Toxic by Design

Eliminating harmful flame retardant chemicals from our bodies, homes, & communities

Endocrine Disruptors Action Group

A White Paper by the Endocrine Disruptors Action Group
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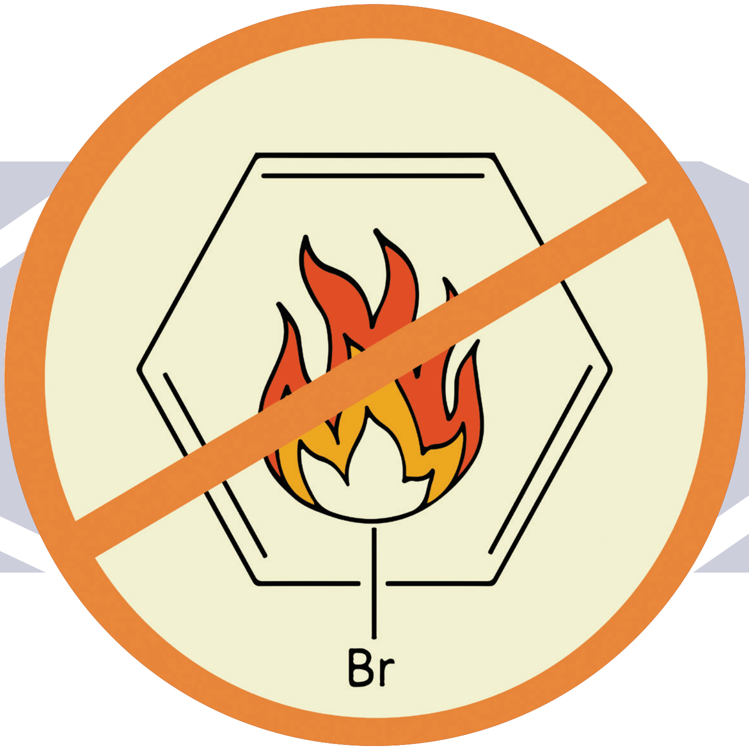

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About the Endocrine Disruptors Action Group (EDAction): EDAction brings together researchers concerned with the widespread presence of endocrine disrupting chemicals in commodities, built environments, industrial emissions, ecologies, waters, and atmospheres. EDAction advocates for improvements to Canadian toxics governance and seeks to advance critical discussions about the regulation, science, and monitoring of endocrine disrupting chemicals.

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Executive Summary

Toxic flame retardant chemicals added to a wide range of ubiquitous consumer products are now commonly found in house dust, breast milk, and blood. Significant exposures to synthetic chemicals are not limited to emissions from factories or industrial practices. **Industrially produced chemicals are embedded in the ordinary materials and objects that populate our everyday lives**, including materials used to make our homes and buildings, vehicles, food packaging, furniture, and commonly owned electronics. Studies have established that some of these chemicals are toxic to human life. Many more of these chemicals are suspected to be toxic. Once these chemicals are built into the products and materials of everyday life, they become ubiquitous, exposing people to potential health harms on a regular basis. Such exposures are difficult to avoid, and almost impossible to remove once they are in our environments. These are called Built-In Exposures. Some chemicals, such as Polychlorinated biphenyls (PCBs), which were used as flame retardants in the 1960s, have been banned. However, because they were built-in to our homes, workplaces, and everyday objects, they are still found in the blood and urine of all the Canadians who have been tested today.

Exposures to toxic flame retardant are an environmental justice problem. Though they are widespread and nearly ubiquitous in our environments, flame retardants affect some people more than others. At low doses, for example, fetuses and infants are affected more than adults. In addition, the uneven distribution of these chemicals in our environments means that people who rely on hunting and fishing for food, people who live near heavy industry, and people who have lower incomes can have higher levels of flame retardants in their bodies and communities.

Current Canadian regulatory efforts to solve the problem of exposures to flame retardant chemical are flawed. Some of the most common flame retardant chemicals used today have been declared "toxic" by the federal government and their manufacture has been prohibited. However, Canadian regulations prohibiting the manufacture and use of PBDEs explicitly do not apply to consumer products or parts of products, such as foam. For this reason, Canadians continue to be exposed to these chemicals regularly. Moreover, the implementation of strict flammability standards for consumer products and furniture may exacerbate the problem as those standards often result in the addition of high volumes of flame retardant chemicals, both those that are already known to be toxic, as well as their "substitutes" that have not yet been assessed for toxicity.

But there are things that can be done to protect the health and wellbeing of Canadians. This white paper, *Toxic by Design*, makes policy recommendations that take account of complex scientific, legal, economic, and social factors. It summarizes the state of scientific research on the toxicity of common flame retardants, including proposed alternatives, as well as their efficacy for fire safety. It also questions our flammability standard-setting process in light of international debates. Our recommendations are guided by the principles of environmental and reproductive justice.

We recommend that the Government of Canada:

1) Prohibit consumer products *and components* of consumer products containing any flame retardant chemical for which there is evidence of harm, including alternative flame retardants, and those that have no environmental health assessment confirming their safety. Such action recognizes that the current substance-by-substance approach under the Canadian Environmental Protection Act (CEPA) and the slow timeline of assessment cannot adequately address the proliferation and distribution of replacement flame retardant chemicals. It also recognizes that the product-by-product approach of the Consumer Product Safety Act (CCPSA) cannot adequately address the widespread use of flame retardants in many kinds of products and materials.

2) Develop a strategy on the use of alternative flame retardant chemicals that meaningfully implements the precautionary principle. This requires, at minimum, that the government address the way that flammability standard-setting processes work at cross-purposes to the aims of CEPA. The government must integrate decision-making across these domains so as to address the problem of Built-in Exposures.

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What are Flame Retardants?

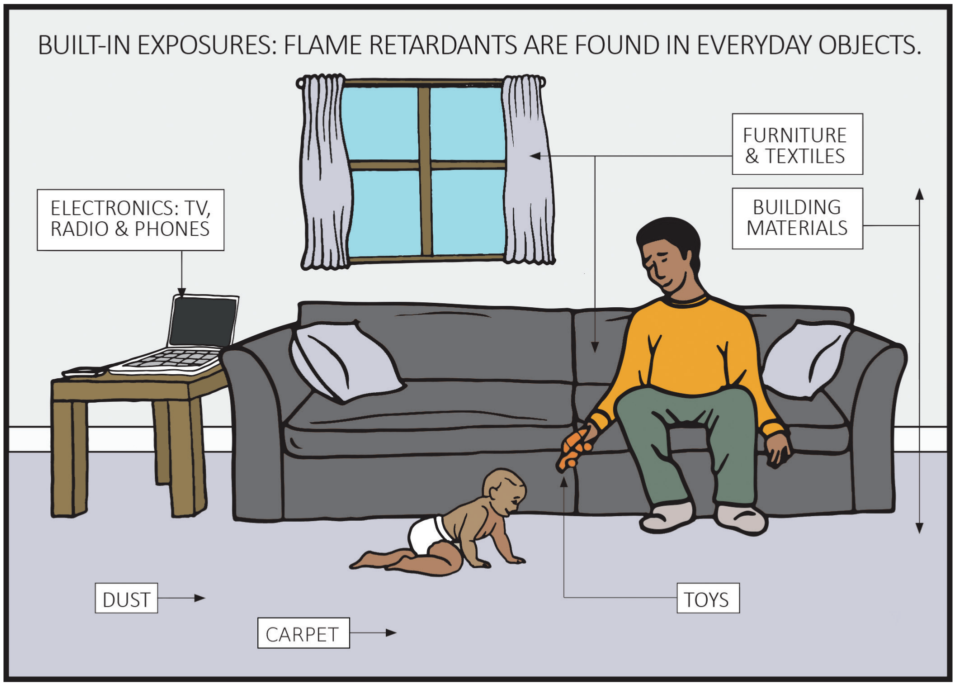
Flame retardants are industrially produced chemicals added to furniture, consumer electronics, camping gear, fabrics, vehicles, construction materials, and other products to decrease flammability.

While not all flame retardants present concerns for human and ecological health, many of the commonly used chemicals do pose a threat. Polychlorinated biphenyls (PCBs) were historically used as chemical flame retardants, and were among the first class of chemicals to be banned from manufacture in Canada and the United States because of their toxicity.

Common chemical flame retardants include: Polybrominated diphenyl ethers (PDBEs), Tris(1,3-dichloro-2-propyl) phosphate, (TDCPP) Triphenyl phosphate (TPP), Hexabromocyclododecane (HBCD), *FireMaster* 550, and Polychlorinated biphenyls (PCBs).

Why Are Flame Retardants Everywhere?

Human-made chemicals have become ubiquitous in the environment and human bodies because they are incorporated into the objects and infrastructures that surround us. As such, **exposure** to many of the approximately 23,000 identified synthetic chemicals used in Canada is not limited to emissions from factories or industrial agricultural practices.[1] Synthetic chemicals are in the materials used to make our homes and buildings, in food and food packaging, in furniture and clothing, and in commonly owned electronics, among other things. People are exposed to synthetic chemicals through the ordinary activities of handling these objects, as well as by breathing, eating, and drinking. Once these chemicals are built into the materials of everyday life, they become ubiquitous exposures. We call these **Built-in Exposures** because they are literally built into our lives in a way that makes them impossible to remove or avoid.



