BEFORE THE ENVIRONMENTAL PROTECTION AGENCY

PETITION FOR RULEMAKING PURSUANT TO SECTION 7004(A) OF THE RESOURCE CONSERVATION AND RECOVERY ACT, 42 U.S.C. § 6974(A), AND SECTION 21 OF THE TOXIC SUBSTANCES CONTROL ACT, 15 U.S.C. § 2620, CONCERNING THE REGULATION OF DISCARDED POLYVINYL CHLORIDE AND ASSOCIATED CHEMICAL ADDITIVES

Credit: NOAA ONMS

CENTER FOR BIOLOGICAL DIVERSITY

PETITIONER

JULY 24, 2014

NOTICE OF PETITION

Gina McCarthy
Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, N.W.
Washington, D.C. 20460
Email: McCarthy.Gina@epa.gov

PETITIONER

Center for Biological Diversity
351 California Street, Suite 600
San Francisco, CA 94104
Tel: (415) 436-9682

The Center for Biological Diversity ("Center") is a non-profit, public interest environmental organization dedicated to the protection of native species and their habitats through science, policy and environmental law. The Center has over 775,000 members and online activists throughout the United States and around the world. The Center's Ocean Program and its supporters are specifically concerned with the conservation of marine species, the preservation of ocean ecosystems and the effective implementation of U.S. environmental laws, including the Resource Conservation and Recovery Act and the Toxic Substances Control Act. The Center submits this petition on its own behalf and on behalf of its members and staff with an interest in protecting the marine environment.

ACTION REQUESTED

Pursuant to section 7004(a) of the Resource Conservation and Recovery Act ("RCRA"), 42 U.S.C. § 6974(a); RCRA's implementing regulations, 40 C.F.R. § 260.20; section 21 of the Toxic Substances Control Act ("TSCA"), 15 U.S.C. § 2620; and section 553(e) of the Administrative Procedure Act ("APA"), 5 U.S.C. § 553(e), the Center for Biological Diversity hereby petitions the Administrator of the U.S. Environmental Protection Agency ("EPA") to promulgate regulations governing the safe treatment, storage and disposal of polyvinyl chloride ("PVC"), vinyl chloride and associated dialkyl- and alkylarylesters of 1,2-benzenedicarboxylic acid, commonly known as phthalate plasticizers.

The U.S. Constitution and various federal statutes, including both RCRA and TSCA, explicitly guarantee a citizen's right of petition. *See* U.S. Const. amend. I ("Congress shall make no law … abridging the right of people … to petition the Government for redress of grievances."); *see also United Mine Workers v. Ill. State Bar Ass'n*, 389 U.S. 217, 222 (1967) ("[T]he right[] … to petition for a redress of grievances [is] among the most precious of the liberties safeguarded by the Bill of Rights."). Specifically, the APA mandates that "[e]ach agency shall give an interested person the right to petition for the issuance … of a rule." 5 U.S.C. § 553(e). RCRA directs EPA to "provide[] for, encourage[], and assist[]" public participation in the development of regulations, and expressly authorizes "any person" to seek promulgation of a new environmental rule. 42 U.S.C. § 6974. Similarly, TSCA empowers "[a]ny person [to] petition [EPA] to initiate a proceeding for the issuance" of more protective regulations. 15 U.S.C. § 2620.

This petition imposes definite response requirements on EPA. Specifically, RCRA stipulates that the agency "*shall* take action" with respect to this petition within a "reasonable time" following its receipt and "*shall* publish notice of such action in the Federal Register, together with the reasons therefor." *Id.* § 6974(a) (emphasis added). Under TSCA, EPA must either grant or deny our petition for additional rulemaking within ninety days of filing, "promptly commenc[ing] an appropriate proceeding if such action is warranted." 15 U.S.C. § 2620(b)(3). Conversely, should the agency decline to regulate vinyl chloride and phthalate plasticizers under TSCA, EPA must publish the reasons for its decision in the Federal Register. *Id.*; *see also* 5 U.S.C. § 555(e) ("Prompt notice shall be given of the denial in whole or in part of a written application, petition, or other request of an interested person made in connection with any agency proceeding.").

The APA provides for judicial review of government decisionmaking and permits courts to compel agency action unlawfully withheld or unreasonably delayed. 5 U.S.C. §§ 704, 706. Similarly, RCRA and TSCA authorize citizens to file suit against EPA to compel the completion of any nondiscretionary duty, 42 U.S.C. § 6972(a)(2), and to challenge an adverse or untimely determination, respectively. 15 U.S.C. § 2620(b)(4).

As described in this petition, discarded PVC satisfies both the criteria for hazardous waste designation, as defined at 42 U.S.C. § 6903(5) and 40 C.F.R. §§ 261.3 & 261.11(3), and the standard for regulation under TSCA, set forth at 15 U.S.C. §§ 2603 & 2605. PVC contains toxic constituents. Moreover, recent scientific research clearly demonstrates that the improper management of this waste poses a substantial threat and an unreasonable risk to human health and the environment, including endangered marine species. If EPA determines that neither hazardous waste designation nor TSCA regulation is warranted, we alternatively request that the agency revise its solid waste management guidelines, *see* 42 U.S.C. § 6907, to recommend management and operating practices sufficient to minimize the threats associated with improperly discarded PVC.

Dated this 24th day of July, 2014.

Alexis Andiman, Oceans Fellow
Emily Jeffers, Attorney, Oceans Program
Miyoko Sakashita, Senior Attorney & Oceans Director
Center for Biological Diversity
351 California St., Ste. 600
(415) 436-9682
AAndiman@biologicaldiversity.org
EJeffers@biologicaldiversity.org
Miyoko@biologicaldiversity.org

TABLE OF AUTHORITIES

Cases

Statutes

Regulations

Federal Register

Other Materials

TABLE OF CONTENTS

INTRODUCTION

The Center for Biological Diversity ("the Center") requests that the Environmental Protection Agency ("EPA") classify discarded polyvinyl chloride ("PVC") as hazardous waste under the Resource Conservation and Recovery Act ("RCRA").[1] For the reasons discussed below, the agency must, at a minimum, revise its solid waste management guidelines to reduce the significant threats to human health and the environment arising from the improper disposal of this plastic trash.[2] In addition, the Center asks that EPA initiate rulemaking under the Toxic Substances Control Act ("TSCA") to address the serious risks associated with PVC, vinyl chloride and phthalate plasticizers.[3, 4]

Scientists, scholars and concerned citizens have long warned that inadequate waste management strategies are contributing to the widespread degradation of the marine environment.[5] In recent years, plastic pollution has attracted increasing attention as an emerging problem of global proportions. As much as eighty percent of ocean litter consists of lightweight and durable plastic trash, which poses a range of serious threats to aquatic organisms and human beings.[6] A recent review of the scientific literature revealed that nearly four hundred species have ingested or become entangled in marine debris, representing an increase of more than forty percent over the previous survey, published only sixteen years before.[7] Plastic consumption affects nearly half of existing seabird and cetacean species, all marine turtles and many ecologically and commercially important fish, shellfish, grasses and corals.[8]

Improperly discarded PVC constitutes a substantial proportion of ocean litter and poses especially significant threats to human and environmental health.[9] Even before the production of this material began to accelerate in the 1930s, researchers suspected that PVC's primary building block, vinyl chloride, produced toxic effects in laboratory animals.[10] Although EPA has now

---

[1] 42 U.S.C. §§ 6901 *et seq.* (2012).

[2] *See* 42 U.S.C. § 6907.

[3] 15 U.S.C. §§ 2601 *et seq.*

[4] Our requests under RCRA and TSCA constitute two independent and fully severable petitions.

[5] *See, e.g.*, Andrés Cózar et al., *Plastic Debris in the Open Ocean*, PROCEEDINGS OF THE NAT'L ACADEMY OF SCI. 1, 1, 5 (2014) (reporting that "the intense consumption and rapid disposal of plastic products" has contributed to the accumulation of "tens of thousands of tons" of plastic debris in surface waters of the open ocean); *see also* David K. A. Barnes et al., *Accumulation and Fragmentation of Plastic Debris in Global Environments*, 364 PHIL. TRANSACTIONS OF THE ROYAL SOC. B 1985, 1986 (2009) (explaining that "plastic persists in landfill sites and if not properly buried may later surface to become 'debris'").

[6] Barnes et al., *supra* note 5, at 1986.

[7] F. Galgani et al., *Marine Litter within the European Marine Strategy Framework Directive*, 70 ICES J. OF MARINE SC. 1055, 1057 (2013).

[8] *Id*; Chelsea M. Rochman et al., *Classify Plastic Waste as Hazardous*, 494 NATURE 169, 169 (2013).

[9] Mark A. Browne et al., *Spatial Patterns of Plastic Debris along Estuarine Shores*, 44 ENVTL. SCI. AND TECH. 3404, 3406 (2010).

[10] Karl Mulder et al., *PVC Plastic: A History of Systems Development and Entrenchment*, 23 TECH. IN SOC. 265, 275 (2001).

acknowledged this substance as a human carcinogen,[11] experts continue to argue that the agency's risk assessments are inadequate.[12] In addition to vinyl chloride, PVC contains significant concentrations of regulated and unregulated chemical additives, including phthalate plasticizers and heat stabilizers mixed from lead, calcium, barium and cadmium.[13] Recent studies reveal that finished PVC products leach significant concentrations of these compounds into the environment as they deteriorate with age, threatening severe biological consequences.[14] For example, one-quarter of U.S. women already exhibit concentrations of phthalate metabolites higher than those correlated with irregular sexual development in male infants,[15] and scientific evidence indicates that contamination might be even more prevalent in urban settings.[16]

Despite its status as "one of the most hazardous consumer products ever created,"[17] PVC and its associated chemical additives are managed in much the same way as food scraps and grass clippings after disposal.[18] Americans already discard billions of pounds of this plastic each year, and experts anticipate that annual waste generation will increase significantly in the near future, as durable products and construction goods reach the end of their useful lives.[19] Marine plastic pollution harms ocean organisms, threatens ecological integrity and damages human health and prosperity.[20] However, policy-makers have implemented few practical measures to address this problem. To protect future generations and preserve the marine environment, we urge EPA to promptly exercise its authority to ensure the safe disposal of discarded PVC and the protective management of associated chemical substances, including vinyl chloride and phthalate plasticizers.

---

[11] *See Vinyl Chloride*, U.S. Envtl. Prot. Agency, http://www.epa.gov/ttn/atw/hlthef/vinylchl.html (last visited July 23, 2014).

[12] *See* Jennifer Beth Sass et al., *Vinyl Chloride: A Case Study of Data Suppression and Misrepresentation*, 113 ENVTL. HEALTH PERSP. 809, 811 (2005) (finding that EPA's assessment of vinyl chloride "downplay[s] risk" and reflects excessive industry participation); *see also* Janet Kielhorn et al., *Vinyl Chloride: Still a Cause for Concern*, 108 ENVTL. HEALTH PERSP. 579, 579 (2000) (explaining that vinyl chloride "remains a cause for concern because potential exposure to this chemical and new cases of [related cancers] are still being reported").

[13] Bonnie Ransom Stern et al., *Are There Health Risks from the Migration of Chemical Substances from Plastic Pipes into Drinking Water? A Review*, 14 HUMAN AND ECOLOGICAL RISK ASSESSMENT 753, 755 (2008).

[14] *Id.* at 773-74.

[15] Shanna H. Swan et al., *Decrease in Anogenital Distance Among Male Infants with Prenatal Phthalate Exposure*, 113 ENVTL. HEALTH PERSP. 1056, 1056 (2005).

[16] Jennifer J Adibi et al., *Prenatal Exposures to Phthalates Among Women in New York City and Krakow, Poland*, 111 ENVTL. HEALTH PERSP. 1719, 1722 (2003) (reporting that pregnant women in New York City "appear to be exposed [to phthalates] at levels above background levels in the United States, which may have implications for their pregnancy and/or the fetus").

[17] S.M. Bidoki et al., *Environmental and Economic Acceptance of Polyvinyl Chloride (PVC) Coating Agents*, 18 J. OF CLEANER PRODUCTION 219, 221 (2010).

[18] *See* Rochman et al., *supra* note 8, at 169.

