INDOOR ENVIRONMENTAL LAW

BY

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Where is the environment in environmental law? People often assume that "the environment" exists only outdoors. Although seemingly benign, this assumption can affect when, how, and how effectively environmental law and policy address indoor and outdoor environmental quality. This piece identifies, explores, and interrogates the assumption of "outdoorsiness" that underlies environmental law and policy, and considers the source, sense, and implications of creating sharp legal and regulatory discontinuity between indoors and out. It concludes that excluding indoor environments from the bailiwick of environmental law is a mistake, influenced by subconscious psychological phenomena that obscure indoor hazard and by romantic but inaccurate accounts of humans as separate from nature. Expanding understanding of the human environment to encompass indoor and outdoor spaces can align legal treatment of the environment with the reality of the human habitat, while providing opportunities to more clearly, comprehensively, and effectively achieve environmental goals.

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I. INTRODUCTION

If you close your eyes and imagine "the environment," what do you see? If you are like most people in environmental law and policy, it is something like what you will find if you Google Image search the same term: a clear river rushing by tall green trees; an expanse of sun-drenched land (whether verdant or blighted); a seedling sprouting from soil. If you open your eyes and look at your surroundings, however, what do you see? If you are like most readers, it is a desk and some bookshelves, the airplane seat of the person in front of you, or the other half of the couch. The difference points to a subconscious disconnect: we imagine the environment outdoors, but we live most of our lives in the environment indoors.

Few people acknowledge just how much time humans spend indoors over the course of their lives. In one recent study of 16,000 North Americans and Europeans, people reported spending an average of only 15.8 hours a day, or 66% of their time, indoors.[1] But in fact, the average worker on an average working day spends just fifteen minutes outdoors.[2] The rest of the time—23.75 hours a day, or 99% of their working days—is spent indoors. Of course some people spend more time outdoors—but even accounting for outdoor jobs, weekend recreation, and the existence of avid joggers, observational evidence suggests that North Americans and Europeans actually spend an average of twenty-two hours a day, or 92% of their lives, inside.[3] And these estimates of "indoor time" are, if

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[1] *See* YOUGOV, THE INDOOR GENERATION: THE EFFECTS OF MODERN LIVING ON HEALTH, WELLBEING AND PRODUCTIVITY 5 (2018), http://www.casaportale.com/public/uploads/Indoor%20generation.pdf (reporting the results of a survey of 16,000 interviews with members of the general public in fourteen countries—Austria, Belgium, Canada, the Czech Republic, Denmark, Great Britain, France, Germany, Italy, Netherlands, Slovakia, Switzerland, Spain, and the United States).

[2] *Id.* at 4.

[3] *See* Neil E. Klepeis et al., *The National Human Activity Pattern Survey (NHAPS): A Resource for Assessing Exposure to Environmental Pollutants*, 11 J. EXPOSURE SCI. & ENV'T

anything, low; in the face of a more extreme outdoor climate, human time spent indoors is poised to increase still further.[4]

This research shows that, despite the outsized perception many people have of the time they spend outdoors, most people spend most of their lives surrounded by indoor physical structures, experiencing indoor environmental conditions. In this sense, the human habitat is now primarily indoors.[5] Billions of nonhumans, meanwhile, also live their lives largely or entirely inside.[6] In that context, it should be striking that environmental law and policy remains predominantly focused on the environment outdoors. This focus weaves itself into the background tapestry of the presumed competence and authority of environmental agencies and authorities, the presumed scope of environmental statutes, and the topics selected to present at environmental conferences and in environmental law courses. In reflection of this, environmental laws and environmental authority are commonly presumed to extend only to the edges of the outdoors.

The impacts of this presumption can be extraordinary. Consider, on this front, the treatment of indoor air pollution—a grave risk vector that the World Health Organization estimates is responsible for 3.2 million deaths per year[7]—by the foremost federal environmental authority in the United States, the Environmental Protection Agency (EPA). The Clean

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EPIDEMIOLOGY 231, 232–33 (2001) (summarizing this literature); *see also* THE USE OF TIME: DAILY ACTIVITIES OF URBAN AND SUBURBAN POPULATIONS IN TWELVE COUNTRIES 114 (Alexander Szalai ed., 1972) (tabulating activity data on participants in Belgium, Bulgaria, Czechoslovakia, France, East Germany, West Germany, Hungary, Peru, Poland, the Union of Soviet Socialist Republics, the United States, and Yugoslavia). Note that these studies significantly predate the COVID-19 pandemic and modern work-from-home culture, which presumably affect not only which indoor environments people spend their time in, but also the portion of time spent traveling (including outside) from home to work.

[4] *See* INST. OF MED., CLIMATE CHANGE, THE INDOOR ENVIRONMENT, AND HEALTH 241 (2011) (concluding that climate change can be expected to affect the indoor environment, worsening existing indoor environmental problems and introducing new problems from new sources); *see also* Neal Fann et al., *Air Quality Impacts*, *in* U.S. GLOB. CHANGE RSCH. PROGRAM, THE IMPACTS OF CLIMATE CHANGE ON HUMAN HEALTH IN THE UNITED STATES: A SCIENTIFIC ASSESSMENT 79–81 (2016), https://perma.cc/R5YZ-NSUF (flagging climate impacts on indoor air quality as an emerging issue).

[5] *See* JOSEPH A. VEECH, HABITAT ECOLOGY AND ANALYSIS 5 (2021) (defining the modern ecological concept of a "habitat" as the physical structure of the place where a species exists as well as the resources provided at the location); *see also Habitat*, MERRIAM-WEBSTER DICTIONARY (2024 ed.) (defining "habitat" as "the place or environment where a plant or animal naturally or normally lives and grows" or, alternatively, "the place where something is commonly found").

[6] *See* discussion *infra* Part II. The Indoors is Part of the Environment.

[7] The World Health Organization estimates that indoor (household) air pollution was responsible for 3.2 million deaths per year in 2020, while outdoor air pollution was responsible for 3.5 million deaths. *See Household Air Pollution*, WORLD HEALTH ORG. (Dec. 15, 2023), https://perma.cc/FUY9-9UXT.

Air Act (CAA)[8] empowers EPA to regulate "air" pollution.[9] Air, of course, exists both outside and inside buildings, and the statute itself does not explicitly mention or otherwise restrict itself to outdoor air. Yet EPA has long assumed that its legal authority over air pollution extends only to outdoor spaces[10]—with the result that the Agency understands themselves to regulate air quality outside, but not inside, an open window.[11]

As a result, and despite Congress having expressly delegated authority on "air" quality to EPA via the CAA, no coordinated authority over indoor air quality exists in the United States.[12] Instead, an overlapping and underlapping patchwork of authorities,[13] including over

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8 42 U.S.C. §§ 7401–7671q (2018).

9 *See id*. The Clean Air Act does not define "air." *See generally id.* § 7602. Several important parts of the Act apply only to "ambient" air. *See, e.g.*, *id.* § 7409 (requiring the setting of National Ambient Air Quality Standards); *id.* § 7602(g) (defining an "air pollutant" as "any air pollution agent or combination of such agents, including any physical, chemical, biological, radioactive . . . substance or matter which is emitted into or otherwise enters the ambient air"). "Ambient" is also not defined in the statute. *See generally id.* § 7602.

10 Although the Clean Air Act is silent as to the location of "air," it defines air pollution by reference to "ambient" air. *See* 42 U.S.C. § 7602(g) (defining an "air pollutant" as "any air pollution agent or combination of such agents, including any physical, chemical, biological, radioactive . . . substance or matter which is emitted into or otherwise enters the ambient air"). EPA has interpreted the ambiguous term "ambient" to mean "that portion of the atmosphere, external to buildings, to which the general public has access," rather than according to its more usual plain meaning, which would be "surrounding" or "existing on all sides." *See* 40 C.F.R. § 49.123 (2023); *cf. Ambient*, MERRIAM-WEBSTER, https://perma.cc/D7QH-Z97E (last visited Feb. 5, 2024) (defining "ambient" as "existing or present on all sides: encompassing"). This interpretation limits EPA's authority under the Clean Air Act to address outdoor air pollution.

11 See Arden Rowell & Kenworthey Bilz, THE PSYCHOLOGY OF ENVIRONMENTAL LAW 173-4 (2021) (identifying psychological influences that may contribute to EPA's neglect of indoor air) [hereinafter THE PSYCHOLOGY OF ENVIRONMENTAL LAW].

12 For an aging but still highly relevant analysis of the uncoordinated U.S. approach to indoor air pollution, see generally Arnold W. Reitze Jr. & Sheryl-Lynn Carof, *The Legal Control of Indoor Air Pollution*, 25 B.C. ENV'T AFFS. L. REV. 247 (1998).

13 *See generally* Laurence S. Kirsch & D. Bruce Myers Jr., *Indoor Air Quality*, *in* ENV'T L. PRAC. GUIDE (MB) § 17A.syn (Michael B. Gerrard ed., 2024) (noting that "[t]o the extent there is regulation of indoor air quality, that regulation tends to be in a piecemeal fashion by legal and non-legal mechanisms").

twenty federal agencies,[14] state governments, and municipalities[15] manage indoor air quality through the issuance of building codes or property disclosure requirements;[16] the application of other areas of law, such as products liability or torts;[17] voluntary and consensus standards;[18]

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[14] The Federal Interagency Committee on Indoor Air Quality, established by Congress in 1983, attempts to coordinate federal action on indoor air quality among the bewildering assortment of federal agencies, state governments, local governments, and private and public actors involved in managing indoor air quality. *Federal Interagency Committee on Indoor Air Quality*, U.S. ENV'T PROT. AGENCY, https://perma.cc/LE2W-HDV3 (Dec. 11, 2023). In a structural choice that emphasizes the extreme fragmentation of legal authority in this realm, the Committee is simultaneously "co-chaired" by five agencies: the Consumer Product Safety Commission (CPSC), the Department of Energy (DOE), the Environmental Protection Agency (EPA), the National Institute for Occupational Safety and Health (NIOSH), and the Occupational Safety and Health Administration (OSHA). *Id.* (listing 24 federal agencies with various responsibilities regarding indoor air quality). In light of the lack of centralized federal authority, each of these agencies has indeed addressed some scattered facet of indoor air quality. *See, e.g.*, *Building America: Smarter Indoor Air Quality Solutions*, U.S. DEP'T OF ENERGY, https://perma.cc/DJ4Y-Q6FF (last visited Feb. 5, 2024) (noting that that "tightness with improved source control, dilution, and high efficiency filtration can have little or no energy penalty," and addressing smarter indoor air quality solutions). The CPSC, for example, recently issued a request for information on the health hazards of gas stove emissions. COMMISSIONER RICH TRUMKA JR., U.S. CONSUMER PROD. SAFETY COMM'N, CSPC APPROVES REQUEST FOR INFORMATION ON GAS STOVE HAZARDS AND POTENTIAL SOLUTIONS 1 (Mar. 1, 2023), https://perma.cc/CVV7-4JVH. OSHA regulates indoor air quality in many workplaces (albeit not in any where employees fail to meet the common law standard of "workers" as opposed to independent contractors). *Indoor Air Quality*, U.S. DEP'T OF LAB., https://perma.cc/52E5-4DFF (last visited Feb. 5, 2024). Meanwhile, in addition to running its advisory "Indoor Air Quality" program, EPA regulates a few specific pollutants with indoor impacts, including asbestos under the Asbestos Hazard Emergency Response Act, 15 U.S.C. §§ 2641–2656 (2018), and several pesticides commonly used inside, such as chlordane (a termiticide) and mercury (a mildewcide), under The Federal Insecticide, Fungicide, and Rodenticide Act, 7 U.S.C. §§ 136–136y (2018) (requiring all pesticides to be registered by EPA).

[15] *See* Kirsch & Myers, *supra* note 13, § 17A.05 (providing an overview of state indoor air legislation, and noting significant variability across states, as well as noting several states—including New Jersey, Maine, New Hampshire, and California—that have promulgated broad indoor air quality regulations).

[16] *See id.* (discussing state approaches to indoor radon contamination using mandated disclosure rules with the sale or rental of real property).

[17] *Id.* § 17A.08 (describing causes of action in common law for indoor air pollution); *see also id.* § 17A.11 (noting that "[r]eliance on common law remedies as a means of reducing exposure to indoor air pollution is unsatisfactory for everyone").

[18] In the absence of centralized regulatory standards, a number of professional organizations, trade associations, and interest groups have set a variety of voluntary standards for indoor air quality. These include the standards set by the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) and guidelines issued by the American Conference of Governmental Industrial Hygienists (ACGIH), as well as the Building Officials and Code Administrators, Inc. (BOCA) standards for ventilation and the Southern Building Code Congress International, Inc. (SBCCI) building, fire, and mechanical codes. *See* Kirsch & Myers, *supra* note 13, § 17A.06 (discussing various voluntary standards). The Green Building Certification Institute's Leadership in Energy and Environmental Design (LEED) certification also provides a rating system for "green" buildings, which includes credits towards certification for several indicators of indoor environmental quality,

and to the attention, understanding, and preferences of individuals, who may review voluntary guidance created by EPA and other agencies.[19] Given the many challenges individuals face in recognizing, assessing, and valuing environmental risks[20]—especially those within their own homes[21]—perhaps it should be no surprise that this uncoordinated approach has left indoor air highly polluted, with indoor concentrations of pollutants often two to five times higher than typical outdoor concentrations.[22] Meanwhile, common sources of indoor air pollution—such as cooking on gas stoves, which can create indoor concentrations of pollution that exceed the EPA's National Ambient Air Quality Standards (NAAQS) in just a few minutes of use[23]—remain largely unregulated.

The claim here is not, to be clear, that no one ever thinks about indoor air quality. In the wake of the COVID pandemic, the problem of indoor air quality has received increased attention from businesses, governments, the medical community, and the public.[24] Yet most discussions of indoor air quality still proceed without the contributions or engagement of environmental law and policy scholars and practitioners. Instead, even post-pandemic, research on indoor air—as opposed to outdoor air—remains the disciplinary exception rather than the rule.[25]

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including indoor air quality, the level of volatile organic compounds (VOCs), lighting, thermal comfort, and views. *See* BRENDAN OWENS ET AL., LEED V4 IMPACT CATEGORY AND POINT ALLOCATION DEVELOPMENT PROCESS (2013), https://perma.cc/S86X-6HXR.

19 *See, e.g.*, *Indoor Air Quality: Interactive Tour of the Indoor Air Quality Demo House*, U.S. ENV'T PROT. AGENCY, https://perma.cc/AM2N-UMT4 (last visited Feb. 6, 2024) (providing a clickable visual resource for individuals to learn about ways they can control indoor air quality in "their" homes).

20 *See generally* THE PSYCHOLOGY OF ENVIRONMENTAL LAW 9, 63 (summarizing psychological research suggesting that people struggle to perceive, understand, and value the environmental impacts of their actions).

21 For reasons to be concerned about relying upon individuals to manage risks presented by indoor environmental hazards, see discussion *infra* Section IV.B1.

22 *See The Inside Story: A Guide to Indoor Air Quality*, U.S. ENV'T PROT. AGENCY, https://perma.cc/E46P-QFZL (last visited Feb. 6, 2024) [hereinafter *A Guide to Indoor Air Quality*] (suggesting that indoor levels of air pollution are often two to five times higher, and occasionally more than 100 times higher, than outdoor pollution levels); *see also* MARA BAUM, U.S. GREEN BLDG. COUNCIL, GREEN BUILDING RESEARCH FUNDING: AN ASSESSMENT OF CURRENT ACTIVITY IN THE UNITED STATES 1 (2006) (same).

23 *See* Eric D. Lebel et al., *Methane and NOx Emissions from Natural Gas Stoves, Cooktops, and Ovens in Residential Homes*, 15 ENV'T SCI. TECH. 2529, 2529–30, 34 (2022) (finding that emissions of nitrogen dioxide from some gas burners and ovens exceeded outdoor NAAQS within a few minutes of use). *Cf. Primary National Ambient Air Quality Standards (NAAQS) for Nitrogen Dioxide*, U.S. ENV'T PROT. AGENCY, https://perma.cc/J88G-L9Z3 (last visited Feb. 6, 2024) (summarizing rule setting outdoor NAAQS for nitrogen dioxide at 100 ppb).

24 *See Post-Pandemic, an Increasing Focus on Indoor Air Quality*, HARV. T.H. CHAN SCH. OF PUB. HEALTH (Nov. 8, 2023), https://perma.cc/2LBP-BRAL.

25 For some recent exceptions, see, for example, Anthony Moffa, *Environmental Indifference*, 45 HARV. ENV'T L. REV. 333, 334, 336 (2021) (addressing the regulation of indoor radon gas, especially in regard to prison exposures); Kirin Goff & Anitha Ramadoss, *Smoke-Free Apartment Laws and Indoor Air Quality in U.S. Jurisdictions*, 32 S. CAL. INTERDISC. L.J.

Most environmental law courses lack any discussion of indoor air, and many of even the best environmental conferences include few if any projects addressing indoor air quality.[26]

Air pollution thus illustrates the sharp divergence between treatment of outdoor and indoor pollution. Yet air pollution is by no means the only context in which the presumption of "outdoorsiness" has shaped—and restrained—environmental law and policy. Another important application of the presumption regards laws guaranteeing environmental rights.[27] Such rights now exist in most constitutions around the world,[28] and some have argued that a right to a clean and healthy environment should be understood as a human right.[29] Many assume that these provisions apply to outdoor environmental quality, but there has not yet been any significant discussion of whether and which laws (also) guarantee rights regarding indoor environmental quality. This exclusive focus on (outdoor) environmental rights makes sense only insofar as the environment exists (only) outdoors. A conception of the environment that includes indoor spaces would beg the question

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567, 568–69 (2023) (addressing regulation of indoor air quality in U.S. jurisdictions); Heather Payne & Jennifer D. Oliva, *Warrantying Health Equity*, 70 UCLA L. REV. 1030, 1037–39 (2023) (exploring the possibility of regulating indoor air quality in some indoor spaces via traditional property law doctrines, especially the warranty of habitability).

[26] As of time of writing, for example, the most-used environmental law and policy textbook—ROBERT V. PERCIVAL ET AL., ENVIRONMENTAL REGULATION: LAW, SCIENCE & POLICY (9th ed. 2021)—devotes 130 pages to (outdoor) air pollution, *id.* at 447–576, and includes only a single mention of indoor air pollution, *id.* at 1168. More generally, the neglect of the indoors within environmental law and policy is so complete that whole books—including this author's own!—have been written summarizing the field without mentioning the indoors at all. *See, e.g.*, ARDEN ROWELL & JOSEPHINE VAN ZEBEN, A GUIDE TO U.S. ENVIRONMENTAL LAW (2021) (summarizing U.S. environmental law and policy without mentioning indoor environments) [hereinafter A GUIDE TO U.S. ENVIRONMENTAL LAW]; JOSEPHINE VAN ZEBEN & ARDEN ROWELL, A GUIDE TO EU ENVIRONMENTAL LAW (summarizing European environmental law and policy without mentioning indoor environments) [hereinafter A GUIDE TO EU ENVIRONMENTAL LAW].

