Buildings' Hidden Plastic Problem

POLICY BRIEF AND RECOMMENDATIONS

HABITABLE

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ABOUT HABITABLE

Habitable (formerly Healthy Building Network) believes that all people and the planet will thrive when the materials economy is in balance with nature. Our team of researchers activate science to reduce pollution, mitigate climate change, and create a healthier and more equitable future for all. Our Informed™ initiative supports built environment practitioners in selecting products with safer chemicals to improve the health of humans and the environment.

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Brief highlights

In this brief, we present highlights from the significant body of science indicating that plastic building materials are contributing to serious health and environmental harms over their life cycle, from fossil fuel extraction to production, use, and disposal. These impacts fall disproportionately on susceptible and marginalized people, including women, children, Indigenous people, low-income communities, and people of color. We share examples of solutions and offer recommendations to strengthen policies that will reduce plastic use in the built environment and associated life cycle harms.

Policy recommendations

- Include building materials in the scope of plastics, chemical, and other relevant policies.
- Target phase-out of unnecessary plastic building materials in favor of safer alternatives, prioritizing the most hazardous plastic polymers, such as PVC and polystyrene.
- Ban classes of chemicals of concern from building materials and require safer alternatives. Alternatives include non-plastic materials that do not require these additives.
- Use accurate service life assumptions for building materials in cost-benefit analysis.
- Require full transparency and public disclosure of chemicals and additives used in the production of building materials. Mandate labeling where needed to ensure that hazardous polymers can be easily avoided and toxic chemicals do not enter recycling and other circular material streams.
- Invest in research and development and pass policies to support infrastructure needed for circular systems of building materials management.

DEFINITIONS

Plastic pollution includes the negative effects and emissions resulting from the production and consumption of plastic materials and products across their entire life cycle.

Safer alternatives to plastic building materials include alternative materials, products, processes, and system designs.

Circular systems consist of non-toxic materials cycles that minimize resource extraction and uphold equity and human rights throughout the life cycle.

Building materials are a significant and growing sector of plastic use.

Globally, building and construction is the second highest-use sector for plastics behind packaging, accounting for 17% of total plastic production.[1]

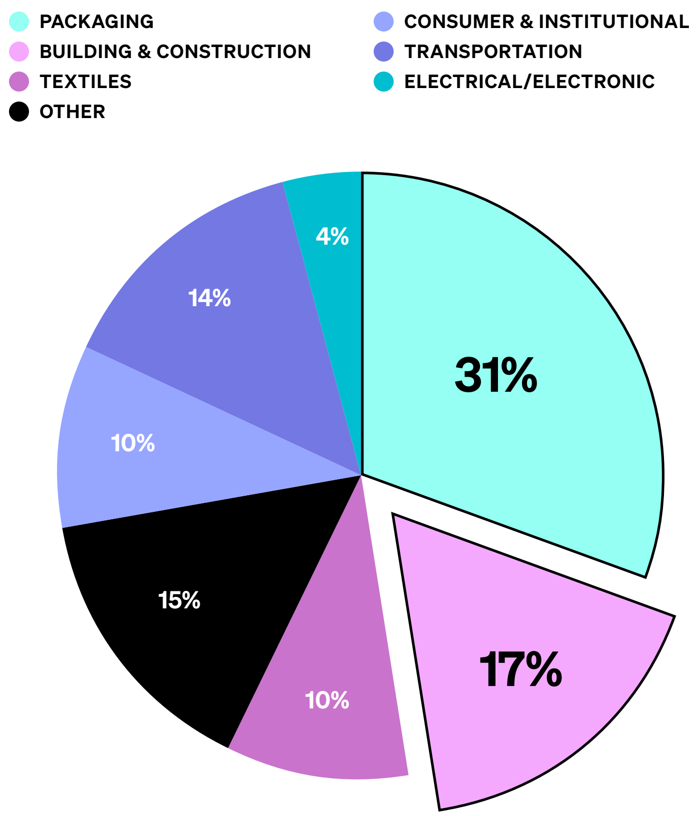


Figure 1. Plastic use by sector in 2019.[1]

There are many common uses and types of plastics in buildings.

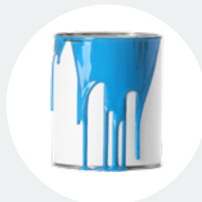
Below are a few examples; other uses include countertops, roofing, windows, and more.[4]

Flooring
Polyvinyl chloride (PVC, vinyl, luxury vinyl tile)

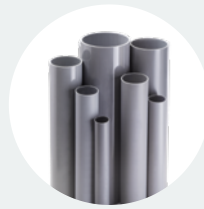
Carpet (nylon, polypropylene, polyester [polyethylene terephthalate or PET])[2]

Insulation
Expanded polystyrene (EPS)

Extruded polystyrene (XPS)



Paint
Acrylics, Polyurethanes[3]



Pipes
PVC

Siding
PVC (vinyl siding or cladding)

Discussions regarding plastic pollution policies to date have primarily focused on targeting packaging and single-use plastics.[5] In 2019, plastic demand for packaging was over 140 million tonnes, with proposed interventions aiming to reduce demand to 90 million tonnes by 2050.[6,7] Projections show that without intervention, demand for plastic building materials is likely to almost double by 2050 to 150 million tonnes, surpassing the 2019 level of plastic packaging production (Figure 2).[8] Such an increase in production would be disastrous for both planetary and human health, resulting in even more toxic pollution, climate pollution, and plastic waste.

