Fireproof Whales and Contaminated Mother's Milk:

The Inadequacy of Canada's Proposed PBDE Regulations

David Suzuki Foundation

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The Inadequacy of Canada's Proposed PBDE Regulations

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Executive Summary

PBDEs (polybrominated diphenyl ethers) are a group of chemicals used as flame-retardants in a wide-range of products including clothing, computers, electronic equipment, motor vehicles, carpets, and furniture. The discovery that PBDEs are rapidly accumulating in mothers' breast milk, wildlife species from killer whales to grizzly bears, and the environment from the Arctic to the Great Lakes has caused an explosion of concern about the negative health and environmental effects of PBDEs.

The breast milk of Canadian women contains the second highest level of PBDE concentrations in the world, behind Americans. In Vancouver, the PBDE levels measured in breast milk samples increased approximately 15 fold from 1992 to 2002. A recent study indicated that some Canadian children have higher concentrations of PBDEs in their bodies than their parents. Research has found Canadian foods—including salmon, ground beef, cheese and butter—are contaminated with PBDEs at levels up to 1,000 times higher than levels found in similar food products in Europe.

Despite these warning signs, Canada is lagging behind other nations in regulating PBDEs. There are currently no restrictions on the manufacture, import, sale or use of PBDEs in Canada. The good news is that the federal government is currently seeking public input on a proposed approach to addressing the negative health and environmental consequences of PBDEs.

The bad news is that the proposed regulatory approach does not reflect current scientific knowledge about the threats posed by PBDEs, does not comply with the *Canadian Environmental Protection Act, 1999*, and would fail to protect the health of Canadians and the environment. Canada's proposed regulatory approach would:

- Ban the import of commercial PBDE mixtures that are already being phased out by manufacturers;
- Ban PBDE manufacturing facilities in Canada (where there are no such facilities, either existing or proposed); and,
- Fail to regulate the most widely used PBDE (decaBDE), which breaks down into the very same chemicals that are being banned for health and environmental reasons.

Pursuant to the *Canadian Environmental Protection Act, 1999*, the federal government has an obligation to virtually eliminate substances that are persistent, toxic, and bioaccumulative. The government acknowledges that all types of PBDEs are persistent, meaning that these chemicals spend a substantial period of time in the environment before breaking down into other substances. The government also acknowledges that all PBDEs are toxic, as evidence shows that exposure to PBDEs can cause many adverse health effects in humans and wildlife, including impaired brain development, liver damage, negative impacts on the hormonal, developmental, immune, and reproductive systems, and possibly cancer.

The government does not, however, recognize that decaBDE, the predominant PBDE in Canada and the world, is bioaccumulative. In other words, the government does not recognize that decaBDE builds up in the bodies of people, wildlife, and food webs. Yet there is compelling scientific evidence that decaBDE is accumulating in humans, killer whales, harbour seals, salmon, polar bears, grizzly bears, peregrine falcons, and other wildlife species. To make matters worse, there is also clear evidence that decaBDE breaks down—both in living organisms and in the environment—into the types of PBDEs that the government is proposing to prohibit.

Although decaBDE is persistent, toxic, and bioaccumulative, and is the predominant PBDE in use today, the government is not proposing to regulate the import, sale or use of decaBDE or products containing decaBDE. Instead, the government is proposing a variety of voluntary agreements with industry. This approach is unlawful, scientifically indefensible, and will not protect the health of Canadians, wildlife, and the environment from the dangers posed by PBDEs.

There is ample scientific evidence of the adverse health and environmental consequences of all PBDEs—pentaBDE, octaBDE, and decaBDE—to justify the elimination of all these harmful chemicals. The widespread dispersal and bioaccumulation of PBDEs that have already been produced will have negative health and environmental consequences for decades to come.

Further justification for a complete ban lies in the fact that there are cost-effective and less hazardous alternatives available that can replace decaBDE. As well, Nordic nations that limited the use of PBDEs years ago have witnessed substantial decreases in the levels of these toxic chemicals in the bodies of people in a relatively short period of time.

The David Suzuki Foundation believes that Canadians should enjoy a level of protection from environmental threats to their health that is equal to or better than the highest standard enjoyed by the citizens of other industrialized nations. In order to address the inadequacies of the current Canadian regulatory proposal and ensure the protection of human health, biodiversity (including killer whales), and the environment, the David Suzuki Foundation offers the following recommendations.