[19] Mehdi Sadat-Shojai et al., *Recycling of PVC Wastes*, 96 POLYMER DEGRADATION AND STABILITY 404, 404 (2011).

[20] *See* M.H. Depledge et al., *Plastic Litter in the Sea*, 92 MARINE ENVTL. RES. 279, 279, 280 (2013).

I. The Resource Conservation and Recovery Act

A. Statutory Background

In 1976, Congress enacted RCRA, recognizing that economic and population growth, accompanied by widespread improvements in the national standard of living, "ha[d] resulted in a rising tide of scrap, discarded, and waste materials," leading to the "needless[] pollut[ion]" of the environment and endangering public health.[21] Accordingly, the statute established guidelines concerning the proper management of "solid waste,"[22] and imposed a comprehensive framework to ensure the safe treatment, storage and disposal of especially hazardous materials.[23]

Within the meaning of RCRA, "hazardous waste" includes any discarded material or "solid waste,"

> which because of its quantity, concentration, or physical, chemical or infectious characteristics *may*—(A) cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or (B) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed.[24]

To minimize the present and future threats associated with these materials, lawmakers directed EPA to impose stringent regulatory safeguards, including standards applicable to generators and transporters;[25] requirements governing treatment, storage and disposal;[26] and an extensive, "cradle to grave" manifest system, tracking the generation, transport and receipt of hazardous wastes.[27] States may assume these regulatory responsibilities upon developing programs that are at least equivalent to federal guidelines, consistent with management practices in neighboring jurisdictions and subject to adequate enforcement.[28]

To implement the Act, EPA has developed criteria governing the identification and listing of hazardous wastes.[29] In relevant part, these regulations authorize EPA to classify as

---

[21] 42 U.S.C. §§ 6901(a), (b).

[22] *See id*. §§ 6941-6969a. Subject to certain exclusions, "solid waste" encompasses "any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities." *Id*. § 6903(27).

[23] *See id.* §§ 6921-6939g.

[24] *Id.* § 6903(5) (emphasis added); *see also id.* § 6903(27). By regulation, EPA has excluded certain solid wastes from this definition, including those "derived from … single and multiple residences, hotels and motels, bunkhouses, ranger stations, crew quarters, campgrounds, picnic grounds and day-use recreation areas." 40 C.F.R. § 261.4(b)(1) (2013).

[25] *Id.* §§ 6922, 6923.

[26] *Id.* §§ 6924, 6925.

[27] *Id.* §§ 6922-6924.

[28] *Id.* § 6926.

[29] *See* 40 C.F.R. pt. 261.

hazardous any solid waste that typically contains a designated "toxic constituent," provided that the agency's analysis of eleven enumerated factors reveals that "the waste is capable of posing a substantial present or potential hazard to human health or the environment when improperly ... managed."[30] EPA has compiled an inventory of known "toxic constituents," including substances that have been scientifically demonstrated "to have toxic, carcinogenic, mutagenic or teratogenic effects on humans or other life forms."[31] In assessing the hazards associated with wastes containing one or more of these substances, EPA must consider:

(i) The nature of the toxicity presented by the constituent.
(ii) The concentration of the constituent in the waste.
(iii) The potential of the constituent or any toxic degradation product of the constituent to migrate from the waste into the environment under [plausible types of improper management].
(iv) The persistence of the constituent or any toxic degradation product of the constituent.
(v) The potential for the constituent or any toxic degradation product of the constituent to degrade into non-harmful constituents and the rate of degradation.
(vi) The degree to which the constituent or any degradation product of the constituent bioaccumulates in ecosystems.
(vii) The plausible types of improper management to which the waste could be subjected.
(viii) The quantities of the waste generated at individual generation sites or on a regional or national basis.
(ix) The nature and severity of the human health and environmental damage that has occurred as a result of the improper management of wastes containing the constituent.
(x) Action taken by other governmental agencies or regulatory programs based on the health or environmental hazard posed by the waste or waste constituent.
(xi) Such other factors as may be appropriate.[32]

In every instance, the agency must limit its analysis to these enumerated factors, consider each factor fully and adequately explain its final listing decision.[33]

---

[30] *Id.* § 261.11(a)(3).

[31] *Id.*; *see id.* pt. 261, app. VIII. In other words, "the presence of any [toxic] constituent is *presumed* to be sufficient to list the waste unless after consideration of the designated multiple factors, EPA concludes that the waste is not hazardous." Identification and Listing of Hazardous Waste, 45 Fed. Reg. 33,084, 33,107 (May 19, 1980) (emphasis added).

[32] 40 C.F.R. § 261.11(a)(3).

[33] *See* Hazardous Waste Treatment Council v. U.S. Envtl. Prot. Agency, 861 F.2d 270, 277 (D.C. Cir. 1988) (limiting agency discretion to the listed factors); *see also* Dithiocarbamate Task Force v. U.S. Envtl. Prot. Agency, 98 F.3d 1394, 1398 (D.C. Cir. 1996) (requiring EPA to consider each factor); Am. Mining Congress v. U.S. Envtl. Prot. Agency, 907 F.2d 1179, 1189-90 (D.C. Cir. 1990) (remanding a listing decision because the agency relied on conclusory statements to dismiss relevant scientific data and otherwise failed to explain its decision).

In addition to expanding federal oversight of hazardous materials, RCRA requires EPA to promulgate "suggested guidelines for solid waste management."[34] Existing regulations address issues pertaining to the thermal processing, collection, storage, and recycling of wastes, and prescribe minimum criteria for state-operated disposal facilities.[35] Although states retain primary authority to regulate non-hazardous materials under the Act, EPA's guidelines are binding upon government agencies and contractors with "jurisdiction over any [federal] solid waste management facility or disposal site."[36] Members of the public may enforce these guidelines against appropriate entities pursuant to the statute's citizen suit provision.[37]

Under RCRA, EPA has broad authority to prescribe all regulations necessary to "promote improved solid waste management techniques" and to "assur[e] that hazardous waste practices are conducted in a manner which protects human health and the environment."[38] Lawmakers explicitly directed the agency to "provide[] for, encourage[], and assist[]" public participation in the "development, revision, implementation, and enforcement of any regulation, guideline, information, or program."[39] In addition, Congress empowered "[a]ny person" to seek further safeguards by petitioning the agency for "the promulgation, amendment or repeal of any regulation" under the Act.[40] EPA must "take action" with respect to citizen petitions "[w]ithin a reasonable time following receipt."[41]

As the General Accounting Office observed over twenty-five years ago, "[t]he first steps to successful nationwide management of hazardous waste are identifying which wastes present a clear threat to human health and the environment and then expeditiously bringing these wastes under regulatory control."[42] Although Congress explicitly directed EPA to "review[] and, where necessary, revise[]" its RCRA regulations at least once every three years,[43] the agency has largely failed to protect against emerging contaminants.[44] As this petition describes, substantial

[34] 42 U.S.C. § 6907.
[35] 40 C.F.R. §§ 240, 243, 246-47, 257-58.
[36] 42 U.S.C. § 6961.
[37] *Id.* § 6972.
[38] *Id.* §§ 6902, 6921(a)(1).
[39] *Id.* § 6974(b)(1).
[40] *Id.* § 6974(a).
[41] *Id.*
[42] U.S. General Accounting Office, *Hazardous Waste: New Approach Needed to Manage the Resource Conservation and Recovery Act* 17 (1988).
[43] 42 U.S.C. § 6912(b) ("Each regulation promulgated under this chapter shall be reviewed and, where necessary, revised not less frequently than every three years.").
[44] *See, e.g.*, U.S. General Accounting Office, *supra* note 42, at 18 (explaining that EPA had made little progress in identifying hazardous wastes by 1988, despite the fact that "EPA [then] believe[d] that potentially large numbers of hazardous wastes may need to be brought under some form of regulatory control"); *see also* Office of Inspector General, U.S. Envtl. Prot. Agency, *EPA Inaction in Identifying Hazardous Waste Pharmaceuticals May Result in Unsafe Disposal* 7 (2012) ("Although EPA has the authority under RCRA, it has [neither] added to its regulations pharmaceuticals that may qualify as hazardous since 1980," nor "established a process for the regular identification and review of pharmaceuticals that may qualify for regulation."); *see also* Office of Inspector General, U.S. Envtl. Prot. Agency, *EPA's Endocrine*

scientific evidence now shows that the widespread mismanagement of discarded PVC has distributed toxic chemicals throughout our environment, threatening ecosystem health and endangering vulnerable portions of the human population. To reduce the need for future corrective action, EPA must promptly revise its regulations to ensure the proper disposal of discarded PVC.[45]

B. Discarded PVC Satisfies the Criteria for Hazardous Waste

As discussed above,[46] the term "hazardous waste" describes any "solid waste, or combination of solid wastes," which possesses characteristics capable of harming human health or the environment.[47] After disposal, PVC necessarily qualifies as "solid waste," a category that is broadly defined to include all "garbage, refuse, ... and other discarded material."[48] For the reasons set forth below, discarded PVC also satisfies the regulatory criteria governing the identification of "hazardous" materials. Specifically, finished PVC products contain vinyl chloride, as well as significant concentrations of chemical additives, such as phthalate plasticizers, known "to have toxic, carcinogenic, mutagenic [and] teratogenic effects on humans [and] other life forms."[49] In addition, application of EPA's multi-factor test, as set forth in detail below, clearly demonstrates that the mismanagement of discarded PVC could "pos[e] a substantial present or potential hazard to human health or the environment."[50] Indeed, recent scientific studies reveal that significant damage has already occurred.[51]

Exposure to vinyl chloride, phthalate plasticizers and other chemical additives is associated with a broad array of developmental and behavioral abnormalities in humans and wildlife species.[52] Depending on desired characteristics, PVC products frequently contain substantial quantities of these compounds,[53] which naturally migrate into the environment following disposal.[54] Once dissociated from plastic waste, phthalates resist physical and chemical degradation,[55] ultimately accumulating in the tissues of aquatic and terrestrial organisms, including human beings.[56] Conventional waste management practices allow substantial quantities of discarded PVC to reach the marine environment,[57] thereby contributing

---

Disruptor Screening Program Should Establish Management Controls to Ensure More Timely Results 9 (2011) (reporting that EPA "has not determined whether any chemical is a potential endocrine disruptor," despite the expiration of relevant deadlines under several environmental laws).

45 *See* 42 U.S.C. § 6902(a)(5).
46 *See* § I.A, *supra*.
47 42 U.S.C. § 6903(5).
48 *Id.* § 6903(27).
49 40 C.F.R. § 261.11(a)(3); *see* §§ I.B.1, I.B.2.a, *infra*.
50 40 C.F.R. § 261.11(a)(3); *see* § I.B.2, *infra*.
51 *See* sources cited *infra* § I.B.2.i.
52 *See* § I.B.2.a, *infra*.
53 *See* § I.B.2.b, *infra*.
54 *See* § I.B.2.c, *infra*.
55 *See* §§ I.B.2.d-e, *infra*.
56 *See* § I.B.2.f, *infra*.
57 *See* § I.B.2.g, *infra*.

to the toxic contamination of vulnerable ocean species.[58] According to recent estimates, Americans discard over seven billion pounds of PVC each year,[59] and experts suspect that virtually universal exposure to phthalate plasticizers "could be the leading cause of reproductive disorders in humans."[60] Existing regulations are inadequate to manage the risks associated with the widespread use and improper disposal of PVC.[61] Indeed, recent research indicates that the actual extent of phthalate contamination likely exceeds previously published estimates.[62] Because discarded PVC satisfies the criteria for hazardous waste designation, we urge EPA to promptly exercise its authority to ensure the safe disposal of this plastic trash.