PLASTIC DEMAND: BUILDINGS VS. PACKAGING

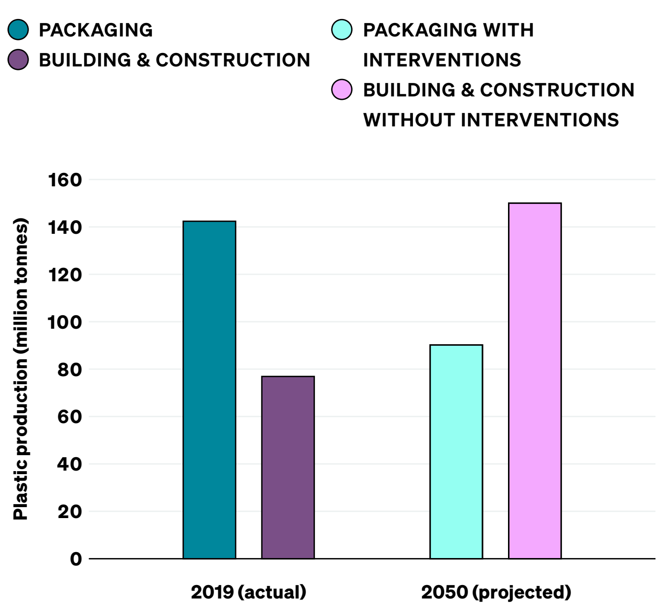


Figure 2. Current demand for plastics used in packaging and building materials, and projected demand by 2050 with interventions for packaging and no interventions for building materials. 2019 plastic production and building and construction projected growth from OECD; packaging projected with interventions from ODI 2020.[6–8]

Plastic building materials pollute across the product life cycle,

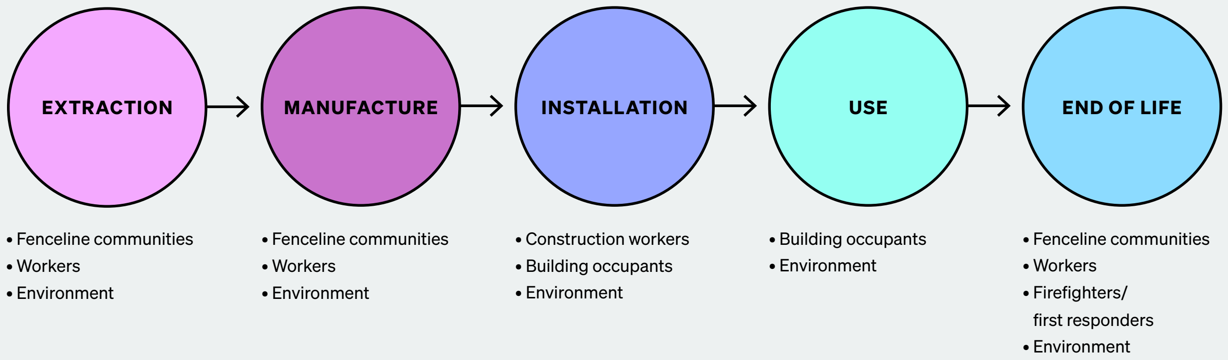
disproportionately raising health hazards for susceptible and marginalized people.

Plastic pollution is defined broadly as "the negative effects and emissions resulting from the production and consumption of plastic materials and products across their entire life cycle."[9] Building materials generate pollution at every stage of their life cycle: from fossil fuel extraction, through manufacturing, installation, use, and disposal. This pollution — including greenhouse gases (GHGs), microplastics, and toxic chemicals — harms communities, workers, building occupants, and the environment (Figure 3).

The pollution from plastics, including plastic building materials disproportionately impacts those who are biologically susceptible and/or marginalized.[10,11] People who are biologically susceptible experience greater harm from toxic chemicals and materials because of factors inherent to their bodies, such as a young age, existing medical conditions, and genetic variation.[12] Power structures worldwide often discriminate against and marginalize people based on their race, ethnicity, nationality, gender, income level, political views, religion, and other aspects of identity.[10]

BUILDING MATERIAL LIFE CYCLE IMPACTS

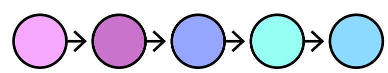
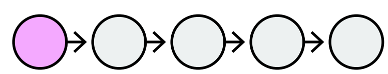
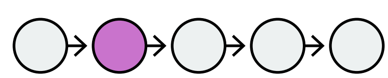
Figure 3.



