

Transformation Targets:

Healthy Building Network’s Transformation Targets are the top priority product and chemical combinations we recommend eliminating in the built environment. We identify and prioritize Transformation Targets based on the severity of the hazard, volume of hazardous chemicals, potential for exposure throughout the product life cycle, and clear pathways to avoid those hazards.



You can use Transformation Targets to identify the best solutions for material health challenges, including: avoidance, substitution, or green chemistry. The best way to eliminate Transformation Targets is to use a different product type, including those that are yellow and green on HBN’s [product guidance](#). See the [white paper](#) for more details.

Use this guide to track Transformation Target chemicals and associated hazards.

KEY: The icons presented in the following table represent the hazards associated with the target chemical, a degradation product, analogous chemical, or process chemicals used to manufacture the target chemical as described in the endnotes.



Carcinogenicity or mutagenicity



Respiratory sensitizer or priority asthmagens



Ozone depletion or global warming potential








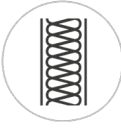





































Reproductive toxicity, developmental toxicity, or endocrine activity.



Meets GreenScreen Benchmark-1 criteria for a persistent bioaccumulative and toxic substance (PBT) including very persistent toxicants (vPT), very bioaccumulative toxicants (vBT) and very persistent, very bioaccumulative substances (vPvB)

HBN Transformation Targets

CATEGORY	TARGET CHEMICAL	HAZARDS
FLOORING 	PFAS ¹	
	BPA related compounds ²	
	PVC and related polymers ³	  
	Isocyanates in wet-applied products ⁴	
INSULATION 	HFRs ⁵	 
	Formaldehyde-based binders ⁶	
	Isocyanates in wet-applied products ⁴	
	HFC/HFO blowing agents ⁷	
PIPES 	PVC and related polymers ³	  
PAINTS 	APEs ⁸	
	PFAS ¹	
DOORS, CABINETRY, & MILLWORK 	Urea formaldehyde-based binders ⁶	

CATEGORY	TARGET CHEMICAL	HAZARDS
COUNTERTOPS 	PFAS ¹	
	Formaldehyde-based binders ⁶	
	Antimicrobials making public health claims ⁹	Various
ROOFING & WATER-PROOFING 	Orthophthalates ¹⁰	
	Isocyanates in wet-applied products ⁴	
SEALANTS & ADHESIVES 	Orthophthalates ¹⁰	
	Isocyanates in wet-applied products ⁴	
	Cyclosiloxanes ¹¹	
	Halogenated solvents ¹³	
	PAHs in coal tar driveway and parking lot sealants ¹²	
VARIOUS PRODUCT CATEGORIES 	Organotin compounds ¹⁴	
	Arsenic & arsenic compounds ¹⁵	
	Toxic heavy metals in recycled content ¹⁶	  
	Antimicrobials making public health claims ⁹	Various
	Pigments containing or manufactured with chlorine ¹⁷	  
	PFAS ¹	

Endnotes

These endnotes provide examples and sources for hazard information and products in which target chemicals are commonly found within the target category. This is not an exhaustive list but is meant to provide more information on how the targets were chosen. Target chemicals may have additional hazards not listed here and may be found in other types of products within the target categories and outside of the target categories.

