

Researching Health Care Chemicals of Concern

Supporting Zero Waste and Toxicity

Prepared by:

Brianne Della Savia, UBC Sustainability Scholar, 2019

Prepared for:

Sonja Janousek | Sustainability Consultant | Energy and
Environmental Sustainability Team | Fraser Health

August 2019

Sustainability Scholars Disclaimer

This report was produced as part of the UBC Sustainability Scholars Program, a partnership between the University of British Columbia and various local governments and organisations in support of providing graduate students with opportunities to do applied research on projects that advance sustainability across the region.

This project was conducted under the mentorship of Fraser Health staff. The opinions and recommendations in this report and any errors are those of the author and do not necessarily reflect the views of Fraser Health or the University of British Columbia.

Acknowledgements

I would like to thank my mentors Sonja Janousek and Glen Garrick at Fraser Health, the Energy Environment and Sustainability Team for welcoming me to Fraser Health and Karen Taylor for organizing the sustainability Scholars program. Thank you for your contribution, feedback, and support throughout this project.

Abstract

This project aims to provide background research and create practical resources to support the Fraser Health – Energy, Environment and Sustainability team. This report details the significance of chemicals of concern and presents informative resources to support the Zero Waste and Toxicity program. This work aims to raise awareness among stakeholders and transition towards reducing chemical exposures across Lower Mainland facilities, health care services and supporting operations.

Executive Summary

The Lower Mainland Health Organizations (LMHO) have set a goal to minimize the use of chemicals of concern in medical facilities, healthcare services and supporting operations. Achieving this goal requires coordinated efforts from multiple LMHO stakeholders in order to influence decision making for clinical and equipment planning and product procurement.

These project efforts are led by the Energy, Environment and Sustainability team (EES) who focus on improving environmental impact of Lower Mainland Health Organization (LMHO) facilities. The EES team serves the four health care organizations in British Columbia's Lower Mainland: Fraser Health, Providence Health Care, Provincial Health Services Authority and Vancouver Coastal Health. The EES team portfolio includes five major focus areas: Smart Energy and Water, Zero Waste and Toxicity, Regenerative Design, Active and Clean Transportation and Workplace Leadership.

This project reflects the on-going efforts of the *Safer Chemicals* program within the *Zero Waste and Toxicity* focus area. The research and development generated through this project contributes to and supports the EES team efforts in:

- Reducing and eliminating staff, patient and visitor exposure to harmful chemicals
- Improving purchase, management, use and disposal practices;
- Developing chemical inventories and monitoring use; and
- Encouraging environmentally preferable purchasing of building materials, patient care equipment and supplies.

Exposure to chemicals of concern has significant health impacts and environmental consequences. Health effects range from acute to chronic impacts such as skin and respiratory sensitivity, reproductive, developmental and neurological dysfunction and certain cancers (Wilkinson, Hooda, Barker, Barton, & Swinden, 2016; Green Policy Institute, 2019). Exposure to many of these substances results in complex chemical and toxicological properties which are also persistent, bioaccumulative and toxic to receiving environments.

These project efforts are committed to minimizing waste generated and toxic chemicals used by the health care system and supporting operations. Within medical facilities and health services, chemical safety is a concern for indoor settings as materials including interior furnishings, maintenance and construction materials, clinical equipment and personal care products may contain toxic chemicals and pose risks to staff, patients and visitors. Exposure to chemicals of concerns occurs through inhalation, touch and ingestion.

The aim of this project is to establish background research and create practical resources for internal use by the EES team. The deliverables of this project will be used to raise awareness, educate and engage Lower Mainland Health Authority stakeholders about chemicals of concern and progress towards the development of a LMHO Safer Chemical's Strategy.

Deliverables include:

- Health Care Chemicals of Concern List – General
- Health Care Chemicals of Concern List – 1. Interior Furnishing + 2. Construction
- Regulatory requirement overview – Federal, Provincial and local legislation summary
- Communication and outreach materials – Powerpoint slide deck
- Department specific resources – Resource tool kit/ handouts
- Final presentation to EES Team
- Summary Report

Innovations in the chemical industry have outpaced the regulatory controls. Many chemicals on the market have little required testing, and much of the science is inconclusive and characterized by uncertainty (Wilkinson et al. 2016; Naidu, Jit Arias & Kennedy, 2016). As such, it is necessary to look beyond required policy, and support a precautionary approach toward chemicals of concern. Various organizations such as Green Policy Institute, Health Care Without Harm and The David Suzuki Foundation have begun to recognize the harmful impacts of chemicals of concern. These networks have developed resources including guidelines, databases and hazard lists that exceed regulatory controls and support reducing exposures to all chemicals of concern.

Achieving the goals of the Safer Chemical program requires stakeholder support and commitment from department staff. This is a long-term project that exceeds the research and development portion of the project. Three key future recommendations are encouraged to further develop the project.

1. **Increase transparency:** continue efforts to develop chemical strategy to improve the level of material disclosure between manufacturer – vendor – LMHO staff by requesting product information.
2. **Communication strategy**
 - A. **Prioritize Efforts:** consider the impact of toxic reduction efforts and decide how best to prioritize and communicate the information. Consider how the information will be received, by whom, and the organizational capacity when engaging different stakeholders.
 - B. **Graphic Development – illustrate specific health care facilities and services.** Develop healthcare-specific graphics to illustrate chemicals of concern and common exposures within hospital and health care settings
3. **Further investigation**
 - A. **Research the relationship between product life cycle, chemical exposure and health risks.** Understand and clearly communicate the health risks posed by certain chemicals, how people are exposed and the life-cycle stage(s) that pose the greatest risks.
 - B. **Research different focuses of third party certifications.** Each certificate is based on different standards and quality control criteria. Research should target: 1. the

chemical substance(s) being measured, 2. the hazard lists or regulations that products are measured against, 3. the type of products assessed, 4. how the information is gathered and assessed.

Project Scope – Methods and Approach

The project was completed in phases to compliment the project development and engagement opportunities. Initially, research was conducted to collect data and information to develop the foundational list of chemicals of concern. This list is based on credible and recognized sources such as the Living Future's Red List, the David Suzuki Dirty Dozen, CEPA's Toxic Substance List: Schedule 1 and California's Proposition 65. In-depth discussions and collaborative meetings with key informant, Dorothy Wigmore, further supported the project development (Wigmore, 2019). Once the list of chemicals was deemed complete, further research was done to characterize each of the chemicals to identify 1. Use/ function, 2. Human and environmental impacts, 3. Exposure routes and 4. Regulatory restrictions and precautions.

The second phase focused on creating department specific resources. The general Health Care Chemicals of Concern List was subdivided and tailored to reflect 4 different product categories: Interior Furnishing, Construction, Clinical Care/ Laboratories and Personal Care Products. The scope of this project was limited to: 1. Interior Furnishing and 2. Construction, as these areas were deemed to have high impact and be most relevant to LMFM stakeholders.

The final phase of the project shifted from research-based to resource development. The goal was to create practical resources to engage stakeholders and initiate conversations with department staff such as clinical planners and procurement teams. Communication and outreach materials were produced to facilitate engagement. This included a power point slide deck, graphic images and handouts.

This project concluded with final summary report outlining research findings, practical resources and recommendations for future project development.

Chemicals of Concern Project breakdown:

1. **Identify** Chemicals of Concern
2. **Characterize** Chemicals
3. **Understand** linkages between chemical function, healthcare setting and health and environmental impacts
4. **Create** resources for different contexts (Interior furnishing and Construction)
5. **Engage** department staff
6. **Strategize** feasible approaches and leverage regulatory requirements
7. **Action focused:** pilot projects with interested stakeholders

Research

This section summarizes the research completed surrounding chemicals of concern within specific health care settings. Sources supporting this research range from academic literature, government documents and recognized and credible grey literature. Direct references are cited throughout the document, and the complete bibliography is listed at the end. Topics covered include:

- Chemicals of Concern
- Six classes of Chemicals
- Role of LMHO
- Canadian Regulatory Framework
- National and International Networks
- Department specific resources –Interior Furnishing and Construction
- Best practice case study – Kaiser Permanente

Chemicals of Concern - What's the Concern About

The way that health care capital projects and facilities are designed, constructed and managed impacts indoor air quality and outdoor environments. The choice of products and interior materials contributes to environmental health and personal well-being. Exposure to certain products or materials that contain *chemicals of concern (CoC)* elevates individual risks of acute effects, chronic diseases, long term health effects and environmental impacts (Wilkinson et al., 2016; Green Policy Institute, 2019). Evidence from local and international authorities have linked exposure of various chemical substances to adverse health impacts such as skin and respiratory irritations, developmental, neurological and reproductive dysfunction and various cancers. In addition, these effects are often paralleled or intensified when discharged into natural settings as they are persistent, bioaccumulative and toxic to their receiving environments (Green Policy Institute, 2019; Health Care without Harm, 2008; Wilkinson et al., 2016).

The life cycle and environmental fate of chemical compounds is complex, especially as many are persistent and bioaccumulative in natural environments. Substances enter the environment from a variety of sources; therefore multiple actors influence the chemical load and ultimate fate of contaminants. Release and use of chemical products can result in direct exposure to contaminated indoor or outdoor air, ingestion as a result of leachate into food and beverages, dermal absorption due to skin contact and further transport of the substances (Wilkinson et al., 2016; Raghav, Eden, Witte, Polle & Michelle, 2013; Green Policy Institute, 2019). Figure 1 illustrates the release and transport of chemicals in the environment and the potential human exposure pathways (Mackay, 2001).