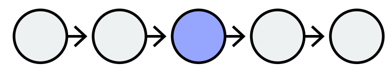
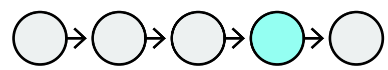
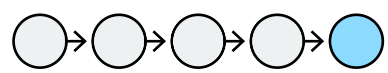
This brief calls specific attention to the impacts of the entire life cycle of plastic building materials on toxic chemical pollution, micro- and macro-plastic pollution, climate change, dangerous incidents, and waste generation and disposal, using specific materials as examples. Many other well-documented impacts occur across the product life cycle—please see citations for more information.

Toxic chemical pollution

Plastic building materials contribute to toxic chemical pollution over the product life cycle.[11,17]

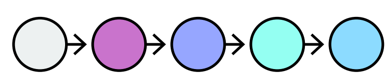
Persistent Organic Pollutants (POPs) such as dioxins and flame retardants released across the life cycle of plastic building materials bioaccumulate, biomagnify through food chains, and concentrate in remote regions such as the Arctic, threatening the lands, food security, and health of **Indigenous nations and communities**.[11,18]	
Extraction and refining of fossil fuel feedstocks for plastic production disrupts ecosystems and contaminates air, water, and soil with toxic chemicals, with specific impacts on **women, Indigenous people, and rural and frontline/fenceline communities worldwide.**[10,11] In the US, frontline/fenceline communities are disproportionately low-income and communities of color.[19]	
PVC manufacturing involves the use and/or release of chemicals of high concern, including per- and polyfluoroalkyl substances (PFAS), asbestos, lead, vinyl chloride, ortho-phthalates, dioxins, mercury, and other chemicals that can cause cancer, disrupt hormones, and harm the reproductive and immune systems.[20–22] These chemicals can impact **manufacturing workers and surrounding communities**. Manufacturing is often co-located with fossil fuel refining, impacting the same frontline/fenceline communities.[10,23] Other negative manufacturing impacts have been documented—for instance, factories making PVC building materials in the Xinjiang Uyghur Autonomous Region in China significantly utilize forced labor of Uyghur and other minoritized people.[22]	

Toxic chemical pollution (cont'd.)

Cutting of polystyrene insulation foam boards generates dust and microplastics that workers breathe in and accidentally swallow.[24] These microplastics and flame retardants added to polystyrene pose health hazards for workers.[25–27] These impacts fall heavily on **marginalized populations** — including Hispanic and immigrant workers in the US, and immigrant workers across low-income countries where hazardous working conditions are common.[28,29]	
Plastics can emit toxic chemicals into indoor air and dust, including ortho-phthalates, flame retardants, and volatile organic chemicals (VOCs); these chemicals are associated with increased risks of cancers, asthma, reproductive harm, learning and developmental problems, and other diseases.[30–32] **Infants and children** have more exposure to contaminated air and dust compared to adults and are more biologically susceptible to the health hazards of these toxic chemicals.[33,34]	
When burned in accidental fires or wildfires, plastic building materials release hazardous chemicals.[11,21] **Firefighters** breathe in and absorb these chemicals on the job, increasing risks of cancer and other diseases.[35,36] Heating plastic pipes releases the cancer-causing chemical benzene and other VOCs, raising drinking water contamination concerns for **communities** with plastic pipes after fires.[37]	

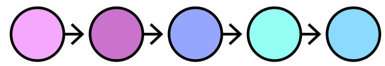
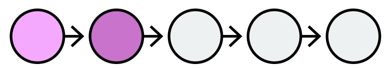
Micro- and macro- plastic pollution

Plastic building materials contribute to microplastic and macroplastic (larger pieces of plastic) pollution over their life cycle.[10]

Almost 18% of all microplastics in oceans and waterways are estimated to come from architectural paint (paint used in buildings), via unused paint, application, wear, removal, and disposal of painted materials.[44] Building materials are a significant source of polystyrene releases to **oceans and waterways**, with one study finding that polystyrene building materials were responsible for more than half of foam plastic debris and litter on Toronto-area beaches.[45,46]	

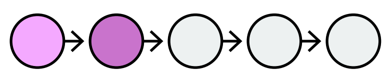
Impact on climate change

As noted in a 2019 report, "At current levels, greenhouse gas emissions from the plastic life cycle threaten the ability of the global community to keep global temperature rise below 1.5°C degrees."[13]

