HBN's Transformation Targets

A Framework for Driving Market Change

BY HEALTHY BUILDING NETWORK

APRIL 2019

HBN KNOW BETTER

HBN'S Transformation Targets:

A Framework for Driving Market Change

HBN's Transformation Target framework distills hundreds of thousands of data points into a small number of simple, actionable product category + chemical combinations by which we, as a community, can move the market towards safer products.

1. EXECUTIVE SUMMARY

Through increased transparency, collaboration, and research, the Healthy Building Network (HBN) knows much more than we did a decade ago about building materials, including the chemicals that are used, the associated hazards, potential for exposure, and chemicals used or released during the manufacturing process. This is a dizzying amount of data to consider when making design, purchasing, product certification, or formulation decisions. HBN has developed a process to analyze this rich data set and identify simple, actionable priorities within a larger strategic framework aimed at eliminating chemicals of concern in building materials. By aligning the efforts with systematic steps toward these goals, manufacturers and consumers can accelerate the elimination of the highest priority substances. We can, collectively, transform the market.

HBN's Transformation Targets are product category + chemical combinations (1) that pose serious human and/or environmental health hazards, and (2) for which there exist one or more transformation pathways for avoiding those chemicals.

HBN generates Transformation Targets using a defined process: (1) research chemicals and materials commonly found in specific building product types (using HBN's Common Product research), (2) screen for target chemicals within those products (using Pharos and Data Commons), (3) prioritize product categories and chemical compound groups, taking into account the severity of hazards, volume of hazardous substances, and where/how products are used, (4) define Transformation Targets. The results of this process are the product category + chemical combinations known as HBN's Transformation Targets. This list will evolve over time as more information becomes available or as changes in the way products are made occur.

Transformation Targets should not be thought of as a restricted substances list (RSL), but rather as a focused strategy to transform the built environment. The broader strategic Transformation Framework considers pathways to avoid these targets and create effective dialogue for market transformation. This paper outlines the various pathways for transformation, specific steps that purchasers can take to advance these pathways, and clear feedback that consumers can provide to the marketplace. This targeted approach focuses industry-wide efforts on some of the most important product + chemical issues by which we, as a community, can move the market towards safer products.

2. INTRODUCTION

It is now possible to envision buildings made with materials devoid of toxic substances, a possibility created by a convergence of complementary efforts: the transparency movement, efforts to more fully understand the hazards of all chemicals, a growing array of health-focused standards and certifications, a marketplace loaded with people eager to make a difference, and growing numbers of retailers and manufacturers with the same objective.

Building-material innovation is accelerating. In recent years, many manufacturers have stopped using formaldehyde in fiber glass insulation,[1] phthalates in flooring,[2] and arsenic treatments in wood decking.[3] Many retailers and manufacturers have stopped using fly ash in carpet,[4] toxic plastics (such as recycled PVC) in floors,[5] and toxic flame retardants in insulation.[6]

These innovations benefit not only building occupants, construction workers, and the communities where the buildings are constructed, but also the many workers and communities connected by material life cycles, from mines to dumps. When the residential fiber glass insulation industry stopped using formaldehyde, people living near their factories were no longer exposed to this carcinogen.[7] When arsenic stopped being used in decking, streams were no longer being polluted by runoff of this aquatic toxicant.[8] As manufacturers cease using phthalates in flooring, fewer infants and toddlers are exposed to these chemicals that can impact their development. The cumulative, quantitative impacts of these decisions are becoming clear. Formaldehyde releases from residential fiber glass insulation production plants have declined by an astounding 90%.[9] Arsenic use in the USA has declined precipitously, with imports falling by 70%, from over 20,000 to 6,000 metric tons per year.[10]

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1 Vallette, James. "Residential Fiberglass Insulation Transformed: Formaldehyde Is No More." Healthy Building Network, October 30, 2015. https://healthybuilding.net/blog/204-residential-fiberglass-insulation-transformed-formaldehyde-is-no-more

2 Walsh, Bill. "Home Depot Will Eliminate Phthalates from Vinyl Flooring." Healthy Building Network, April 22, 2015. https://healthybuilding.net/blog/193-home-depot-will-eliminate-phthalates-from-vinyl-flooring. and Vallette, James. "The End Is near for Phthalate Plasticizers." Healthy Building Network, July 9, 2015. https://healthybuilding.net/blog/196-the-end-is-near-for-phthalate-plasticizers.

3 Walsh, Bill. "Removing Arsenic from Building Materials: A Success Story." Healthy Building Network, March 12, 2013. https://healthybuilding.net/blog/8-removing-arsenic-from-building-materials-a-success-story.