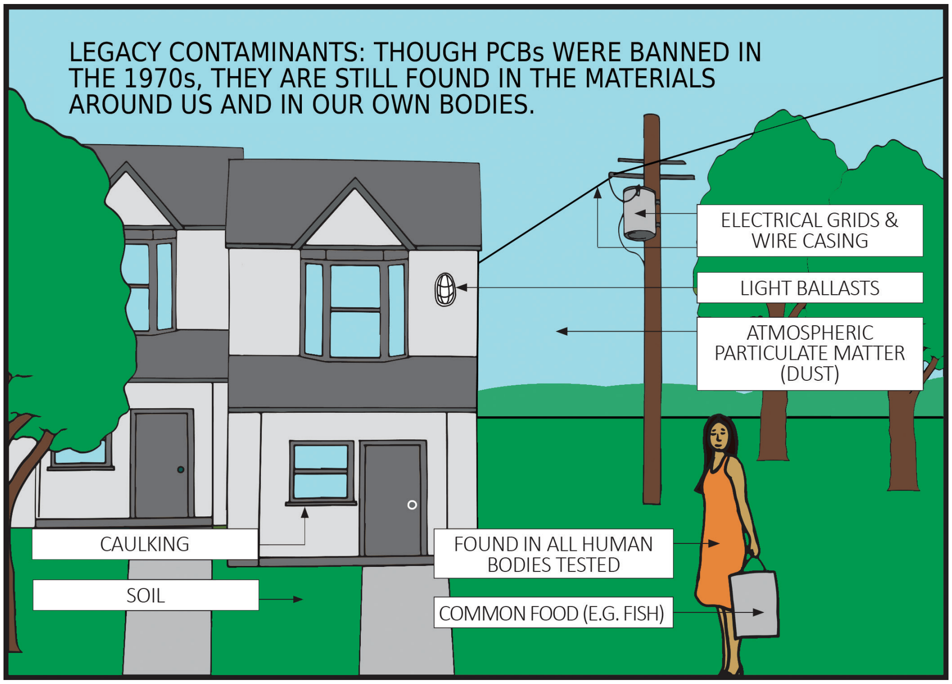
Exposures are contact with or absorption of a substance through the ordinary activities of handling objects, breathing, washing, eating, and drinking. Exposures can be acute (occurring for a short period of time) or chronic (occurring over a long-period of time). Exposures can also occur in utero, leading to adverse impacts on fetal development.

Built-In Exposures are exposures to human-made chemicals that are embedded in everyday objects and infrastructures, including materials used to make our homes and buildings, in food and food packaging, in furniture and clothing, in cosmetics, and in commonly owned electronics, among other things. The ubiquity of these exposures make them extremely difficult to avoid or eliminate altogether, and in some cases, lead to adverse human and environmental health impacts.

There are some Built-in Exposures that have endured in our built environment for decades, while others are caused by the proliferation of newer synthetic chemicals. Polychlorinated biphenyls, or PCBs, were one of the first widely used chemicals to be banned from manufacture in Canada and the United States, and later globally in the Stockholm convention because of their persistence in the environment and their toxicity. PCBs were used as flame retardants because of their stability, heat resistance, flame resistance, and low conduction of electricity. They were installed in the mid-century Canadian electrical grid, and were used in paint, caulking, fluorescent light ballasts, carbonless copy paper, and cash register receipts. While their manufacture, sale, import, and reuse in Canada have been prohibited since 1977, there are regulatory exceptions that allow PCBs to continue to be used. Today they remain in aging infrastructures and buildings, continuously creating new exposures.[2] PCBs have become legacy chemicals, and contemporary global monitoring studies have failed to find a person alive that does not have PCBs in their blood, despite their ban decades ago.[3]

Flame retardants like PCBs and polybrominated diphenyl ethers, or PBDEs, provide examples of Built-in Exposures: synthetic chemicals that are purposely built into the materials and objects of everyday life, and that make their way into human bodies. Materials and products are intentionally created with these chemicals, often because they provide inexpensive ways to, for example, control heat, make materials more flexible, or prevent fire. They are, therefore, not accidental exposures, but rather purposefully installed in the everyday experience of Canadians.

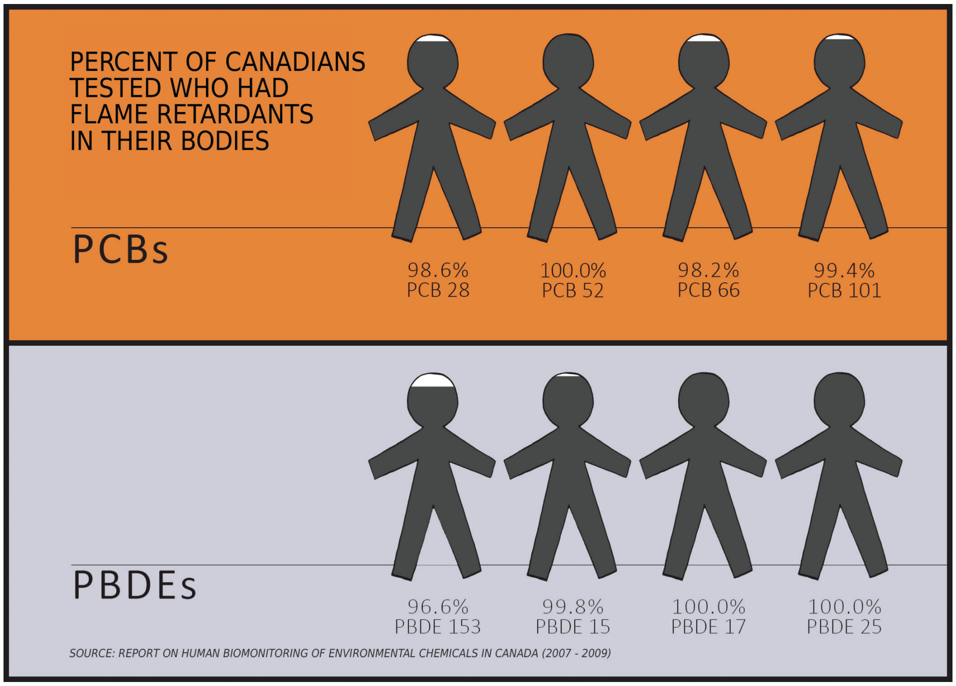
If we were to look at one chemical or consumer object at a time, our exposure to toxic chemicals might seem insignificant. It is critical, however, to account for the cumulative effects of all the sources of exposure in our lived environments, including in our homes, workplaces, public spaces, and in wider ecosystems. Some chemicals leach or off-gas directly from objects, and hence cause exposures when we touch them or hold them close. Significant exposures can also occur less directly, through household dust and from consuming foods grown in contaminated environments.[4] For example, the foam in upholstered furniture is often laden with flame retardants. As the foam breaks down, it is transported as household dust, which is easily ingested and inhaled.[5] Upholstered furniture is thus a significant source of ongoing exposure. These exposures add up. For example, in the most recent national biomonitoring studies on flame retardants in Canada, PBDEs were found in 75% of tested Canadians, aged 20-79.[6] In a 2012 study of PBDEs in breast milk in Winnipeg and Sherbrooke, 92% and 96% percent of samples contained detectable levels.[7]



Some of these exposures are from chemicals like PCBs. What makes

PCBs so concerning is that they are persistent, which means that they are slow to break down over time. Once built into objects and infrastructures, they will continue to be sources of exposure for decades. Other chemicals are less persistent, such as bisphenol A (BPA), a chemical added to polycarbonate plastics and to the thermal paper used in cash register receipts. Even though these chemicals break down relatively quickly, their ubiquity in consumer products and industrial waste make our exposures to this chemical chronic and unavoidable.

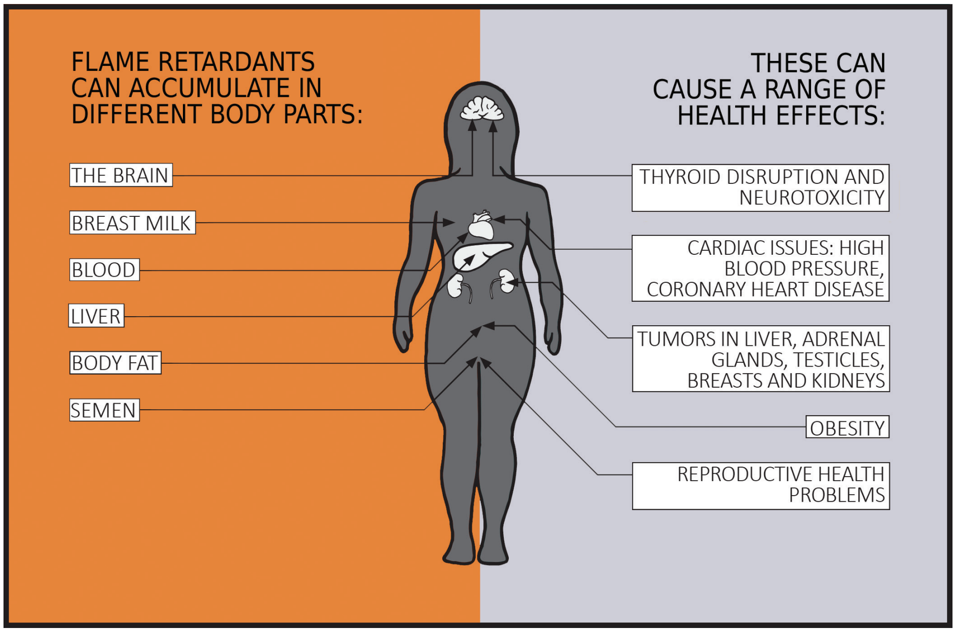
As flame retardant chemicals move out of manufactured goods and into our wider environments, individual consumer choice can do little to circumvent exposures.[8]



How do Flame Retardants Cause Harm?

Flame retardants can be found in the brain, liver, body fat, blood, semen, breast milk, and can cross the placenta.[9] The chemical structures of many flame retardants make them particularly toxic to humans and animals. Convincing evidence has shown that brominated flame retardants and their metabolites have the potential to disrupt the endocrine (hormone) systems that support cellular function.[10] Rather than acting like poisons, **endocrine disrupting chemicals (EDCs)** participate in the body's hormone system. Hormones guide the chemical processes that activate and repress gene expression, thereby shaping the production of proteins, cellular metabolism, and tissue development. Subtle changes in hormone signaling may have no noticeable effects, or they may produce changes in gene expression that can shape the development of an organism and its reproductive capacity. This is because some effects of endocrine disruption manifest in later generations, including the children and grandchildren of a person exposed. These epigenetic and delayed effects make the impact of EDCs notoriously difficult to trace.[11]

Moreover, endocrine systems have receptors and feedback loops that respond differently depending on the dose of exposure to hormones—or their mimics, which include synthetic EDCs. Even low doses of an EDC can participate in metabolic and gene expression processes that are sensitive to low levels of hormones. These low dose responses cannot be extrapolated from tests that examine the impact of higher dose exposures to EDCs. EDCs may in fact have the greatest effect at trace doses (called a non-monotonic dose-response curve), especially when the exposures are chronic. Low doses can have profound effects at particular pivotal windows of bodily development, such as prenatal development or in infancy.