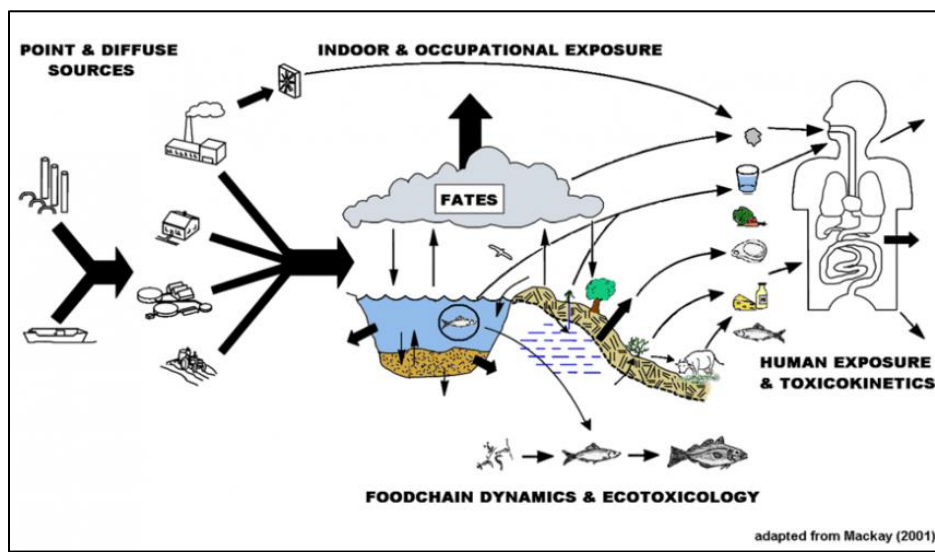


Figure 1: Pathways of exposure for chemical contaminants. (Mackay, 2001)

Understanding Chemicals of Concern

Chemicals of concern refers to chemicals that, through credible evidence, have or pose risks of adverse health effects to people or the environment. Included in the definition are those that are found to be carcinogenic and reproductive/development toxicants, as well as, persistent, bioaccumulative, and toxic to the environment. Many of these chemicals are synthetic man-made substances that haven't been tested for health and environmental impacts as the biochemical industry outpaces regulatory controls and testing isn't required for all substances (Raghav, Eden, Witte, Polle, & Mitchell, 2013; Bolong, Ismail, Salim, & Matsuura, 2009; Wigmore, 2019)

Chemicals of concern are found in everyday products such as furnishings, construction materials, personal care products and medical equipment. One way of understanding chemicals of concern is through their functional use. The Green Science Policy Institute has classified chemicals of concern into 6 distinct classes to help characterize the substances by their functional use and avoid regrettable substitutions (Green Policy Institute, 2019). Figure 2 lists the six chemical classes and illustrates each with an example.



Figure 2: Six classes of chemicals of concern. (Green Policy Institute, 2019)

The six class approach is a clear way to communicate the types of chemicals that pose threats to human and environmental health. By organizing chemicals in terms of their function, the six classes provide information on chemicals and substances with similar properties, which helps to avoid regrettable substitution (Green Policy Institute, 2019).

Each of these types of products are found in healthcare facilities and/or operations, therefore it is important to understand how LMHO employees, contractors, patients and visitors are exposed. Below is a summary of each of the chemical classes with information specific to healthcare services and the type of products and departments where these chemicals are commonly used. Appendix A - Six Chemical Class Summary approach summarizes the information below in a table.

1. Highly fluorinated – PFAS + PFOS

Highly fluorinated chemicals such as PFAS and PFOAs are used in many consumer products for their protective and oil-/ water-/stain repellent properties. Exposure to this class of substance presents risks to human health as they are carcinogens linked specifically to kidney and testicular cancers, endocrine disruptors which pose risks to hormone, development, immune and thyroid disruption and other serious health consequences such as high cholesterol, hypertension and obesity (Green Policy Institute, 2019). These substances also pose significant consequences to the environment as they are persistent and bioaccumulative (Green Policy Institute, 2019). Health care employees, patients and visitors are exposed to these substances as they migrate from products into the air and are inhaled, ingested or absorbed through skin contact.

Highly fluorinated chemicals can be found many different contexts across health services including:

- **Interior furnishings:** mattresses, foam furniture and cushions, textiles and upholstery, protective spray for furniture and high traffic areas
- **Construction materials:** carpets
- **Personal care products:** soaps, moisturizers, tissues etc.
- **Clinical Care/ Laboratories:** medical imaging devices

2. Anti-Microbials – Triclosan

Anti-microbials, or biocides, are additives that inhibit bacterial growth and provide antiseptic properties to consumer products. Anti-microbials are added to many materials and products as a preventative measure against the spread of germs; however, evidence suggests that their adverse consequences may out-weigh their benefit (Green Policy Institute, 2019). Exposure to these substances has been linked to endocrine disruption which impacts regular hormonal and thyroid function (Green Policy Institute, 2019). In addition, substances such as triclosan are persistent and bioaccumulative therefore extending the risks to the receiving environments. People are primarily exposed to these substances through dermal absorption.

Anti-Microbials such as Triclosan are found across health care facilities in a variety of products including:

- **Interior furnishings:** household products, fixtures and furniture fabric
- **Construction:** Paint, tiles, composite wood, sealants and coatings, carpet and backing and wall protection
- **Personal Care Products:** antibacterial soap, cleansers, hand sanitizers, lotions, fragrances, cosmetics, toothpaste, deodorants and antiperspirants

3. *Flame Retardants – polybrominated diphenyl ethers (PBDEs) and chlorinated tris (TCPP)*

Flame retardants are applied to consumer products and materials as a preventative measure against fire. These substances slow ignition and help to prevent fires in interior environments and are typically applied to meet flammability regulations (Green Policy Institute, 2019). In Canada, the risks of exposure to flame retardants has been recognized by CEPA and many flame retardants, such as chlorinated tris (TCPP), are being assessed for regulatory restrictions (Government of Canada, 2017). Exposure to flame retardants such as PBDE and TCPP pose health risks including endocrine disruption such as neurological, memory and behaviour disorders, reproductive impairment and thyroid disruption (Green Policy Institute, 2019). These substances are also toxic at low concentrations, and are persistent and bioaccumulative in the environment. People are exposed via inhalation, ingestion or dermal absorption.

Within health care facilities it is possible that flame retardants are found in the following areas:

- **Interior furnishings:** furniture, mattress and foam cushions, foam bedding and padding, curtains, window covers, lampshades and plastic casing
- **Construction:** finishing treatments
- **Clinical Care/ Laboratories:** electronic equipment, pulse oximeters, ventilators, and IV pumps

4. *Bisphenols + Phthalates – Bisphenol A (BPA), diethyl phthalate (DEH), Di(2-ethylhexyl) phthalate (DEPH)*

Bisphenols and phthalates are plasticizers used in the production of plastic products such as PVC as well as in some cosmetics and fragrances. As a plasticizer, these substances increase the plasticity flexibility and durability of the material which would otherwise be rigid and brittle (Green Policy Institute, 2019). Exposure to plasticizers occurs due to the substances leaching into food and water that is consumed, vapours migrating out of the product into the air or through dermal absorption. Both bisphenols and phthalates are known endocrine disruptors that can cause hormonal, reproductive and developmental dysfunction as well as carcinogens and respiratory/ skin irritants (Green Policy Institute, 2019). These substances are toxic to their receiving environments, and specifically, BPA is persistent and bioaccumulative.

Bisphenols and phthalates are found in a variety of plastic materials throughout health care services including:

BPA:

- **Interior furnishings:** PVC plastics

- **Construction:** industrial paint and water pipes
- **Clinical Care/ Laboratories:** dental sealants, fillings or orthodontic appliances, medical tubing, hemodialysers and newborn incubators.

Phthalates:

- **Interior furnishing:** PVC plastics, upholstery and curtains.
- **Construction:** Carpet backing and wood finishes
- **Clinical Care/ Laboratories:** IV bags and tubing
- **Personal Care products:** soaps, lotions etc.

5. Solvents- Halogenated organic solvents, toluene, benzene, chlorobenzene

Solvents are used primarily in liquid / wet applied products to dissolve or disperse other substances. Exposure to these substances occurs as the product vapours migrate out of the product impacting the indoor air quality. Many contribute to the production of dioxin during manufacture. Dioxins are classified as persistent organic pollutants which can persist in the environment and bioaccumulate having lasting impacts on the environment (Green Policy Institute, 2019). Human health impacts range from acute short term impacts such as fatigue, headaches and nausea to chronic impacts that interfere with reproductive and development, central nervous system and kidney and liver function (Green Policy Institute, 2019). Exposure is generally due to inhaling vapours and contaminated air or through dermal absorption.

Within health care settings, **solvents** are used in the following areas:

- **Construction:** paint, paint thinners and adhesives.
- **Clinical Care/ Laboratories:** pharmaceuticals

6. Metals – arsenic, mercury, lead, cadmium, chromium

Heavy metals are incorporated in consumer products for their inherent properties. Exposure is often due to the use or proximity to certain products via inhalation or dermal absorption. Some of these metals pose serious health risks and disruption to regular neurological development, organ function, development and reproduction disruption, and cause respiratory and skin irritations (Green Policy Institute, 2019).

These substances are recognized by many toxic regulators worldwide as they pose parallel adverse impacts on the environment including reproductive and development disruption, immediate toxic effects and are persistent and bioaccumulative in the environment (Green Policy Institute, 2019).

Metals can be used as raw materials or as mixtures; it is possible they are found in the following areas:

- **Interior furnishings:** stainless steel products, textile dyes
- **Construction:** light bulbs, paints, solder, sheet metal and pipes

- **Clinical Care/ Laboratories:** Blood pressure gauges, thermometers, foley catheters, dental amalgam and preservative in vaccination

Lower Mainland Health Organization's Role

Health Authorities must strive to provide the best quality facilities and excellent patient care. LMHOs seek to provide top-quality interior environments and health services complimented with low environmental impacts. There are many opportunities available across the Lower Mainland to coordinate efforts to reduce the usage and exposure of chemicals of concern; however, it is equally important to recognize that many products and processes are necessary within LMHOs operations. From antibacterial agents, flame retardants, solvents and personal care products, these are valuable materials for their medical benefits and functional properties. In order to continue to provide the best quality patient care, the efforts of the EES Safer Chemicals program seek to eliminate, substitute and reduce unnecessary exposure to materials and substances that pose health and environmental related threats. Where it is not possible to eliminate chemicals of concern, the goal is to monitor use and continue researching safer alternatives and substitutions.

Reducing exposures, where possible, to toxic substances requires a collective effort that includes stakeholders from diverse types and phases of capital projects and health care operations. Across lower main land facilities and their management, stakeholders and project teams impacted by these efforts include:

- Capital Project teams
- Clinical planners
- Procurement teams
- Facility maintenance operators
- Infection control
- Workplace health and safety
- Departments where biomedical and hazardous waste is generated

Key projects and operations impacted by government regulation include:

- Product procurement
- Waste and hazardous waste management
- Occupational Health and Safety requirements and exposure limits

Canadian Regulatory Framework

Capital projects and facilities management across hospital campuses and health care services is influenced by Federal, Provincial and local policy. It is important to know the jurisdiction of federal, provincial and local authorities and understand how legislation influences LMFM operations and projects. Amongst all the regulations discussed, there is a common theme of healthy people and safe workplaces. Each of these federal, provincial and local regulations contributes to maintaining and protecting human and environmental health and managing

exposures and discharge of hazardous and toxic substances. *Appendix B – Canadian Regulatory Framework* outlines the regulatory framework and specific legislative documents for each level of government.