[27] *See* DAVID R. BOYD, DAVID SUZUKI FOUND., THE STATUS OF CONSTITUTIONAL PROTECTION FOR THE ENVIRONMENT IN OTHER NATIONS (2013), https://perma.cc/HR86-8JQ3. Nowadays, more than three quarters of the world's national constitutions address environmental rights and/or responsibilities. *Id.* This includes the majority of nations in Africa, Asia-Pacific, Central America, Europe, and South America. Interestingly, of the quarter of nations that lack such protections, the majority are made up of the United Kingdom and its former colonies. *Id.*

[28] *Id.* at 6. While the United States constitution, which was drafted in 1789, lacks any mention of the environment, several U.S. states have constitutional provisions on the environment. *See, e.g.*, ILL. CONST. art. XI, § 2 ("Each person has the right to a healthful environment."); MONT. CONST. art. II, § 3 ("All persons are born free and have certain inalienable rights. They include the right to a clean and healthful environment . . . ."); PA. CONST. art. I, § 27 ("The people have a right to clean air, pure water, and the preservation of the natural, scenic, and esthetic values of the environment."); MASS. CONST. art. XCVII ("The people shall have the right to clean air and water, freedom from excessive and unnecessary noise, and the natural, scenic, historic, and esthetic qualities of the environment . . . ."); HAW. CONST. art. XI, § 9 ("Each person has the right to a clean and healthful environment . . . .").

[29] *E.g.*, James May, *The Case for Environmental Human Rights: Recognition, Implementation, and Outcomes*, 42 CARDOZO L. REV. 983, 984–85 (2021).

whether—and to what extent—legal guarantees of environmental quality apply to those indoor spaces.

The presumption of "outdoorsiness"—that the environment exists only outdoors—can also affect understanding of general environmental legislation. Consider the typical interpretation of comprehensive environmental statutes, such as the U.S. National Environmental Policy Act (NEPA),[30] a broad (and widely copied[31]) statute intended to address the impacts of government action on the "human environment."[32] Like many other pieces of environmental legislation, the statute does not explicitly address whether the environment should be understood as including indoor spaces alongside outdoor ones, or whether the environment should be presumed to end at the edges of buildings. But the statute's broad, interconnected understanding of the environment,[33] as well as its sweeping goal to "assure for all Americans, safe, healthful, productive, and aesthetically and culturally pleasing surroundings,"[34] leave room for consideration of the environmental quality of indoor spaces.[35] Furthermore, nothing in the statute would seem to preclude understanding the "human environment" to include the indoors—i.e., the surroundings in which humans spend the vast majority of their lives. Nevertheless there is no common practice for environmental impact statements to address *indoor* environmental quality; there is apparently not even any guidance from the Council on Environmental Quality, the agency responsible for promulgating interpretations of NEPA, regarding indoor environmental impacts. Rather, environmental impact statements routinely assume that the "environmental impacts" to be discussed are exclusively those that accrue outdoors.[36]

What explains the strong, unarticulated, and—as this article will argue—peculiarly constrained intuition that the environment exists only

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30 National Environmental Policy Act of 1969, 42 U.S.C. §§ 4321–4370h (2018).

31 For a review of modern legislative requirements on environmental impact assessment around the globe, see U.N. ENV'T PROGRAMME, ASSESSING ENVIRONMENTAL IMPACTS: A GLOBAL REVIEW OF LEGISLATION (2018), https://perma.cc/645A-CCAX.

32 *See* 42 U.S.C. § 4332 (requiring environmental impact statements for federal actions affecting the quality of the "human environment").

33 *See id.* § 4331(a) ("Congress, recognizing the profound impact of man's activity on the interrelations of all components of the natural environment, particularly the profound influences of population growth, high-density urbanization, industrial expansion, resource exploitation, and new expanding technological advances and recognizing further the critical importance of restoring and maintaining environmental quality to the overall welfare and development of man . . . .").

34 *Id.* § 4331(b)(2).

35 Although this view has not been widely applied, it is reflected in EPA's interpretation some years ago in a report to Congress on indoor air pollution. OFF. OF AIR & RADIATION, U.S. ENV'T PROT. AGENCY, EPA/400/1-89/001C, REPORT TO CONGRESS ON INDOOR AIR QUALITY: VOLUME II: ASSESSMENT AND CONTROL OF INDOOR AIR POLLUTION 8-1 (1989) (identifying NEPA as a potential legal basis for review of indoor air pollution, noting that "[w]hile not specific to indoor air, this broad overarching legislation provides a context for consideration of indoor air quality and other environmental concerns in all major Federal actions taken pursuant to other authorities").

36 *See* discussion *infra* Part IV.A.

outdoors? Exploring this intuition can help us in understanding whether there is sense in it.

One important aspect of this intuition may be a legacy of 19th century Romantic accounts of the separation between man and nature, which conceive of the "natural" environment as separate from humans.[37] Importantly, while such Romantic accounts may have intuitive appeal for many, they predate—and are inconsistent with—modern ecological understandings of the environment, which emphasize the interconnection of ecosystems, species, and systems, and which understand humans to be part of the ecosystems in which they live.[38]

The intersection of environmental law and psychology provides another potential explanation for the neglect of indoor environments. Past research has suggested that psychological processes combine to make environmental harms especially difficult for people to perceive, understand, and value.[39] Risks that are especially familiar, or which originate from benign-seeming sources, are especially prone to neglect.[40] Such intuitions, combined with the (sometimes misleading) emotional sense of safety that mammals associate with shelter and the general blind spots created by sleep, may go some way to explaining how indoor spaces have come to be intuitively excluded from legal accounts of the environment.

Although potentially explanatory, neither social nor psychological processes provide good reasons for checking environmental concern at the door. Identifying the sources of neglect of indoor environments may,

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[37] *See infra* Part IV.A; Jonathan Baert Wiener, *Law and the New Ecology: Evolution, Categories, and Consequences*, 22 ECOL. L.Q. 325, 340–45 (1995) (tracking the "separatist intuition" that "human action is separate from nature"); Jonathan Baert Wiener, *Beyond the Balance of Nature*, 7 DUKE ENV'T L. & POL'Y F. 1, 7–8 (1996) [hereinafter Wiener, *Beyond the Balance*].

[38] As Lynton Caldwell, a scientist whose proposal for a national environmental planning regime formed the basis of NEPA, described it: "The ecological viewpoint might be described in these terms: Man is a part of his own environment and is in dynamic equilibrium with it; this total environment exists in dynamic equilibrium governed by natural 'laws.'" LYNTON KEITH CALDWELL, ENVIRONMENT: A CHALLENGE FOR MODERN SOCIETY 238 (1970); *see also* Wiener, *Beyond the Balance*, *supra* note 37, at 3–5 (analyzing inconsistent perceptions of humans as "separate from nature" and modern empirical understanding of the environment); Jan G. Laitos & Lauren Joseph Wolongevicz, *Why Environmental Laws Fail*, WM. & MARY ENV'T L. & POL'Y REV., Dec. 2014, No. 2, at 40–41 (arguing that environmental laws fail when they are based on the (false) notion that humans are separate from nature).

[39] *See infra* Part IV.B.1; *see also* THE PSYCHOLOGY OF ENVIRONMENTAL LAW, *supra* note 20, at 9, 63 (discussing psychological phenomena that affect how people perceive, understand, and value environmental harm); Arden Rowell, Kenworthey Bilz & Howard Jyun-Syun Li, *Environmental Law and Psychology*, *in* THE RESEARCH HANDBOOK ON LAW AND PSYCHOLOGY (Rebecca Hollander-Blumoff ed., forthcoming 2024) (manuscript at 1) (providing an overview of environmental law and psychology).

[40] *See* Rowell, Bilz & Li, *supra* note 39 (manuscript at 1); *see also* Arden Rowell & Kenworthey Bilz, *The Psychology of Pollution Control*, 54 ARIZ. ST. L.J. 899, 912 (2022) (discussing the psychology of source effects); Paul Slovic et al., *Rating the Risks*, *in* PAUL SLOVIC, THE PERCEPTION OF RISK 104 (2000) (discussing the impact of familiarity on risk perception).

however, help us in charting not only where environmental law and policy is now, but also where it should be in the future.[41]

The remainder of this Article proceeds as follows. Part II explains why—despite subconscious intuitions to the contrary—the indoors should be understood as part of the environment. It flags the existence of natural and nonhuman indoor spaces, before pointing to a series of examples meant to illustrate the broad range of indoor spaces and environmental hazards that should be—but most often are not—considered part of environmental law and policy. Building upon this point, Part III argues that indoor spaces not only exist as part of the environment, but that they are an *important* part—to humans, nonhumans, and even to regulation of the outdoors—such that neglect by environmental law and policy is a mistake. Part IV explores the extent of this neglect and social and psychological reasons why it may have developed. Part V identifies some of the key legal, policy, and scholarly implications of recognizing that indoor spaces are part of the environment. Finally, the Article concludes that environmental law and policy should reorient its understanding of the environment to include indoor as well as outdoor spaces.

II. THE INDOORS IS PART OF THE ENVIRONMENT

It is easy to think of indoor spaces as especially "human." But humans do not have a monopoly on indoor spaces. Consider beavers: large, semiaquatic rodents who live across the Northern Hemisphere.[42] Beavers have thick pelts, flat tails, and chisel-like teeth, which they use to fell trees.[43] Alongside other resources like rocks and mud, beavers use the lumber they harvest in engineering and construction projects.[44] Although humans often associate beavers with their dams,[45] it is a different type of construction—the beaver lodge—that is the centerpiece of a beaver colony.[46]

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41 *See* Josephine van Zeben & Arden Rowell, Environmental Law Beyond Emergencies: Lessons from the Future (forthcoming 2024) (articulating a set of directions for "new" environmental law that include incorporating new voices, new spaces [including indoor spaces], and transformational change) (manuscript at 6) (on file with author).

42 *See* Bruce W. Baker & Edward P. Hill, *Beaver (Castor canadensis), in* WILD MAMMALS OF NORTH AMERICA: BIOLOGY, MANAGEMENT, AND CONSERVATION 288, 289 (George A. Feldhamer et al. eds., 2d ed. 2003); *see also* DIETLAND MÜLLER-SCHWARZE, THE BEAVER: ITS LIFE AND IMPACT 57–58 (2d ed. 2011).

43 Baker & Hill, *supra* note 42, at 289.

44 *See* MÜLLER-SCHWARZE, *supra* note 42, at 58.

45 Beaver dams have significant ecological impact, slowing water flow and creating wetlands where other species live. *See id.* at 135–136; Annegret Larsen et al., *Dam Builders and Their Works: Beaver Influences on the Structure and Function of River Corridor Hydrology, Geomorphology, Biogeochemistry and Ecosystems*, EARTH-SCI. REV. July 2021, No. 103623, at 37–38, https://perma.cc/D6KZ-72V4 (discussing the role of beavers as ecosystem engineers due to their impact on the local environment).

46 *See* MÜLLER-SCHWARZE, *supra* note 42, at 58. Lodges are so important to beavers that the presence of an artificial lodge is viewed as a prerequisite for humane beaver captivity.

Beaver lodges provide indoor shelter from predators and the elements, as well as places to raise young and eat.[47] Lodge building styles come in two varieties: simpler "bank lodges"—underground burrows, dug out along a shore—and more complex "open-water lodges," which are freestanding, conical buildings built over a platform of piled-up sticks.[48] Both types are accessible only via underwater entrances and are generally carpeted with bedding made of plant materials, which the beavers dispose of and replace regularly.[49]

As with the burrows, shelters, and structures built and utilized by other animals,[50] conditions inside a beaver lodge differ significantly from conditions outside. The enclosure they create forms a protective barrier against outdoor hazards (such as heat or snow) and an insulating barrier concentrating heat (and other emissions) inside.[51] Even partial or limited enclosure provides some protection from the elements—think of the impact of a shade pavilion on a sunny summer day—but the separation between indoor and outdoor conditions can be significant in a tightly built enclosure. The insulation of open-water beaver lodges—accomplished with layers of mud plaster over stick-built walls—is so effective that even when outdoor temperatures reach as low as -38°C, indoor temperatures will resemble those of the surrounding water (0.5°C).[52] In fact, this enclosure method is so successful that beavers who use it—and who therefore concentrate emissions of carbon dioxide and heat inside the lodge—must include at least one ventilation shaft.[53] This allows for vital gas exchange, keeping the indoor air quality consistently breathable by allowing carbon dioxide to flow out and oxygen to flow in.[54]

See Róisín Campbell-Palmer & Frank Rosell, *Captive Care and Welfare Consideration for Beavers*, 34 ZOO BIOLOGY 101, 105–06 (2015), https://perma.cc/RYY9-QRTD.

47 *See* MÜLLER-SCHWARZE, *supra* note 42, at 56–60. Beavers do not defecate in their lodges, instead swimming to designated "latrine" areas. *See id.*

48 *Id.* at 57–58. Bank lodges are usually used as summer homes, as temperatures inside are typically about 2°C cooler than surrounding air. *Id.* at 58–59.

49 *Id.* at 32–33, 57–58.

50 *See generally* MIKE HANSELL, BUILT BY ANIMALS: THE NATURAL HISTORY OF ANIMAL ARCHITECTURE (2007) (discussing structures built by diverse animals, including rodents, birds, ants, shrimp, termites, amoeba, apes, and arachnids); INGO ARNDT, ANIMAL ARCHITECTURE (2014) (providing a visually engaging presentation of a diverse collection of structures built by nonhumans, including termite towers, bird nests, and bee hives).

51 *See* MÜLLER-SCHWARZE, *supra* note 42, at 59.

52 *See* A. B. Stephenson, *Temperatures Within a Beaver Lodge in Winter*, 50 J. MAMMALOGY 134, 134–35 (1969) (finding that the temperature within a beaver lodge in winter remained around freezing even while the outdoor temperature varied between -38°C and -2°C); MÜLLER-SCHWARZE, *supra* note 42, at 58 (discussing beavers' use of mud plaster).

53 *See* Baker & Hill, *supra* note 42, at 294–95 (describing techniques used to allow ventilation—in bank lodges, through the use of small holes in the surface soil to permit air exchange, and in open-water lodges, by leaving a portion of the top of the lodge unsealed by mud).

54 *See* MÜLLER-SCHWARZE, *supra* note 42, at 60 (describing the ventilation quality of beaver lodges, and explaining that "[t]he levels of carbon dioxide and oxygen inside the lodge do not vary over the seasons," and that "[e]xperimentally added carbon dioxide is cleared away within 60 minutes").

Are beaver lodges part of the environment? Logically and legally, the answer is "yes." Logically, beavers do not disappear from the environment when they enter their lodges. While they experience different environmental conditions inside the lodges than outside, this does not mean that they exist extra-environmentally; it just means that their exposures and environmental quality are affected not only by outdoor hazards and conditions but also by the characteristics of the enclosure that surrounds them. Fortunately for beavers, the law already reflects this logic: in areas where beavers have legal protections,[55] disturbing or destroying beaver lodges is regulated or prohibited.[56] The EU Habitats Directive, for instance, explicitly prohibits "deterioration or destruction of breeding sites or resting places" for listed species, including beavers.[57]

For species like beavers, who spend much of their lives indoors,[58] it seems especially important that environmental protection does not suddenly stop at the entrance to their homes. Doing so, after all, would fly in the face of modern ecological understandings of the environment as an interconnected system. Indeed, nowadays, the ecological focus of environmental law is often understood as a primary feature distinguishing it from other areas of law.[59] Importantly, ecological understandings of the environment view humans as part of the ecosystems in which they live. As Lynton Caldwell, a scientist whose proposal for a national environmental planning regime formed the basis of the National Environmental Policy Act, explained: "[T]he ecological

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55 Eurasian beavers have special protected status in the European Union. Council Directive 92/43/EEC, annex IV(a), 1992 O.J. (L 206) 7, 38. Beavers are not federally protected in the United States, though state hunting laws and regulations often protect them as furbearers. *See Beaver Damage Management*, ANIMAL & PLANT HEALTH INSPECTION SERV., U.S. DEP'T OF AGRIC., https://perma.cc/V8Y9-FERG (last updated Mar. 14, 2024).

56 In the EU, where beavers are a protected species under the Habitats Directive, Member States must prohibit "deliberate disturbance" of protected species, as well as deterioration or destruction of breeding sites or resting places. Council Directive 92/43/EEC, *supra* note 55, at 12. Even in areas where beavers are merely regulated as furbearers, however, there are often regulatory constraints on the disturbance of beaver lodges. *See, e.g.*, N.Y. ENV'T CONSERV. LAW § 11-0505(6) (2024) ("Except as permitted by the department, no person shall at any time disturb a beaver dam, house or den . . . ."); GA. CODE. ANN. § 27-1-30 (2023) ("Except as otherwise provided by law or regulation, it shall be unlawful to disturb mutilate, or destroy the dens, holes, or homes of any wildlife . . . .").

57 Council Directive 92/43/EEC, *supra* note 55, at 12.

58 *See* STEVE BOYLE & STEPHANIE OWENS, U.S. DEP'T OF AGRIC., FOREST SERV., ROCKY MOUNTAIN REGION, NORTH AMERICAN BEAVER (CASTOR CANADENSIS): A TECHNICAL CONSERVATION ASSESSMENT 14 (Feb. 6, 2007), https://perma.cc/GUQ8-LWFG (describing beavers as active outside the lodge for periods of 11–13 hours in summer and shorter periods in winter, for example 7.5 hours in November).

59 *See, e.g.*, Richard Lazarus, *Restoring What's Environmental About Environmental Law in the Supreme Court*, 47 U.C.L.A. L.R. 703, 745 (2000) (explaining that the "common denominator" in environmental law "is the ecological injury that serves as the law's threshold and often exclusive focus"); Fred Bosselman & Dan Tarlock, *The Influence of Ecological Science on American Law: An Introduction*, 69 Chi. K. L. R. 847 (1994) (reviewing the historical contributions of ecological science to the development of environmental law, such that "[o]ne of ecology's primary contributions to modern environmental law, and warning against failing to adapt understandings of ecological science).

viewpoint might be described in these terms: Man is a part of his own environment and is in dynamic equilibrium with it."[60] While concepts of equilibrium have developed in subsequent decades alongside understanding of ecosystems,[61] the core ecological idea—that humans are connected with, rather than separate from, their environment—remains foundational to modern environmental law.[62]

In identifying spaces that form part of "the environment," the concept of the "ecosystem" itself—first coined by Arthur Tansley in the 1930s—incorporates a spatial sense of surroundings into our understanding of living organisms.[63] As Tansley explained, "[t]hough the organisms may claim our prime interest, when we are trying to think fundamentally, we cannot separate them from their special environments, with which they form one physical system."[64] From an ecosystem perspective, it seems clear that the human ecosystem includes (primarily!) indoor spaces, and that human-built structures now form expansive parts of ecosystems for nonhuman species as well. The conclusion should be that—indoor or outdoor—such ecosystems are part of the environment.

As environmental law co-developed with ecological science, so too did environment-specific ideas, concepts, and approaches that have become classics in the field—including a commitment to integration with environmental science and social science; recognition and management of environmental externalities and the third-party effects of environmental impacts, whether via law, social norms, or markets; acknowledgment and engagement with the interactions between human and nonhuman systems; and an entire toolbelt to control pollution and manage ecosystems.[65] For reasons that have yet to be articulated, however, that expertise has been almost exclusively directed towards those portions of the environment not enclosed by walls.[66] Environmental law and policy experts have largely ignored indoor spaces—and specifically, indoor

60 CALDWELL, *supra* note 38, at 238. *See also* Arthur Tansley, TANSLEY TEAM, INC., https://perma.cc/V9V2-BKGH (quoting Arthur Tansley for the assertion that "[t]hough the organisms may claim our prime interest, when we are trying to think fundamentally, we cannot separate them from their special environments, with which they form one physical system").