Studies demonstrate that current doses of exposure to flame retardants in our everyday environments are causing hormone disruptions, with negative health effects in humans and wildlife. Among other effects, EDCs are impacting reproductive health,[12] obesity,[13] and fetal development via thyroid disruption in pregnant women and rats.[14] Further, they have been linked to autism,[15] cardiac issues,[16] and neurotoxicity.[17]

Exposure to flame retardant chemicals is a **reproductive justice** issue. Reproductive Justice is concerned with the right to have children or not, to make decisions about one's life and body, to parent children in safe and healthy environments, and to thrive as a community. Reproductive justice includes the obligations of government and society to ensure that conditions for these rights are met.[21] Thus, **environmental violence**, racism and toxic chemicals all are important dimensions of reproductive justice. Exposures to chemicals with endocrine disrupting and epigenetic effects are reproductive justice issues because they affect not only people's capacities to bear healthy children, but also the health of children as they develop, the future health of descendants, and the ability of a community to sustain itself over generations. A Canadian biomonitoring study conducted between 2007-2009 suggests that "the age group with potentially the greatest exposure [to PBDEs] is 0- to 6-month-old breast-fed infants, with breast milk accounting for 92% of the exposure."[22] Because PBDEs and other flame retardants are ubiquitous, pregnant women and breast-feeding infants cannot avoid low-level exposures that may have significant effects during these important windows of development.

Even though flame retardants are ubiquitous, exposure to them is still uneven, and this unevenness falls along lines of race, class, Indigeneity, and age. In Canada, environmental racism concentrates harmful chemical exposures in Indigenous communities whose territories are occupied by or are proximate to extractive industries, refineries, or factories. For example, the old General Motors factory built next to Akwesasne First Nation has resulted in concentrated levels of PCBs in their environment and fish; Aamjiwnaang First Nation is exposed to the cumulative emissions of over 60 petro-chemical refineries as part of the Sarnia-Lambton industrial area; and, since the 1970s, the people of Grassy Narrows First Nation have been exposed to high levels of mercury emitted into their environment by a now closed paper mill.[23] Because persistent pollutants like PCBs and PBDEs can biomagnify in food chains, there are increased exposures for communities that rely on fishing and hunting practices.

There is evidence from Canada and the US that exposure to flame retardants like PBDEs are unevenly distributed. In studies from the US, people with lower income levels had higher levels of flame retardant exposure; children with mothers and caregivers who have lower education

Endocrine Disrupting Chemicals (EDCs) are synthetic compounds that alter the hormone system and can cause adverse health effects. EDCs are the same shape as hormones, so rather than poisoning the body, they are recognized by receptors in the body. Since hormones are responsible for coordinating genetic activity and protein production, EDCs can have subtle but long-lasting effects on individuals, their descendants, or on populations; because of how gene expression works, a mother's exposure to EDCs could affect her unborn daughter's children. Sensitivity to EDCs is greatest when the hormone system is working at its height, which includes fetal development, infancy and childhood, puberty, and during breastfeeding.

Reproductive Justice focuses on the right to have children or not, to make decisions about one's life and body, to parent children in safe and healthy environments, and to thrive as a community.

Environmental Justice is the recognition that disproportionate burdens of environmental hazards are borne by Indigenous communities, communities of colour, and low-income communities, as well as by women and children. Environmental justice calls for the significant involvement of Indigenous, racialized, gendered, and low-income communities in environmental decision-making.[18]

Environmental Violence concerns the systemic and disproportionate impacts, concentrated by Indigeneity, race, gender, class and age, that result from exposures to environmental toxicants and the processes of industrial development. These impacts include reproductive health problems, cancers and other illnesses, multigenerational effects, and chronic social stressors.[19]

EDCs and Windows of Development

The **endocrine disrupting chemicals (EDCs)** that make up some flame retardants can have significant effects at pivotal windows in the developmental cycle of organisms, especially when gene expression activity is highest, such as before pregnancy, before birth, infancy and childhood, while breast-feeding, and during puberty. When chemicals with hormone mimicking or disrupting activity are present during these developmental windows, they affect gene expression, which in turn affects the unfolding development of cells and tissues. Hormones circulate within the body at low concentrations, shaping the development of the body from conception through the coordination of the many millions ofspecialized cells that make up the blood, bones, brain, and other tissues. Periods in the life cycle when hormones play an important role in bodily growth are pivotal windows of development when even low levels of EDCs can interfere with activities of hormones involved in development, and thus may result in significant and irreversible changes to the structure or function of a physiological system.[20] Thus, the health impacts of Built-in Exposures do not depend high doses; low dose and chronic exposures to chemicals like EDCs, which are found ubiquitously in our environments, can produce significant and lasting harm.

levels had higher body burdens; and in California, Black and Hispanic children had higher body burdens than White and Asian children.[24] Some studies have found higher levels of PBDEs in children compared to adults, possibly associated with children's greater contact with dust.[25] Wealthy people may be able to reduce their exposures through their consumption and construction practices, but this ability may not extend to people with more limited resources or to infants and children. Built-In Exposures remain in the legacy of furniture and products from years past, and thus people with less income who cannot replace furniture are structurally more vulnerable to exposures, even if future products are regulated. Thus, the strategy of limiting exposures through buying habits can amplify disparities in chemical exposures across the entangled differences of race, class, gender, and geographic location.

In the case of PCBs, for example, the highest levels are associated with geographic proximity to point sources of pollution, and yet decades later PCBs are also found in all people, and can sometimes be found at higher levels among people with higher incomes. Likewise, a Canadian national study found PBDE concentrations in maternal cord plasma at higher levels in people with higher incomes (above $100,000).[26] Thus, disparities in exposure levels should not lead to the conclusion that the most privileged people are effectively managing their exposures. What is certain is that environmental regulations can produce and amplify disparities in exposure levels. If our regulations stay unchanged, our flawed environmental regulatory system will continue to put the burden on individuals to navigate a world of uncertain and under-monitored Built-in Exposures. Thus it will continue to exacerbate the inequality of exposure burdens.

Why Do We Use Flame Retardants?

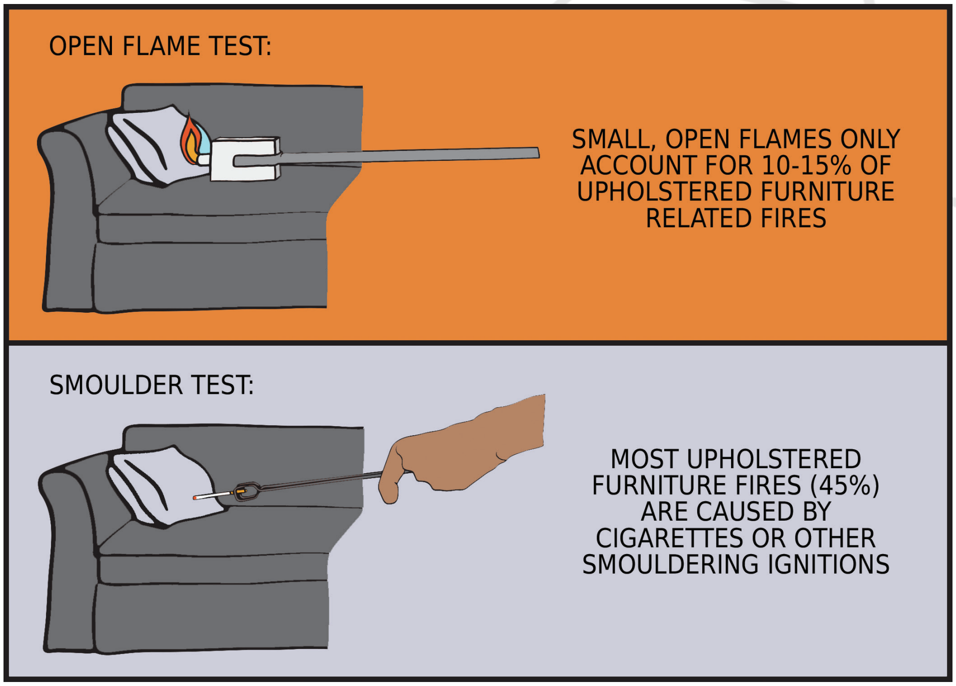
Flame retardant chemicals are meant to reduce the flammability of objects so fires do not start, or do not grow as quickly as they would without flame retardants. Flame retardants are put into the foam in upholstered furniture for this reason.

Yet, a study by the US Consumer Product Safety Commission found that "the fire-retardant foams did not offer a practically significantly greater level of open-flame safety than did the untreated foams."[27] Two other studies found that flame retardants made "made no significant, consistent difference in either ignition or flame spread."[28] A Chestnut Ridge Foam, Inc. study found that foam treated with the flame retardant pentaBDE provides only an additional three seconds before igniting (19 seconds treated v. 16 seconds untreated).[29] These studies suggest that flame retardant chemicals do not necessarily make our homes safer.

How can this be? One of the issues around flame retardant chemicals is that flammability is measured by highly technical tests. These tests need to follow instructions that are described in **flammability standards**. A flammability **standard** defines the exact details of the test to which a class of products will be subjected. Standards are performance based; the standard does not say how a product should pass the test, it only describes the test that it must pass. However, the design of the test is not impartial; manufacturers may rely on low-cost flame retardant chemicals as the primary way to pass the test. Moreover, the test designs used to measure flammability do not necessarily replicate a real world fire, but rather are shaped by other engineering and industry considerations. There are two main genres of flammability testing used on furniture: (1) In the **open-flame test**, a gas burner flame is held against the furniture for a set number of seconds and; (2) in a **smoulder test** a cigarette is placed between the cushions, and the test monitors how long the furniture takes to ignite. Many experts believe that a smoulder test more closely mimics how fires are actually started, especially by cigarettes. Both tests measure variables such as how long it takes to ignite, and how extensively the furniture chars. Some tests measure the flammability of the foam inside furniture, while other tests are directed at the fabric. Thus, the technical parameters of a test can dictate how a standard will be met by the manufacturers; the open flame test for foam is typically met by adding large volumes of chemical flame retardants to the foam, while a smoulder test might be met through the use of non-flammable fabrics.