National and International Networks

Around the world, there is a national and International network of industry professionals, researchers and regulatory agencies engaged in efforts aimed at reducing exposures and releases of toxic chemicals. Various stakeholders are engaged in this emerging area of concern by creating resources to help identify and evaluate products, and set progressive standards that challenge industries to search for innovative solutions. Interest in this area has spread across several industries attracting stakeholders from a wide array of disciplines and backgrounds as the effects of chemical toxicity doesn't discriminate and there are infinite routes of exposure. *Appendix C – International Networks* lists a variety of resources and organizations engaged in reducing human and environmental exposure to chemicals of concern.

Third party certifications present an opportunity as a resource that could be integrated into existing LMFM procurement processes to emphasize interest in reducing chemical exposures and environmental preferable purchasing. This could be done by incorporating requests into the RFP process or requesting vendors for certain product certifications. *Appendix D – Third Party Environmental Certifications* details the specifications for several certifications.

Chemicals of Concern Database

The final phase of the project shifted from being research based to resource development. The goal was to create practical resources to reflect different stakeholder's role within LMHO. The communication and outreach materials created are tailored to department specific contexts to focus the information to reflect different organizational capacities as well as material conditions. Research and review of various data bases, credible resources and hazardous substance lists was conducted to create a resource for LMHO staff to understand where chemicals of concern may exist within health care facilities. Sources used to compile the information are listed within the *References Section*. The resources originate from regulatory authorities, credible research organizations and informative web-based resources from reliable networks.

The first deliverable was a spreadsheet that summarized chemicals of concern and their characteristics. *Appendix G – Health Care Chemicals of Concern Spreadsheet* is a sample of the spreadsheet. The list contains over 50 chemical substances and details the following characteristics:

1. Use/ function
2. Human and environmental impacts
3. Exposure routes + audiences
4. Regulatory restrictions and precautions

The *Health Care Chemicals of Concern List – General* was then refined and adapted to create department specific resources that outlines chemicals of concern specific to different contexts.

Chemical exposures impact numerous audiences. Within in scope of this project, five distinct health-related focus areas were identified and categorized to understand use, function, environmental and health impacts, exposure types/ audiences and existing Canadian and international regulations. Each reflects various products and processes found in LMHO facilities.

The five distinct areas identified include:

- (1) Interior furnishings
- (2) Construction
- (3) Personal care Products
- (4) Clinical Care / Laboratories
- (5) Other

Within the scope of this project, two of the focus areas identified above 1) Interior Furnishings and 2) Construction were developed into internal resource documents that organize chemicals and their hazards by product category.

Interior Furnishings

Designing and planning health care facilities requires an abundance of interior furnishings including seating, work surfaces (tables/ benches), fixtures, curtains, window and wall coverings, textiles and upholstery, bedding etc.... Many of the materials contain chemicals of concern as common elements such as foam, plastic and adhesives. Suppliers provide a variety of products and material options, some that contain chemicals of concern while others do not. The initial step toward reducing chemical exposure is increasing transparency through identifying hazards and monitoring use. This resource is aimed to help supply chain and procurement staff to be informed about the possible chemical exposures, increase transparency and where possible substitute to safer alternatives. In order to gain transparency within the procurement processe, it is important to first understand what substances are found in certain types of products.

Appendix E –*Interior Furnishings Safer Chemicals Resource* is an internal resource intended for LMHO stakeholders who source and procure interior furnishings. The information regarding chemicals of concern is organize by product category (see below) and details specific use/function and health and environmental impacts. This helps to determine what products and materials commonly contain chemicals of concern and what they are used for.

Interior Furnishing Categories:

- Textiles, fabrics, upholstery
- Plastics
- Steel products and finishes
- Foam
- Protective/ Resistant coatings
- Wood Products

- Furniture
- Household products

Construction

New construction and major renovations require a variety of construction materials. There are various materials where chemicals of concern are found such as flooring, paint, sealants, and composite woods. The initial step toward reducing chemical exposure is increasing transparency through identifying hazards and monitoring use. This resource is aimed to help project staff to be informed about the possible chemical exposures, increase transparency by identifying specific chemicals of concern and substitute to safer alternatives where possible.

Appendix F – *Construction Safer Chemicals Resource* provides a breakdown of the construction categories, the relevant chemicals of concern, their use /function and human and environmental impacts. This helps to determine what products and materials commonly contain chemicals of concern and what they are used for.

Construction Categories

- Metal products/ finishing
- Insulation
- Flooring – vinyl, laminate, tile, carpet, carpet backing
- Sealant/ adhesive/ finishing treatment
- Paint
- Roofing
- Pipes plumbing
- Electrical
- Plastics
- Foam
- Wood products

Best Practice Example

Kaiser Permanente is a leading health organization in the USA who has recognized the significance of reducing exposure to chemicals of concern. The organization is taking precautionary measures, above regulatory requirements to phase out the use of chemicals of high concern (Kaiser Permanente , 2015). The advances in Kaiser Permanente’s environmental sustainability serve as a best practice example that inspires LMHO safer chemical program.

The Environmentally Preferable Purchasing policy specifies that the following chemicals should be avoided:

- Persistent, bioaccumulative and toxic chemicals (PBTs);
- Carcinogens and reproductive toxicants listed by the State of California under Proposition 65—the Safe Drinking Water and Toxic Enforcement Act of 1986;

- Halogenated flame retardants; and
- Phthalates (including DEHP), polyvinyl chloride (PVC), bisphenol-A, latex and mercury.

Current progress achieved through Kaiser Permanente's Environmentally Preferable Purchasing Principles and Standards (Kaiser Permanente , 2015):

- ✓ Goal to increase to 50% the products and materials it purchases that meet company environmental standards by 2025
- ✓ Eliminated triclosan and triclocarban from soaps, lotions and sanitizers.
- ✓ Eliminated PVC and DEHP from IV solution bags.
- ✓ Prohibited the purchase of building products containing PVC in resilient flooring, carpet and carpet backing, cove bases, corner guards, wall protection, handrails and bumper guards, perimeter edging on tables, signage (vinyl lettering), and above-ground piping.
- ✓ Prohibited the purchase of fabric, furniture, finishes and building materials containing fluorochemical additives or treatments.
- ✓ Prohibited the purchase of fabrics, furniture, and finishes containing added anti-microbial agents in all large projects.
- ✓ Prohibited the purchase of upholstered furniture containing chemical flame retardants.
- ✓ Received EPEAT Awards for excellence in the procurement of environmentally preferable electronic equipment for four consecutive years.
- ✓ Conducted studies that found that exposure to BPA could cause harm to human reproductive health and increase the risk of obesity in children.

Summary

This project presents background information and several resources to support EES team goals towards reducing chemical exposures across LMHO facilities, health care services and supporting operations. Innovation within the design, construction and furnishing of interior spaces offers opportunities to reduce chemical exposures and improve the overall quality of indoor environments.

Chemicals of concern are found in a variety of materials and products, many of which are purchased, used and stocked within Lower Mainland facilities. Chemical substances provide many uses that are beneficial for their functional use and health advantages; however some health risks outweigh their benefit as there are safer alternatives available (Green Policy Institute, 2019). The six chemical classes presented by the Green Policy Institute highlight the use and function of chemicals of concern. This clearly communicates chemicals with similar characteristics with the aim to avoid regrettable substitutions.

Health Authorities across the Lower Mainland strive to provide excellent patient care and quality health care facilities. Advancing the EES Safer Chemical efforts will help to build awareness and increase transparency amongst LMHO project stakeholders. While it will not be feasible to eliminate all chemicals of concern from health care facilities and services, the EES team efforts

strive to increase transparency, monitor exposures and reduce where possible. This project supports Lower Mainland Health Organization's efforts to minimize chemical exposures and transition towards chemical free environments.

Recommendations

Future efforts within the Safer Chemical focus area should consider the following recommendations.

1. Increase transparency: continue efforts to develop chemical strategy to improve the level of material disclosure between manufacturer – vendor – LMHO staff by requesting product information. It is important to raise awareness about LMHO's interest in reducing chemical exposures and provide opportunity for vendors to share information about their products. This can be initiated through vendor contracts, RFP processes and major construction projects. Over the long-term, develop an inventory of LMHO-specific inventory of products to transition the resources from generic product categories to specific brands used and purchased by LMHO.

2. Communication strategy –

A. Prioritize Efforts: consider the impact of toxic reduction efforts and decide how best to prioritize and communicate the information. It is possible to organize CoC in terms of total cost to products, annual volume purchased, health/ environmental impact or chemical-by-chemical approach. The presentation of information, the level of detail and the approach taken should be tailored depending on the audience. Consider how the information will be received, by whom, and the organizational capacity when engaging different stakeholders.

The Healthy Building Network and Health Care without Harm have developed several resources to guide the reduction of chemical exposures. HBN published a Green Materials Hierarchy specific to health care that outlines specific criterion to manage chemical exposures and HBN along with several other contributors developed a prioritization criteria specific to resilient flooring and chemical hazards. The HBN hierarchy and prioritization criteria are attached: Appendix I – *Healthy Building Network Material Hierarchy and Appendix J – Criteria for Prioritizing Chemicals.*

B. Graphic Development: illustrating specific health care facility and services. Develop health care specific graphics to illustrate chemicals of concern within specific departments. The graphic could be designed to visually display various hospital and health care settings, common products and the potential health and environmental risks. This could include for example, office, operating room, examination room, waiting room, dining hall etc.

- Appendix H (A) – *Chemicals in the Home* is an inspirational infographic from BodyLogicMD that could be replicated with health care specific information.
- Appendix H (B) is a draft of one section of information that could be transferred into the graphic.
- Appendix H (C) is a sample graphic drafted regarding indoor air quality.

3. Further investigation:

- A. Research the relationship between product life cycle, chemical exposure and health risks.** It is important to understand and clearly communicate the health risks posed by certain chemicals, how people are exposed and the life-cycle stage(s) that pose the greatest risks. Some substances are released only at specific life cycle stages such as the manufacture of the item, the use and contact with the substance or the disposal/ incineration at the product's end-of-life. For example, if considering the impacts of PVC, the greatest risks are exposed during the manufacture and disposal/ incineration of the product, while flame retardants migrate from the product into the air during the use of the product.

