PROPERTY'S PROBLEM WITH EXTREMES

Lynda L. Butler[*]

Western-style property systems are ill-equipped to deal with extremes—extreme poverty, extreme wealth, extreme environmental harm. Though they can effectively handle many problems, the current systems are inherently incapable of providing the types of reform needed to address extreme situations that are straining the fabric of societies—situations that are stressing the integrity of core societal and natural systems to the breaking point. The American property system, in particular, is problematic. The system has a long tradition of strong individual rights and relies primarily on the efficiency norm to operate and shape the incentives of rights holders. The economic model that now dominates the American property system cannot, on its own, make the reforms needed to address problems of extremes. The assumption of a rational property owner and the individual scale of decision-making create an intrinsically self-serving system that will not, without redirection, force individual owners to consider important, outside interests or internalize serious, long-term externalities. Constitutional protection of property, with its increasingly economic focus, reinforces the owner-centric approach.

Yet property systems are fundamentally important to free and secure societies. Strong property rights protect the autonomy of individuals against government and third-party infringement. They also promote economic activities, rewarding investment and labor. A strong property system, in other words, provides a way to order a society and its resources by establishing a framework for allocating, distributing, and managing interests in the resources. This

 Chancellor Professor of Law and Director, Property Rights Project, William & Mary Law School. B.S., William & Mary; J.D., University of Virginia. I would like to thank William & Mary for supporting this project through a Plumeri Award and the Law School for its summer research grant support. Much appreciation also to Dennis Taylor for his insightful comments and questions, participants at the 2018 Association of Law, Property and Society Conference for their excellent questions and comments, Lindsey Whitlow and Andrea Gumushian for their superb research assistance, and Felicia Burton for her dedicated word processing support.

framework includes organizational and operating principles that enable the society's economic and political systems to work on a daily basis.

This Article focuses on property's problem with extremes by asking whether it is possible to have a property system that both protects individual rights and sustains the integrity of the earth system. Because of its global scale and potentially disastrous impacts, climate change provides the ultimate lens for examining property's ability to handle extremes. Climate change is a problem that affects the whole regardless of the contributions of the part. It is a problem that needs solutions from the whole but can benefit from the responsiveness of the part. In order for Western property systems to operate in ways that minimize property's adverse effects on the earth and on humans, some fundamental rewiring of property's incentive structure and operating rules must occur.

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Climate change is rewriting the world's sense of scale and place, reiterating, with increasing poignancy, that greenhouse gas emissions from human activities are fundamentally changing Earth's climate and natural systems. "Within a year of emission, carbon

dioxide is uniformly distributed throughout the global atmosphere"[1] and can affect atmospheric conditions for many years to come.[2] Climate change is a problem that affects the whole regardless of the contributions of the part, ignoring the spatial and temporal ties that have traditionally existed between uses and their place of origin. It is a problem that needs the attention of the whole but can benefit from the responsiveness of the part. Though an individual user's emissions may seem minor, they accumulate in the atmosphere with other users' emissions, producing a much greater cumulative impact over time.[3] Greenhouse gas emissions from a factory in India, coal-fired powered plants in the United States, and deforestation in Indonesia all affect our shared climate system, accumulating in the atmosphere to the point where global temperatures have increased, oceans have warmed, and global weather patterns have changed for generations to come. The indeterminate number of emitters throughout the world complicates the task of assigning legal responsibility under standard legal principles, while the attenuated links between particular emissions and particular harms exacerbate the moral dilemma facing efforts to correct injustice or provide compensation for harm.[4]

The complexity of the climate change problem is evident from the multitude of reports discussing the problem.[5] From the climate

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1. Jedediah Purdy, *Climate Change and the Limits of the Possible*, 18 DUKE ENVTL. L. & POL'Y F. 289, 292 (2008).

2. JOSEPH ROMM, CLIMATE CHANGE: WHAT EVERYONE NEEDS TO KNOW 22 (2d ed. 2018) ("Some of the CO_2 that humans are putting into the air stays there for thousands of years."); INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *Climate Change 2014: Mitigation of Climate Change*, *in* FIFTH ASSESSMENT REPORT 129 (2014), https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_full.pdf ("Because of the long atmospheric lifetime of CO_2, a fraction of the CO_2 emitted to the atmosphere from James Watt's steam engine that in the late 18th century helped trigger the Industrial Revolution still remains in the atmosphere.").

3. Douglas A. Kysar, *What Climate Change Can Do About Tort Law*, 41 ENVTL. L. 1, 35 (2011) ("[A]ny individual defendant can . . . offer the 'consequentialist alibi' that its emissions are simply too small of a share of global emissions to cause a discernable difference. It is only in combination with millions of other emitters that the anthropogenic greenhouse effect becomes a radical and potentially devastating climactic experiment.").

4. *Id.* at 20. The myriad of links in the "causal chain," each with their own level of culpability, create severe difficulties for climate change plaintiffs. *Id.*

5. According to a June 2017 report written by thirteen federal agencies and given final clearance by the Trump Administration, climate models still do not capture all of the elements of the earth's system affecting climate change. Further, the "unprecedented experiment" humans conduct on the climate system through emissions, deforestation, and other changes to landscape have the potential to lead to compound tipping point events. U.S. GLOB. CHANGE RESEARCH PROGRAM, CLIMATE SCIENCE SPECIAL REPORT 35 (2017); *see also* Lisa Friedman, *Scientists Fear Trump Will Dismiss Blunt Climate Report*, N.Y. TIMES (Aug. 7, 2017), https://www.nytimes.com/2017/08/07/climate/climate-change-drastic-warming-trump.html. For earlier reports, see INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 2, at 113–14; U.S. NAT'L ACAD. SCI. & ROYAL SOC'Y, CLIMATE CHANGE: EVIDENCE AND CAUSES B6 (2016); NICHOLAS STERN, THE

scientists explaining the dynamics of Earth's climate system to the scientific methodologies used to study causes and effects and the computer modeling performed to track data and identify trends, climate change quickly enters a realm beyond the expertise of most people.[6] Adding to the complexity is the uncertainty about the rate and the timing of the change and the magnitude of future harm.[7] Though the vast majority of climate scientists agree on general predictions given current conditions, more specific results depend, in part, on actions taken by humans—for example, the uncertain nature and level of future economic activities and government responses to the problem.[8] Further complicating the problem is the inertia of

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ECONOMICS OF CLIMATE CHANGE: THE STERN REVIEW 7–8 (2007); AM. METEOROLOGICAL SOC'Y, STATE OF THE CLIMATE IN 2016 (Jessica Blunden & Derek S. Arndt eds., 2017), http://www.ametsoc.net/sotc2016/StateoftheClimate2016_lowres.pdf.

6. *See* INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 2, at 1281–328; Daniel A. Farber, *Climate Models: A User's Guide* 1 (U.C. Berkeley Pub. Law & Legal Theory Research Paper Series, Paper No. 1030607, 2007) (discussing computer modeling used in studying climate change).

7. *See* HARI OSOFSKY & LESLEY MCALLISTER, CLIMATE CHANGE LAW AND POLICY 182 (2012).

8. *See* INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 2, at 157–59 (discussing "[u]ncertainties that matter for climate policy choices"). The authors note specifically that market behavior can be reliant on individuals' investment behavior, which in turn depends on other uncertain factors, like the price of fossil fuels. *Id.* at 158. They explain that decision makers are affected by their perceptions of risks and uncertainties and how they weigh the costs and benefits of potential policy changes. *See id.* The Intergovernmental Panel on Climate Change ("IPCC") also recognizes observational uncertainties relating to the effect of anthropogenic influence in other areas, including, but not limited to, tropospheric temperatures (*very likely* that anthropogenic forcings contributed to cooling of the lower stratosphere), Arctic warming ("*likely* that there has been an anthropogenic contribution to the very substantial Arctic warming over the past 50 years"), upper ocean warming ("*very likely* that anthropogenic forcings have made a substantial contribution to upper ocean warming . . . since the 1970s"), and Arctic sea ice loss ("Anthropogenic forcings are *very likely* to have contributed to Arctic sea ice loss since 1979."). INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *Climate Change 2013: The Physical Science Basis*, *in* FIFTH ASSESSMENT REPORT 869–70 (2013), https://www.ipcc.ch/site/assets/uploads/2018/02/WG1AR5_all_final.pdf.

It is important to note that the IPCC Working Groups discuss uncertainties using two metrics: quantitative probabilities and qualitative assessments of "[c]onfidence in the validity of a finding, based on the type, amount, quality, and consistency of evidence . . . and the degree of agreement." MICHAEL D. MASTRANDREA ET AL., GUIDANCE NOTE FOR LEAD AUTHORS OF THE IPCC FIFTH ASSESSMENT REPORT ON CONSISTENT TREATMENT OF UNCERTAINTIES 1 (2010), https://wg1.ipcc.ch/AR6/documents/AR5_Uncertainty_Guidance_Note.pdf. For instance, a demarcation of *very high confidence* reflects "robust" evidentiary support, in conjunction with "high" agreement with the result. *See id.* at 3. A classification of *very likely* has a 90–100 percent level of probability. *Id.* Further, Working Group III's report on uncertainties contends that the way climate change is managed will affect policy choices, represented by a feedback loop. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 2, at 156–57. Policy

climate change as well as its continuous nature.[9] Since the Industrial Revolution began, humans have been emitting greenhouse gases without realizing that those gases would eventually accumulate in the atmosphere and the oceans to the point where the climate system would change.[10] Even if humans immediately stopped all greenhouse gas emissions, climate change would still occur for years to come because of the gases already accumulated in the atmosphere and the oceans.[11] The wide range of sources of greenhouse gas emissions further adds to the difficulty of determining how to tackle the problem.[12]

Despite the complexity of the climate change problem, 97 percent of climate scientists agree that it is "extremely likely that human influence has been the dominant cause of the observed warming since

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choices lead to perception of risk and responses to risk, which help create tools for analyzing risk and uncertainty. These responses and tools allow for risk and uncertainty management, which in turn influence policy decisions, completing the loop. *Id.* at 156, fig.2.1.

9. Holly Doremus, *Climate Change and the Evolution of Property Rights*, 1 U.C. IRVINE L. REV. 1091, 1093 (2011).

10. *See* INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 2, at 129.

11. *See* INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *Climate Change 2007: Synthesis Report*, *in* FOURTH ASSESSMENT REPORT 46 (2008), https://www.ipcc.ch/site/assets/uploads/2018/02/ar4_syr_full_report.pdf; ROMM, *supra* note 2, at 28–30 (discussing whether we have crossed any tipping points yet). The climate inertia problem reflects the slow environmental response time to the elimination of a cause of climate change. The earth's system will continue to change even after a source of the problem is eliminated, the impact on the system only becoming apparent after a long period of time. *See* Massachusetts v. EPA, 549 U.S. 497, 525–26 (2007) (recognizing the problem of climate inertia); Kysar, *supra* note 3, at 40 ("Most greenhouse gases are stock pollutants, capable of persisting in the atmosphere and warming the planet for decades, even centuries."); Kysar, *supra* note 3, at 40 n.195 ("Even if all anthropogenic greenhouse gas emissions stopped tomorrow, the atmosphere would not restore its pre-industrial concentration levels for one thousand years." (citing Susan Solomon et al., *Irreversible Climate Change Due to Carbon Dioxide Emissions*, 106 PROCEEDINGS NAT'L ACAD. SCI. 1704, 1705 (2009))).

12. Some of the biggest contributors of greenhouse gas emissions include the burning of fossil fuels, deforestation and agriculture, and industry. *See* INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 2, at 123 (approximating that in 2010, 35 percent of total anthropogenic greenhouse gas emissions were attributed to the energy sector (made up of the burning of oil, gas, and coal for electricity and heat production, but also fugitive, unintended gas leaks), 23 percent to deforestation and agriculture, and 18 percent to industry). While energy production makes up the largest portion of greenhouse gas emissions, the calculation can become complicated. According to the report, "Within the energy sector, most emissions originate from generation of electricity that is, in turn, used in other sectors. Thus, accounting systems in other sectors often refer to direct emissions from the sector . . . as well as 'indirect' emissions that arise outside the boundaries of that particular economic sector . . . ." *Id.* at 125.

the mid-20th century."[13] The latest studies show that carbon in the atmosphere is continuing to rise faster than predicted even though greenhouse gas emissions have stabilized.[14] Temperatures are still rising, producing the hottest years on record and more warming than predicted.[15] Glaciers are rapidly melting, affecting wildlife, increasing the risk of fire, and contributing to rising sea levels.[16] In July 2017, a massive iceberg about the size of Delaware broke off from the Antarctica ice shelf—much sooner than expected.[17] In December 2015, parties to the United Nations Framework Convention on Climate Change agreed at its Paris meeting to a global climate accord that recognized the urgency of capping global warming below 2 degrees Celsius (i.e., 3.6 degrees Fahrenheit).[18] Experts are hoping that meeting this goal will prevent the earth from reaching a tipping

13. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *Climate Change 2014 Synthesis Report: Summary for Policymakers*, *in* FIFTH ASSESSMENT REPORT 4 (2013), https://www.ipcc.ch/pdf/assessment-report/ar5/syr/AR5_SYR_FINAL_SPM.pdf. A 2017 final draft report reaches an even stronger conclusion, stating that human influence on global warming is "*extremely likely*" (or 95 to 100 percent certain). U.S. GLOB. CHANGE RESEARCH PROGRAM, *supra* note 5, at 14. The report states that "there are no convincing alternative explanations" to the dramatic increase in climate change-related issues supported by observational evidence. *Id.* Between 1951 and 2010, human contribution led to a 1.1° to 1.4° Fahrenheit global mean temperature increase. *Id.*; *see also* ROMM, *supra* note 2, at 7 (stating that "all of the warming since 1970 is due to human causes").

14. *See, e.g.*, Justin Gillis, *Carbon in Atmosphere is Rising, Even as Emissions Stabilize*, N.Y. TIMES (June 26, 2017), https://www.nytimes.com/2017/06/26/climate/carbon-in-atmosphere-is-rising-even-as-emissions-stabilize.html.

15. *See* U.S. GLOB. CHANGE RESEARCH PROGRAM, *supra* note 5, at 195 ("The annual average temperature of the contiguous United States is projected to rise throughout the century. Increases for the period 2021–2050 relative to 1976–2005 are projected to be about 2.5°F . . . . Notably, a 2.5°F . . . increase makes the near-term average comparable to the hottest year in the historical record (2012). In other words, recent record-breaking years may be 'common' in the next few decades."); John Abraham, *Bad News for Climate Contrarians – 'The Best Data We Have' Just Got Hotter*, GUARDIAN (July 3, 2017, 6:00 AM), https://www.theguardian.com/environment/climate-consensus-97-per-cent/2017/jul/03/bad-news-for-climate-contrarians-the-best-data-we-have-just-got-hotter (discussing updated data that reveals more rapid warming).

16. Oliver Milman, *US Glacier National Park Losing Its Glaciers with Just 26 of 150 Left*, GUARDIAN (May 11, 2017, 5:09 AM), https://www.theguardian.com/environment/2017/may/11/us-glacier-national-park-is-losing-its-glaciers-with-just-26-of-150-left.

17. Maria-Jose Viñas, *Massive Iceberg Breaks Off from Antarctica*, NASA (July 12, 2017), https://www.nasa.gov/feature/goddard/2017/massive-iceberg-breaks-off-from-antarctica.

18. Paris Agreement art. 2, *opened for signature* Apr. 22, 2016, T.I.A.S. No. 16-1104, U.N.T.S. I-54113 (entered into force Nov. 4, 2016); *see also* Robinson Meyer, *A Reader's Guide to the Paris Agreement*, ATLANTIC (Dec. 16, 2015), https://www.theatlantic.com/science/archive/2015/12/a-readers-guide-to-the-paris-agreement/420345/; Lynne Peeples, *Historic Climate Change Agreement Adopted in Paris*, HUFFPOST (Dec. 12, 2015, 1:28 PM), https://www.huffpost.com/entry/climate-change-paris_n_566c2048e4b0e292150e169b.

point—a threshold beyond which change becomes unstoppable and a new state emerges.[19]

Impacts of climate change in the United States are already noticeable in every part of the country. In addition to an increase in average temperatures, more intense rain events, longer droughts, and more extreme heat waves,[20] sea level rise is already affecting East Coast and Gulf Coast communities.[21] In the Norfolk, Virginia, and the Fort Lauderdale/Miami areas, residents are experiencing frequent flooding of streets and homes.[22] Miami is planning a $400 million project to raise roads and seawalls and install pumps, while sea level rise in Norfolk is decades ahead of most other coastal areas.[23] According to a 2017 report by the Union of Concerned Scientists, "[w]ithin 20 years . . . nearly 170 coastal US communities—roughly twice as many as today—will reach or exceed the threshold for chronic inundations, given moderate sea level rise. . . . More than half of these 170 communities are currently home to socioeconomically vulnerable neighborhoods."[24] Sea and land ice sheets also have been melting more quickly than expected in Alaska and upper regions of the continental United States, causing

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19. In a 2007 report, John Holdren, a leading US climate scientist, referred to the importance of avoiding a tipping point. *See* John P. Holdren, *The Future of Climate Change Policy: The U.S.'s Last Chance to Lead*, SCI. AM. (Sept. 1, 2008), https://www.scientificamerican.com/article/the-future-of-climate-change-policy/; INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *Climate Change 2014: Impacts, Adaptation, and Vulnerability, Part A: Global and Sectoral Aspects*, *in* FIFTH ASSESSMENT REPORT 1125 (2014), https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-PartA_FINAL.pdf; ROMM, *supra* note 2, at 28–30 (discussing whether we have crossed any tipping points yet); *see also* Green Mountain Chrysler Plymouth Dodge Jeep v. Crombie, 508 F. Supp. 2d 295, 312–20 (D. Vt. 2007) (discussing the tipping point theory and legal challenges to it).

20. Other impacts include the spread of tropical diseases and worsening wildfires. Justin Gillis, *U.S. Climate Has Already Changed, Study Finds, Citing Heat and Floods*, N.Y. TIMES (May 6, 2014), https://www.nytimes.com/2014/05/07/science/earth/climate-change-report.html; Craig Welch, *Climate Change Pushing Tropical Diseases Toward Arctic*, NAT'L GEOGRAPHIC (June 14, 2017), http://news.nationalgeographic.com/2017/06/vibrio-zika-west-nile-malaria-diseases-spreading-climate-change/.