The life cycle of plastic building materials generates greenhouse gas emissions contributing to climate change.[14] These climate impacts fall disproportionately on **women, children, low-income people, and other marginalized groups**.[15]	
Manufacture of PVC uses fossil fuel feedstocks, contributing to **GHG emissions** — for example, PVC flooring production in China uses coal as a feedstock.[16]	

Dangerous incidents

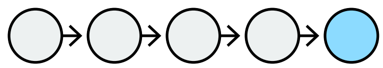
The extraction and refining of fossil fuels, production of chemicals, production of plastics, and transportation of chemicals for these processes creates risk of fires, explosions, spills, leaks, and other incidents at production facilities and in transport.[17] These hazards impact **frontline/fenceline communities** — predominantly low-income individuals and people of color — who live near extraction, refining, and manufacturing facilities, as well as transportation routes.[23]

In the US between 2010 and 2023, there were 966 incidents involving vinyl chloride, including explosions, fires, and spills at manufacturing facilities, railways, roads, and ports.[38] In East Palestine, Ohio, US the 2023 derailment and burning of five rail cars of vinyl chloride created an environmental and public health disaster that led to contamination in at least 16 states.[38] Fires, explosions, and other incidents at PVC-related facilities have killed and injured people globally.[39]	

Waste generation and disposal

In 2019, building materials accounted for an estimated 16.2 million tonnes of plastic waste.[40] If production of plastic building materials grows, waste generation will also grow due to the lack of safe and circular management systems for building materials at the end of life. The majority of plastic building materials and related waste generated across the life cycle are landfilled or incinerated, with little reused or recycled.[4,41] Pollution from landfills and incinerators disproportionately impacts systemically marginalized communities.[42]

The United Kingdom landfills 400,000 tonnes of carpet a year.[43] The US discards about 1.1 million tonnes of plastic from carpet each year, an equivalent amount to all the plastic straw, bag, and water bottle waste generated in the country annually (see Appendix).



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1.1 million tonnes

of plastic in carpet discarded in the US each year

1.2 MILLION TONS

All plastic water bottles, bags, and straws

used in the US each year

Building materials are a large use of problematic plastics

and frequently contain toxic chemical classes.

Polyvinyl chloride (vinyl or PVC) is widely considered to be problematic as it is one of the most toxic plastics for human health and the environment throughout its life cycle.[20,47–49] Building and construction is by far the largest user of PVC, accounting for 70% of total use in 2019 (Figure 4).[50] Globally, around 45% of PVC is used to create pipes and fittings, and it is also used in siding, window frames, roofing membranes, flooring, and more.[51]

On par with packaging, building and construction is a leading sector for polystyrene use with both sectors each responsible for 30% of total polystyrene use in 2019 (Figure 5).[50] In buildings, polystyrene is used mainly for insulation (also known as foam board insulation, EPS, and XPS). Like PVC, polystyrene is toxic throughout its life cycle and widely considered problematic.[21,48,49,52,53]

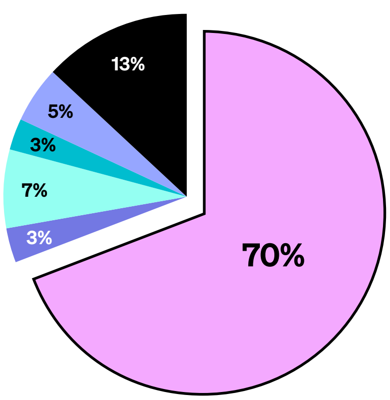

Figure 4. PVC use by sector in 2019.[50]

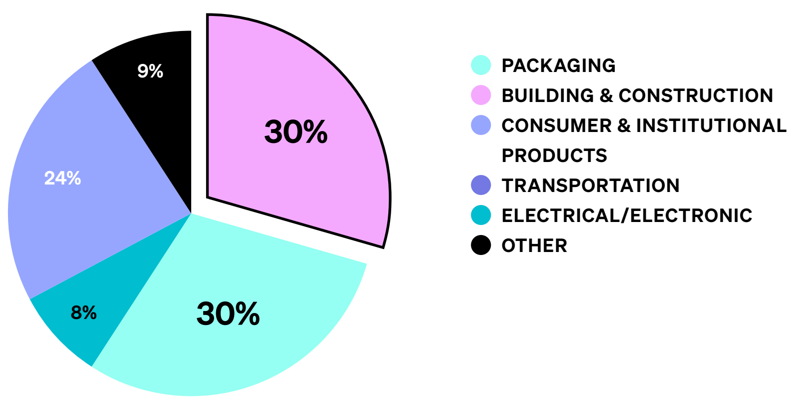

Figure 5. Polystyrene use by sector in 2019.[50]