This distinction is helpful for different stakeholders to understand as roles and responsibilities may differ depending on the exposure. For example, Workplace Health and Safety may not be concerned with the emission and exposures outside the site.

- B. Further investigations: research different focuses of third party certifications.** Third party certification programs such as Eco-Logo, Green Screen, Floor Score and Declare Label provide a measure of the environmental impact and the chemical footprint of a product. Each certificate is based on different standards and quality control criteria. It would be useful to conduct further research into these certifications to understand what information is being provided and how to best utilize third party certifications. Research into these certifications should target: 1. The chemical substance(s) being measured, 2. the hazard lists or regulations that products are measured against, 3. The type of products assessed, 4. How the information is gathered and assessed

References

- Agency for Toxic Substances and Disease Registry (ATSDR). (n.d.). *Chemical profiles*. Retrieved from <https://www.atsdr.cdc.gov/toxprofiledocs/index.html>
- Body Logic MD. (2014). *How to ID Toxic Chemicals at Home*. Retrieved from <https://thegreendivas.com/2014/10/22/how-to-id-toxic-chemicals-at-home-infographic/>
- Bolong, N., Ismail, A. F., Salim, M. R., & Matsuura, T. (2009). A review of the effects of emerging contaminants in wastewater and options for their removal. *Desalination*, 239(1), 229–246.
- California Department of Public Health. (2014). *Healthy Cleaning & Asthma-Safer Schools: A How-To Guide*. Retrieved from <https://www.cdph.ca.gov/Programs/CCDCPHP/DEODC/OHB/WRAPP/Pages/CLASS-Guide.aspx>
- Center for Environmental Health. (n.d.). *Kicking Toxic Chemicals Out of Office Furniture*. Retrieved from https://www.ceh.org/wp-content/uploads/Flame_Retardant_EGuide_May_2017.pdf
- ChemHat. (n.d.). *Toxicological Profiles*. Retrieved from <https://chemhat.org/en>
- City of Vancouver. (2018). *Green Building Policy for Rezoning*. Retrieved from <https://guidelines.vancouver.ca/G015.pdf>
- Clean Production Action. (2017). *Chemical Footprint Pediatrics Report*. Retrieved from https://www.cleanproduction.org/images/ee_images/uploads/resources/ChemicalFootprintPediatrics_Report_201712204.pdf
- Cosmetic Ingredient Review Expert Panel. (2017). *Safety Assessment of Polyurethanes used in Cosmetics*. Retrieved from <https://www.cir-safety.org/sites/default/files/polyurethanes.pdf>
- Danish Ministry of the Environment. (2013). *Survey of alkylphenols and alkylphenol ethoxylates*. Retrieved from <https://www2.mst.dk/Udgiv/publications/2013/04/978-87-92903-99-0.pdf>
- David Suzuki Foundation. (2010). *The “Dirty Dozen” Ingredients Investigated*. Retrieved from <https://david Suzuki.org/wp-content/uploads/2010/10/dirty-dozen-BACKGROUNDER.pdf>
- European Environmental Agency. (2013). *Late Lessons from Early Warnings*. Retrieved from <https://www.eea.europa.eu/publications/late-lessons-2>
- Floor Score. (2019). *Indoor Air Quality Certification for Flooring*. Retrieved from <https://www.scsglobalservices.com/services/floorscore>
- Global Green and Healthy Hospitals. (2019). Retrieved from <https://www.greenhospitals.net/>
- Government of Canada. (2017). *Overview of Canadian Environmental Protection Act 1999*. Retrieved from <https://www.canada.ca/en/environment-climate-change/services/canadian-environmental-protection-act-registry/general-information/overview.html>

- Government of British Columbia. (2014). *BC Hazard Waste Regulation Leachate Quality Standards - Table 1 Schedule 4*. Retrieved from <http://www.bclaws.ca/404-BCLaws.html>
- Government of British Columbia. (2017). *Environmental Management Act: Hazardous Waste Regulation*. Retrieved from http://www.bclaws.ca/Recon/document/ID/freeside/63_88_00
- Government of British Columbia. (2019). *Environmental Management Act 2003*. Retrieved from http://www.bclaws.ca/civix/document/id/complete/statreg/03053_00
- Government of Canada. (2016). *Chemicals Management Plan*. Retrieved from <https://www.canada.ca/en/health-canada/services/chemical-substances/chemicals-management-plan.html>
- Government of Canada. (2018). *Domestic substances list: categorization of existing substances*. Retrieved from <https://www.canada.ca/en/environment-climate-change/services/canadian-environmental-protection-act-registry/substances-list/domestic/categorization-existing.html>
- Government of Canada. (2019). *Toxic substances list: schedule 1*. Retrieved from <https://www.canada.ca/en/environment-climate-change/services/canadian-environmental-protection-act-registry/substances-list/toxic/schedule-1.html>
- Green Policy Institute. (2019). *Six Chemical Classes*. Retrieved from <https://www.sixclasses.org/>
- Green Seal. (2019). *The Green Seal Certification*. Retrieved from <https://www.greenseal.org/>
- Green Spec. (2019). *Toxic Chemistry: Chemicals in Construction*. Retrieved from <http://www.greenspec.co.uk/building-design/toxic-chemistry-health-environment-pollution/>
- Health Care Without Harm. (2008). *Guide to Choosing Safer Products and Chemicals: Implementing Chemical Policy in Health Care*. Retrieved from https://noharm-europe.org/sites/default/files/documents-files/57/Guide_to_Safer_Chems.pdf
- Health Care without Harm and Center for Health Design. (n.d.). *Designing the 21st Century Hospital*. Retrieved from <https://www.healthdesign.org/chd/research/designing-21st-century-hospital-environmental-leadership-healthier-patients-and-familli>
- Healthy Building Network. (2017). *Eliminating Toxics in Carpet*. Retrieved from <https://s3.amazonaws.com/hbnweb.dev/uploads/files/eliminating-toxics-in-carpet-lessons-for-the-future-of-recycling.pdf>
- Healthy Building Network, Global Health and Safety Initiative, Health Care without Harm, UCI School of Public Health. (2009). *Criteria for Prioritizing Chemicals*.
- Healthy Building Network. (2008). *Toxic Chemicals in Building Materials*. Retrieved from <https://s3.amazonaws.com/healthy-materials-lab/resources/toxic-chemicals-in-building-materials.pdf>
- International Living Future Institute. (2019). *Red List of Building Materials*. Retrieved from <https://living-future.org/declare/declare-about/red-list/>

- Kaiser Permanente . (2015). *Kaiser Permanente's Health & Wellness Strategy: Avoiding Chemicals of Concern*. Retrieved from <https://greensciencepolicy.org/wp-content/uploads/2016/02/10-Jennifer-MacDaniel-2-11-16.pdf>
- Mackay. (2001). Exposure Sources Graphic.
- Metro Vancouver. (2018). *Hospital Pollution Prevention Bylaw*. Retrieved from <http://www.metrovancouver.org/services/Permits-regulations-enforcement/liquid-waste/hospital-pollution-prevention-bylaw/Pages/default.aspx>
- Naidu, R., Jit, J., Arias, A. V., & Kennedy, B. (2016). (2016). Emerging contaminant uncertainties and policy: The chicken or the egg conundrum. *Chemosphere*, 154, 385–390.
- National Cancer Institute. (n.d.). *Formaldehyde and Cancer Risk*. Retrieved from <https://www.cancer.gov/about-cancer/causes-prevention/risk/substances/formaldehyde/formaldehyde-fact-sheet?redirect=true%20-%20q7VIA%20Red%20list>
- New Hampshire Department of Environmental Services. (2010). *Environmental Fact Sheet: Chlorofluorocarbons (CFCs)*. Retrieved from <https://www.des.nh.gov/organization/commissioner/pip/factsheets/ard/documents/ard-ehp-34.pdf>
- Physicians for Social Responsibility. (n.d.). *Hazardous Chemicals in Health Care*. Retrieved from <https://www.psr.org/wp-content/uploads/2018/05/hazardous-chemicals-in-health-care.pdf>
- Raghav, M., Eden, S., Witte, B., Polle, J., & Mitchell, K. (2013). Contaminants of Emerging Concern in Water. *Arroyo*, 12.
- San Francisco Estuary Institute and the Aquatic Science Center. (n.d.). *Alkylphenols and alkylphenol ethoxylates*. Retrieved from https://www.sfei.org/sites/default/files/general_content/APE_profile_0.pdf
- State of California. (2019). *Proposition 65*. Retrieved from <https://oehha.ca.gov/media/downloads/proposition-65/p65list030819.pdf>
- Stockholm Convention. (2008). *Short-chain chlorinated paraffins (SCCPs)* . Retrieved from [http://chm.pops.int/Implementation/Alternatives/AlternativestoPOPs/ChemicalslistedinAnnexA/Shortchainchlorinatedparaffins\(SCCPs\)/tabid/5986/Default.aspx](http://chm.pops.int/Implementation/Alternatives/AlternativestoPOPs/ChemicalslistedinAnnexA/Shortchainchlorinatedparaffins(SCCPs)/tabid/5986/Default.aspx)
- Strategic Approach to International Chemicals Management. (2019). Retrieved from <http://www.saicm.org/>
- Toxic Free Futures. (2019). *Chemicals of Concern Profiles*. Retrieved from <https://toxicfreefuture.org/science/chemicals-of-concern/>
- UL. (2019). *EcoLogo Certification Program*. Retrieved from <https://www.ul.com/resources/ecologo-certification-program>

- US Environmental Protection Agency (EPA). (n.d.). *Indoor Air Quality (IAQ)*. Retrieved from <https://www.epa.gov/indoor-air-quality-iaq/volatile-organic-compounds-impact-indoor-air-quality>
- USA Environmental Protection Agency . (n.d.). *Toxicological Profile: Chlorobenzene*. Retrieved from <https://www.epa.gov/sites/production/files/2016-09/documents/chlorobenzene.pdf>
- Wigmore, D. (2019, 06 17). Chemicals Management Systems to Prevent Injury, Illness, Disease and Death. (B. D. Anousek, Interviewer)
- Wilkinson, J., Hooda, P., Barker, J., Barton, S., & Swinden, J. (2016). Ecotoxic pharmaceuticals, personal care products, and other emerging contaminants: A review of environmental, receptor-mediated, developmental and epigenetic toxicity with discussion of proposed toxicity to humans. *Environmental Science and Technology* 46(4), 336-381.
- WorkSafeBC. (2019). *Occupational Health and Safety Regulation*. Retrieved from <https://www.worksafebc.com/en/law-policy/occupational-health-safety/searchable-ohs-regulation/ohs-regulation>
- World Health Organization. (2016). *Dioxins and their effects on human health*. Retrieved from <https://www.who.int/en/news-room/fact-sheets/detail/dioxins-and-their-effects-on-human-health>
- World Health Organization. (2017). *WHO Chemicals Road Map*. Retrieved from <https://www.who.int/ipcs/saicm/roadmap/en/>
- World Health Organization. (2019). *Draft WHO global strategy on health, environment and climate change: the transformation needed to improve lives and well-being sustainably through healthy environments*. Retrieved from https://apps.who.int/gb/ebwha/pdf_files/WHA72/A72_15-en.pdf