1. Discarded PVC Contains Toxic Constituents

As described above, EPA may classify as hazardous any solid waste that contains a "toxic constituent" and threatens to "pos[e] a substantial present or potential hazard to human health or the environment when improperly … managed."[63] Vinyl chloride, which forms the base of finished PVC, is a known human carcinogen and designated toxic constituent.[64] Moreover, because PVC is intrinsically unstable, the commercial viability and almost unlimited versatility of this material derive from complex formulations of chemical additives, which frequently include multiple toxic constituents.[65] For example, stabilizers mixed from lead, barium and cadmium are often employed to facilitate high-temperature manufacturing processes.[66] In addition, the industry relies heavily upon dialkyl- and alkylarylesters of 1,2-benzenedicarboxylic acid, commonly known as phthalate plasticizers, to impart a range of beneficial properties to myriad consumer, construction and industrial goods.[67] These compounds

---

[58] Maria Cristina Fossi et al., *Are Baleen Whales Exposed to the Threat of Microplastics? A Case Study of the Mediterranean Fin Whale (*Balaenoptera physalus*)*, 64 MARINE POLLUTION BULL. 2374, 2378 (2012).
[59] *See* § I.B.2.h, *infra*.
[60] Giuseppe Latini et al., *Phthalate Exposure and Male Infertility*, 226 TOXICOLOGY 90, 90 (2006); *see also* § I.B.2.i, *infra*.
[61] *See* § I.B.2.j, *infra*.
[62] *See* § I.B.2.k, *infra*.
[63] 40 C.F.R. § 261.11(a)(3).
[64] *Vinyl Chloride*, U.S. Envtl. Prot. Agency, http://www.epa.gov/ttn/atw/hlthef/vinylchl.html (last visited July 23, 2014); *see* 40 C.F.R. pt. 261, app. VIII. EPA has also listed vinyl chloride as a drinking water contaminant and hazardous air pollutant. *See List of Contaminants and their (MCLs)*, U.S. Envtl. Prot. Agency, http://water.epa.gov/drink/contaminants/#List (last visited May 18, 2014); *see also The Original List of Hazardous Air Pollutants*, U.S. Envtl. Prot. Agency, http://www.epa.gov/ttn/atw/188polls.html (last visited July 23, 2014).
[65] Michael W. Allsop et al., *Poly(Vinyl Chloride)*, *in* 28 ULLMANN'S ENCYCLOPEDIA OF INDUS. CHEMISTRY 441, 441, 442, 463 (Electronic ed. 2012); *see also* David F. Cadogan et al., *Plasticizers*, *in* 27 ULLMANN'S ENCYCLOPEDIA OF INDUS. CHEMISTRY 599, 607 (Electronic ed. 2012) ("PVC would be of little use" as a commodity polymer "[w]ithout the wide range of additives available.").
[66] Stern et al., *supra* note 13, at 755.
[67] Holger M. Koch et al., *Human Body Burdens of Chemicals Used in Plastic Manufacture*, 364 PHIL. TRANSACTIONS OF THE ROYAL SOC. B 2063, 2064 (2009); Cadogan et al., *supra* note 65, at 599; *see also see also* Chris E. Talsness et al., *Components of Plastic: Experimental Studies in*

may comprise up to eighty percent of finished PVC, depending upon desired characteristics.[68] Despite the availability of less harmful alternatives,[69] the industry consumes over fifteen billion pounds of vinyl chloride[70] and sixteen billion pounds of phthalate plasticizers each year.[71]

According to EPA, many commercially important chemical additives, including phthalates, "have toxic, carcinogenic, mutagenic or teratogenic effects on humans or other life forms."[72] Specifically, the agency's list of known toxic constituents includes butyl benzyl phthalate ("BBP"), dibutyl phthalate ("DBP"), diethyl phthalate, diethylhexyl phthalate ("DEHP"), dimethyl phthalate, and di-*n*-octyl phthalate ("DnOP").[73] EPA has also expressed concern about diisobutyl phthalate ("DIBP"), di-n-pentyl phthalate, diisononyl phthalate ("DINP") and diisodecyl phthalate ("DIDP").[74] These substances are not chemically bound to PVC and, thus, enter the environment naturally as discarded plastics deteriorate with age, resulting in pervasive contamination.[75] As described below, mounting scientific evidence links phthalate exposure to a broad array of health and behavioral problems among human beings and wildlife.[76] To prevent further harm associated with the widespread dispersal of these toxic constituents, EPA must promptly revise its regulations to ensure the safe management of discarded PVC.

Animals and Relevance for Human Health, 364 PHIL. TRANSACTIONS OF THE ROYAL SOC. B 2079, 2080 (2009) (explaining that "the addition of phthalates makes brittle [PVC] soft").

[68] Mustafizur Rahman et al., *The Plasticizer Market: An Assessment of Traditional Plasticizers and Research Trends to Meet New Challenges*, 29 PROGRESS IN POLYMER SCI. 1223, 1231 (2004); *see also* Allsop et al., *supra* note 65, at 442 ("Each producer makes a range of PVC polymers which vary in morphology and in molecular mass, depending on the intended end use.").

[69] Joshua Kastner et al., *Aqueous Leaching of Di-2-Ethylhexyl Phthalate and "Green" Plasticizers from Poly(Vinyl Chloride)*, 432 SCI. OF THE TOTAL ENV'T 357, 363 (2012).

[70] Paul Wesley Brandt-Rauf et al., *Plastics and Carcinogenesis: The Example of Vinyl Chloride* 2, J. CARCINOGENESIS (2012), http://www.carcinogenesis.com/text.asp?2012/11/1/5/93700.

[71] Subjankar Chatterjee et al., *Removal of the Endocrine Disrupter Butyl Benzyl Phthalate from the Environment*, 87 APPLIED MICROBIOLOGY AND BIOTECH. 61, 62 (2010); Delilah Lithner et al., *Leachates from Plastic Consumer Products – Screening for Toxicity with* Daphnia magna, 74 CHEMOSPHERE 1195, 1199 (2009).

[72] 40 C.F.R. § 261.11(a)(3).

[73] *See id.* pt. 261, app. VIII; *see also* Cadogan et al., *supra* note 65, at 600, 601 (listing phthalate plasticizers in common use).

[74] *See* U.S. Envtl. Prot. Agency, *Phthalates Action Plan* 2 (2012), http://www.epa.gov/oppt/existingchemicals/pubs/actionplans/phthalates.html.

[75] Ursel Heudorf et al., *Phthalates: Toxicology and Exposure*, 210 INT'L J. HYGIENE AND HEALTH 623, 624 (2007).

[76] *See* § I.B.2.a, *infra*.

2. Discarded PVC Poses Significant Hazards to Human Health and the Environment

Before classifying a solid waste as hazardous, EPA must determine both that the material contains a designated toxic constituent and that its improper management could "pos[e] a substantial present or potential hazard to human health or the environment."[77] As discussed above, the agency has acknowledged that vinyl chloride, phthalate plasticizers and additional chemical compounds "have toxic, carcinogenic, mutagenic [and] teratogenic effects on humans [and] other life forms."[78] In assessing the present and potential hazards arising from the widespread use and improper disposal of discarded PVC, EPA must consider eleven regulatory factors, set forth below.[79] The following paragraphs summarize existing scientific knowledge concerning the toxicity, persistence and bioaccumulation of vinyl chloride, phthalates and other chemical additives. To reduce the serious harm to public health and the environment associated with these toxic constituents, EPA must immediately initiate rulemaking to ensure the safe disposal of discarded PVC.

a. Nature of the Toxicity Presented by Constituent Chemicals

Researchers, regulators and industry representatives have long known that vinyl chloride causes cancer in laboratory animals and human beings.[80] Now, mounting scientific evidence demonstrates that phthalate plasticizers interfere with the endocrine system, which governs the production and distribution of hormones in humans and wildlife species. Stricter regulation of discarded PVC is necessary to minimize environmental exposure to these chemicals.

Inadequate waste management has already contributed to the extensive chemical pollution of the marine environment.[81] Aquatic organisms accumulate phthalate plasticizers directly from the surrounding water, as well as through the consumption of contaminated food and particles, giving rise to significant concerns about far-reaching biological consequences.[82] Researchers have hypothesized that endangered whales may be chronically exposed to phthalates

---

[77] 40 C.F.R. § 261.11(a)(3).

[78] *Id.*; *see also* § I.B.1, *infra*.

[79] 40 C.F.R. § 261.11(a)(3).

[80] *See* Mulder et al., *supra* note 10, at 275-76; *see also* Sass et al., *supra* note 12, at 809 (arguing that, although industry toxicologists had reason to know of the "deadly hazards" of vinyl chloride by 1960, manufacturers "delayed public release of [these] findings" until 1974, when three factory workers died from an otherwise rare cancer associated with vinyl chloride exposure).

[81] Ting Ye et al., *Exposure to DEHP and MEHP from Hatching to Adulthood Causes Reproductive Dysfunction and Endocrine Disruption in Marine Medaka (*Oryzias melastigma*)*, 146 AQUATIC TOXICOLOGY 115, 116 (2014); Ju-Chan Kang et al., *Anti-Oxidative Status and Hepatic Enzymes Following Acute Administration of Diethyl Phthalate in Olive Flounder,* Paralichthys olivaceus, *a Marine Culture Fish*, 73 ECOTOXICOLOGY AND ENVTL. SAFETY 1449, 1449 (2010).

[82] *See, e.g.*, Herman O. Sanders et al., *Toxicity, Residue Dynamics, and Reproductive Effects of Phthalate Esters in Aquatic Invertebrates*, 6 ENVTL. RES. 84, 88 (1973) (reporting that "[i]nvertebrates exposed continuously to [phthalate esters in water rapidly accumulated total body residues many times greater than the concentrations in water").

as a result of plastic fragment ingestion.[83] In addition, laboratory evidence links environmentally relevant concentrations of these compounds to behavioral and developmental abnormalities in a range of aquatic species,[84] demonstrating a "concrete risk" for populations living in polluted regions and threatening a cascade of effects throughout the ocean ecosystem.[85]

Relative salinity may influence the toxicity of aquatic contaminants.[86] Thus, although phthalate exposure alters enzyme activity in the vital organs of certain freshwater fish, contributing to "sluggish, non-motile behavior," these compounds appear to produce opposite effects among some brackish species.[87] Specifically, a recent study found that mummichogs (*Fundulus heteroclitus*) were approximately twice as likely to engage in agitated swimming patterns after brief exposure to low phthalate concentrations.[88] In addition, the contaminated individuals exhibited altered social behavior, tending to shoal with relatively small fish, rather than joining similarly sized conspecifics.[89] Because shoaling helps fish to evade predation, while also minimizing competition for food, these effects have "serious negative implications" for exposed individuals and, ultimately, may threaten population viability.[90]

A considerable body of scientific literature indicates that phthalates are potent endocrine disruptors,[91] which interfere with hormone regulation and reduce reproductive success among multiple aquatic and terrestrial species, including human beings.[92] For example, environmentally relevant concentrations of phthalate plasticizers exert estrogenic effects in zebrafish (*Danio rerio*), quickly compromising reproductive cell development and thereby

---

[83] *See* Fossi et al., *supra* note 58 at 2378.

[84] *See, e.g.*, Jörg Oehlmann et al., *A Critical Analysis of the Biological Impacts of Plasticizers on Wildlife*, 364 PHIL. TRANSACTIONS OF THE ROYAL SOC. B 2047, 2051 (2009) ("Exposures to phthalates have … been shown to alter behavior in fish."); *see also* Ye, *supra* note 81, at 116 (explaining that "DEHP has been extensively characterized as a developmental and reproductive toxicant in many aquatic toxicological studies," and reviewing relevant research).

[85] Oliana Carnevali et al., *DEHP Impairs Zebrafish Reproduction by Affecting Critical Factors in Oogenesis*, 5 PLoS ONE e10201, 5 (2010); Sanders et al., *supra* note 82, at 89 (1973).

[86] Ye, *supra* note 81, at 116.

[87] Nivedita Ghorpade et al., *Toxicity Study of Diethyl Phthalate on Freshwater Fish* Cirrhina mrigala, 53 ECOTOXICOLOGY AND ENVTL. SAFETY 255, 258 (2002).

[88] Lisa A.E. Kaplan et al., *Impact of Benzyl Butyl Phthalate on Shoaling Behavior in* Fundulus *heteroclitus (Mummichog) Populations*, 86 MARINE ENVTL. RES. 70, 74 (2013).

[89] *Id.*

[90] *Id.*

[91] *See, e.g.*, D.B. Martinez-Arguelles et al., *Maternal* In Utero *Exposure to the Endocrine Disruptor Di-(2-Ehtylhexyl) Phthalate Affects the Blood Pressure of Adult Male Offspring*, 266 TOXICOLOGY AND APPLIED PHARMACOLOGY 95, 95 (2013).