21. Justin Gillis, *Flooding of Coast, Caused by Global Warming, Has Already Begun*, N.Y. TIMES (Sept. 3, 2016), https://www.nytimes.com/2016/09/04/science/flooding-of-coast-caused-by-global-warming-has-already-begun.html; Justin Gillis, *The Sea Level Did, in Fact, Rise Faster in the Southeast U.S.*, N.Y. TIMES (Aug. 9, 2017), https://www.nytimes.com/2017/08/09/climate/the-sea-level-did-in-fact-rise-faster-in-the-southeast-us.html.

22. Gillis, *Flooding of Coast, Caused by Global Warming, Has Already Begun*, *supra* note 21.

23. *Id.*

24. UNION OF CONCERNED SCIENTISTS, WHEN RISING SEAS HIT HOME: HARD CHOICES AHEAD FOR HUNDREDS OF US COASTAL CITIES 2 (July 2017), https://www.ucsusa.org/sites/default/files/attach/2017/07/when-rising-seas-hit-home-full-report.pdf. The Union of Concerned Scientists defines a community as subject to chronic inundation when 10 percent or more of its land area (excluding wetlands) experiences flooding, on average, twenty-six times a year. *Id.* at 1.

permafrost to thaw and release more greenhouse gases, destroying important wildlife habitat and increasing erosion.[25] Only twenty-six of 150 glaciers in the United States' Glacier National Park remain, and the continental United States will likely lose all of its glaciers in a few decades.[26]

In one notable case, the melting of sea ice exposed an Eskimo village, Kivalina, to significantly greater erosion and storms.[27] The village brought a federal nuisance suit against a number of fuel and utility companies for substantially contributing to the climate change that is adversely affecting Kivalina.[28] Though recognizing the serious harm being done to the village, the court concluded that a federal common law nuisance action could not be brought because the Clean Air Act and Environmental Protection Agency ("EPA") action displaced federal common law nuisance claims.[29]

The Trump Administration's shift in the federal government's approach to climate change from regulation and active participation in global agreements to denial of a problem[30] puts into question the validity of the displacement conclusion. When the federal administration denies the existence of the climate change problem and dismantles the regulatory regime addressing climate change, the basis for the displacement conclusion appears to evaporate. "The existence of laws generally applicable to the question is not sufficient;

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25. *See* ROMM, *supra* note 2, at 73–74, 80–84, 118–23; *see generally* John P. Holdren, The Science of Climate Change in the Arctic and Its Impacts (Oct. 27, 2016), https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/the_science_of_climate_change_in_the_arctic_jph_fulbright_10-27-16.pdf (slide deck) (describing the effects of climate change in the Arctic region).

26. Milman, *supra* note 16.

27. Native Vill. of Kivalina v. ExxonMobil Corp., 696 F.3d 849 (9th Cir. 2012).

28. *Id.* at 853.

29. *Id.* at 856–58 (relying on the holding in Am. Elec. Power Co. v. Connecticut, 564 U.S. 410, 424 (2011)).

30. Not only has the Trump Administration pulled the United States out of the Paris Agreement, but agencies under the Trump Administration have made efforts to remove climate change documents from main agency web pages and change language referring to "climate change" to broader themes. *See* Umair Irfan, *"Climate Change" and "Global Warming" Are Disappearing from Government Websites*, VOX (Jan. 11, 2018, 12:30 PM), https://www.vox.com/energy-and-environment/2017/11/9/16619120/trump-administration-removing-climate-change-epa-online-website (breaking down by agency the changes made in language on websites and in placement of documents); *see also* Gregory Wallace, *Trump Environmental Nominees Question Climate Science*, CNN (Nov. 8, 2017, 7:14 PM), https://www.cnn.com/2017/11/08/politics/trump-environmental-nominees-question-climate-science/index.html (noting that Kathleen Harnett White, the Trump Administration's nominee to head the White House Council on Environmental Quality in 2017, believes that the "CO2 in the atmosphere has none of the characteristics of a pollutant that contaminates and fouls and all of that that [sic] . . . can have direct impact on human health as an atmospheric gas," and that "science should overwhelmingly guide assessments, but . . . [it should not] dictate policy results").

the applicability of displacement is an issue-specific inquiry."[31] The "salient question is 'whether Congress has provided a sufficient legislative solution to the particular [issue] to warrant a conclusion that [the] legislation has occupied the field to the exclusion of federal common law.'"[32] The Supreme Court, in *American Electric Power Co. v. Connecticut*[33] ("*AEP*"), reasoned that Congress had addressed greenhouse gas emissions through the Clean Air Act's delegation to the EPA and that the delegation and the emerging regulatory regime displaced federal common law.[34] The *AEP* Court, however, found displacement in an entirely different context than what currently exists. The *AEP* context involved an agency that had made the endangerment finding for greenhouse gases, had begun to regulate the emissions, and did not deny the occurrence of human-induced climate change.[35] Now that the EPA has started to rescind or withdraw actions that it had previously taken to deal with greenhouse gas emissions[36] and therefore no longer appears to agree that greenhouse gases endanger the public, the basis of the *AEP* Court's displacement conclusion is at least partially if not totally gone.[37] The test for displacement is lower than that for preemption—

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31. *Native Vill. of Kivalina*, 696 F.3d at 856.

32. *Id.* (quoting Michigan v. U.S. Army Corps of Eng'rs, 667 F.3d 765, 777 (7th Cir. 2011)).

33. 564 U.S. 410 (2011).

34. *Id.* at 424. The Court held that "[t]he test for whether congressional legislation excludes the declaration of federal common law is simply whether the statute 'speak[s] directly to [the] question at issue.'" *Id.* (quoting Mobil Oil Corp. v. Higginbotham, 436 U.S. 618, 625 (2010) (alterations in original)). Referencing *Massachusetts v. Environmental Protection Agency*, the Court held that:

> [T]he Clean Air Act and the EPA actions it authorizes displace any federal common-law right to seek abatement of carbon-dioxide emissions from fossil-fuel fired powerplants. *Massachusetts* made plain that emissions of carbon dioxide qualify as air pollution subject to regulation under the Act. . . . And we think it equally plain that the Act 'speaks directly' to emissions of carbon dioxide from the defendants' plants.

Id. (citing Massachusetts v. EPA, 549 U.S. 497, 528–35 (2007)).

35. *See Am. Elec. Power Co.*, 564 U.S. at 416–17; *see also Massachusetts*, 549 U.S. at 532 ("Because greenhouse gases fit well within the Clean Air Act's capacious definition of 'air pollutant,' we hold that EPA has the statutory authority to regulate the emission of such gases from new motor vehicles.").

36. *See Complying with President Trump's Executive Order on Energy Independence*, EPA, https://www.epa.gov/energy-independence (last visited Mar.. 28, 2020); News Release, EPA, EPA to Review the Clean Power Plan Under President Trump's Executive Order, (Mar. 28, 2017), https://www.epa.gov/newsreleases/epa-review-clean-power-plan-under-president-trumps-executive-order; Nadja Popovich et al., *78 Environmental Rules on the Way Out Under Trump*, N.Y. TIMES, https://www.nytimes.com/interactive/2017/10/05/climate/trump-environment-rules-reversed.html (last updated Dec. 28, 2018).

37. The Court introduced its displacement test by referring to the Clean Air Act and EPA action. *See Am. Elec. Power Co.*, 564 U.S. at 424. Now that the EPA is reversing its actions and removing climate change as part of its agenda, displacement is no longer an "academic question," as described by the Court in

for good reason.[38] It would not make sense to allow serious and potentially catastrophic harm to occur, without any redress in federal courts, just because of political gridlock, ignorance, or worse in the federal legislative and executive branches of government.

Many recommendations have been made and plans developed to combat climate change and avoid the catastrophic consequences of reaching a tipping point.[39] Generally ignored by these recommendations and plans is consideration of the role of Western-style property systems in contributing to climate change and in possibly addressing the problem.[40] Those commentators who do focus on property systems assume that solutions must be exogenous or, in the case of the American property system, address the extent to which constitutional principles would allow changes in property rights without triggering constitutional obligations.[41] What is left out, in other words, is an examination of the fundamental norms and operating principles of the property system, the extent to which they

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2011. *Id.* at 423. Further, the precedent that the Court relied on in stating that action by the EPA was not yet necessary involved a different statutory setting with an effective date set in the act. *Id.* at 420, 426.

38. *See id.* at 423 ("Legislative displacement of federal common law does not require the 'same sort of evidence of a clear and manifest [congressional] purpose' demanded for preemption of state law." (quoting City of Milwaukee v. Illinois, 451 U.S. 304, 317 (1981))).

39. The Paris Agreement, for example, calls for "[h]olding the increase in the global average temperature to well-below 2°C above pre-industrial levels" and "[i]ncreasing the ability to adapt to the adverse impacts of climate change . . . in a manner that does not threaten food production." Paris Agreement, *supra* note 18, at art. 2(1)(a)–(b).

40. *See* Kysar, *supra* note 3, at 4. Commentators, for example, are calling for the use of tort law to establish "baseline principles of responsibility for harms caused . . . by anthropogenic climate change." Douglas A. Kysar, *The Public Life of Private Law: Tort Law as a Risk Regulation Mechanism* 5 (Yale L. Sch. Pub. L. Research Paper No. 607, 2017), https://ssrn.com/abstract=3006237.

41. The primary constitutional obligations that could be triggered by government action involve the Takings and Due Process clauses of the Fifth Amendment. The Takings Clause provides that no "private property shall be taken for public use, without just compensation," while the Due Process Clause protects citizens against deprivation of "life, liberty, or property, without due process of law." U.S. CONST. amend. V; *see also* J. Peter Byrne & Kathryn A. Zyla, *Climate Exactions*, 75 MD. L. REV. 758, 763–65 (2016) (suggesting that imposing monetary exactions to discourage new developments that will exacerbate climate problems can help the government avoid litigating costly regulatory takings claims that may require large compensation awards); Daniel A. Farber, *Property Rights and Climate Change* 10–12 (Mar. 31, 2014), https://ssrn.com/abstract=2418756 (noting that takings doctrine can pose difficulties for efforts to restrict development in coastal areas and recognizing that while takings law must strike a balance between flexibility and stability, climate change can add "a kind of wildcard" to the balance analysis). *But see* Doremus, *supra* note 9, at 1105–10 (discussing the tension between flexibility and stability in property law and observing that though coastal lands are dynamic, the legislature and judiciary are reluctant to require private property owners to adapt to and internalize environmental changes).

have contributed to climate change, and the ability of a Western-style property system to change—to evolve in ways that address the global threat of climate change. To be meaningful, the changes would need to include an expanded management function, an incentive structure that reflects realistic biophysical conditions, and norms and values that recognize outward-regarding obligations to vital social-ecological systems affected by the exercise of property rights.

II. PROPERTY'S CONTRIBUTIONS TO CLIMATE CHANGE

The institution of property provides a way to order a society and its resources. Under the American and other Western-style systems,[42] property enables a society's economic system to work on a daily basis and strengthens the autonomy of individuals in the political system. Property facilitates the operation of social systems by providing an infrastructure for allocating, distributing, and managing interests in resources. The way property carries out these functions, however, can tear a society apart when extremes develop—extremes like widespread poverty, extraordinary wealth in the hands of a few, global collective action problems, and disastrous environmental harm like climate change. Understanding the structure of property will help to identify aspects of property that act as enablers of climate change.

A. Introducing the Structure of Property

The American property system is rooted in a strong tradition of individual rights. During the early development of the common law system, commentators and jurists tended to justify property rights from a natural law perspective[43] and stressed property's fundamental

42. Much of the focus of this Article will be on the American system of property. This is, in part, because the United States has, until recently, been the world's leading greenhouse gas emitter, and also because of some important differences between the American and European systems that make it more difficult for the American property system to change and adapt. As explained in more detail in this Article, the American system includes constitutional protections for property rights that have become intertwined with the mainstream economic approach to property rights, as well as with common law principles that reflect a weaker norm of sharing and a stronger, in rem nature. *See* Lynda L. Butler, *The Resilience of Property*, 55 ARIZ. L. REV. 847, 854 (2013). In *The Resilience of Property*, I discuss how the economic vision of property is being constitutionalized, leading to a fundamental change in the institution of property that involves a loss of resilience, adaptability, and flexibility. *See id.* at 854, 863; *see also infra* Part III.

43. Many attribute this approach to John Locke. *See* JOHN LOCKE, *Second Treatise of Civil Government*, *in* TWO TREATISES OF GOVERNMENT 119, 133–37 (Thomas I. Cook ed., 1947); *see also* Bret Boyce, *Property as a Natural Right and as a Conventional Right in Constitutional Law*, 29 LOY. L.A. INT'L & COMP. L. REV. 201, 203 (2007); Roger Pilon, *The Constitutional Protection of Property Rights: America and Europe*, PROGRESS FOUND. 1, 2 (June 13, 2007), www.progressfoundation.ch/en/document/286 (stating that the "clearest

role in protecting the liberty interest of individuals.[44] Though the importance of property to individual liberty is still recognized and promoted,[45] the mainstream economic approach has become the primary justification for private property rights in ordinary life, promoting efficient use by decreasing information costs, transaction costs, and collective action problems.[46] Further, it has even become the central basis of regulatory takings analysis through concepts like reasonable investment-backed expectations, diminution in value, and loss of economically viable use.[47]

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manifestation [of the natural law tradition is] . . . in John Locke's *Second Treatise of Government*, which set forth not only the theory of rights on which American government rests but the property and social contract theories that so informed the founding generation's vision"); David C. Snyder, *Locke on Natural Law and Property Rights*, 16 CANADIAN J. PHIL. 723, 726, 733–35, 738 (1986).

44. JAMES MADISON, PROPERTY (1792), *reprinted in* VI THE WRITINGS OF JAMES MADISON 101–03 (Gaillard Hunt ed., 1906); *see also* JAMES W. ELY, JR., THE GUARDIAN OF EVERY OTHER RIGHT: A CONSTITUTIONAL HISTORY OF PROPERTY RIGHTS 10–14, 16–17 (3d. ed. 2008); Butler, *supra* note 42, at 859.

45. Indeed, in recent years the individual rights perspective has taken on renewed vigor through clarification and expansion of the U.S. Supreme Court's takings jurisprudence. *See, e.g.*, Koontz v. St. Johns River Water Mgmt. Dist., 570 U.S. 595, 604–05, 607, 619 (2013) (using the unconstitutional conditions doctrine to reverse the Florida Supreme Court's decision denying the existence of a compensable taking, with Justice Alito explaining that "[e]xtortionate demands for property in the land-use permitting context run afoul of the Takings Clause not because they take property but because they impermissibly burden the right not to have property taken without just compensation. As in other unconstitutional conditions cases in which someone refuses to cede a constitutional right in the face of coercive pressure, the impermissible denial of a governmental benefit is a constitutionally cognizable injury"); Palazzolo v. Rhode Island, 533 U.S. 606, 630 (2001) (holding that plaintiff's *Penn Central* claim "is not barred by the mere fact that title was acquired after the effective date of the state-imposed restriction"); Lucas v. S.C. Coastal Council, 505 U.S. 1003, 1015, 1019 (1992) (concluding that, while there is no definitive rule to determine whether a compensable taking has occurred, "there are good reasons for . . . [the Supreme Court's] frequently expressed belief that when the owner of real property has been called upon to sacrifice all economically beneficial uses in the name of the common good, that is, to leave his property economically idle, he has suffered a taking").

46. *See* Doremus, *supra* note 9, at 1094–96; Gary D. Libecap & James L. Smith, *The Economic Evolution of Petroleum Property Rights in the United States*, 31 J. LEGAL STUD. S589, S589 (2002).

47. In *Penn Central*, for example, the Court announced that the presence of reasonable investment-backed expectations was one of the factors important to determining whether a regulatory taking had occurred. Penn Cent. Transp. Co. v. City of New York, 438 U.S. 104, 124 (1978) (noting that "[t]he economic impact of the regulation on the claimant and, particularly, the extent to which the regulation has interfered with distinct investment-backed expectations are, of course, relevant considerations"). Again, in *Lucas*, the Court clarified that a total loss of economically viable use was categorically a regulatory taking. *Lucas*, 505 U.S. at 1015–16 (concluding that there are two types of categorical regulatory takings, in which, regardless of the benefit to the public, the individual should be compensated: an actual, physical invasion of land, and in cases where regulation

Under the mainstream economic theory of property, the system allocates interests in resources to an owner, who acquires the power to decide how and when to use the resource.[48] Reflecting an owner-centric, exclusion-based approach, the dominant theory views each owner as a gatekeeper having important in rem rights that, when exercised, bind all others in the legal system.[49] Even third parties not in a direct relationship with the owner may nonetheless be bound by the owner's decisions.[50] Although courts have developed some constraints on the exercise of the owner's gatekeeping powers, those constraints deal, for the most part, with direct relationships that principles of economics and equity suggest should be part of the property owner's decision-making process.[51] Traditional doctrines limiting a property owner's gatekeeping powers generally focus on the relationship between the property owner and others having an interest in the same property (e.g., successors-in-interest, tenants, and easement holders) and, to a more limited extent, on relationships between the property owner and close neighbors (e.g., in nuisance situations).[52] The mainstream approach thus values the norms of efficiency, individual autonomy, and rewarding labor.

"denies all economically beneficial or productive use of land" (quoting Agins v. City of Tiburon, 447 U.S. 255, 260 (1980))).

48. *See* Butler, *supra* note 42, at 853–54.

49. Lynda L. Butler, *Property as a Management Institution*, 82 BROOK. L. REV. 1215, 1215 (2017). In rem rights are more limited in European property systems, due in part to a more restrictive interpretation of the *numerus clausus* doctrine, which defines the number and nature of permitted property rights as well as the methods for creation, transfer, and destruction. *See* CASES, MATERIALS AND TEXT ON PROPERTY LAW 65–75 (Sjef van Erp & Bram Akkermans eds., 2012). Conversely, in the United States, in rem rights are paramount and are interpreted as giving broad gatekeeping or decision-making powers over the property. In cases such as *Ghen v. Rich*, 8 F. 159, 160–62 (D. Mass. 1881) and *Pierson v. Post*, 3 Cai. 175, 177–80 (N.Y. Sup. Ct. 1805), for example, exclusive rights to the hunted animals belonged to the "first possessor" as defined by the courts, regardless of any labor exerted by a third party.