61 *See, e.g.*, Dan Tarlock, *The Nonequlibrium Paradigm in Ecology and the Partial Unraveling of Environmental* Law, 27 LOY. L.A. L. REV. 1121, 1121–1127 (1993) (describing the history and power of the equilibrium paradigm in ecology); Wiener, *Beyond the Balance*, *supra* note 37, at 3–5.

62 *See* Wiener, *Beyond the Balance*, *supra* note 37, at 4; Nükhet Yilmaz Turgut, *The Influence of Ecology on Environmental Law: Challenges to the Concept of Traditional Law*, 10 ENV'T L. REV. 112, 115–117 (2008); Laitos & Wolongevicz, *supra* note 38, at 43; Tseming Yang & Robert V. Percival, *The Emergence of Global Environmental Law*, 36 ECOL. L.Q. 615, 623–24 (2009).

63 Arthur Tansley, *The Use and Abuse of Vegetational Concepts and Terms*, 16 ECOLOGY 284, 299 (1935).

64 *Id.*

65 For discussion on environment-specific ideas, concepts, and approaches that have become classics in the field, see A GUIDE TO U.S. ENVIRONMENTAL LAW, *supra* note 26; THE PSYCHOLOGY OF ENVIRONMENTAL LAW, *supra* note 20.

66 *See* discussion *infra* Section IV.B.

spaces built by humans—as if they exist extra-environmentally or outside the realm of their expertise.

This abdication of expertise should strike us as strange. Like beavers, humans do not disappear from the environment when they enter their homes. Humans are animals. The homes and structures of humans and nonhuman animals alike exist in, and interconnect with, their surroundings. Humans, of course, build many more indoor structures than beavers do, and spend even more time within them. But this seems like a reason humans' indoor spaces are especially pervasive and important, rather than a reason to neglect them, either legally or theoretically. It is true that humans' indoor spaces present different and sometimes additional environmental hazards beyond those encountered outdoors—but this, too, seems more a justification for attention than neglect.

Once one reflects on the matter as an environmental issue, the extraordinary range of indoor spaces where environmental hazards affect environmental quality inside human-made structures is remarkable. Consider, on this front, the management of the following hazards:

> A factory worker applies adhesive as part of her job. The adhesive contains benzene, a carcinogen.[67]
>
> Children returning to a middle school after the summer break complain that the air-conditioned rooms smell musty.[68] By the end of the first month, the school has sent home over 10% of the students for illness—over three times the illness rate compared to other schools in the district.[69]

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[67] Benzene is a colorless, flammable liquid with a sweet smell and a number of useful industrial applications, including in adhesives. *Facts About Benzene*, CTRS. FOR DISEASE CONTROL & PREVENTION, https://perma.cc/WJZ6-ZSRN (last updated Apr. 4, 2018). The International Agency for Research on Cancer (IARC) and the U.S. EPA categorize it as a known human carcinogen. U.S. DEP'T OF HEALTH & HUM. SERVS., TOXICOLOGICAL PROFILE FOR BENZENE 6 (2007), https://perma.cc/Z67Z-XM2G.

[68] Mold, which can have a musty smell, is very common in buildings and homes, and can cause a variety of health impacts, including upper respiratory tract symptoms and asthma exacerbation. *See Basic Facts about Mold and Dampness*, CTRS. FOR DISEASE CONTROL & PREVENTION https://perma.cc/5689-WEUF (Nov. 14, 2022). (explaining that "[i]f you can see or smell mold, a health risk may be present," and concluding that "[n]o matter what type of mold is present, you should remove it," despite the fact that "[s]tandards for judging what is an acceptable, tolerable, or normal quantity of mold have not been established"). In some rare cases, indoor exposure to mold can be deadly. *See, e.g.*, *Awaab Ishak: Guidance on Mould to be Reviewed After Toddler's Death*, BBC NEWS (Jan. 14, 2023), https://perma.cc/R3QX-9KPC (reporting on ministerial calls for additional "guidance to landlords" after the death of a two-year-old from mold exposure in his rented home). In the United States, there are no federal standards or recommendations for airborne concentrations of mold spores. *See A Brief Guide to Mold in the Workplace*, U.S. DEP'T OF LAB., https://perma.cc/F94Z-6RE9 (last updated Nov. 8, 2013).

[69] *See, e.g.*, Amy Passaretti Willis, *Public Records Show PCS Approached Topsail Middle Air Quality Issues with Lax Response*, PORT CITY DAILY (Jan. 4, 2023), https://perma.cc/GW3Y-2ETE (reporting student illnesses following mold and air-quality issues at a North Carolina middle school).

A plane full of passengers settle in for a long-haul flight from Rome to Sydney. Just as the plane reaches its highest point, a solar flare occurs, exposing everyone on board to 2mSv/h of radiation—twice the annual public exposure limit.[70]

Spectators at a college basketball game smell the strawberry-scented ultrafine particles from someone smoking a vape pen.[71]

A commuter steps tiredly onto a subway train, coughing slightly and reaching for their asthma inhaler. They just missed the prior train and had to wait longer than normal at the stuffy subway station.[72]

A pest control company sprays pesticide in and around a mall food court. Later that day, customers and employees feel sick; one patron is hospitalized.[73]

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[70] Ionizing radiation causes cancer in humans, as well as reproductive problems; as a result, the National Council on Radiological Protection (NCRP) recommends a maximum exposure limit of 1 mSv/year for the public (with a maximum 0.5 mSv/month during pregnancy). *Ionizing Radiation: Pregnant Workers*, OCCUPATIONAL SAFETY & HEALTH ADMIN., https://perma.cc/77NR-7Z84 (last visited Feb. 6, 2024). Solar flares can cause radiation exposures that exceed the annual safe imit within a few hours. *See* Moe Fujita et al., *Probabilistic Risk Assessment of Solar Particle Events Considering the Cost of Countermeasures to Reduce the Aviation Radiation Dose*, 11 SCI. REPS., Sept. 2021, No. 17081 (quantifying the radiation risk to airline passengers presented by solar flares and concluding that solar flares will occasionally expose passengers to as much as 2 mSv/h).

[71] Secondhand or passive inhalation of vape aerosols may cause cancer and other illnesses. *See* Scott Gottlieb & Amy Abernethy, *Understanding the Health Impact and Dangers of Smoke and "Vapor"*, FOOD & DRUG ADMIN. (Apr. 3, 2019), https://perma.cc/R766-85ML (summarizing research on the health impacts of vaping and vape aerosols).

[72] One recent study of subway systems in the northeastern United States found fine particle pollution at rush hours to typically be two to seven times the U.S. EPA's 24-hour ambient air standard. *See* David G. Luglio et al., *PM2.5 Concentration and Composition in Subway Systems in the Northeastern United States*, ENV'T HEALTH PERSPS., Feb. 2021, No. 027001, at 8; *see also National Ambient Air Quality Standards (NAAQS) for PM*, U.S. ENV'T PROT. AGENCY, https://perma.cc/CWE9-7PVB (last updated Mar. 29, 2023) (reporting the 24 hour standard of 35 $\mu g/m^3$). Fine particle pollution can aggravate asthma and cause long-term cardiovascular and respiratory issues, including cancer. *See Health and Environmental Effects of Particulate Matter (PM)*, U.S. ENV'T PROT. AGENCY, https://perma.cc/9BT4-96MV (Aug. 23, 2023). For a review of potential legal strategies for addressing subway air pollution, as well as a summary of the current lack of regulation in the United States, see Maia Foster, Note, *Legal Strategies to Minimize Subway Air Pollution in the United States*, 72 DUKE L.J. 1345 (2023).

[73] Pesticides are typically designed to kill pests, and many also present human health risks. *Human Health Issues Related to Pesticides*, U.S. ENV'T PROT. AGENCY, https://perma.cc/T8PJ-HCJJ (last visited Feb. 23, 2024). *See generally* Federal Insecticide, Fungicide, and Rodenticide Act, 7 U.S.C. §§ 136–136y (2018). Indoor pesticide spray can generate fumes of sufficient concern to evacuate a large commercial space like a mall. *See, e.g.*, Thomas Lanahan, *Part of Richland Mall Evacuated Due to Pesticide Spray*, WACH FOX 57 (Apr. 5, 2018), https://perma.cc/T8PJ-HCJJ (reporting evacuation of 100,000 square feet of a mall and one hospitalization due to fumes from overnight pesticide spray).

A parent cooks quesadillas for her three children on a gas stove.[74] The two older children wait impatiently at the dining table of their 1950s detached single-family home, while the toddler nibbles on some paint chipping off the dining room wall.[75]

A concentrated animal feeding operation houses 125,000 chickens in a "chicken house"—a large, windowless building. The operation uses a "dry-waste" system, where the animal waste falls from cages onto the floor.[76]

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[74] Cooking generates significant indoor air pollution. Worldwide, household air pollution—largely from cooking—was responsible for an estimated 3.2 million deaths per year, including over 237,000 deaths of children under the age of five. *Household Air Pollution*, WORLD HEALTH ORG. (Nov. 28, 2022), https://perma.cc/T26L-T4GG. In addition to traditional air pollutants like nitrogen oxides, gas stoves generate significant quantities of the powerful greenhouse gas methane, even when turned off. *See* Lebel et al., *supra* note 23, at 2536 ("76% of the total methane emissions from stoves originated during steady-state-off."). Methane emissions resulting from the usage of gas stoves in the U.S. "were comparable in climate impact to the carbon dioxide emissions of approximately 500,000 gas-powered cars." *Id.* at 2535.

[75] Lead paint is an important source of childhood lead exposure and can cause irreversible neurological damage and developmental harm. *See Lead in Paint*, CTRS. FOR DISEASE CONTROL & PREVENTION (Dec. 16, 2022), https://perma.cc/Z9VD-86L7; *Health Effects of Lead Exposure*, CTRS. FOR DISEASE CONTROL & PREVENTION (Sept. 2, 2022), https://perma.cc/KQ7H-MTTH. Despite the fact that people often assume lead paint is an old risk, it is still sold in most countries worldwide and remains a significant hazard even in countries that have banned its use. *FAQ—Questions and Answers about Lead Paint and Lead Paint Laws*, U.N. ENV'T PROGRAMME, https://perma.cc/FN2D-88SD (last visited Feb. 5, 2024); *see* U.N. ENV'T PROGRAMME, LEAD PAINT LAW COMPLIANCE AND ENFORCEMENT GUIDE 6 (2023), https://perma.cc/8557-Z3JW ("Compliance promotion materials may include fact sheets . . . with information on: . . . The date on which lead paint . . . can no longer be legally sold."). This is because, although European nations began banning leaded indoor paint early in the 20th century, and indoor lead-based paint has been outlawed in the United States since 1978, homes built before bans still frequently contain interior lead paint. *Lead in Paint*, *supra* note 75. In Chicago, for example, one recent investigation suggested that "the vast majority of Chicago's housing stock still contains potentially toxic levels" of lead paint. Paris Schutz, *Posing a Danger for Children, Majority of Chicago Homes Contain Hazardous Levels of Lead Paint, Health Officials Say*, WWTW (Mar. 21, 2023, 12:41 AM), https://perma.cc/Y5SW-9MET. And globally, lead paint continues to be sold in a number of countries worldwide. *See* U.N. Env't Programme, *Despite Bans, Most Countries Still Have Lead Paint* (Oct. 27, 2018), https://perma.cc/KH3V-A57K (reporting continued high lead levels in paints around the world, and estimating that lead exposure kills 540,000 people per year).

[76] In the United States, the EPA categorizes feeding operations of this size as large concentrated animal feeding operations (CAFOs). 40 C.F.R. § 122.23(b)(4)(x) (2022). The EPA does not regulate conditions inside CAFOs, but under their interpretation of the Clean Water Act, categorization as a CAFO affects whether feeding operations are subject to a permit requirement before disposing of their waste into the waters of the United States. *See id.* § 122.23(a). In addition to creating indoor waste that can pollute outdoor water quality, concentrated poultry operations generate indoor and outdoor air pollution via ammonia, hydrogen sulfide, methane, and particulate matter emissions, present risks of pathogenic contamination and spread, and can be breeding grounds for insect vectors such as houseflies, stable flies, and mosquitoes. *See* CARRIE HRIBAR, NAT'L ASS'N OF LOC. BDS. OF HEALTH, UNDERSTANDING CONCENTRATED ANIMAL FEEDING OPERATIONS AND THEIR IMPACT ON

A retired person takes a shower in his vintage apartment bathroom, inhaling fine water droplets via the spray. Later, he and several of his neighbors fall sick with severe pneumonia. Testing reveals *Legionella* bacteria in the apartment building's pipe system.[77]

A child sleeps under an insecticide-treated mosquito net in an area where malaria, a mosquito-borne illness, is endemic.[78] While identical mosquito nets worked well for the child's older siblings, this child wakes many mornings with at least one mosquito bite, and eventually contracts malaria.[79]

COMMUNITIES 4, 5, 8 (Mark Schultz ed., 2010) (summarizing a variety of environmental and other impacts of CAFOs).

77 Legionnaire's disease is a severe pneumonia caused by inhaling *legionella* bacteria, which can grow in water systems within large buildings (as within pipes that extend between the water meter and the tap). *See Legionella*, U.S. ENV'T PROT. AGENCY (Jan. 2, 2024), https://perma.cc/4WPV-FVGH; *e.g.*, Latisha Jensen, *A North Portlander Dies After Apartment Water Supply Becomes Contaminated: Health Officials Confirmed an Outbreak of Legionnaire's Disease on Monday and Notified 100 Residents to Evacuate*, WILLAMETTE WEEK (Jan. 5, 2021), https://perma.cc/46TH-AKSK.

78 Malaria control campaigns are estimated to have prevented 1.5 billion malaria cases between 2000–2019 and to have averted 7.6 million malaria deaths. *See* WORLD HEALTH ORG., WORLD MALARIA REPORT 2020: 20 YEARS OF GLOBAL PROGRESS AND CHALLENGES 50 tbl.5.2., 58 (2020), https://perma.cc/43VL-WTFZ. Insecticide-treated bed nets are widely understood as the single most effective intervention in preventing malaria. *See* S. Bhatt et al., *The Effect of Malaria Control on* Plasmodium falciparum *in Africa Between 2000 and 2015*, 526 NATURE 207, 208 (2015) (reporting a 40% reduction in malaria cases over this period, and concluding that of cases of malaria averted by malaria control interventions since 2000, "68 (62–73)% . . . and 10 (5–14)% were contributed by ITNs [Insecticide-Treated Bed Nets] and IRS [Indoor Residual Spraying], respectively"). Meanwhile, use of treated mosquito nets has been shown to significantly reduce the hazard presented by night-time mosquitoes in areas where malaria is endemic. *See also* Günther Fink et al., *Mosquito Net Use in Early Childhood and Survival to Adulthood in Tanzania*, 386 NEW ENG. J. MED. 428, 430, 435 (2022) (reporting a longitudinal study finding that 20 years after the use of bed nets in malaria-endemic areas of Tanzania, survival of children who habitually slept under nets was over 40% higher than the survival of those who had used them less than half the time in early childhood).

79 Anti-malaria campaigns have distributed over 2 billion insecticide-treated bed nets since 2005. *WHO Publishes Recommendations on Two New Types of Insecticide-Treated Nets*, WORLD HEALTH ORG. (Mar. 14, 2023), https://perma.cc/86KP-SBMH [hereinafter *WHO Publishes Net Recommendations*]. All of these nets were treated with a single insecticide class: pyrethroid. *See id.* Meanwhile, progress on fighting malaria—against which bed nets had been the most effective intervention—began to stall in 2015, as pyrethroid resistance spread across mosquito populations. *See* WORLD HEALTH ORG., WORLD MALARIA REPORT 2023 13 fig.3.4. (2023), https://perma.cc/3M85-5UMR; Not until 2023, however, did the World Health Organization conclude that pyrethroid resistance among malaria-transmitting mosquitoes was the key threat to the effectiveness of nets. *Id.* at 2. The World Health Organization issued its first full recommendation for a new insecticide formulation in March 2023. *See WHO Publishes Net Recommendations*, *supra* note 79.

> A prisoner arrives at a state prison built on a toxic waste disposal site. Other prisoners warn him that, like them, he will soon suffer from skin sores and constant gastrointestinal issues, and that many inmates die of cancer.[80]

> As part of a religious ceremony, worshippers light incense in a place of worship[81] and inhale the scented smoke.[82]

Few, if any, of these scenarios are generally understood as falling within the scope and authority of environmental law.[83] And those that are addressed are controlled via a patchwork of other legal approaches and theories—via labor and occupational safety and health law, tort law, aviation law, smoking ordinances, urban planning, property law, products liability, agricultural law, public health, landlord/tenant law, criminal procedure, or building ordinances.

Which of these scenarios *should* environmental law and policy consider within its bailiwick? I believe that the best answer is: each of them. Each involve the management of (indoor) environmental quality. Each involves at least one environmental hazard—air pollution, water pollution, exposure to toxic substances, interaction between human and nonhuman species, waste management—that falls within the core of environmental expertise, and which are hazardous because of the harm they may cause to human (or nonhuman) surroundings. The harm from these hazards is diffuse, complex, and involves nonhuman vectors, stakeholders, or processes—the touchstone qualities of environmental harm. Environmental harm is distinctive from harms addressed by other areas of law,[84] and where there is harm of this type, environmental law

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80 *See, e.g.*, ABOLITIONIST LAW CTR., NO ESCAPE: EXPOSURE TO TOXIC COAL WASTE AT STATE CORRECTIONAL INSTITUTION FAYETTE 1, https://perma.cc/F8SX-U7J8 (describing the State Correctional Institution Fayette, a state prison in Pennsylvania, which is surrounded by "about 40 million tons of waste, two coal slurry ponds, and millions of cubic yards of coal combustion waste," and summarizing serious health impacts on prisoners); *see also* Moffa, *supra* note 25, at 375 (discussing neglect of air pollution hazards in prisons).

81 For a compelling discussion of the environmental impacts of religious and ceremonial incense use, see, for example, JAY WEXLER, WHEN GOD ISN'T GREEN: A WORLD-WIDE JOURNEY TO PLACES WHERE RELIGIOUS PRACTICE AND ENVIRONMENTALISM COLLIDE 13 (2016).

82 Research suggests that incense smoke contains hazardous compounds, including particulate matter, polycyclic hydrocarbons, and carbon monoxide, and that inhaling it is comparable to—or perhaps even more unhealthy—than inhaling secondhand cigarette smoke. *See* Chiang-Wen Lee et al., *The Adverse Impact of Incense Smoke on Human Health: From Mechanisms to Implications*, 14 J. INFLAMM. RSCH. 5451, 5454 (2021); *see also* WEXLER, *supra* note 81, at 13.

83 With the occasional exception of a brief treatment of occupational safety and health, environmental law textbooks and courses—including historically the author's own!— include few if any of these topics. *See generally, e.g.*, A GUIDE TO U.S. ENVIRONMENTAL LAW, *supra* note 26 *and* A GUIDE TO EU ENVIRONMENTAL LAW, *supra* note 26 (neglecting indoor environmental law).

84 *See* Lazarus, *supra* note 59, at 744–45 (defining the distinctiveness of environmental law by reference to environmental injury); *see also* THE PSYCHOLOGY OF ENVIRONMENTAL LAW, *supra* note 20, at 9–13 (explaining that environmental injury is psychologically distinctive).

and policy offers tools and expertise that are valuable, if not critical, to effective management. Furthermore, if any of these hazards occurred outside, they would be easily and intuitively categorized as "environmental" hazards.