[92] *See, e.g.*, Safa Abdul-Ghani et al., *The Teratogenicity and Behavioral Teratogenicity of Di(2-Ethylhexyl) Phthalate (DEHP) and Di-Butyl Phthalate (DBP) in a Chick Model*, 34 NEUROTOXICOLOGY AND TERATOLOGY 56, 60 (2012) (observing that "phthalate-induced DNA damage [among fetal chicks was] consistent with those found in mice and humans"); *see also* Swan et al., *supra* note 15, at 1060 ("[O]ur data suggest that the end points affected by … phthalates are quite consistent across species.").

impairing fecundity.[93] These results are particularly alarming because the genetic structure of zebrafish closely mirrors that of human beings.[94] Similarly, low phthalate doses, corresponding to observed levels of human exposure,[95] lead to abnormal sexual differentiation in laboratory animals when administered during the "sensitive window" of fetal development.[96] Among male offspring, prenatal phthalate contamination causes genital malformations, including undescended testicles and urethra displacement, impaired sperm production and significantly reduced testosterone levels, which persist into adulthood.[97] Exposed females may experience excessive breast tissue growth and altered fertility cycles, in addition to various reproductive organ abnormalities.[98] Recent laboratory studies demonstrate that phthalate metabolites induce similar or more severe effects among marine animals[99] and rodents.[100]

In the United States and other industrialized nations, human exposure to multiple phthalate plasticizers is "virtually universal,"[101] beginning in the womb[102] and continuing

---

[93] Bruna Corradetti et al., *Bis-(2-Ethylexhyl) Phthalate Impairs Spermatogenesis in Zebrafish (*Danio rerio*)*, 13 REPROD. BIOLOGY 195, 200 (2013); Carnevali et al., *supra* note 85, at 5; *cf.* Sanders, *supra* note 82, at 88 (concluding that chronic exposure to low phthalates concentrations significantly reduces rates of reproduction among ecologically important aquatic invertebrates).
[94] Carnevali et al., *supra* note 85, at 2.
[95] *See* Martinez-Arguelles et al., *supra* note 91, at 98.
[96] D.B. Martinez-Arguelles et al., *Fetal Origin of Endocrine Dysfunction in the Adult: The Phthalate Model*, 137 J. OF STEROID BIOCHEMISTRY & MOLECULAR BIOLOGY 5, 8 (2013) [hereinafter *Fetal Origin*]; Jane Fisher, *Environmental Anti-Androgens and Male Reproductive Health: Focus on Phthalates and Testicular Dysgenesis Syndrome*, 127 REPROD. 302, 305-06 (2004); *see also* Takashi Tanida et al., *Fetal and Neonatal Exposure to Three Typical Environmental Chemicals with Different Mechanisms of Action: Mixed Exposure to Phenol, Phthalate, and Dioxin Cancels the Effects of Sole Exposure on Mouse Midbrain Dopaminergic Nuclei*, 189 TOXICOLOGY LETTERS 40, 40 (2009) (reporting that "pre- and neonatal exposure to [endocrine disruptors] can disturb development even though the amounts of exposure are lower than the no-observed-adverse-effect level determined by toxicological tests using adult animals").
[97] *Fetal Origin*, *supra* note 96, at 8; Hanne Frederiksen et al., *Metabolism of Phthalates in Humans*, 51 MOLECULAR NUTRITION & FOOD RES. 899, 905 (2007); Latini et al., *supra* note 60, at 93.
[98] *Fetal Origin*, *supra* note 92, at 12.
[99] Ye, *supra* note 81, at 125.
[100] *See* Martinez-Arguelles et al., *supra* note 91, at 95.
[101] S.H. Swan et al., *Prenatal Phthalate Exposure and Reduced Masculine Play in Boys*, 33 INT'L J. OF ANDROLOGY 259, 2 (2010) [hereinafter *Masculine Play*]; Kembra L. Howdeshell et al., *Mechanisms of Action of Phthalate Esters, Individually and in Combination, to Induce Abnormal Reproductive Development in Male Laboratory Rats*, 108 ENVTL. RES. 168, 169 (2008).
[102] Frederiksen et al., *supra* note 97, at 906; *see also* Martinez-Arguelles et al., *supra* note 91, at 95 (explaining that phthalates and their metabolites are present in amniotic fluid, umbilical cord blood and breast milk).

throughout life,[103] thereby raising concerns about negative health consequences at every age.[104] For example, experimental and epidemiological evidence demonstrates that low levels of prenatal phthalate exposure influence fetal hormone regulation, resulting in abnormal development of the brain[105] and reproductive organs.[106] Additional adverse effects, such as altered gender-specific play behaviors[107] and the potential for increased susceptibility to drug addiction, may become apparent only later in life.[108] Ingestion of contaminated breast milk interferes with androgenic hormone production in male infants, potentially affecting sexual development,[109] and childhood exposure may contribute to rising rates of attention deficit hyperactivity disorder,[110] asthma[111] and obesity,[113] as well as premature breast development in girls.[114] These results are consistent with laboratory data indicating that low doses of DEHP, including levels not previously associated with any adverse effect, "irreversibly" disturb brain development among fetal mice, subsequently inducing hyperactivity.[115] Among adult men,

---

[103] *Phthalates Factsheet*, CTRS. FOR DISEASE CONTROL AND PREVENTION (July 16, 2013), http://www.cdc.gov/biomonitoring/phthalates_factsheet.html (confirming that phthalate contamination is widespread among all age groups).

[104] *See, e.g.*, Richard W. Stahlhut et al., *Concentrations of Urinary Phthalate Metabolites Are Associated with Increased Waist Circumference and Insulin Resistant in Adult U.S. Males,* 115 ENVTL. HEALTH PERSP. 876, 880 (2007) (explaining that phthalate exposure might affect different segments of the population differently).

[105] R. Hokanson et al., *DEHP, Bis(2)-Ethylhexyl Phthalate, Alters Gene Expressive in Human Cells: Possible Correlation with Initiation of Fetal Developmental Abnormalities*, 25 HUMAN & EXPERIMENTAL TOXICOLOGY 687, 694 (2006).

[106] Y. Suzuki et al., *Foetal Exposure to Phthalate Esters and Anogenital Distance in Male Newborns*, 34 INT'L J. OF ANDROLOGY 236, 243 (2012); Swan, *supra* note 15, at 1061.

[107] *Masculine Play*, *supra* note 101, at 8.

[108] *See* Douglas C. Jones, *The Effects of Environmental Neurotoxicants on the Dopaminergic System: A Possible Role in Drug Addiction*, 76 BIOCHEMICAL PHARMACOLOGY 569, 576 (2008) (explaining that "exposure to environmental estrogens during development can impact adult behaviors and sensitivity to the rewarding effects of drug abuse").

[109] Katharina M. Main et al., *Human Breast Milk Contamination with Phthalates and Alterations of Endogenous Reproductive Hormones in Infants Three Months of Age*, 114 ENVTL. HEALTH PERSP. 270, 272-73 (2006).

[110] Bung-Nyun Kim et al., *Phthalates Exposure and Attention-Deficit/Hyperactivity Disorder in School-Age Children*, 66 BIOLOGICAL PSYCHIATRY 958, 960-61 (2009).

[111] Barbara Kolarik et al., *The Association Between Phthalates in Dust and Allergic Diseases Among Bulgarian Children*, 116 ENVTL. HEALTH PERSP. 98, 102 (2008).

[113] Susan L. Teitelbaum et al., *Associations Between Phthalate Metabolite Urinary Concentrations and Body Size Measures in New York City Children*, 112 ENVTL. RES. 186, 189 (2012).

[114] Ivelisse Colón, *Identification of Phthalate Esters in the Serum of Young Puerto Rican Girls with Premature Breast Development*, 108 ENVTL. HEALTH PERSP. 895, 899 (2000).

[115] Tanida et al., *supra* note 96, at 45; *cf.* Martine Culty et al., *In Utero Exposure to Di-(2-Ethylhexyl) Phthalate Exerts Both Short-Term and Long-Lasting Suppressive Effects on Testosterone Production in the Rat*, 78 BIOLOGY OF REPROD. 1018, 1025 (2008) (reporting that

urinary concentrations of phthalate plasticizers correlate with poor semen quality,[116] abdominal obesity and insulin resistance.[117] Exposed women may be more likely to suffer pregnancy complications[118] and contract diabetes.[119] In addition, scientific studies indicate that phthalate plasticizers may exert carcinogenic effects in the liver and other organs.[120] In light of well-established scientific evidence concerning the toxicity of discarded PVC, vinyl chloride and associated chemical additives, we urge EPA to take prompt action to ensure the safe disposal of this material.

b. Concentration of Toxic Constituents in Discarded PVC

Discarded PVC contains substantial concentrations of vinyl chloride and phthalate plasticizers, thus illustrating the need for more protective regulations. As a whole, the PVC industry consumes over 98 percent of global vinyl chloride production and at least 90 percent of phthalate output worldwide,[121] which respectively exceed 16 and 18 billion pounds each year.[122] These substances are essential components of a wide variety of goods, ranging from artificial leather and traffic cones to plastic bags, children's toys and construction supplies.[123] Depending on desired characteristics, phthalate plasticizers may constitute up to 80 percent of finished PVC products, thereby posing significant risks to human health and the environment.[124] For example, over a decade ago, the American Medical Association warned that PVC treatment devices

---

"behavioral and other deficits … might occur during early development if the brain is not exposed to adequate androgen levels").

[116] Russ Hauser et al., *Altered Semen Quality in Relation to Urinary Concentrations of Phthalate Monoester and Oxidative Metabolites*, 17 EPIDEMIOLOGY 682, 687 (2006); Susan M. Duty et al., *Phthalate Exposure and Human Semen Parameters*, 14 EPIDEMIOLOGY 269, 274 (2003).

[117] Stahlhut et al., *supra* note 104, at 800.

[118] *Fetal Origin*, *supra* note 96, at 12.

[119] Katherine Svensson et al., *Phthalate Exposure Associated with Self-Reported Diabetes Among Mexican Women*, 111 ENVTL. RES. 792, 795 (2011).

[120] Ivan Rusyn, *Mechanistic Considerations for Human Relevance of Cancer Hazard of Di(2-Ethylhexyl) Phthalate*, 750 MUTATION RES. 141, 154 (2012).

[121] Brandt-Rauf et al., *supra* note 70, at 2; Lithner et al., *supra* note 71, at 1199; *cf.* Sass et al., *supra* note 12, at 809 (reporting that "[v]inyl chloride … is manufactured exclusively for polymerization into [PVC]").

[122] Brandt-Rauf et al., *supra* note 70, at 2; Chatterjee et al., *supra* note 71, at 62.

[123] Chatterjee et al., *supra* note 71, at 62; Ctrs. for Disease Control and Prevention, Dep't of Health and Human Servs., *Fourth National Report on Human Exposure to Environmental Chemicals* 258 (2009); T.J. Wams, *Diethylhexylphthalate as an Environmental Contaminant: A Review*, 66 SCI. OF THE TOTAL ENV'T 1, 2 (1987).