Among many other reasons, PVC and polystyrene are considered problematic because of the toxicity of chemicals used in their production — including vinyl chloride and styrene, both carcinogens — and the lack of responsible management options.[49] In addition, each type of plastic can contain over 400 hazardous chemicals, including monomers, additives, processing aids, non-intentionally added substances, and more.[54,55] PVC and polystyrene building materials can contain major chemical classes of concern, including ortho-phthalates, organotins, flame retardants, and/or chlorinated paraffins.[54]

Addressing plastics holistically

The reduction of hazardous chemical additives within plastics should be paired with efforts to reduce the use of plastics themselves. For example, policies should leverage the success of initiatives targeting PVC flooring with toxic ortho-phthalate plasticizers to restrict the use of PVC flooring itself and promote safer options. Focusing on reducing the threat of a single toxic chemical additive in a plastic building material can risk regrettable substitutions of other less-studied but still toxic chemicals.[56,57] Further, even if one toxic additive is removed or replaced, other toxic chemicals like heavy metals and VOCs commonly present in plastic products may remain.[57,58] Finally, unless the plastics themselves are addressed, the serious life cycle harms of those plastics remain.

Viable, safer alternatives to plastic building materials are readily available.

Fortunately, safer alternatives to plastic building materials are widely available today. Many of these materials have been used successfully long before plastics became common in construction after 1950.[14]

Sustainable building materials are inherently low-hazard, responsibly managed, waste-free, and made from renewable or recycled resources.[14,47,52] Fossil-fuel based plastic building materials do not meet these criteria, but in almost all cases, plastic building products can be replaced by alternatives that are no/low-plastic or contain less-hazardous plastics. Non-plastic materials are often entirely free of chemical classes of concern, or contain significantly fewer and/or lower amounts of chemicals of concern.[59]

Many no/low-plastic alternatives available on the market today are safer, as well as more sustainable, affordable, and widely used.[4] A recent European Union report concluded, **"potential alternatives exist in the majority, if not all, PVC applications that have been assessed in detail."**[51] For example, evidence shows plastic pipes are not essential for water infrastructure.[4,60] In the US, iron remains the most common material for water mains, though PVC use varies by region.[61] In the EU, PVC is not used for new drinking water lines or mains in any country except France.[60] This wide variation in material choices — both within and between countries — demonstrates that proven alternatives to plastic pipes are readily available.

NGOs offer free resources that identify available building materials with minimal plastic content, fewer hazardous chemicals, and lower life cycle impacts (Table 1).[62,63]

NO/LOW-PLASTIC BUILDING MATERIAL ALTERNATIVES

PRODUCT CATEGORY	MATERIALS WITH NO/LOW-PLASTIC CONTENT
FLOORING	Linoleum Ceramic tile Wood
INSULATION	Mineral wool Cellulose Wood fiber Fiberglass Hemp
PAINT	Mineral silicate Lime
PIPES	Copper Iron Concrete Steel
SIDING/CLADDING	Brick Stone Wood Fiber cement Stucco

Table 1. Example no/low-plastic building materials for the product categories mentioned in this brief.[62,63]

The hidden cost of plastics

The cost of no/low-plastic alternatives varies: while some match conventional plastic products in price, others appear more expensive — but initial price comparisons don't tell the full story. While plastic materials appear inexpensive, their price excludes substantial societal costs of health impacts and environmental harm.[9]

Annually, production of plastics is estimated to cost USD 592 billion globally in health harms while chemicals related to plastics are estimated to cost USD 249 billion in medical and associated social costs, in the US alone.[11,64] Plastic pollution is estimated to result in USD 100 billion of environmental damage every year.[9] Scarcity of data means that these estimates do not include a full accounting of cost (for example, the plastic-related chemicals calculation accounts for only a small subset of chemicals with sufficient available data), but they provide a general idea of the monumental and costly scale of impact.

Government subsidies mask the true cost of plastic materials, with annual global subsidies reaching USD 7 trillion for fossil fuels and USD 30 billion for plastic polymer production in the top 15 producing countries.[65,66] Alternative materials may last longer than plastics, resulting in lower lifetime costs.[67] As demand for these alternatives grows, their prices are likely to decrease further. [68]

Case studies

The following case studies demonstrate how substituting no/low-plastic alternatives can reduce both toxic chemical use and plastic waste. See Appendix for more information.