Recommendation 1. Prohibit the manufacturing, import, sale, and use of all PBDEs in Canada

Recommendation 2. Support a global ban on all PBDEs pursuant to the *Stockholm Convention on Persistent Organic Pollutants*

Recommendation 3. Knowledge gaps regarding PBDEs need to be addressed by research programs and bio-monitoring of the Canadian population

Recommendation 4. Recognize that all Canadians have the right to live in a healthy environment

"PBDEs are slated to become one of the pre-eminent Persistent Organic Pollutants of the century."

Dr. Peter S. Ross, Institute of Ocean Sciences, 2005

Introduction

What do killer whales and Canadian women have in common? Scientific evidence reveals that the bodies of killer whales and Canadian women share the dubious distinction of being among the world's leaders as receptacles for a group of toxic industrial chemicals known as brominated flame-retardants.

Polybrominated diphenyl ethers (PBDEs) have been used extensively as fire retardants in products including clothing, computers, electronic equipment, motor vehicles, construction products, carpets, and furniture. However in recent years, scientists discovered that PBDEs were rapidly accumulating in women's breast milk, adipose tissue (body fat), human blood, wildlife, and the environment. In coastal British Columbia, the Great Lakes, and even in remote Arctic regions, concentrations of PBDEs in species such as killer whales, ringed seals, and grizzly bears are dramatically increasing. PBDEs have been found in house dust, meat, fish, and dairy products, sewage sludge (which is often applied to agricultural land as a fertilizer), and soil.

Canadians have the second highest level of PBDE concentrations in women's breast milk in the world, behind Americans.[1] In Vancouver, the PBDE levels measured in breast milk samples increased approximately 15 fold from 1992 to 2002. A recent study indicated that some Canadian children have higher concentrations of PBDEs in their bodies than their parents.[2] Research has found Canadian foods—including salmon, ground beef, cheese and butter—are contaminated with PBDEs at levels up to 1,000 times higher than levels found in similar food products in Europe.[3]

There are currently no restrictions on the manufacture, import, sale or use of PBDEs in Canada, although restrictions already exist in many other nations. The good news is that after years of delay, the Government of Canada is proposing regulations ostensibly intended to protect human health and the environment from the harmful effects of PBDEs.[4] The bad news is that the proposed regulatory approach does not reflect current scientific knowledge about the threats posed by PBDEs and would fail to protect the health of Canadians and the environment.

As this report will demonstrate, the proposed regulatory approach would:

- Ban the import of commercial PBDE mixtures that are already being phased out by manufacturers;
- Ban PBDE manufacturing facilities in Canada (where there are no such facilities, either existing or proposed); and,
- Fail to regulate the most widely used PBDE, which breaks down into the very same chemicals that are being banned for health and environmental reasons.

This report provides brief background information about PBDEs, examines the health and environmental effects of exposure to PBDEs, compares the approach to regulation of PBDEs in Canada, Europe, the United States, and Australia, and concludes with recommendations for strengthening Canada's approach to these hazardous chemicals.

Basic Information About PBDEs

PBDEs were first manufactured in the 1970s for use as flame-retardants in a variety of commercial products. There are 209 different PBDE congeners that share the same basic molecular structure and are classified into 10 major groups according to the number of bromine atoms (e.g. tetrabrominated diphenyl ether or tetraBDE, pentaBDE, hexaBDE, heptaBDE, octaBDE, nonaBDE, and decaBDE). PBDEs with five or fewer bromine atoms are often referred to as lower brominated PBDEs, while those with more than five bromine atoms are referred to as higher brominated PBDEs. Scientific concerns about the health and environmental effects of lower PBDEs surfaced first because their lower weight and smaller size made them more likely to disperse widely and be absorbed into living organisms. Many experts have observed that PBDEs bear a striking resemblance to PCBs, both structurally and toxicologically.

The focus of Canada's proposed regulatory approach, and accordingly also the focus of this report, is on the three commercial mixtures of PBDEs (referred to as pentaBDE, octaBDE, and decaBDE). Other brominated flame-retardants raising health concerns are tetrabromobisphenol A (TBBPA), hexabromocyclododecane (HBCD), and decabromodiphenyl ethane.[5] However, these three are not yet subject to regulation in any of the jurisdictions assessed in this study.

As of 2001, decaBDE made up more than 80 per cent of global PBDE use. This percentage has inevitably risen in recent years as pentaBDE and octaBDE have been banned in numerous jurisdictions and major manufacturers of pentaBDE and octaBDE have stopped making them. The majority of global demand for PBDEs is in North America.

The Health and Environmental Effects of PBDEs

In recent years there has been an explosion of scientific concern about the negative health and environmental effects of brominated flame-retardants, and PBDEs in particular. A review of the PUBMED database established by the US National Library of Medicine and the National Institutes of Health reveals more than 100 peer-reviewed scientific articles on PBDEs published in the first 10 months of 2006.