[124] *See, e.g.*, Rahman et al., *supra* note 68, at 1231 (explaining that certain medical plastics, such as dialysis tubing, contain as much as 80 percent DEHP by weight); San Francisco Dept. of the Env't, *Detailed Results of Phthalate Testing in Children's Toys* 2 (2008), http://www.sfenvironment.org/sites/default/files/fliers/files/sfe_th_phthalate_testing_in_toys_detailed_results.pdf (presenting test results indicating that phthalate plasticizers comprise over 77 percent of certain children's toys).

expose critically ill infants to levels of DEHP likely to impair reproductive development.[125] In addition, scientific research demonstrates that a number of PVC consumer products, including bath toys and inflatable swim rings, release phthalate plasticizers and other chemical additives to water in concentrations which may produce acutely toxic effects.[126] EPA itself has acknowledged that DEHP is a "probable human carcinogen."[127]

Despite these risks, existing regulations fail to ensure the safe disposal of discarded PVC. For instance, although the construction sector accounts for approximately one-half of PVC demand[128] and one-third of national DEHP consumption,[129] an EPA guidance document identifies most industry waste as nonhazardous, and fails to include any instructions for the proper management of discarded PVC.[130] Stricter regulation is necessary to minimize the potential for additional harm.

c. Migration Potential

Because vinyl chloride, phthalate plasticizers and other chemical additives migrate into the environment as discarded PVC deteriorates with age, EPA must immediately impose additional regulations to protect human health and the environment from further chemical contamination. As the agency has explained, any waste that includes a toxic constituent is "presum[ptively]" hazardous.[131] Indeed, with respect to discarded materials containing vinyl chloride and other drinking water contaminants, such as barium, cadmium, DEHP and lead,[132] EPA "treat[s] ... factors such as migration potential as essentially mitigating considerations which *might* render the waste *non-hazardous*."[133]

In the present situation, a review of existing scientific literature clearly supports the stricter regulation of discarded PVC. Recent scientific evidence demonstrates that PVC pipe, which constitutes a growing percentage of the nation's water system, leaches increasing concentrations of vinyl chloride and other chemical compounds during use and after disposal.[134]

---

[125] Am. Med. Ass'n, *DEHP Use in Neonatal Intensive Care Units* (2001), Health Care Without Harm, http://noharm.org/lib/downloads/pvc/PVC_Stmt_AMA_12-01.pdf.
[126] Lithner, *supra* note 71, at 1199.
[127] *Di(2-Ethylhexyl) Phthalate (DEHP)*, U.S. Envtl. Prot. Agency, http://www.epa.gov/iris/subst/0014.htm.
[128] Bidoki, *supra* note 17, at 220.
[129] S. Magdouli, *Di 2-Ethylhexylphtalate in the Aquatic and Terrestrial Environment: A Critical Review*, 127 J. OF ENVTL. MGMT. 36, 39 (2013).
[130] *See generally* Office of Solid Waste and Emergency Response, U.S. Envtl. Prot. Agency, *RCRA in Focus: Construction, Demolition, and Renovation* (2004).
[131] *See* Identification and Listing of Hazardous Waste, 45 Fed. Reg. 33,084, 33,107 (May 19, 1980).
[132] *See List of Contaminants and their (MCLs)*, U.S. Envtl. Prot. Agency, http://water.epa.gov/drink/contaminants/#List (last visited May 18, 2014).
[133] Identification and Listing of Hazardous Waste, 45 Fed. Reg. at 33,107 (emphasis added).
[134] Ryan K. Walter et al., *Investigation of Factors Affecting the Accumulation of Vinyl Chloride in Polyvinyl Chloride Piping Used in Drinking Water Distribution Systems*, 45 WATER RES. 2607, 2614 (2011); Stern et al., *supra* note 13, at 755, 758, 761; *see also* L. Zhang et al., *Investigation of Organic Compounds Migration from Polymeric Pipes into Drinking Water*

The rate of accumulation varies significantly according to the conditions of use, as well as the age, origin and manufacturer of the pipe.[135] For example, "early era" pipes, which were built before 1977 and remain in use today, may be especially likely to release dangerous quantities of vinyl chloride.[136] Moreover, as described above,[137] phthalate plasticizers are not chemically bound to the plastic matrix and thus "leach, migrate or evaporate" into surrounding media and the atmosphere even under ideal conditions,[138] resulting in pervasive contamination.[139] High concentrations of these compounds seep into soil and groundwater following conventional landfill disposal,[140] ultimately collecting in aquatic ecosystems and entering marine food webs.[141] As a result of their widespread use and significant tendency to migrate, phthalates are

---

Under Long Retention Times, 70 PROCEDIA ENGINEERING 1753, 1754 (2014) (reporting that "the main leachates from PVC pipe are metal stabilizers like lead, tin, barium, [and] calcium …, vinyl chloride monomers … and other contaminants related with plasticizers, antioxidants and lubricants commonly used in pipe manufacturing processes"); *see also* M.R. Lasheen et al., *Factors Influencing Lead and Iron Release from Some Egyptian Drinking Water Pipes*, 160 J. OF HAZARDOUS MATERIALS 675, 676 (2008) (finding that PVC pipes release more lead than other common varieties).

[135] Walter et al., *supra* note 134, at 2614; Stern et al., *supra* note 13, at 758.

[136] Stern et al., *supra* note 13, at 758, 761.

[137] *See* § 1.B.1, *supra*.

[138] Heudorf et al., *supra* note 75, at 624; *see also* Yvonne R. Shashoua, *Effect of Indoor Climate on the rate and Degradation Mechanism of Plasticized Poly (Vinyl Chloride)*, 81 POLYMER DEGRADATION AND SUSTAINABILITY 29, 29 (2003) (reporting that "[i]n many international museum collections, degradation of plasticized PVC materials … has been detected as early as 5 years after acquisition," and concluding that "[t]he rate and extent of deterioration of plasticized PVC and the migration and loss of DEHP plasticizer [are] related").

[139] *See, e.g.*, Fossi et al., *supra* note 58, at 2375 ("[Phthalates] are not covalently bound to plastic and migrate from the products to the environment, thus becoming ubiquitous contaminants."); *see also* Kaplan et al., *supra* note 88, at 71 (reporting that "[p]hthalates have been detected in all aspects of the environmental [sic]: water, air, sediment, biota, marine, and freshwater ecosystems"); *see also* M. Abdel daiem et al., *Environmental Impact of Phthalic Acid Esters and their Removal form Water and Sediments by Different Technologies – A Review*, 109 J. OF ENVTL. MGMT. 164, 167 (2012) 167 (explaining that "the slow release of phthalates from plastics and other phthalate containing materials due to weathering" accounts for much of the presence of these compounds in the environment).

[140] Abdel daiem et al., *supra* note 139, at 165, 168; *see also* Chatterjee et al., *supra* note 71, at 68 ("Appreciable amounts of phthalates have been detected in liquid samples withdrawn from landfills and in landfill leachates."); *see also* Emma L. Teuten et al., *Transport and Release of Chemicals from Plastics to the Environment and Wildlife*, 364 PHIL. TRANSACTIONS OF THE ROYAL SOC. B 2027, 2028 (2009) (reporting that discarded PVC and other plastics waste release phthalate plasticizers "after their disposal, for example in landfills").

[141] Depledge et al., *supra* note 20, at 280; *see also* Zhang Cheng et al., *Risk Assessments of Human Exposure to Bioaccessible Phthalate Esters through Market Fish Consumption*, 57-58 ENVT. INT'L 75, 75 (2013) ("Human exposure to phthalate ester mainly occurs through dietary intake, due [in part] to the bioaccumulation of phthalate esters in food chains.").

the most abundant anthropogenic chemicals in the environment.[142] To reduce the need for future corrective action, we urge EPA to promptly revise its regulations so as to ensure the safe disposal of discarded PVC.

d. Persistence

The environmental persistence of phthalate plasticizers indicates the urgent need for more protective regulation. By definition, persistent pollutants resist physical, chemical and biological degradation, thus remaining in the environment for years. Multiple researchers have acknowledged the persistent nature of phthalate plasticizers,[143] and the widespread occurrence of these compounds clearly demonstrates that their massive rate of synthesis outpaces natural removal processes.[144] For example, DEHP is abundant in surface waters, despite its medium-specific half-life of fewer than five weeks.[145] Further, as a consequence of its "highly hydrophobic" character, this compound also tends to form strong bonds with suspended particulates and ultimately accumulates in aquatic sediments, where estimates indicate it will persist for more than 100 years.[146] The environmental ubiquity of phthalate plasticizers serves both to reflect the extensive production of these compounds, and to demonstrate their resistance to degradation. Because existing levels phthalate contamination will continue to threaten humans and wildlife species indefinitely, EPA must promptly take action to minimize future exposure.

e. Degradation Potential and Rate of Degradation

An examination of the process by which phthalate plasticizers degrade clearly demonstrates the need for stricter regulation. As discussed above,[147] these compounds are ubiquitous in the environment. Once released from discarded PVC, phthalates resist physical

---

[142] Susan Jobling et al., *A Variety of Environmentally Persistent Chemicals, Including Some Phthalate Plasticizers, Are Weakly Estrogenic*, 103 ENVTL. HEALTH PERSP. 582, 585 (1995).
[143] *See, e.g.*, Abdel daiem et al., *supra* note 139, at 166 (listing phthalates among "persistent toxic organic compounds"); *see also* Walter Klöpffer, *Environmental Hazard Assessment of Chemicals and Products. Part V. Anthropogenic Chemicals in Sewage* Sludge, 33 CHEMOSPHERE 1067, 1072 (1996) (arguing that DEHP "should be considered as a persistent chemical," because "it is not degraded in anaerobic media"); *see also* Jobling et al., *supra* note 142, at 582 (describing phthalate plasticizers as "environmentally persistent chemicals").
[144] Rishikesh Mankidy et al., *Biological Impact of Phthalates*, 217 TOXICOLOGY LETTERS 50, 56 (2013).
[145] B. Migliarini et al., *Perspectives on Endocrine Disruptor Effects on Metabolic Sensors*, 170 GEN. AND COMPARATIVE ENDOCRINOLOGY 416, 417 (2011); *see also* Magdouli, *supra* note 129, at 42 (observing that "[t]he abundance of DEHP in [the] aqueous environment is mainly related to its extensive utilization and production" because, "[d]ue to its highly hydrophobic properties, the principal fate of DEHP in water and wastewater could be adsorption to the suspended solids").
[146] Migliarini et al., *supra* note 145, at 417.
[147] *See* § I.B.2.c, *supra*.

and chemical degradation.[148] Scientists have long recognized that the biological transformation of phthalate plasticizers "comes to a standstill" under anaerobic conditions, such as those found in deep soils, aquatic sediments, and most landfills.[149] In aerobic environments, the partial degradation of these chemicals yields metabolites that are more harmful than the original plasticizers, including 2-ethylhexanoic acid, 2-ethylhexanal and 2-ethylhexanol.[150] Field studies have detected these acutely toxic metabolites in surface waters, river sediment, freshly fallen snow and even tap water, giving rise to significant concern about potential consequences for human health and the environment.[151]

f. Bioaccumulation

Scientific evidence clearly shows that phthalate plasticizers concentrate in animal tissues and vegetable matter, posing a significant threat to human and ecosystem health. Fish and other aquatic organisms accumulate phthalates directly from the environment and as a consequence of ingesting contaminated food and particles.[152] For example, scientific evidence indicates that certain microscopic plastic fragments enter the marine food web by adhering to algae.[153] In addition, studies have documented plastic consumption among vertebrates and invertebrates from every feeding guild,[154] ranging from zooplankton[155] to large, predatory sharks[156] and endangered sperm whales (*Physeter macrocephalus*).[157] Nearly a decade ago, researchers found that over 97 percent of dead and injured Laysan Albatross (*Phoebastria immutabilis*) chicks contained plastics, and concluded that the incidence and quantity of ingestion was likely

---

[148] Wams, *supra* note 123, at 1; *see also, e.g.*, Magdouli et al., *supra* note 129, at 42 (reporting that the half-life of DEHP under sunlight irradiation in aquatic environments may exceed four years).

[149] Wams, *supra* note 123, at 6.

[150] Owen Horn et al., *Plasticizer Metabolites in the Environment*, 38 WATER RES. 3693, 3695 (2004); Sandro Nalli et al., *Metabolites from the Degradation of Di-Ester Plasticizers by* Rhodococcus rhodochrous, 366 SCI. OF THE TOTAL ENV'T 286, 293 (2006).

[151] Horn et al., *supra* note 150, at 3695; *see* S. Barnabé et al., *Plasticizers and Their Degradation Products in the Process Streams of a Large Urban Physicochemical Sewage Treatment Plant*, 42 WATER RES. 153, 154 (2008) (summarizing existing data).

[152] *See, e.g.*, Wen-Xiong Wang et al., *Dioxin and Phthalate Uptake and Assimilation by the Green Mussel* Perna viridis, 178 ENVTL. POLLUTION 455, 461 (2013).

[153] Priyanka Bhattacharya et al., *Physical Adsorption of Charged Plastic Nanoparticles Affects Algal Photosynthesis*, 114 J. OF PHYSICAL CHEMISTRY C 16,556, 16,558-60 (2010).