Use no/low-plastic alternatives to polystyrene insulation

Shifting 20% of annual use of expanded polystyrene board insulation in buildings globally to mineral wool boards could avoid almost:

7,600
tonnes of halogenated flame retardants

76
tonnes of polystyrene particle releases (from cutting)

0.67M
tonnes of plastic — equivalent to almost 73 billion water bottles

Use no/low-plastic alternatives to plastic flooring

Shifting 20% of PVC flooring in the EU to no/low-plastic flooring could avoid almost:

56,000
tonnes of plastic each year — about the same as 6 billion water bottles

57,000
tonnes of vinyl chloride — equivalent to ~710 rail cars

Substituting 10% of plastic carpet with no/low-plastic flooring in an office space of about 7,500 square meters could avoid:

35
tonnes of total waste over a 50-year period including 33 tonnes of plastic waste — equivalent to 3.5 million water bottles

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For a 100 unit apartment building, using no/low-plastic flooring instead of PVC flooring and plastic carpet could avoid:

10
tonnes of plastic immediately

50
additional tonnes of plastic over 50 years[69]

6.5M
equivalent to 6.5 million water bottles worth of plastic

Policy context, recommendations, and examples

The information presented in this brief on plastic building materials is relevant to a number of current policy discussions, including the UN Global Plastics Treaty, Stockholm and Basel Conventions, and national and sub-national policies such as: plastic taxes; extended producer responsibility (EPR) programs; phase-out of problematic plastics; fossil fuel subsidies; and chemical regulations.

General best practices for plastic pollution policies are provided in the breakout box *Reduce and eliminate plastic use in all sectors*. In addition, we provide the following recommendations and illustrative examples of specific policies for the building sector. Approaches are context-dependent — see citations for additional policy examples and guidance.

Include building materials in the scope of plastics, chemical, and other relevant policies

To date, global policymakers focused on plastic pollution reduction have prioritized reducing single-use plastics and packaging, as they are leading sectors for both production and waste. Policies have also focused on restricting hazardous chemicals within plastics, including ortho-phthalates, metals, bisphenols, flame retardants, and chlorinated paraffins in packaging, children's products, and other product categories. However, meaningful progress toward plastic pollution reduction requires expanding policy action to address plastic use in the building sector, targeting problematic plastics themselves in addition to chemical classes of concern. This approach will reduce plastic use globally and associated negative life cycle impacts.

BUILDING MATERIAL POLICY EXAMPLE

Update government procurement policies to prefer no/low-plastic building materials.[14]

Comprehensive policy approaches are needed to ensure that all building materials are safe and circular by design.

Create safe and circular materials systems

Policies should ensure that building products are *safe and sustainable by design*, a framework established by the EU to ensure chemicals and materials are part of non-toxic materials cycles that are safe for the environment and human health — from raw materials through production, use, and end of life management.[78] Many existing definitions of "circular" or "circular economy" leave out or insufficiently address material toxicity.[79] Circular systems must consist of non-toxic materials cycles that minimize resource extraction and uphold equity and human rights throughout the life cycle.[79–81] Currently, no such systems exist for building materials management and therefore investment, research, and development is needed to further advance the field.[14]

BUILDING MATERIAL POLICY EXAMPLE

Reduce demand for building materials overall by mandating material efficiency in building design, construction, and renovation; prioritizing use and renovation of existing buildings; and creating reuse systems.[4,14]

Consider actual service life of building materials

Many policy frameworks require cost-benefit analyses to support proposed regulatory changes. Such analyses might compare the costs and benefits of plastic building materials to alternative materials. To conduct accurate analyses, it is critical that factual assumptions of material service life are used in these calculations. Plastic building materials are generally considered "durable" and many models use a 35-year lifetime estimate for these materials based on assumptions in Geyer, et al (2017).[82] However, applying one service life assumption to all materials is inaccurate as many plastic building materials have significantly shorter lifetimes.[4] For example, PVC siding may be replaced as often as every 20 years, PVC flooring every 12 years, residential carpet every 6 years, and commercial carpet every 5 years.[83,84]

Reduce and eliminate plastic use in all sectors

Without intervention, plastic use will grow substantially over the next several decades, resulting in plastic pollution harms that disproportionately impact susceptible and marginalized people across the world. Policies must aim to reduce and eliminate plastic use in all sectors. Decision-makers should include the following requirements in related policy efforts:

Set goals

for reduction of plastics and hazardous chemicals consistent with the UN Sustainable Development Goals and UN Global Framework on Chemicals.[70,71]

Require transparency

and public disclosure of chemicals and additives used in the production of products, ensuring this information is trackable and traceable through the value chain.[11,54]

Phase out hazardous plastics and chemicals and require safer alternatives

Prioritize the most hazardous plastics and chemicals first and use a group/class-based approach rather than one chemical at a time. This approach will reduce chemical hazards throughout the entire life cycle of products, including safer reuse and recycling.[52] Safer alternatives to plastic materials include alternative materials, products, processes, and systems.

Define safer alternatives using a hazard-based approach

This definition can be codified in practice; for example, in the US, the state of Washington adopted a definition and criteria for "safer" under its hazard-based Safer Products for Washington law to regulate classes of chemicals in a wide range of products.[72]

Apply an *essential use* approach to plastic use

To reduce unnecessary uses of plastics, policies should take an *essential use* approach to both chemicals and materials. The concept of *essential use* originated as a policy tool to limit hazardous chemicals, but is also applicable to materials.[73,74] A plastic material should be deemed temporarily essential only if all of the following are true:

- There are no safer alternatives to the plastic material available; **and**
- the function of the plastic material is necessary for the product to work; **and**
- the plastic material is being used in a product that is critical for health, safety, or the function of society.[75]

If any of these statements is false, that use is non-essential. Any use deemed temporarily essential should be prioritized for research to develop and replace with safer alternatives.

