HEALTHY ENVIRONMENT
HEALTHY CANADIANS

# prescription for a healthy Canada

## TOWARDS A NATIONAL ENVIRONMENTAL HEALTH STRATEGY

David Suzuki Foundation

SOLUTIONS ARE IN OUR NATURE

SEPTEMBER 2007

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## TOWARDS A NATIONAL ENVIRONMENTAL HEALTH STRATEGY

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**Prescription for a Healthy Canada: Towards a National Environmental Health Strategy**


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of the Lefebvre Charitable Foundation.

**Dedication**

This report is for my daughter Meredith, my niece Sonje, and my nephew Seamus. Healthy kids need a healthy planet.

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This report, as well as summary for policy-makers that highlights the main findings and recommendations are available at www.davidsuzuki.org/publications.

*We increasingly understand that the health and well-being of our families depends on a clean and healthy environment.*

– Declaration on Children's Environmental Health
by Leaders of the G8 Summit (1997)


Environmental pollution and degradation take a tremendous toll on the health of Canadians. Environmental hazards contribute to the deaths of thousands of Canadians each year, largely due to respiratory disease, heart disease, and cancer. Each year, millions of Canadians become ill or disabled after being exposed to environmental contaminants. Environmental contaminants are linked to asthma, gastrointestinal illness, poisonings, cancer, Alzheimer's disease, Parkinson's disease, developmental disorders, birth defects, and reproductive problems. These negative health effects impose enormous costs on Canadian society. We cannot adequately put a price on the pain, the suffering, the diminished quality of life, and the loss of life caused by these illnesses and deaths. However, we do know that environmental contamination costs Canada billions of dollars each year due to healthcare expenses, school absenteeism, decreased intelligence, and lost productivity.

Many Canadians will find it disturbing to learn that their country has fallen behind other industrialized nations in protecting its citizens from environmental threats to their health. While most developed countries have adopted national health and environment strategies or action plans, Canada has not. Unlike the U.S., Australia, and the European Union, Canada lacks both a national program to monitor children's exposures to environmental contaminants, and a national system to track diseases and deaths caused by environmental contaminants. Many Canadian health and environmental laws and policies are weaker than corresponding laws and policies in other nations. For example:

- Canada does not have legally binding national standards for air quality and drinking water quality.
- Canada permits the use of pesticides that other countries have banned for health and environmental reasons.
- Compared to other nations, Canada allows higher levels of pesticide residues on our food.
- Canada has completely failed to regulate some toxic substances, including polybrominated diphynel ethers (PBDEs), phthalates, and polycyclic aromatic hydrocarbons (PAHs).
- Canada has weaker regulations for toxic substances such as radon, lead, mercury, arsenic, and asbestos.

The good news is that we can prevent the majority of the adverse environmental effects on our health. Canada could join other world leaders in protecting public health by embracing this report's recommendations for reducing air pollution, protecting water quality, improving food safety, addressing threats posed by consumer products, and banning the most hazardous substances currently being used. The history of pollution regulation in Canada proves that industry overestimates the costs, governments underestimate the benefits, and action to regulate toxic substances is taken only after significant health and environmental damage has been inflicted.

We must learn from the mistakes of the past. Our failure to regulate lead, benzene, sulphur, CFCs, mercury, PCBs, and other toxic substances in a timely fashion has resulted in significant costs. We must adopt a preventative and precautionary approach to our future. There are safer substitutes for most, if not all, of the toxic chemicals currently being used and released into the environment. These safer substitutes would save lives, prevent illnesses, protect ecosystems, and benefit our economy. Preventing environmental impacts on our health is crucial to relieving the pressure on Canada's health care system and to fulfilling the David Suzuki Foundation's vision of achieving sustainability within a generation.

The David Suzuki Foundation calls on the federal government, in collaboration with the provinces and territories, to adopt a national environmental health strategy for Canada. This must include initiatives to improve monitoring and research; strengthen laws, regulations, and policies; build professional capacity and raise public awareness; protect vulnerable populations; and promote environmental health on the international stage. These five priority areas for a national environmental health strategy are summarized below and explained in more detail in the report.

**I. Improve research and monitoring**

Canada should conduct regular biomonitoring studies – testing blood, urine, etc. – to identify and track toxic substances that enter our bodies. The federal government and the Province of Alberta recently launched initial, exploratory studies. These programs, however, must be expanded and extended to provide comprehensive and ongoing data on Canadians' exposure to environmental contaminants. This and other information should be fed into a national environmental health tracking system designed to inform the public and health professionals about environmental contamination and to hold industry accountable for toxic products and releases. The government must also increase funding for health and environment research.

**II. Strengthen laws, regulations, and policies**

Canada must consistently apply the precautionary principle and ban potentially dangerous substances, unless industry can prove beyond any reasonable doubt that they are safe. Canada must also apply the substitution principle, requiring manufacturers to replace all toxic products with safer alternatives. Specific amendments to this effect are proposed to the Canadian Environmental Protection Act 1999, the Pest Control Products Act, and the Hazardous Products Act. More broadly, the government should enact legally binding national standards for air quality and drinking water quality, impose pollution taxes, eliminate subsidies and incentives that cause environmental damage, require manufacturers to be responsible for the life-cycle environmental costs associated with their products, and accelerate the transition to an energy-efficient, low-carbon economy.