Environmental law and policy should recognize that its core focus—the environment—includes indoor spaces such as those listed above. The mere existence of a hazard within an enclosed or partially enclosed space should not preclude legal consideration, nor foreclose environmental analysis. Whether animal- or human-built, the indoors is part of the environment, and neglecting indoor spaces impoverishes the ability of environmental law and policy to effectively achieve environmental ends. When environmental law fails to recognize, theorize, and address indoor spaces, it abdicates its responsibility to regulate the environment.

III. THE IMPORTANCE OF THE INDOORS

Adjusting our understanding of the environment to include indoor spaces will take work. This work is worthwhile because indoor spaces are not only part of the environment, but an *important* part.

As this Part explains, indoor spaces are important in at least three ways. First, from an anthropocentric view that prioritizes human interests, indoor spaces are important because they comprise a key portion of the human habitat and impact human health in significant ways. Second, from a biocentric perspective that values environmental quality for nonhumans for their own sake, indoor spaces matter because they affect nonhuman species (both incidentally and purposefully). And third, because indoor environmental quality interacts with outdoor environmental quality directly (as through venting of pollutants to the outdoors) and indirectly (as by insulating human perception of outdoor environmental quality), recognizing, understanding, and managing indoor environmental quality will sometimes matter to outdoor environmental quality as such.

A. Humans: An "Indoor Species"

Accounts of environmental law and policy that prioritize human well-being and interests should address indoor spaces because humans spend most of their lives inside.

Readers will, of course, have their own experiences on which to draw when considering how much of their own lives they spend indoors. From an empirical perspective, I have already alluded to some of the key research on this point, including research that suggests that people overestimate how much time they spend outside by an average of about eight hours a day.[85] To address this and other mental timekeeping issues, sociological studies generally rely upon diary-keeping, and specifically

[85] *See supra* notes 1–3 and accompanying text.

upon the keeping of a time budget, which painstakingly records key information about an activity including the time it began and ended.[86] The first major multinational study of people's time budgets was the Multinational Comparative Time Budget Research Project (MCTBRP) in 1972, which tabulated data on 25,000 people in twelve countries.[87] Interpretation of these budgets suggested that the average employed American spent only about 2% of their time outdoors, with the remainder spent indoors (92%) or in transit (6%). In other countries, the average time spent outside ranged from 0.4 hours (or 1.7%) in Poland to 1.9 hours (or 7.9%) in then-West Germany.[88] The National Human Activity Pattern Survey (NHAPS)—an exhaustive, two-year survey of over 9,000 randomly selected Americans—generated similar estimates some years later.[89] (These estimates are still used by the EPA to approximate human exposures to various environmental hazards.[90]) That study reported that respondents spent an average of 93% of their time indoors, with 87% in enclosed buildings and 6% in enclosed vehicles.[91] As one early researcher concluded, these numbers suggest that humans "are basically indoor animals" and "[i]n a modern society, total time outdoors is the most insignificant part of the day, often so small that it barely shows up in the total."[92]

If the habitat of the human species is now primarily indoors, it places additional pressure on the quality of the indoors. Indeed, health researchers now view indoor environmental exposures to be at least as great a threat to human health and well-being as outdoor exposures.[93] Indoor pollution levels rival and regularly exceed those found outdoors.[94]

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86 *See* Kleipeis et al., *supra* note 3, at 233 (summarizing this literature).

87 *See* SZALAI, *supra* note 3, at V.

88 *See id.* at 580–594; *see also* Wayne R. Ott, *Human Activity Patterns: A Review of the Literature for Estimating Time Spent Indoors, Outdoors, and in Transit, in* U.S. ENV'T PROT. AGENCY, EPA/600/4-89/004, PROCEEDINGS OF THE RESEARCH PLANNING CONFERENCE ON HUMAN ACTIVITY PATTERNS, 3-1, 3-12 (1989) (discussing time patterns for employed men).

89 *See* Kleipeis et al., *supra* note 3, at 232, 234 (reporting on surveys conducted via computer-assisted telephone interviews from 1992 to 1994).

90 EPA continues to use NHAPS data for inputs to its human exposure models, which it uses to inform a number of regulatory rules, such as those addressing (outdoor) air quality. *See* U.S. ENV'T PROT. AGENCY, EPA/600/R-09/052F, EXPOSURE FACTORS HANDBOOK: 2011 EDITION 16-1 to 16-2 (2011) (recommending use of NHAPS data for determining "time spent indoors and outdoors"); *see also About the Exposure Factors Handbook*, U.S. ENV'T PROT. AGENCY, https://perma.cc/B4YG-FVDN (last visited Mar. 21, 2024) (explaining the continued use and partial updating of the handbook).

91 Kleipeis et al., *supra* note 3, at 248.

92 Ott, *supra* note 88, at 3-32.

93 CAL. AIR RES. BD., INDOOR AIR POLLUTION IN CALIFORNIA 31 (2005), https://perma.cc/3MDW-MVKF; Wayne R. Ott & John W. Roberts, *Everyday Exposure to Toxic Pollutants*, SCI. AM., Feb. 1998, at 86, 87.

94 EPA has suggested that some indoor levels of pollution may be significantly higher than outdoor pollution levels. *See A Guide to Indoor Air Quality*, *supra* note 22; BAUM, *supra* note 22. The World Health Organization estimates that indoor (household) air pollution was responsible for 3.2 million deaths per year in 2020, while outdoor air pollution was

Radon, formaldehyde, asbestos, volatile organic compounds (VOCs), biological contaminants, pesticides, tobacco smoke, and airborne contaminants that trigger "sick building syndrome" are all significant threats.[95] For context, in homes with particularly high radon levels, radon exposure causes lung cancer risks comparable to smoking 135 packs of cigarettes each day.[96] Typical indoor formaldehyde concentrations, meanwhile, can be as much as twenty times higher than typical outdoor concentrations.[97] And while indoor air pollution, as noted, did gain public attention during the pandemic, the indoors also presents other important environmental hazards (as via concentration of toxic substances, water, and radiation, and non-pathogenic air pollution) and determinants of environmental quality (as in temperature, light pollution, and sound pollution).

Variation in type and extent of indoor hazards, uses, exposure patterns, identity of actors, and level of control may all affect the quality of indoor environments and the legal and policy implications of controlling that quality. The implications of this variability have yet to be meaningfully categorized and mapped.[98] As a starting point, however, it is worth noting that indoor hazards vary according to the type and quality of the indoor space—apartment buildings, for example, present different hazards from airplanes and motor vehicles. The uses of indoor spaces vary as well, ranging from transportation to occupational, commercial, recreational, educational, religious, and residential use. The variation in uses affects exposure patterns—indoor air quality in one's residence, for instance, may be especially important given the time spent sleeping, while dermal and ingestion routes of exposure may prove more important in daycares or restaurants.[99] Indoor environmental impacts also arise from known third parties—like a family member's cooking, or an employer's selection of toxic substances to use in one's job—and unknown ones, as with previous occupants of one's apartment painting the walls

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responsible for 4.2 million deaths in 2019. *See Household Air Pollution*, WORLD HEALTH ORG., (Dec. 15, 2023), https://perma.cc/WQP3-S2MT; *Ambient (Outdoor) Air Pollution*, WORLD HEALTH ORG., (Dec. 19, 2023), https://perma.cc/43RS-UZTY.

95 Kirsch & Myers, *supra* note 13, § 17A.02.

96 John H. Dorsey, *New Jersey Opinion: Radon Pollution may be the Country's Most Far-reaching Environmental Hazard*, N.Y. TIMES (June 29, 1986), https://perma.cc/FMG8-U5L7.

97 A.T. Hodgson et al., *Sources of Formaldehyde, Other Aldehydes and Terpenes in a New Manufactured House*, 12 INDOOR AIR 235, 239 (2002).

98 For an attempt at a start, see discussion *infra* Part V.

99 *See* Nuno Canha et al., *How Is Indoor Air Quality During Sleep? A Review of Field Studies*, 12 ATMOSPHERE, Jan. 2021, No. 110, at 1–2 (2021) (discussing the adverse effects of air quality while one sleeps); Gabriel Beko et al., *Children's Phthalate Intakes and Resultant Cumulative Exposures Estimated from Urine Compared with Estimates from Dust Ingestion, Inhalation and Dermal Absorption in Their Homes and Daycare Centers*, PLOS ONE, Apr. 2013, at 1, 6 (finding dermal absorption has primary route of exposure for certain compounds in daycares); Annette M. Hormann et al., *Holding Thermal Receipt Paper and Eating Food after Using Hand Sanitizer Results in High Serum Bioactive and Urine Total Levels of Bisphenol A (BPA)*, PLOS ONE, Oct. 2014, at 2, 11 (noting high risk of dermal absorption of BPA in food and beverage establishments).

with lead paint.[100] And they occur in contexts over which one has a range of control—from owned residences where the owner has substantial control over both their presence in the building and the environmental quality inside that building; to prisons, schools, and indoor agricultural facilities where the occupants have no control over either their presence or the quality of their surroundings; to commercial buildings like grocery stores, where consumers have some choice about whether to enter—but once inside, have only limited control over indoor quality.[101]

The diversity of indoor spaces that humans have developed exhibit significant variance. This variance should not obscure, however, that the indoor spaces comprise an important part of the human habitat, and that the environmental quality of those spaces has extraordinary importance to the health and well-being of the humans that live, work, study, shop, travel, and sleep in them. In addition to acknowledging that human-built structures exist as part of the environment, environmental law and policy should recognize the importance of indoor spaces as central to human experience, health, and well-being. This should include reflecting not only upon the specific determinants of indoor environmental quality in diverse indoor spaces, but also upon the legal, institutional, constitutional, and policy implications of incorporating the indoors into our understanding of the environment.[102]

B. The Nonhuman Indoors

Whether environmental policy should focus on the protection of humans from the environment, or protection of the nonhuman environment from humans—or both—remains a controversial question.[103] How important are indoor spaces if environmental law should be primarily or even solely concerned with the impact of environmental quality on nonhuman species? This subsection explains why environmental policy would do well to recognize indoor spaces as part of the environment, even if human interests are not the only or even the primary appropriate target for environmental law and policy. At a basic level, this is because indoor spaces affect nonhumans as well as humans.

Indoor spaces affect nonhuman species through at least three pathways: when nonhuman species make their own indoor spaces; when humans place nonhuman species into indoor spaces created by humans; and when nonhuman species colonize the human-built indoors, creating (at least by human measures) "accidental" ecosystems. Each of these

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100 *See A Guide to Indoor Air Quality*, *supra* note 22 (listing sources of indoor environmental impacts).

101 *Id.*

102 For a start in addressing some of these implications, see discussion *infra* Part V.

103 Helen Kopnina et al., *Anthropocentrism: More than Just a Misunderstood Problem*, 31 J. AGRIC. & ENV'T ETHICS 109, 110 (2018) (discussing the longstanding disagreement around anthropocentrism and environmentally-concerned critics).

categories is worth consideration, and each presents a different set of legal and policy puzzles regarding management of the nonhuman indoors.

First, consider the category of nonhuman creators. Although it can be easy to think of the indoors as an exclusively human product, humans do not create, control, or monopolize all indoor environments. It is true that most nonhuman species live outdoors. But it is also true that many other species live at least partially in enclosed "indoor" environments that they (or other nonhuman species) have constructed. As noted above, beavers routinely build highly insulated homes called "lodges" accessible only via secret underwater openings.[104] And as a general matter, constructing shelter is actually a common behavior among nonhuman animals.[105] The observation that nonhumans also create indoor spaces can be helpful by highlighting the peculiarity of excluding human-built indoor spaces from our concept of the environment—even as we comfortably recognize that beaver lodges, wasp nests, and owl burrows interact ecologically with their surroundings.[106]

Next, consider how humans use human-built indoor spaces to house nonhuman species, whether as guests or prisoners. As guests, we might consider the hosting of a billion or so pets within (largely) indoor environments.[107] One recent industry study found that more than half of the global population has a pet in their home.[108] Common pet species include dogs, cats, fish, birds, horses, reptiles, and small mammals like gerbils, hamsters, and guinea pigs.[109] Meanwhile, in the United States, one study suggests that 66% of consumers have at least one indoor plant.[110] There appears to be less information available about the global pervasiveness and diversity of house plants, though these, too, constitute nonhuman species living in human-built indoor spaces.

Many more nonhumans live in indoor agricultural spaces. Indoor farming of vegetables and other plants has increased in recent decades, and some business commentators expect it to continue to do so, in part because of climate-change induced reductions in arable (outdoor) land

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104 MÜLLER-SCHWARZE, *supra* note 42, at 56–58.

105 *See* MIKE HANSELL, *supra* note 50 (discussing animal-built structures, focusing particularly on shelters); *see also* ARNDT ET AL., *supra* note 50 (providing visual depictions of animal architecture).

106 *See supra* notes 42–58 and accompanying text.

107 *Global State of Pet Care: Stats, Facts, and Trends*, HEALTH FOR ANIMALS (Sept. 2022), https://perma.cc/27N8-83X9 (reporting on global trends in the pet population, including that families in the United States, Brazil, EU and China alone account for over half a billion dogs and cats).

108 *Man's Best Friend: Global Pet Ownership and Feeding Trends*, GFK (Nov. 22, 2016), https://perma.cc/SBM3-3L6D (reporting pet ownership internationally, including percentage of people living with different pets in twenty-two markets).

109 *See, e.g.*, AM. PET PRODS. ASS'N, APPA NATIONAL PET OWNERS SURVEY (2023–2024), https://perma.cc/26XS-MMNP (reviewing frequency of ownership of various pet types in the United States).

110 Luke Revitsky, *Gen Z Houseplant Ownership Stems from the Desire to Care for Something Alive*, CIVICSCIENCE (Apr. 20, 2020), https://perma.cc/ZWK8-L2GZ (reporting on houseplant ownership in the United States based on a survey of 5,000 Americans).

and ecosystem degradation.[111] Indoor farms involve purposeful selection and cultivation of plant species under controlled environmental conditions. In addition to providing indoor spaces for the growth of nonhuman species, indoor farms have potentially transformative environmental impacts on outdoor air, water, and soil conditions, both in their own right and as partial substitutes for outdoor farming.[112]

Animal husbandry creates an additional set of indoor spaces housing nonhumans. Worldwide, concentrated or intensive animal feeding operations, or "factory farms," confine livestock in indoor spaces such as stalls, cages, or poultry "houses."[113] These facilities keep billions of animals across the globe indoors,[114] often in spaces presenting a number of environmental hazards, both to the animals and from them.[115] Higher concentrations of animals indoors generate higher concentrations of waste, as well as increased risk from infectious zoonotic diseases, such as COVID-19 or H1N1, which spread quickly in confined, unventilated indoor environments.[116] While environmental law and policy has long addressed some of the outdoor environmental impacts of indoor animal

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111 *See, e.g.*, *North American Indoor Farming Market Size, Share & Industry Trends Analysis Report by Component, by Facility Type (Greenhouses, Vertical Farms), by Crop Type, by Country and Growth Forecast, 2022–2028*, KBV RSCH. (2022), https://perma.cc/3LGQ-WYEN (reporting that "[t]he North America Indoor Farming Market is expected to witness market growth of 12.3% CAGR during the forecast period (2022–2028)."); Brian Kateman, *Is the Future of Farming Indoors?*, FORBES MAG. (July 14, 2020), https://perma.cc/JP6X-AFKV.

112 *See* Eric Stein, *The Transformative Environmental Effects Large-Scale Indoor Farming May Have on Air, Water, and Soil*, AIR, 14 SOIL & WATER RSCH., Jan.–Dec. 2021.

113 *See* CARRIE HRIBAR, NAT'L ASS'N OF LOC. BDS. OF HEALTH, UNDERSTANDING CONCENTRATED ANIMAL FEEDING OPERATIONS AND THEIR IMPACT ON COMMUNITIES 1–2 (Mark Schultz ed., 2010) (discussing changes in animal agriculture and the development of concentrated animal feeding operations).

114 In the United States, 9 billion broiler chickens a year are raised, virtually all (at least 95%) of whom live entirely indoors in "growout houses," which lack any outdoor access or component. *See Broiler Chicken Industry Key Facts 2021*, NAT'L CHICKEN COUNCIL, https://perma.cc/PN8R-K57 (discussing number of broiler chickens raised); C. Victor Spain et al., *Are They Buying It? United States Consumers' Changing Attitudes Toward More Humanely Raised Meat, Eggs, and Dairy*, 8 ANIMALS, July 25, 2018, No. 128 (2018) (discussing broiler chickens' indoor conditions). Although specific numbers of livestock animals indoors globally are difficult to calculate, an estimated 92.2 billion animals are slaughtered annually around the world. *See Crops and Livestock Products*, FOOD & AGRIC. ORG. OF THE U.N. (2023), https://perma.cc/P6VE-3PF2.

115 *See* HRIBAR, *supra* note 113, at 3–11 (summarizing environmental impacts of CAFOs, including on air quality, surface and ground water, greenhouse gas emissions, odors, insect vectors, pathogens, and antibiotic resistance).

116 *See* Helena Masiello, *Note, CAFOs are a Public Health Crisis: The Creation of COVID-19*, 76 U. MIA. L. REV. 900 (2022) (discussing the increased risk of infectious zoonotic disease from concentrated animal feeding operations, reviewing the role of operations in creating and transmitting diseases such as the H1N1 virus, and calling for the U.S. Department of Agriculture to address the issue); *see also* HRIBAR, *supra* note 113, at 8–10 (discussing pathogenic risks presented by CAFOs).

farming,[117] indoor environmental conditions remain largely underregulated.[118]

Finally, consider how human-built indoor spaces act as accidental ecosystems—as homes for species that are not purposefully invited or imprisoned, and which indeed may not even be desired. Most residences, for instance, teem with (nonhuman) life. One recent survey found 579 species of arthropods—including insects, spiders, beetles, mites, flies, and ants—in suburban North Carolina homes, with an average of 100 arthropod species per home.[119] When told of the results of the survey, residents were generally "surprised" and "horrified" to learn of their cohabitants—scientists "had to calm them down by saying it was normal."[120] Normal, indeed, even inescapable; among 554 residential rooms surveyed, almost every room had at least one arthropod species living in it.[121] Notably, very few of these species were "pests" as the word is typically used.[122] One of the most common species found, for example, were *armadillididae* ("pill bugs," or in the parlance of my childhood, "roly-polies")[123]—harmless and, to some, even cute.

The study participants' surprise and horror upon learning that they were hosting a menagerie of arthropods in their homes underscores the inadvertence of such ecosystems. Even among environmental law professors—more likely than the general population to know and understand the critical ecosystem services provided by arthropods[124]—

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117 *See, e.g.*, 40 C.F.R. § 122.23(b)(4)(x) (2022) (requiring such operations to receive a permit before disposing of their waste into the waters of the United States); *cf.* HRIBAR, *supra* note 113, at 1 (discussing additional environmental impacts).

118 *See* Masiello, *supra* note 116, at 903 (reviewing the current regulatory status of conditions inside CAFOs and noting that "[t]he unregulated conditions of factory farms have many negative impacts").

119 *See* Matthew A. Bertone et al., *Arthropods of the Great Indoors: Characterizing Diversity Inside Urban and Suburban Homes*, PEERJ, 2016, No. 1582, DOI 10.7717/peerj.1582 (describing the first comprehensive census of house-dwelling arthropods, looking at 50 detached single-family homes in a suburb of Raleigh, North Carolina).

120 *See* Andy Coghlan, *Your Home is a Jungle Inhabited by 100 Different Species*, NEW SCIENTIST (Jan. 19, 2016), https://perma.cc/T937-R4WM.

121 *See* Bertone et al., *supra* note 119, at 12 (finding than fewer than 1% (n=5) of residential rooms had no arthropods detected).