50. *See* Butler, *supra* note 49, at 1215 (stating that the exclusion-based approach binds "all others in the legal system . . . to respect the property," including parties outside of the transaction at hand).

51. *See id.* at 1215–16, 1216 nn.2–5 (listing doctrines that place constraints on property owners' gatekeeping powers, including the do-no-harm principle (requiring landowners to consider the interests of neighboring landowners and neighbors' sensitivity to spillovers), nuisance law (governing "unreasonable and substantial interference with another's use and enjoyment of her property"), the doctrine of equitable conversion (shifting constructive title—and therefore risk of loss to the land—to the purchaser between execution of the contract for sale and closing), and the doctrine of waste (restricting tenants' use of property in order "to protect the landlord's reversionary interest")).

52. *See id.* at 1216 nn.2–5. In Louisiana, for example, neighbors must be in "close proximity" for nuisance liability to exist. *See, e.g.*, Woods v. Turbeville, 168 So.2d 915, 917 (La. Ct. App. 1964) (holding that "a lawful business" cannot be abated as a nuisance "unless the business is being operated in such a way as to give serious and material discomfort and inconvenience to those who are living in close proximity thereto"); *see also* Barasich v. Columbia Gulf Transmission Co.,

Except when extremes develop, the dominant approach to property works well much of the time. It is a low-cost approach to allocating interests in resources, relying on the marketplace to shape the incentives of property owners in managing and using their resources. With a simple delegation of power, ownership rights are placed in an individual owner and are protected from encroachment and interference through the right to exclude.[53] Those property owners who use and manage their property efficiently are rewarded, while those who do not are eventually replaced through the marketplace. Reliance on the marketplace as a vehicle for managing property interests thus means that the efficiency norm underlies the modern American property system, and economic infeasibility becomes the only consistent constraint.[54]

B. Limitations of the Dominant Approach to Property

The dominant approach to American property rights has built-in features that limit its ability to deal with climate change. It was built on physical facts about the earth and the natural environment that have changed significantly over time—in part because of overuse and ineffective resource management, and now because of greenhouse gas emissions. The property system developed in a geologic era that preceded the Anthropocene, where humans have become the dominant geologic force.[55] During the prior era, resources were abundant, and the air and waters were in pristine condition.[56] The

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467 F. Supp. 2d 676, 690, 695 (E.D. La. 2006) (noting that the cases the plaintiffs relied on were unconvincing to prove liability because they dealt with "relationships between property owners that are characterized by proximity," where in this case such proximity did not exist).

53. Butler, *supra* note 49, at 1217.

54. *See* Paul Krugman, *Building a Green Economy*, N.Y. TIMES MAG. (Apr. 7, 2010), http://www.nytimes.com/2010/04/11/magazine/11Economy-t.html. Krugman states that when a mutually beneficial transaction creates negative externalities that do not require either transacting party to pay, "any presumption that the market economy, left to its own devices, will do the right thing goes out the window." *Id.* One way to deal with the negative externalities is to impose laws and regulations (like a pollution tax) that make it infeasible for the transacting parties to strike the bargain that creates the externalities. *Id.* Another is the now popular "cap and trade" system—a system that allows for the trading of emissions permits. *Id.*

55. *See* JOHN BELLAMY FOSTER ET AL., THE ECOLOGICAL RIFT: CAPITALISM'S WAR ON THE EARTH 13–14 (2010) (defining "Anthropocene" as meaning "New Human" and—starting around the time of the Industrial Revolution—representing "a new geological epoch in which humanity has become the main driver of rapid changes in the earth system"); *see also* ELY, *supra* note 44, at 10–11 (discussing how property ownership in the colonies stemmed from English common law).

56. *See* FOSTER ET AL., *supra* note 55, at 128–38 (discussing how human activities have changed the accumulation of carbon in the atmosphere and the climate cycle in unparalleled ways); *see also* ELY, *supra* note 44, at 25 ("The constitutional underpinnings of property rights were forged during the colonial

institution of property was superimposed on Earth's preexisting biophysical systems. Land development, land use regulation, and the expectations of property owners thus developed in the context of physical facts that are changing or are no longer true. A 100-year floodplain, for example, reflects historic records that are now outdated and do not take into account a future with climate change.[57]

Though local and state governments can update their land use regulatory standards and plans to reflect current biophysical conditions and processes, the investment-backed expectations of property owners have been shaped by now-outdated facts—and those expectations matter enormously to constitutional and common law property. By ratifying reasonable expectations of owners, property law encourages investment and rewards productive use, enabling economic activity to occur. Efforts to change the expectations of property owners encounter serious resistance because reasonable expectations may be constitutionally protected, shaped by values and norms embedded within the property system itself.[58] Under the mainstream approach, those values and norms have taken on an economic perspective, with the efficiency norm and the marketplace platform used to allocate interests, communicate individual preferences, and conduct transactions.

1. The Logic of Efficiency

The mainstream economic theory advanced to justify individual property rights reflects certain values and assumptions that are

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era. Blessed with abundant land, colonial North America furnished a uniquely attractive environment for the property-conscious tenets of English constitutionalism.").

57. In a lecture given at the University of Florida, Professor Daniel Farber noted that in its 2010 report on sea-level rise, the Florida Oceans and Coastal Council relied on historical data from 1929 to develop its coastal infrastructure. Farber, *supra* note 41, at 2–3. He observed:

> The world of 1929 is not going to be a good guide to the future. The assumption of an unchanging natural world clearly does not hold today, and it will be even further from reality in the future. Yet, our views of property were developed during a world of stability that we have now left behind us.

Id. at 3.

58. *See* Butler, *supra* note 42, at 888. Embedded norms often lead to constitutional protection. *Id.* These norms can frame the way government regulations are viewed even with respect to public property or problems with the commons. *Id.* Staunch supporters of individual property rights, for example, attack regulations addressing the problem of sea level rise, viewing the laws as a way for the government to undermine fundamental property rights, rather than as a mechanism to protect coastal lands. *Id.*; *see also* Doremus, *supra* note 9, at 1099 ("Cognitive framing suggests that there should be less political resistance to changes that appear to strengthen rights than to those that appear to weaken or remove rights, even those rights that no longer function efficiently.").

inherently inconsistent with solving the climate change problem.[59] The theory uses the logic of efficiency to make certain assumptions and define the key principles that are used to analyze resource conflicts and property rights issues.[60] Although these assumptions and principles might be useful for modeling market transactions and behavior, they disregard the natural resource conditions that contradict the assumptions. The allocation of gatekeeping powers over a resource to the individual owner and the in rem effect generally given to the exercise of those powers produces an inherent bias for owner-centric thinking. For instance, in the past, American landowners routinely drained and filled wetlands without considering or understanding the important ecosystem services provided by those wetlands.[61] Even today, flood control projects along America's large rivers employ dams, levees, and canals to control water flow and minimize flooding of shorelands, despite the loss of nutrient-rich sediment provided by flood waters.[62] The impact on surrounding agricultural lands has been significant, with farmers having to spend more on fertilizer and rotate their fields more frequently.[63]

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59. *See* Lynda L. Butler, *The Pathology of Property Norms: Living Within Nature's Boundaries*, 73 S. CAL. L. REV. 927, 968–70 (2000) (discussing how property norms have adversely affected ecosystems by causing them to be less resilient and making them more vulnerable to disturbances).

60. *See id.* at 934–38 (discussing key principles and policies of the traditional property approach); *id.* at 996–99 (discussing sources or bases of traditional property norms).

61. *See* WILLIAM J. MITSCH & JAMES G. GOSSELINK, WETLANDS 45–47, 565–75 (2d ed. 1993); Butler, *supra* note 59, at 956 (discussing the millions of acres of wetlands that have been drained and converted in the United States since the late 1700s). Wetlands and forests are essential to maintaining ecosystems—they help control water pollution, preserve wildlife habitats, and produce energy savings. *Id.* at 956–57. And yet, both are disappearing by the millions of acres. *Id.* at 956. Interestingly, one of Aristotle's students studied the practice of draining wetlands, observing that this activity affected how water moderated temperature and resulted in more extreme cold weather. *See* FOSTER ET AL., *supra* note 55, at 128.

62. *See* Butler, *supra* note 59, at 946–47 (discussing how the channelization policies result in swifter and more efficient water flow but carry significant ecological costs by increasing runoff, erosion, and flooding).

63. For instance, when watershed management programs focus on management through a hydrological perspective—one that focuses on the water collection, storage, and discharge functions of watersheds—rather than through an ecological perspective, they ignore the fact that watersheds also provide habitats for flora and fauna. *See* Butler, *supra* note 59, at 946–48. Consider the federal government's channelization policy. In order to provide a faster, more efficient water flow, the government adopted a policy to straighten rivers and streams. *Id.* at 946. While the policy has some advantages, it has also increased erosion and runoff, which in turn removes vegetative land cover and results in greater downstream flooding. *Id.* at 946–47. In the case of the Mississippi River, the lost nutrient-rich sediment is now carried downstream to the mouth of the Mississippi and deposited into the Gulf beyond New Orleans toward the outer continental shelf, instead of on shoreland along the way. ROBERT R.M. VERCHICK, FACING CATASTROPHE 19 (2010) (stating that the "real culprits" in Louisiana's

The mainstream economic theory of property also assumes that the property owner is a rational actor and that the owner's decisions generally will promote the social welfare.[64] A rational actor, however, often will only consider her best interests in making decisions and will ignore negative externalities and spillovers as long as the owner's benefits exceed her costs.[65] Under the American property system's framework, individual property owners are "unknowingly guided by options and assumptions embedded in the exclusion-based property system."[66] Property owners lack the incentives to bear the external costs of their decisions unless forced to do so—not even when the external costs are high and threaten the integrity of the whole.[67] They, for instance, would cut costs by eliminating aspects of a resource that do not produce a return, appear redundant and therefore wasteful, or do not have an obvious economic role—even though those features might be important to maintaining the integrity of the resource.[68] Studies by behavioral economists further

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eroding coastlines are "human-made: Louisiana's vast network of levees, navigational channels, and oil-and-gas infrastructure. The levee system accelerates coastal land loss by reducing the natural flow of the river's freshwater and sediment to wetland areas, where the lost land would then naturally be replenished." The sediment that the river deposits in the Gulf of Mexico is lost, and "the formation of barrier islands is impossible.").

64. Butler, *supra* note 42, at 854.

65. *See* Butler, *supra* note 49, at 1257–58 (discussing property's negative externalities and spillovers and stating that "[a] rational acting property owner will eliminate redundancies and focus narrowly on what is 'directly and immediately beneficial to the owner'").

66. *Id.* at 1258–59. Efficiency guides the economic vision of property, leading to increased "focus on allocation of interests in resources and away from other important norms and factors." Butler, *supra* note 42, at 886. A strategy of exclusion creates incentives for "property owners to maximize wealth," which in turn leads to a "dichotomy of choices" and inflexibility in the institution of property. *Id.* Rigidity develops as behavioral norms based on this dichotomy "lose their connection to their original context and become drivers of behavior in and of themselves." *Id.* Court decisions reinforce the rigidity, allowing the options and assumptions to become embedded in the property regime. *See id.* at 886–87 ("The exclusion strategy, for example, is now being used to justify the [Supreme] Court's per se approach to treating all permanent physical invasions by government as compensable takings, no matter how small the invasion, how beneficial the invasion to the private landowner, or how significant the public interest. In other words, the traditional meaning of the exclusion strategy, with all its advantages and weaknesses, has become part of the constitutional history of property . . . .").

67. Butler, *supra* note 49, at 1259. Indeed, some commentators have argued that a cognitive bias toward individual victims is more likely to result in aid for the victims than in a situation involving a general, society-wide harm. *See* Purdy, *supra* note 1, at 296–97 (discussing how individuals are more likely to give to an individual victim than to a more general cause that produced such victims).

68. *See* Butler, *supra* note 49, at 1258; *see also id.* at 1254–57 (discussing how the commodity-based view of ecosystem services "has hastened 'the decline of functionality throughout the natural systems . . . [and] limited the ability of ecosystems to regenerate and sustain themselves.'" A systems-based view of

undermine reliance on the rational actor assumption, revealing that individuals do not always decide as a rational actor would. These studies have advanced our understanding of the degree to which individuals deviate from rational actor thinking, identifying heuristics and biases that affect decision-making.[69] Climate change, however, may be too overwhelming and too extreme to get our attention, rational or otherwise. It is, in other words, a "hyperobject"—a massive, "unimaginably vast" phenomenon that humans cannot observe or access in its entirety.[70]

The economic-based concept of property is the engine that drives a capitalist economy. Yet that engine has no brakes. Just as a car built without brakes will eventually crash, so too will a property system that encourages fossil fuel use and assumes brakes are not necessary. Such a property system facilitates the commodification of natural resources but does so without limitation, assuming that unlimited growth is possible and that the exchange value in the marketplace includes some form of environmental value.[71] This conversion "corrupt[s] . . . [the environment's] intrinsic value in deference to a market logic."[72] The dominant, economic-based property system does not recognize the need for an internal braking system. Indeed, growth is often offered as a cure for society's ills.[73]

The problem of climate change, however, demonstrates all too clearly that the property system is not operating in a world of infinite resources with the ability to absorb serious and continuing externalities. Instead of curing the world's ills, the property system is promoting and legitimizing the continuous release of greenhouse gases into the atmosphere with serious consequences. Instead of producing net social welfare, the growth-oriented property system is encouraging the release of greenhouse gas emissions to the point where experts fear the earth is reaching a tipping point.[74] Beyond

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ecosystem services would recognize the value of not just the goods, but also the services ecosystems provide.).

69. *See* Purdy, *supra* note 1, at 297. People, for example, tend to "overestimate greatly the importance of phenomena that are *salient*, that is, readily available to the mind." *Id.* at 296; *see also id.* ("For instance, terrorism acquired great salience as a threat in the wake of September 11, 2001, with the result that Americans not only ranked it very high among threats and problems facing the country, but estimated their personal risk of suffering a terrorist incident at a little over eight percent—a vast overstatement, which would have more than 25 million Americans a year directly affected by terrorism.").

70. TIMOTHY MORTON, HYPEROBJECTS: PHILOSOPHY AND ECOLOGY AFTER THE END OF THE WORLD 1, 7–9, 15–16, 60, 70, 125, 131–32 (2013); *see* Purdy, *supra* note 1, at 297.

71. CHRISTOPHER WRIGHT & DANIEL NYBERG, CLIMATE CHANGE, CAPITALISM, AND CORPORATIONS: PROCESSES OF CREATIVE SELF-DESTRUCTION 190–93 (2015).

72. *Id.* at 190.

73. *See* Butler, *supra* note 49, at 1251.

74. *See* WRIGHT & NYBERG, *supra* note 71, at 1, 6. In December 2019, two experts warned that the Amazon is now facing a tipping point because of deforestation and fires. *See* Chris Mooney & Brady Dennis, *Top Scientists Warn*

that point, the climate system cannot rebound and return to current conditions.[75] The unconstrained march toward a tipping point has convinced some experts that a new definition of growth is needed—one that includes a qualitative dimension.[76] Rather than viewing growth as "linear and unlimited," this new definition would recognize that "[w]hile certain parts of organisms, or ecosystems, grow, others decline, releasing and recycling their components."[77] A qualitative definition of growth, in other words, would recognize that growth must "enhance[] the quality of life" by producing a more complex, sophisticated, and mature system.[78]

What features of the system would such a qualitative dimension promote? A systems view of life helps to identify those characteristics and related principles.[79] Such an approach views a system as an "integrated whole[]."[80] "[T]he qualities of a complex system refer to properties of the system that none of its parts exhibit."[81] Because these qualities arise from the "processes and patterns of relationships among the parts," they "cannot be expressed as the sum of properties of the parts."[82] Examples of qualities of the whole include the health, stress level, and integrity of the system.[83] These qualities are not captured in quantitative measurements of the properties of the parts (e.g., their mass or energy).[84] The properties of the parts do not tell us about a system's pattern of organization or how interactions of the parts or the processes of interaction exert stress on the whole.[85] What

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of an Amazon 'Tipping Point', WASH. POST (Dec. 20, 2019, 3:14 PM), https://www.washingtonpost.com/climate-environment/top-scientists-warn-of-an-amazon-tipping-point/2019/12/20/9c9be954-233e-11ea-bed5-880264cc91a9_story.html.

75. *See* ROMM, *supra* note 2, at 29–30 ("The latest science suggests that we are getting close to levels of greenhouse gases in the atmosphere that will trigger irreversible changes . . . ."); INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 13, at 77 ("The risks associated with temperatures at or above 4°C include severe and widespread impacts on unique and threatened systems, substantial species extinction, large risks to global and regional food security, consequential constraints on common human activities, increased likelihood of triggering tipping points (critical thresholds) and limited potential for adaptation in some cases (*high confidence*).").

76. FRITJOF CAPRA & PIER LUIGI LUISI, THE SYSTEMS VIEW OF LIFE: A UNIFYING VISION 368 (2014).

77. *Id.*

78. *Id.*

79. *Id.*

80. *Id.* at 63.

81. *Id.* at 368.

82. *Id.* at 368–69.

83. *See id.*

84. *See id.*

85. *See id.*; Butler, *supra* note 49, at 1252–53. The IPCC's fifth report has been interpreted as taking a systems approach. *See* Sarah J. Adams-Schoen et al., *A Response to the IPCC Fifth Assessment*, 45 ENVTL. L. REP. 10027, 10035–36 (2015).

good is the part if the stability of the whole is in danger of catastrophic collapse?

2. Collective and Outward-Regarding Interests

The mainstream economic theory of property ignores collective interests and fundamental norms not central to the individual property owner's decision-making. Values like equality (which is fundamental to a democracy) or resilience (which is critical to ecological integrity) are not considered in a property system driven by efficiency. Collective interests in preventing climate change are too diffused to impose pressure on individual decision-making and too attenuated in a temporal sense to cause concern.[86] A "not-in-my-lifetime" mentality pervades the thinking of many Americans today.[87] Even when presented with the now-real impacts of sea-level rise or intensified storms, many deny or ignore the evidence and purchase property along the East and Gulf coasts.[88] A business-as-usual approach grounded in mainstream economics also drives the thinking of many elected officials who are supported by powerful lobby groups for the fossil fuel industry.[89]

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86. Paul G. Harris, *Collective Action on Climate Change: The Logic of Regime Failure*, 47 NAT. RESOURCES J. 195, 211 (2007).