One of the main criticisms of using an open flame test is that it does not account for how furniture burns in real-life fire scenarios. Once the fabric begins to burn, the foam is exposed to a much larger flame, and a small open-flame test on a portion of the foam cannot predict the behaviour of larger-scale fires on completed furniture.[30] In effect, making an open-flame test the basis of a fire safety standard does not necessarily allow furniture to withstand anything beyond a small open-flame.

Instead of measuring ignition time to determine the success of an open-flame test, researchers have identified that the heat release rate (HRR), or energy output of a fire that can cause fires to grow rapidly, as "the most significant predictor of fire hazard."[31] This is because: (1) HRR is the prime driver of fires; (2) Increases in the HRR lead to increases in other fire hazards, such as smoke and toxic gas emissions, and; (3) High HRR levels can have lethal consequences.[32] Two studies found that the use of flame retardants in residential furniture does not demonstrate a reduction in HRR.[33] Thus, if flammability tests weighed HRR more heavily, fire retardant chemicals might be less successful at meeting flammability standards for upholstered furniture.



The details of flammability tests are only one issue to look at. Another issue is the role played by flame retardants in reducing real-world flammability. Studies have shown that flame retardants do not offer significant benefit regarding smoldering ignition from cigarettes. Cigarette-ignition is the leading cause of furniture fires (45%).[34] In contrast, small, open-flames only account for 10-15% of upholstered furniture-related deaths.[35] A Consumer Product Safety Commission study found that "certain small amounts of FR formulations of foams can cause foams to be more prone to smoldering [via cigarette ignition]".[36] Moreover, the US National Fire Protection Association (NFPA) notes that, between 1980 and 2005, the state of California, which then adhered to an open flame standard for upholstered furniture, had similar rates of reduction in fire deaths as other states that did not have a standard.[37] In short, there are compelling reasons to conclude that our current ways of setting flammability standards for furniture and meeting them with flame retardant chemicals do not substantially benefit fire safety.

A focus of fire safety standards on furniture itself, rather than the source of fire, is also questionable from a scientific standpoint. Fires linked to upholstered furniture are often started by cigarettes. Documents released to the public as part of the Tobacco Master Settlement Agreement of 1998 demonstrate the Tobacco Industry's coordinated efforts to divert attention from the possibility of regulations that would require a self-extinguishing cigarette, and their encouragement of attention to regulating furniture instead.[38] In 2005, Canada was one of the first jurisdictions to regulate cigarette ignition. This amendment to the Tobacco Act created a standard that requires lit cigarettes to not burn their full length more than 25% of the time.[39] The successful regulation of cigarette ignition calls further into question the need for a furniture flammability standard.

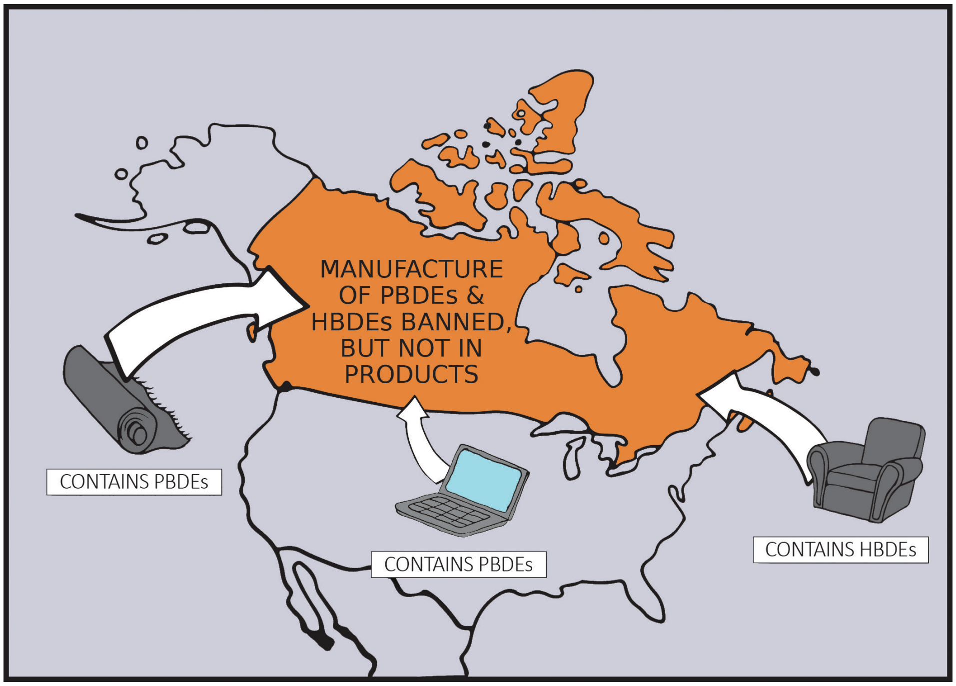
Finally, the inclusion of flame retardant chemicals in furniture poses problems for firefighter health and safety. Flame retardants can increase the emission of carbon monoxide, soot and toxic gases, such as toxic dioxins and furans.[40] For this reason, firefighting groups in the United States have mobilized to remove flame retardants from furniture and building materials.[41]

Yet, fire safety remains a concern. There are methods beyond chemical flame retardants that contribute to fire safety. Research from Underwriters Laboratories, a prominent international standard development and testing organization, has found that placing a fire-resistant layer between the fabric and foam is more effective than using flame retardants in the foam, for example.[42] The same report outlines how some fabrics make better fire barriers, exclusive of whether interior foams have flame retardants or not, and that future research should be done to determine the flammability of furniture fillers other than polyurethane foam, which may also have natural flame retardant properties.[43]

Why Haven't Flame Retardants Been Regulated?

The main problem is that even where regulatory action has been taken, continuous exposures persist. Canada has been slowly moving to regulate PBDEs through the **Canadian Environmental Protection Act, 1999 (CEPA)**, beginning with the prohibition of the manufacture, use, sale, or import of some PBDEs in 2008 and extending this prohibition in 2016 to all PBDEs, as well as HBCD beginning January 1, 2017.[44] It is important to note that PBDEs have never been manufactured in Canada. This regulation prohibits the use and sale of PBDEs as a product of the chemical industry; however, this regulation also has an important exception that does not extend the prohibition to the import, distribution, or sale of *products* or *parts of components* of products *that already contain PBDEs*. This exception is phrased as such: "[t]hese Regulations do not apply to a product that is formed into a specific physical shape or design during its manufacture and that has, for its final use, a function or functions dependent in whole or in part on its shape or design, if that product contains a polybrominated diphenyl ether [PBDEs]."[45] This is a crucial omission. This exception means that PBDEs are not prohibited in imported products, such as furniture, or in components of a product, such as foam, that a manufacturer may purchase from elsewhere and then assemble into furniture in Canada. By allowing products with PBDEs to be assembled and sold in Canada, this CEPA regulation does little to stop the exposures from furniture or electronics manufactured elsewhere.

Vested Interests:



Flame retardant chemicals are an unusual instance of a Built-in Exposure because their use has been justified in the name of public health. Their use in furniture, electronics, camping gear, vehicles, and construction materials is tied to the aim of preventing death and injury from fires, which is a serious issue. However, it is important to look closely at who benefits from such widespread use of potentially toxic chemicals as the first line of defense for fire safety. Given such ubiquitous application of flame retardants to consumer goods, there is a large and growing market for these chemicals. The chemical industry, particularly the Bromine industry, has significant economic power. This industry has actively lobbied for flammability standards for furniture, electronics, and candles – standards that can only be met with the use of the chemicals they produce. Thus, in addition to the regulation of toxic substances under CEPA, 1999, another important area of exposure regulation in Canada is product standard setting.

Flammability standards can undermine chemical regulation:

CEPA is the primary legislative instrument for regulating and screening toxic substances in Canada. However, when a substance is found toxic, the Government can deploy a suite of risk management responses that includes both regulatory measures and voluntary measures. Regulatory measures that prohibit a substance are rarely used. When a substance found in products has implications for human health, the government tends to turn to **Health Canada's Consumer Product Safety Program (CPSP)**, which administers the **Canada Consumer Product Safety Act (CCPSA)** in order to regulate the safety of projects. While CEPA is organized to respond and regulate *substance-by-substance*, the CCPSA is organized by a *product by product approach*. This difference matters in the ways the CEPA and the CCPSA operate. This distinction between substances and products creates a disjuncture when attempting to translate findings of toxicity for a specific chemical into a product-based regulation, particularly when that chemical is found in many kinds of products.

The CCPSA, administered by Health Canada can both regulate the flammability of a product (and thus introduce binding standards that effectively encourage more flame retardant chemicals to be built into products), and can prohibit or limit the use of toxic chemicals in products. For example, the CCSPA regulation regarding the flammability of children's sleepwear includes rules against using any chemicals with oral, dermal (skin), or mutagenic (changes genes) toxicities.[47] In April 2014, an addition to the CCPSA Schedule 2 list prohibits TCEP, (a flame retardant chemical of the "Tris" group that has been identified as a carcinogen and reproductive

Regulations and the CCPSA

Overall, the Health Canada's **Consumer Product Safety Program (CPSP)** has brought forward few regulations that limit or prohibit toxic chemicals in products—rather, it has been criticized for its weak enforcement and uneven monitoring of its existing regulations. The Auditor General's Spring 2016 report on Health Canada's administration of "Chemicals in Consumer Products and Cosmetics" was highly critical, singling out the program's weak post-market enforcement of its own regulations. The report concluded that Health Canada, "could not fully assure Canadians that its post-market oversight activities were working to protect the public by addressing or preventing dangers to human health or safety posed by chemicals of concern in household consumer products and cosmetics."[46] The CCSPA could, but does not, include a broad-based regulation that would prohibit or limit the presence of flame retardant chemicals in the many consumer products that contain them.