4 Vallette, James. "HBN's Top 5 Healthy Product Innovations of 2017." Healthy Building Network, December 18, 2017. https://healthybuilding.net/blog/469-hbns-top-5-healthy-product-innovations-of-2017.

5 Vallette, James. "Rapid Change Sweeps Flooring Industry." Healthy Building Network, November 13, 2015. https://healthybuilding.net/blog/445-rapid-change-sweeps-flooring-industry.

6 Vallette, James. "HBN's Top 5 Healthy Product Innovations of 2017." Healthy Building Network, December 18, 2017. https://healthybuilding.net/blog/469-hbns-top-5-healthy-product-innovations-of-2017.

7 Vallette, James. "Residential Fiberglass Insulation Transformed: Formaldehyde Is No More." Healthy Building Network, October 30, 2015. https://healthybuilding.net/blog/204-residential-fiberglass-insulation-transformed-formaldehyde-is-no-more

8 Khan, Bernine I., Helena M. Solo-Gabriele, Timothy G. Townsend, and Yong Cai. "Release of Arsenic to the Environment from CCA-Treated Wood. 1. Leaching and Speciation during Service." *Environmental Science & Technology* 40, no. 3 (February 1, 2006): 988–93. https://doi.org/10.1021/es0514702.

9 Vallette, James. "Residential Fiberglass Insulation Transformed: Formaldehyde Is No More." Healthy Building Network, October 30, 2015. https://healthybuilding.net/blog/204-residential-fiberglass-insulation-transformed-formaldehyde-is-no-more

10 Walsh, Bill. "Removing Arsenic from Building Materials: A Success Story." Healthy Building Network, March 12, 2013. https://healthybuilding.net/blog/8-removing-arsenic-from-building-materials-a-success-story.

This paper describes HBN's process for identifying the next set of product + chemical combinations that are the highest current priority. HBN's Transformation Targets focus on a small set of targets that we (retailers, manufacturers, designers, contractors, and building occupants) can remove, replace, or creatively design out. This process is part of a larger HBN framework for ways in which purchasers can use Transformation Targets to have productive conversations with manufacturers by preferring fully disclosed products with fully assessed alternatives.

This paper was released along with Version 1 (V.1) "Top 20" list of HBN's Transformation Targets. As the market and our knowledge about materials and hazards evolves, this list can be updated.

3. TRANSFORMATION TARGET IDENTIFICATION PROCESS

HBN's methodology for identifying Transformation Targets distills hundreds of thousands of data points into simple, actionable priorities. The goal of this prioritization process is to identify those chemical targets in each product category that have maximum potential for transformation when supported by concerted market action.

The process for identifying targets includes the following:

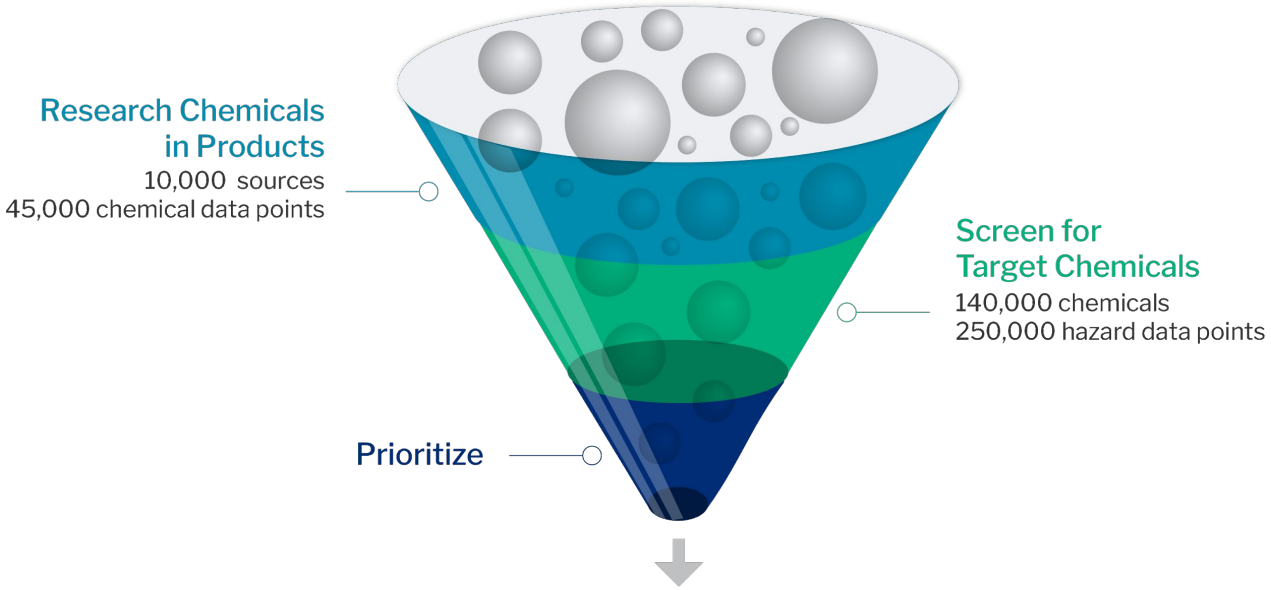
1. researching chemicals and materials commonly found in specific building product categories,
2. screening for potential target chemicals within those products falling into one of the following categories:
    - chemical of concern (see definition below) is present in the product,
    - chemical degrades to a chemical of concern,
    - chemical has an analog that is of concern or is part of a compound group of structurally similar chemicals known or suspected to be of concern,
    - chemical has process chemistry or end-of-life concerns including the use or release of chemicals of concern;
3. prioritizing high-volume product categories with target chemicals,
4. defining Transformation Targets: define target by compound group of structurally similar chemicals known or suspected to have similar health concerns, to avoid similar regrettable substitutions; these product category + chemical group combinations are the Transformation Targets.