Ensure a level playing field for no/low-plastic materials

by removing subsidies to petrochemical industries.[76,77]

BUILDING MATERIAL POLICY EXAMPLES

- Prioritize banning chemical classes with strong scientific evidence of hazard, like chlorinated paraffins, halogenated flame retardants, and ortho-phthalates. Establish hazard-based criteria for defining "safer" and banning additional classes.[77]
- Because there are existing safer alternatives for many plastic building materials, these materials should be deemed non-essential and targeted for phase-out. For example, a phase-out of PVC siding, flooring, and pipes in new construction should be required, paired with the removal of subsidies that support PVC production and repurposing those subsidies to reward safer and more equitable material production.[4,14,76]
- Update existing standards for reporting on building material content to include chemicals used throughout the process.[14]

Conclusion

Addressing plastic building materials will decrease the use of toxic fossil-fuel based materials and chemicals, decrease plastic waste, and improve the environment and community health for everyone — especially for people who are susceptible and/or marginalized around the world. Today, decision-makers have the opportunity and information in hand to make changes towards a healthier, more equitable tomorrow.

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For all of the below calculations, it was assumed that a water bottle weighs approximately 9.25 grams per Recycling Today. (Recycling Today. "Weight of Water Bottles Decreases, While Recycled Content Increases," October 20, 2015. https://www.recyclingtoday.com/news/water-bottle-weight-decreases-recycled-content-increases)

STATEMENT:

The US discards about 1.1 million tonnes of plastic from carpet each year, an equivalent amount to all the plastic straw, bag, and water bottle waste generated in the country annually.

CALCULATION IS BASED ON:

Estimated carpet waste in 2019 from: Carpet America Recovery Effort. "CARE 2019 Annual Report," June 2020. https://carpetrecovery.org/wp-content/uploads/2020/06/CARE-2019-Annual-Report-6-7-20-FINAL-002.pdf. And typical carpet composition: broadloom carpet is around 62% weight plastic, excluding additives: Habitable. "Common Product: Broadloom Carpet." Pharos, 2017. https://pharos.habitablefuture.org/common-products/2086257.

Weight of plastic bag: Hellman, Andrew. "Plastic Bags: To Recycle or Not: Essential Answer." Stanford Magazine, July 1, 2009. https://stanfordmag.org/contents/plastic-bags-to-recycleor-not-essential-answer.; Weight of straw: Borenstein, Seth. "Science Says: Amount of Straws, Plastic Pollution Is Huge." Boston Globe, April 20, 2018. https://www.boston.com/news/politics/2018/04/20/science-says-amount-of-straws-plastic-pollution-is-huge/.; Water bottles per day: Staff, E. D. N. "Fact Sheet: Single Use Plastics." Earth Day, March 29, 2022. https://www. earthday.org/fact-sheet-single-use-plastics/.; Straws per year: US National Park Service. "The Be Straw Free Campaign (US National Park Service)," August 11, 2021. https://www.nps.gov/articles/straw-free.htm.; Plastic bags per year: Factory Direct Promos. "The Life Cycle of a Plastic Bag – Infographic," June 9, 2016. https://www.factorydirectpromos.com/blog/the-life-cycle-of-a-plastic-bag-infographic/.

STATEMENT:

Shifting 20% of PVC flooring in the EU to no/low-plastic flooring could avoid almost 56,000 tonnes of plastic each year (about the same as 6 billion water bottles), and 57,000 tonnes of vinyl chloride (equivalent to ~710 rail cars).

CALCULATION IS BASED ON LINOLEUM FLOORING AS THE ALTERNATIVE AND THE FOLLOWING SOURCES:

Per ECHA, there are 278,000 tonnes of PVC in flooring placed on the market in the EU-27 each year. (ECHA. "Investigation Report on PVC and PVC Additives - Appendix C," November 22, 2023. https://echa.europa.eu/completed-activities-on-restriction.)

There is a small portion of plastic in the flooring finish for both PVC and linoleum flooring. For simplicity, the plastic in the finish is assumed to be equal for PVC and linoleum flooring. With no other plastic in linoleum flooring, the amount of PVC avoided is assumed equal to the amount of plastic avoided.

The ratio of vinyl chloride to PVC is 1.03:1 per Chlorine and Building Materials. (Vallette, Jim. "Chlorine & Building Materials Project: Phase 1 Africa, The Americas, and Europe." Healthy Building Network, July 2018. https://habitablefuture.org/wp-content/uploads/2024/03/57-Chlorine-Building-Materials-Phase-1-v2.pdf.)