Appendices

Appendix A – Six Chemical Class Summary

Appendix B – Canadian Regulatory Framework

Appendix C – International Networks

Appendix D – Third Party Certifications

Appendix E – Interior Furnishings Safer Chemicals Resource

Appendix F – Construction Safer Chemicals Resource

Appendix G – Health Care Chemicals of Concern Spreadsheet Sample

Appendix H – Chemicals in the Home: Infographic

Appendix I – Healthy Building Network Materials Hierarchy

Appendix J – Healthy Building Network Criteria for prioritizing Chemicals

Appendix A Six Chemical Class Summary

What it is	Where Found + Health/ Impacts
<p>Highly Fluorinated Chemicals: → synthetic oil- / water- / stain resistant Ex. PFOA + PFOS</p>	<p>Carpets, food packaging, furnishings, cosmetics, outdoor gear, adhesives and sealants, non-stick cookware, car seats, firefighting foam Health: Cancer, decreased fertility, thyroid function, decreased immune response Enviro: Persistent + bioaccumulative</p>
<p>Antimicrobials: Ex. Triclosan, triclocarbon, Quats, Nanosilver</p>	<p>Personal care products, food packaging, textiles and upholstery, kitchenware Health: EDC, allergen, asthma, antibiotic resistance Enviro: persistent and bioaccumulative</p>
<p>Flame Retardants → prevents / slows ignition Ex. Polybrominated diphenyl ethers (PBDEs)</p>	<p>Furniture foam, building insulation, textile, mattresses, paint/ coating, wire sheathing Health: Hyper-activity, cancer hormone / fertility disruption, Enviro: persistent and bioaccumulative</p>

What it is	Where Found + Health
Bisphenols + Phthalates → Plasticizer → Ex. BPA, phthalates	Plastics products, epoxy, adhesives personal care products Health: EDC. Hormone/ developmental/ fertility disruption, asthma, cancer, obesity Enviro: hormonal disruption
Solvents → Dissolve or disperse other substances → Ex. Halogenated organic solvents, toluene, benzene	Oil-based paint, paint strippers, adhesives, sealant, cosmetics, aerosols, cleaners Health: acute sensitizer, cancer risks, neurological defects Enviro: persistent
Metals Ex. Arsenic, cadmium, lead, mercury	Personal care products, metal solder, paint, pipes, furnishings Health: Cancer risk, fertility and development disruption, liver and kidney damage, cardiovascular damage Enviro: persistent and bioaccumulative

Appendix B Canadian Regulatory Framework

LEGISLATION	JURISDICTION	HIGHLIGHTS
Canadian Environmental Protection Act (CEPA) 1999	Federal- Government of Canada	<p>CEPA 1999 outlines the national approach and requirements including managing hazard and toxic substances, environmental and human health risk assessments, eliminating and reducing exposures to harmful substances and ensuring long term environmental protection.</p> <p>Domestic Substance List: List of all 23,000 <i>existing substances</i> in Canada. All substances categorized to identify <i>priority substances</i> that are <i>inherently toxic</i> and have the <i>greatest potential for exposure</i>.</p> <p>Chemicals Management Plan: Government initiative to assess the risks and prescribe risk management requirements for all 4,300 <i>priority substances</i>. This initiative is on-going and is to be completed by 2021.</p> <p>Toxic Substance List: List of all substances that have been identified as <i>toxic</i> through the Chemical's Management Plan risk assessment. For each chemical/ substance, information is available regarding the state-of-science, risk management, exposure and discharge restrictions.</p>
Environmental Management Act 2003	Provincial- Government of British Columbia	<p>The Environmental Management Act 2003 regulates discharge and disposal of all industrial and municipal waste discharge, pollution, hazardous waste and contaminated site remediation.</p> <p>Enforcement mechanisms include permits, regulations, codes of practice, administrative penalties, orders and fines.</p> <p>Hazardous waste, including toxic substances, is managed by the Hazardous Waste Regulation B.C. Reg 63/88.</p>
WorkSafeBC: Occupational Health and Safety Regulation	Provincial- Government of British Columbia	<p>WorkSafeBC regulations outline employee and employer rights and responsibilities to ensure safe working conditions.</p> <p>Section 5- Chemical Agents and Biological Agents</p> <p>Control Exposure 5.48 – 5.59 includes detailed restrictions on exposure limits for chemical and biological substances, hierarchy of controls, the requirement for practicable substitution, and <i>Exposure Control Plans</i>.</p> <p>Emergency Procedures 5.97 – 5.101 discusses inventory requirements, emergency procedures and <i>Emergency Plans</i>.</p>
Hospital Pollution Prevention Bylaw No.319	Local – Metro Vancouver	<p>Bylaw No. 319 prohibits hospitals to directly/ indirectly discharge restricted substances into the sewer/ sewage system.</p> <p>Under this bylaw, <i>pollution prevention plans</i> are required to outline the measures in place to manage discharge of pollutants. The plan must include 'continuous improvements'. Ex. use of <i>less toxic chemicals</i>.</p>
Green Building Policy For Rezoning: Near Zero Emission Building or Low Emission Green Buildings	Local – City of Vancouver	<p>All rezonings must meet the requirements for either <i>Near Zero or Low Emission Green Buildings</i>. This policy requires projects to be designed with <i>low-emitting materials</i> to minimize emissions of volatile organic compounds (VOCs) or added urea formaldehyde.</p>
Greenest City Action Plan 2020	Local – City of Vancouver	<p>Under the Greenest City Action Plan, Goal 4: Zero Waste discusses the importance of managing waste to reduce the overall environmental impacts of solid waste, including hazardous waste. <i>Extended Producer Responsibility (EPR)</i> is supported under this initiative.</p>

Appendix C International Networks

Hazardous Substances Lists:

- CEPA Toxic Substance List
- The David Suzuki Dirty Dozen
- Living Futures The Red List (POPs)
- California's Proposition 65
- The Stockholm Convention – Persistent Organic Pollutants (POPs)

Networks and organizations:

- The Healthy Building Network
- Health Care Without Harm
- Practice Green Health
- Clean Production Action
- Center for Environmental Health
- Green Policy Institute
- Kaiser Permanente - US Health Provider

Screening Databases:

- Green Screen
- The Chemical Footprint
- Pharos Database / The Data Commons
- ChemHat



Third Party Certifications:


- Green Seal
- Ecologo
- Floor Score

Regulatory Agencies:

- US EPA
- Canada CEPA – Toxic substance list
- World Health Organization
- EU REACH / ECHA

Appendix D Third Party Certifications

CERTIFICATION	DESCRIPTION
 <p data-bbox="189 730 378 755">Green Seal, 2019</p>	<p data-bbox="829 397 1816 454">Green Seal is a third party certification that indicates that products have met the life-cycle-based criteria and environmental excellence.</p> <p data-bbox="829 470 1816 527">Products are measured against product-specific standards which outline requirements unique to the product category. There are two classes of standards: products and services.</p> <p data-bbox="829 544 1270 568">Example of category standards includes:</p> <ul data-bbox="871 576 1333 771" style="list-style-type: none"> • Cleaning products for household use • Food service packaging • Adhesives for commercial use • Windows • Recycled paint • Personal care and cosmetic products <p data-bbox="829 787 1816 950">The requirements to meet the standards are detailed through structured certification checklists where manufacturers declare the ingredients of their product and state the status of certain product properties, presence of chemicals of concern and health and environmental risks. Elements include: performance, product-specific sustainability, manufacturing sustainability, packaging sustainability and certification and labeling.</p> <p data-bbox="829 966 1816 1023">Products that have been registered are listed in the database according to the standard and links are available to the manufacturer's website.</p>
 <p data-bbox="189 1388 294 1412">UL, 2019</p>	<p data-bbox="829 1039 1816 1128">Ecologo is a third party certification developed by UL. Certification indicates that products, services and packaging have undergone rigorous testing and has proven to meet Ecologo's life-cycle-based environmental standards.</p> <p data-bbox="829 1144 1501 1169">Product specific standards are divided by category including:</p> <ul data-bbox="1060 1177 1438 1404" style="list-style-type: none"> • Building and construction • Cleaning • High tech and office products • Paper and plastics • Personal care • Renewable electricity • Other

	<p>The standards measure products against metrics in the following categories:</p> <ul style="list-style-type: none">• Materials• Energy• Manufacturing and operations• Health and environment• Product performance and use• Product stewardship and innovation
 <p><u>Floor Score, 2019</u></p>	<p>Floor Score is a third party certification developed by <i>Resilient Flooring Covering Institute</i> that recognizes indoor air quality. The standard certifies hard surface flooring materials, adhesives and underlayment.</p> <p>Products are tested for 35 individual Volatile Organic Compounds (VOCs) consistent with California Standard Method V1.2.</p> <p>Testing includes, but not limited to:</p> <ul style="list-style-type: none">• Formaldehyde• Chlorobenzene• Toluene• Ethylene Glycol• Styrene <p>An inventory of Floor Score certified products is available online: https://www.scsglobalservices.com/certified-green-products-guide</p>