Of special concern to scientists, regulators, and the public are chemicals that are persistent, bioaccumulative, and toxic. Persistent chemicals spend a substantial period of time in the environment before breaking down into other substances, with the result that these chemicals may be transported long distances and have a long period during which

humans or wildlife may be exposed. Bioaccumulative substances build up in the bodies of people and wildlife and also may build up in food webs. Toxic substances are those that have harmful effects on either humans or the environment. Pursuant to the *Canadian Environmental Protection Act, 1999*, substances that meet the criteria for persistence, bioaccumulation, and toxicity must be placed on the List of Toxic Substances and regulatory action must be taken to ensure the virtual elimination of these toxic substances from Canada.

Persistence
Health Canada and Environment Canada correctly conclude that all PBDEs, including decaBDE, are persistent, meaning they spend a substantial period of time in the environment before breaking down into other substances.[6]

Bioaccumulation
PBDEs are atmospherically transported and are accumulating at exponential rates in several areas in Canada, including the Arctic. In particular, decaBDE has been shown to occur in airborne particles in the high Arctic.[7] Canadian scientists found that PBDE concentrations in the blubber of ringed seals (the most common seal in the Arctic) increased tenfold between 1981 and 2000, with a doubling rate of four to five years. Female ringed seals had lower PBDE levels than male seals, suggesting that these chemicals are passed to their offspring through lactation.[8] Harbour seals in the Georgia Basin, the waters adjacent to Vancouver and Seattle, have shown a 7000 per cent increase in PBDE levels and are doubling every 3.5 to 4 years.[9] Killer whales, an endangered species in Canada, also have exceptionally high concentrations of PBDEs and also show regional variances suggesting differences in the transport and possible sources of these contaminants (see Sidebar: Fireproof killer whales).[10]

Sidebar: Fireproof killer whales

Canada's preeminent marine mammal toxicologist, Peter Ross, coined the term 'fireproof killer whales' in response to his findings of exponentially increasing levels of fire retardants, PBDEs, found in British Columbia's marine mammals.[11] Killer whales are an iconic species that represent deeply held Canadian values towards nature. Sadly, it is scientifically defensible to state that the Pacific Coast of Canada may be void of killer whales in the near future. [12] Strong immediate measures are required to protect killer whales, including the regulation of all forms of PBDEs.

There are two different 'ecotypes' of killer whales that frequently occupy near shore waters of British Columbia; the fish-eating 'resident' whales and the marine mammal eating 'transient' whales. Both types are at high risk of extinction and are listed under Schedule I of Canada's *Species at Risk Act*.[13] The southern resident population is now comprised of only 87 animals, of which only 23 are breeding females. Contamination from a variety of endocrine disrupting contaminants, such as PCBs and PBDEs, is considered a major conservation concern for Canada's Pacific killer whale populations.

Female killer whales can live up to 85 years and males 50 years, and therefore, they have a long exposure to contaminants, such as fire retardants that accumulate in their tissues. Obtaining tissue biopsies from killer whales is necessary to detect PBDEs, but it is difficult to undertake this research due to legal, logistical and ethical challenges. Recent published studies on PBDE concentrations in killer whales are based on biopsy samples taken between 1993 and 1996.[14] These studies show that PBDEs in southern resident and transient killer whales are approaching 1000 ug/kg, or about 40 times that found in the breast milk of Canadian women.[15] What is more disconcerting is that PBDE levels in harbour seals, a primary prey for transient killer whales, have increased by 7000 per cent and are doubling in Puget Sound every 3.5-4 years.[16] It is likely that killer whales are realizing the same rate of exponential increase and therefore concentrations in 2006 may have increased fourfold since the study was undertaken.

Exact causal relationships between high PBDE concentrations in marine mammals and adverse health effects have not been made. However, the weight of evidence from other mammals show that levels of PBDEs well below that found in killer whales can impair several physiological processes.[17] Particularly worrying are reproductive effects of PBDEs found in laboratory studies. [18] With only 23 reproductive females remaining in the Southern Resident killer whale population they cannot afford to be reproductively impaired.

Killer whales in Canada's Pacific waters have the dubious honour of being the most contaminated marine mammal in the world due to accumulation of PCBs.[19] The synergistic toxicological effects of several contaminants acting simultaneously are poorly understood. In rats, a recent study found the combined exposure of PBDEs and PCBs worsened the developmental and neurobehavioural defects. [20]

Protection of killer whales will require regulations that prohibit the manufacturing, import, sale, and use of all three commercial mixtures of PBDEs—pentaBDE, octaBDE, and decaBDE.