**III. Build professional capacity and raise public awareness**

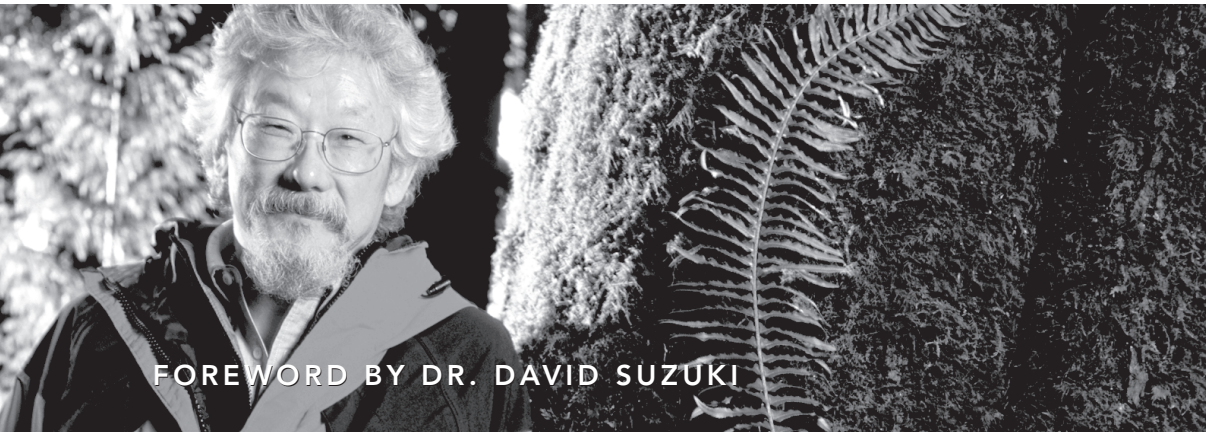
Governments must work with educational institutions and medical associations to ensure that training and professional development programs include an environmental health component. A national environmental health strategy should also support information services for both health professionals and the public at large.

**IV. Confront the unjust distribution of environmental harms and protect vulnerable populations**

The national environmental health strategy must include an explicit commitment to achieving environmental justice. Too often in Canada, environmental health hazards disproportionately impact Aboriginal and poor communities. Environmental health policy must also recognize the heightened vulnerability of children, pregnant women, and people with compromised immune systems.

**V**. **Prioritize environmental health on the international stage**

Canada must stop exporting toxic substances that are banned in Canada. We must support international laws that are designed to phase out the production, use, and release of toxic substances – such as asbestos and mercury – instead of obstructing such laws. Canada must also acknowledge that all citizens have the right to live in a healthy environment, including the right to clean water.



# FOREWORD BY DR. DAVID SUZUKI

In Canada, human health and the environment have become two of the most interconnected and salient issues we all face today. While we fight to maintain and improve one of the world's best health-care systems, we have ignored new, important preventative actions that can save us from illness and death. We should pay attention to keeping healthy people healthy, instead of focusing on treating illness after it sets in.

Most Canadians agree that environmental degradation has a negative impact on their health. Sadly, children are particularly vulnerable to environmental health hazards.

This report, *Prescription for a Healthy Canada*, champions the idea of a national environmental health strategy. Such a strategy can save or improve the lives of thousands of Canadians, increase productivity, protect biodiversity, and enhance the quality of life in this country.

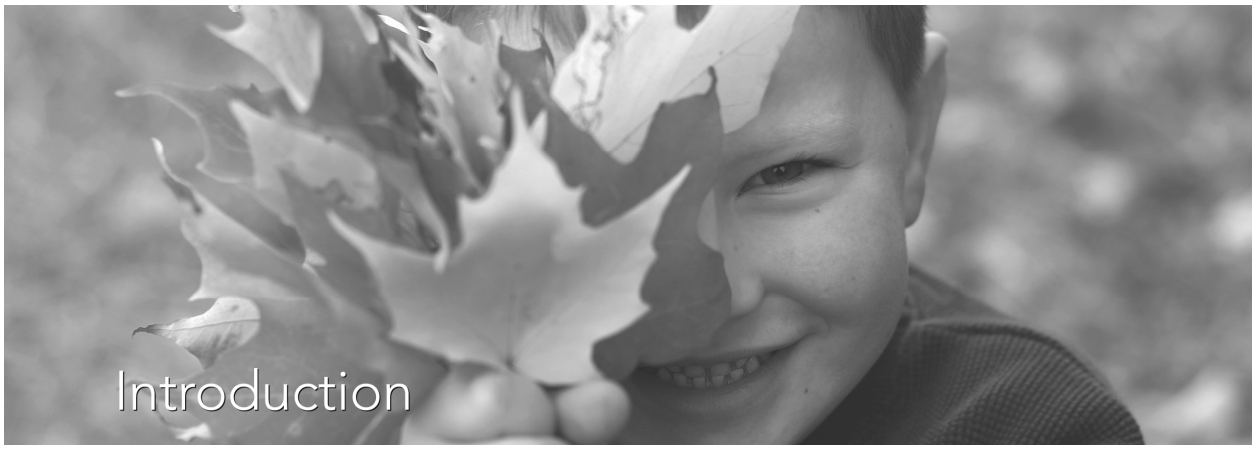
As a species capable of forethought, we possess the capacity to preserve our health and our children's health before illnesses emerge. Through proper judgement and planning, we can ensure we're breathing clean air, drinking clean water and eating food that's free from harmful pollutants. Individuals can also play a role by taking the steps outlined in our Nature Challenge. As well, businesses have an obligation to clean up their act. But to guarantee a clean natural environment and healthy citizens, we require adequate systems, laws, policies and commitments by all levels of government.