Using this approach enables specifiers to create priorities for substantially eliminating hazardous chemicals from their choices for building products. Innovative manufacturers will be rewarded for designing toxics out of their products.

It is important to note that HBN's Transformation Targets are influenced both by the prioritization process identified above and by the information available at the time of this analysis. A different process or data set would have different results. This process can be used by other industries to identify priorities based on a data set specific to their industry.

The above steps outlining the process for identifying Transformation Targets are explained in more detail below.

The Process to Define Transformation Targets



3.1 Research chemicals and materials commonly found in specific building product types

HBN compiled a rich data set of product content information. These data are compiled and presented in three forms, our Common Product profiles, our in-depth research reports, and our Pharos Building Product Library. These sources form the basis of our Transformation Target analysis.

Common Product profiles (CPs) are descriptions of products that are not specific to any manufacturer, and list the substances that are most commonly present in a product type (vinyl composition tile, for example) as delivered to building sites in North America. Each CP includes a general description of the product type, a list of the most common substances serving each function in the product, the median percentage of each substance, and the health hazards associated with these substances. CPs are developed by performing in-depth research on the product type based on a wide range of publicly available sources that includes product literature such as safety and technical data sheets, trade-association literature, HPDs and other transparency documents, patents, and academic literature. More details on the methodology can be found here. For the most current Common Product profiles and hazard information, see the Pharos database.

HBN has gathered additional insight from focused research on specific types of building materials and their feedstocks. This research is summarized in HBN Reports, for example: *Making Affordable Multifamily Housing More Energy Efficient: A Guide for Healthier Upgrade Materials,* the Optimizing Recycling series, which examines many of the major recycled feedstocks used in building materials, and *Full Disclosure Required: A Strategy to Prevent Asthma Through Building Product Selection*. Our review of chemicals and materials found in building products includes information from these research reports, which can be accessed here. Additionally, individual reports are listed at the end of this paper for reference.

HBN also reviewed historical data in the Pharos Building Product Library (BPL). The BPL was the original building product transparency platform and houses historical records that combine manufacturer transparency and independent research into the content and associated hazards of a range of building products.

3.2 Screen for target chemicals within those products

The following sections outline how HBN defines chemicals of concern and how chemicals within products qualified as potential targets in the analysis. Chemicals in a product qualify as a potential target if (1) the chemical is itself identified as a chemical of concern, (2) the chemical degrades to a chemical of concern, (3) the chemical is analogous to a chemical known or suspected to be of concern, or (4) the chemical has process chemistry or end-of-life concerns, including the use or release of chemicals of concern.

Chemicals of concern were identified using the HBN data system, Pharos Chemical and Material Library. Pharos is an independent database of chemicals and associated human and environmental hazards. The database aggregates hazard data from 78 authoritative lists of hazards issued by governments, NGOs, and other expert bodies for approximately 140,000 chemicals, polymers, metals, and other substances. Pharos incorporates the results of detailed hazard assessments performed by qualified toxicologists from various organizations. Pharos also includes process chemistry research which identifies chemicals used and released during the manufacture of many building materials and chemicals.