Environment Canada admits that there have been "dramatic increases in tissue concentrations" of PBDEs in Canadian biota in the past two decades.[21] While Health Canada and Environment Canada recognize the bioaccumulative potential of the lighter forms of PBDEs, they do not yet recognize that decaBDE is also a bioaccumulative compound. This conclusion seems scientifically unwarranted in light of current knowledge. A study published earlier this year in the peer reviewed scientific journal *Environmental Science and Technology* concluded: "Our data confirms unambiguously that BDE 209 [i.e. decaBDE] does bioaccumulate in terrestrial top predators."[22] Another study, published in 2005, found bioaccumulation in top predators in Norway—glaucous gulls and polar bears.[23]

It was once thought that the "heavier" PBDE congeners, such as decaBDE, were too large to readily transfer across biological membranes and enter biological systems. Yet decaBDE is now readily found in species including Vancouver Island marmots, grizzly bears, and peregrine falcons.[24] PBDEs are the dominant contaminant found in interior

British Columbia grizzly bears, and furthermore the majority (83 per cent) of the PBDE load is comprised of decaBDE.[25] The detection of decaBDE in grizzly bears feeding on vegetation in parts of B.C. is surprising and underlines the possible role that atmospheric transport plays in introducing decaBDE to remote areas. However, it is no wonder that humans, who are in constant contact with myriad substances and products containing PBDEs, are becoming increasingly contaminated.

Although the precise bioaccumulation and bioconcentration factors associated with decaBDE are not known, decaBDE has a high log Kow value (10.33), indicating that it has high potential to bioaccumulate.[26] Comprehensive assessments by state environmental protection agencies in Illinois (2006) and Washington (2005) concluded that decaBDE meets criteria for designation as bioaccumulative.[27]

Toxicity

There is widespread agreement that all forms of PBDEs are toxic to both human health and the environment. This is the conclusion reached by both Health Canada and Environment Canada.[28]

Although the human health impacts of exposure to PBDEs are not well understood, tests on animals indicate impaired brain development; negative impacts on the hormonal, developmental, immune, and reproductive systems; and possibly cancer.[29] According to the U.S. Environmental Protection Agency, toxicological testing: "indicates these chemicals may cause liver toxicity, thyroid toxicity, and neurodevelopmental toxicity."[30] It is also clear from toxicological studies that PBDEs have immunological effects – meaning that exposure to PBDEs can cause disruption of normal immune system functions and make an animal unable to respond to and recover from further stressors such as illness and disease.

Although most of the early evidence of the toxicity of PBDEs focused on pentaBDE and octaBDE, more recent studies have found similar adverse health effects from decaBDE. For example, in rats, PBDE exposure causes thyroid hormone disruption, developmental neurotoxicity, changes in fetal development, and hepatotoxic effects (i.e. damage to the liver and liver functions).[31] Studies published in 2006 in the journals *Neurotoxicology* and *Toxicological Science* found conclusive evidence that both lower and higher PBDEs (including decaBDE) "cause similar neurotoxic effects in both mice and rats."[32] PBDEs, including decaBDE, also have adverse effects on reproductive organs.[33] Other toxicology studies in animals have found nervous system damage, reproductive and developmental damage (e.g. reduced sperm production), endocrine disruption, and cancer following exposure to high doses of decaBDE.[34] Endocrine disruption may result in developmental delays, decreased IQ, reproductive failure, and estrogen-related cancers.

Most studies examining the adverse health effects of exposure to toxic substances focus on a single chemical. Yet in the real world, humans and wildlife are exposed to hundreds, if not thousands of chemicals on a daily basis. These multiple exposures can produce cumulative, interactive, and multiplicative effects. For example, exposure to a

combination of PBDEs and PCBs can result in worsened developmental and neurobehavioural defects.[35]

Finally, the U.S. Environmental Protection Agency (EPA) has classified decaBDE as a possible human carcinogen because of tests on laboratory animals (mice and rats) that resulted in cancers.[36]

Exposure to PBDEs

There is relatively good understanding as to how PBDEs are released into the environment – however, how they ultimately find their way into humans and wildlife varies. Suggested exposure routes include inhalation, food ingestion, dust ingestion and dermal absorption. Feeding, however appears to be by far the most important route for uptake, particularly for wildlife. In the case of humans, household dust and occupational exposure represent secondary, yet important, routes of exposure.