Appendix E Interior Furnishings Safer Chemicals Resource

FURNISHING CATEGORY	CHEMICAL OF CONCERN	USE/ FUNCTION	HEALTH AND ENVIRONMENTAL IMPACTS
Textiles, fabrics, upholstery Ex. privacy curtains, drapes, blinds, lampshades, rugs, furniture fabric	Alkylphenols	Leather and textile processing	Reproductive toxin EDC Skin irritant PBT
	Asbestos	Heat resistant fabrics	Carcinogen Mesothelioma and Asbestosis
	Chromium VI	leather and textile die/ pigments	Respiratory/ skin/ eye/ nasal irritant Carcinogen Developmental/ reproductive toxin Birth defects Gene damage PBT
	Antimony (trioxide)	Use in flame retardants	Carcinogen Respiratory/ skin/ eye/ stomach irritant Cardio vasc. System Birth defects Gene damage Other health effects PBT
	Formaldehyde	Use in disinfectants/ biocides	Carcinogen eyes/ nose/ lung irritant
	Glutaraldehyde	Leather processing Use in disinfectants	Throat, skin, eye, respiratory (asthma and wheezing) irritant
	Halogenated Flame Retardants (HFRs)	Use in flame retardant	Carcinogen EDC: respiratory/ hormonal toxin Obesity, lowered IQ Liver toxicity Other health effects PBT
	Polybrominated diphenyl ethers (PBDEs)	Use in flame retardant	Carcinogen Neurological disorders Reproductive/ thyroid toxin
	Perfluorinated chemicals or compounds (PFCs) PFAS / PFOAs	Use as protective coating	EDC: hormone/ thyroid/ immune disruption Developmental, neurological toxin Carcinogen PBT

FURNISHING CATEGORY	CHEMICAL OF CONCERN	USE/ FUNCTION	HEALTH AND ENVIRONMENTAL IMPACTS
	Phthalates	Use as plasticizer	EDC: hormone disruption Reproductive/ development/neurological toxin Carcinogen Kidney and liver dysfunction
	Polyvinyl chloride (PVC)	Contains plasticizers	Carcinogen EDC: reproductive/ developmental/ immune/ endocrine toxin Respiratory irritant Obesity PBT
	Triclosan	Use as anti-microbial	EDC: thyroid and hormonal toxin PBT
	Short Chain Chlorinated Paraffins (SCCPs)	Use in flame retardants and plasticizer	Liver/ hormone/ kidney damage Carcinogen Skin / eye irritant Liver/ hormone/ kidney damage Carcinogen Skin / eye irritant PBT
	Volatile Organic Compounds (VOCs)		Carcinogen Respiratory/ skin/ eye/ throat irritant Reproductive toxin Kidney/ liver and nervous system dysfunction
	Chlorinated Tris	Upholstered furniture Use in flame retardants	Carcinogen Reproductive and hormonal toxin
	Plastics	Bisphenol-A (BPA)	Plastic containers Use as plasticizer
Antimony (trioxide)		Plastics and rubber materials Use in flame retardants	Carcinogen Respiratory/ skin/ eye/ stomach irritant Cardio vasc. System Birth defects Gene damage Other health effects PBT

FURNISHING CATEGORY	CHEMICAL OF CONCERN	USE/ FUNCTION	HEALTH AND ENVIRONMENTAL IMPACTS
	Phthalates	PVC plastic products Use in plasticizers	Carcinogen EDC: reproductive/ developmental/ immune/ endocrine toxin Respiratory irritant Obesity PBT
	Volatile Organic Compounds (VOCs)	Plastics	Carcinogen Respiratory/ skin/ eye/ throat irritant Reproductive toxin Kidney/ liver and nervous system dysfunction
	Chlorinated Polyethylene and Chlorosulfonated Polyethylene	thermoplastics, synthetic rubbers	Reproductive/ developmental/ immune/ hormonal toxin Carcinogen POP PBT
Steel products	Chromium VI	metallic finishes, plating	Respiratory/ skin/ eye/ nasal irritant Carcinogen Developmental/ reproductive toxin Birth defects Gene damage PBT
Foam Ex. furniture foam, mattress, cushions, foam padding, bedding, pillow, baby products – change table foam, padding	Chlorofluorocarbons (CFCs) and Hydrochlorofluorocarbons (HCFCs)	Foam Aerosols	Carcinogen Central nervous/ cardio vasc. / immune system dysfunction Cataracts Ozone depletion
	Chloroprene (Neoprene)	Foam Synthetic rubber	Carcinogen Respiratory irritant Gastrointestinal disorder Dermatitis Cardiac palpitation Dizziness, headache, chest pain POP, produce dioxins
	Halogenated Flame Retardants (HFRs)	Use in flame retardants	Carcinogen EDC: respiratory/ hormonal toxin Obesity, lowered IQ Liver toxicity Other health effects PBT
	Polybrominated diphenyl ethers (PBDEs)	Use in flame retardants	Carcinogen Neurological disorders

FURNISHING CATEGORY	CHEMICAL OF CONCERN	USE/ FUNCTION	HEALTH AND ENVIRONMENTAL IMPACTS
			Reproductive/ thyroid toxin
	Perfluorinated chemicals or compounds (PFCs) PFAS / PFOAs	Use in protective coating	EDC: hormone/ thyroid/ immune disruption Developmental, neurological toxin Carcinogen PBT
	Polyurethane		Serious bronchial/ respiratory irritant
	Chlorinated Tris	Use in flame retardants	Carcinogen Reproductive and hormonal toxin
Protective/ Resistant coatings	Perfluorinated chemicals or compounds (PFCs) PFAS / PFOAs	Use in water- /oil-/stain- /grease protective coating	EDC: hormone/ thyroid/ immune disruption Developmental, neurological toxin Carcinogen PBT
Wood products	Formaldehyde	Used in anti-microbials/ disinfectants	Carcinogen Eyes/ nose/ lung irritant
Ex. hardwood, veneer core composite wood: particle board, plywood and fiberboard, finishing treatments, wood preservatives, laminare	Volatile Organic Compounds (VOCs)	Emitted bi-product	Carcinogen Respiratory/ skin/ eye/ throat irritant Reproductive toxin Kidney/ liver and nervous system dysfunction
	Creosote	Wood treatment	Carcinogen Liver/ kidney dysfunction
	Arsenic	Wood treatment	Carcinogen Skin sensitizer Acute toxin
	Pentachlorophenol	Used in anti-microbials / disinfectants	Liver and immune system damages Reproductive and thyroid toxin
	Organotin compounds ex. tributyltin (TBT), dibutyltin (DBT)	Wood Treatment	Reproductive toxin PBT
	Triclosan	Used in anti-microbials/ disinfectants	EDC: thyroid and hormonal toxin PBT
Furniture (unspecified)	Polyvinyl chloride (PVC)	Contains plasticizers	Carcinogen EDC: reproductive/ developmental/ immune/ endocrine toxin Respiratory irritant Obesity PBT
	Volatile Organic	Emitted bi-product	Carcinogen

FURNISHING CATEGORY	CHEMICAL OF CONCERN	USE/ FUNCTION	HEALTH AND ENVIRONMENTAL IMPACTS
	Compounds (VOCs)		Respiratory/ skin/ eye/ throat irritant Reproductive toxin Kidney/ liver and nervous system dysfunction
	Formaldehyde	Use as disinfectant/ biocide	Carcinogen eyes/ nose/ lung irritant
Household products (unspecified)	Formaldehyde	Use as disinfectant/ biocide	Carcinogen eyes/ nose/ lung irritant
	Triclosan	Use as anti-microbial	EDC: thyroid and hormonal toxin PBT

Appendix F Construction Safer Chemicals Resource

CONSTRUCTION CATEGORY	CHEMICAL OF CONCERN	USE/ FUNCTION	HEALTH AND ENVIRONMENTAL IMPACTS
Metal products/ finishing Ex. Solder Sheet and pipe, Bearing metals, casting and type metal	Alkylphenols	metal working	Reproductive toxin EDC Skin irritant PBT
	Lead (pb)	Heavy metal	Carcinogen Developmental/ neurological/ hormonal/ reproductive/ thyroid toxin Cardiovascular/ renal/ cognitive disruption Respiratory diseases PBT
	Antimony (trioxide)	Use in flame retardant; inherent strength	Carcinogen Respiratory/ skin/ eye/ stomach irritant Cardio vasc. System Birth defects Gene damage Other health effects PBT
Insulation Ex. wall insulation, sound insulation, fiber glass insulation, foam insulation,	Asbestos		Carcinogen Mesothelioma and Asbestosis
	Chloroprene (Neoprene)		Carcinogen Respiratory irritant Gastrointestinal disorder Dermatitis Cardiac palpitation Dizziness, headache, chest pain POP, produce dioxins
	Formaldehyde	Use as disinfectant/ biocide	Carcinogen eyes/ nose/ lung irritant
	Halogenated Flame Retardants (HFRs)	Use as flame retardant	Carcinogen EDC: respiratory/ hormonal toxin Obesity, lowered IQ Liver toxicity Other health effects PBT
	Polyurethane		Serious bronchial/ respiratory irritant
	Volatile Organic Compounds (VOCs)	Emitted bi-product	Carcinogen Respiratory/ skin/ eye/ throat irritant Reproductive toxin Kidney/ liver and nervous system dysfunction
Flooring	Asbestos		Carcinogen

Ex. Vinyl, laminate, tile, carpet, carpet backing, wood flooring finishes	Bisphenol A (BPA)	Use in plasticizers	Mesothelioma and Asbestosis EDC: reproductive, developmental, thyroid toxin Carcinogen Cardio vasc. Diseases Diabetes, obesity Skin/ eye irritant PBT
	Formaldehyde		Carcinogen eyes/ nose/ lung irritant
	Halogenated Flame Retardants (HFRs)	Use in flame retardants	Carcinogen EDC: respiratory/ hormonal toxin Obesity, lowered IQ Liver toxicity Other health effects PBT
	Perfluorinated chemicals or compounds (PFCs) PFAS / PFOAs	Use in protective coatings	EDC: hormone/ thyroid/ immune disruption Developmental, neurological toxin Carcinogen PBT
	Phthalates	Use in plasticizer	Carcinogen EDC: reproductive/ developmental/ immune/ endocrine toxin Respiratory irritant Obesity PBT
	Polyvinyl chloride (PVC)	Contains plasticizers	Material strength, plasticizer
	Polyurethane		Serious bronchial/ respiratory irritant
	Volatile Organic Compounds (VOCs)	Emitted bi-product	Carcinogen Respiratory/ skin/ eye/ throat irritant Reproductive toxin Kidney/ liver and nervous system dysfunction
	Chlorinated Tris	Use in flame retardants	Carcinogen Reproductive and hormonal toxin
	Triclosan	Use in anti-microbials	EDC: thyroid and hormonal toxin PBT
Sealant/ adhesive/ finishing treatment Ex. glue, gaskets, geomembranes, caulking	Alkylphenols		Reproductive toxin EDC Skin irritant PBT
	Antimony (trioxide)	Use in flame retardants	Carcinogen Respiratory/ skin/ eye/ stomach irritant Cardio vasc. System Birth defects Gene damage