87. *See* Megan Brenan & Lydia Saad, *Global Warming Concern Steady Despite Some Partisan Shifts*, GALLUP (Mar. 28, 2018), https://news.gallup.com/poll/231530/global-warming-concern-steady-despite-partisan-shifts.aspx?version=print.

88. *See* BENDIXEN & AMANDI INT'L, *2017 Miami-Dade Real Estate Study*, MIAMI HERALD 85–86 (2017), http://www.miamiherald.com/latest-news/article163066413.ece/binary/Miami_Dade_Real_%20Estate_Study_2017.pdf (noting that 59 percent of real estate agents express concern about the global impact of climate change and sea-level rise in the south Florida housing market, but only 36 percent of their clients mention this concern in their housing search); Blake Miller, *10 Hottest Real Estate Markets to Watch in 2017*, TRULIA BLOG (Dec. 28, 2016, 8:10 AM), https://www.trulia.com/blog/10-hottest-real-estate-markets-to-watch-in-2017/ (noting the top three "hot" markets are in Florida; of the top ten, six are coastal cities). *But see* Erika Bolstead, *High Ground Is Becoming Hot Property as Sea Level Rises*, SCI. AM. (May 1, 2017), https://www.scientificamerican.com/article/high-ground-is-becoming-hot-property-as-sea-level-rises/ (discussing the gentrification effect of sea level rise in Miami and noting that "[t]o be on the beach and to be on the water costs a lot more money, and the cheaper parts of town were furthest from the beach — but it just turns out that the cheapest parts of town farthest from the beach are the highest elevation, and now they're worth a lot more than they used to be"); Ian Urbina, *Perils of Climate Change Could Swamp Local Real Estate*, N.Y. TIMES (Nov. 24, 2016), https://www.nytimes.com/2016/11/24/science/global-warming-coastal-real-estate.html ("Rising sea levels are changing the way people think about waterfront real estate. Though demand remains strong and developers continue to build near the water in many coastal cities, homeowners across the nation are slowly growing wary of buying property in areas most vulnerable to the effects of climate change.").

89. *See* Lindsay Renick Mayer, *Big Oil, Big Influence*, PBS NOW (Aug. 1, 2008), http://www.pbs.org/now/shows/347/oil-politics.html (noting that under the George W. Bush Administration, the task force charged with contemplating an

Public interests in government-owned or common resources are frequently labeled as inefficient or wasteful.[90] The importance of the resource to the public and the legitimacy of government ownership are ignored or challenged,[91] with efforts made to alter the "mission" of the resource or transfer it to private parties.[92] Some powerful

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energy policy for the United States met in secret and acted on the recommendations of "Big Oil behemoths Exxon Mobil, Conoco, Shell Oil, BP America and Chevron"; during that administration, oil companies spent over $390 million lobbying the federal government); Suzanne Goldenberg & Helena Bengtsson, *Oil and Gas Industry Has Pumped Millions into Republican Campaigns*, GUARDIAN (Mar. 3, 2016, 7:00 AM), https://www.theguardian.com/us-news/2016/mar/03/oil-and-gas-industry-has-pumped-millions-into-republican-campaigns ("About one in three dollars donated to Republican hopefuls from mega-rich individuals came from people who owe their fortunes to fossil fuels – and who stand to lose the most in the fight against climate change."); John Noël, *The Chilling Effect of Oil and Gas Money on Our Democracy*, CLEAN WATER ACTION (Apr. 20, 2016), http://www.cleanwateraction.org/publications/chilling-effect-oil-and-gas-money-our-democracy ("In 2014 the oil and gas industry contributed $64 million to campaigns, committees and outside groups.").

90. *See* Butler, *supra* note 49, at 1253–54; *see also* Butler, *supra* note 42, at 862–63 (noting that private, or individual rights, dominate the property regime). For a thoughtful response to the current approach of property law and its impact on society, see David A. Super, *A New New Property*, 113 COLUM. L. REV. 1773, 1783–85 (2013) (discussing how property's role as protector of individual rights should apply to all people by proposing a "new New Property" that uses prescriptive rights, equitable doctrines, land use laws, and the Takings Clause to protect vulnerable people).

91. *See* Butler, *supra* note 49, at 1254 n.209; Heather Hansman, *Congress Moves to Give Away National Lands, Discounting Billions in Revenue*, GUARDIAN (Jan. 19, 2017, 9:39 AM), https://www.theguardian.com/environment/2017/jan/19/bureau-land-management-federal-lease (discussing revision to the House of Representatives' budget that would effectively cede 640 million acres of public federal land to the states for "possible sale, mining or development"); Martin Heinrich, Opinion, *The Land Grab Out West*, N.Y. TIMES (Oct. 26, 2014), https://www.nytimes.com/2014/10/27/opinion/the-land-grab-out-west.html (discussing attempts by western states to have federal lands that are not included in national parks sold to private owners or given to governmental entities for management).

92. The mission of the National Park Service states that:

> The National Park Service preserves unimpaired the natural and cultural resources and values of the National Park System for the enjoyment, education, and inspiration of this and future generations. The Park Service cooperates with partners to extend the benefits of natural and cultural resource conservation and outdoor recreation throughout this country and the world.

About Us, NAT'L PARK SERV., https://www.nps.gov/aboutus/index.htm (last updated Jan. 31, 2020). There are those who believe the National Park Service has abandoned its mission with its recent actions. *See* Jonathan Ratner, *National Park Service Abandons Its Mission*, 23 WESTERN WATERSHEDS PROJECT MESSENGER 12, 12–13 (2016) (explaining that the National Park Service is aware of the degradation of land cause by the grazing of cattle, but has not acted to prevent the damage); Opinion, *NPS Abandons Its Mission*, TIMES-TRIBUNE (Oct. 4, 2012), http://thetimes-tribune.com/opinion/nps-abandons-its-mission-1.1382751 (opining that the circuitous route taken to input a new power line

property owners even blatantly ignore public rights in shared resources and try to exclude the public from the resource. In the case of Martin's Beach, for example, a Silicon Valley billionaire bought the beach and then denied access to the public even though the public had used the beach for almost one hundred years for surfing, fishing, and other recreational purposes.[93] In August 2017, a California appellate court recognized the public's rights in the beach under California law and ordered the billionaire to give the public access.[94] Other wealthy individuals have similarly tried to buy famous beaches in California and turn them into exclusive private property.[95] Under the current economic and exclusion-based approach to property, public goods and interests are often taken for granted, with noneconomic values ignored or subordinated to private economic interests.

3. Over-Fragmentation

Another important limitation of the economic- and exclusion-based approach to property is the overuse of the right to exclude and

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through the Delaware Water Gap National Recreation Area created an eyesore that is the opposite of the National Park Service's mission).

Some note that there is an inherent bias toward public-private partnerships, assuming "for ideological reasons, that the private sector can always outperform publicly managed projects." Michael Laris, *State Control of I-66 Expansion Could Net Virginia Substantial Revenue*, WASH. POST (May 19, 2015), https://www.washingtonpost.com/local/trafficandcommuting/state-control-of-i-66-expansion-could-net-virginia-substantial-revenue/2015/05/18/a3629d58-fd7f-11e4-805c-c3f407e5a9e9_story.html.

93. Sam Levin, *Silicon Valley Billionaire Loses Bid to Prevent Access to Public Beach*, GUARDIAN (Aug. 10, 2017, 5:39 PM), https://www.theguardian.com/environment/2017/aug/10/martins-beach-california-public-vinod-khosla.

94. Surfrider Found. v. Martin's Beach 1, LLC, 221 Cal. Rptr. 3d 382, 418 (Ct. App. 2017). The trial court held that the California Coastal Act of 1976 required appellants to apply for a coastal development permit before closing off public access to the beach. *Id.* at 388. The trial court then issued an injunction that required "appellants to allow public coastal access at the same level that existed when appellants bought the Martin Beach property in 2008." *Id.* At the time of the decision, the status of public access rights in the privately-owned beach was still undetermined and awaiting the resolution of a separate case. *See* Friends of Martin's Beach v. Martin's Beach 1, LLC., 201 Cal. Rptr. 3d 516 (Ct. App. 2016). The appellate court in *Surfrider* presumed, pending the result of *Friends of Martin's Beach*, "that prior access was permissive" because Surfrider had not yet established a public right to access that was "*recorded or judicially determined*." *Surfrider*, 221 Cal. Rptr. 3d at 404. The appellate court treated the injunction as "temporarily restricting appellants' right to exclude the public from its property"; its temporary nature meant that the injunction was not a per se taking. *Id.* at 404–05. Because appellants did not assert a basis for reversing the injunction under the multi-factor test used to determine whether a taking had occurred, the appellate court held that the trial court did not abuse its discretion and affirmed the injunction. *Id.* at 400; *see also* Levin, *supra* note 93.

95. Mary O'Hara, *Get Off My Beach! How the Wealthy are Laying Claim to California's Coast*, GUARDIAN (Oct. 2, 2015, 1:04 PM), https://www.theguardian.com/us-news/2015/oct/02/california-wealthy-public-beaches-private-security.

the corresponding power to veto projects affecting or producing shared resources. When too many property owners have the right to exclude others from a shared or common resource, the problem of over-fragmentation or the anti-commons arises.[96] Exclusion-based rights encourage the segmentation of resources.[97] Each property owner has the incentive to hold out for an exorbitant payout, stymying efforts to protect resources or produce public goods. Each disaggregation builds the veto power into increasingly smaller units.[98] Yet systems theory suggests that the dissection of the system into smaller and smaller units may eventually destroy the whole.[99] In developing a tract of land, for example, the landowner will ignore the ecosystem services provided by different parts and by the interactions of the parts. Habitat support generally will not figure into the rational actor's decision-making calculus, nor will flood control, nutrient recycling, the integrity of food webs, and water purification.[100] Eventually, after this pattern of decision-making is repeated enough, ecosystems will begin to collapse and man-made efforts to replace them will be too costly, inadequate, or simply ineffective.[101]

4. Property's Problem of Scale

The individual nature of property rights is central to the American property system.[102] It reflects the fundamental importance of property rights to Americans' liberty interests and fits well with the modern economic theory of property.[103] It does not, however, take

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96. *See* Michael A. Heller, *The Tragedy of the Anticommons: Property in the Transition from Marx to Markets*, 111 HARV. L. REV. 621, 622, 624 (1998); Frank I. Michelman, *Ethics, Economics, and the Law of Property*, *in* 24 NOMOS: ETHICS, ECONOMICS, AND THE LAW 3, 6, 9 (J. Roland Pennock & John W. Chapman eds., 1982).

97. *See* Heller, *supra* note 96, at 677.

98. *See* Butler, *supra* note 49, at 1260.

99. *See id.*

100. *See* Butler, *supra* note 59, at 986–87 (discussing the development proposal for land along the Potomac River in southern Maryland).

101. When deciding whether to build a water treatment system or rely on natural processes, for example, New York City chose to forego building expensive treatment facilities in favor of managing water naturally as it ran through private lands in upper New York State by using various land use controls. *See* Adams-Schoen et al., *supra* note 85, at 10036–37; Robert F. Kennedy, Jr., *A Culture of Mismanagement: Environmental Protection and Enforcement at the New York City Department of Environmental Protection*, 15 PACE ENVTL. L. REV. 233, 236 n.7 (1997). Man-made wetlands also lack the diversity and quality of natural wetlands. EPA, *Executive Summary*, 1 WETLAND CREATION AND RESTORATION: THE STATUS OF THE SCIENCE xii (Jon A. Kusler & Mary E. Kentula eds. 1989) ("Restoration or creation of a wetland that 'totally duplicates' a natural-occurring wetland is impossible; however, some systems may be approximated and individual wetland functions may be restored or created.").

102. *See* Butler, *supra* note 49, at 1215.

103. *See id.* at 1218, 1258–59.

into account the potentially catastrophic problem of climate change—at least not as property is currently structured. Under current thinking, significant problems of scale arise from the narrow focus on the individual owner's rights and interests and not on the true scales of a decision—the actual footprint of the owner's decisions over time, space, and systems (both natural and social). The individual owner's decision-making calculus is confined for the most part to the owner's chain of title and to the physical or legal boundaries of the property.[104] Left out of the owner's thinking is any sense of cumulative impact on ecosystems, diffused harm to systems, or distributional consequences for society. When these factors lead to extreme harm, the larger threat to the whole should matter.

The inadequacy of the temporal scale of a property owner's decision-making is especially evident in the context of climate change. The owner reaps the benefits of activities releasing greenhouse gas emissions that will impose potentially catastrophic costs on future generations. Though economic analysis uses discounting to include some of those future costs, many commentators are troubled by the application of discounting to such a potentially catastrophic problem.[105] Present value analysis assumes that the costs on future generations can be adequately measured and does not bring home the costs to the emitter absent legal action.[106] Also, as the climate change problem so poignantly demonstrates, discounting ignores the serious if not catastrophic harm of cumulative greenhouse gas emissions. Because the harm could occur hundreds of years from now, discounting those future costs is nearly impossible.[107] The problem of climate inertia further complicates the analysis. Greenhouse gases that have already accumulated in the atmosphere will remain there for a very long time, with new emissions adding to those

104. *See id.* at 1247, 1261–62.

105. *See id.* at 1261; Douglas A. Kysar, *Sustainability, Distribution, and the Macroeconomic Analysis of Law*, 43 B.C. L. REV. 1, 40–44 (2001) [hereinafter Kysar, *Sustainability*]; Douglas A. Kysar, *Law, Environment, and Vision*, 97 NW. U. L. REV. 675, 688–91 (2003) [hereinafter Kysar, *Vision*].

106. *See* Butler, *supra* note 49, at 1261; Kysar, *Sustainability*, *supra* note 105, at 3–5, 8–17, 28–31; Kysar, *Vision*, *supra* note 105, at 678–83, 685–93.

107. Kysar, *supra* note 3, at 40 ("Most greenhouse gases are stock pollutants, capable of persisting in the atmosphere and warming the planet for decades, even centuries."). According to the EPA, carbon dioxide is the most commonly emitted greenhouse gas, at 65 percent of global and 81 percent of U.S. greenhouse gas emissions. *See Global Greenhouse Gas Emissions Data*, EPA, https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data (last updated Sept. 13, 2019). Greenhouse gases remain in the atmosphere for different amounts of time. For example, methane persists for roughly twelve years, nitrous oxide can dissolve in around 114 years, while carbon dioxide can remain in the atmosphere anywhere from twenty to two hundred years. *See* Duncan Clark, *How Long Do Greenhouse Gases Stay in the Air?*, GUARDIAN (Jan. 16, 2012), https://www.theguardian.com/environment/2012/jan/16/greenhouse-gases-remain-air.

concentrations.[108] The cumulative and additive nature of greenhouse gas emissions thus makes the individual property owner's sense of time totally inadequate.

The spatial scale of an individual property owner's decision-making also is too narrowly defined to capture the true footprint of the decision. Although common law principles of property and nuisance law force owners to consider some spatial considerations that reach beyond their property's physical boundaries,[109] those principles are generally limited to neighbors in close proximity or to direct and specific causal links.[110] Legal principles like the substantial harm requirement and the foreseeability concept limit the availability of relief to individual landowners.[111] As a consequence, diffused harm that is substantial in the aggregate but not on an individual basis is ignored. Even though the actual harm from climate change may be substantial over spatial and temporal scales, the harm to a particular property owner may be minor.

The ecological or natural systems scale of a property owner's perspective is also problematic. Although environmental laws have forced property owners to consider the ecological impacts of some uses, these laws tend to ignore long-term, global, or system-wide impacts.[112] These laws, for example, do not require a property owner

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108. *See* Doremus, *supra* note 9, at 1093 (discussing climate inertia); *supra* text accompanying notes 9, 11. *See also* Massachusetts v. EPA, 549 U.S. 497, 525, 545 (2007) (recognizing the cumulative and additive characteristics of greenhouse gas emissions).

109. *See* Kysar, *Vision*, *supra* note 105, at 695–96.

110. *See, e.g.*, Barasich v. Columbia Gulf Transmission Co., 467 F. Supp. 2d 676, 690, 694 (E.D. La. 2006) (rejecting plaintiffs' group liability theory absent a showing of individual causation).

111. *See* RESTATEMENT (SECOND) OF TORTS § 821F (AM. LAW INST. 1979).

112. *See, e.g.*, Endangered Species Act of 1973, 16 U.S.C. §§ 1531–1544 (2018) (providing a method for the conservation and protection of endangered species and their habitats by regulating the import, export, interstate, and foreign commerce involving listed endangered species); Clean Water Act, 33 U.S.C. §§ 1251–1388 (regulating disposal of pollutants into waters of the United States, and quality standards for surface waters); Clean Air Act, 42 U.S.C. §§ 7401–7671q (regulating emissions from motor vehicles, power plants, industrial plants, and other nonmobile facilities, as well as chemical emissions, hazardous and toxic air pollutants, and, as of a 2007 Supreme Court decision, greenhouse gases). One exception would be the laws addressing the ozone problem. In contrast to climate change, developed countries were able to agree on how to solve the problem in the Montreal Protocol. Unlike climate change, the problem and solutions were clear, and the results fairly immediate. The 1987 Montreal Protocol on Substances that Deplete the Ozone Layer provided controls on ozone-depleting substances ("ODS"). *See* Owen Greene, *The System for Implementation Review in the Ozone Regime*, *in* THE IMPLEMENTATION AND EFFECTIVENESS OF INTERNATIONAL ENVIRONMENTAL COMMITMENTS: THEORY AND PRACTICE 89, 89–90 (David G. Victor et al. eds., 1998). Within ten years, 156 states had ratified the Protocol, "global consumption and production of the main ODS stopped expanding and began to decrease . . . [and m]ost developed countries had

to manage for ecological resilience.[113] Rather, under the dominant approach, a property owner is allowed to segment natural resources into individually owned units while ignoring important ecosystem services provided by a resource, especially the dynamic interactions among the parts.[114] By severing the natural resource into legally independent units, the owner is able to convert the natural resource into smaller units having an exchange value.[115] As the process of subdivision or severance continues, the narrow scales of the individual owner's decision-making become incorporated into increasingly segmented resources. The gatekeeping power of the owner is thus dispersed, resulting in a "diffusion of responsibility" and a loss of accountability.[116] Over time, as the diffusion continues, the impacts on the overall system become progressively attenuated and insulated, limiting legal liability.

