. Our proposal for accelerated cost recovery coupled with prospective grandfathering gives utilities a meaningful economic benefit and it may even increase the competitive advantage of natural gas over coal.

Some may object that this proposal amounts to paying off the natural gas industry when no payment should be necessary. Not only is it normatively problematic to transfer money to an industry creating a significant public harm, it also amounts to an implicit concession that compensation may be required for the

Benefits and Potential Pitfalls of Federal & State Government Subsidies and the Future of Nuclear Power in California, 30 ENERGY L.J. 497, 502 (2009) (noting that cost recovery for nuclear power is often structured without regard to budget overruns or commercial viability); William Boyd & Ann E. Carlson, *Accidents of Federalism: Ratemaking and Policy Innovation in Public Utility Law*, 63 UCLA L. REV. 810, 849 (2016) (citing disputes over cost recovery for facilities that would never be useful).

eventual regulation of natural gas and for the regulation of fossil fuels more broadly. Both are serious objections. But the accelerated cost recovery we envision should be viewed as an inducement to develop energy infrastructure in the face of a shorter-than-normal lifespan. It is not compensation for the eventual regulation, so much as it is creating incentives for the development of natural gas despite its inevitable regulation. What we offer is a form of implicit compensation that prevents the eventual regulation of natural gas from being a taking in the first place.

We must also acknowledge that nothing in this proposal will prevent owners of natural gas infrastructure from suing in the future, regardless of the ex ante payoff. They can take the money from accelerated depreciation and then sue under the Takings Clause when the government eventually regulates. There is, of course, no way to prevent someone from suing in the future; courts remain accessible for adjudicating constitutional claims. Nevertheless, the logic of prospective grandfathering and ex ante amortization will make takings claims even more difficult to win than they already are. And perhaps even more importantly, our proposal should shift the politics of such regulatory takings claims. State officials should not fear losing either in courts of law or in courts of public opinion when the natural gas industry is understood to have benefitted in clear and quantifiable ways leading up to the regulation.

More creative approaches could change those dynamics further. For example, instead of allowing utilities to capture the benefits of accelerated depreciation immediately, those extra funds could, in effect, be escrowed for the life of natural gas, to be paid only when natural gas is, in fact, eliminated. Utilities in the future would then have a more complicated decision about whether to challenge the inevitable regulation. The money set aside would amount to a kind of payment in the future if and when utilities acquiesced to the new regulatory regime. This could be combined with limits on legal challenges, more-or-less complicated payout triggers and schedules, and so forth. We are confident that many different structures would accomplish our overall goals, but we reserve those details for future work. One advantage of implementing prospective grandfathering through state utility regulators is the opportunity to experiment with a number of different approaches.

Focusing on state regulators to trigger prospective grandfathering has another obvious disadvantage, however. It will allow

for prospective grandfathering only in those states that actually adopt our proposal, and in which amortization is allowed. Takings claims will remain as viable as before in states that do not allow accelerated depreciation. Nevertheless, this is still an improvement over the status quo. And to the extent that the natural gas infrastructure relies on network effects, anticipating the loss of pipelines, wells, and even power plants in some states may be enough to alter the reasonable expectations of the industry as a whole.

Other policy levers could have the same effect as accelerated cost recovery through state utility regulators. For instance, the IRS could offer accelerated depreciation for tax purposes. This would, in effect, allow the natural gas industry to deduct a greater portion of its capital costs in its federal tax returns. Other approaches could include state or federal tax credits, or other forms of more explicit payment. We are agnostic, but we suspect that our proposal for intervention by state utility regulators is both the most likely politically, and the most effective. We consider the politics of our proposal next.

C. IN DEFENSE OF PROSPECTIVE GRANDFATHERING

Stepping back from the details of accelerated cost recovery by state regulators, our proposal to sunrise new regulation promises some important benefits that go beyond just natural gas. For one, opposition may be less intense because the expected cost of the regulation is relatively small today. By delaying the effect of new regulations far into the future, the discounted present value of the regulatory burdens will be relatively small. Indeed, that is the doctrinal justification for our approach.