122 *See* MERRIAM-WEBSTER DICTIONARY, https://perma.cc/VGT8-6JE7 (defining a "pest" as "something resembling a pest in destructiveness," especially "a plant or animal detrimental to humans or human concerns"); Bertone, supra note 119, at 15 ("Typical household pests were found in a minority of the homes, such as German cockroaches (*Blattella germanica*: 6% of houses), subterranean termites (Rhinotermitidae: 28% of houses), and fleas (Pulicidae: 10% of houses); bed bugs (*Cimex lectularius* Linnaeus) were not found during the study.").

123 *See id.*

124 *See* Mary Jane Angelo & Megan Lancaster, *The Insect Apocalypse: Legal Solutions for Protecting Life on Earth*, 49 ECOL. L.Q. 1, 1, 3–4 (2022) (discussing the importance of insects for a legal audience); *see also, e.g.*, John E. Losey & Mace Vaughan, *The Economic Value of Ecological Services Provided by Insects*, 56 BIOSCIENCE 311, 312 (2006) (estimating the value of U.S. insect ecosystem services at more than $57 billion); Oliver Dangles & Jérôme Casas, *Ecosystem Services Provided by Insects for Achieving Sustainable Development*

one would look long and hard to find anyone who purposefully seeks to cultivate biodiverse arthropod populations in their indoor environments. This is not to say that people do not engage in a wide set of behaviors that affect arthropod numbers and variety.[125] It is just to say that such behaviors are taken without consideration of their impact on arthropod populations (or even with the specific goal of eliminating such populations).

People are frequently horrified by other nonhuman species as well, including arthropod pests (such as cockroaches or termites), rodents (such as mice or rats), and fungi (such as mold and mildew). Indeed, the entire "pest control" industry—valued at $24.6 billion in 2022[126]—is premised upon the idea that nonhuman species may impinge upon human spaces in undesirable ways, and that such "pest" species should be "controlled."

The existence of the nonhuman indoors matters for at least three reasons.

First, recognizing that humans do not have a monopoly on the indoors is a corrective tonic against several psychologically appealing oversimplifications.[127] Humans are not separate from nature; we live embedded within it alongside nonhuman species—even inside our personal dwellings. Similarly, the indoors is not separate from nature; nonhuman species create their own indoor spaces and dwell in indoor spaces made and used by humans.

Second, noting the existence of nonhuman species within indoor environments may help in recognizing neglected areas of environmental concern and areas of potential human-nonhuman conflict. In some cases, such as with mold or malaria, nonhuman species that exist indoors threaten human health and well-being and may require the management both of indoor environments and of human-nonhuman interactions.

Finally, considering the existence of the nonhuman indoors may have larger implications for environmental law and policy, in part through its relation to environmental ethics. Does the existence of the nonhuman indoors have ethical implications for environmental law and policy? Do humans have different ethical obligations regarding indoor and outdoor ecosystems—or different ethical obligations to (nonhuman) invitees than trespassers? If so, what are these (differing) obligations, and how can they be fulfilled?

Goals, 35 ECOSYSTEM SERVS. 109, 110–11 (2019) (discussing the essential role of insects in global ecosystem services).

125 *See* Angelo & Lancaster, *supra* note 124, at 12–26 (discussing a variety of human impacts on insect numbers and diversity, including via habitat loss and degradation, industrial agriculture, deforestation, pesticide use, and climate change).

126 *See Pest Control Market Size, Share, Competitive Landscape and Trend Analysis Report by Application (Commercial, Residential, Agriculture, Industrial, Other), by Type (Chemical, Mechanical, Biological, Other), by Pest Type (Insects, Termites, Rodents, Other): Global Opportunity Analysis and Industry Forecast, 2023–2032*, ALLIED MARKET RESEARCH (May 2023), https://perma.cc/W5PN-PS6H.

127 *See* discussion *infra* Part IV.B.1.

Finally, it is worth recognizing that reflection on the nonhuman indoors might also prompt institutional and procedural questions. Does the federal government have a sufficient interest in the nonhuman indoors to ground federal jurisdiction over indoor environments? Suppose that a census of arthropods in my home discovered a heretofore unknown species of beetle, which so far as anyone can discover exists only in my home.[128] Would—should—existing statutes protecting endangered species protect a purely indoor species of this type? Why or why not? These are questions that—if they are answerable—may be so, at least in part, because of traditional tools and analytical approaches familiar within environmental law and policy.

C. Interconnection with the Outdoors

The indoors is an important part of the environment in its own right, both because of its relevance to human health and well-being, and because many billions of nonhumans also inhabit indoor spaces. That said, because indoor spaces exist within outdoor surroundings—and because, as part of ecosystems, these spaces interact—attention to indoor environmental quality can also pay dividends in the management of outdoor environmental quality.

Additional work on the best way to theorize indoor/outdoor environmental interactions would be a valuable contribution. At least as a starting point, however, we might note that indoor environmental quality can impact outdoor environmental quality (and vice versa) in a number of ways. These include:

1) exchange-based effects, as where pollution from indoor sources are vented to the outdoors, or outdoor pollution infiltrates indoor spaces;

2) construction impacts, as where construction of an indoor space generates outdoor environmental externalities;

3) displacement effects, as where the existence of an indoor space displaces an outdoor space (or vice versa);

4) exposure-based effects, as where exposures to indoor (or outdoor) pollutants increases vulnerability to harm from outdoor (or indoor) pollutants;

5) behavioral impacts, as where indoor behaviors (such as energy use) generate outdoor environmental externalities; and

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[128] Such a species could develop through spontaneous mutation, and in response to selective pressures over multiple generations, where interbreeding with other populations was impossible.

> **6) psychological impacts**, such as via the effects of indoor environmental quality on perceptions of the quality, vulnerability, or value of outdoor spaces.

Further exploring these varying types of interactions may help in understanding both the stakes and the qualitative impact of more fully incorporating the indoors into our understanding of environmental systems.

Environmental law and policy experts are perhaps most familiar with what I am calling "exchange-based effects," where there is some direct impact of either indoor environmental quality on the outdoors, or vice versa. After all, a great deal of environmental law and policy already deals with one direction of this impact: pollution control mechanisms that regulate (indoor-generated) emissions, such as via air quality emissions control, effluent limitations, or solid waste disposal requirements. Significant scientific research also reveals that outdoor environmental quality impacts indoor environmental quality.[129] For example, outdoor air quality affects indoor air quality, outdoor temperature affects indoor temperature, and the quality of water that is piped into a building affects the quality of water that is available at the tap. Recognizing that indoor spaces are situated within the larger environment may help in considering, accounting for, and managing these interactions.

Another important interaction between indoor and outdoor spaces relates to construction **impacts**. Land use choices, such as whether and how to develop and construct buildings, have significant effects on environmental quality.[130] These impacts arise from the generation and use of raw materials to construct indoor spaces and in the actual construction process, which may generate more or less degradation of the surrounding outdoor environment depending upon methods used.[131] Although less salient for most environmental law practitioners, construction of built outdoor spaces can, of course, also impact indoor environmental quality.[132] On this front, consider the construction of a highway: while the existence of the highway will likely directly impact nearby indoor structures by decreasing air quality and increasing noise, the construction itself may also increase air pollution and decrease local water quality.

A related but distinct set of interactions between indoor and outdoor environmental quality arises where the mere existence of an indoor/outdoor space causes **displacement** of other uses, thereby

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[129] *Report on the Environment: Indoor Air Quality*, U.S. ENV'T PROT. AGENCY, https://perma.cc/5Z59-QZBS (last visited Feb. 23, 2024).

[130] *See* Grace Alexander et al., *Reconciling Housing and the Environment: Is It Possible and How?*, OECD ECOSCOPE (July 12, 2021), https://perma.cc/Q8WZ-QENK.

[131] *See, e.g.*, *Smart Growth and Affordable Housing*, U.S. ENV'T PROT. AGENCY, https://perma.cc/5L48-TEKR (last visited Feb. 23, 2024).

[132] *See* Tasneem Amina et al., *Environmental Factors Affecting Indoor Air Quality (Educational Institution) in Urban Settings*, 15 BIOLOGICAL F., May 20, 2023, at 1369, 1371 ("Outdoor construction sites affect[] indoor air quality around educational institutes.").

generating outdoor/indoor environmental externalities. The presence of buildings may crowd out or displace outdoor ecosystems, for instance, contributing to ecosystem degradation. Alternatively, a building may affect the functioning of natural systems by impacting runoff, generating heat islands, or creating a barrier to migration. The mere presence of outdoor spaces may also affect indoor environmental quality by preserving access to sunlight or offering some adjacency bonus, such as territorial views or a vista over a park.

Exposure-based effects can also arise where exposure to a pollutant indoors (or outdoors) affects vulnerability to other exposures. Such interactions may be especially important where pollutants exhibit nonlinear dose-response functions.[133] Environmental agencies interested in outdoor environmental quality have long recognized the importance of tracking indoor exposures;[134] such reasoning underlies the best existing research on the time that people spend indoors.[135] At a basic level, lower-quality spaces either indoors or outdoors that create higher exposures to pollutants will increase vulnerability, either by reducing overall health status and generating or exacerbating pre-existing conditions (such as asthma), or by increasing the total dose of pollutant to which people (or nonhumans) are exposed.[136] By contrast, increasing environmental quality either indoors or outdoors can decrease total exposure levels, thereby increasing starting health status and decreasing the total dose received.[137]

Another important set of interactions between indoor and outdoor environmental quality are **behavioral impacts**, where actions taken in one space generate environmental externalities in another. One important set of behaviors in this category relates to energy use; people routinely use energy to turn on lights, cool or heat rooms, run air purifiers and ventilation systems, or vacuum, for example. These behaviors tend to increase indoor environmental quality, but the generation of energy used to perform them creates a number of (largely outdoor) environmental externalities.[138] These depend significantly upon the type of energy used—whether natural gas, heating oil, electricity (and of what

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133 For a discussion of varying policy implications of pollutants with differing dose-response functions, see Arden Rowell, *Allocating Pollution*, 79 U. CHI. L. REV. 985, 988–89 (2012).

134 *E.g.*, *A Guide to Indoor Air Quality*, *supra* note 22.

135 *See, e.g.*, Klepeis et al., *supra* note 3, at 1 (reporting on indoor exposures for the purposes of informing exposure models for outdoor pollution).

136 Laura G. Hooper & Joel D. Kaufman, *Ambient Air Pollution and Clinical Implications for Susceptible Populations*, 15 ANNALS AM. THORACIC SOC'Y S64, S65 (2018).

137 *Id.* at S66–S67; *see also* Felicia Wu et al., *Improving Indoor Environmental Quality for Public Health: Impediments and Policy Recommendations*, 115 ENV'T HEALTH PERSPS. 953, 956 (2007) (giving the example of wide-spread lead-based paint remediation which resulted in dramatic blood lead level declines in children).

138 Michelle L. Bell et al., *Adverse Health Effects of Particulate Air Pollution*, 20 EPIDEMIOLOGY 682, 684 (2009).

type)—but will often include outdoor air pollution, water pollution, and emission of greenhouse gases.[139]

Finally, it may be worth considering psychological interactions between indoor and outdoor environmental quality. Most people spend much of their lives at least somewhat separated from outdoor environmental quality, within the shelter of indoor spaces.[140] How does this affect human perception, understanding, and valuation of outdoor environmental quality? How does this affect their attention to, understanding of, and interest in outdoor environmental quality?

Recognizing these interactions between indoor and outdoor environmental quality can underscore the dividends to be paid by recognizing how indoor spaces function as an important part of the environment. For current purposes, however, the key point is simply that excluding indoor spaces from our understanding of "the environment" obscures important interactions between indoor and outdoor spaces, and thus contributes to an incomplete understanding of environmental quality. Whether the primary interest of environmental law should be humans, nonhumans, or even the outdoors, the indoors also matters.

IV. NEGLECT OF THE INDOORS

This Part expands upon the argument that the indoors is an important part of the environment in two ways: by highlighting ways that current environmental law neglects indoor spaces (despite the relevance of expertise on environmental hazards), and by exploring the potential reasons for this neglect. It concludes that psychological and social factors may explain—but do not justify—legal neglect of human-built indoor spaces.

A. Legal Neglect of the Indoors

Establishing that environmental law and policy neglects indoor spaces—or that it focuses on outdoor spaces to the exclusion of indoor ones—is both an easy task and a difficult one. It is difficult in the sense that proving a negative—an omission—is always difficult. It is easy in the sense that, at least as a starting point, readers in the field can check their own experiences and understanding to evaluate the truth of the proposition. Readers are likely to realize that (when they think about it)the outdoor focus of environmental law and policy is such that one may attend entire conferences without encountering indoor projects; read entire textbooks without addressing indoor environmental quality; and peruse many thousands of pages of environmental impact statements and

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139 Bob Schildgen, *What's Better for the Environment, Heat Pumps or Furnaces?*, SIERRA CLUB (May 27, 2019), https://perma.cc/DLR9-S36U; *Benefits of Renewable Energy Use*, UNION OF CONCERNED SCIENTISTS (Dec. 20, 2017), https://perma.cc/J7TA-MPYW.

140 Wu et al., *supra* note 137, at 953 ("People in modern societies spend more than 90% of their time in indoor environments.").

environmental rulemakings without encountering mention of indoor environmental impacts. People simply do not think of the indoors when they think of environmental law and policy—or, for that matter, of environmental law when they think of the indoors.

Practitioners may also recognize—in their colleagues and perhaps themselves—a kind of identity-based attachment to the outdoors; a sort of pride in being an "outdoorsy" discipline. Those in the field enact this, for example, through the sporting of outdoor gear—hiking boots, sandals, or technical hiking jackets—even in professional spaces. Practitioners perform "outdoorsiness" socially as well, in outdoor hiking excursions attached to conferences and in conversations about where to find the area's best paddling or skiing. Such identity-based actions reinforce the intuitive sense in the field that what "we" are engaged in is a study of the law and policy of the outdoors.

We then mirror this in the coverage of courses we teach, the comments and scholarship that we write, and the cases that we bring. It is also evident in the intuitive practice and interpretation of laws that address environmental quality and the institutions and structures of environmental authority. Though generally subconscious, environmental law and policy's outdoor orientation then contributes to indoor environmental quality being regulated by non-environmental authorities,[141] and to the treatment of indoor environmental quality as a discretionary bonus[142] or—when it is addressed—as merely an instrument for the better regulation of outdoor environmental quality.[143]

Even in the most comprehensive environmental legislation—such as the constellation of statutes around the world requiring environmental impact assessments prior to government action[144]—lawmakers have seemingly subconsciously narrowed the required analysis to consider *outdoor* environmental impact. The pattern repeats in media-specific environmental legislation, as with the Clean Air Act in the United

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141 Consider, on this front, that it is the World Health Organization (rather than, say, the United Nations Environment Programme) who has taken primary steps to address the global hazards of indoor air pollution. *See* WORLD HEALTH ORG., WHO GUIDELINES FOR INDOOR AIR QUALITY: SELECTED POLLUTANTS 1–2 (2010) (detailing The World Health Organization's involvement in setting indoor air quality standards).

142 EPA, for example, treats regulation of household products containing VOCs as required only insofar as they impact outdoor air quality under the Clean Air Act. *See, e.g.*, *Does EPA Regulate Volatile Organic Compounds (VOCs) in Household Products?*, U.S. ENV'T PROT. AGENCY (Mar. 15, 2023), https://perma.cc/UR3S-3LZT (also explaining EPA's limited authority with regard to indoor air quality).

143 Even the chief study of time people spend indoors was generated for developing exposure models for outdoor environmental quality. *See* Kleipeis et al., *supra* note 3, at 234 (reporting on surveys guided by air pollution, pesticides, drinking water, and exposure modeling scientists to assist EPA in creating computer-based human exposure models).

144 *See, e.g.*, NEPA, 42 U.S.C. § 4332(2)(C) (2018); *see also* U.N. ENV'T PROGRAMME, ASSESSING ENVIRONMENTAL IMPACTS: A GLOBAL REVIEW OF LEGISLATION 6 (2018).

States,[145] or the long disassociation between drinking water as treated and delivered at the street versus drinking water consumed indoors at the tap. Importantly, the focus on the outdoors is often a matter of interpretation or presumption rather than text; in general, legislation on environmental quality reasonably addresses the "environment" or a media such as "air," rather than the "outdoor environment" or "outdoor air." This is not universally true, of course—it is clearly possible to draft legislation that is explicitly only about the outdoors environment, and there are at least a few statutes that include such limitations.[146] But, that it is possible to include explicit textual limitations only begs the question of why implicit limitations are read into so many pieces of legislation.In addition to the (relatively rare) laws that explicitly restrict themselves to outdoor environmental quality, there are also pieces of environmental legislation and regulation with primarily or essentially outdoor impacts; consider the creation of the Natura 2000 network,[147] Marine Protected Areas, and National Parks, or the preservation of protected or endangered species whose critical habitats are outdoors. This is not a troubling observation; the outdoors, after all, is also an important part of the environment. The puzzle is why a focus on the outdoors seems to lead to simultaneous neglect of the indoors.

To be clear, again, this is not a claim that *no one* ever thinks about indoor spaces or that everyone neglects indoor hazards. Large cohorts of smart, educated people in other fields—including architecture, engineering, and public health—have dedicated whole careers to indoor hazards and quality, and the COVID-19 pandemic heightened this attention, especially with regard to air quality.[148] The concern here, however, is (largely subconscious) neglect of these spaces by *environmental law and policy*. Occupational hazards, pollution from indoor cooking, bacterial contamination of water pipes, radiation exposure inside airplanes, the use of pesticide-treated bed nets to combat mosquito-borne illness, conditions inside prisons, air quality in vehicles—rather than treat these as matters that touch on the core of environmental expertise, environmental law and policy delegates them to experts in other areas.

Why does it matter if environmental law and policy is viewed—either by adjacent disciplines or indeed by environmental law and policy practitioners themselves—as offering relevant authority or expertise on the indoors? It matters because environmental law and policy offers important legal, technical, and ethical expertise on the question of how

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145 *See* CAA, 42 U.S.C. § 7401 (2018) (framing the issues confronted by the Clean Air Act as "injury to agricultural crops and livestock, damage to and the deterioration of property, and hazards to air and ground transportation").

146 *See, e.g.*, CONN. GEN. STAT. § 22a-170 (2023) (defining air pollution as "the presence in the outdoor atmosphere of one or more air pollutants or any combination thereof").

147 *The Natura 2000 Protected Areas Network*, EUR. ENV'T AGENCY, (Feb. 28, 2023) https://perma.cc/5EGG-2M3R. Natura 2000 is a network of areas across the European Union protected from destruction to ensure the existence of special habitat and species. *Id.*

148 *Post-Pandemic, an Increasing Focus on Indoor Air Quality*, *supra* note 24.

environmental hazards can and should be managed. Environmental law and policy has developed that expertise for the last fifty years, and during that half century, the field has identified many skills, tools, patterns, and frequently asked questions designed to address environmental problems, manage environmental quality, and address environmental harms.[149] Study of environmental hazards has shown them to be particularly challenging targets for management, given their indirect qualities, their diffusion through time and space, their complexity, and the interactions they present between nonhuman species and natural processes.[150] Over the decades, environmental law and policy has developed methods for addressing some of these challenges—for evaluating complex ecological interconnections and externalities, for calculating nonlinear dose-response curves and the importance of tipping points, for grappling with exposures, risks, and uncertainty.[151] These issues arise indoors as well as outdoors. Why reinvent the wheel?