[154] Juliana A. Ivar do Sul et al., *Pelagic Microplastics Around an Archipelago of the Equatorial Atlantic*, 75 MARINE POLLUTION BULL. 305, 305 (2013).

[155] *See, e.g.*, Matthew Cole et al., *Microplastic Ingestion by Zooplankton*, 47 ENVTL. SCI. & TECH. 6646, 6647 (2013); *see also* Outi Setälä et al., *Ingestion and Transfer of Microplastics in the Planktonic Food Web*, 185 ENVTL. POLLUTION 77, 80 (2014).

[156] Henry S. Carson, *The Incidence of Plastic Ingestion by Fishes: From the Prey's Perspective*, 74 MARINE POLLUTION BULL. 170, 173 (2013).

[157] Jeff K. Jacobsen et al., *Fatal Ingestion of Floating Net Debris by Two Sperm Whales (*Physeter macrocephalus*)*, 60 MARINE POLLUTION BULL. 765, 766 (2010); *see also* 50 C.F.R. § 17.11 (listing *P. macrocephalus* as endangered under the Endangered Species Act, 16 U.S.C. §§ 1531 *et seq.*).

increasing.[158] Although most organisms seem to mistake plastic debris for natural prey or passively ingest particles during normal feeding behavior,[159] certain species preferentially consume PVC and other plastic waste.[160]

Once ingested by lower trophic organisms, plastic fragments and associated chemical additives pass to aquatic predators, ultimately affecting commercially-harvested fish and endangering human health. Scientific evidence demonstrates that ingested plastics can remain in an organism's body for weeks, accumulating in the digestive tract or translocating to the circulatory system, thereby facilitating trophic transfer and increasing the risk that phthalates and other toxic chemicals will migrate into the organism's tissues.[161] Indeed, a recent study demonstrated that shore crabs (*Carcinus maenas*) ingest and retain plastic fragments originally consumed by prey.[162] Moreover, new experimental evidence confirms what scientists have long suspected: additive chemicals transfer from plastics to organisms following ingestion.[163] These

---

[158] Heidi J. Auman et al., *Plastic Ingestion by Laysan Albatross Chicks on Sand Island, Midway Atoll, in 1994 and 1995*, *in* ALBATROSS BIOLOGY AND CONSERVATION 239, 240, 243 (G. Robinson et al. eds., 1997).
[159] Stephanie L. Wright et al., *The Physical Impacts of Microplastics on Marine Organisms: A Review*, 178 ENVTL. POLLUTION 483, 484 (2013).
[160] Erin R. Graham et al., *Deposit- and Suspension-Feeding Sea Cucumbers (Echinodermata) Ingest Plastic Fragments*, 368 J. OF EXPERIMENTAL MARINE BIOLOGY AND ECOLOGY 22, 25, 27, 28 (2009).
[161] *See, e.g.*, Mark A. Browne et al., *Ingested Microscopic Plastic Translocates to the Circulatory System of the Mussel,* Mytilus edulis *(L.)*, 42 ENVTL. SCI. AND TECH. 5026, 5028 (2008) (noting that "particles of plastic have been shown to accumulate in the gut cavity of birds, fish, and polychaete worms," and reporting data indicating that plastic particles "translocated from gut cavity [of mussels] to the circulatory system in as little as 3 days and persisted in the circulatory system for over 48 days").
[162] Paul Farrell et al., *Trophic Level Transfer of Microplastic:* Mytilus edulis *(L.) to* Carcinus maenas *(L.)*, 17 ENVTL. POLLUTION 1, 3 (2013); *see also* Fiona Murray et al., *Plastic Contamination in the Decapod Crustacean* Nephrops norvegicus *(Linnaeus, 1758)*, 62 MARINE POLLUTION BULL. 1207, 1212 (2011) (reporting that commercially-harvested Norway lobsters (*Nephrops norvegicus*) accumulated plastic transported by prey items).
[163] *See* Radwa A. Barakat et al., *Early Investigation of Hepatocarcinogenic Effect of Polyvinyl Chloride in Rat*, 12 GLOBAL VETERINARIA 67, 72 (2014) (finding that, after consuming PVC, rats exhibit symptoms similar to those associated with direct exposure to vinyl chloride); *see also* Mark Anthony Browne et al., *Microplastic Moves Pollutants and Additives to Worms, Reducing Functions Linked to Health and Biodiversity*, 23 CURRENT BIOLOGY 2388, 2390 (2013) (presenting "the first suitably controlled experimental evidence showing that eating of plastics can move pollutants and additives into the tissues of animals"); *see also* Cole et al., *supra* note 155, at 6653 (reporting that "[t]he leaching of additives and disassociation of toxic chemicals post-ingestion has been modeled in polychaete worms and demonstrated in streaked shearwaters"); *see also* Chelsea M. Rochman et al., *Ingested Plastic Transfers Hazardous Chemicals to Fish and Induces Hepatic Stress*, 3 SCI. REP. 3263, 5 (2013) (finding that fish absorb chemical constituents and other pollutants from ingested plastic debris); *see also* Michael O. Gaylor et al., *House Crickets Can Accumulate Polybrominated Diphenyl Ethers (PBDEs) Directly from Polyurethane Foam Common in Consumer Products*, 86 CHEMOSPHERE 500, 504

data bolster field observations indicating that fish,[164] seabirds[165] and endangered fin whales (*Balaenoptera physalus*)[166] accumulate contaminants, including phthalate plasticizers, as a result of exposure to plastic debris. Thus, scientific evidence strongly indicates that the consumption of PVC and other plastic waste constitutes an important vector of chemical additives into the marine food web.[167]

After dissociating from PVC, phthalates accumulate in the tissues of aquatic organisms,[168] including those targeted by commercial fisheries.[169] Scientific evidence indicates that humans acquire these chemicals primarily as a result of dietary exposure,[170] including the

---

(2012) (concluding that soil-dwelling insects may "accumulate appreciable .. burdens" of additive chemicals as a result of plastic ingestion).

[164] Chelsea M. Rochman et al., *Polybrominated Diphenyl Ethers (PBDEs) in Fish Tissue May Be an Indicator of Plastic Contamination in Marine Habitats*, 476-77 SCI. OF THE TOTAL ENV'T 622, 623 (2014).

[165] Kosuke Tanaka et al., *Accumulation of Plastic-Derived Chemicals in Tissues of Seabirds Ingesting Marine Plastics*, 69 MARINE POLLUTION BULL. 219, 221 (2013).

[166] Fossi, *supra* note 58, at 2378; *see also* 50 C.F.R. § 17.11 (listing *B. physalus* as endangered under the Endangered Species Act, 16 U.S.C. §§ 1531 *et seq.*).

[167] Because many plastic additives are ubiquitous in the environment, scientists have struggled to establish that the bioaccumulation of these substances results from ingestion, rather than some other form of exposure. *See, e.g.*, Rochman et al., *supra* note 164, at 632. Despite the surprising lack of data, experts have hypothesized that plastic consumption spreads chemical contamination throughout the food web. *See, e.g.*, *id.* (concluding that existing evidence "suggests that the ingestion of plastic debris may be an important mechanism for the bioaccumulation of hazardous chemicals in wildlife"); *see also* Galgani et al., *supra* note 7, at 1057 ("Ingestion of microplastic material … presents a route by which chemicals could pass from plastics into the food chain."); *see also* Peter Davison et al., *Plastic Ingestion by Mesopelagic Fishes in the North Pacific Subtropical Gyre*, 432 MARINE ECOLOGY PROGRESS SERIES 173, 173 (2011) ("[Ingestion of plastic by fishes may] serve as a point of entry of plastic-associated toxins into the food chain."); *see also* Barnes et al., *supra* note 5, at 1995 ("Small and microscopic plastic fragments present a likely route for the transfer of [additive] chemicals.").

[168] *See, e.g.*, A. Dick Vethaak et al., *An Integrated Assessment of Estrogenic Contamination and Biological Effects in the Aquatic Environment of The Netherlands*, 59 CHEMOSPHERE 511, 516 (2009) (detecting nine phthalates and other endocrine-disrupting chemicals in the muscle tissue of wild-caught bream (*Abramis brama*) and European flounder (*Platichthys flesus*)).

[169] *See generally* Davison et al., *supra* note 167, at 173 (observing that "[m]any commercially harvested fish feed at a high trophic level and may be subject to biomagnification of the toxins ingested by their prey"); *see also* Chatterjee, *supra* note 71, at 62 ("[Certain phthalates] can accumulate in the food chain via biomagnifications as one organism consumes food lower in the food chain and is subsequently consumed by an organisms higher in the food chain; humans are generally at the top of such chains and this increases their exposure.").

[170] *See, e.g.*, Giuseppe Latini et al., *Plasticizers, Infant Nutrition and Reproductive Health*, 19 REPRODUCTIVE TOXICOLOGY 27, 28 (2004) (explaining that dietary exposure is the main source of DEHP contamination among the general population); *see also* Leonardo Trasande et al., *Phthalates and the Diets of US Children and Adolescents*, 126 ENVTL. RES. 84, 84 (2013)

consumption of contaminated fish and seafood.[171] A recent analysis of marine and freshwater fish purchased from Hong Kong markets detected multiple phthalates in each sample, raising concerns that fish-heavy diets might lead to an increased incidence of cancer.[172] Similarly, in a study evaluating infertile men, researchers determined that phthalate concentrations were highest among regular fish-eaters, regardless of other lifestyle factors.[173] Scientific research reveals that phthalates also accumulate in terrestrial ecosystems,[174] contributing to the contamination of fruit, vegetables, meat, poultry, eggs and dairy products.[175] In addressing the dangers associated with the bioaccumulation of PVC-derived chemicals, EPA must account for all sources of human exposure[176] and consider the additive, synergistic and multiplicative toxic effects of other pervasive pollutants.[177]

g. Plausible Improper Management

As this petition explains, the mismanagement of discarded PVC is not only "plausible," but typical. Accordingly, this factor strongly supports the issuance of more protective regulations. In evaluating the risks associated with the plausible mismanagement of a potentially hazardous waste, EPA considers whether improper disposal *could* result in a "substantial hazard" to human health or the environment.[178] The agency will consider the possibility of harm even if

---

("[D]ietary intake from contaminated food is the largest contributor of [DEHP] exposure in children.").

[171] Cheng et al., *supra* note 141, at 78.

[172] *Id.* at 79.

[173] Roya Rozati et al., *Role of Environmental Estrogens in the Deterioration of Male Factor Fertility*, 78 FERTILITY AND STERILITY 1187, 1191 (2002).

[174] *See, e.g.*, Abdel daiem et al., *supra* note 139, at 166 (observing that "[t]he use of sewage sludge in agriculture ... poses a growing threat to ecosystems and human health," because it introduces phthalates into the food chain).

[175] *See generally* Justin A. Colacino et al., *Dietary Intake is Associated with Phthalate Body Burden in a Nationally Representative Sample*, 118 ENVTL. HEALTH PERSP. 998, 1002 (2010) (assessing the contribution of various foods to phthalate exposure); *see also* T. Fierens et al., *Phthalates in Belgian Cow's Milk and the Role of Feed and Other Contamination Pathways at Farm Level*, 50 FOOD AND CHEMICAL TOXICOLOGY 2945, 2950 (2012) (explaining that phthalates present in raw cow's milk might derive from contaminated feed, including pasture plants); *see also* Ce-Hui Mo et al., *Polycyclic Aromatic Hydrocarbons and Phthalic Acid Esters in Vegetables from Nine Farms of the Pearl River Delta, South China*, 56 ARCHIVES OF ENVTL. CONTAMINATION AND TOXICOLOGY 181, 186-87 (2009) (explaining that vegetables accumulate phthalates "from soil-to-root transfer and subsequently root-to-shoot translocation").

[176] *See, e.g.*, Matthias Wormuth et al., *What are the Sources of Exposure to Eight Frequently Used Phthalic Acid Esters in Europeans?*, 26 RISK ANALYSIS 803, 816 (2006) (analyzing various "oral, dermal, and inhalation pathways causing consumer exposure to phthalates").

[177] *See* Colacino, *supra* note 175, at 1002; *see also* José G. Dórea, *Persistent, Bioaccumulative and Toxic Substances in Fish: Human Health Considerations*, 400 SCI. OF THE TOTAL ENV'T 93, 94 (2008) (explaining that "human exposure to pollutants, when consuming fish or seafood, is rarely limited to a single chemical, especially when consuming large predatory species coming from a marine environment").