In the context of natural gas, this means specifically that industry has less reason to fight the sunrise provision today.²¹³ Industry will have plenty of opportunity to lobby against any eventual regulations in subsequent decades, and so the costs of this early authorization are perhaps too abstract to generate intense political opposition. Moreover, the law can be viewed as a kind of safety valve or insurance policy in case the dire predictions of global climate change come true. The kind of deferred regulatory authorization that a sunrise provision reflects may

213. Cf. Gersen & Posner, *supra* note 169, at 570–71 (“[R]ules that require delay between when a problem is identified and when legislation may be enacted will weaken the relative power of interest groups, and thus increase the probability that public-spirited legislation will be enacted.”).

actually thread the increasingly thin needle of political feasibility and meaningful impact. The costs today are modest, but by preventing future regulatory takings claims, it preserves greater flexibility for regulators in the future faced with the need to eliminate natural gas from our energy infrastructure.

More subtly, pushing implementation far into the future may also cause decision-makers today to be more other-regarding. In the context of constitutional changes, Professor Amar observed: "Once Americans understand that . . . they are setting up fair procedures not so much for themselves as for their unborn grandchildren and great-grandchildren, they should be more likely to focus on what is truly right rather than what is in their own current interest."²¹⁴ The same logic applies to our proposal, and so promises a way through some legislative logjams. Pushing the implementation date of carbon regulations far enough into the future allows for an exclusively future-oriented rule. And, of course, if the world turns out differently than current policy makers predict, they can always change the rule later.

This last point is important both legally and conceptually. One objection to the kind of sunrise rule we propose—especially with the long duration necessary for natural gas—is the problem of dead hand control. One Congress or agency cannot make policy binding on future generations.²¹⁵ Lawmakers must respond to the policy preferences of their own constituents and are not beholden to the past. A long sunrise provision may appear to be an attempt to force contemporary policy preferences on to the future. But we are, in fact, arguing for just the opposite. Our focus is on preserving policy flexibility into the future, by ensuring that property rights are not allowed to constrain foreseeable regulatory initiatives. And of course, there is nothing binding about a sunrise rule. Its strength lies in its inertia. If future generations want to change course, there is nothing to prevent them from doing so. If the scientific consensus on climate change turns out to be wrong or the balance of costs and benefits shifts in a different direction than now seems likely, future policymakers will not be prevented from allowing the continued use of natural

214. AMAR, *supra* note 24, at 475; see also Herz-Roiphe & Grewal, *supra* note 24, at 1980 (arguing that sunrise lawmaking "can be used to enlarge the sphere of democratic participation when short-term vested interests might otherwise stand in the way").

215. See Serkin, *supra* note 25, at 881 ("In a democracy, governments are not allowed to bind future governments.").

gas plants. But they will have the flexibility to act.

This observation does not undermine the value of sunrise rules because their inertial force may be considerable. Moreover, adopting the rule today will—as we argue—defang one of the objections that future generations might have to adopting a rule themselves: that it interferes too much with settled expectations. Compared to enacting a ban or significant regulation of carbon today, the approach we propose is indeed weak tea. But as compared to doing nothing today, our proposal may meaningfully change both the political and legal landscape decades from now when the nation will need to wean itself off of natural gas.

CONCLUSION

Natural gas poses a particular challenge to policymakers today. Rapid and widespread proliferation of natural gas is essential if we are to make major progress in reducing carbon emissions. However, we will eventually have to wean ourselves off of natural gas, too, and so we can anticipate strict new emissions rules applying to natural gas several decades from now. When that happens, investors and owners of the natural gas infrastructure are almost certain to object and claim that the inevitable regulations are unconstitutional takings of their property. Fortunately, there are tools available to us today that will help to defang those takings claims in both public debates and legal actions. For one, developing a clear and widely disseminated record detailing the likely future constraints on natural-gas-fired power plants will help to limit reasonable investment-backed expectations of the natural gas industry. More provocatively, too, adopting rules with long sunrise periods should count as a kind of prospective grandfathering that allows the natural gas industry to amortize its investments. This, in turn, will forestall takings claims, allowing even regulations that eliminate existing uses of property without explicit monetary compensation.

Prospective grandfathering through sunrise rulemaking may prove useful beyond the context of natural gas. It is a particularly powerful tool for easing transition costs, and may cut through some of the political opposition that faster changes often generate. In a world with seemingly hopeless legislative gridlock, deploying these kinds of creative timing rules may provide some modest opportunity to pursue meaningful changes in the law.