Indeed, attempting to do so may be dangerous as well as wasteful. When environmental law and policy experts excuse themselves from environmental discussions, it impoverishes decision making—to potentially tragic ends. Consider the progress that environmental law and policy experts might have made before the COVID-19 pandemic they had considered indoor air quality or ventilation to be an important part of their bailiwick.[152] Or consider the possibility that environmental law and policy experts could have played a role in more promptly identifying the correlation between insecticide resistance and the waning impact of insecticide-treated bed nets in anti-malarial initiatives.[153] This is not to say that the progress being made now is inappropriate or illegitimate. It is simply to emphasize the stakes of involving environmental law and policy in the management of indoor hazards, and the value of doing so to manage environmental hazards well—whether those hazards arise indoors or out.

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149 *See, e.g.*, RICHARD LAZARUS, THE MAKING OF ENVIRONMENTAL LAW 251–54 (2004) (providing a history of the field).

150 *See id.*; *see also* PSYCHOLOGY OF ENVIRONMENTAL LAW (summarizing the legal and psychological challenges presented by the diffuse, complex, and nonhuman character of environmental injury).

151 *See, e.g.*, THE MAKING OF ENVIRONMENTAL LAW, *supra* note 141; *see generally*, POLICY INSTRUMENTS IN ENVIRONMENTAL LAW (Josephine van Zeben and Kenneth Richards eds.) (2020).

152 *See, e.g.*, *Post-Pandemic, an Increasing Focus on Indoor Air Quality*, *supra* note 24 ("[P]aying attention to buildings, and how to make them healthier through better air handling systems, would have saved countless lives from the [COVID-19] virus.").

153 *WHO Publishes Net Recommendations, supra* note 79 (recommending the use of dual ingredient insecticide treated nets using pyrethroid-chlorfenapyr or pyrethroid-pyriproxyfen in order to enhance the potency of pyrethroids against resistant mosquitoes).

B. Explaining Indoor Neglect

If the indoors is part of the environment, why has environmental law and policy evolved in a way that neglects indoor spaces, even as it has developed increasing sophisticated ways of managing environmental hazards outdoors? This section points to several interconnected psychological and social factors that may have contributed—albeit subconsciously—to environmental law and policy's neglect of indoor environments. It concludes that these factors, while potentially explanatory, do not ultimately justify the neglect.

1. The Psychological Obscurity of Indoor Environmental Risks

In past work, Kenworthey Bilz, and I have suggested that the neglect of indoor environments may be at least partially psychological.[154] People exhibit a number of psychological challenges in managing environmental risks. Some of these challenges may be exacerbated when those risks present themselves indoors.[155]

First, consider general findings in environmental law and psychology, which suggest that people struggle to perceive, understand, and value environmental injury because of its distinctively diffuse, complex, and nonhuman qualities.[156] That environmental injuries often span space and time, for example, makes such injuries less vivid and imaginable, and thus more likely to be underestimated in both likelihood and severity.[157] The complexity of environmental injury triggers a tendency towards acting as a "cognitive miser," and to simplify complex problems to understand them;[158] such simplification heuristics are particularly likely to "misfire" and mistake when operating in

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154 *See* PSYCHOLOGY OF ENVIRONMENTAL LAW, *supra* note 20, at 173–74.

155 *Id.*

156 *See generally id.* at 173–75; *see also* ROWELL ET AL., *supra* note 39, at 3 (summarizing the psychological distinctiveness of environmental injury).

157 *See, e.g.*, Daniel Kahneman & Amos Tversky, *Prospect Theory: An Analysis of Decision Under Risk*, 47 ECONOMETRICA 263, 265 (1979) (stating that under the certainty effect, "people overweigh outcomes that are considered certain, relative to outcomes which are merely probable"); Amos Tversky & Daniel Kahneman, *Judgment Under Uncertainty: Heuristics and* Biases, 185 SCIENCE 1124, 1124 (1974) (discussing how people assess the probability of an uncertain event or the value of an uncertain quantity); Timur Kuran & Cass R. Sunstein, *Availability Cascades and Risk Regulation*, 51 STAN. L. REV. 683, 685 (1999) (stating that the availability heuristic is key to an individual's judgment and perception); Wiener, *Beyond the Balance*, *supra* note 37, at 14 (stating that while change is inevitable, what matters in our choice of which changes are benign and which are adverse to preservation of the environment); *see also* PSYCHOLOGY OF ENVIRONMENTAL LAW, *supra* note 20, at 31–62 (summarizing the psychological implications of the diffusion of environmental injury).

158 *See* SUSAN T. FISKE & SHELLEY E. TAYLOR, SOCIAL COGNITION FROM BRAINS TO CULTURE 15 (3d ed. 2017); *see also* THE PSYCHOLOGY OF ENVIRONMENTAL LAW, *supra* note 20, at 63–92 (summarizing the psychological implications of complexity in environmental injury).

legitimately high-complexity systems,[159] such as those presented by nonlinear and interactive dose-response relationships or the management of nonhuman and human behaviors and responses within a larger, interconnected ecosystem. In such cases, people fall back on straightforward but oversimplified understandings of risk, perceiving novel sources and types of risk as more dangerous than familiar ones.[160] Finally, people—who must operate within social brains, embedded with a stucture that is optimized and accustomed to gleaning meaning from other humans[161]—often struggle to process the nonhuman impacts, stakeholders, and processes implicated by environmental injury.[162]

Each of these factors may help in understanding how environmental harm—even outdoors—is prone to neglect. Additional research, however, may have special import for *indoor* environmental risks, as it suggests a particular tendency to neglect and minimize such risks[163] and thus to lack motivation to actively manage those risks.[164] To understand these findings, it may be helpful to consider three lines of psychological research: perception of familiar risks, the psychology of shelter, and the impact of sleep.

First, consider the possibility the fact people spend so much time in indoor spaces increases the familiarity of those spaces.[165] Risk perception research strongly suggests that people discount risks that are familiar.[166] Research also shows that people tend to systematically underestimate

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159 *See* Gretchen B. Chapman & Eric J. Johnson, *The Limits of Anchoring*, 7 J. BEHAVIORAL DECISION MAKING 223, 226 (1994); *see also* Rowell, Bilz & Li, *supra* note 39 (manuscript at 6).

160 *See* Paul Slovic, *Perception of Risk*, 236 SCIENCE 280, 281, 283 (1987) (discussing how unobservable, new, and unknown risks are perceived as riskier and more dangerous).

161 *See* Ralph Adolphs, *The Social Brain: Neural Basis of Social Knowledge*, 60 ANN. REV. PSYCH. 693, 706 (2009) (discussing how specific areas of the human brain are activated when tasked with understanding the intentions and beliefs of others).

162 *See* Rowell, Bilz & Li, *supra* note 39 (manuscript at 7) (summarizing psychological challenges presented by the nonhuman character of environmental injury); *see also* THE PSYCHOLOGY OF ENVIRONMENTAL LAW, *supra* note 20, at 93 (discussing how humans experience psychological barriers in comprehending harms to the nonhuman environment and its implication in environmental law).

163 *See* Peter Dingle & Fairuz Lalla, *Indoor Air Health Risk Perceptions in Australia*, 11 INDOOR & BUILT ENV'T 275, 277 (2002) (discussing how the public views the indoors as a means to escape the outdoor pollution); D.J. Moschandreas & P.E. Chang, *On the Use of a Risk Ladder: Linking Public Perception of Risks Associated with Indoor Air with Cognitive Elements and Attitudes Toward Risk Reduction*, 28 ATMOSPHERIC ENV'T 3093, 3098 (1994) (describing low concern about indoor air risks, albeit pre-pandemic); Sonny Rosenthal, *Measuring Knowledge of Indoor Environmental Hazards*, 31 J. ENV'T PSYCH. 137, 137 (2011) (finding significant gaps in knowledge of indoor environmental hazards).

164 Meg Gerrard et al., *A Longitudinal Study of the Reciprocal Nature of Risk Behaviors and Cognition in Adolescents: What You Do Shapes What You Think, and Vice Versa*, 15 J. HEALTH PSYCH. 344, 345 (1996).

165 THE PSYCHOLOGY OF ENVIRONMENTAL LAW, *supra* note 20, at 173–75.

166 Paul Slovic et al., *Perception of Risk*, 236 SCIENCE 280, 282 (1981); Paul Slovic et al., *The Affect Heuristic*, 177 EURO. J. OPERATIONAL RSCH. 1333 (2007).

risk from familiar sources.[167] Personal, identity-related sources of risk—such as those stemming from familiar people—are especially likely to be discounted. Thus people tend to estimate the risk of sexual aggression by an acquaintance as lower than by a stranger, and to believe that their romantic partners are less likely to cheat on them than the actual rate of infidelity suggests.[168] They also (inaccurately) underestimate the likelihood of health risks that have come to seem familiar to them, such as heart disease, stroke, asthma, and diabetes.[169]

Of course, people may encounter familiar risks and risk sources outside as well as inside; indeed, this tendency provides a psychological explanation of the popularity of environmental grandfathering schemes and people's tolerance of "hometown pollution," or of familiar sources of pollution that have become normalized and thus seem less risky.[170] But the fact that people spend so much of their lives indoors exacerbates this phenomenon. Indoor risks and sources of risk therefore have even greater opportunity to become familiar and slide under the psychological radar. For environmental hazards associated with a sense of coziness—such as home cooking, the lighting of scented candles, or a crackling wood fire—the tendency to dismiss attendant risks may be even greater.[171]

A related psychological factor that may subconsciously further neglect of environmental risks, and which is distinctive to indoor environments, is the psychological implications of a sense of shelter. On this front, we might begin by recalling psychologist Maslow's famous "hierarchy of needs," a highly influential motivational theory meant to describe what humans are motivated to seek out.[172] Individuals must

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167 PETER M. SANDMAN, RESPONDING TO COMMUNITY OUTRAGE: STRATEGIES FOR EFFECTIVE RISK COMMUNICATION 19 (2012), https://perma.cc/C6ZS-NP68.

168 *See* Paula Nurius, *Risk Perception for Acquaintance Sexual Aggression: A Social-Cognitive Perspective*, 5 AGGRESSION & VIOLENT BEHAVIOR 63, 63–65 (2000) (finding that women report a low level of perceived personal risk regarding rape by an acquaintance rather than a stranger); Sarah J. Watkins & Susan D. Boon, *Expectations Regarding Partner Fidelity in Dating Relationships*, 33 J. SOC. & PERS. RELATIONSHIPS 237, 241 (2015) (finding that "participants believed their partners were less likely to cheat on them than would be suggested by the actual base rate of infidelity among participants in this study in their current relationships.").

169 Sarah Lichtenstein et al., *Judged Frequency of Lethal Events*, 4 J. OF EXP. PSYCH. 551, 555 (1978) (finding a simultaneous overestimation of some very rare risks, such as those posed by botulism or tornadoes, and underestimation of more common health risks).

170 THE PSYCHOLOGY OF ENVIRONMENTAL LAW, *supra* note 20, at 170.

171 *Id.* at 165–66 (discussing the dangers of positive emotional associations further obscuring the dangers of some pollutants, such as those emitted by candles or woodfires). In this context, cultural concepts of coziness that encourage practices like candle lighting, such as the Danish concept of *hygge*, may contribute to neglect of important sources of indoor pollution. *See* Bente D. Knudsen, *Candles—Deadly Danish Hygge?*, YOUR DANISH LIFE (Nov. 12, 2023), https://perma.cc/K6MM-UF9H (suggesting that Danes "take note that in a country, where on average 16 hours a day are spent at home, candles are more dangerous to your health than most Danes will accept").

172 A. H. Maslow, *A Theory of Human Motivation*, 50 PSYCH. REV. 370 (1943), *reprinted in* CLASSICS IN THE HISTORY OF PSYCHOLOGY (Christopher D. Green ed., 2000) [hereinafter

satisfy those needs lower down in the hierarchy before they can attend to higher needs, and physiological needs—including shelter—make up the base of the hierarchy.[173] In Maslow's model, once people satisfy a set of needs—such as the physiological need for shelter—other needs (for safety, love and belongingness, esteem, self-actualization) become salient.[174] Having shelter thus increases the subjective sense of safety and constancy—to the point that lacking stable shelter generates significant mental health impacts.[175] While associating shelter with safety may make sense as a general matter, however, it may also exacerbate the tendeny to overlook hazards that originate within that shelter.

A further emerging line of psychological and social research highlights the emotional, social, and cultural meaning of shelter, and specifically of the concept of "home."[176] Some research suggests that people associate homes with themselves and their own identity.[177] Indeed, many intrinsically associate "home" with safety and comfort—despite the hazards they face in indoor spaces.[178]

Finally, consider the specific mental blind spot that people exhibit about sleep time. When awake, people cannot consciously remember what happens around them when they sleep.[179] They often struggle to

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Maslow, *A Theory of Human Motivation*], https://perma.cc/3Q8X-CRRT; *see also* ABRAHAM H. MASLOW, MOTIVATION & PERSONALITY 25 (1954) (discussing the prioritization of different "drives or needs").

173 Maslow, *A Theory of Human Motivation*, *supra* note 172, at 372–73, 375.

174 *Id.* at 375–76, 380–82.

175 *See* Deborah K. Padgett, *Homelessness, Housing Instability and Mental Health: Making the Connections*, 44 BJPSYCH BULL. 197, 197 (2020).

176 *See* Katherine Ellsworth-Krebs et al., *Integrated Framework of Home Comfort: Relaxation, Companionship, and Control*, 47 BLDG. RSCH. & INFO. 202, 203 (2018) (providing a qualitative account of the perception and subjective value attached to the comforting sense of home); Lindsay T. Graham et al., *The Psychology of Home Environments: A Call for Research on Residential Space*, 10 PERSPS. ON PSYCH. SCI. 346, 347 (2015) (calling for further psychological research on the role of homes).

177 *See* Graham et al., *supra* note 176, at 348; CLARE COOPER MARCUS, HOUSE AS A MIRROR OF SELF: EXPLORING THE DEEPER MEANING OF HOME 2, 7–9 (1995). Other indoor environments may be less likely to trigger the same emotions or tie so closely to a sense of personal identity, and thus may be less likely to obscure indoor environmental risks. *See* THE PSYCHOLOGY OF ENVIRONMENTAL LAW, *supra* note 20, at 166.

178 *See* John Manuel, *A Healthy Home Environment?* 107 ENV'T HEALTH PERSPS. A352, A353–57 (1999) (contrasting the subjective sense of safety at home with a list of indoor environmental hazards).

179 *See* Roy Cox et al., *Sound Asleep: Processing and Retention of Slow Oscillation Phase-Targeted Stimuli*, PLOS ONE, July 2014, No. 101567, at 1 (describing sleeping organisms as exhibiting "a relative disconnection of their brains from the environment," and explaining that "[w]hile this daily recurring suspension of 'online' processing comes at a risk, it also allows brains to perform 'offline' tasks they cannot carry out during the constant sensory bombardment of wakefulness"). Interestingly, some research suggests that some learning can happen unconsciously while people sleep—but that learning remains "consciously inaccessible in the waking state." Simon Ruch & Katharina Henke, *Learning During Sleep: A Dream Come True?*, 24 TRENDS COGNITIVE SCIS. 170, 171 (2020).

accurately report even the quality or duration of their own sleep.[180] Environmental factors during sleep—such as noise pollution, light pollution, temperature, humidity, and a window facing natural amenities (such as green space or water)— affect sleep quality,[181] as does indoor air pollution.[182] Meanwhile, exposure to inhalation hazards, radiation, and contact-based toxic substances can happen as easily while asleep as while awake. But because sleep-time exposures occur outside conscious awareness, such impacts are especially easy to neglect. That the fact that people are inattentive to their surroundings during periods (often six to seven hours a day) where they literally lack consciousness may help to explain the difference between the amount of time people report spending indoors and the amount time people actually spend indoors.[183]

Combining the factors noted above suggests that individuals will face a special set of challenges in managing the environmental quality of indoor spaces, and perhaps especially of their own homes. Detecting, understanding, and evaluating the potential sources of indoor environmental hazards is already a tall informational order for any decisionmaker—and one likely to be subject to typical psychological factors that make environmental risks difficult to perceive, understand,

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180 Diane S. Lauderdale et al., *Objectively Measured Sleep Characteristics among Early-Middle-Aged Adults: The CARDIA Study*, 164 AM. J. EPIDEMIOLOGY 5, 6, 12 (2006) (noting that "[s]elf-reports of usual sleep hours may not be particularly accurate," and finding that objectively measured sleep duration was shorter than self-reported sleep duration); Katarina Aili et al., *Reliability of Actigraphy and Subjective Sleep Measurements in Adults: The Design of Sleep Assessments*, 13 J. CLINICAL SLEEP MED. 39, 39 (2017) (finding "a low correlation between the investigated [objective] sleep parameters and subjective sleep quality"); Dayna A. Johnson et al., *Environmental Determinants of Insufficient Sleep and Sleep Disorders: Implications for Population Health*, 5 CURRENT EPIDEMIOLOGY REPS. 61, 65 (2018) (noting that "subjective measures of sleep . . . do not correlate well with objective sleep measures").

181 *See* Johnson et al., *supra* note 180, at 62.

182 *See* Fu Wei et al., *Association Between Chinese Cooking Oil Fumes and Sleep Quality Among a Middle-Aged Chinese Population*, 227 ENV'T POLLUTION 543 (2017).

183 *Compare* YouGov, *supra* note 1, at 5 *with* Klepeis et al., *supra* note 3, at 248 (indicating a difference in perceived and recorded indoor time averaging 6.2 hours). Americans sleep an average of 6.8 hours a night. Jeffrey M. Jones, *In U.S., 40% Get Less Than Recommended Amount of Sleep*, GALLUP (Dec. 19, 2013), https://perma.cc/ZMC2-TLQM. Few Americans sleep outdoors. *How Many Homeless People are in the US? What Does the Data Miss?*, USA FACTS (May 23, 2023), https://perma.cc/XUF5-MMLE (finding that about 18 out of every 10,000 Americans are unhoused). Even people experiencing homelessness—of which the Department of Housing and Urban Development (HUD) reports about 582,000 in the U.S.—often sleep in some kind of shelter, either because of weather, safety, and exposure concerns, or because of the increasing number of states and cities making sleeping outside illegal. TANYA DE SOUSA ET AL., U.S. DEP'T OF HOUS. & URBAN DEV., 2022 ANNUAL HOMELESSNESS ASSESSMENT REPORT (AHAR) TO CONGRESS: PART 1: POINT-IN-TIME ESTIMATES OF HOMELESSNESS 2 (2022) (reporting that, amongst people experiencing homelessness, "[s]ix in ten (60%) were staying in sheltered locations—emergency shelters, safe havens, or transitional housing programs—and four in ten (40%) were in unsheltered locations such as on the street, in abandoned buildings, or in other places not suitable for human habitation"); *see also* Samantha Fields, *As Homelessness Rises, Some States Make It Illegal to Sleep Outside*, MARKETPLACE (Aug. 11, 2022), (reporting laws against sleeping outside across more than 150 cities and 7 states).

and value.[184] When people must manage the indoor environmental quality of their *own* indoor spaces, however, they face additional barriers. Some of these are, in a sense, obvious; people cannot actively manage, or even remember, their own environmental quality while sleeping. Even while awake, however, people's intuitive perception of the quality of their environment is likely to be distorted by familiarity and a sense of shelter. To fully calibrate their management of indoor environmental quality, individuals (or businesses, or institutions) must overcome not only the practical difficulties in detecting and responding to indoor environmental risks; they must also manage a series of psychological phenomena and heuristics that, however evolutionarily sound, lead to systematic neglect, oversimplification, and undervaluation of indoor environmental risks.