1. [Per and polyfluorinated alkyl substances \(PFAS\)/ Perfluorinated Compounds \(PFCs\)](#), are highly persistent chemicals. They can meet GreenScreen Benchmark-1 criteria for a persistent bioaccumulative and toxic substance (PBT) (which includes very persistent toxicants (vPT), very bioaccumulative toxicants (vBT) and very persistent, very bioaccumulative substances (vPvB)). For example, [perfluorooctane sulphonate \(PFOS\) and its salts](#) are considered [PBTs](#) per OSPAR. For a more specific example, perfluorohexanoic acid, CAS# 307-24-4, is [very persistent and toxic \(vPT\)](#) per a GreenScreen Assessment completed by ToxServices, LLC. The U.S. EPA requires facilities to report annual emissions and management of over 180 PFAS under its [Toxics Release Inventory \(TRI\)](#), which focuses on chemicals that cause chronic or acute human health effects, and/or significant adverse environmental effects. PFAS/PFCs as a class should be considered a concern unless a full assessment demonstrates a GreenScreen Benchmark 2 or higher. PFAS are used in many different types of products. They are commonly found in oil-repelling sealers used on concrete, ceramic tile, [stone](#), and [cementitious grout](#). PFAS can also be present in [broadloom carpet](#) and [carpet tile](#), and they can be a regrettable substitute for alkylphenol ethoxylate surfactants in paints.
2. [Bisphenol A \(BPA\)-based chemicals and polymers](#) contain and can release BPA. BPA, CAS# 80-05-7, is on the EU Substances of Very High Concern (SVHC) list due to [endocrine disrupting properties](#). BPA related compounds are found in [epoxy flooring adhesives](#) and [fluid-applied flooring](#).
3. [Polyvinyl chloride \(PVC\) and related polymers](#), are high volume materials that require chemicals of concern in the manufacturing process. All [chlorine and vinyl chloride monomer production](#) uses mercury, asbestos and/or PFAS. Mercury is a [developmental toxicant](#) per Prop 65. Asbestos is a [carcinogen](#) per Prop 65. PFAS/PFCs are persistent chemicals. PVC is found in [vinyl sheet flooring](#), [vinyl composite tile](#), [multilayer resilient flooring \(WPC\)](#), [luxury vinyl tile](#), PVC and CPVC [pipes](#), and [PVC roofing membranes](#).
4. [Isocyanates](#) are considered [respiratory sensitizers](#) by Collaborative on Health and the Environment. Some of the most common isocyanates used in building products are identified as [Hazardous Air Pollutants \(HAPs\)](#) by the U.S. EPA. HDI, CAS# 822-06-0, found in [biobased fluid-applied flooring](#), also carries the hazard statement [H334 - May cause allergy or asthma symptoms or breathing difficulties if inhaled](#) by EU - GHS. Isocyanates in wet-applied products react when the products are applied to form polyurethanes, and are commonly found in both two-part products like [spray foam insulation](#) and [spray foam roofing](#), and one part products like [single component spray foam sealants](#) and [polyurethane sealants](#). They are also commonly used in [fluid applied flooring](#).
5. [Halogenated flame retardants \(HFRs\)](#) can be PBTs and/or carcinogens. For example, Tris-(1,3-dichloro-2-propyl)phosphate (TDCPP), CAS# 13674-87-8, is listed as a [carcinogen](#) by California's Proposition 65. Hexabromocyclododecane (HBCD), CAS#s 25637-99-4 and 3194-55-6, is listed as a [PBT](#) by the EPA. While these particular flame retardants are being phased out of insulation products they are being replaced with other HFRs whose toxicity data is not as well understood. For instance, Tri-(2-chloroisopropyl)phosphate (TCPP), CAS# 13674-84-5, is a phosphate ester flame retardant, a type of halogenated flame retardant that still [lacks toxicity data on cancer](#). The [San Antonio Statement](#), signed by over 150 scientists from over 22 countries, addresses this pattern of regrettable substitution of one HFR for another. HFRs as a class should be considered a concern unless a full assessment demonstrates a GreenScreen Benchmark 2 or higher. HFRs are present in [expanded polystyrene](#), [extruded polystyrene](#), [polyisocyanurate](#) and [spray foam](#) insulation.
6. [Formaldehyde-based binders](#) (e.g. urea-formaldehyde, phenol-formaldehyde and melamine-formaldehyde) can [release formaldehyde during product use](#). Formaldehyde, CAS# 50-00-0, is listed as a [carcinogen](#) by numerous agencies including IARC. Urea phenol formaldehyde, CAS# 25104-55-6, based binders are found in mineral wool [batt](#) and [board](#) insulation, [fiberglass board insulation](#), and [fiberglass pipe insulation](#). Urea-Formaldehyde, CAS# 9011-05-6, based binders are found in [doors](#) and [high pressure laminate](#) (used for laminate countertops). Phenol formaldehyde, CAS# 9003-35-4, based binders are used in [cabinetry](#).
7. Many [Hydrofluorocarbons \(HFCs\)](#) are considered to have a [high global warming potential \(GWP\)](#) by the EPA, such as HFC 245FA CAS# 460-73-1 and HFC 134A CAS# 811-97-2, which have GWP≥1000. HFCs are present in [spray foam insulation](#) and [XPS insulation](#). According to a report by the [World Climate Research Programme](#), newer, alternative blowing agents, Hydrofluoroolefins (HFOs), used in some foam insulation products are [produced](#) using carbon tetrachloride, CAS# 56-23-5, a [carcinogen](#) per Prop 65 that is also a [potent ozone depleter \(ODP\)](#) with a [high GWP](#) per the EPA.
8. [Alkylphenol ethoxylates \(APEs\)](#) include nonylphenol ethoxylates and octylphenol ethoxylates. [Nonylphenol ethoxylates](#) are on the EU Candidate List of Substances of Very High Concern due to [endocrine disrupting properties](#). Several nonylphenol ethoxylates and [octylphenol ethoxylates](#) are on the ChemSec SIN List for [endocrine disruption](#) and on The Endocrine Disruption Exchange for potential [endocrine disruption](#). APEs can be found in [wall and ceiling paint](#).
9. [Antimicrobials](#) used in products for the purpose of making a public health claim should be avoided. A wide range of products, including building products, rely on them as preservatives in order to protect the products themselves from mold, mildew or spoilage. These uses are not the focus of this transformation target. The focus is on products that contain antimicrobials in order to make or imply [public health claims](#), such as “made with antimicrobials for a safer home” or “antimicrobial countertop surfaces-how to protect your home or business from COVID-19”. There remains no evidence that antimicrobial additives protect human health, and credible organizations such as the [Center for Disease Control and Prevention](#) and Food and Drug Administration dissuade even hospitals from using products impregnated with antimicrobials. Products containing antimicrobials in order to make public health claims or public health benefits include, but are not limited to, countertops, floors, and paints.
10. [Orthophthalates](#) can be [developmental toxicants](#) per the US National Toxicology Program. Orthophthalates can be found in [hybrid or silyl-terminated polyether \(STPE\)](#) and [polyurethane](#) sealants. Orthophthalates can also be found in some acrylic and siliconized latex sealants. They are present in very large amounts in [PVC roofing membranes](#), and are commonly used in [water-based roofing adhesives](#) used with these and other fully adhered single-ply roofing membranes.
11. Cyclosiloxanes, [Octamethylcyclotetrasiloxane \(D4\)](#), CAS# 556-67-2, [Decamethylcyclopentasiloxane \(D5\)](#), CAS# 541-02-6, and [Dodecamethylcyclohexasiloxane \(D6\)](#), CAS# 540-97-6, are all considered [PBTs](#) by multiple sources including the EU SVHC Candidate List.