5. The Coupling Problem of Constitutionally Protected Property

To compound matters, the inherent bias of the American property system for an exclusion-based approach has become embedded in constitutionally protected property rights.[117] Constitutional

substantially phased out consumption of chlorofluorocarbons (CFCs) and halons." *Id.*

In contrast, the United Nations Framework Convention for Climate Change ("UNFCCC") met first in 1994 to discuss the Kyoto Protocol for setting target reductions in greenhouse emissions. *See What Is the Kyoto Protocol?*, U.N. FRAMEWORK CONVENTION FOR CLIMATE CHANGE http://unfccc.int/kyoto_protocol/background/items/2879.php (last visited Mar. 28, 2020). Within a year, UNFCCC's member countries recognized the need for stricter demands in reducing greenhouse gases. *Id.* In 2001, more negotiations occurred, and it was not "entered into force" until 2005. *Id.* The complexity of the climate change problem produced a complicated response, with commitments to reduction, though binding, varying across each adopting nation. *See id.*; ROMM, *supra* note 2, at 153–54 (discussing the Kyoto Protocol's requirement that developing countries cut total greenhouse gas emissions by 5 percent from 1990 to 2008–2012). To complicate matters further, to "compensate for binding targets," countries had flexibility in how they achieve their target goal; for instance, rather than actually reducing their emissions, member countries could partially compensate for their emissions by planting forests, or "sinks," in their own territory or the territory of another member nation. *See* UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE, KYOTO PROTOCOL REFERENCE MANUAL: ON ACCOUNTING OF EMISSIONS AND ASSIGNED AMOUNT 4, 12, 15, 21, (2008), https://unfccc.int/resource/docs/publications/08_unfccc_kp_ref_manual.pdf.

113. *See, e.g.*, Endangered Species Act of 1973, 16 U.S.C. §§ 1531–1544; Clean Water Act, 33 U.S.C. §§ 1251–1388; Clean Air Act, 42 U.S.C. §§ 7401–7671q.

114. *See* DAVID HARVEY, SEVENTEEN CONTRADICTIONS AND THE END OF CAPITALISM 250–51 (2014).

115. *See id.*

116. *See* MARILYN A. BROWN & BENJAMIN K. SOVACOOL, CLIMATE CHANGE AND GLOBAL ENERGY SECURITY: TECHNOLOGY AND POLICY OPTIONS 215–16 (2011); Butler, *supra* note 49, at 1263.

117. Butler, *supra* note 42, at 876–82.

protection of property under the Takings Clause directs the courts toward an individual rights analysis that reflects the exclusionary approach to property.[118] In evaluating a property owner's takings claim, courts rely on this bias in defining the economic impacts of a law on the property owner.[119] The public interest does not become part of the constitutional calculus in evaluating whether a regulatory taking has occurred, only in determining whether the law was a constitutionally valid exercise of the police power.[120] Instead of considering the costs of a property use to a shared or common resource in determining the economic impact, courts view the public interest merely as a threshold "public exigency" that may validate police power action but not justify the regulatory intrusion on property rights.[121] This logic seems to rule out consideration of the public quality of a shared or common resource like navigable waters, the atmosphere, and the climate system. Unfortunately, then, the embedding of the exclusion-based, economic approach to property within constitutionally protected property is magnifying property's problem of scale in potentially catastrophic ways.

The problem with addressing extreme or improbable events is that they are so unexpected that societies are unable to recognize or handle them.[122] Some experts suggest that climate change may be such a phenomenon, with its impacts falling on the most unlikely part of a standard probability distribution.[123] Under the dominant economic- and exclusion-based approach to property, the American institution of property is not prepared for such an event. It has become locked into a logic of decision-making that omits outward-regarding interests vital to the integrity of the whole and spillovers that do not immediately or directly affect the owner's bottom line. The property owner's expectations are shaped by incomplete or incorrect assumptions and operating principles. Constitutional property then may give those investment-backed expectations protection under the Takings Clause, raising the costs to the

118. *See id.*

119. *See id.*

120. *See* Pennsylvania Coal Co. v. Mahon, 260 U.S. 393, 413–16 (1922); Butler, *supra* note 49, at 1264. Though Justice Holmes wrote the majority opinion in *Pennsylvania Coal*, 260 U.S. at 413–16 (recognizing what is now called a regulatory taking), he also penned a dissent in *Lochner v. New York*, 198 U.S. 45, 75 (1905) (Holmes, J., dissenting) ("[A] constitution is not intended to embody a particular economic theory . . . ."), *abrogated by* W. Coast Hotel Co. v. Parrish, 300 U.S. 379 (1937).

121. *See Pennsylvania Coal*, 260 U.S. at 413–16; Butler, *supra* note 49, at 1264.

122. *See* William D. Nordhaus, *A New Solution: The Climate Club*, N.Y. REV. BOOKS, June 10, 2015 (reviewing GERNOT WAGNER & MARTIN L. WEITZMAN, CLIMATE SHOCK (2015)), https://www.nybooks.com/articles/2015/06/04/new-solution-climate-club/.

123. *See id.*

government and the rest of society for handling the impacts.[124] Rather than treating these expectations as reasonable, courts must recognize that they arise in an "unsettled" world that will require significant adaptation and change.[125]

Because property provides everyday ordering to American social and legal systems in ways that are affecting the integrity of the whole, it is imperative that the property system makes the changes needed to help address climate change and deal more effectively with systemic harms that attack the whole. A critical inquiry thus involves determining whether Western-style property systems can adjust in ways that will limit property's contributions to climate change.

III. PROPERTY'S ABILITY TO CHANGE

Is it possible for the American system of property to change, and remove or significantly restrict, those features of property that enable climate change to continue largely unchecked by the system? Answering that question will require a discussion of how property law normally adapts and whether those processes can accommodate the necessary adjustments. Could any legal concepts or systemic approaches thwart efforts to change? Do core justifications for change overcome any of these barriers? Finally, what changes in the property system must occur to address property's role as an enabler of climate change?

A. Property's Processes for Change

Given the strong scientific consensus on the severity of the climate change problem and on humans' role in causing the problem,[126] it is clear that climate change raises powerful questions about property's norms, values, and principles and about whether property can change in ways that address its contributions to the problem. Like any other complex system, property must have an inherent ability to be sensitive to feedbacks and to respond to those signals in order to persist over time.[127] The American property system has shown that adaptability in the past, changing formally through legislative and judicial action, and informally through market transactions, social practices, customs, and other informal or extralegal devices. As the following discussion explains, key formal

124. Butler, *supra* note 42, at 876–82.

125. *See generally* Victor B. Flatt, *Unsettled: How Climate Change Challenges a Foundation of Our Legal System, and Adapting the Legal State*, 2016 BYU L. REV. 1395 (2016) (advocating for a reexamination of the static parts of the legal system).

126. *See supra* notes 13–19 and accompanying text; *see also* ROMM, *supra* note 2, at 7.

127. *See* THOMAS PRINCEN, THE LOGIC OF SUFFICIENCY 35 (2005) ("Change is inherent in complex adaptive systems."). Without change, complex systems become obsolete over time.

and informal processes have allowed the property system to address changing physical and social conditions, both foreseeable and unexpected. Though climate change poses more severe risks to fundamental biophysical and social systems than past problems, property is a dynamic system that has the ability to adapt in significant ways.

1. Formal Processes

Formal change through the courts occurs incrementally and on an ex post basis. Though judicial change is incremental, courts can have a major impact on property law by making course corrections and updating expectations and obligations to reflect real-world conditions. These changes may occur through recognition of new property interests, redistribution of interests for equitable reasons, or management of complex resource situations through a governance strategy that involves greater judicial intervention than what occurs under the exclusion-based approach.

Courts are guided by the core norm of efficiency to make allocation decisions about recognition of new property interests or the reshaping of existing interests.[128] Mortgages, for example, evolved over time to allow parties to become homeowners when personal assets were insufficient or to capture some of the land's market value, promoting efficient investment in land and other resources.[129] The property owner's right to transfer has justified invalidation of direct restraints on alienation because of the importance of alienation to efficient use of resources.[130] Courts also did not allow form to prevail over substance when serious free-rider problems existed under the traditional approach to real covenants. For example, a New York court allowed a homeowner's association to enforce a covenant to pay a maintenance fee against a homeowner even though the association did not own any land in the subdivision and thus could not technically meet the privity of estate requirement for a covenant to run with the land at law.[131] Courts also have modified remedial rights of property

128. *See* Harold Demsetz, *Toward a Theory of Property*, 57 AM. ECON. REV. 347, 350 (1967) (postulating that property rights develop in response to inefficiencies in existing arrangements).

129. *See* JOSEPH WILLIAM SINGER, PROPERTY 560–69 (5th ed. 2017); *see also* Farber, *supra* note 41, at 31 ("Just as property law long ago devised the mortgage as a way to meet the pressing need for secured loans against property, so too it is likely to find new ways to meet social needs in the era of climate change.").

130. *See, e.g.*, Mountain Brow Lodge No. 82, Indep. Order of Odd Fellows v. Toscano, 64 Cal. Rptr. 816, 817 (Ct. App. 1967) ("Conditions restraining alienation, when repugnant to the interest created, are void." (quoting CAL. CIV. CODE § 711 (West 1872))); RICHARD A. POSNER, ECONOMIC ANALYSIS OF LAW 32 (3d ed. 1986) (discussing the importance of alienation to efficiency).

131. *See* Neponsit Prop. Owners' Ass'n v. Emigrant Indus. Sav. Bank, 15 N.E.2d 793, 798 (N.Y. 1938) ("Only blind adherence to an ancient formula devised to meet entirely different conditions could constrain the court to hold that a corporation formed as a medium for the enjoyment of common rights of property

owners when the benefits to society far outweighed the costs to the aggrieved property owner. In *Boomer v. Atlantic Cement Co.*,[132] for instance, the New York Court of Appeals decided that the gross economic disparity between the costs of issuing an injunction to protect the property owner from substantial harm and the costs of allowing the nuisance to continue with the payment of permanent damages justified the court's departure from the traditional rule of awarding an injunction upon proof of substantial harm.[133] Further, in contrast to the requirements for a trespass action, courts have decided to require substantial injury before a landowner can prevail in a nuisance action, reasoning that progress may reasonably require some inconvenience and annoyance.[134]

Common law property also uses certain straightforward operating principles to define methods of acquiring original ownership and resolve priority disputes among rights holders. These principles work efficiently in dealing with a wide variety of situations by relying on common sense concepts like physical possession and first in time that are flexible and relatively easy to apply. Discovery and the rule of capture both rely on the first-in-time principle as the basis of original ownership in previously unowned resources.[135] Over time, the courts have refined these operating principles as the nature of the resource, technological advances, and other circumstances have changed.[136] The courts also adopted the concept of relativity of title

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owners owns no property which would benefit by enforcement of common rights and has no cause of action in equity to enforce the covenant upon which such common rights depend. . . . In substance if not in form the covenant is a restrictive covenant which touches and concerns the defendant's land, and in substance, if not in form, there is privity of estate between the plaintiff and the defendant.").

132. 257 N.E.2d 870 (N.Y. 1970).

133. *See id.* at 874 (awarding permanent damages instead of an injunction because of the gross disparity between the economic consequences of the nuisance on the landowner and an injunction on the public interest).

134. *See, e.g.*, Rose v. Chaikin, 453 A.2d 1378, 1381, 1384 (N.J. Super. Ct. Ch. Div. 1982); *see also* Adams v. Cleveland-Cliffs Iron Co., 602 N.W.2d 215, 222 (Mich. Ct. App. 1999) (distinguishing between trespass and nuisance).

135. *See* Johnson v. M'Intosh, 21 U.S. 543, 587–89 (1823) (holding that though the Native American tribes were the rightful occupants of the land in dispute, the tribes could not convey the land to the plaintiffs because mere occupancy does not signify ownership; rather, European settlers, as first discoverers, had the exclusive right to appropriate the lands occupied by the Native Americans); *see also* Pierson v. Post, 3 Cai. 175, 178–79 (N.Y. Sup. Ct. 1805) (holding that the owner of *ferae naturae* is the first hunter to capture the wild animal on unappropriated lands, not merely to pursue it).

136. In *Pierson*, for example, the court discussed how the meaning of the rule of capture had been expanded from corporeal possession to mortal wounding by one not abandoning pursuit. *See Pierson*, 3 Cai. at 178–79. In *Hinman v. Pacific Air Transport*, 84 F.2d 755, 757–58 (9th Cir. 1936), the court recognized the importance of new technology by redefining the *ad coelum* doctrine to allow airplane flights that did not unreasonably interfere with the use and enjoyment of lands lying below the flight path.

to allow the rights and obligations of parties in resources to vary depending on the relation of the parties in time and space. The first finder, for example, prevails over a subsequent finder but loses to the true owner under traditional common law,[137] while a downstream riparian owner's rights are subject to the reasonable uses of upstream riparians.[138] The doctrine of merger is also used to clean up the title when a party with a limited interest in a tract later acquires the remaining ownership interests; this doctrine has long been a means for reconciling the interests of a landowner with those of a community's.[139]

When norms of fairness and justice demand equitable relief, courts have instead changed the distribution of property or property-like interests. Courts have allowed the good faith improver to keep the improved property when the improver's labor has significantly transformed property not owned by the improver and added much value.[140] Under similar thinking, a minor building encroachment made in good faith may be allowed to remain when it does not affect the actual landowner's use and grave hardship would result if removal were ordered.[141] Further, an oral license to use land in a certain manner may become irrevocable if the landowner knowingly allows the user to expend money and labor to conduct or maintain the use.[142] And equity may provide permanent relief against a permitted

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137. *See* Armory v. Delamirie (1722) 1 Str. 505, 505 (K.B.); *see also* SINGER, *supra* note 129, at 824–29.

138. *See* Lynda L. Butler, *Allocating Consumptive Water Rights in a Riparian Jurisdiction: Defining the Relationship Between Public and Private Interests*, 47 U. PITT. L. REV. 95, 124–30 (1985). For example, domestic uses of water usually take higher priority than others. *See id.* at 126, 126 n.83; *see also* A. DAN TARLOCK & JASON ANTHONY ROBISON, LAW OF WATER RIGHTS AND RESOURCES § 3:60 (2019).

139. *See* Stuart Banner, Murr *and Merger*, 7 BRIGHAM-KANNER PROP. RTS. CONF. J. 185, 191–92 (2018) (discussing how the merger doctrine helps to reconcile title with a community); Ann M. Burkhart, *Freeing Mortgages of Merger*, 40 VAND. L. REV. 283, 284 (1987) (discussing use of the merger doctrine to clean up title).

140. *See, e.g.*, Wetherbee v. Green, 22 Mich. 311, 316–22 (1871) (finding that defendant, who in good faith made barrel hoops from timber cut on plaintiff's land, had transformed the wood to the extent that its original identity was destroyed and its value enhanced, and therefore the original owner could not reclaim it).

141. *See, e.g.*, Golden Press, Inc. v. Rylands, 235 P.2d 592, 595–96 (Colo. 1951) (holding that, although the foundation and footings of defendant's building extended two to three and a half inches onto plaintiff's land, the encroachment was unintentional and slight and therefore not requiring removal of the offending encroachment; "plaintiff's use [was] not affected and his damage small and fairly compensable, while the cost of removal is so great as to cause grave hardship or otherwise make its removal unconscionable").

142. *See, e.g.*, Richardson v. Franc, 182 Cal. Rptr. 3d 853, 856 (Ct. App. 2015) ("[I]t would be inequitable to deny respondents an irrevocable license given their substantial investment of time and money on the landscaping and other improvements and appellants' years of acquiescence."); Holbrook v. Taylor, 532 S.W.2d 763, 764, 766 (Ky. 1976) (holding that where a plaintiff landowner

use conducted randomly and intermittently on another's land when the use causes injury.[143]

Despite the more limited management focus of the exclusion-based approach, courts have, on occasion, transformed direct property relationships by looking beyond the traditional purposes of the relationship to current social or physical conditions.[144] In the 1960s and 1970s, for instance, courts rebalanced the landlord/tenant relationship to recognize the need for a more complex governance approach that reflected the new roles of the landlord and the tenant, the changed expectations accompanying those roles, and the poor housing conditions existing in many urban rental markets.[145] Some influential courts recognized that modern residential leaseholds involve complicated mechanical systems, that residential tenants no longer have the skills or access needed to handle major repairs, and that the tenants expected a place to live that was habitable in some basic ways.[146] Because of the change in expectations and in housing

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allowed defendants use of a roadway on his land to gain access to their home from the public highway, "to take in heavy equipment and material and supplies for construction of the residence, [to perform] general improvement of the premises, the maintenance of the roadway, and the construction by appellees of a $25,000 residence, all with the actual consent of appellants or at least with their tacit approval," "the . . . [plaintiff] may not revoke the license and restore his premises to their former condition after the [defendant] has exercised the privilege given by the license and erected the improvements at considerable expense" (quoting Lashley Tel. Co. v. Durbin, 228 S.W. 423, 423 (Ky. 1921))). An oral agreement to conduct a use on another's land similarly may be recognized as an easement, despite the absence of a deed, when the user detrimentally relies on the oral agreement to expend money and labor. *See* Baseball Publ'g Co. v. Bruton, 18 N.E.2d 362, 365 (Mass. 1938).

143. *See, e.g.*, Baker v. Howard Cty. Hunt, 188 A. 223, 230 (Md. 1936) ("[W]here it appears that the defendant manifests an intention of persisting in the perpetration of unlawful acts, the expense, annoyance, and trouble of prosecuting numerous actions at law to recover trifling damages render an action at law an inadequate remedy. . . . [I]t is long since settled that equity will relieve against continuing or repeated trespasses committed in pursuance of a single plan or purpose." (citations omitted)).

144. For the most part, the courts focus on direct relationships between the owners and parties in their chain of title or having interests in the same property and between the owners and neighboring landowners in close proximity. *See supra* text accompanying note 47.