3.2.1 Chemical of concern is present in the product

For the purpose of our analysis, chemicals of concern are those which have been identified as having a high or very high hazard level for any one of the following endpoints or a high hazard level for a combination of endpoints:

1. carcinogenicity
2. mutagenicity/genotoxicity
3. reproductive toxicity or developmental toxicity
4. endocrine activity
5. respiratory sensitization or priority asthmagens
6. ozone depletion
7. global warming potential
8. persistent + bioaccumulative + toxic substance (PBT)

Criteria for establishing a high hazard level for endpoints 1 through 5 are as defined by the GreenScreen® for Safer Chemicals (GreenScreen).[11] Moderate to high hazard levels are included for endocrine activity and respiratory sensitization. Priority asthmagens are based on HBN's research report *Full Disclosure Required: A Strategy to Prevent Asthma Through Building Product Selection.* Endpoint 8 includes chemicals that meet GreenScreen Benchmark-1 criteria for a persistent bioaccumulative See sidebar "GreenScreen for Safer Chemicals" for more detail on the GreenScreen.

HBN has established criteria for a high hazard level for endpoints 6 and 7:

- global warming potential (GWP) greater than 1,000
- listed as an ozone depletion gas by the US Environmental Protection agency or the European Union

[11] Clean Production Action. "The GreenScreen for Safer Chemicals." V 1.4 (Jan 2018) https://www.greenscreenchemicals.org/method

GreenScreen for Safer Chemicals

For the Transformation Target hazard assessment, HBN relies primarily on chemical hazard assignments made under the GreenScreen for Safer Chemicals (GreenScreen). The GreenScreen is a globally recognized, transparent methodology for assessing chemical hazard that supports identifying and benchmarking chemicals of concern and identifying safer alternatives. It provides a protocol for assigning a level of hazard (typically from high to low) for individual health endpoints (such as carcinogenicity) and then assigning a Benchmark score to reflect the overall level of concern for the chemical. HBN uses the GreenScreen protocol to identify and target chemicals for carcinogenicity, mutagenicity, reproductive or developmental toxicity, endocrine activity, and respiratory sensitization, or to target chemicals that meet 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). The hazard-level assignment can come from review of governmental hazard lists as presented in GreenScreen List Translator results, or from a full review of the scientific literature, as presented in a GreenScreen assessment report.

3.2.2 Chemical present in the product will degrade to a chemical of concern

Chemicals can degrade into other chemicals that have different human or environmental hazards. These chemicals may degrade by biodegradation or photodegradation pathways, for example, and may result in chemicals with higher toxicity for certain endpoints than the parent chemical. The GreenScreen methodology refers to these as "Environmental Transformation Products." In the GreenScreen method, a feasible and relevant environmental transformation product can lower the Benchmark Score of the parent compound when it has a lower Benchmark Score itself. Similarly, our analysis considers the human health and environmental impacts associated with known degradation products. If a degradation product is considered a chemical of concern as described above, then the parent chemical will also be considered a chemical of concern for the purposes of our assessment process.

Examples of of this are nonylphenol ethoxylates (NPEs), which degrade to nonylphenol (NP). NP is considered an endocrine-disrupting chemical and is on the Substances of Very High Concern (SVHC) list in Europe. For this reason, alkylphenol ethoxylates, as a class, which includes nonylphenol ethoxylates, are included as chemicals of concern for the purposes of this assessment. The same applies for other chemical groups whose degradation products result in a chemical of concern.

3.2.3 Chemical has an analog that is of high concern or is part of a compound group of structurally similar chemicals known or suspected to be of high concern

Because of the incomplete hazard information available for a large number of chemicals, HBN takes a precautionary approach, applying a compound group read-across analysis to help fill some of those data gaps. Groups of chemicals that are structurally similar can have similar associated hazards. For chemicals for which less data is available, the hazards of structurally similar chemicals are used to better understand potential hazards and to help avoid regrettable substitutions.[12]

For example, tris(2-chloroisopropyl)phosphate (TCPP) is a common flame retardant found in insulation. The available hazard information for the chemical itself does not qualify it as a chemical of concern as defined above.[13] TCPP does, however, have a number of data gaps for key hazard endpoints, like carcinogenicity. TCPP is part of a compound group called chlorinated flame retardants and is structurally similar to Tris(1,3-dichloro-2-propyl)phosphate (TDCPP), another chemical within that group. TDCPP is considered a high hazard for cancer per GreenScreen, so is flagged as a chemical of concern in our analysis.[14] Based on the structural similarity between these two chemicals and the fact that TCPP does not have any conclusive carcinogenicity data, TCPP is considered a chemical of concern until test data is available that proves otherwise.