[178] Identification and Listing of Hazardous Waste, 45 Fed. Reg. 33,084, 33,113 (May 19, 1980).

"most or all generators ... dispose of [a given] waste properly."[179] Moreover, the presence of potential carcinogens or "significant concentrations" of other toxic constituents give rise to a presumption in favor of listing.[180] In certain situations, "actual damage incidents involving the waste or waste constituents demonstrate empirically that waste constituents may migrate, persist, and cause substantial harm if mismanaged," thus eliminating the need for this theoretical analysis.[181]

As described below, existing environmental regulations are inadequate to ensure the safe disposal of discarded PVC.[182] Experts attribute a large portion of marine plastic pollution to flawed waste management techniques,[183] including the careless transport and improper burial of plastic trash.[184] Similarly, scientific evidence indicates that phthalate plasticizers may percolate into groundwater through poorly lined landfills or enter the atmosphere as a consequence of PVC incineration, resulting in widespread contamination.[185] Indeed, "virtually universal" human exposure may already have contributed to a variety of public health crises,[186] including the increased incidence of obesity[187] and declining fertility rates throughout the Western world.[188] Because the improper management of discarded PVC continues to damage human health and the environment, EPA must promptly regulate this waste as hazardous.

h. Quantities of Waste Generated

The vast quantities of PVC fabricated and discarded each year demonstrate the need for an improved management regime. Despite slow economic growth, United States manufacturers produced over 100 billion pounds of plastics in 2013, including nearly 15.5 billion pounds of PVC[189] and approximately 4.7 billion pounds of associated DEHP.[190] Experts expect these totals to increase in coming years, as "the surge in unconventional oil and gas development" lowers production costs, and the continued recovery of the construction industry and other important markets gives rise to increasing demand.[191] According to EPA, PVC is "not widely recycled in

---

[179] *Id.*; *but see* Dithiocarbamate Task Force v. U.S. Envtl. Prot. Agency, 98 F.3d 1394, 1401 (D.C. Cir. 1996) (concluding that "simple accidents" do not constitute plausible mismanagement).
[180] Identification and Listing of Hazardous Waste, 45 Fed. Reg. at 33,113.
[181] *Id.*
[182] *See* §§ I.B.2.j, *infra*.
[183] National Oceanic and Atmospheric Administration, INTERAGENCY REPORT ON MARINE DEBRIS SOURCES, IMPACTS, STRATEGIES & RECOMMENDATIONS 19-20 (2008).
[184] Barnes et al., *supra* note 5, at 1986.
[185] Chatterjee et al., *supra* note 71, at 62; Kang et al., *supra* note 81, at 1440.
[186] *Masculine Play*, *supra* note 101, at 2. Latini, *supra* note 60, at 90.
[187] Teitelbaum et al., *supra* note 113, at 189; Stahlhut et al., *supra* note 104, at 800.
[188] *See* § I.B.2.i, *infra*.
[189] Am. Chemistry Council, *U.S. Resin Production & Sales 2013 vs. 2012* (Mar. 2014), http://www.americanchemistry.com/Jobs/EconomicStatistics/Plastics-Statistics/ Production-and-Sales-Data-by-Resin.pdf.
[190] *See* Wams, *supra* note 123, at 2 (explaining that, on average, DEHP constitutes 30 percent of finished PVC).
[191] Am. Chemistry Council, *U.S. Resins Industry Strengthens in 2013* 1, http://www.

practice."[192] Indeed, estimates indicate that more than 7.2 billion pounds of this material enter landfills throughout the United States each year.[193] We urge the agency to promptly revise its regulations so as to ensure the safe management of this increasing volume of waste.

i. Nature and Severity of the Human Health and Environmental Damage that Has Occurred

The improper disposal of PVC has likely already caused significant harm to human health. By the mid-1970s, vinyl chloride had contributed to nearly one dozen worker deaths,[194] and experts warn that the continued widespread use of this substance "remains a cause for concern."[195] As described above,[196] prenatal exposure to phthalate plasticizers and their metabolites interferes with hormone regulation and alters sexual development in male laboratory animals, inducing a suite of abnormalities known to scientists as "phthalate syndrome."[197] Among humans, chronic contamination begins even before birth,[198] posing grave biological consequences.[199] Moreover, a growing body of experimental and epidemiological evidence suggests that widespread exposure to phthalates and other endocrine-disrupting chemicals has already contributed to significant declines in semen quality[200] and deteriorating reproductive health across the industrialized world.[201]

Within the past decade, researchers have identified a spectrum of increasingly prevalent disorders, collectively termed "testicular dysgenesis syndrome," which likely arise from impaired hormone production during fetal development.[202] Specific symptoms, including genital

---

americanchemistry.com/Jobs/EconomicStatistics/Plastics-Statistics/Year-in-Review.pdf (last visited May 13, 2014).

[192] U.S. Envtl. Prot. Agency, *Plastics* 3 (Feb. 2012), http://www.epa.gov/epawaste/conserve/tools/warm/pdfs/Plastics.pdf.

[193] Michael Belliveau et al., *PVC – Bad News Comes in Threes: The Poison Plastic, Health Hazards and the Looming Waste Crisis* 10, 12 (Dec. 2004), http://chej.org/wp-content/uploads/Documents/PVC/bad_news_comes_in_threes.pdf (calculating, on the basis of existing data, that annual PVC disposal ranges up to 7.2 billion pounds, but observing that "[t]he amount of PVC [generated by the construction industry] may be seriously underestimated").

[194] Mulder et al., *supra* note 10, at 275.

[195] Kielhorn et al., *supra* note 12, at 579.

[196] *See* § I.B.2.a, *supra*.

[197] Latini et al., *supra* note 60, at 93.

[198] Frederiksen et al., *supra* note 97, at 906.

[199] *See* Swan et al., *supra* note 15, at 1060 ("[H]umans may be more sensitive to prenatal phthalate exposure than rodents.").

[200] *See* Shanna H. Swan et al., *The Question of Declining Sperm Density Revisited: An Analysis of 101 Studies Published 1934-1996*, 108 ENVTL. HEALTH PERSP. 961, 964 (2000); *see also* Fisher, *supra* note 96, at 306 (reporting that 48 percent of young Danish men reporting for military service between 1996 and 1998 exhibited sperm counts associated with impaired fertility, while one-quarter qualified as "abnormal," according to World Health Organization guidelines).

[201] Latini et al., *supra* note 60, at 90.

[202] Fisher, *supra* note 96, at 307.

malformations, such as undescended testicles and displaced urethras, poor semen quality and testicular cancer, mirror the effects of prenatal phthalate contamination in laboratory animals,[203] leading experts to conclude that "phthalate exposures could be the leading cause of reproductive disorders in humans."[204] Moreover, the analogous "female phthalate syndrome," characterized by various reproductive tract abnormalities and reduced fecundity, is "striking[ly] similar" to the effects of Mayer-Rokitansky-Kuster-Hauser syndrome in women.[205] We urge EPA to promptly revise its regulation of discarded PVC to prevent additional damage to public health.

j. Action Taken by Other Governmental Agencies or Regulatory Programs Based on the Health or Environmental Hazard Posed by Discarded PVC, Vinyl Chloride and Phthalate Plasticizers

Existing regulations are inadequate to manage the risks associated with the widespread use and improper disposal of PVC. Government officials have recognized the problem of marine pollution for nearly a century,[206] and have implemented a variety of international agreements, federal legislation, and state laws to curb this growing threat.[207] In the four decades since researchers first reported the presence of plastic litter in the oceans, however, these measures have proven insufficient to prevent the further contamination of the marine environment.[208] For example, although the International Convention for the Prevention of Pollution from Ships, commonly known as MARPOL, explicitly prohibits vessels from dumping plastic waste at sea,[209] "large amounts of [illegally-discharged] plastic continue to wash ashore, obstruct navigation, and entangle marine life,"[210] including endangered Hawaiian monk seals (*Monachus schauinslandi*).[211] In addition to suffering from inadequate enforcement, MARPOL and other

---

[203] Howdeshell et al., *supra* note 101, at 168; *see also* Frederiksen et al., *supra* note 97, at 899, 905.

[204] Latini et al., *supra* note 60, at 90.

[205] Bethany R. Hannas et al., *In Utero Phthalate Effects in the Female Rat: A Mode for MRKH* Syndrome, 223 TOXICOLOGY LETTERS 315, 320 (2013).

[206] *See* Daud Hassan, *International Conventions Relating to Land-Based Sources of Marine Pollution Control: Applications and Shortcomings*, 16 GEO. INT'L ENVTL. L. REV. 657, 660 n.19 (2004) (reporting that expserts from thirteen maritime powers, including the United States, met in June 1926 to discuss measures to prevent ocean-going vessels from contaminating the marine environment).

[207] *See generally* Grant A. Harse, *Plastic, the Great Pacific Garbage Patch, and International Misfires at a Cure*, 29 UCLA J. ENVTL. L. & POL'Y 331, 344-353 (2011) (reviewing international agreements and federal laws pertaining to problem of marine plastic pollution, and observing that "for all of these, plastics continue to reach our oceans").

[208] *See, e.g.*, Barnes, *supra* note 5, at 1985 (observing that "the ubiquity and abundance of plastic debris … is still growing and even if stopped immediately will persist for centuries").

[209] *See* Sally Ann Lentz, *Plastics in the Marine Environment: Legal Approaches for International Action*, 18 MARINE POLLUTION BULL.N 361, 362 (1987).

[210] Recordkeeping of Refuse Discharges from Ships, 59 Fed. Reg. 18,700, 18,700 (Apr. 19, 1994).

[211] *See* John R. Henderson, *A Pre- and Post-MARPOL Annex V Summary of Hawaiian Monk Sea Entanglements and Marine Debris Accumulation in the Northwestern Hawaiian Islands, 1982-1998*, 42 MARINE POLLUTION BULL. 584, 587, 588 (2001) (observing that the amount of plastic

existing legal regimes fail to address the major source of plastic pollution. Specifically, according to data collected by the National Marine Debris Monitoring Program, as much as 82 percent of shoreline litter may result from activities on land that fall outside the scope of international conventions, including plastics manufacturing and improper waste management.[212]

In 2008, Congress restricted the use of certain phthalates in children's toys and childcare articles, and mandated further testing to ascertain the risks associated with human exposure to these substances.[213] Legislators have enacted similar provisions in California,[214] Vermont[215] and Washington.[216] In addition, several state and federal agencies have sought to limit levels of these compounds in the environment.[217] However, as this petition describes, the current regulatory scheme is wholly inadequate to prevent the harm likely to result from the continued

---

debris washing ashore in the Northwestern Hawaiian Islands "show[ed] no sign of diminishing" between 1982 and 1998, "despite implementation of MARPOL Annex V in 1989," and reporting that "Hawaiian monk seals continue to become entangled in marine debris"); *see also* 50 C.F.R. § 17.11 (listing *M. schauinslandi* as endangered under the ESA).

[212] National Oceanic and Atmospheric Administration, *supra* note 183, at 19-20; *but see* Michael J. Bean, *Legal Strategies for Reducing Persistent Plastics in the Marine Environment*, 18 MARINE POLLUTION BULL. 357, 357 (1987) (estimating that 90 percent "of the total pollution entering the oceans … enters from land-based sources via rivers, estuaries and other avenues").

[213] *See* 15 U.S.C. § 2057c (mandating, *inter alia*, that "it shall be unlawful for any person to manufacture for sale, distribute in commerce, or import into the United States any children's toy or child car article that contains concentrations of more than 0.1 percent of [DEHP, DBP, or BBP]"). Controls intended to reduce exposure among children also exist in Argentina, Fiji, Japan and Mexico, as well as throughout the European Union. Rachael Rawlins, *Teething on Toxins: In Search of Regulatory Solutions for Toys and Cosmetics*, 20 FORDHAM ENVTL. LAW REV. 1, 5 (2009) (noting the existence of relevant laws in Austria, Denmark, Finland, France, Germany, Greece, Norway and Sweden). In addition, Germany, Spain and Sweden have enacted broader bans on the use and disposal of PVC. *See PVC Policies Across the World*, CTR. FOR HEALTH, ENV'T & JUSTICE, http://www.chej.org/pvcfactsheets/PVC_Policies_Around_The_World.html (last visited Apr. 7, 2014).