Per Toxic Free Future, an average tank car carries 177,111 pounds of vinyl chloride. (Toxic-Free Future, and Material Research, L3C. "Toxic Cargo: How Rail Transport of Vinyl Chloride Puts Millions at Risk, an Analysis One Year After the Ohio Train Derailment," January 22, 2024. https://toxicfreefuture.org/research/toxic-cargo/how-much-vinyl-chloride-is-shipped-from-oxyvinyls-around-the-u-s-every-year/.)

STATEMENT:

Substituting 10% of plastic carpet with no/low-plastic flooring in an office space of about 7500 square meters could avoid 35 tonnes of total waste over a 50 year period including 33 tonnesof plastic waste — equivalent to 3.5 million water bottles.

CALCULATION IS BASED ON LINOLEUM FLOORING AS THE ALTERNATIVE AND THE FOLLOWING SOURCES:

Carpet tile contains about 70% plastic or about 0.53 lb/ft2, and linoleum contains about 0.5% plastic or about 0.003 lb/ft2 per Common Products. (Habitable. "Common Product: Carpet Tile w/ Nylon 6 Fiber, Polyolefin Backing, and Limestone Filler," 2015. https://pharos.habitablefuture.org/common-products/2079042.; Habitable. "Common Product: Linoleum Flooring," 2019. https://pharos.habitablefuture.org/common-products/2077807.)

Calculation assumes carpet tile would be replaced every three years per the building owner's team, and linoleum is replaced every ten years (conservative estimate based on reported lifespan of 15-35 years from e.g. US Department of Housing and Urban Development. CNA e-Tool Estimated Useful Life Table; Tarkett. "Linofloor XF2." Accessed November 5, 2024. https://declare.living-future.org/products/linofloor-xf.;).

STATEMENT:

For a 100 unit apartment building, using no/low- plastic flooring instead of PVC flooring and plastic carpet could avoid 10 tonnes of plastic immediately, and an additional 50 tonnes of plastic over 50 years, the equivalent of a total of 6.5 million water bottles total.

CALCULATION BASED ON LINOLEUM FLOORING AS THE ALTERNATIVE AND THE FOLLOWING SOURCES:

Data presented in Habitable. Advancing Health and Equity through Better Building Products. (2024) https://habitablefuture.org/wp-content/uploads/2024/07/Habitable_Minnesota-Report_Advancing-Health-and-Equity-through-Better-Building-Products_May-2024_F-rev.pdf

STATEMENTS:

Shifting 20% of annual use of expanded polystyrene board insulation in buildings globally to mineral wool boards could avoid almost 7,600 tonnes of halogenated flame retardants, 76 tonnes of polystyrene particle releases (from cutting), and 0.67M tonnes of plastic — equivalent to almost 73 billion water bottles.

CALCULATIONS BASED ON:

7.2 million tonnes of EPS was consumed worldwide in 2022, 53% of which is used in construction projects per Plastics Today. (Plastics Today. "Construction, Packaging Fuel EPS Demand through 2032." February 27, 2023. https://www.plasticstoday.com/building-construction/construction-packaging-fuel-eps-demand-through-2032.)

Per Lassen et al., the majority of EPS in construction is for board insulation. Assuming all EPS is board insulation for simplicity. (Lassen, C., et al., 2019. Survey of polystyrene foam (EPS and XPS) in the Baltic Sea. Danish Fisheries Agency/Ministry of Environment and Food of Denmark, Copenhagen, Denmark. February 2019. https://www.helcom.fi/wp-content/uploads/2019/10/Survey-of-polystyrene-foam-EPS-and-XPS-in-the-Baltic-Sea.pdf.)

EPS boards contain about 1% halogenated flame retardants and 97% polymers, with a median density of 1.35 lb/ft3, and mineral wool boards contain about 2.1% polymers, with a median density of 6 lb/ft3 per Common Products. (Habitable. "Common Product: EPS Insulation (Expanded Polystyrene)," 2019. https://pharos.habitablefuture.org/common-products/2079007.; Habitable. "Common Product: Mineral Wool Board Insulation," 2015. https://pharos.habitablefuture.org/common-products/2086296.)

Median R-values of 4.0 for EPS and 4.1 for mineral wool were used to calculate the quantity of mineral wool board insulation required to achieve the same thermal performance as the EPS board it would be replacing.

The release of particles from cutting EPS boards is estimated to be 100 g particles per tonne of EPS per: "Data on Manufacture, Import, Export, Uses and Releases of HBCDD as Well as Information on Potential Alternatives to Its Use." ECHA, 2009. https://echa.europa.eu/documents/10162/eb5129cf-38e3-4a25-a0f7-b02df8ca4532. Data on potential particle releases from cutting of mineral wool boards was not identified.