3.2.4 Chemical has process chemistry or end-of-life concerns including the use or release of chemicals of concern

Many human and environmental health impacts of building material choices occur far from the place where the products are used. HBN has documented the upstream and downstream impacts of many building materials and of the substances from which they are manufactured. Within these life cycles are additional opportunities for systemic changes that promote social equity and environmental justice, while reducing exposures to toxic substances worldwide. These life cycle considerations include process chemicals, manufacturing pollutants, recycling, and disposal.

The Pharos Chemical and Material Library (CML) includes process chemistry associations for over 900 substances used in building materials. HBN conducted preliminary literature reviews of process chemicals, from which we identified substances that may become part of products that are not typically identified in manufacturer product disclosures. These include potential residuals such as monomers, catalysts, nonreactive additives, and other contaminants. Primary resources for this research include National Library of Medicine's Hazardous Substance Data Bank (HSDB), the National Renewable Energy Laboratory (NREL) US Life Cycle Inventory Database, and other governmental and nongovernmental information sources such as patents.[15]

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[12] A chemical can be removed from a compound group that is considered hazardous if a manufacturer, or other entity, provides data showing that the chemical has been fully assessed by a licensed GreenScreen Profiler using the GreenScreen for Safer Chemicals (and the assessment publicly disclosed) to demonstrate that it does not meet the criteria for high hazard for a chemical of concern.

[13] HBN Data Commons pages for TCPP. https://commons.healthymaterials.net/chemicals/2004842 and Rosenblum, E. "GreenScreen Assessment for Tris (2-chloro-1-methylethyl) phosphate (TCPP) CAS# 13674-84-5. November 16, 2014. Certified, Expired.

[14] HBN Data Commons profile for TDCPP. https://commons.healthymaterials.net/chemicals/2004627 and Rosenblum, E. "GreenScreen Assessment for Tris (1,3-dichloro-2-propyl) phosphate (TDCPP) CAS# 13674-87-8. November 16, 2014. Certified, Expired.

[15] Pharos CML Description. "Chemical & Material Library (CML)". The Pharos Project of the Healthy Building Network. June 26, 2018. https://www.pharosproject.net/uploads/files/library/Pharos_CML_System_Description.pdf

HBN research also identifies chemicals that are not direct inputs into the process chemistry of the substance but are closely related to the production of those chemicals. These include substances used or released during the extraction, harvesting, and manufacturing of feedstocks.

3.3 Prioritize high-volume product categories with chemicals of concern

Our 142 common product profiles and other product data are grouped into larger product categories (e.g. paint, insulation.,etc.). Product categories are prioritized for consideration based on the prevalence and relative quantity of those products used. Interior products were prioritized according to the high potential for exposure during product use, installation, or demolition. The volume of chemicals of concern was also considered as part of the prioritization.

3.4 Define HBN's Transformation Targets

Using the prioritization process described above, a set of priority product category + chemical combinations were identified. Where appropriate, those chemicals were expanded into chemical compound groups that consist of structurally similar chemicals known and suspected to have similar hazard concerns. These product category + chemical compound group combinations are the Transformation Targets.

"Top 20" list

Transformation Targets provide a starting place to begin removing hazardous chemicals from building materials. They provide a high "return on investment" by addressing chemicals with high hazards, used in high volumes, with potentially high human exposures. As more information becomes available about materials and their hazards and as specific industries evolve, this list will evolve, and over time we, as an industry, can systematically eliminate chemicals of concern from entire product categories.

Beyond Restricted Substances Lists

Many programs define the search for healthier products with restricted substance lists (RSLs). These RSLs identify chemicals to eliminate from all products. Examples of these include The Living Building Challenge Red List, Cradle to Cradle banned list, and Perkins+Will Precautionary List. These lists have done much to help design teams and manufacturers prioritize and advance the effort to avoid chemicals of concern. However, these lists can also confuse and overwhelm people trying to implement them. Currently, HBN's Pharos Database references 32 different RSLs, each with a different set of chemicals, which can send mixed signals about what to prioritize.

Transformation Targets provide a focused strategy for using RSLs to address the most significant opportunities in transforming the built environment. By pinpointing a small number of chemical groups for any given product category, and outlining a framework to work toward fully disclosed and assessed alternatives, all stakeholders can focus on the best solutions for material health challenges: avoidance, substitution, or green chemistry.

4. USING TRANSFORMATION TARGETS: The Transformation Pathways

There are many potential ways for manufacturers to remove target chemicals from their products and for material specifiers and purchasers to accelerate the transformation of entire product categories by preferring products that do not contain target chemicals. The following list focuses on actions for specifiers and purchasers of materials. With clear and consistent purchasing preferences, buyers can accelerate the transformation of an entire product category. Possible transformation pathways available for avoiding the target chemicals include:

1. choosing products whose target chemicals have been removed without substitution
2. choosing products whose target chemicals have been replaced with functional alternatives
3. substituting a different product type
4. designing the project to eliminate the need for the product
5. promoting green chemistry

In this section, we discuss each of these pathways and provide examples.