Researchers conducting on studies on human exposure to PBDEs have discovered that in "measurements of house dust, sediments, and indoor air, BDE-209 (decaBDE) seems to be dominant."[37] The sources of decaBDE in the home are likely to include household products including televisions, furniture, and carpet foam that slowly degrade into the surrounding household environment.

The U.S. EPA is concerned that children may be particularly at risk from PBDEs: "Studies of various commercial mixtures and individual congeners have suggested potential concerns about liver toxicity, thyroid toxicity, developmental toxicity, and developmental neurotoxicity. These findings raise particular concerns about potential risks to children. In addition, the presence of PBDEs in house dust and breast milk indicates that there are likely to be pathways of exposure to PBDEs that are of particular relevance for children." [38]

Regardless of the exposure pathway, somehow both lower and higher PBDEs are entering ecological systems and human bodies.

Risk = Toxicity X Exposure

The U.S. EPA uses the simple equation, *Risk = Toxicity X Exposure*, to characterize risk to human health from environmental contaminants.[39] Based on this logic, Washington State is moving forward with regulating a complete ban on all PBDEs.[40] The scientific information presented above clearly shows the mounting risk associated with PBDEs due to rapidly increasing exposure and proven toxicological effects.

Summary of health and environmental evidence for decaBDE

The chemical industry has denied that decaBDE is persistent, bioaccumulative, or toxic.[41] The contention of the chemical industry was that decaBDE was stable and would not biodegrade. DecaBDE, it claimed, was too heavy to be subject to long-range atmospheric transport and the molecules too large to be absorbed into the bodies of humans or

wildlife. And finally, the chemical industry claimed that decaBDE is not toxic, as it caused no adverse health or environmental effects. All of the chemical industry's claims have now been proven wrong. This is a familiar pattern for those familiar with the history of hazardous substances including lead, chlorofluorocarbons (CFCs), PCBs, and numerous pesticides.

Environment Canada's *Ecological Screening Assessment Report on Polybrominated Diphenyl Ethers (PBDEs)* recognizes that decaBDE is the most prevalent and widely used PBDE product in Canada and the world. Environment Canada has also recognized that decaBDE is accumulating at high levels in the environment and is debrominating (i.e. losing bromine atoms) into lower PBDEs (e.g. pentaBDE, octaBDE) that are more bioaccumulative and directly toxic. In the words of Environment Canada: "There is a weight of evidence suggesting that highly brominated PBDEs, such as decaBDE, are precursors of the more toxic, bioaccumulative, and persistent lower brominated PBDEs." These findings have led researchers to conclude that even low levels of debromination to lighter forms of PBDEs will, over the course of decades, result in "serious ecological consequences."[42] Furthermore, the phototransformation of decaBDE and products containing decaBDE can result in the production of dibenzofurans, another toxic compound.

In summary, there is substantial scientific evidence that decaBDE:

- Is the most prevalent and widely used PBDE product in Canada and the world;
- Accumulates in the environment;
- Enters biological and ecological systems;
- Bioaccumulates in high trophic level animals in aquatic and terrestrial ecosystems;
- Can have a range of toxic effects on humans and wildlife; and
- Can debrominate, or break down, into other more toxic and more bioaccumulative lighter forms of PBDE, including pentaBDE and octaBDE.

These scientific conclusions about decaBDE indicate that Canada's proposed approach to regulating PBDEs is inadequate for protecting human health and the environment.

International Comparison of Approaches to PBDE Regulation

International Environmental Agreements

PentaBDE and octaBDE are currently in the process of being added to lists of prohibited substances under two major international environmental agreements, including the *Stockholm Convention on Persistent Organic Pollutants* and the *United Nations Economic Commission for Europe Long-Range Transport of Air Pollutants Protocol on Persistent Organic Pollutants*. Norway proposed adding pentaBDE to Annex A of the *Stockholm Convention* after a study found higher pentaBDE levels in Norwegian children than adults.[43] The proposal to add octaBDE to Annex A of the *Stockholm Convention* was made by the European Union. The *Stockholm Convention* is more important because it can result in a legally binding ban on nations around the world who have ratified the

Convention. There is not yet a formal proposal to add decaBDE to the list of prohibited substances under these international agreements.

Canada

No PBDEs are manufactured in Canada. In 2000, approximately 1,300,000 kg of PBDE commercial product was imported into Canada (not including PBDEs contained within manufactured products). PentaBDE was imported in the greatest volume, followed by decaBDE and octaBDE.[44] Today, however, it is certain that decaBDE is by far the leading PBDE imported into and used in Canada, making at least 85% of total use.[45] As of 2004, the only North American manufacturer of PBDEs stopped making pentaBDE and octaBDE.