Within the **Canada Consumer Product Safety Act (CCPSA)**, the regulatory aim of reducing fire risks and the regulatory aim of reducing environmental health risks come into potential conflict with one another in the case of flammability standards. In Canada, there is currently no flammability standard for upholstered furniture. Flammability standards dictate the highly technical laboratory tests through which a product line must pass before it can be sold in a given jurisdiction. Some standards are voluntary within an industry, and others are turned into government regulations that become mandatory. In Canada, children's sleepwear, mattresses, and textiles all have CCPSA flammability standards. There are also many fire safety standards that regulate practices, such as the need for sprinkler systems, fire alarms, or the presence of upholstered furniture in hallways of multi-apartment complexes. These regulations, in addition to smoking and cigarette manufacture regulations, have implications for whether upholstered furniture becomes a fire hazard. It is important to note that a flammability regulation for furniture may not significantly reduce the cause or severity of fires; yet it could increase the load of Built-In Exposures that Canadians experience.

toxicant) in foam consumer products intended for children under the age of three.[48] The CCPSA even includes a broad-based regulation that limits the concentration levels of an entire group of chemicals, called Phthalates, in children's toys or care articles.[49] These are three instances of how the CCPSA has regulated toxic chemicals in products in the past. In principle, the CCPSA could, but does not, include a broad-based regulation that would prohibit or limit the presence of flame retardant chemicals in the many consumer products that contain them.

In the case of flame retardant chemicals, the substance-by-substance approach of CEPA and the product by product approach of CCPSA creates an incommensurate patchwork of regulations, which allows exposure from alternative flame retardant chemicals in a multitude of products to proliferate into the future. Moreover, approaches to flammability standards and toxicity regulation work at cross purposes. The addition of a new flammability standard for products would threaten to increase the presence of flame retardant chemicals, exacerbating how flammability standards and the regulation of toxic substances can work at cross purposes.

Standards and Closed Doors:

In addition to regulations passed under legislation, Canada also has standards that are created to regulate construction, infrastructure, safety, manufacturing, sports, health care facilities, food, and consumer products. Most of these standards are voluntary and are governed by industry sector organizations. Some of these standards, however, become legally binding as they are written into regulations under a variety of legislative Acts in Canada, such as the Food and Drug Act, or, importantly the CCPSA. Standards are developed and written by private, not-for-profit organizations that specialize in standard writing and research. Flammability standards are developed and tested by these organization. Standard development and testing organizations tend to be linked to transnational corporations, with branches in Canada, the US, Japan, UK, and Europe. The Underwriters Laboratories is one such organization, and has organized efforts to set a Canadian flammability standard for furniture. It researches and writes standards, and also sells the standards and testing services. Standards are proprietary, which means that the details of how to meet the standard cannot be accessed without paying. Testing is also a for-pay service. In 2012, Underwriters Laboratories became a for-profit company. While the standard writing arm of the organization is not-for-profit, testing and other services are for-profit enterprises. Although the government can commission a standard writing organization to develop a new standard for use in regulation, more often, industry will propose voluntary standards.

Who Develops Flammability Standards?

Underwriters Laboratories Canada (ULC) began working on a possible open-flame flammability standard for upholstered furniture in 2008, and again in 2012. Both times, non-profit organizations concerned about the spread of PBDEs were able to appeal to the committee and the standard did not go forward.[51] In 2016, an open-flame standard for upholstered furniture was once again under development. Concerned environmental organizations only learned of the revival of this proposed standard through informal networks. Standard development organizations such as ULC are only required to make public the development of a standard after it has already been drafted. As required by accreditation terms of the Standards Council of Canada (SCC), these organizations are required to provide "reasonable access for all potential stakeholders to participate in the process of standards development, the public must be notified at specific milestones in the development process."[52] Importantly, who counts as a stakeholder is not delineated. To fulfill this obligation of public notice, ULC posts announcements of a proposed standard on both its own website, and, since 2014, centrally on the SCC website. These announcements are posted with a 15-day period for public comments. The standards are primarily accessible through a search function that requires prior knowledge of the proposal as well as its title. Standards are then approved by consensus in the standard development organization committee, before being published in both official languages.

Critically, relevant stakeholders may be omitted from the consultation process. The onus is on interested organizations or citizens to proactively research proposed standards without prior notification from either ULC or the SCC. The implications are profound: if potential stakeholders are not versed in ULC and SCC website and search function protocols, they may fail to notice a standards announcement. Thus, a standard could be developed with implications for Built-In Exposures without the benefit of their input and expertise.

Proposed standards are developed within committees inside of standard development organizations, such as ULC. According to the requirements of the Standards Council of Canada (SCC), committees are composed of "affected stakeholders that may include representatives from industry, governments, academia, and the public interest," who develop standards by consensus.[50] In May 2015, the ULC committee in charge of developing a revised flammability standard for upholstered furniture included fire safety experts from the public research sector, academia, and from industry. However, since the membership of a committee is not made public until after a standard is drafted, it is difficult to monitor who is involved in setting a particular standard, and thus whether questions of potential chemical exposures are adequately being considered. For example, there was no representative with expertise in toxicity, environmental health, or

Transparency in Standard Development?

The minutes of standard development committee meetings are not made public. Interested parties can send letters for the committee's consideration, and may even be invited to speak directly to committee members. ULC and similar organizations also undertake research towards standard development, yet this research is proprietary and not in the public domain. In Canada, lobbyists, such as those for the international bromine industry (some flame retardants contain bromide), are required to register their activities and communications with politicians and state departments. Such registries reveal that the bromine industry is investing in such lobbying in Canada, particularly around the regulation of flame retardant chemicals through CEPA. However, such lobbyists are under no such obligation to register their activities with standard development organizations, so we have no knowledge of the extent of their involvement in advocating for particular flammability standards, nor any knowledge of the extent to which they support the research of those organizations.

representing Environment and Climate Change Canada on the May 2015 committee considering an open flame standard for upholstered furniture—a standard that has well known implications for the spread of flame retardant chemicals that are now prohibited from manufacture in Canada.

The standard development process is problematic for a number of reasons.

- It lacks transparency;
- The public is not given meaningful access to information that would facilitate participation of interested organizations;
- It is characterized by a committee membership structure that emphasizes industry representatives and not representatives with the public's health as a primary interest;
- It is not coordinated with CEPA, and thus could be working at cross-purposes to regulatory aims to protect health and the environment;
- The proprietary nature of the standards further prevents citizens and civil society organizations from accessing them.
- The dominance of industry representation in the process and the lack of obligation to report lobbying activities.

Given these shortcomings, improvements to the public transparency and consultation process in standards setting, particularly in cases when standards have implications for exposure to toxic chemicals, are necessary if Built-In Exposures are to be reduced in the long term. The same criteria of transparency and access to information required for state research and policy making could be applied to the standard writing process. More robust practices might involve:

(1) the requirement that committees include representatives from Health Canada and Environment and Climate Change Canada who have expertise in regulating toxics, as well as,

(2) requirements that industry lobbyists involved in advocating for a potential standard register on the national Register of Lobbyists.

As it stands, the flammability standard setting process creates a window of opportunity for increasing exposures that can threaten future Canadians' environmental health. Thus, the importance of effective oversight cannot be overstated. In 2015-6, at the same time that CEPA was expanding its regulations to include more flame retardants, a new flammability standard was under development without public scrutiny. This was a standard that could lead to increased use of flame retardants in upholstered furniture. This example shows that toxic chemical regulation and the development of flammability standards were working at cross purposes. Since the regulatory measures taken under CEPA do not include prohibitions against the presence of PBDEs and other flame retardants in products, a new flammability standard could lead to long-term increases exposures to flame retardants, at potentially higher concentrations, putting Canadians at further risk of harm.

What Do Other Countries Do?

Like Canada, the United States has no national flammability standard for upholstered furniture. However, California—a large market for furniture—has such standards, which are often adopted by manufacturers that sell products in both the US and Canada. In 1975, California passed regulation TB 117, which required that the foam inside upholstered furniture be able to withstand a small open flame for 12 seconds without igniting. This standard was often met by adding flame retardant chemicals to the foam.

Since California is such a large market for consumer products, manufacturers across the US, Canada, and beyond complied with TB 117 (1975). Thus, California standard TB 117 (1975), for all practical purposes, increased the presence of flame retardant chemicals, particularly PBDEs, in nearly all upholstered furniture sold in the US and Canada after 1975. In this way, a product standard passed in the state of California has had a strong influence on the exposure profiles of Canadians. Given global markets for products like furniture and electronics, as well as the ways products are assembled out of parts made in global supply chains, flammability standards in one jurisdiction can impact populations far beyond regulatory boundaries.