4.1 Choose products whose target chemicals have been removed without substitution

The first pathway to transformation is to consider whether the function performed by the chemical is necessary to the product. If not, it is possible to choose a product that has removed the hazardous chemical without replacing it with a functional alternative. Some uses of antimicrobials and flame retardants fall into this category: they can be eliminated without impacting product performance. By making their preferences clear, purchasers can provide incentives to manufacturers to halt the use of these unnecessary hazards. In the case of flame retardants, this may require changes to outdated regulations. Building industry leaders supported the successful effort to revise California Technical Bulletin 117, which removed outdated fire-testing requirements for upholstered foam furniture. Currently, building-industry leaders can support efforts to change building codes which require the use of flame retardants in insulation used underground and below grade.

4.2 Choose products whose target chemicals have been replaced with functional alternatives

In some cases, a particular chemical function may be necessary in order for the product to work as required or expected. One option in this case is to choose products whose target chemicals have been replaced with a functional alternative. Ideally, the substitute should be assessed to be of lower hazard than the replaced chemical in order to avoid a regrettable substitution. An example of this sort of transformation opportunity is that of alkylphenol ethoxylate surfactants, commonly used in water-based paints. This function is necessary to the product, but alternative surfactants are available.

The EPA has identified over two hundred safer surfactants that can be used as replacements for alkylphenol ethoxylates.[16] Their review focuses on use in cleaning products and on the chemical's rate of biodegradation, the degradation products, and the level of aquatic toxicity, rather than on a full hazard assessment. Most of these alternate chemicals have significant data gaps in list-screening information, and very few are fully assessed, so additional information is needed to ensure that these are indeed safer chemicals.

4.3 Substitute a different product type

In some cases, the best way to avoid a chemical of concern is to use an alternative product type that has less hazardous content. To help identify alternative product types with better health hazard standing within a product category, HBN has developed a simplified hazard-based ranking called a Hazard Spectrum. Seven Hazard Spectra are available in the Products section of HBN's HomeFree site. The simplified rankings are based on our research on the common content of different types of products and on prioritizing chemicals to avoid, including HBN's Transformation Targets. The hazard spectrum for insulation provides recommendations of what to look for or avoid in this product category and particular types of insulation to be preferred whenever possible. For example, in order to achieve insulation and air sealing while avoiding isocyanates in spray polyurethane foam, HBN recommends the use of a combination of lower hazard sealants (such as acrylic caulk or foam sealant tape) and insulation (such as fiberglass or cellulose). See the references section below for links to additional HomeFree Hazard Spectra.

[16] US EPA, OCSPP. "Safer Chemical Ingredients List." Data and Tools. US EPA, December 11, 2013. https://www.epa.gov/saferchoice/safer-ingredients.

4.4 Design the project to eliminate the need for the product

In some cases, it may be possible to avoid the target by opting for a design that removes the need for that type of product. One great example of designing out a product is to opt for flooring that doesn't require an adhesive. By changing the design of the flooring installation to use products that are mechanically installed, you avoid the need for adhesives, all of which contain some chemicals of concern. Some target products may add a new but unnecessary functionality, so can also be designed out of a building. For example, whiteboard paint, which can contain unreacted isocyanates, can easily be avoided. Alternatives for sharing information include use of an actual whiteboard.

4.5 Promote Green Chemistry

The EPA defines green chemistry as the "design of chemical products and processes that reduce or eliminate the use or generation of hazardous substances. Green chemistry applies across the life cycle of a chemical product, including its design, manufacture, use, and ultimate disposal."[17]

Where no clear pathways exist for avoiding Transformation Targets, product specifiers and purchasers can promote and support innovations in green chemistry. For example, over the past decade, manufacturers have made a series of binder substitutions in composite wood products like casework and countertops in order to reduce formaldehyde emissions. While regulations and market demand have reduced manufacturers' reliance upon urea formaldehyde-based binders, other toxic chemicals (especially epichlorohydrin and isocyanates) have taken their place. There are no market-ready, fully assessed substitutes for composite wood binders. This means there is a market opportunity for green chemists, product designers, and manufacturers who are first to place a non-toxic, affordable solution on the market. Specifiers and buyers can participate in groups like the Green Chemistry & Commerce Council (GC3) to communicate the market need to manufacturers and to work across industry sectors and supply chains to drive innovative solutions.