For years, Environment Canada and Health Canada have been wrestling with the problem of PBDEs. Canada is home to some of the world's leading scientific researchers on the subject of PBDEs. However, unlike other jurisdictions, there are currently no regulations restricting the import, manufacturing, sale, or use of PBDEs in Canada.

Earlier in 2006, Health Canada and Environment Canada recommended adding PBDEs to the List of Toxic Substances under the *Canadian Environmental Protection Act, 1999*. This is the first step toward potential federal regulation of these substances, although there is no guarantee that any restrictions or prohibitions on manufacturing or use will follow listing. In and of itself, placing a chemical on the List of Toxic Substances has no regulatory effect.

In September 2006, the Government of Canada published a document on its proposed regulatory approach for purposes of public consultation. The proposed regulatory approach differentiates between pentaBDE and octaBDE, which are to be effectively prohibited, and decaBDE whose use will continue to be permitted. The main elements of the proposed approach include:

1. Prohibit manufacturing of all types of PBDEs in Canada;
2. Prohibit the import, sale, or use of pentaBDE and octaBDE, including the presence of these chemicals in imported products; and,
3. An Environmental Performance Agreement, Code of Practice, or other similar non-regulatory measure to minimize releases of decaBDE from textile and plastic manufacturing operations in Canada.

While these steps may provide the appearance of strong government action to uninformed observers, this perception is misleading. Because of earlier regulatory action in Europe and the U.S., pentaBDE and octaBDE are no longer manufactured in North America. The federal government's consultation document admits, "penta and octaBDE mixtures have seen limited and declining use in recent years and are almost phased out of use in Canada" (p. 6). As a result, Canada is effectively prohibiting the import, manufacturing, and sale of chemicals that are no longer commercially available.

For decaBDE, a far weaker approach is proposed. The Government of Canada will continue to allow the import, sale, and use of decaBDE. A regulation will prohibit the manufacturing of decaBDE in Canada. The effect of this proposed regulation is questionable, however, because there are no such manufacturing facilities, nor is there any publicly available evidence that any corporation is proposing to build such a facility. In contrast, the government proposes a variety of voluntary agreements with industry to minimize releases of decaBDE from only two sectors—textile and plastic manufacturing operations. There is no mention of restrictions on decaBDE in consumer products or other manufactured goods.

Allowing the continued use of decaBDE completely undermines the effectiveness of the proposed regulatory approach. It is now incontrovertible that decaBDE breaks down into pentaBDE and octaBDE, as this has been observed in carp, lake trout and in the environment under a variety of conditions (e.g. exposure to sunlight or particular microbes).[46] In other words, the use of decaBDe produces pollution in the form of the very substances that Canada is planning to ban because of health and environmental concerns.

Scientific research, much of it very recent, provides compelling evidence that decaBDE is persistent, bioaccumulative and toxic. Therefore, decaBDE meets the requirements of the Persistence and Bioaccumulation Regulations passed pursuant to the *Canadian Environmental Protection Act, 1999* (*CEPA 1999*).[47] These conclusions leave the government with no choice. Pursuant to s. 77(4) of *CEPA 1999*:

> 77 (4) Where the Ministers propose to take the measure referred to in paragraph (2)(*c*) in respect of a substance and the Ministers are satisfied that:
>
> (*a*) the substance is persistent and bioaccumulative in accordance with the regulations,
>
> (*b*) the presence of the substance in the environment results primarily from human activity, and
>
> (*c*) the substance is not a naturally occurring radionuclide or a naturally occurring inorganic substance,
>
> the Ministers shall propose the implementation of virtual elimination under subsection 65(3) of the substance.[48]

In summary, Canada's proposed approach to regulating PBDEs lacks scientific credibility, is inconsistent with the requirements of *CEPA, 1999*, and will not achieve the objective of protecting human health, biodiversity, and the environment from these toxic chemicals.

Europe

In 2003, the European Union banned the use of certain PBDEs (pentaBDE and octaBDE) over concerns about the health impacts of these chemicals and direct evidence these chemicals were accumulating in the breast milk of European women.[49] DecaBDE is currently under review by the E.U. authorities and an extension of the existing prohibition to include decaBDE is possible. Europe also prohibits the use of pentaBDE

and octaBDE (as well as lead, mercury, cadmium, hexavalent chromium, and polybrominated biphenyls) in the manufacturing of electronic and electrical equipment.[50]

Sweden was the first nation to ban some PDBEs and has since experienced a significant decline in PBDE concentrations in the breast milk of Swedish women.[51] Sweden intends to prohibit decaBDE and will push the entire European Union to extend the existing PBDE prohibitions to cover decaBDE. Sweden, Denmark, and the European Parliament are seeking to have decaBDE added to the list of hazardous substances prohibited in the manufacturing of electrical and electronic equipment.