Alarms were raised about the toxicity of flame retardant chemicals as early as the 1970s, and as scientific consensus developed, American environmental, consumer protection, furniture manufacturer, and firefighter organizations (which have increasingly been concerned with occupational exposures to toxic chemicals)[76] began to advocate for a revision of this standard. The battle intensified in the 2000s with a push to revise Californian standard TB 117. Investigative journalists began to expose the counter-efforts of the chemical industry, such as in the large-scale investigation reported by the Chicago Tribune in 2012.[77] Eventually, it was revealed that the chemical industry spent some $23 million dollars in lobbying against the introduction of a new standard, which would reduce the use of flame retardant chemicals.[78]

Despite this powerful economic pressure, TB 117 (1975) was revised in 2013. The new standard uses a smoulder test, and focuses on the flammability of the fabric that covers furniture. The logic is that most upholstered furniture fires (45%) are caused by cigarettes or other smouldering ignitions,[79] and that the outside of furniture is the most important barrier to ignition, not the foam inside.[80] The change in standard was supported by research, including a 2005 US Consumer Product Safety Commission Study that found that furniture made with flame resistant fabrics that did not require chemical treatment were far more effective at reducing flammability than flame retardant treated foam.[81] This new standard was accompanied by further California legislation that required labelling of upholstered furniture to state whether or not it contained flame retardants, allowing consumers to avoid PBDEs or their substitutes if they had the means. Fire safety advocates of open-flame tests—those who believe that such tests would enhance fire safety and reduce deaths, but want to avoid toxic flame retardants—tend to support standards that focus on the fabric barriers.[82]

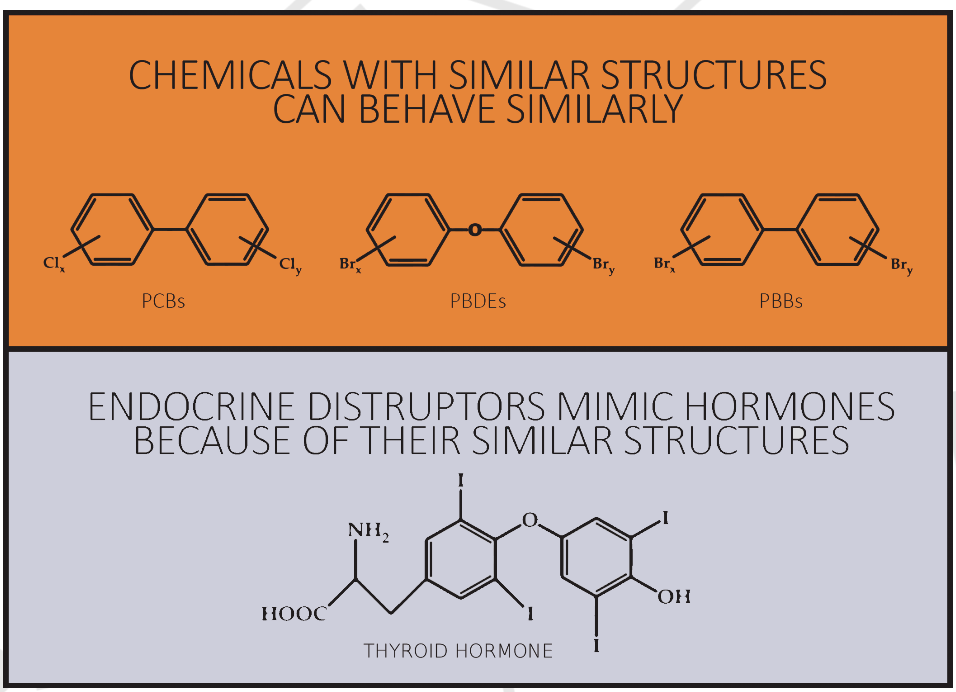
Alternatives Are Just the Same: As alternatives to PCB and PBDEs proliferate, exposures to EDCs are not being eliminated, rather these new substances are becoming sources of new exposures. The long-standing practice

Common Flame Retardants & Their Alternatives

Polybrominated diphenyl ethers (PDBEs)
PBDEs are one of the most common categories of flame retardants. They are organobromine compounds, and are structurally similar to now-banned PCBs. Prenatal exposure to PBDEs can have adverse impacts on fetal development by altering thyroid function in pregnant women;[53] exposures can impact fine motor skills[54] and attention,[55] producing neurodevelopmental deficits,[56] hyperactivity,[57] as well as low birth weights.[58] Exposure to PBDEs has also been related to disruptions of sexual and reproductive health. Prenatal exposure in male rats reduced sperm count and quality, decreased sex steroids, reduced anogenital distance (the distance between the anus and genitals in males), and contributed to the delayed onset of puberty, which can also happen following juvenile exposure. Exposure to increased levels of PBDEs in breast milk has been linked to an increased risk of undescended testes amongst boys studied in Finland and Denmark. For female rats, low-dose and high-dose exposures have different results, including a reduction in primary ovarian follicles (at low dose exposure), a reduction in secondary ovarian follicles (in high dose exposure), and delayed onset of puberty (at high dose exposure). Moreover, increased PBDE levels are linked to reduced fertility,[59] as well as an increase in pre-term births.[60] Finally, a recent study made links between PBDE exposure, metabolic obesity[61] and enlarged livers, which can contribute to a host of other health issues, such as: type 2 diabetes, coronary heart disease, stroke, high blood pressure, osteoarthritis, gall bladder disease, sleep apnea as well as certain cancers.[62]

of regulating chemicals one-by-one has triggered a replacement game between regulators and the chemical industry. As one chemical is prohibited, industry inserts a similar chemical in its place, triggering a new round of risk assessment studies and contestations. This process continually delays the possibility of removing flame retardant chemicals from manufactured goods.

To give an overview of the harmful characteristics shared by many flame retardants, the San Antonio Statement on Brominated and Chlorinated Flame Retardants was created in 2010.[83] This consensus statement has over 200 signatories from 30 countries, representing a broad range of expertise on health, environment, and fire safety. The signatories call for efforts “to ensure that current and alternative chemical flame retardants do not have hazardous properties, such as mutagenicity and carcinogenicity, or adverse effects on the reproductive, developmental, endocrine, immune, or nervous systems.”[84] Similarly, several environmental health groups, workers’ organizations, and furniture and bedding associations in the European Union recently released a policy paper on the health impacts of various flame retardants, as well as documenting their general ineffectiveness in preventing fires and the negative economic impacts borne by the furniture industry.[85]

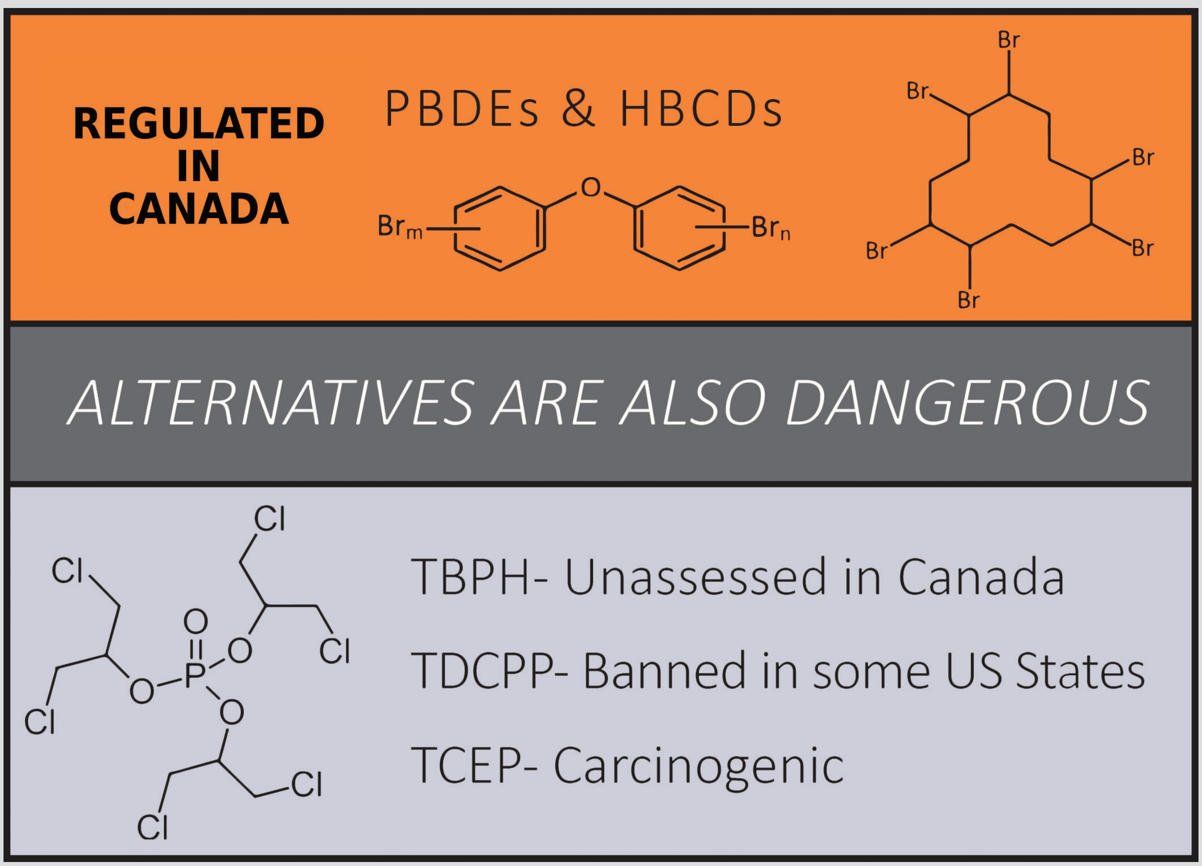


Rather than deal with flame retardants chemical by chemical, scientists have recommended looking at structural similarities between molecules. Molecules with similar structure can have similar effects on cellular function.[86] Alternative flame retardant chemicals tend to behave

FireMaster 550FireMaster 550 was developed to repace PBDEs. It is a proprietary mix of chemicals, including 2-ethylhexyl tetrabromobenzoate (TBB) and bis(2-ethylhexyl) tetrabromophthalate (TBPH). Rat studies on FireMaster 550 show that "the most distinctive physiological outcome [in both males and females] was markedly elevated body weight at the high exposure dose." According to this study, "[t]his effect became evident prior to adolescence and persisted into adulthood. In females, this increased mass contributed to accelerated pubertal onset and was accompanied by glucose intolerance, reduced activity, and elevated anxiety."[63] Further, two of the four major ingredients in FireMaster 550 (isopropylated triphenyl phosphate and triphenyl phosphate) are classified as a "Very High hazard" to aquatic life by the Environmental Protection Agency in the United States (US EPA). Isopropylated triphenyl phosphate is also classified as a "High hazard" in the areas of reproductive, developmental and neurological health.[64]