2. Historical and Social Factors Contributing to Legal Neglect of the Indoors

A related set of historical and social factors may also contribute to the neglect of indoor spaces by environmental law and policy. In particular, it is worth considering how historical and social conceptions of "the environment" have shaped—and continue to shape—people's beliefs about where the environment is located.

Consider the impact of accounts of humans as separate from nature.[185] Such views conceive of humans as standing apart from nature, either because humans have dominion over nature,[186] or, per 19th century Romanticism, because nature is intrinsically sublime and only by association with humans can it be tainted.[187]

The Romantic separatist account has had a special impact in the development of U.S. environmental law, where Romantic thought played a central role in the development of early land conservation

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184 *See* THE PSYCHOLOGY OF ENVIRONMENTAL LAW, *supra* note 20, at 29–30 (outlining various psychological factors that make environmental injuries difficult to perceive).

185 Jonathan Baert Wiener, *Law and the New Ecology: Evolution, Categories, and Consequences*, 22 ECOL. L.Q. 325, 340–45 (1995) (tracking the "separatist intuition" that "human action is separate from nature"); *see also* Wiener, *Beyond the Balance*, *supra* note 37, at 3–5 (distinguishing between multiple types of separatist intuition based upon their view of mankind as appropriately dominating, stewarding, or preserving nature).

186 *See* Wiener, *Beyond the Balance*, *supra* note 37, at 3–5; *see also* KEITH THOMAS, MAN AND THE NATURAL WORLD: A HISTORY OF THE MODERN SENSIBILITY 17 (1983) (reviewing Tudor-era dominion-based views of human relationships with nature); Lynn White, Jr., *The Historical Roots of Ecologic Crisis*, 155 SCIENCE 1203, 1203–07 (1967) (arguing that implementations of dominion-based accounts of human relationship with nature generate ecological crisis). The concept of dominion over the natural world also has obvious religious overtones. *See Genesis* 1:26 ("Then God said, 'Let us make man in our image, in our likeness, and let them rule over the fish of the sea and the birds of the air, over the livestock, over all the earth, and over all the creatures that move along the ground.'").

187 *See* Thomas R. Cox, *Americans and Their Forests: Romanticism, Progress, and Science in the Late Nineteenth Century*, 29 J. FOREST HIST. 156, 156–57 (1985) (describing the American development of Romantic and transcendentalist accounts of unsullied wilderness).

movements.[188] In particular, Romantic portrayals of wilderness "untrodden by man"[189]—in poetry, prose, paintings, and eventually photography[190]—helped spur establishment of public lands schemes, including the National Park System.[191] Although especially influential in the United States, Romantic movements in Europe also generated important shifts in social values regarding the environment.[192]

Romantic portrayals of nature focused explicitly on the outdoors, including as a tonic to the indoors. Consider the ideal of a withdrawal from human civilization and a "return to nature," as advocated for in Henry David Thoreau's *Walden*—originally titled *Walden: or, a Life in the Woods*—or of leaving the "over-civilization" of indoor human-built spaces to experience nature outside.[193] Although not explicitly used to justify neglect of indoor spaces, such appeals may imply a Romantic intuition behind such neglect. Of course, as noted above, not all indoor spaces are human-built; termites, beavers, and many other animals also create indoor shelters and buildings.[194] And human-built structures house billions of nonhuman animals.[195] These facts make it difficult to cleanly separate indoor "human" spaces from outdoor "natural" ones.

Separatist accounts of nature as divorced from humans may retain intuitive appeal for many. Yet it is important to recognize that the idea that humans are separate from nature predates—and is largely inconsistent with—modern ecological understandings of the relationship between humans and the environment.[196] Modern environmental lawis based on an understanding of the interconnection of ecosystems, species,

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188 *See id.* (exploring the role of historical Romanticism, progress, and science on the development of conservation movements); THE PSYCHOLOGY OF ENVIRONMENTAL LAW, *supra* note 20, at 180–85; *see also* HENRY DAVID THOREAU, WALDEN (1910); JOHN MUIR, THE STORY OF MY BOYHOOD AND YOUTH (Houghton Mifflin Company, The Riverside Press, Cambridge 1913).

189 *See* GEORGE PERKINS MARSH, MAN AND NATURE 27, 34 (1869) (advocating for nature to be "left undisturbed" and "untrodden by man"); *see also* Wilderness Act of 1964, 16 U.S.C. §§ 1131–1136 (defining wilderness areas as those "where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain").

190 *See* Lily Rothman & Liz Ronk, *These 1861 Photographs Helped Save America's Wilderness*, TIME (Aug. 22, 2016), https://perma.cc/H4DK-QF4Q.

191 *See* Cox, *supra* note 187, at 159; *see also* RODERICK FRAZIER NASH, WILDERNESS AND THE AMERICAN MIND 1–7 (5th ed. 2014) (tracing historical and social conceptions of wilderness in the United States).

192 JOHN A. WILLIAMS, TURNING TO NATURE IN GERMANY: HIKING, NUDISM, AND CONSERVATION, 1900–1940, at 2, 10–12 (2007) (explaining that the Romantic period in Germany supported the development of a number of *Lebensreform* movements, including the precursors of modern naturopathy).

193 *See* THOREAU, *supra* note 188, at 232; *see also, e.g.*, WILLIAM WORDSWORTH, TO MY SISTER (1798), *reprinted in* POEM ANALYSIS, https://perma.cc/78LC-SCSP (last visited Feb. 22, 2024) (exhorting his sister to "come forth [outdoors] and feel the sun").

194 *See* discussion *supra* Part II.

195 *See* discussion *supra* Part III.B.

196 *See* Wiener, *Beyond the Balance*, *supra* note 37, at 3–5 (analyzing inconsistencies perceptions of humans as "separate from nature" and modern empirical understanding of the environment); Laitos & Wolongevicz, *supra* note 38, at 4 (arguing that environmental laws fail when they are based on the (false) notion that humans are separate from nature).

and systems, and on an understanding that humans are part of the ecosystems in which they live. This understanding of environmental law demands that we calibrate our conception of the environment to include all of the interconnected spaces that humans inhabit and affect.

3. Evaluating Neglect

In sum, psychological research on risk perception suggests that people may struggle to perceive, understand, and value environmental harms. The familiar, shelter-based context of indoor environmental risks, as well as the tendency for people to exhibit both sleep-blindness and inattention to their own pollution, may generate even greater psychological barriers to recognizing and addressing *indoor* environmental risks. And the psychological tendency to neglect indoor risks may be further exacerbated, at least in the United States, by a social and historical legacy of Romantic, non-ecological conceptions of nature as separate from humans—a legacy that no longer reflects modern conceptions of the environment but which may nevertheless continue to animate unreflective and emotional intuitions. These factors may combine to create inadvertent path dependence, and to a kind of scholarly channeling towards the outdoors that has become entangled with the personal identity of many scholars and practitioners of environmental law.

These are not good reasons to continue theoretical and applied neglect of indoor environmental quality. It remains important for environmental law and policy to continue in its tradition of successes addressing outdoor environmental quality. It may turn out to be the case that the outdoors implicates distinctive qualities that deserve special forms of attention and regulation—if so, however, we can best understand the distinctive qualities of outdoor environments by comparing them to the distinctive qualities of indoor environments. In the meantime, thinking comprehensively about indoor and outdoor space is important to the future integrity and effectiveness of a field that is based upon interconnected, ecological understandings of the environment.

V. IMPLICATIONS

This Part explores some of the logical, legal, and institutional implications that flow from recognizing that the indoors is part of the environment.It argues that reimagining the environment to include indoor spaces has legal, constitutional, institutional, and interpretive implications. As noted above, recognizing indoor environments has potentially transformative constitutional implications for the many countries in the world who have incorporated environmental rights into their constitutions (or who view environmental rights as human rights). At the least, "seeing" indoor spaces highlights the importance of asking whether those rights apply to indoor as well as outdoor environmental quality—and if not, why not, and according to what limiting principle.

Meanwhile, even beyond constitutional or human rights implications, indoor spaces present a series of institutional puzzles. In the United States, for instance, indoor spaces implicate questions of federalism, while in the European Union (EU), recognizing the indoors as part of the environment may trigger reevaluation of the reach of EU environmental competence. Finally, recognizing the indoors as part of the environment puts pressure on past interpretations of environmental laws, at least insofar as those interpretations presumed that the environment existed only outside human-built walls.

From a policy perspective, meanwhile, conceiving of the indoors as part of the environment can highlight the importance of having environmental law and policy experts "in" on law, policy, research, and conversations about indoor environmental quality. This may involve outreach both by and to environmental scholars and experts. Finally, reconceptualizing the environment to include indoor and outdoor spaces creates a series of research pathways for scholars. Such pathways include definitional work on the categorization pathways already flagged, defining and specifying types and characteristics of indoor spaces and hazards; normative work on identifying, articulating, and defining priorities in indoor environmental law; and ethical work reflecting on environmental ethics indoors.

A. Implications for Environmental Rights

Is there a right to indoor environmental quality? In addition to emerging arguments that environmental rights are human rights, most constitutions in the world explicitly guarantee some right to environmental quality—in this realm, the United States (along with other former colonies of the United Kingdom) is a notable outlier.[197] For states and legal systems with explicit and/or recognized rights to a clean environment, recognizing that the indoors comprises part of the environment should trigger rexamination of the extent of those rights. Exploring the extent of environmental rights in indoor spaces thus offers a promising area for future scholarly inquiry.

Bringing the indoors into the environment may have important rights-based implications even in jurisdictions without explicit environmental rights. The U.S. Constitution, written in 1789, does not mention the environment at all, much less grant any affirmative environmental rights.[198] Any argument of an affirmative right to indoor environmental quality would thus have to be based on another, non-environmental right. Interestingly, this is an area in which indoor environmental protection may have a firmer constitutional foundation than outdoor environmental protection. Consider, on this front, the

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[197] *See* BOYD, *supra* note 27, at 9, 25–30 (discussing constitutional environmental protections in different countries).

[198] *See generally* U.S. CONST.; *see also* ROWELL & VAN ZEBEN, *supra* note 26, at 11–17 (providing additional context and discussion).

potential use of the Fourteenth Amendment's guarantee of "equal protection of the laws" to address problems of environmental justice.[199] Challenges to state action based on equal protection grounds have generally failed in regards to (outdoor) environmental quality, largely because it is extremely difficult to prove intentional discrimination, which courts have traditionally required for such claims.[200] For at least some indoor spaces, however, the analysis may be different. For public housing in particular, the Supreme Court has applied a disparate impact standard rather than requiring intentional discrimination.[201] As the disparate impact standard is based upon measurable differences in impact rather than intentional discrimination, it offers a plausible route for constitutional claims where at least some indoor spaces (i.e. in public housing) impact protected groups.

Freedoms of religion or privacy may also interact with indoor environmental law..[202] Regulation of indoor environmental quality that affects religious gathering spaces, for example, is most likely to generate potential conflict with individual religious rights, while regulation of residences would presumably trigger greater concerns about privacy.Conflicts have arisen in the past between regulation of outdoor environmental quality and, for example, outdoor religious rituals,[203] so to

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199 U.S. CONST. amend. XIV ("No State shall make or enforce any law which shall . . . deny to any person within its jurisdiction the equal protection of the laws.").

200 *See* U.S. DEP'T OF JUST., C.R. DIV., TITLE VI LEGAL MANUAL: VI PROVING DISCRIMINATION–INTENTIONAL DISCRIMINATION 2–6, https://perma.cc/MNG6-XT8S (discussing practical challenges in proving intentional discrimination).

201 *See* Tex. Dep't. of Hous. & Cmty. Affairs v. Inclusive Cmtys. Project, 576 U.S. 519, 546–47 (2015) (applying the disparate impact standard for purposes of the Fair Housing Act of 1968).

202 Constitutional rights to freedom of religion and privacy obviously vary across nations. The U.S. Constitution explicitly guarantees that the U.S. "Congress shall make no law respecting an establishment of religion, or prohibiting the free exercise thereof." U.S. CONST. amend. I. There is no express right to privacy in the U.S. Constitution, but the U.S. Supreme Court has (sometimes) found an implicit right to privacy derived from other explicitly stated constitutional protections. *See* Griswold v. Connecticut, 381 U.S. 479, 483–485 (1965) (holding that the U.S. Constitution should be interpreted to create a "zone of privacy" for married couples regarding the right to purchase contraceptives); Lawrence v. Texas, 539 U.S. 558, 562 (2003) (extending the right to privacy by relying on the Fourteenth Amendment's guarantee of equal protection to overturn legislation criminalizing intimate sexual conduct between same-sex couples, and explaining that "[l]iberty protects the person from unwarranted government intrusions into a dwelling or other private places. In our tradition the State is not omnipresent in the home. And there are other spheres of our lives and existence, outside the home, where the States should not be a dominant presence"); *see also* Louis Brandeis, *The Right to Privacy*, 4 HARV. L. REV. 193, 193 (1890) (advocating for a right to privacy as a "right to be let alone"). The right to privacy has not (yet) been extended to environmental regulation, though it is worth considering that some of the reasoning given—for example in *Lawrence v. Texas*—might apply to indoor environmental regulation if such regulation were applied to private structures, particularly dwellings.

203 *See, e.g.*, WEXLER, *supra* note 81, at 30–31 (describing how a scientific article concluded that Holi, an Indian religious festival where colorful dyes and liquids are used, has deleterious effects on water resources, soil fertility, and microorganisms living within those

some extent, management of these conflicts has a map to follow for resolution. That said, that so many religious and residential activities occur indoors may place additional pressure on these conflicts, suggesting that further consideration may prove valuable. And, of course, religious actions with environmental impacts will not always occur in separate religious spaces; many religious observances also occur in the home. Some of these observances—such as lighting incense[204] or candles[205]—may have indoor environmental impacts that affect the observer, as well as other inhabitants of or visitors to the residential building or complex. Religious practices may even generate long-term or intergenerational indoor environmental impacts, as with the practice of sprinkling mercury in one's residence to fend off evil—a ritual observance in the Afro-Caribbean religion of Santeria.[206] That practitioners of a religious observance may associate the behavior with ritual purity or purification may, moreover, reduce the extent to which individuals perceive the behavior as (environmentally) polluting.[207] It is beyond the scope of this Article to analyze the interactions of these rights, but it seems worth at least recognizing the ways they relate to the regulation of indoor environmental quality.

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water resources). The article's authors called upon the government to instill greater regulatory control over the hazardous chemicals sold for Holi. *Id.* at 31.

[204] Incense burning is a common practice in many religions, including Buddhism, Hinduism, Taoism; such uses contribute to the burning of 200 million tons of incense per year. Lee et al., *supra* note 82, at 5451. Unfortunately, recent research suggests that inhaling incense smoke—which contains a number of hazardous compounds, including polycyclic hydrocarbons, particulate matter, and carbon monoxide—is a comparable hazard to secondhand cigarette smoke. *See id*. at 5453–54, 5467 (noting higher rates of NOx, particulate matter, and genotoxicity in incense smoke); R. Zhou et al., *Higher Cytotoxicity and Genotoxicity of Burning Incense than Cigarette*, 13 ENV'T CHEMISTRY LETTERS 465, 471 (2015) (finding incense smoke samples more genotoxic and cytotoxic than reference cigarette smoke sample, but declining to infer incense smoke is more dangerous given different routes of administration).

[205] A number of religious traditions commonly use candles, including in Judaism. Walter Alison Phillips, *Lights, Ceremonial Use of*, *in* 16 ENCYCLOPEDIA BRITANNICA, at 2–3, (1911). Unfortunately, research shows that burning candles indoors can substantially impact indoor air quality as it releases fine particulate matter and—depending on the candle—may also release lead and carcinogens such as benzene, toluene, and formaldehyde. *See Indoor Air Pollution and Your Health Free Information from EHSO,* ENV'T, HEALTH, & SAFETY ONLINE, https://perma.cc/N3DE-5XUQ (last visited Feb. 23, 2024).

[206] *See* WEXLER, *supra* note 81, at 11 (discussing the practice, and citing the case of a three-year-old in Rhode Island who fell seriously ill when her family moved into an apartment that had previously been occupied by practitioners of Santeria); *see* Donna M. Riley et al., *Assessing Elemental Mercury Vapor Exposure from Cultural and Religious Practices*, 109 ENV'T HEALTH PERSPS. 799, 799 (2001) (noting practice of sprinkling mercury in the home to ward off evil among practitioners of Santeria, among other Afro-Caribbean and Latin American religious traditions).

[207] *See* THE PSYCHOLOGY OF ENVIRONMENTAL LAW, *supra* note 20, at 156–57 (discussing perceptions of, and responses to, pollution).

B. Institutional Implications

Who should regulate indoor environmental quality? Any regulation of indoor environmental quality must take place against an institutional backdrop. From a legal perspective, one of the key institutional puzzles is how to allocate the authority to regulate indoor environmental quality amongst various legal authorities and the extent to which it should be reserved to individuals instead.

In federalist and confederalist systems, a key question will be whether there is national or federal/supranational jurisdiction over indoor environmental quality. The answer matters and should be understood to vary according to both institutional structure and the characteristics and uses of the indoor spaces being regulated. Regulation of fstationary detached residences used by a single individual or family, for example, will implicate different jurisdictional and competence concerns than regulation of the indoor environmental quality of motor vehicles, which are mobile and routinely cross state and national borders. I sketch some of the most obvious implications for the United States and European Union system here, though further consideration of each of these (as well as other systems) is likely to prove fruitful. While I leave further nuance to future scholars, this section concludes that, at a minimum, the federal government in the United States has obvious jurisdiction over many (millions) of indoor spaces, including those owned by the federal government and mobile indoor spaces (such as airplanes, trains, and automobiles).

1. Federalism Concerns in the United States

First, let us consider the role of the federal government in the United States in regulating indoor environmental quality. The United States is a government of enumerated powers, and any powers not explicitly delegated to the federal government in the U.S. Constitution are reserved to the individual states or the people.[208] As noted above, unlike most modern constitutions, the U.S. Constitution—one of the oldest in the world—does not explicitly mention "the environment."[209] As a result, federal action on environmental law and policy must be justified by reference to one or more of the enumerated powers.[210] This has most often rested on the Commerce Clause, which states that the federal government has power "[t]o regulate Commerce with foreign Nations, and among the Several States, and with the Indian Tribes,"[211] though the

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208 U.S. CONST. amend. X.

209 *See generally* U.S. CONST. For further context and discussion, see A GUIDE TO U.S. ENVIRONMENTAL LAW, *supra* note 26, at 11–17.

210 *See* A GUIDE TO U.S. ENVIRONMENTAL LAW, *supra* note 26, at 13, 16.

211 U.S. CONST. art. I, § 8, cl. 3; *see also* A GUIDE TO U.S. ENVIRONMENTAL LAW, *supra* note 26, at 12–16; Hodel v. Va. Surface Mining & Reclamation Assoc., Inc., 452 U.S. 264, 282 (1981) (explaining that the Commerce Clause is "broad enough to permit congressional

Property Clause[212] and the treaty power[213] also have environmental applications.