[17] US EPA, OCSPP. "Basics of Green Chemistry." Overviews and Factsheets. US EPA, February 12, 2013. https://www.epa.gov/greenchemistry/basics-green-chemistry.

5. TRANSFORMATION TARGETS AS A DRIVER FOR FULLY DISCLOSED, FULLY ASSESSED ALTERNATIVES

In order to transition the marketplace away from Transformation Targets by using different Transformation Pathways, the need for disclosure of material content and assessment of hazards within those materials becomes critical. This section explains the importance of these two sets of data points, full disclosure and hazard assessment, and provides a framework for considering them when making product selections.

5.1 Request full public disclosure of product content

Transparency is critical to solving our material health challenges. The first step toward product optimization is to understand what products are actually made of – and that means having a public inventory of product content and known hazards. Improving our understanding of what chemicals are most prevalent in our built environment allows health-impact research to be prioritized. Full disclosure of product contents and associated hazards allows for more informed choices and helps prevent regrettable substitutions. Look for public disclosures on the Health Product Declaration Public Repository or the International Living Future Institute's Declare database.

Too many products are marketed only as "free of" specific chemicals or materials, or "compliant with" certification standards or green building credits, while failing to disclose what substances are actually in the product. If alternatives to Transformation Targets are not disclosed, ask the manufacturer to publicly disclose the product content. In general, ask for and prefer products that have a public Health Product Declaration (HPD). HPD is the industry's collaborative, user-designed open standard for disclosure of product contents and associated health hazards. Prefer products with public HPDs that have full disclosure, which HBN defines to mean all contents characterized, screened, and identified to 100 ppm. Further, prefer products that have been third-party verified for product content.

5.2 Request full hazard assessment of chemicals in the product

Because very few of the tens of thousands of chemicals in use have been fully assessed for health hazards, there is a great need for expansion of publicly available hazard assessments. This is particularly true for chemicals that may be substitutes for known high hazard chemicals. When full assessments are not available, there is always the risk of a regrettable substitution. Hazard lists provide good guidance information, but typically only identify chemicals *known to be hazardous* and do not indicate where research has shown there to be no hazards or where there are gaps in the available information. They also may be slow to adapt when new research becomes available. Full hazard assessments, like those used in the GreenScreen Assessment method, reach into the scientific literature to include all of the available information. These sorts of assessments are critical for filling gaps in hazard list information and identifying where more health research is still needed. HBN's Transformation Targets help to call out high priority chemicals or chemical groups for full hazard assessment by identifying the product category + chemical combinations where fully assessed alternatives are most needed.

A fully assessed product is one for which all chemicals and materials in the product have been assessed by the GreenScreen methodology or a similar hazard assessment tool, and the assessments have been made publicly available.

5.3 Send feedback to the marketplace

It can be difficult for purchasers to determine how best to influence market transformation when there is no flawless choice. Challenging paradoxes arise when one manufacturer fully discloses the toxic content of a product and a product that is not fully disclosed appears to have fewer hazards. The manufacturers who have invested in full assessments and full content disclosure should be applauded. Full assessment and full content disclosure takes time, money, and often a grassroots effort within a company by under-resourced sustainability teams. As project teams move products along this continuum of improvement, the marketplace should support teams by providing feedback in the form of information requests and product purchases. Product specifiers and purchasers can take the following actions.

5.3.1 Disclosed & assessed: buy

Fully disclosed, fully assessed products should be preferred. While we recognize that fully disclosed and assessed is a high bar that not many products have achieved, we are confident in the market's ability to transform to meet this bar in the near future.

5.3.2. Poor disclosure &/or assessment: buy, but ask for more

If there are alternatives that appear to avoid the targeted chemical group(s), but the contents are either not fully disclosed, or not fully assessed, our recommendation is to buy the alternative but communicate with the manufacturer that the buyer is seeking a more fully disclosed product and/or more fully assessed product for future projects. Use the HBN Hazard Spectra to identify less hazardous types of products within product categories.

5.3.3. No good alternative: green chemistry opportunity

If there are no good alternatives in the product category, then we cannot endorse a purchase recommendation. The buyer is encouraged to communicate with the manufacturer that the buyer is seeking a safer option for future projects and to encourage the manufacturer to invest in green chemistry.

Using the framework outlined throughout this paper creates priorities for specifiers to substantially eliminate hazardous chemicals from their building product choices, and innovative manufacturers will be rewarded for designing toxics out of their products.

6. CONCLUSION

HBN's Transformation Target framework distills hundreds of thousands of data points into simple, actionable product category + chemical combinations by which we, as a community, can move the market towards safer products. Transformation Targets maximize and hasten positive outcomes by identifying the key leverage points for the most important product-chemical issues.