*Tris(1,3-dichloro-2-propyl) phosphate (*TDCPP*) and triphenyl phosphate (TPP)* Other flame retardants, such as Tris(1,3-dichloro-2-propyl) phosphate (TDCPP) and triphenyl phosphate (TPP), which are used as alternatives to PBDEs, are known carcinogens in rats,[65] producing tumors in the liver, adrenal glands, testicles, breasts, and kidneys.[66] These chemicals have been shown to decrease sperm quality,[67] count,[68] and mobility.[69] They are regarded as both genotoxic[70] (because they damage the genetic information within a cell, causing mutations) and neurotoxic[71] (in that these chemicals alter the normal activity of the nervous system and damage nervous tissue). Notably, TDCPP has been banned in several US states.[72]

Flame Retardants and Chemical Structures
The three flame retardants described above are just a few of the more common types of chemicals being used in consumer goods. Others include: Hexabromocyclododecane (HBCD), which the European Chemicals Agency has listed as a "Substance of Very High Concern;"[73] bis(2-ethylhexyl) 2,3,4,5-tetrabromophthalate (TBPH), which has only just begun to be studied, but has a similar chemical structure (the same carbon skeleton) as; di(ethylhexyl) phthalate (DEHP), a known reproductive toxicant;[74] and Dechlorane Plus (DP), which has been found in the air and sediment around the Great Lakes, as well as in zooplankton, fish, and mussels in seawater from the Arctic to Antarctica—though no studies have been done on its toxicity to date.[75]



like the harmful chemicals they are replacing because they share two common molecular structures that result in ecological and human toxicity. These are: (1) chlorine or bromine bonded to carbon,[87] and (2) phosphorous bonded to carbon.[88] When synthetic chemicals contain either of these two molecular configurations, they are likely to be:

1. *Persistent in the environment:* They will not break down into safer molecules in the environment. This increases their exposure lifetimes.
2. *Capable of long-range transport:* Because of this durability, they will travel far from their origin of release, and become distributed globally, meaning that people and environments far from sources can be exposed.[89]
3. *Bio-accumulative:* They can build up in the tissues of people and other animals, including breast milk, and can concentrate as they move up food webs as contaminated organisms are consumed.
4. *Toxic:* They can cause harm, often in the form of long-term or chronic effects. Many flame retardants lack adequate toxicity information, but their structural similarity to known toxic chemicals raises concerns.

Regulating only some of the oldest flame retardant chemicals will not prevent continued exposure to flame retardant chemicals overall if the problem of flammability continues to be addressed by substituting one regulated chemical with another unregulated chemical.

What Can We Do?

In an ideal world, this white paper would not be necessary. Mass exposure would be prevented because exposures to potentially toxic chemicals would be prevented before such chemicals were manufactured, put into circulation, emitted by industry, or built into products. This white paper is describing a flawed regulatory system in which it is only once a chemical has become widely used, and many scientific studies attest to its problems that the Canadian government consider regulatory action. In our current system, people are often forced to make strategic recommendations for changing environmental regulation after exposures have already been built into our everyday lives, as is the case with flame retardants.

Labelling: One response to this flawed system is to enact a labelling system for flame retardant chemicals in upholstered furniture, and even for all consumer products. While electronics and upholstered furniture are two well-known classes of products that habitually contain flame retardant chemicals to meet flammability standards, other classes of products also contain these chemicals. These other products can, in the future, become vehicles for Built-in Exposures, in part because they offer profitable markets for the bromine and chemical industry. When California changed its flammability standard for furniture, it also passed legislation that required a label that designates the presence of flame retardants in upholstered furniture. In the context of a failing regulatory system for toxic chemicals—one that is characterized by long wait times as chemicals are assessed one by one, and by troubling gaps in how regulations are designed and enforced—such a label can help informed consumers who have economic means avoid some exposures.

Also, while labeling is not the answer to the exposure problems posed by flame retardants, labeling as a regulatory approach can help to promote the voluntary phase-out of toxics. This occurred in California, after TB 117 (2013) was implemented. Specifically, the use of PBDEs and TDCPP in upholstered furniture decreased across the United States. However, the use of alternative Flame retardants, such as TBPP and TCIPP increased, while products containing FM550 stayed the same.[90]

Canada could go one step further than California and require the labelling of all products, and not just upholstered furniture, for the presence of flame retardant chemicals. As new replacement flame retardants are substituted for PBDE and HBCD, there will be an inevitable lag before scientific studies can assess their possible toxicity. Although labelling is a limited solution to a flawed regulatory system, it may help us track and advocate against the ongoing substitution of one harmful chemical for another. What labelling can do is provide researchers, consumers and organizations with data about the changing distribution and nature of flame retardant chemicals. Labelling can also help people to recognize sources of Built-in Exposures. It can also provide opportunities for some people with financial means the opportunity to reduce their exposures in their own homes. Working within a flawed environmental regulatory system, labels can be a tactical way to monitor the activities of manufacturers and gather data on the ever shifting presence of synthetic chemicals in our lives.

Labelling isn't enough: in practice, it can only do so much. Ingredient labelling in the absence of the prohibition of toxic substances puts the onus on people to protect themselves as individual consumers. But we live in a complex and entangled world: no one person can build an environment safe from toxic chemicals. Infants cannot make "informed" consumer choices, and limited access to financial resources constrain many people's ability to purchase safe products. Thus, labelling can exacerbate disparities in exposure even as they reduce exposures for some. Labelling alone will not prevent ubiquitous exposures to flame retardants – especially as no one can control exposures built into public spaces -- but it may help to reveal the extent of such exposures and the inadequacy of our current regulatory approach.[91]

The complex problem of flame retardants reveals the limits and failures in the current patchwork of Canadian regulations and standards. The limits and failures in Canada's current responses to toxic chemicals are not unique to flame retardants. The **environmental justice** problem highlighted by flame retardants requires the government to re-evaluate its strategies for regulating toxic exposures and the ways it enacts its commitments to pollution prevention more broadly. It is possible to design a scheme of regulatory responses that can give Canadians confidence that when a chemical is suspected to be toxic to humans or harmful to the environment it will be banned. Such regulatory responses will prevent toxic chemicals from adding new exposures to our already burdened bodies and environments. If the current schema, in which a chemical can be identified as toxic and yet remain as a presence in consumer products, is allowed to stand, it will create a future in which ubiquitous Built-In exposures to toxic chemicals persist for generations.

We recommend that the government:

1) Prohibit consumer products and components of consumer products containing any flame retardant chemical for which there is evidence of harm, including alternative flame retardants, and those that have no environmental health assessment confirming their safety. Such action recognizes that the current substance-by-substance approach under the Canadian Environmental Protection Act (CEPA) and the slow timeline of assessment cannot adequately address the proliferation and distribution of replacement flame retardant chemicals. It also recognizes that the product by product approach of the Consumer Product Safety Act (CCPSA) cannot adequately address the widespread use of flame retardants in many kinds of products and materials.

2) Develop a strategy on the use of alternative flame retardant chemicals that meaningfully implements the precautionary principle. This requires, at minimum, that the government address the way that flammability standard-setting processes work at cross-purposes to the aims of CEPA. The government must integrate decision-making across these domains so as to address the problem of Built-in Exposures.

Reproductive and Environmental Justice values can guide a renewed effort to regulate flame retardant chemicals. Meaningful implementation of the precautionary principle, responsive to scientific research on EDCs and the low-dose effects of chemicals at pivotal windows of development, demands decisive regulatory action to address the problem of ubiquitous Built-In exposures.

Appendix A: Glossary of Terms

Built-In Exposures - Exposures to human-made chemicals that come from everyday living: handling objects, breathing, washing, eating, and drinking, because industrial chemicals are embedded in everyday objects and infrastructures, including materials used to make our homes and buildings, in food and food packaging, in furniture and clothing, in cosmetics, and in commonly owned electronics, among other things. The ubiquity of these chemicals makes them extremely difficult to avoid or eliminate altogether, and in some cases, lead to adverse human and environmental health impacts. Some human-made chemicals are lacking in toxicity data; therefore, the impacts on human and environmental health are unknown.

Canada Consumer Product Safety Act (CCPSA) - Under the administration of Health Canada's **Consumer Product Safety Program** (CPSP), CCPSA is responsible for product safety regulations. Prohibitions under the CCPSA include the manufacture, import, sale or advertisement of substances and products deemed a threat to the health and safety of Canada. The CCPSA can pass regulations on both the flammability of products, and on their toxicity.

Canadian Environmental Protection Act (CEPA), 1999 - Administered by Environment and Climate Change Canada, CEPA 1999 is the current version of the Act, which was first put into place in 1988. It is defined as "An Act respecting pollution prevention and the protection of the environment and human health in order to contribute to sustainable development," and is responsible for the assessment and management of chemicals in Canada. Importantly, CEPA explicitly notes the Government of Canada's endorsement of the precautionary principle, as well as the importance of eliminating persistent and bioaccumulative toxic substances from our environments. CEPA oversees screening assessments of substances to determine whether they are toxic.

Endocrine Disrupting Chemicals (EDCs) are synthetic compounds that alter the hormone system and can cause adverse health effects. EDCs are the same shape as hormones, so rather than poisoning the body, they are recognized by receptors in the body. Since hormones are responsible for coordinating genetic activity and protein production, EDCs can have subtle but long-lasting effects on individuals, their descendants, or on populations; because of how gene expression works, a mother's exposure to EDCs could affect her unborn daughter's children. Sensitivity to EDCs is greatest when the hormone system is working at its height, which includes fetal development, infancy and childhood, puberty, and during breastfeeding.

Environmental Justice - The recognition that disproportionate burdens of environmental hazards are borne by Indigenous communities, communities of colour, and low-income communities, as well as by women and children. Environmental justice responds to environmental racism, which is a structural violence that concentrates in environmental harms through systems of racism and colonialism. Environmental justice advocates call for fair treatment, as well as the significant involvement of Indigenous, racialized, gendered, and low-income communities in environmental decision-making.[92]

Environmental Violence - The systemic and disproportionate impacts, concentrated by Indigeneity, race, gender, class and age, that result from exposures to environmental toxicants and the processes of industrial development. These impacts include reproductive health problems, cancers and other illnesses, multigenerational effects, and chronic social stressors.[93]

Exposures - Contact with or absorption of a substance through the ordinary activities of handling objects, breathing, washing, eating, and drinking. Exposures can be acute (occurring for a short period of time) or chronic (occurring over a long-period of time). Exposures can also occur in utero, leading to adverse impacts on fetal development.