[214] CAL. HEALTH & SAFETY CODE §108935-39 (restricting the manufacture, sale and distribution of certain toys and child care articles containing more than 0.1 percent of DEHP, DBP, BBP, DINP, DIDP, or DnOP).

[215] VT. STAT. ANN. tit. 18, § 1511 (restricting the manufacture, sale and distribution of certain toys and child care articles containing more than 0.1 percent of DEHP, DBP, BBP, DINP, DIDP, or DnOP).

[216] WASH. REV. CODE § 70.240.020(1)(c) (restricting the manufacture, sale and distribution of "children's product[s] or product component[s]" containing, *inter alia*, "[p]hthalates, individually or in combination, at more than 0.10 percent by weight (one thousand parts per million)").

[217] *See, e.g.*, 40 C.F.R. pt. 132 (requiring Great Lakes States and Tribes to adopt, *inter alia*, provisions sufficient to protect local wildlife from "bioaccumulative chemicals of concern," including six phthalate plasticizers); *see also* CAL. CODE REGS. tit. 27, § 25805 (prohibiting businesses from knowingly discharging "chemicals causing reproductive toxicity," including five phthalate plasticizers, into any source of drinking water).

widespread use and improper disposal of PVC.[218] Phthalate contamination is now ubiquitous among the population of industrialized nations, and exposure to vinyl chloride "remains a cause for concern."[220] According to a 2005 study, one-quarter of U.S. women exhibit concentrations of phthalate metabolites higher than those correlated with irregular sexual development in male infants,[221] and evidence indicates that contamination might be even more prevalent among pregnant women in urban settings.[222] To protect the next generation and preserve the marine environment, EPA must promptly take action to manage discarded PVC as hazardous waste.

k. Other Appropriate Factors

As this petition explains, a considerable body of scientific research implicates discarded PVC, vinyl chloride and associated phthalate plasticizers in a range of threats to human health and the environment. Moreover, recent research indicates that exposure pathways "outside the scope of traditional toxicity testing" might result in additional harm.[223] For example, low doses of phthalates and other endocrine-disrupting chemicals often produce health effects different from or more severe than those associated with higher concentrations.[224] Simultaneous exposure to multiple phthalates or to a single phthalate mixed with other environmental pollutants, might elicit a synergistic response.[226] In addition, the recent discovery of additional phthalate metabolites indicates that human exposure probably exceeds previously published estimates.[228] Because the majority of chemical compounds used in PVC production remain untested, existing toxicity data likely underestimate risks arising from the improper disposal of discarded PVC.[229]

---

[218] In addition to ignoring significant sources of human and environmental exposure to phthalate plasticizers, existing laws may suffer from inadequate enforcement. *See, e.g.*, Margaret H. Lemos, *State Enforcement of Federal Law*, 86 N.Y.U.L. REV. 698, 738 (2011) (explaining that federal phthalate restrictions "allow[] states to influence policy by adjusting the intensity of enforcement and hence the degree to which manufacturers are deterred from using phthalates," and observing that an elected attorney general from a "conservative" state might have little incentive to take action in the consumer protection field).

[220] Wormuth et al., *supra* note 176, at 803; Kielhorn et al., *supra* note 12, at 579.

[221] Swan et al., *supra* note 15, at 1056.

[222] Adibi et al., *supra* note 16, at 1722 (reporting that pregnant women in New York City "appear to be exposed [to phthalates] at levels above background levels in the United States, which may have implications for their pregnancy and/or the fetus").

[223] Heather J. Hamlin, *Embryos as Targets of Endocrine Disrupting Contaminants in Wildlife*, 93 BIRTH DEFECTS RES. PART C: EMBRYO TODAY: REV. 19, 23 (2011).

[224] *Id.* at 21, 25.

[226] Mankidy et al., *supra* note 144, at 56; Hamlin et al., *supra* note 223, at 25; Howdeshell et al., *supra* note 101, at 175; *see also* Jobling et al., *supra* note 142, at 586 (noting that scientific literature suggests that "measuring the total estrogenic burden due to environmental contaminants may have more relevance than assessing exposure by measuring levels of individual estrogens alone," because "environmental estrogens may act cumulatively").

[228] Frederiksen et al., *supra* note 97, at 902-03, 906.

[229] Stern et al., *supra* note 13, at 774.

II. The Toxic Substances Control Act

A. Statutory Background

In 1976, Congress enacted the Toxic Substances Control Act ("TSCA"), 15 U.S.C. §§ 2601 *et seq.*, "to assure that … innovation and commerce in … chemical substances and mixtures do not present an unreasonable risk of injury to health or the environment."[230] Accordingly, lawmakers required manufacturers and processors to develop "adequate data" concerning the effects of these compounds, and granted the U.S. Environmental Protection Agency ("EPA") "authority … to regulate [those] chemical substances and mixtures which present an unreasonable risk."[231]

Pursuant to section 6 of TSCA, EPA "*shall*" regulate a chemical substance if "there is a reasonable basis to conclude" that the compound "presents or will present an unreasonable risk of injury to health or the environment."[232] Permissible regulations include requirements prohibiting or "limiting the amount of such substance … which may be manufactured, processed, or distributed in commerce."[233] In assessing risk, EPA must consider:

(A) the effects of such substance or mixture on health and the magnitude of the exposure of human beings to such substance or mixture,
(B) the effects of such substance or mixture on the environment and the magnitude of the exposure of the environment to such substance or mixture,
(C) the benefits of such substance or mixture for various uses and the availability of substitutes for such uses, and
(D) the reasonably ascertainable economic consequences of the rule, after consideration of the effect on the national economy, small business, technological innovation, the environment, and public health.[234]

Factual certainty is not required; instead, the agency may "base its action on scientific theories, consideration of projections from available data, modeling using reasonable assumptions, and extrapolations from limited data."[235] Even if EPA determines that another federal law "could [sufficiently] eliminate[] or reduce[]" the risk associated with a particular chemical substance, the agency may elect to regulate the substance under TSCA, provided that a "comparison of the estimated costs" and "relative efficiency" reveals that such action promotes the public interest.[236]

In the event that EPA lacks adequate data and experience upon which to determine the health and environmental risks associated with a particular chemical substance, the agency "*shall*

---

[230] 15 U.S.C. § 2601(b)(3) (2012). Within the meaning of TSCA, the term "chemical substance" includes "any organic or inorganic substance of a particular molecular identity." *Id.* § 2602(2).
[231] *Id.* § 2601(b)(1) & (2).
[232] *Id.* § 2605(a) (emphasis added).
[233] *Id.* § 2605(a)(1)(B).
[234] *Id.* § 2605(c).
[235] Lead Fishing Sinkers; Response to Citizens' Petition and Proposed Ban, 59 Fed. Reg. 11,122, 11,138 (Mar. 9, 1994) (*citing* H.R. Rep. No. 1341, 9th Cong., 2d Sess. 32 (1976)).
[236] *Id.*

by rule require that testing be conducted on such substance."[237] Specifically, under 15 U.S.C. § 2603, EPA may compel manufacturers and processors to evaluate the safety of substances that "may present an unreasonable risk of injury to health or the environment" or that "[are] or will be produced in substantial quantities" and, thus, "may reasonably be anticipated to enter the environment in substantial quantities" or result in "significant or substantial human exposure."[238]

B. Vinyl Chloride and Phthalate Plasticizers Pose an Unreasonable Risk of Harm to Human Health and the Environment

Although Congress did not define the phrase "unreasonable risk," EPA has interpreted relevant legislative history to require that the agency:

> balance the benefits derived from risk reduction against the social and economic costs incurred, taking into account such factors as the extent and magnitude of risk posed; the societal consequences of removing or restricting use of products; availability and potential hazards of substitutes; and impacts on industry, employment, and international trade.[239]

No specific factual determination is necessary to establish "unreasonable risk." For example, even under the stricter standard of 15 U.S.C. § 2606, EPA need not present evidence of actual injury before obtaining emergency injunctive relief to control "immanently hazardous chemical substance[s] or mixture[s]."[240]

A growing body of scientific evidence clearly shows that the inadequate management of PVC, vinyl chloride and phthalate plasticizers poses significant threats to human and ecosystem health. As a result of their widespread use, significant tendency to migrate, and resistance to degradation, phthalates are the most abundant anthropogenic chemicals in the environment,[241] contaminating even freshly fallen snow.[242] Once dissociated from PVC, these compounds accumulate in the tissues of aquatic and terrestrial organisms,[243] interfering with hormone regulation and altering sexual development in laboratory animals and human beings.[244] Moreover, recent research indicates that human contamination probably exceeds previously published estimates,[245] and exposure pathways "outside the scope of traditional toxicity testing" might result in additional harm.[246] For example, simultaneous exposure to multiple phthalates,[247] or to a single phthalate mixed with other environmental pollutants, likely elicits a

[237] 15 U.S.C. § 2603 (emphasis added).
[238] *Id.*
[239] Guidance for Petitioning the Environmental Protection Agency Under Section 21 of the Toxic Substances Control Act, 50 Fed. Reg. 46,825, *2 (Nov. 13, 1985).
[240] *See* H.R. Conf. Rep. No. 94-1679 78 (1976).
[241] Jobling et al., *supra* note 142, at 585.
[242] Horn et al., *supra* note 150, at 3695.
[243] *See* §§ I.B.2.f, *supra.*
[244] Latini et al., *supra* note 60, at 93.
[245] Frederiksen et al., *supra* note 97, at 902-03, 906.
[246] Hamlin, *supra* note 223, at 23.
[247] Mankidy et al., *supra* note 144, at 56.

synergistic response.[248] Experts suspect that virtually universal exposure to phthalate plasticizers "could be the leading cause of reproductive disorders in humans" and vinyl chloride also "remains a cause for concern."[249] Despite the availability of less harmful alternatives,[250] the PVC industry consumes over 32 billion pounds of these toxic chemicals each year.[251]

We urge EPA to promptly initiate rulemaking under 15 U.S.C. § 2605 to reduce the unreasonable risk to public health and the environment associated with continued dependence on PVC, vinyl chloride and phthalate plasticizers. In the event that the agency concludes that there are insufficient data and experience upon which to determine or predict the effects of ubiquitous contamination, we alternatively request that the agency adopt a rule under section 4 of the Act, 15 U.S.C. § 2603, requiring manufacturers and processors responsible for the generation of these compounds to undertake additional toxicity testing.

CONCLUSION

As this petition explains, inadequate management strategies have permitted substantial quantities of discarded PVC to accumulate in the marine environment, contributing to a broad array of social, economic and environmental harms. Conventional landfill disposal practices also fail to contain vinyl chloride and plastic additives, including designated toxic constituents, which easily migrate from discarded PVC and ultimately infiltrate aquatic and terrestrial ecosystems. The environmental persistence of these chemicals, combined with the massive rate of PVC production, has resulted in nearly universal human exposure, raising concerns about a range of associated health problems, including birth defects, cancers and diabetes.

Discarded PVC satisfies the statutory definition of "hazardous waste." After disposal, this material necessarily qualifies as potentially hazardous "solid waste." Moreover, because PVC typically contains substantial concentrations of toxic constituents, the improper disposal of this material poses a substantial present and future threat to human health and the environment. The analysis of EPA's regulatory criteria set forth in detail above supports the listing of discarded PVC as hazardous waste, and demonstrates that continued widespread use of PVC, vinyl chloride and phthalate plasticizers poses an unreasonable risk to human health and the environment. Immediate action is necessary to reduce the need for future corrective action and prevent additional harm. Accordingly, we urge EPA to promptly exercise its authority to ensure the safe disposal of discarded PVC.

---

[248] Hamlin et al., *supra* note 223.
[249] Latini et al., *supra* note 60, at 90; Kielhorn et al., *supra* note 12, at 579.
[250] Kastner et al., *supra* note 69, at 363.
[251] Brandt-Rauf et al., *supra* note 70, at 2; Chatterjee et al., *supra* note 71, at 62; Lithner et al., *supra* note 71, at 1199.