145. *See* Javins v. First Nat'l Realty Corp., 428 F.2d 1071, 1077 (D.C. Cir. 1970) ("In our judgment the common law itself must recognize the landlord's obligation to keep his premises in a habitable condition. . . . The common law rule absolving the lessor of all obligation to repair originated in the early Middle Ages. Such a rule was perhaps well suited to an agrarian economy; the land was more important than whatever small living structure was included in the leasehold, and the tenant farmer was fully capable of making repairs himself."); Brown v. Southall Realty Co., 237 A.2d 834, 836–37 (D.C. 1968) (holding that a tenant's lease was invalid and no rent was owed because the landlord rented premises that were not "safe and sanitary" in violation of the law).

146. *See* Mary Ann Glendon, *The Transformation of American Landlord-Tenant Law*, 23 B.C. L. REV. 503, 505 (1982).

construction, as well as the public health concerns raised by poor living conditions, those courts implied a warranty of habitability into residential leases.[147] Eventually, legislatures followed the groundbreaking path of the courts by enacting various versions of the Uniform Landlord/Tenant Act.[148]

Courts have also used common law doctrines to manage property relationships when those relationships are based on conditions that have become obsolete or do not reflect fundamental changes in legal and social norms. Restrictive covenants may be terminated because of changed circumstances in the restricted area that make fulfillment of the covenant impossible[149] or because of significant changes in the law or in physical conditions.[150] The common law governing property rights in shore lands similarly developed adaptive doctrines to address changes due to natural processes.[151] Under the doctrines of erosion and accretion, gradual and imperceptible changes in the shore lands result in a fluctuating boundary between private and public rights.[152] This low-cost approach avoids the almost impossible task of having to determine the original boundary's location—had it remained the legal boundary despite the slowly shifting sands, allowing the waterfront landowner and the public to rely on

147. *See, e.g.*, *Javins*, 428 F.2d at 1076–77 ("In our judgment, the old no-repair rule cannot coexist with the obligations imposed on the landlord by a typical modern housing code, and must be abandoned in favor of an implied warranty of habitability.").

148. UNIF. RESIDENTIAL LANDLORD TENANT ACT §§ 2.104, 4.101 (NAT'L CONF. COMM'RS UNIF. ST. LAWS 1972); *see, e.g.*, VIRGINIA RESIDENTIAL LANDLORD & TENANT ACT, VA. CODE ANN. §§ 55.1-1200–55.1-1262 (2019).

149. *See* Bolotin v. Rindge, 41 Cal. Rptr. 376, 378 (Dist. Ct. App. 1964) (noting that "[a] court will declare deed restrictions to be unenforceable when, by reason of changed conditions, enforcement of the restrictions would be inequitable and oppressive, and would harass plaintiff without benefiting the adjoining owners").

150. *See, e.g.*, Shelley v. Kraemer, 334 U.S. 1, 23 (1948) ("Whatever else the framers sought to achieve, it is clear that the matter of primary concern [in enacting the Fourteenth Amendment] was the establishment of equality in the enjoyment of basic civil and political rights and the preservation of those rights from discriminatory action on the part of the States based on considerations of race or color."); Hadacheck v. Sebastian, 239 U.S. 394, 409 (1915) (noting that, though petitioner acquired the land before the area had been annexed to the city of Los Angeles, "the district [the legislation] created had become primarily a residential section and that the occupants of the neighboring dwellings are seriously incommoded by the operations of petitioner," and because the legislation did not operate discriminatorily or arbitrarily, the city did not violate the Fourteenth Amendment by enacting the legislation that forbid petitioner from brickmaking within city limits).

151. *See, e.g.*, Gunderson v. State, 90 N.E.3d 1171, 1186–87 (Ind. 2018).

152. As a beach erodes, the waterfront landowner loses land and the government gains it. *See* TARLOCK & ROBISON, *supra* note 138, § 3:35 (noting that "[s]tates have long asserted a strong interest in promoting access to coastal waters for navigation . . . and recreational purposes . . . . For these reasons, title to the beds under navigable waters is generally vested in the states").

observable high and low water marks.[153] Sudden change, however, is not a risk that the waterfront landowner bears, for the change is easily noticeable and thus the legal boundary remains the same under the doctrine of avulsion.[154] The waterfront landowner can even reclaim identified shore land lost suddenly.[155]

Now that many coastal areas are facing unrelenting sea level rise,[156] waterfront landowners need to confront the reality of losing their interests in shore land whenever the loss is due to the slow and imperceptible rise in the seas.[157] When waterfront landowners who have gradually lost shore lands to sea level rise have sued to enjoin the public from using areas now below the high water mark, courts have tended to reject their claims under the common law doctrines of accretion and erosion.[158] Similarly, when waterfront landowners have sued the government for just compensation after being denied a permit to build a hardened erosion control structure, courts have tended to rule against the landowners, reasoning that natural processes—not the regulatory ban or permit denial—caused the loss.[159] Given that the seas are progressively rising due to climate

153. *See id.*

154. *See id.* § 3:42.

155. *See id.* §§ 3:42–3:43; *see also* Walton Cty. v. Stop Beach Renourishment, Inc., 998 So. 2d 1102, 1117 (Fla. 2008), (citing 1 HENRY PHILIP FARNHAM, THE LAW OF WATERS AND WATER RIGHTS § 74 (1904) ("If a portion of the land of the riparian [or littoral] owner is suddenly engulfed, and the former boundary can be determined or the land reclaimed within a reasonable time, he does not lose his title to it.")), *aff'd* 560 U.S. 702 (2010).

156. In its 2014 report, the Union of Concerned Scientists predicted that sea-level rise will cause frequent, widespread tidal flooding over the next fifteen to thirty years across the East and Gulf Coasts and estimated that "two-thirds of these [coastal] communities could see a tripling or more in the number of high-tide floods each year" in that time. ERIKA SPANGLER-SIEGFRIED ET AL., ENCROACHING TIDES: HOW SEA LEVEL RISE AND TIDAL FLOODING THREATEN U.S. EAST AND GULF COAST COMMUNITIES OVER THE NEXT 30 YEARS 2, 10–11, 22 (2014), https://www.ucsusa.org/sites/default/files/attach/2014/10/encroaching-tides-full-report.pdf. The report anticipated that the mid-Atlantic coast can expect to see the greatest increase in frequency: by 2030, the region could experience floods more than once a week, "an average of 80 to 130 tidal floods a year." *Id.* at 2, 16–18. By 2045, Washington, D.C. may see nearly four hundred tidal floods per year. *Id.* at 7, 22. And population-dense, low-lying areas like Miami are especially vulnerable to sea-level rise; the report predicts the "frequency of tidal flooding [in Miami] to increase nearly eightfold." *Id.* at 32–33.

157. *See* J. Peter Byrne, *The Cathedral Engulfed: Sea-Level Rise, Property Rights, and Time*, 73 LA. L. REV. 69, 80 (2012).

158. *See id.* at 79–82; *see also* Gove v. Zoning Bd. of Appeals, 831 N.E.2d 865, 868, 872–75 (Mass. 2005) (holding that a ban on residential development was not a taking because, among other reasons, the coastal land was prone to severe flooding).

159. *See* City of Long Branch v. Jui Yung Liu, 4 A.3d 542, 547–55 (N.J. 2010) (concluding that the landowner lost beachfront property due to an avulsive event under state common law and therefore that the government owned the restored beach); Shell Island Homeowners Ass'n v. Tomlinson, 517 S.E.2d 406, 414–15 (N.C. Ct. App. 1999) (holding that a ban on the use of permanent erosion control

change, it may be time to recognize the necessity of reforming the legal regime governing coastal lands to reflect the realities of climate change.

Further, American property law already employs flexible and adaptive common law principles to deal with certain complex relationships involving shared and common resources. Significantly, in defining the rights and obligations of private waterfront landowners, the public, and the government with respect to navigable waters and related lands, courts have developed different definitions of navigability to address distinct jurisdictional and legal situations. Navigability, for federal jurisdictional purposes, is tied to the federal government's constitutionally based power over commerce and governs the allocation of title to submerged beds between federal and state governments.[160] State law definitions of navigability, however, may further determine how and whether the public may use waterways and their submerged beds, as well as the extent of ownership rights of waterfront landowners.[161] A watercourse that is not navigable in fact for commerce under federal law may nevertheless be navigable under state law for recreational and other public uses.[162] State courts adopting an expanded view of navigability for purposes of determining public use rights in watercourses have explained that the meaning of navigability varies according to the function being served.[163] Although the federal definition of navigability is tied to the Commerce Clause,[164] state definitions serve a different purpose—to balance the rights of private waterfront landowners with the use rights of the public.[165] This long-standing ability of the courts to govern complex relationships among numerous stakeholders demonstrates the inherent ability of property to adapt, to be flexible, and to respond to current conditions.

In a functioning political system, legislative action can provide more comprehensive change to property law. The problem of climate

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structure on a barrier island was not a taking when the harm to the property was caused by natural processes of erosion and migration of water); McQueen v. S.C. Coastal Council, 580 S.E.2d 116, 120 (S.C. 2003) (holding that the denial of a permit to build a bulkhead was not a compensable taking because natural forces caused the erosion and conversion to wetlands).

160. *See* Gibbons v. Ogden, 22 U.S. 1, 197–98 (1824); Lynda L. Butler, *Environmental Water Rights: An Evolving Concept of Public Property*, 9 VA. ENVTL. L.J. 323, 337, 337 n.75 (1990). For a discussion of allocation of title, see *id.* at 338.

161. *See* Butler, *supra* note 160, at 338.

162. *See id.* at 338–39.

163. *See, e.g.*, State v. McIlroy, 595 S.W.2d 659, 664 (Ark. 1980) ("It is the policy of [Arkansas] to encourage the use of its water courses for any useful or beneficial purpose. There may be other public uses than the carrying on of commerce of pecuniary value." (quoting Barboro v. Boyle, 178 S.W, 378, 380 (1915))); *see also* Butler, *supra* note 160, at 338–39, 338 n.81.

164. *See* Butler, *supra* note 160, at 337.

165. *See id.* at 338–40.

change, however, has become too politicized an issue for some state and federal legislatures to address.[166] For reasons that cannot possibly reflect the facts and findings of climate science, some politicians have denied the existence of the problem, often after accepting support from fossil fuel companies.[167] These politicians have not only refused to take action but have also limited the ability of others to act.[168] Some companies have even run campaigns of disinformation about climate change to cast doubt about the existence of the problem and about the scientists supporting action.[169] ExxonMobil, for instance, funded research by outside scientists both to contradict the research of its own scientists after they had found a connection between fossil fuel burning and climate change and also

166. *See* Peter Howard & Michael A. Livermore, *Sociopolitical Feedbacks and Climate Change*, 43 HARV. ENVTL. L. REV. 119, 163 (2019) (discussing the failure to address climate change legislation because of partisan deadlock); Carlos Anchondo, *Once Again, Bills to Study the Impact of Climate Change in Texas Have Stalled*, TEX. TRIB. (May 10, 2019, 12:00 PM), https://www.texastribune.org/2019/05/10/climate-change-bills-do-not-get-hearings-this-session-in-texas/ (discussing Texas legislature's failure to address bills to study climate change because of political polarization).

167. *See* Coral Davenport & Eric Lipton, *How G.O.P. Leaders Came to View Climate Change as Fake Science*, N.Y. TIMES (June 3, 2017), https://www.nytimes.com/2017/06/03/us/politics/republican-leaders-climate-change.html (examining the effect of fossil fuel campaign contributions on politicians denying climate change).

168. In North Carolina, for example, the state legislature decided to limit the ability of state agencies and local governments to address one impact of climate change—sea level rise—by prohibiting the use of up-to-date flood data; instead, "the law restrict[ed] all sea-level predictions used to guide state policies" through 2016 to "those based on 'historical data.'" *See* Alon Harish, *New Law in North Carolina Bans Latest Scientific Predictions of Sea-Level Rise*, ABC NEWS (Aug. 2, 2012, 12:54 PM), http://abcnews.go.com/US/north-carolina-banslatest-science-rising-sea-level/story?id=16913782; Jane J. Lee, *Legislating Sea Level Rise*, SCI. MAG. (June 12, 2012, 6:15 PM), https://www.sciencemag.org/news/2012/06/legislating-sea-level-rise.

Several bills to limit the use of science also have been introduced at the federal level. *See, e.g.*, Honest and Open New EPA Science Treatment ("HONEST") Act of 2017, H.R. 1430, 115th Cong. (2017) (prohibiting the EPA from "proposing, finalizing, or disseminating regulations or assessments based upon scientific evidence that is not transparent or reproducible"). According to the House Report, "covered" EPA actions cannot be disseminated unless the information used in decision-making can be "specifically identified" and is "publicly available in a manner sufficient for independent analysis and scientific replication." H.R. REP. NO. 115-59, at 2, 9 (2017). This bill would effectively prevent reliance on medical studies that rely on confidential personal information or on monitoring a person's health over time. *See* Better Evaluation of Science and Technology ("BEST") Act, S. 578, 115th Cong. (2017) (amending 5 U.S.C. § 553 to include limitations regarding the use of scientific information in rule making).

169. *See* James Weinstein, *Climate Change Disinformation, Citizen Competence, and the First Amendment*, 89 U. COLO. L. REV. 341, 342–43 (2018) (examining Exxon's disinformation campaign that attempted to cast doubt on climate change and the scientists that support it).

to shape public opinion about climate change.[170] Given the paralysis within Congress and other legislative bodies, judicial action may, at the present time, be the only viable method for refocusing the property system on its contributions to climate change and on rewiring the incentive structure of property.

2. Informal Processes

Property law can also change informally as social practices and market incentives reshape norms and preferences. Sometimes changes in property rules result from a society's long-standing resistance to formal rules imposed on them.[171] Eventually, the informal practices developed in reaction to the formal system may form the basis of new property rules. One telling example of this evolutionary path involves settlers in the American colonies who resisted England's imposition of the feudal system, with all of its complicated rules, conditions, and obligations. In colonial Virginia, for instance, settlers refused to pay quit rents and developed a number of ways to circumvent limitations imposed on their ability to acquire land rights.[172] The English government reacted to the colonists' resistance by trying different land distribution schemes—none of which succeeded in overcoming the opposition.[173] In other situations, close-knit or homogeneous groups have informally developed their own distinctive property system and operating rules over time.[174] The gold mining camps in California, for example, developed their own practices for allocating, distributing, and

170. *See* Geoffrey Supran & Naomi Oreskes, *Assessing ExxonMobil's Climate Change Communications (1977-2014)*, 12 ENVTL. RES. LETTERS 1, 9, 13–15 (2017); Ian Johnston, *ExxonMobil: Oil and Gas Giant 'Misled' the Public About Climate Change, Say Harvard Experts*, INDEPENDENT (Aug. 23, 2017, 1:00 PM), http://www.independent.co.uk/environment/exxonmobil-climate-change-oil-gas-fossil-fuels-global-warming-harvard-a7908541.html.

171. *See, e.g.*, Eric T. Freyfogle, *Land Use and the Study of Early American History*, 94 YALE L.J. 717, 728–29 (1985) (book review) (describing changes in colony property rules as a result of early colonist's long-standing resistance to England's imposed limitations on land use).

172. *See* LYNDA LEE BUTLER & MARGIT LIVINGSTON, VIRGINIA TIDAL AND COASTAL LAW § 8.1 (1988) (discussing how the colonists resisted their English rulers' land distribution laws).

173. *Id.* For a suggestion that it is time for further change in American property law, see Lee Anne Fennell, *Fee Simple Obsolete*, 91 N.Y.U. L. REV. 1457, 1479–1504 (2016).

174. *See* ROBERT C. ELLICKSON, ORDER WITHOUT LAW 40–64 (1991) (studying ranchers and farmers in Shasta County and concluding that when they form a close-knit community, they reach efficient results through informal norms and not by bargaining around legal rules); ELINOR OSTROM, GOVERNING THE COMMONS: THE EVOLUTION OF INSTITUTIONS FOR COLLECTIVE ACTION 26–28, 88–102 (Canto Classics ed. 2015) (studying groups of people engaged in self-monitoring of common-pool resources, and finding that, though each community developed substantially different sets of rules, the rules were based on the same underlying principles).

managing mining rights.[175] This informal system worked well because miners in the camps were a fairly homogeneous group and agreed on a basic principle of equal opportunity.[176] Eventually, the system became the basis of the federal approach.[177] Property rules have also evolved in the context of particular resources to provide a source of livelihood and promote economic activities. In the Tidewater region of Virginia, for instance, fisheries and waterfowl were especially abundant and became critical to survival and trade.[178] In part because of their importance, Virginia recognized, even during its colonial era, certain marshlands and shore lands as common lands subject to public rights to fish, fowl, and hunt.[179] Eventually, the commons concept was extended to various waters and shores in the western part of the state.[180]

Property law can also change incrementally through marketplace transactions as rational actors receive signals about the costs and benefits of various options.[181] Over time, these transactions may become so prevalent that they shape expectations and become part of property law.[182] Markets, however, are not *the* answer to the climate change problem, though they may become part of the solution.[183] Markets work effectively to the extent that a correctible misallocation of costs exists. Climate change reflects a basic failure of property owners and societies to even see—much less understand—the costs of greenhouse gas emitting activities.[184] Among other factors, the time scales of climate change lie outside the ability of market detection and response. Further, institutional failures may block the changes that are needed—changes like the creation of new rights and obligations, the consideration of competing public interests, or the recognition of

175. GARY D. LIBECAP, CONTRACTING FOR PROPERTY RIGHTS 29–30 (James Alt & Douglass North eds., 1989).

176. *See id.* at 29–34, 36–37 (discussing the evolution of private mineral rights in open access lands by over six hundred mining camps in the West).

177. *Id.* at 36–37.

178. *See* Jack Temple Kirby, *Virginia's Environmental History: A Prospectus*, 99 VA. MAG. HIST. & BIOGRAPHY 449, 449, 451, 459 (1991) (describing the abundant fish and waterfowl trade in the Tidewater portion of Virginia).

179. *See* BUTLER & LIVINGSTON, *supra* note 172, §§ 6.1–6.2 (discussing the development of the commons concept in England, colonial Virginia, and the Commonwealth of Virginia).

180. *Id.* § 10.2 (discussing the expansion of common lands to include "banks, shores, and beds of rivers and creeks in the western parts of this commonwealth").

181. *See* Doremus, *supra* note 9, at 1091, 1117–19.

182. *See id.* at 1117.

183. *See* Doremus, *supra* note 9, at 1117–19. *See generally* Krugman, *supra* note 54 (discussing how markets react and account for "negative externalities," and noting that environmental economics can help legislators deal with these externalities).