The European Union is at the forefront in advocating international action to address the health and environmental threats posed by PBDEs (as detailed above), in regard to their efforts to have pentaBDE and octaBDE added to the *Stockholm Convention*.

United States

The world's highest levels of PBDEs in human breast milk are found in American women.[52] Five per cent of American women have body burdens of PBDEs at levels that cause reproductive damage in laboratory animals.[53] As in Canada, American children sometimes have PBDE levels that exceed their parents.[54]

There is no federal American regulation prohibiting PBDEs. The U.S. Environmental Protection Agency (U.S. EPA) reached a voluntary agreement with Great Lakes Chemical, the only manufacturer of pentaBDE and octaBDE in the U.S., to cease production by the end of 2004. However, the agreement does not cover imports of PBDEs, or products manufactured using PBDEs and then imported into the US. In 2006, the EPA proposed a Significant New Use Rule pursuant to the *Toxic Substances Control Act*, requiring any company or individual seeking to import or manufacture PBDEs to notify the EPA.[55] Despite these steps, the US remains the world's largest user of PBDEs.

Although there is an absence of regulatory action at the federal level, pentaBDE and octaBDE are subject to elimination in an increasing number of American states. In 2003, California passed a law prohibiting the manufacture, distribution or sale of products containing pentaBDE and octaBDE, effective in 2006. Hawaii, Illinois, Maine, Maryland, Michigan, New York, and Oregon have passed similar laws and a number of other states are currently considering similar prohibitions. Maine has also proposed a ban on decaBDE that will take effect in 2008, assuming acceptable alternatives are available.[56]

Australia

A study commissioned by the Australian Government, published by the Environment Protection Council of Australia and New Zealand in January 2005, showed that the levels of PBDEs in women's breast milk in Australia are five times higher than those observed in Europe and Japan.[57]

PBDEs are not regulated in Australia. However, the National Industrial Chemical Notification and Assessment Scheme (NICNAS) did issue the following warning in 2001: "It is recommended that industry carefully consider the selection of PBFR compounds for use, to ensure that those known to be hazardous are avoided, and that PBFRs of unknown hazard are not introduced."[58]

While PBDEs are not manufactured in Australia, they are imported as pure chemicals or in mixtures, or come in on finished products and articles. According to NICNAS, 430 tonnes of polybrominated flame-retardants were imported into Australia in 2003-04. This figure includes a significant decline in pentaBDE and octaBDE, offset by rising imports of decaBDE, tetrabromobisphenol A, and hexabromocyclododecane.[59]

Comparative Analysis
Canada has not yet taken regulatory action to prohibit or restrict the uses of PBDEs. The proposed Canadian approach would be ineffective and would fail to comply with the requirements of the *Canadian Environmental Protection Act, 1999*. Europe is a world leader in regulating PBDEs, demonstrating a willingness to apply the precautionary principle and lead the push for international action. The U.S. has taken no regulatory steps at the federal level to address the health threats posed by PBDEs, but did use moral suasion and the threat of regulation to convince the sole American manufacturer of PBDEs to discontinue production of pentaBDE and octaBDE. In the absence of federal regulation, a growing number of American states have introduced their own prohibitions, patterned after the European legislation and in some states going further by enacting plans to ban decaBDE. Australia, to date, is relying on voluntary approaches to reducing the use of PBDEs.

Conclusion and Recommendations

The David Suzuki Foundation believes that Canadians should enjoy a level of protection from environmental threats to their health that is equal to or better than the highest standard enjoyed by the citizens of other industrialized nations. It is also fundamentally important to apply the precautionary principle, meaning that where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing measures to prevent environmental degradation.

Scientific evidence of the adverse health and environmental consequences of all PBDEs—pentaBDE, octaBDE, and decaBDE—continues to rapidly grow. There is already ample reason to move swiftly to eliminate the risks posed by these persistent, bioaccumulative, and toxic substances. PentaBDE and octaBDE are harmful chemicals that should have been banned years ago. The widespread dispersal and bioaccumulation of these toxic substances will have negative health and environmental consequences for decades to come.