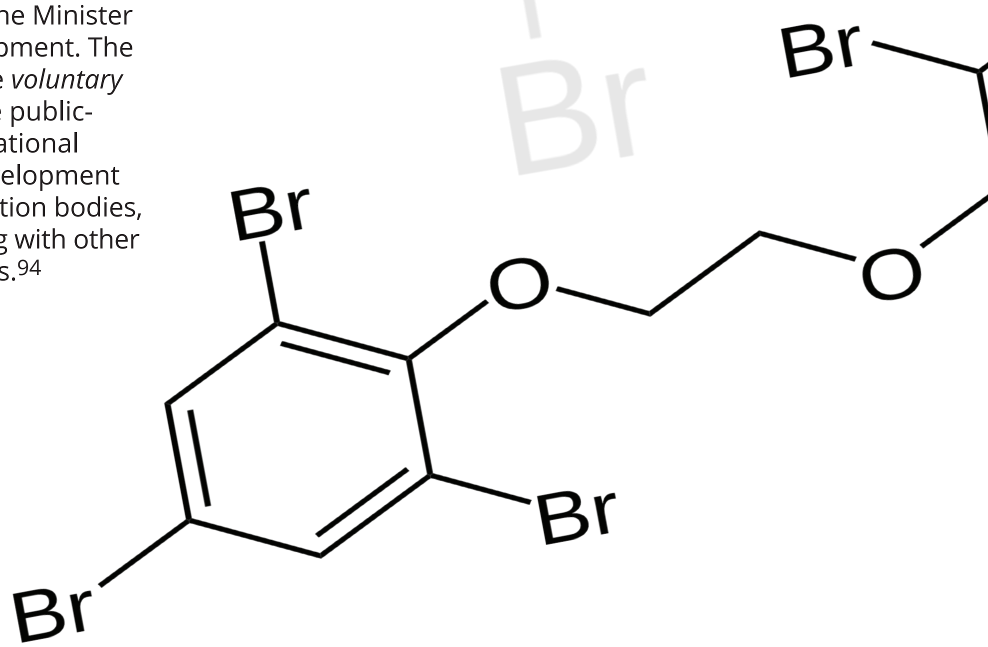
Flame Retardants - Industrially produced chemicals that are infused in a variety of consumer products -- from furniture and electronics, to camping gear, and construction materials -- for the purposes of reducing flammability. Flame retardants are sources of Built-In Exposures, are bioaccumulative, and are persistent. While many have not been adequately tested for their toxicity, commonly used flame retardants are linked to adverse human and environmental health outcomes, ranging from endocrine disruption, to reproductive, and neurodevelopmental health impacts. For this reason, several flame retardants have been banned (or are in the process of being banned) from manufacture in Canada (PBDEs, HBCD), while others are under consideration for regulation by CEPA (TDCPP).

Flammability Standards - A set of guidelines, principles and/or practices in place to reduce the flammability of a product. Such standards can be required by law, or voluntarily. Flammability standards designate highly technical laboratory tests, which products must pass before they can be approved for sale in a jurisdiction. The standard does not say *how* a product should pass the test, just that it must. In Canada, various items are regulated by flammability standards outlined in the CPSA. This includes children's sleepwear, mattresses, and textiles.

Standards Council of Canada (SCC) - A Crown corporation formed in 1985 that reports to the Minister of Innovation, Science and Economic Development. The primary mandate of the SCC is to coordinate *voluntary* standards within industries and to "promote public-private sector cooperation," overseeing a National Standard System that includes standard development organizations, testing organizations, certification bodies, and inspecting bodies, as well as coordinating with other international standards setting organizations.[94]

Standards - Broadly, this can be defined as a set of guidelines, principles and/or practices that can be required by law, or voluntarily. Canada has a variety of standards, regulating construction, infrastructure, safety, manufacturing, sports, health care facilities, food, and consumer products. The majority of these standards are voluntary, and governed by industry sector organizations; however, a few have become law, (e.g. Food Safety Act, Consumer Product Safety Act).

Toxicity - A substance's ability to cause injury to a living organism via chemical changes after exposure. Often, because there are already countless chemical changes happening in our bodies naturally, it can be difficult to assess whether an effect came directly from the presence of one industrial chemical or another. This is why some toxicity is contested or uncertain. While toxicity is most often used as a scientific term, within the Canadian Environmental Protection Act, 1999 "toxic" is a legal term used to designate a substance that meets a set of criteria set out within the Act, including criteria concerning estimates of average levels of exposure. Thus, even though scientific study might find a substance to be toxic to an organism, it might still not be declared legally "toxic" because average levels of exposures are calculated as below the threshold of for such effects.



FLAME RETARDANT REGULATION TIMELINE

1977: As a result of findings of mutagenicity and carcinogenicity, Canada bans wearable apparel treated with tris (2.3 dibromopropyl) phosphate (brominated tris), under the Hazardous Products Act. This regulation continues to be enforced under the CCPSA.

The manufacture, sale, import and reuse of PCBs are also banned, due to findings of carcinogenicity.

1999: Amendments to CEPA, 1999 require the Government of Canada to assess PBDEs and 23,000 other substances.

Feb 2004: Health Canada releases Screening Assessment Report on PBDEs.

Jun 2006: CEPA, 1999 Ecological Screening Assessment Report on Polybrominated Diphenyl Ethers (PBDEs) released.

Sep 2006: Environment Canada releases Risk Management Strategy for PBDEs.

Dec 2006: PBDEs are added to List of Toxic Substances.

Regulation is proposed, prohibiting the use, sale, offer of sale and import of substances used in the commercial mixtures, PentaBDE and OctaBDE. DecaBDE (the most common mixture) is excluded, as are manufactured items containing PBDEs.

Feb 2007: NGOs file a formal Notice of Objection, urging the Government to ban DecaBDE.
The Canadian branch of the International Association of Fire Fighters (IAFF) later expresses support for the ban of all PBDEs, citing high cancer rates.

Jun 2008: The Government prohibits the use, sale, offer of sale and import of substances used in the commercial mixtures, PentaBDE and OctaBDE. DecaBDE is excluded from the prohibition, as are manufactured items containing PBDEs.

Aug 2010: The Government releases the final State of the Science Report on decaBDE in response to the Notice of Objection filed by NGOs. The Final Revised Risk Management Strategy for PBDEs is also released, with the objective being to "prevent the introduction of their [tetra-decaBDEs] manufacture in Canada, their import into Canada and to minimize their releases into the environment from all sources in Canada. This includes restrictions on the importation of the PBDE substances and products manufactured or imported into Canada that contain PBDEs."

Appendix B

Mar 2011: CEPA, 1999 Annual Report for April 2010 – March 2011 notes: "A preliminary study on two polybrominated diphenyl ether-replacement organophosphate flame retardants, tris(1,3-dichloro -2-propyl) phosphate (TDCPP) and tris (1-chloro-2-propyl) phosphate (TCPP), did reveal cytotoxicity (cell damage) and significant changes in genes associated with xenobiotic metabolism, thyroid hormone regulation, and growth and lipid metabolism in chicken liver and brain cells. These results were similar to those observed for hexabromocyclododecane, a compound that is now being phased out due to its toxicity."

Aug 2011: NGOs express dismay over the lack of information on the proposed PBDE ban.

Feb 2013: The Government releases Proposed Risk Management Measure for Polybrominated Diphenyl Ethers (PBDEs), subject to a 60-day public comment period.

Mar 2013: The Government begins the assessment of ten organic flame retardants, including Melamine, ATE, Dechlorane Plus, TDCPP, TBPH, EBTBP, DBDPE, TBB, TCP, and TCPP.

Apr 2014: The CCPSA is amended to prohibit "the manufacture, import, advertising or sale of consumer products intended for children under three years of age that are made, in whole or in part, of PUF [polyurethane foam] that contains TCEP. This prohibition includes consumer products such as toys, sleep positioners, and nursing pillows made of PUF that contains TCEP" (CCSPA, 2014).

Apr 2015: Proposed regulation of PBDEs is published in the Canada Gazette, subject to a 75-day public comment period. Manufactured items are excluded.

Apr 2015: Proposed regulation of HBCD is announced: "The proposed amendments would prohibit the manufacture of HBCD in Canada as of the coming into force of the amendments. By January 1, 2017, the amendments would prohibit the manufacture, use, sale, offer for sale or import of HBCD, as well as expanded and extruded foams containing HBCD used in building/construction applications" (Environment and Climate Change Canada, 2015).

Jun 2015: NGOs identify loopholes in the regulation, specifically the failure of the Government to ban PBDEs in manufactured items.

Jun 2016: Originally registered in 1987, under the Hazardous Products Act, the Children's Sleepwear Regulations under the CCPSA states that flame retardants used in children's loose-fitting sleepwear must not cause adverse health issues, including gene mutation and the development of tumors. Further, it must contain a label indicating the use of flame retardants.

Fall 2016: Draft screening assessment of ten organic flame retardants (Melamine, ATE, Dechlorane Plus, TDCPP, TBPH, EBTBP, DBDPE, TBB, TCP, and TCPP) are released.

Dec 2016: PBDE Regulations are repealed. PBDEs are now regulated under the Prohibition of Certain Toxic Substances Regulation, 2012. The amended regulations expand to include the prohibition of the use, sale, offer of sale and import of the DecaBDE mixture, and all products that contain PBDEs, with the exception of manufactured items.

Endnotes

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The main purpose of precautionary labelling on a consumer product is to bring an issue to the attention of the user, and to help them use the product safely. Mandatory labelling to identify an inherent health hazard from the reasonably foreseeable use of a product would allow the product to be sold without significantly reducing the health risk.

It cannot be assumed that a label on children's products identifying TCEP content would be sufficient to prevent young children from mouthing these products. It is therefore prudent to introduce a prohibition that would provide greater health and safety protection to this susceptible subgroup."

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