184. *See* Doremus, *supra* note 9, at 1119; *see also* WRIGHT & NYBERG, *supra* note 71, at 47–72 (discussing how corporations are strategically framing climate change as a business risk and therefore an opportunity for capital growth).

the interests of future generations.[185] Maximizing the economic potential of certain types of resources, like navigable waters, may only be possible through a system based on collective rights, not private rights, because of the increasing returns to scale that their use generates.[186] Marketplace transactions also do not deal effectively with situations where costs are diffused among many but are significant in the aggregate.[187] Moreover, actors in the marketplace may be biased in how they consider and value costs and benefits, ignoring long-term costs, non-marginalized change, and interests that are hard to value because of their complexity or intangible nature.[188] The actors generally assume the legitimacy of current methods of production and consumption, even though those methods have, in the case of climate change, led to the problem.[189]

B. Obstacles to Change

As the prior Subpart has explained, property law has formal and informal processes for evolving in response to changing conditions and needs, both social and biophysical. Addressing the extreme problem of climate change will require eliminating or modifying those aspects of property that enable climate change to occur. What obstacles, if any, could potentially thwart changes to common law property that would address its enabling features? One obstacle is the narrow incentive structure of neoliberal economics that has become woven into the fabric of key property principles and concepts. Another obstacle concerns current judicial interpretations of constitutionally protected property that magnify the narrow perspective and logic of efficiency.

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185. *See* Doremus, *supra* note 9, at 1097–99 (discussing the need for a flexible and adaptive property system with mechanisms for creating or changing property rights).

186. *See* Carol Rose, *The Comedy of the Commons: Custom, Commerce, and Inherently Public Property*, 53 U. CHI. L. REV. 711, 772–73 (1986) (discussing how treating navigable waters as a commons produces increasing returns to scale and a comedy of the commons).

187. *See* Butler, *supra* note 49, at 1257–58, 1258 n.234; *see also* Doremus, *supra* note 9, at 1119 (explaining that free rider problems lead to market inefficiencies, such as the underproviding of public goods).

188. *See* Butler, *supra* note 49, at 1257–58 (discussing the negative externalities of the American property system and how the economic theory of property "generally lacks the incentives to manage for resilience"); *see also* James Y. Stern, *The Essential Structure of Property Law*, 115 MICH. L. REV. 1167, 1186 (2017) (discussing the difficulty of valuing future interests in an estate because the eventual right is not distinctly a property right); Krugman, *supra* note 54 (suggesting some reasons why the costs of action or inaction may be hard to value in the climate change context because of the uncertainty of the magnitude of the problem, climate inertia, and the delay of seeing any benefits until the future). *See generally* STEPHEN M. GARDINER, A PERFECT MORAL STORM 247–98 (2011) (evaluating the use of cost-benefit analysis in the climate change context).

189. *See* WRIGHT & NYBERG, *supra* note 71, at 51–54, 60–64 (asserting that risk management practices legitimize corporate approaches to climate change).

1. The Incentive Structure of Property

Common law property operates effectively in part because of a number of options embedded in the system's default rules. Those embedded options make strategic choices that guide decision-making.[190] The choices, for example, make assumptions about the allocation of risk between buyers and sellers of real estate when casualty loss occurs during the transition period between execution of the contract for sale and the closing.[191] Similarly, embedded options allocate gains and losses between landlord and tenant during the lease[192] and "include a preference for [both] private ordering" and individual rights over public or common interests.[193] As the economic theory of property has gained dominance, it has shaped and influenced the options and assumptions embedded in property's structure, directing decision-making along the normative path of efficiency and away from other paths.[194] That is, economic incentives have become part of property's fabric, framing the choices of the gatekeeper—the property owner—consistent with the assumptions of neoliberal economics.

The mainstream economic theory of property, however, takes a narrow perspective that favors economic over noneconomic values and individual over collective interests. Further, since the bundle of sticks conception of property has gained acceptance, the focus of the common law has shifted more towards the owner's economic interests in particular sticks in the bundle.[195] Indeed, legal principles shaping property rights or resolving property conflicts are often analyzed within the confines of economic thinking, regardless of the nature of the problem.[196] Literature on neoliberal economics suggests that the

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190. *See* Butler, *supra* note 42, at 885.

191. *But see* 11 THOMPSON ON REAL PROPERTY, THOMAS EDITIONS § 93.09 (2019) (describing how, in real property transactions, the parties, often by contract (or by other means, such as insurance, or state law), allocate the risk of loss due to casualty in the executory period differently). *See generally* 14 POWELL ON REAL PROPERTY § 81.03 (Michael A. Wolf ed., 2019) (discussing allocation of risk between buyer and seller in a real estate transaction).

192. *See* Lee Anne Fennell, *Options for Owners and Outlaws*, 1 BRIGHAM-KANNER PROP. RTS. CONF. J. 239, 239–40 (2012); *see, e.g.*, Smith v. McEnany, 48 N.E. 781, 781 (Mass. 1897) (discussing allocation of risk under a lease).

193. Butler, *supra* note 42, at 885–86; *see also* David Kennedy, *Some Caution About Property Rights as a Recipe for Economic Development*, 1 ACCT., ECON., & L. 1, 21–22, 34 (2011) (discussing the complex relationship between private and public ordering).

194. *See* Butler, *supra* note 42, at 886.

195. *See* THOMAS W. MERRILL & HENRY E. SMITH, THE OXFORD INTRODUCTIONS TO U.S. LAW: PROPERTY 2–5 (Oxford Univ. Press ed. 2010) (describing economic analysis of property rights as well as general "bundle of sticks" analysis); Butler, *supra* note 42, at 876–82 (analyzing the coupling of the mainstream economic theory of property and constitutional property).

196. *See* WRIGHT & NYBERG, *supra* note 71, at 187–89 (discussing market-based solutions for climate change); Demsetz, *supra* note 128, at 347–49

modern system of capital is a perpetually functioning machine, operating without integration with other systems (legal or otherwise).[197] Natural systems are treated as part of the capital stock of property owners—as free gifts of nature generally entitling the owners to use nature's resources in promoting their individual economic interests.[198] Property rights, in other words, depend on the "ongoing consumption of the natural world that we depend on for survival."[199] Yet a dollar bill does not have intrinsic value in and of itself but rather is symbolic, conveying information that interacts with other systems—with labor, economic, and natural systems. Instead of considering Earth as the constraining system, property and economic systems view nature as a bundle of valuable assets available to owners to exploit, commodify, and use. No general duty to preserve the integrity of vital biophysical systems is recognized.[200] Though economic analysis is an important method for evaluating options and considering relevant factors, it should not exclude other important values from the decision-making process, ignore constraints imposed by other systems, or assume that other interests can be measured accurately in monetary and economic terms.

The embedded options now shaped by the mainstream economic theory ignore the complex relations often existing in shared resources. Outward-regarding interests are generally promoted only to the extent that they are consistent with economic preferences. Many shared resources and systems are important to the ecological integrity of biophysical systems. The health of the climate system, for example, is critical to the survival of the human species. Like other aspects of the American legal system, however, property law has failed to recognize the importance of imposing legal accountability for knowingly contributing to the degradation of the climate system.[201] Complex relations in shared resources require a more nuanced approach than that provided by the economic theory of

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(discussing the role that economic principles play in the development of property rights).

197. *See* WILLIAM E. CONNOLLY, THE FRAGILITY OF THINGS 7, 11–12, 20–42 (2013) (discussing the impact of neoliberalism on human and biophysical systems).

198. WRIGHT & NYBERG, *supra* note 71, at 186–90.

199. *Id.* at 187.

200. *Id.* at 188–89.

201. Indeed, the Trump Administration continues to deny the energy industry's contributions to climate change. This is particularly apparent in the nomination of Kathleen Hartnett-White, a vocal climate change skeptic, to chair the Council on Environmental Quality. *See* Brady Dennis & Chris Mooney, *Trump Taps Climate Skeptic for Top White House Environmental Post*, WASH. POST (Oct. 13, 2017), https://www.washingtonpost.com/news/energy-environment/wp/2017/10/13/trump-taps-climate-skeptic-for-top-white-house-environmental-post/. As of October 2017, the administration also had sought to reverse more than sixty environmental rules, which could have dangerous effects on climate protection. *See* Popovich et al., *supra* note 36.

property rights. Because of the limitations of the economic approach, changes that can address property's enabling features will need to reach into the incentive structure of property to shape the operation of property rules on a daily basis.

2. Constitutionally Protected Property

Constitutional protection of property under the Takings Clause magnifies the economic incentives of the dominant mainstream approach to property. At its core, takings jurisprudence emphasizes an exclusion-based view of property that centers on the right to exclude and the sovereign-like power to decide how to use the property.[202] This jurisprudence includes two categorical rules for identifying compensable takings that do not require further inquiry into the public interest when the rules are triggered.[203] One applies whenever a government action causes a physical invasion of private property, no matter how small.[204] The second arises when a government action deprives an owner of all economically viable use.[205] These categorical rules allow courts to ignore the public interest that justifies the government action in conducting takings analysis and thus to magnify the focus of the mainstream approach on the owner's economic interests. Left out of the equation is any consideration of important third party or public interests affected by the property owner's decisions.

Property's tradition of encouraging productive use has also strengthened the ties between the economic theory of property and constitutionally protected property.[206] Regulatory takings analysis, in particular, focuses on the economic impact of government acts on the property owners. As Justice Scalia explained in *Lucas v. South Carolina Coastal Council*,[207] the right to conduct an economically viable use is part of the "historical compact" reflected in the Takings Clause.[208] To guard that compact, the majority in *Lucas* adopted a categorical rule finding a compensable taking whenever a government act totally deprives a property owner of economically viable use unless the legal restriction "inhere[s] in the title itself."[209] With a *Lucas* situation, then, the economic interests of the property owner are elevated over public interests and are automatically given constitutional stature. The Court considers that stature to be

202. *See* Lucas v. S.C. Coastal Council, 505 U.S. 1003, 1014–18 (1992).
203. *Id.*
204. *Id.* at 1015.
205. *Id.* at 1015–16.
206. *See* Butler, *supra* note 42, at 881–82 (discussing property's focus on productive use).
207. 505 U.S. 1003 (1992).
208. *See id.* at 1028.
209. *Id.* at 1028–29.

functionally equivalent to a physical taking of property.[210] A public interest as compelling as climate change would not even be considered under the categorical thinking of *Lucas*; the property owner's right to exploit and profit from her bundle of sticks would prevail under the Takings Clause—just as the right to possess is protected from a permanent physical occupation no matter how small.

Coupling the economic interests of property owners with constitutional protection through such a one-dimensional per se rule unnecessarily creates a serious obstacle to addressing climate change. If the economic interests of property owners retain this one-dimensional type of protection, efforts to address the extreme problem of climate change could bankrupt federal, state, and local governments.[211] Providing such protection ignores the history of the Takings Clause. Initially, the only type of compensable taking was a physical appropriation or occupation.[212] Instead of evaluating the economic interests of property owners, early decisions of the Supreme Court asked whether a permanent, physical invasion or occupation had occurred.[213] As physical takings claims involved less permanence, less physicality, and less directness, the Court developed a more nuanced framework for analysis that included the character of the government action, the impact on use value, and the importance of the public interest.[214] The history of constitutionally protected property involved an ongoing struggle between public and private ordering of rights in resources—a struggle about the

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210. This functional equivalence logic comes from Justice Holmes's opinion in *Pennsylvania Coal Co. v. Mahon*, 260 U.S. 393, 413 (1922).

211. *See* U.S. GOV'T ACCOUNTABILITY OFFICE, INFORMATION ON POTENTIAL ECONOMIC EFFECTS COULD HELP GUIDE FEDERAL EFFORTS TO REDUCE FISCAL EXPOSURE 1 (2017).

212. *See* MORTON J. HORWITZ, THE TRANSFORMATION OF AMERICAN LAW, 1780-1860 63–67 (1979) (discussing the history of just compensation for physical takings in the United States); Butler, *supra* note 42, at 883; John F. Hart, *Land Use Law in the Early Republic and the Original Meaning of the Takings Clause*, 94 NW. U. L. REV. 1099, 1099–101 (2000) (concluding that the conventional history of early American land use law is misplaced and wrong); William Michael Treanor, Note, *The Origins and Original Significance of the Just Compensation Clause of the Fifth Amendment*, 94 YALE L.J. 694, 695–98 (1985) (noting that colonial laws and early statehood constitutions did not recognize a right to just compensation). *See* Lynda L. Butler, *The Governance Function of Constitutional Property*, 48 U.C. DAVIS L. REV. 1687, 1689 (2015) (describing the history of constitutional protection of property and the shifts in approaches to physical takings).

213. Butler, *supra* note 212, at 1689.

214. *Id.* at 1722–23; *see* HORWITZ, *supra* note 212, at 66, 71–74, 84–85, 97–99 (discussing the relationship between the gradual acceptance of the compensation principle and the development of takings principles). Noxious use cases provide excellent examples of how important public interests affected the Court's analysis. *See, e.g.*, Hadacheck v. Sebastian, 239 U.S. 394, 410–11 (1915); Mugler v. Kansas, 123 U.S. 623, 662–66 (1887); *see also* Pennsylvania Coal Co. v. Mahon, 260 U.S. 393, 420–21 (1922) (Brandeis, J., dissenting) (discussing the importance of the public interest).

appropriate mix of collective and private interests given current socioeconomic, political, and ecological conditions.[215]

Further, if the coupling of the economic theory of property with constitutionally protected property continues, a federal dimension will be further injected into the common law of property to the point where the operating rules of property will be fundamentally altered on a national level. State law traditionally has defined the basic rules and principles governing property rights.[216] These rules have operated without much fanfare, percolating up from the ground as property conflicts have arisen. By imposing a top-down approach controlled by federal constitutional norms, the Supreme Court will redirect the operation of property principles away from the states to the federal approach, with its more limiting normative path of efficiency. The embedded options of the economic vision will control the definition of property on a national level, leading to greater rigidity in the formal system as the options frame the meaning of state property law.[217] The flexibility of a bottom-up approach and the experimentation by fifty states will be lost, along with property's ability to look beyond efficiency.[218] Property's capacity to evolve and respond to crises in natural and man-made systems thus will be further limited.

The Court, in *Lucas v. South Carolina Coastal Council*, recognized an important exception to its categorical rule for any restrictions that "inhere in the title itself"—in background principles of common law property and nuisance.[219] The fallacy of this exception for background principles is that it ignores real-time background facts, focusing instead on legal principles formed at a certain point in time. Suppose, for example, that years ago Lucas had instead bought a tract of coastal land not located in a subdivision and consisting largely of a beach area and salt marshes. If Lucas were denied a permit to fill the marshlands because of significant adverse effects that would result to neighboring lands from losing the flood protection services of coastal marshes, a claim that Lucas was denied all economically viable use likely would prevail under Scalia's analysis. Since the *Lucas* categorical rule is defined in the context of traditional legal principles, there appears to be no room for considering background facts that should inform application of the legal principles—facts like the nature of the property and the now-understood functions performed by marshlands, including protection of the upland from storm surge, sea level rise, and erosion. Yet

215. Lee Anne Fennell, *Ostrom's Law: Property Rights in the Commons*, 5 INT'L J. COMMONS 9, 16–17 (2011); Kennedy, *supra* note 193, at 21–23.

216. *See* Hart, *supra* note 212, at 1130–31.

217. *See* Butler, *supra* note 42, at 886.

218. For further discussion of the dangers of coupling, see *id.* at 883–90.

219. Lucas v. S.C. Coastal Council, 505 U.S. 1003, 1028–29 (1992).

shouldn't the character of a tract of land be an inherent limitation—or at least a relevant consideration—under a *Lucas* analysis?

The Court's reliance on the common law of nuisance and property as a source of background principles also locks takings analysis in time,[220] and in ways that hinder efforts to address severe collective action problems like climate change. Adherence to the common law doctrines governing gains and losses in coastal lands through accretion and erosion, for example, would mean that coastal landowners will always lose to public rights when the change is gradual and imperceptible as in the case of sea level rise. Under the doctrine of accretion, the boundary between private and public rights moves gradually with the tides.[221] But if the change is sudden—for example, from a storm—the doctrine of avulsion dictates that the boundary remains fixed and allows the property owner to try to identify and recover the lost shore land.[222] The assumption of those common law doctrines is that the gains and losses of gradual change will even out over time.[223] Now that sea levels are rising in most coastal areas, the tidal boundaries will gradually but continuously move landward until they eventually overcome the private landowners' improvements. Though it would make sense to reevaluate the common law doctrines in light of the changing biophysical conditions, Justice Scalia stressed in *Lucas* that the common law principles governing property could not change and evolve through the courts.[224] Yet, if the courts had the ability to revise common law principles when the interests of private property owners were threatened, then surely the courts should have the ability to update common law principles when the exercise of property rights under the current incentive structure threatens the earth's biosphere. A rigid approach would box in the courts in an unproductive way. The founding fathers never envisioned that the earth's climate system would be so detrimentally affected by greenhouse gas emissions.[225] Courts must have an obligation to

220. This is one of Justice Stevens's objections to the majority's approach in *Lucas*. *See Lucas*, 505 U.S. at 1064–67 (Stevens, J. dissenting) ("[B]ecause of the elastic nature of property rights, the Court's new rule will also prove unsound in practice . . . . [T]he Court emphasizes that because total takings are 'relatively rare' its new rule will not adversely affect the government's ability to 'go on' . . . . The Court's suggestion only begs the question of why regulations of *this* particular class should always be found to effect takings.").

221. Byrne, *supra* note 157, at 80.

222. *See* Stop the Beach Renourishment, Inc. v. Fla. Dep't of Envtl. Prot., 560 U.S. 702, 710–11, 730–33 (2010).

223. *See* Byrne, *supra* note 157, at 94.

224. *Lucas*, 505 U.S. at 1031–32 ("It seems unlikely that common-law principles would have prevented the erection of any habitable or productive improvements on petitioner's land. . . . South Carolina must identify background principles of nuisance and property law that prohibit the uses . . . [Lucas] now intends in the circumstances in which the property is presently found.").