			Other health effects PBT
	Chloroprene (Neoprene)	Synthetic rubber – weather-/ chemical-/ oil- flammability resistant	Carcinogen Respiratory irritant Gastrointestinal disorder Dermatitis Cardiac palpitation Dizziness, headache, chest pain POP, produce dioxins
	Formaldehyde	Use as microbial/ biocide	Carcinogen Eyes/ nose/ lung irritant
	Glutaraldehyde	Use in disinfectant/ biocide	Throat, skin, eye, respiratory (asthma and wheezing) irritant
	Polybrominated diphenyl ethers (PBDEs)	Use in flame retardants	Carcinogen Neurological disorders Reproductive/ thyroid toxin
	Polyvinyl chloride (PVC)	Contains plasticizers	Carcinogen EDC: reproductive/ developmental/ immune/ endocrine toxin Respiratory irritant Obesity PBT
	Polyurethane		Serious bronchial/ respiratory irritant
	Volatile Organic Compounds (VOCs)	Emitted bi-product	Carcinogen Respiratory/ skin/ eye/ throat irritant Reproductive toxin Kidney/ liver and nervous system dysfunction
	Triclosan	Finishing treatment, sealants Use in anti-microbials	EDC: thyroid and hormonal toxin PBT
Paint/ Paint Thinner	Alkylphenols	Surfactants	Reproductive toxin EDC Skin irritant PBT
	Asbestos	Strength and heat resisting capabilities	Carcinogen Mesothelioma and Asbestosis
	Bisphenol A (BPA)	Industrial paint Use in plasticizers	EDC: reproductive, developmental, thyroid toxin Carcinogen Cardio vasc. Diseases Diabetes, obesity Skin/ eye irritant PBT
	Lead (pb)	Use in plasticizers Heavy metal	Carcinogen Developmental/ neurological/ hormonal/ reproductive/ thyroid

			toxin Cardiovascular/ renal/ cognitive disruption Respiratory diseases PBT
	Chromium VI	Anti-corrosive	Respiratory/ skin/ eye/ nasal irritant Carcinogen Developmental/ reproductive toxin Birth defects Gene damage PBT
	Formaldehyde	Use in anti-microbial/ biocides	Carcinogen Eyes/ nose/ lung irritant
	Glutaraldehyde	Use in anti-microbials/ biocides	Throat, skin, eye, respiratory (asthma and wheezing) irritant
	Polyurethane		Serious bronchial/ respiratory irritant
	Triclosan	Use in anti-microbials	EDC: thyroid and hormonal toxin PBT
	Volatile Organic Compounds (VOCs)	Emitted bi-product	Carcinogen Respiratory/ skin/ eye/ throat irritant Reproductive toxin Kidney/ liver and nervous system dysfunction
	Toluene		Respiratory/ eye/ throat/ nasal irritant, fatigue and vision impairment Central nervous system/ liver/ kidney system dysfunction Developmental and reproductive toxin Other health effects
	Pentachlorophenol	Use as anti-bacterial/ disinfectants	Liver and immune system damages Reproductive and thyroid toxin
Roofing	Asbestos	Strength and heat resistance	Carcinogen Mesothelioma and Asbestosis
Ex. roof membranes, geomembrane, ceiling tiles,	Lead (pb)	Use in plasticizers Heavy metal	Carcinogen Developmental/ neurological/ hormonal/ reproductive/ thyroid toxin Cardiovascular/ renal/ cognitive disruption Respiratory diseases PBT
	Chlorinated Polyethylene and Chlorosulfonated Polyethylene	Thermoplastics: material strength and inherent resistance	Reproductive/ developmental/ immune/ hormonal toxin Carcinogen POP

			PBT
	Polyvinyl chloride (PVC)	Contains plasticizers	Carcinogen EDC: reproductive/ developmental/ immune/ endocrine toxin Respiratory irritant Obesity PBT
	Volatile Organic Compounds (VOCs)	Emitted bi-product	Carcinogen Respiratory/ skin/ eye/ throat irritant Reproductive toxin Kidney/ liver and nervous system dysfunction
	Triclosan	Use in anti-microbials	EDC: thyroid and hormonal toxin PBT
Pipes Plumbing	Bisphenol A (BPA)	Water pipe- lining Use in plasticizers	EDC: reproductive, developmental, thyroid toxin Carcinogen Cardio vasc. Diseases Diabetes, obesity Skin/ eye irritant PBT
	Lead (pb)	Use in plasticizers	Carcinogen Developmental/ neurological/ hormonal/ reproductive/ thyroid toxin Cardiovascular/ renal/ cognitive disruption Respiratory diseases PBT
	Polyvinyl chloride (PVC)	Contains plasticizers	Carcinogen EDC: reproductive/ developmental/ immune/ endocrine toxin Respiratory irritant Obesity PBT
Electrical Ex. Electrical shielding/ sheaths, switches, conduit, thermostats, lightbulbs	Lead (pb)	Use in plasticizers	Carcinogen Developmental/ neurological/ hormonal/ reproductive/ thyroid toxin Cardiovascular/ renal/ cognitive disruption Respiratory diseases PBT
	Mercury		Carcinogen Skin / eye irritant Neurological toxin Central Nervous/ immune/ digestive system disruption Hyper activity/ ADHD

			Kidney / Liver disease Bioaccumulative
	Chlorinated Polyethylene and Chlorosulfonated Polyethylene	Thermoplastics: material strength and inherent resistance	Reproductive/ developmental/ immune/ hormonal toxin Carcinogen POP PBT
	Chlorofluorocarbons (CFCs) and Hydrochlorofluorocarbons (HCFCs)	Refrigerant	Carcinogen Central nervous/ cardio vasc. / immune system dysfunction Cataracts Ozone depletion
	Polyvinyl chloride (PVC)	Contains plasticizers	Carcinogen EDC: reproductive/ developmental/ immune/ endocrine toxin Respiratory irritant Obesity PBT
Plastics Ex. adhesives, rubber, corner guards, wall coverings,	Antimony (trioxide)	Used in plasticizers	Carcinogen Respiratory/ skin/ eye/ stomach irritant Cardio vasc. System Birth defects Gene damage Other health effects PBT
	Chloroprene (Neoprene)	Synthetic rubber – weather-/ chemical-/ oil-flammability resistant	Carcinogen Respiratory irritant Gastrointestinal disorder Dermatitis Cardiac palpitation Dizziness, headache, chest pain POP, produce dioxins
	Polyvinyl chloride (PVC)	Corner guards, wall coverings	Carcinogen EDC: reproductive/ developmental/ immune/ endocrine toxin Respiratory irritant Obesity PBT
	Polyurethane	Thermoplastics	Serious bronchial/ respiratory irritant
	Triclosan	Used in anti-microbials/ biocides	EDC: thyroid and hormonal toxin PBT
Foam Ex. molded foam	Chlorofluorocarbons (CFCs) and Hydrochlorofluorocarbons (HCFCs)	Foams and aerosols	Carcinogen Central nervous/ cardio vasc./ immune system dysfunction Cataracts Ozone depletion
	Chloroprene (Neoprene)	Synthetic rubber –	Carcinogen

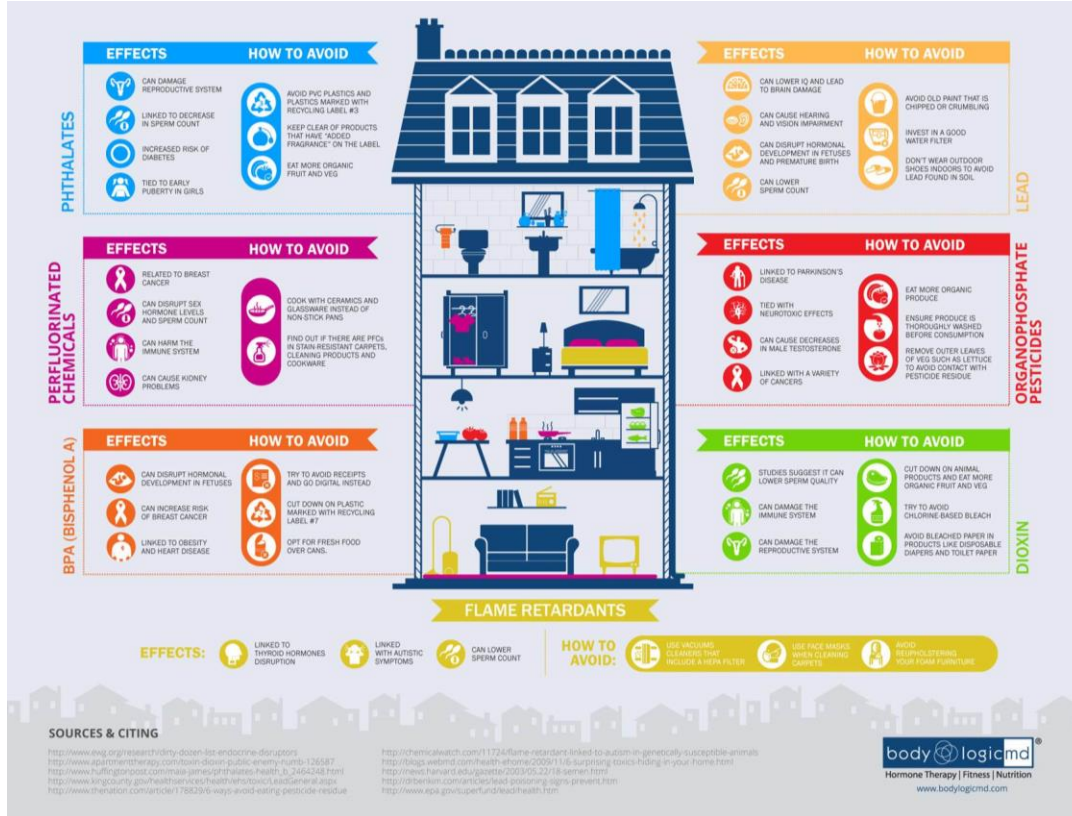
		weather-/ chemical-/ oil-flammability resistant	Respiratory irritant Gastrointestinal disorder Dermatitis Cardiac palpitation Dizziness, headache, chest pain POP, produce dioxins
Wood products Ex. Hardwood, veneer core composite wood: particle board, plywood and fiberboard, finishing treatments, wood preservatives, laminate	Formaldehyde	Used in anti-microbials/ disinfectants	Carcinogen Eyes/ nose/ lung irritant
	Volatile Organic Compounds (VOCs)	Emitted bi-product	Carcinogen Respiratory/ skin/ eye/ throat irritant Reproductive toxin Kidney/ liver and nervous system dysfunction
	Creosote		Carcinogen Liver/ kidney dysfunction
	Arsenic		Carcinogen Skin sensitizer Acute toxin
	Pentachlorophenol	Used in anti-microbials / disinfectants	Liver and immune system damages Reproductive and thyroid toxin
	Organotin compounds ex. tributyltin (TBT), dibutyltin (DBT)		Reproductive toxin PBT
	Triclosan	Used in anti-microbials/ antibacterials	EDC: thyroid and hormonal toxin PBT