In the United States, many indoor environments clearly fall within federal jurisdiction. The most straightforward category is likely indoor spaces that are owned or administered by the federal government, such as government buildings (offices, prisons, post offices, and military buildings, to name a few).[214] This is not a small category; as of 2020, federal agencies owned, leased, or otherwise possessed 285,829 buildings--totaling over 2.8 billion square feet—and 537,080 other structures.[215]

Another category obviously within federal control is indoor spaces that routinely cross state lines: planes, trains, automobiles, and things of that ilk.[216] This would include the nearly 278 million personal and commercial vehicles registered to U.S. drivers.[217] Indeed, EPA already regulates mobile sources of pollution under separate statutory schemes; Title II of the Clean Air Act applies to mobile sources, for example.[218] It requires EPA to prescribe "standards applicable to the emission of any air pollutant from any class or classes of new motor vehicles or new motor vehicles engines, which in his judgment cause, or contribute to, air pollution which may reasonably be anticipated to endanger public health or welfare."[219] The Agency, among others, has long interpreted this provision as requiring outdoor "tailpipe" emission standards and applying (only) to outdoor emissions of vehicles.[220] It seems that EPA has yet to

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regulation of activities causing air or water pollution, or other environmental hazards that may have effects in more than one State").

212 *See* U.S. CONST. art. IV, § 3, cl. 2 (giving the U.S. Congress the power to "make all needful Rules and Regulations respecting the Territory or other Property belonging to the United States"). This power has been used, for example, to sustain legislation addressing wild animals on public lands, even where those animals exist outside interstate commerce. *See* Kleppe v. New Mexico, 426 U.S. 529, 546–47 (1976) (upholding the Wild Free-Roaming Horses and Burros Act of 1971). It is also more generally understood to articulate federal control over federal property, including the 28% of U.S. land owned by the federal government. *See* CONG. RSCH. SERV., R42346, FEDERAL LAND OWNERSHIP: OVERVIEW AND DATA 1–2 (Feb. 21, 2020), https://perma.cc/9WZY-RE7T.

213 *See* U.S. CONST. art. II, § 2, cl. 2 (providing that the President "shall have Power, by and with the Advice and Consent of the Senate, to make Treaties, provided two-thirds of the Senators present concur"). This power has been used, for example, to implement a treaty on migratory birds via the Migratory Bird Act of 1918. *See* Missouri v. Holland, 252 U.S. 416, 430–35 (1920).

214 U.S. GEN. SERVS. ADMIN., REAL PROPERTY POLICY: DATA COLLECTION AND REPORTS: FY2021 FRPP SUMMARY DATA SET (2022), https://perma.cc/U7YB-KFT3.

215 *See id.* (reporting 126,407 buildings owned or leased by civilian agencies in FY2020, and 159,435 by the Department of Defense).

216 *See* 13 AM. JUR. 2d *Carriers* § 41 (updated Feb. 2024) (noting exclusive federal control over carriers engaged in interstate commerce).

217 U.S. DEP'T OF TRANSP., FED. HIGHWAY ADMIN., HIGHWAY STATISTICS SERIES: STATE MOTOR-VEHICLE REGISTRATIONS—2021, https://perma.cc/A8CL-YVB4 (Oct. 2023).

218 CAA, 42 U.S.C. §§ 7521–7590 (2018).

219 *Id.* § 7521(a)(1).

220 *See, e.g.*, Multi-Pollutant Emissions Standards for Model Years 2027 and Later Light-Duty and Medium-Duty Vehicles, 88 Fed. Reg. 29184, 29184 (proposed, May 5, 2023) (to be

consider whether it would also justify (or even require) consideration of emissions of air pollutants from motor vehicles *inside* the cabin of the vehicle,[221] either from the vehicle's ventilation system[222] or from Volatile Organic Compounds (VOCs), which are inherently present in newly produced components for auto interiors (and responsible for "new car smell").[223]

Stationary spaces not owned or administered by the federal government become more complicated. Historically, some of these have still fallen within the purview of the federal government; federal jurisdiction over indoor workplaces in particular is relatively well established, presumably because of its connection to national labor markets and commercial activity.[224] This has thus far extended only to workers' experience of those workplaces[225]—i.e., a grocery store may have federal standards relating to indoor environmental quality for workers,

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codified at 40 C.F.R. pts. 85, 86, 600, 1036, 1037, and 1066) (proposing new outdoor mobile source emissions standards, without considering or addressing indoor emissions).

221 EPA is required to issue emissions standards for "moving sources" under Title II of the Clean Air Act. 42 U.S.C. §§ 7521–7590 (2018). However, EPA does not regulate any indoor air spaces. *Regulatory and Guidance Information by Topic: Air*, ENV'T. PROT. AGENCY, https://perma.cc/EGC8-F2TU (stating that EPA does not regulate indoor air). On the other hand, the Federal Aviation Administration regulates cabin air on airplanes. FED. AVIATION ADMIN., CABIN SAFETY SUBJECT INDEX 1 (Jul. 10, 2022), https://perma.cc/QRF7-JJG2; *see also, e.g.*, *Cabin Air Quality in Cars and Vans*, AIR INDEX, https://perma.cc/N3ZP-34UA (last visited Feb. 23, 2024) (summarizing determinants of and hazards presented by indoor air quality in motor vehicles and discussing proposed methods for collecting data on indoor cabin air quality).

222 *See* Jinwon Seo & Yunho Choi, *Estimation of the Air Quality of a Vehicle Interior: The Effect of the Ratio of Fresh Air to Recirculated Air from a Heating, Ventilation and Air-Conditioning System*, 227 J. AUTO. ENG. 1162, 1162–63 (2013) (discussing air quality and pollutants present inside vehicle interiors).

223 *See, e.g.*, Ruihua Guo et al., *Evaluation of Typical Volatile Organic Compounds Levels in New Vehicles under Static and Driving Conditions*, 19 INT. J. ENV'T RSCH. & PUB. HEALTH 7048, 7048 (2022) (discussing emissions of VOCs inside vehicles); *Is That New-Car Smell Toxic?*, U.S. NEWS & WORLD REP. (Sept. 14, 2016) https://perma.cc/CPE8-3PNK.

224 *See, e.g.*, Occupational Safety and Health Act of 1970, 29 U.S.C. § 651 (2018) (directing the Occupational Safety and Health Administration to "assure as far as possible every working man and woman in the Nation safe and healthful working conditions and to preserve our human resources").

225 Because of OSHA's inhibited interpretation of the OSH Act, workplace protections are extended only to a limited class of workers, namely those who qualify as "employees" under the arcane common law principles of agency. *See Employment Law Guide: Safety and Health Standards: Occupational Safety and Health*, U.S. DEPT. OF LABOR (Dec. 2016), https://webapps.dol.gov/elaws/elg/osha.htm (explaining that the OSH Act covers most employees); Occupational Injury and Illness Recording and Reporting Requirements, 66 Fed. Reg. 5916, 6038 (Jan. 19, 2001) (to be codified at 29 C.F.R. pts. 1904, 1952) ("Whether an employment relationship exists under the Act is determined in accordance with established common law principles of agency."); RESTATEMENT (THIRD) OF AGENCY § 7.07 (using common law principles of agency to define "employee"). This excludes, for example, all workers who are independent contractors or "gig" workers. *See generally* Arden Rowell, *The Regulatory Landscape Regarding Respiratory Protection*, *in* NAT'L ACADS. OF SCIS., ENG'G, & MED., FRAMEWORKS FOR PROTECTING WORKERS AND THE PUBLIC FROM INHALATION HAZARDS 9–10, 447–528 (2022) (discussing gaps in the coverage of occupational safety and health regulation).

but there are no federal standards for indoor environmental quality in the same space for consumers. This may be a function of the drafting and/or interpretation of current legislation, rather than a representation of the full extent of federal authority, however. In particular, privately owned commercial spaces, such as malls or stores, would seem to have an intuitive connection to the Commerce Clause--but additional analysis in light of emerging Commerce Clause jurisprudence would be reasonable.

Recreational, residential, and religious spaces may present more complex questions, given their (arguable) remove from commerce, and (arguable) special constitutional protections for the latter two.[226] That said, under the Property Clause, the federal government has clear jurisdiction over spaces it owns, such as the Smithsonian or U.S. military housing, and their indoor environmental quality.[227] Public housing subject to federal standards is also subject to federal control of indoor environmental quality. Indeed, the Department of Housing and Urban Development (HUD) has developed indoor air requirements for publicly owned and subsidized housing.[228]

In sum, the federal government has obvious jurisdiction over the indoor environmental quality of millions of indoor spaces, including those that it owns under the Property Clause and those that are mobile and move through interstate commerce under the Commerce Clause.[229] The full extent of federal jurisdiction over stationary indoor spaces that the government does not own is subject to additional question and may rest upon interpretations of the full extent of the federal government's commerce authority.

2. Competence in the European Union

The EU, like the federal government of the United States, is a government of enumerated ("conferred") powers.[230] In Europe, the Member States and the transnational European Union frame their authority to regulate a particular area in terms of "competence."[231] Unlike the U.S. Constitution, however, the EU's treaties—which enumerate its

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226 *See* discussion *supra* Parts V.A.1.

227 *See* U.S. Const. art. IV, § 3 (giving the U.S. Congress the power to "make all needful Rules and Regulations respecting the Territory or other Property belonging to the United States").

228 *See* 24 C.F.R. §§ 5.703, 5.703(f) (2022) (requiring that public housing owned by HUD-approved entities must be "decent, safe, sanitary, and in good repair," including that "dwelling units and common areas . . . have proper ventilation and be free of mold, odor, . . . or other observable deficiencies"); *id.* § 982.401(h)(2)(i) (requiring that government-subsidized housing units be "free of pollutants in the air at levels that threaten the health of the occupants," including that they "be free from dangerous levels of air pollution from carbon monoxide, sewer gas, fuel gas, dust, and other harmful pollutants").

229 *See* discussion *supra* Part V.A.2.a.

230 Treaty on European Union art. 5, § 2, Oct. 26, 2012, 2012 O.J. (C 326) 13 [hereinafter TEU].

231 A GUIDE TO E.U. ENVIRONMENTAL LAW, *supra* note 26, at 12–28 (2021) (discussing the structure and key actors of the European Union as applied to environmental law).

competences—do address the environment.[232]The Treaty on European Union refers explicitly to the EU's competence in creating a "high level of protection and improvement of the quality of the environment"[233] and the Treaty on the Functioning of the European Union (TFEU) demands that "[e]nvironmental protection requirements must be integrated into the definition and implementation of the Union's policies and activities,"[234] a principle known as the "integration principle."[235] The TFEU further sets out a series of provisions detailing the parameters of the competence,[236] including environmental policy objectives,[237] principles,[238] and legal procedures.[239]

The EU has broad articulated powers to address environmental matters. However, environmental policy is, by designation, an area of shared competence. In determining whether the EU or the Member States are authorized to act, two principles must be observed: 1) "subsidiarity," which requires that the EU act only if the objectives of a proposed action cannot be sufficiently achieved by Member States, and it would be better achieved by EU action;[240] and 2) the principle of

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232 *See* Treaty on the Functioning of the European Union art. 4, §1(e), Oct. 26, 2012, 2012 O.J. (C 326) 47 [hereinafter TFEU]. This was not always the case; when the E.U. was first created, as with the U.S. Constitution, there was no explicit environmental competence, meaning that any EU-level laws aimed at regulating or protecting the environment had to be justified by reference to another competence that had been explicitly conferred (typically, the EU's competence over the European economic market or the general project of European integration). *See* A GUIDE TO E.U. ENVIRONMENTAL LAW, *supra* note 26, at 77–80 (discussing development of the EU's competence in environmental law). During this period, the Court of Justice of the European Union, which has exclusive jurisdiction over the validity and interpretation of European laws, came to view environmental objectives as common market measures, concluding that "environmental protection . . . is one of the [European] Community's essential objectives." *See* Case C-240/83, Procurerur de la République v. Association de défense des brûleurs d'huiles usages, 1985 E.C.R. 531, 549; Declaration of the Council of the European Communities and of the representatives of the Governments of the Member States meeting in the Council of 22 November 1973 on the programme of action of the European Communities on the environment Title II, § 2, 1973 O.J. (C 112) 1 (describing consideration of the environment as "necessary" to planning and decision-making within the European Community).

233 TEU, *supra* note 230, art. 3, § 3.

234 TFEU, *supra* note 232, art. 11 ("Environmental protection requirements must be integrated into the definition and implementation of the Union's policies and activities, in particular with a view to promoting sustainable development.").

235 *General Principles: Integration,* ACAD. OF EUR. L., https://perma.cc/862V-9TWW (last visited Feb. 23, 2024).

236 TFEU, *supra* note 232, art. 191–193.

237 *Id.* art. 191, § 1.

238 *Id.* art. 191, § 2.

239 *Id.* art. 192.

240 TEU, *supra* note 230, art. 5, § 3. ("Under the principle of subsidiarity, in areas which do not fall within its exclusive competence, the Union shall act only if and in so far as the objectives of the proposed action cannot be sufficiently achieved by the Member States, . . . but can rather, by reason of the scale or effects of the proposed action, be better achieved at the Union level.").

"proportionality," which requires the EU to act only when "necessary to achieve the objectives of the Treaties."[241]

The EU has regulated in a range of environmental areas—air and water pollution, nature protection and restoration, waste management, and climate change.[242] A puzzle for European legal scholars is whether the EU's competence in these policy areas extends only to *outdoor* iterations of these areas—outdoor air, outdoor water, outdoor nature, outdoor waste, outdoor climate emissions—or whether, since the indoors are part of the environment, *indoor* environmental quality and behaviors are also part of its competence. That said, in the context of the EU's environmental competence, the argument articulated here—that the indoors are part of the environment—suggests that the EU could claim competence over the environmental quality of indoor spaces. This competence, like others, will be subject to the limiting principles of subsidiarity and proportionality.

C. Legislative and Interpretive Implications

Thus far, environmental legislation in the United States and the European Union has been widely—but seemingly subconsciously—interpreted through an outdoor lens. This lens is neither inevitable, nor representative of the modern ecological understanding of what the "environment" means—an understanding which recognizes that human-built structures occupy a place within the larger environment and which incorporates indoor spaces into an understanding of the environment.

Reconsideration of indoor spaces as part of the environment opens the door to reinterpretation of environmental legislation and regulation previously viewed exclusively through an outdoor lens. Such reconsideration is possible both for general "environmental" and more media-specific legislation and regulation.

One particularly promising area for reconsideration is the requirements for environmental impact assessment, including under NEPA and the European Community's Directive.[243] These requirements call for comprehensive analyses of "environmental" impacts but have been almost universally interpreted to apply only to outdoor impacts.[244] Recognizing that indoor environmental impacts are equally important significantly expands the scope of environmental impact assessments and similarly important analyses.

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241 *Id.* art. 5, § 4.

242 *Environment Policy: General Principles and Basic Framework*, EUR. PARL., https://perma.cc/R26H-BCJ6 (last visited Feb. 23, 2024).

243 *See* Council Directive of 27 June 1985 on the Assessment of the Effects of Certain Public and Private Projects on the Environment 85/337/EEC, 1985 O.J. (L 175) 40 (EC).

244 For a review of legislative requirements around the globe—without any treatment of indoor environmental impacts—see generally U.N. ENV'T PROGRAMME, ASSESSING ENVIRONMENTAL IMPACTS: A GLOBAL REVIEW OF LEGISLATION (2018), https://perma.cc/3TQ6-PDCN.

In light of a more comprehensive understanding of environmental quality, media-specific environmental statutes are also due for reconsideration. For instance, as noted above, air pollution can occur indoors as well as out, and regulation of air pollution should consider this. In the United States, this should include reconsideration of the extent of the responsibilities and authority of the EPA to regulate indoor air quality under the Clean Air Act, through its mobile source provisions and, perhaps, its stationary source provisions. Endangered species may also arise not only outdoors, but indoors as well; where legislation or regulation protects such species, it is worth considering whether and how indoor protection might operate.

D. Future Directions

The priority of this Article has been to argue that indoor environmental quality is part of the bailiwick of environmental law and policy. Reorienting our understanding of "the environment" to include indoor spaces will allow environmental law and policy scholars and practitioners a more expansive role in engaging in interdisciplinary discussions on various indoor hazards. This more expansive role is appropriate, as the legitimate expertise they hold in addressing, categorizing, and managing environmental hazards will prove valuable in indoor *and* outdoor spaces.

Reorientation of the field to include indoor as well as outdoor spaces opens up a number of exciting possibilities for future research. At least five future research directions in indoor environmental law seem to me especially pressing. These are specification, interactions, prioritization, ethics, and implementation.

First, it would be helpful to develop further theoretical specification of indoor environments. What makes a space "indoors" versus "outdoors"—and when does this matter? What hazards and qualities are characteristic of indoor versus outdoor spaces? What legal and policy tools are best fit to these qualities and characteristics? For example, one possibility is that level of enclosure, insulation, or separation from the outdoors should inform the definition of indoor spaces. Depending upon insulation and ventilation, the environmental quality of indoor spaces may have more or less connection to outdoor environmental quality; highly insulated and enclosed spaces will generally have greater separation from the outdoors than less-insulated and less-enclosed spaces. The greater the insulation, the greater the risks posed by internal sources of risk.

Second, and relatedly, how should understandings of indoor environmental quality interact with or diverge from outdoor environmental quality? This piece has identified a set of ways that indoor and outdoor environmental quality interact, but are these a complete set? If so (or if not), which are the most important interactions? And when does indoor and outdoor environmental quality diverge rather than

interact? It may be, for example, that the key determinant of divergence is some combination of the location of a pollution source (whether indoor or outdoor) and the extent of enclosure, insulation, or separation between spaces. If so, which are the indoor (and outdoor) spaces where we should most expect divergence—and where is using outdoor environmental quality as a proxy for indoor most likely to go awry?

Third, the extent and variability of indoor spaces, combined with their historical lack of environmental regulation, leaves important questions of prioritization between indoor and outdoor spaces and amongst indoor spaces. Which spaces should environmental law and policy prioritize—of which types, with which characteristics? Is it most important whether they are mobile or stationary? Public or private? The type of use, identity of users, extent or type of enclosure, level of individual control? Some combination of these? For example, various users may have more or less control over the environmental quality of a space or their presence in that space. In some cases—as with children in school, inmates in prisons, members of the military at military stations, or animals in agricultural facilities—users may have little control over either. Should lack of user control be a reason to prioritize regulation of these spaces? Should some other characteristic(s) be used to prioritize instead?

Fourth, research on environmental ethics has, like environmental law and policy, thus far focused on outdoor spaces, largely to the exclusion of indoor ones. This piece has suggested some ways that anthropocentric and biocentric theories of environmental ethics interact with the recognition of indoor spaces as part of the environment, but that analysis assumes that existing modes of environmental ethics are appropriate for the indoors. Are there alternative considerations for environmental ethics that relate to the indoors—for example, do human obligations to nonhumans differ depending upon location? Are there other characteristics or types of indoor spaces that affect ethical obligations? Are there special ethical considerations attached to the preservation or management of the outdoors? The indoors? What are these? Are relationships between ethics and aesthetics constant between the two, or might aesthetics play a different role in certain indoor spaces?

Finally, the discussion of legal implications has flagged a significant number of open legal puzzles, including some important constitutional, institutional, and interpretive questions, and has provided only incomplete musings in response. Future research and consideration of indoor environmental law may benefit from more thorough analysis.

VI. CONCLUSION

Environmental law should address the quality of the environment. The environment includes indoor spaces, where most humans spend most of their time; where billions of nonhumans live; and which interact with the outdoor spaces in which they are located. Neglect of indoor spaces

hurts the integrity, the comprehensiveness, and the effectiveness of environmental law and policy by undermining its ability to address human surroundings, nonhuman interests, and the interactive qualities of indoor and outdoor spaces. Environmental law should continue to address outdoor environmental quality. At the same time, it should reassess its own role in managing the whole of the environment—indoors as well as out.