225. Farber, *supra* note 41, at 22.

update the common law to reflect new knowledge and understandings.[226]

A top-down approach to constitutional protection of property could seriously thwart the adoption of reforms needed to mitigate and adapt to climate change. The costs of litigation alone could be too high for many local and state governments to respond effectively to the impacts of climate change, much less address the causes through regulation. Consider a coastal locality's options in responding to sea level rise, recurrent flooding, and rising storm surge. If major flooding occurs only occasionally, the locality could choose to ban seawalls and other hardened structures, opting instead to encourage use of living shorelines to protect coastal lands. Hardened structures tend to speed up wave action and worsen the erosion of neighboring shores not similarly protected.[227] Living shorelines trap sand and blunt the force of the tides, slowing erosion and sometimes even extending the shore areas.[228] As the flooding becomes more frequent and the risk of harm increases, the locality could move to a managed retreat policy allowing waterfront landowners to remain until flooding becomes so chronic and serious that it adversely affects property values and public safety. When that point is reached, the locality might then adopt a forced retreat policy, banning current uses as well as new development. The locality could also decide to manage coastal lands through its land development process, imposing conditions on the type, location, and manner of development.

Each of these scenarios could lead to constitutional challenges brought by affected property owners, raising the costs of government action even if a challenge is unsuccessful. A ban on hardened structures is likely to be challenged as a partial economic taking,[229] while a ban on development or a forced retreat raises the prospect of a total economic loss claim under *Lucas*.[230] To determine whether the loss was partial or total, courts would need to define the denominator for measuring the extent of the economic loss.[231] After *Murr v. Wisconsin*[232] though, lower courts are not likely to define the

226. Kysar, *supra* note 3, at 62 ("Law lags science, it does not lead it." (quoting Rosen v. Ciba-Geigy Corp., 78 F.3d 316, 319 (7th Cir. 1996) (Posner, C.J.))); *see also* DePass v. United States, 721 F.2d 203, 209 (7th Cir. 1983) (Posner, J., dissenting) ("[J]udges must not let themselves lag too far behind the progress of knowledge.").

227. *See* LIVING SHORELINES: THE SCIENCE AND MANAGEMENT OF NATURE-BASED COASTAL PROTECTION 3–11 (Donna Marie Bilkovic et al. eds., 2017).

228. *See id.* at 211–30; *see generally Living Shorelines*, VA. INST. MARINE SCI., http://www.vims.edu/ccrm/outreach/living_shorelines/index.php (last visited Mar. 28, 2020) (providing information about living shorelines).

229. *See, e.g.*, Shell Island Homeowners Ass'n v. Tomlinson, 517 S.E.2d 406, 415 (N.C. Ct. App. 1999) (alleging a significant reduction in value).

230. *See, e.g.*, Gove v. Zoning Bd. Appeals, 831 N.E.2d 865, 871–75 (Mass. 2005) (rejecting the claim of a total loss of economically viable use under *Lucas*).

231. *See* Lucas v. S.C. Coastal Council, 505 U.S. 1003, 1054 (1992).

232. 137 S. Ct. 1933 (2017).

denominator as the regulated portion of the property, as opposed to the property as a whole.[233] For the most part, courts have rejected regulatory taking challenges to government actions addressing sea level rise and flooding, rationalizing that natural processes—not man-made actions—caused the owner's losses.[234] The imposition of conditions on development through the regulatory process may present more difficult and complex issues, requiring a takings nexus review. Any condition might then need to bear an essential nexus to a legitimate public interest and be roughly proportional to the projected impact of the proposed development.[235]

If the coupling of constitutionally protected property and the economic theory of property continues to grow, it will be difficult for property law to adapt on the ground through a state's common law system. The United States Constitution might prevent the change without payment of just compensation, yet compensating for all the government actions needed to slow down and reverse climate change would likely be too costly for governments to handle. Despite its inherent ability to evolve formally and informally, then, property would have lost its adaptive advantage.[236]

C. Overcoming the Barriers Through the Lens of Climate Change

Any justification for changing property to enable it to address public interests should be compelling—so compelling that reasonable property owners would, if they understood the science and the evidence, accept the reorientation of the property system without feeling outraged.[237] Property rights are fundamentally important to the liberty interests of individuals and to the operation of economic systems. It ought to be possible, however, to shape those rights in ways that are supportive of the earth system, not destructive to the point of collapse. Climate change provides such a justification, revealing that the everyday exercise of property rights under the current, economic-based approach is based on false assumptions that lead to systemic harm to the entire biosphere. When the harm is system-wide and approaching a tipping point of no return, societies must treat the harm as an *existential threat* different than localized harms and risks.

The current property system, for example, promotes the maximization of individual welfare and assumes that such

233. *Id.* at 1945.

234. *See, e.g.*, *Shell Island*, 517 S.E.2d at 414–15.

235. Dolan v. City of Tigard, 512 U.S. 374, 386, 391 (1994).

236. Kysar, *supra* note 3, at 48 (describing tort law as having an "adaptive disadvantage" in dealing with climate change claims).

237. .*See generally* Frank I. Michelman, *Property, Utility, and Fairness: Comments on the Ethical Foundations of "Just Compensation" Law*, 80 HARV. L. REV. 1165 (1967) (introducing the concept of outrage or demoralization costs into takings analysis).

maximization is good for society as a whole. Climate change demonstrates that this leap of faith is not valid. Property systems can no longer safely operate on the assumption that net social welfare will be produced by the individual decisions of property owners, rational or not. The legal system cannot afford to allow the systemic harm from the exercise of property rights to continue unabated, not when the harm poses a grave threat to the ability of future generations to survive.[238] Further, even if serious collective action and political problems were not preventing the adoption of effective national and global solutions, changes to property would still be required to correct the daily operation of the property system and thus reshape the formation of investment-backed expectations.

Now that climate scientists active in the field overwhelmingly agree on the role of humans in causing climate change,[239] policymakers need to treat the systemic harm resulting from the exercise of property rights differently than localized harms and risks. Harm to the earth system within which the property system operates provides a compelling justification for reevaluating and, when necessary, adjusting property's norms and values. Addressing the limitations of the dominant approach will help to realign the property system within its macro system and move property along a path of sustainability. Otherwise, constitutional challenges brought by property owners will continue to thwart much-needed government efforts to address the causes and the impacts of climate change. Until the property system is resituated within the larger whole in ways that account for the integrity of the whole, the investment-backed expectations of property owners will continue to reflect the economic-based approach that has become coupled with constitutionally protected property.

The lens of climate change helps to focus attention on a critical next question: How do the norms and values of a property system promoting neoliberal capitalism differ from those of a property system tempered by the sustainability and integrity of the whole? Answers to this question will help identify a path forward.

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238. *See* Juliana v. United States, 217 F. Supp. 3d 1224, 1233–34 (D. Or. 2016) (allowing plaintiffs' claims that the government's knowing endangerment of the climate system by approving and encouraging fossil fuel development violated the plaintiffs' fundamental right to life and liberty under the substantive Due Process Clause, as well as plaintiffs' public trust rights, because of the profound damage done to the planet and the future loss of natural resources essential to life), *motion to certify appeal denied*, No. 6:15–cv–01517–TC, 2017 WL 2483705 (D. Or. June 8, 2017). On January 17, 2020, a Ninth Circuit panel reversed the district court's decision by a vote of 2 to 1, remanding with instructions to dismiss due to lack of standing because the plaintiffs' injuries were not redressable. Juliana v. United States, 947 F.3d 1159, 1170–75 (9th Cir. 2020).

239. *See* Naomi Oreskes, *The Scientific Consensus on Climate Change*, 306 SCI. 1686, 1686 (2004).

IV. REWIRING PROPERTY

In contrast to the goals of the current economic theory of property, a sustainability based approach would take a holistic, systems view, nesting the institution of property within the whole and recognizing property's dependence on the whole. Systems integrity, resilience, and interconnectedness all would be important features of a systems approach. Systems integrity requires a focus on the interaction of the parts and on patterns of organization, not just on each part in isolation.[240] A system is resilient when it has the ability to return to a particular equilibrium state after a disturbance or can absorb the disturbance without being significantly redefined.[241] Features that promote resilience include the flexibility to adapt, sufficient diversity of functions and features to enable the system to recover from a disturbance, and enough redundancy to cover for loss or damage to functions and resources.[242] The goals of a sustainable property system thus would include ensuring that the property system is resilient enough to absorb change, whether anticipated or unforeseen, and allocating and managing property rights in ways that promote the integrity of the whole.

Because a system reflects the processes of interaction and patterns of relationships among the parts, the system will always have properties not reflected in the parts.[243] "[T]he qualities of a complex system refer to the properties of the system that none of its parts exhibit" and include health, stress, and systems integrity.[244] They arise from interactions among the parts and thus are not equal to the sum of the parts.[245] Properties of the parts include their mass and energy.[246] When measured quantitatively, the sum of one of these properties of the parts expresses the corresponding property of the whole,[247] but these sums do not measure qualities about the system's complexity, networks, or integrity. Management strategies used for properties of a particular part thus cannot adequately respond to the needs or qualities of the whole.

Justice Brandeis once said, in his dissenting opinion in *Pennsylvania Coal Co. v. Mahon*,[248] that "the sum of the rights in the

240. Butler, *supra* note 42, at 893.

241. *Id.* at 891–92; *see* Lance Gunderson, *Resilience, Flexibility and Adaptive Management – Antidotes for Spurious Certitude?*, ECOLOGY & SOC'Y (June 30, 1999), https://www.ecologyandsociety.org/vol3/iss1/art7/.

242. Butler, *supra* note 42, at 893. *See generally* BRIAN WALKER & DAVID SALT, RESILIENCE THINKING: SUSTAINING ECOSYSTEMS AND PEOPLE IN A CHANGING WORLD (2006) (discussing the important role that resilience plays in environmental management).

243. CAPRA & LUISI, *supra* note 76, at 63–66.

244. *Id.* at 368.

245. *Id.*

246. *Id.*

247. *Id.* at 368–69.

248. 260 U.S. 393 (1922).

parts cannot be greater than the rights in the whole."[249] As an example, he explained how a landowner who had sold his air rights 100 feet or more above the surface could not prevent the state from regulating the height of buildings.[250] To this must be added the necessary implication of the systems view—that the whole is greater than the sum of the parts. In the parlance of Justice Holmes, the difference between the whole and its parts is a difference in kind and not a "question of degree."[251] Under a systems view, then, the disaggregation of property should never threaten the integrity of the whole by undermining its resilience and ability to adapt.

The institution of property has become a self-organizing and self-regulating system in the sense that its internal rules and processes shape the operation of property.[252] These internal rules and processes guide property rights by driving or limiting interactions between right holders and third parties over resources. The interactions are influenced by norms and options embedded in the decision-making paths hidden within the structure of property. The marketplace provides the main network of communication for economic preferences, responding to inefficiencies of collective ownership through the emergence of private rights.[253] The courts act as the main communicator of legal rights and responsibilities. Through the marketplace and the courts, property acts as the primary institution for integrating power over resources into daily life. Because of how property operates, communicates, and self-regulates, property has the ability and the power to evolve as conditions change, correct as new information and knowledge reveal erroneous assumptions, and assimilate new behavioral rules as informal practices signal external threats to the system or the whole.

This power to self-regulate should not be underestimated. The management function of property[254] can be broadened to include a sustainability dimension defined from the perspective of the realization that the institution of property is nested within the earth system. In contrast to tort law, which has been described as having "a distinctly private law history,"[255] property law has a history that involves both public and private law.[256] Some of the public and semi-public arrangements recognized in property law include common

249. *Id.* at 419 (Brandeis, J., dissenting).
250. *Id.*
251. *Id.* at 416.
252. Butler, *supra* note 49, at 1242.
253. *See supra* note 103 and accompanying text.
254. For a discussion of the management role of property, see Butler, *supra* note 49, at 1223–39.
255. Kysar, *supra* note 40, at 1.
256. Ugo Mattei, *Codifying Property Law in the Process of Transition: Some Suggestions from Comparative Law and Economics*, 19 HASTINGS INT'L & COMP. L. REV. 117, 131 (1995).

lands, public trust property, and semi-commons.[257] Property law even has a category described by the courts in the 1800s as property affected or "clothed with a public interest."[258]

Incorporating a sustainability dimension into property will require a more prominent role for the governance strategy of managing property rights.[259] Under the governance strategy, the courts are more active in considering and weighing the public and third-party interests impacted by a property dispute.[260] The governance approach could take into account the interconnectedness of private rights, collective interests, and the external world,[261] and thus could consider outward-regarding interests related to the whole and not just to the part. An exclusion-based strategy, in contrast, focuses primarily on the interests of the private property owner, protecting the decision-making powers and in rem rights of the individual owner.[262] The exclusionary strategy limits consideration of third-party interests to those directly related to the property owner's use or rights and encourages property owners to maximize individual welfare.[263]

The common law decision-making model has the flexibility to adapt to changing conditions. Its incremental approach allows adaptation to occur more easily than a comprehensive approach requiring a functioning legislative branch and could more specifically target false or obsolete assumptions underlying a property rule.[264] The common law also is evolving differently in fifty states—in ways that depend on the circumstances, conditions, customs, and informal practices of a particular jurisdiction. As long as the Supreme Court does not preempt the ability of states to experiment with their property systems through the Court's interpretation of constitutionally protected property, the elasticity of the property concept should allow the development of alternative paths of decision-making that make the adjustments needed to promote the

257. *See, e.g.*, David Benavides & Ryan Golten, *Righting the Record: A Response to the GAO's 2004 Report Treaty of Guadalupe Hidalgo: Findings and Possible Options Regarding Longstanding Community Land Grant Claims in New Mexico*, 48 NAT. RESOURCES J. 857, 871–72 (2008); Karl S. Coplan, *Public Trust Limits on Greenhouse Gas Trading Schemes: A Sustainable Middle Ground*, 35 COLUM. J. ENVTL. L. 287, 305–12 (2010); Lydia Pallas Loren, *Building a Reliable Semicommons of Creative Works: Enforcement of Creative Commons Licenses and Limited Abandonment of Copyright*, 14 GEO. MASON L. REV. 271, 274–75 (2007).

258. *See, e.g.*, Munn v. Illinois, 94 U.S. 113, 126 (1876).

259. For a discussion of the governance strategy, see Butler, *supra* note 49, at 1245–50.

260. *Id.* at 1245.

261. *Id.* at 1222.

262. *Id.* at 1223.

263. *Id.* at 1223–26, 1233.

264. For a discussion of some of those assumptions, see *supra* notes 59–85 and accompanying text.

sustainability of the whole.[265] Just as markets allow transactions to reflect changing preferences, the legal system also should allow property to respond to changing biophysical conditions.

Because of its incremental nature, though, common law property obviously would not be able to accomplish the time-sensitive and whole-scale change needed to address climate change. An ad hoc approach would not be quick enough or bold enough to slow down, much less solve the problem. But even if legislation were enacted, it would be difficult, ex ante, to reach the underlying incentives, values, and structure of property that shape the meaning and operation of property on a daily basis. Without change to the incentive structure of property, external legal solutions or plans will be met with stiff resistance in the courts.[266] The extensive nature of greenhouse gas emissions and of the land use activities that contribute to the emissions means that this resistance would be widespread.[267] Because of the embedded options and behavioral rules hidden in property's infrastructure, evolution of common law property thus is a necessary ingredient of any effort to address climate change.

When would an enhanced governance strategy apply? A critical first step is to identify those resource situations that need a broader approach because the property system cannot handle a serious disturbance without threatening the integrity of the whole.[268] Resource situations needing an outward-regarding, governance management strategy may arise because of the ineffectiveness of the exclusionary approach in managing the resource given the nature of the resource (such as when a resource is intangible, lacking physical boundedness) or because of the large number of users sharing the resource under a mix of property arrangements. The exclusionary strategy loses its effectiveness as resources become more complex and intangible (like the climate system) or as resource situations involve multiple stakeholders and social networks, especially when increasing returns to scale result from adding more users.[269] Navigable waters, for example, are subject to important private and public rights, including the rights of private waterfront landowners, the public navigational servitude, and the government's jurisdictional interests.[270] An exclusionary approach would tend to ignore or discount the interests of third parties and the public, much like what is now occurring in some western states in a battle over control of

265. *See supra* notes 117–25, 202–36 and accompanying text (discussing the coupling of the economic vision of property and constitutionally protected property).

266. Butler, *supra* note 49, at 1263–64.

267. *See id.*

268. Butler, *supra* note 42, at 893–94.

269. *See* Rose, *supra* note 186.

270. *Id.* at 753–58.

public waters.[271] An outward-regarding, governance approach also could be more effective in dealing with long-term or diffused harms from property use and with new resources or uses made possible by technological advances.[272] More deliberation is needed to allocate interests, manage uses, and resolve conflicts when a resource situation involves present and future generations, private and public interests, new technology, and serious, diffused or cumulative harm.

How must the incentive structure of property change to address property's problem with extremes—here, with the problem of climate change? The changes must correct outdated, inaccurate, or false assumptions that are part of property's structure and contribute to climate change. It is important to recognize that changes addressing the systemic harms resulting from property's operation are correcting rather than redefining property—vitally important because the survival of human societies depends on it. If everyone agreed that our survival depended on changing these assumptions, would property owners be reasonable in expecting compensation for all the changes adversely affecting their economic interests or in challenging the legitimacy of every change that surely would limit their property rights? It is also important for the property system to replace the assumption that net social welfare is promoted by the owner's maximization of individual welfare with a guiding principle of constrained maximization. The maximization of individual welfare would be constrained by considerations of the integrity of the whole built into property's decision-making process to keep the impacts of the owner's decisions within a safe range. A systems view, with all of its corollaries, would become a guiding constraint on the operation of the property system. Qualities of the whole would not just be relevant but central to property's management strategies for resource situations involving significant system-wide harm. We must recognize that changes adopted to protect the integrity of the whole—whether from collapse because of climate change or some other extreme harm—are not about emotions but rather about responding to signs of the imminent collapse of a world that can support human life. Though an intensity of conviction may underlie the responses, it is a conviction that arises from a deep understanding of how the earth system works and about the fragility of that system.[273]

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271. *See* Cassidy Randall, *Who Owns Water? The US Landowners Putting Barbed Wire Across Rivers*, GUARDIAN (Mar. 15, 2018, 6:00 AM), https://www.theguardian.com/environment/2018/mar/15/privatized-rivers-us-public-lands-waterways.

272. *See* Butler, *supra* note 49, at 1244.

273. *See generally* CONNOLLY, *supra* note 197 (discussing the interaction of neoliberalism and self-organizing systems).