Cyclosiloxanes can be found in [silicone sealants](#).

12. [Polycyclic aromatic hydrocarbons \(PAHs\)](#) are [carcinogens](#) per MAK. PAHs can be found in [coal tar sealants](#).
13. Halogenated solvents may be found as regrettable substitutes for other volatile organic compounds (VOCs). Low-VOC adhesives, sealants, and coatings are formulated to reduce the amount of chemicals these products contain that contribute to smog formation. Para-chlorobenzo trifluoride (PCBTF), CAS# 98-56-6, meets the [EU's definition of VOC](#), but it is exempt from both [U.S. EPA](#) and [California \(SCAQMD\)](#) VOC content reporting requirements since it contributes little to smog formation. Even though PCBTF is considered a Prop 65 carcinogen in California it is commonly found in [low-VOC solvent-based roofing adhesive](#) formulations marketed there, and it is integrated into [low VOC calculations for paints and coatings](#). PCBTF also meets the [Organisation for Economic Co-operation and Development \(OECD\)](#) definition of PFAS.
14. [Organotin compounds](#) can be reproductive and developmental toxicants. For example, dibutyltin dilaurate, CAS# 77-58-7, is a [reproductive toxicant](#) per the [EU Annex VI](#) harmonized classification. It is on the ChemSec SIN List for being known or suspected to cause cancer, genetic defects or to damage fertility or the unborn child. Organotins are used as catalysts in the manufacture of polyurethane systems including polyurethane [spray foam insulation](#), [sealants](#), and [adhesives](#). They are also used in some [silicone](#) and [hybrid or STPE sealants](#) and in [PVC products](#) including [PVC pipes](#), [CPVC pipes](#), and [solvent cements](#).
15. [Arsenic and arsenic compounds](#) are [known human carcinogens](#) per EPA. Arsenic based antimicrobials are used in building products. For example, 10,10'-bis(phenoxyarsinyl)oxide, CAS# 58-36-6 is an antimicrobial that can be found in [mildew-resistant silicone sealants](#). Chromated copper arsenate (CCA) treated wood was [voluntarily phased out](#) for most residential uses, however, it is still available for use in commercial and industrial applications.
16. Toxic heavy metals are defined, for the purposes of this target list, as compounds containing [arsenic](#), [cadmium](#), [hexavalent chromium](#), [lead](#) or [mercury](#). These compounds all have multiple hazards associated with them. For example, arsenic based compounds, cadmium based compounds, and hexavalent chromium based compounds are [known human carcinogens](#) per multiple sources including EPA. Lead compounds are [developmental and reproductive toxicants](#) per EPA and lead and mercury compounds are [PBTs](#) per EPA. Fly ash, found as recycled content in [carpets](#), can contain arsenic, mercury, cadmium and lead. [Recycled glass](#) can contain lead and mercury. [Recycled PVC](#) has been shown to contain lead and cadmium. [Recycled tires](#) used in [flooring](#) may contain lead and other heavy metals.
17. [Pigments containing or manufactured with chlorine](#) are a concern because they may contain residual levels of polychlorinated biphenyls (PCBs). PCBs are considered [PBTs](#) by the U.S. EPA and have [numerous health hazards](#) associated with them. While production of PCBs is banned under the Toxic Substances Control Act (TSCA), inadvertent PCBs (iPCBs) are [allowed in pigments](#). The levels of PCBs in pigments, such as those found in [paint colorants](#), are generally low but they should still be avoided even at low concentrations because they are persistent and bioaccumulative. The presence of chlorine in a pigment or its production process does not definitively indicate that PCBs are present, but it can indicate which pigments are more likely to contain them.