Appendix G Health Care Chemicals of Concern Spreadsheet Sample

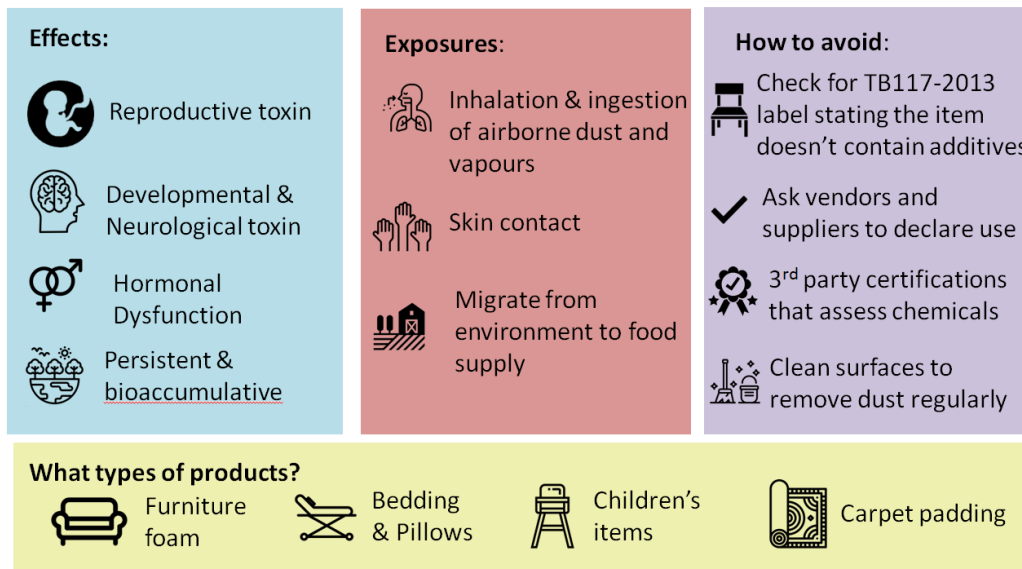
Substances	Use	Function	Environmental Impacts	Health Impacts	Exposure Type	Prohibited/Avoid/Declare Lists/ Reg
Alkylphenols	Leather and textile processing	Surfactants	bioaccumulative, endocrine disruption in fish (12) Breakdown in the environment to nonylphenol ethoxylates and	Reproductive toxin (13) Endocrine disruptor (25) Nonylphenols: Acute: skin irritation, toxic to humans and	Inhalation, ingestion, dermal	The Red List; The Danish Environmental Protection Agency's List of Undesirable Substances (LOUS); Skin and Wound VAT
Asbestos	Heat resistant fabrics	Strength and heat resistance	/	human carcinogen (6) (12) (21): increases risk of lung cancer, mesothelioma and asbestosis	eye / skin contact and inhalation	The Red List; Prop 65
Chromium VI	leather and textile die/ pigments	Metal plating	Chromium vi: immediate harm to aquatic ecosystems, persistent, longterm harm to	respiratory, skin and nasal irritant, nasal irritation; nasal/skin ulcers, allergen (12) (34)	Inhalation, ingestion, dermal	The Red List; Prop 65; WorksafeBC; BC Hazardous Waste Regulation Leachate Quality
Antimony (trioxide)	Textiles	Synergist in flame retardants, catalyst to produce polyethylene terephthalates (PET) - Polyester (27)	antimony + antimony trioxide: persistent, immediate harm to aquatic life, bioaccumulative	Carcinogen (4)(6) (27) not classified carcinogen according to EPA (28) eye/ lung irritant, heart and	inhalation or ingestion	Prop 65; worksafe BC
Formaldehyde	Furniture, textiles and leather tan	Improves crease resistance, pest/ bio/germicide, disinfectant (4) (15)	/	carcinogen (4) (6) (8) (12) (15) eyes/ nose/ lung irritant (15) (20) when exceeding 0.1 ppm may experience watery/	inhalation of vapours or dermal absorption of	Schedule 1; Prop 65; David Suzuki Dirty Dozen; The Red List; WorksafeBC
Glutaraldehyde	leather processing	Disinfectant, biocide, sterilizer.	water/ air/ soil contamination	Throat, skin, eye, respiratory (asthma and wheezing) irritant/sensitizer (18) contact irritant,	Inhalation; skin contact; water release	WorkSafeBC
Halogenated Flame Retardants (HFRs)	fabrics and upholstery, curtains	Flame retardant (7)	persistent, bioaccumulative (12)	carcinogen (10) Endocrine disruptor: decreased fertility, hormone disruption, lowered IQs,	migrates from pro	The Red List
Polybrominated diphenyl ethers (PBDEs)	privacy curtains drapes	Flame retardant (1) (4)		neurological, memory and behaviour disorders,	spread from products to	EU RoHS; Kaiser Permanente;

Appendix H Chemicals in the Home: Infographic

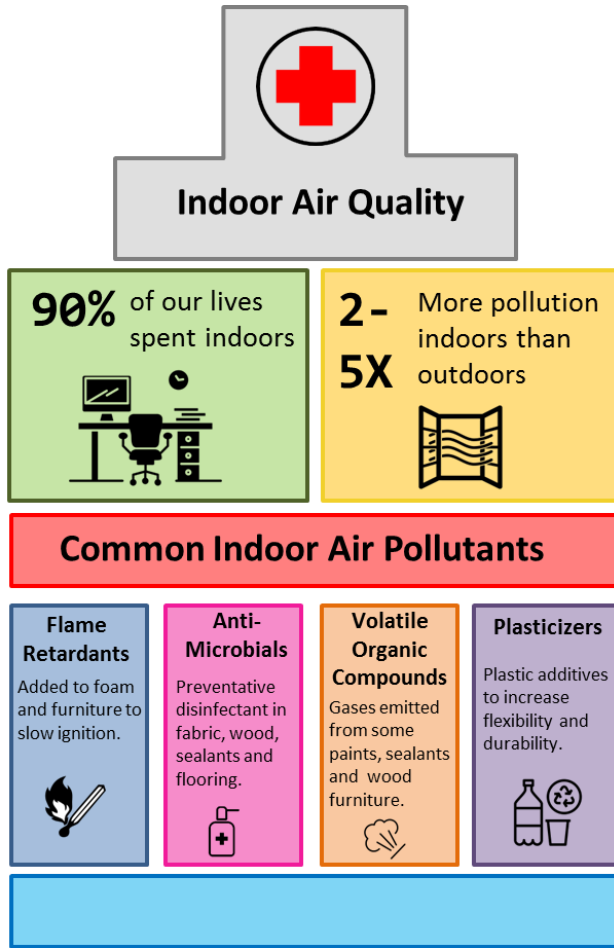
(A) Chemicals in the Home (Body Logic MD, 2014)



(B) Frame Retardant Draft Info



(C) Indoor Air Quality Hospital Graphic



Appendix I Healthy Building Network Materials Hierarchy

Green Materials Hierarchy for Healthcare⁷²

Criterion 1: Do not use materials that contribute to the formation of persistent organic pollutants (POPs) as defined by the Stockholm Convention.

Criterion 2: Do not use materials that contain or emit highly hazardous chemicals, including:

- a. Do not use materials that contain:
 1. Persistent, bioaccumulative, toxics (PBTs) or
 2. Very persistent, very bioaccumulative (vPvB) chemicals
- b. Avoid materials that contain:
 1. Carcinogens
 2. Mutagens
 3. Reproductive or developmental toxicants
 4. Neurotoxicants
 5. Endocrine disruptors
- c. Avoid materials that emit criteria levels of VOCs.

Criterion 3: Use sustainably sourced bio-based or recycled and recyclable materials

- a. Prefer sustainably produced bio-based materials that are:
 1. Grown without the use of genetically modified organisms (GMOs).
 2. Grown without the use of pesticides containing carcinogens, mutagens, reproductive toxicants, or endocrine disruptors.
 3. Certified as sustainable for the soil and ecosystems.
 4. Compostable into healthy and safe nutrients for food crops.
- b. Prefer materials with the highest post-consumer recycled content.
- c. Prefer materials that can be readily reused or recycled into a similar or higher value products and where an infrastructure exists to take the materials back.

Criterion 4: Do not use materials manufactured with highly hazardous chemicals, including those described in Criterion 2.




*Written and produced by Healthy Building Network.
Production funded by the Global Health and Safety Initiative
with the support of Health Care Without Harm.*

(Healthy Building Network, 2008)

Appendix J Healthy Building Network Criteria for Prioritizing Chemicals

Table 1: Criteria for prioritizing chemicals based on persistence, bioaccumulation, health endpoints and confidence in the science

Very High Concern	Persistent Organic Pollutants (POPs) targeted in the Stockholm POPs treaty and other Persistent Bioaccumulative Toxicants (PBTs)*	Highest priority to eliminate  Use with caution. Avoid where possible Prefer
High Concern	Known or likely carcinogens, mutagens, reproductive toxicants, developmental toxicants or endocrine disruptors .	
Moderate Concern	Significant possibility of above hazards but lower confidence or known or likely neurotoxicants, respiratory sensitizers or leading to other chronic human or ecotoxicity endpoints .	
Caution	Moderate concern for any of the above health endpoints or preliminary indications of higher concern but with inadequate test data or acute human health concern	
Low Concern	Tested with low concern for any of the above endpoints**	

See Appendix B for explanation of criteria and how various chemical lists are ranked by these criteria.

* includes chemicals which are very persistent and bioaccumulative but toxicity is unknown.

** This paper reports on the chemicals that fall in the Moderate to Very High categories, not Caution or Low.

Few authoritative lists yet identify chemicals for "Low" categorization.



(Healthy Building Network, Global Health and Safety Initiative, Health Care without Harm, UCI School of Public Health, 2009)