Canada must not repeat the same mistake with decaBDE. Unfortunately, Canada's proposed regulatory approach for PBDEs does not incorporate the most recent scientific

evidence about the threats posed by decaBDE. As a result, the proposed approach is incapable of fulfilling the federal government's obligations pursuant to the *Canadian Environmental Protection Act, 1999*, which states that Canada must, "exercise its powers in a manner that protects the environment and human health."[60]

Because decaBDE is persistent, bioaccumulative, and toxic, the federal government is legally obligated to propose the virtual elimination of decaBDE pursuant to *CEPA 1999*. The proposed voluntary approach is unlawful, and a wealth of evidence exists that suggests voluntary approaches are ineffective in achieving environmental objectives. From a regulatory perspective, decaBDE is by far the most important PBDE because it's the most commonly used PBDE in Canada and the world.

Further support for a comprehensive and consistent approach to the virtual elimination of all PBDEs is provided by evidence that there are cost-effective and less hazardous alternatives available that can replace decaBDE.[61] Potential alternatives include safer chemicals, modified manufacturing techniques, substitution of different materials, and product redesign.

Since Nordic nations moved to aggressively limit the use of PBDEs, further evidence now exists to substantiate the claim that levels of these toxic chemicals in the bodies of people and wildlife will decrease substantially in a relatively short period of time.

In order to address the inadequacies of the current Canadian regulatory proposal and ensure the protection of human health, biodiversity (including killer whales), and the environment, the David Suzuki Foundation offers the following recommendations.

Recommendation 1. Prohibit the manufacturing, import, sale, and use of all PBDEs in Canada

All PBDEs – tetra, penta, hexa, hepta, octa, nona, and deca – should be designated for virtual elimination under the *Canadian Environmental Protection Act, 1999*. To sufficiently protect human health and the environment, Canada requires regulations that prohibit the manufacturing, import, sale, and use of all three commercial mixtures of PBDEs—pentaBDE, octaBDE, and most importantly, decaBDE.

For purposes of comparison, this recommendation differs from the Government of Canada's proposed approach in that the David Suzuki Foundation's approach addresses the health and environmental threats posed by decaBDE – the predominant PBDE on the market, and a substance that degrades into the very substances that the federal government is purporting to regulate.

Recommendation 2. Support a global ban on all PBDEs pursuant to the *Stockholm Convention on Persistent Organic Pollutants*

Canada should support the listing of all PBDEs pursuant to the *Stockholm Convention on Persistent Organic Pollutants*, which would effectively result in a global ban on these

substances. Unless a global effort is made to eliminate PBDEs from the environment, global systems (i.e., atmospheric transport, food webs, etc.) will continue to bring these harmful chemicals into Canada's marine and terrestrial territories (particularly the Canadian Arctic), and ultimately into food consumed by Canadians.

Recommendation 3. Knowledge gaps regarding PBDEs need to be addressed by research programs and bio-monitoring of the Canadian population

Canada should begin to conduct national bio-monitoring studies to regularly identify and track the exposure of Canadians to PBDEs and other toxic substances by testing blood, urine, etc.[62] The U.S. Centres for Disease Control and Prevention conduct national bio-monitoring studies and publish the results bi-annually.[63]

The federal government, in partnership with the provinces, should establish a national environmental health tracking system.[64] The system would monitor environmental hazards, environmental exposures, and health impacts (e.g. waterborne illnesses, pesticide poisonings, hospital admissions caused by cardiovascular and respiratory illness related to air quality, learning and behavioural disabilities, childhood cancers, reproductive health outcomes, etc). This information should be made publicly available to help inform and shape public health policies and actions. The United States recently began building a national environmental health tracking system, which could serve as a template.[65]

Environmental health indicators would ensure accountability by enabling the public to monitor progress, and would also play a role in public education. As a result, Canada should develop a robust set of indicators, building on work that has been done in the U.S., Europe, and Australia.[66]

In addition, Canada should increase funding for research on health and environment issues through the Canadian Institutes of Health Research, the Social Sciences and Humanities Research Council, and the Natural Science and Engineering Research Council. Research should be focused on informing regulatory actions by: identifying pathways from hazards to exposures; understanding the effects of these exposures on health; identifying vulnerable sub-populations; and exploring the health effects of new substances, substances in combination, and gene-environment interactions. With respect to PBDEs, research efforts should focus on the health and environmental effects of decaBDE.

Finally, Canada should significantly increase support for the National Collaborating Centre for Environmental Health (established in B.C. by the federal government in 2004).

Recommendation 4. Recognize that Canadians have the right to live in a healthy environment

Canada should recognize that all Canadians enjoy a basic human right to breathe clean air, drink clean water, and live in a healthy environment. The Supreme Court of Canada

has endorsed recognition of the right to live in a healthy environment.[67] In recent years more than seventy nations, including more than twenty in Europe, have explicitly acknowledged, in their constitutions, that all citizens have the right to a healthy environment.

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