These Targets are part of a larger framework that addresses the problem of regrettable substitutions by incorporating a review of products on the market to identify types of products whose health hazard risks are typically lower and that moves the market toward fully disclosed, fully assessed alternatives.

Not all targets are actionable by all audiences. Different interest groups have different roles to play. For example:

- **Consumers** can help transform the market by asking the right questions of manufacturers and by incorporating Transformation Targets in their specifying and purchasing decisions.
- **Retailers** can help transform the market by using their mass purchasing power, as many have done by removing coal tar pavement sealants, methylene chloride paint strippers, and phthalate-laden vinyl floors from their shelves.
- **Product manufacturers** can redesign their products to avoid the highest priority substances. Most manufacturers are also consumers: they too can demand information from their suppliers and exert market influence by incorporating the avoidance of specific targets into their own supply chain decisions. Manufacturers can use the process described above and our Pharos and Data Commons tools to screen their own chemical inventory and identify their own target chemicals.

Using HBN's Transformation Target framework to initiate these signals and actions will remove the highest priority substances from the built environment and ensure that their solutions are not later regretted.

7. REFERENCES AND HELPFUL RESOURCES

A. TRANSPARENCY
   i. Blog: The Solution is Transparency: Public disclosure of product content and hazard is critical to solving material health challenges (2019)

B. PAINTS
   i. Paint Hazard Spectrum
   ii. Blog: It's Not Just About VOCs: Select APE-free Paint, Too (2018)
   iii. Blog: Time to Close the Europe/US Paint Healthfulness Gap (2014)
   iv. Blog: No, no, nonyl(phenol) (2010)
   v. Report: Full Disclosure Required: a Strategy to Prevent Asthma Through Building Product Selection (2013)

C. INSULATION
   i. Insulation Hazard Spectrum
   ii. Report: Making Affordable Multifamily Housing More Energy Efficient: A Guide to Healthier Upgrade Materials (2018, with Energy Efficiency for All)
   iii. Comments to the U.S. Environmental Protection Agency (EPA) on the Scope of its Risk Evaluation for the TSCA Work Plan Chemical: CARBON TETRACHLORIDE (CTC) (2017, with Safer Chemicals, Healthy Families and Environmental Health Strategy Center)
   iv. Blog: Beware the Hidden Ozone Depleter: Upstream Impacts of Blowing Agents (2018)
   v. Blog: Does Healthy SPF Exist? (2017)
   vi. Blog: Q&A from "When is it "green"? Preventing the Toxic Effects of Spray Foam Insulation" (2017)

D. FLOORING
   i. Flooring Hazard Spectrum
   ii. Flooring Adhesives Hazard Spectrum
   iii. Report: Eliminating Toxics in Carpet: Lessons for the Future of Recycling (2017)
   iv. Chlorine & Building Materials Project (2018-2019)
   v. Report: Healthy Environments: What's New (and What's Not) With PVC (2015, with Perkins+Will)

E. DOORS, CABINETRY, AND MILLWORK
   i. Composite Woods/Substrates Hazard Spectrum

F. COUNTERTOPS
   i. Countertops Hazard Spectrum

G. SEALANTS
   i. Sealant Hazard Spectrum
   ii. Report: Making Affordable Multifamily Housing More Energy Efficient: A Guide to Healthier Upgrade Materials (2018)
   iii. Report: Optimizing Recycling: Reclaimed Asphalt Pavement (RAP) in Building & Construction (2017)
   iv. Report: Phthalate-free Plasticizers in PVC (2014)

H. VARIOUS PRODUCT CATEGORIES

i. Organotin Compounds

1. Blog: Obesity and Prediabetes Linked to Chemical Common in PVC and Polyurethane (2018)
2. Report: Making Affordable Multifamily Housing More Energy Efficient: A Guide to Healthier Upgrade Materials (2018)
3. Report: Eliminating Toxics in Carpet: Lessons for the Future of Recycling (2017)
4. Report: Healthy Environments: What's New (and What's Not) With PVC (2015, with Perkins+Will)

ii. Toxic Heavy Metals in Recycled Content

1. Report: Eliminating Toxics in Carpet: Lessons for the Future of Recycling (2017)
2. Report: Optimizing Recycling: Post-Consumer Cullet In California (2015)
3. Report: Optimizing Recycling: Post-Consumer Polyvinyl Chloride In Building Products (2015)
4. Report: Avoiding Contaminants in Tire-Derived Flooring (2013)
5. Blog: Made in the USA: A Healthy Choice for Ceramic Tiles (2014)