Our Foundation is committed to achieving sustainability within a generation in Canada – a national plan to address environmental health is a huge step in that direction. A healthy environment is a vital cornerstone of a sustainable, prosperous future.

David Suzuki
Founder, David Suzuki Foundation

## ACRONYMS

| | |
|---|---|
| ADHD | Attention Deficit Hyperactivity Disorder |
| CDC | Centers for Disease Control and Prevention |
| CEPA | *Canadian Environmental Protection Act, 1999* |
| CFC | Chlorofluorocarbon |
| CIHI | Canadian Institute for Health Information |
| COPD | Chronic Obstructive Pulmonary Disease |
| CPI | Consumer Price Index |
| CRTK | Community Right To Know |
| DALY | Disability Adjusted Life Year |
| DecaBDE | Decabromodiphenyl Ether |
| EAF | Environmentally Attributable Fraction |
| EBD | Environmental Burden of Disease |
| EPA | U.S. Environmental Protection Agency |
| EPR | Extended Producer Responsibility |
| GST | Goods and Services Tax |
| HCB | Hexachlorobenzene |
| HPA | *Hazardous Products Act* |
| IQ | Intelligence Quotient |
| LEED | Leadership in Energy and Environmental Design |
| NCCEH | National Collaborating Centre for Environmental Health |
| NPRI | National Pollutant Release Inventory |
| OMA | Ontario Medical Association |
| PAH | Polycyclic Aromatic Hydrocarbons |
| PBDE | Polybrominated Diphenyl Ether |
| PCB | Polychlorinated Biphenyl |
| PCPA | *Pest Control Products Act* |
| PFC | Perfluorochemical |
| PFOA | Perfluorooctanoic Acid |
| PFOS | Perfluorooctane Sulfonate |
| POP | Persistent Organic Pollutants |
| PVC | Polyvinyl Chloride |
| OECD | Organization for Economic Co-Operation and Development |
| SARS | Severe Acute Respiratory Syndrome |
| UV radiation | Ultraviolet Radiation |
| VOC | Volatile Organic Compound |
| WHO | World Health Organization |



# Introduction

*The association between certain chronic diseases and environmental causes is devastatingly clear, yet knowledge about the scope of environmental health risks and their impact on the public's health is limited.*

U.S. Institute of Medicine, 2002

*There are many more factors that affect your health than can be cured by a medical prescription from a doctor or even a policy prescription from a health minister. . . A clean and safe environment is vital. Contaminants in our air, water, food and soil can cause everything from cancer to birth defects, to respiratory illness and gastrointestinal ailments.*

Roy Romanow

*The area of environmental impacts on health has been seriously neglected in Canada and requires urgent investment.*

National Advisory Committee on SARS and Public Health, 2003

On the surface, Canada is one of the most beautiful nations in the world, with seemingly abundant fresh water, clean air, and few obvious signs of environmental contamination. However, looks are deceiving. Pollution is pervasive, affecting every ecosystem in Canada. Twenty-first century environmental contaminants are largely invisible. We cannot necessarily see the pollution in the air we breathe, taste the pathogens and chemicals in the water we drink,

or smell the pesticides in the food we eat. Yet, we intuitively understand that these invisible contaminants are harming us.

Environmental contamination and degradation cause thousands of deaths, tens of thousands of hospital and emergency room visits, millions of days lost to illness, and billions of dollars in health care costs.[1] The World Health Organization estimates that almost one-quarter of the global disease burden (years lost to premature death, disability, and illness) is attributable to environmental factors.[2] Scientists link environmental threats to many adverse health outcomes, including premature birth, birth defects, permanent decreases in IQ, autism, behavioural problems, asthma, chronic obstructive pulmonary disorder (COPD), cancer, cardiovascular disease, brain damage, and damage to the immune, nervous, gastrointestinal, hormone, and reproductive systems.

Canadians hear media reports about smog advisories, contaminated drinking water, pesticides in our food, high cancer rates, mind-boggling volumes of toxic industrial emissions, and hazardous chemicals in products ranging from cosmetics and children's toys to household cleaning products and building materials. Pollution ranks at the top of the list, ahead of stress, when Canadians are asked to identify the main factors that are harming their health. The proportion of Canadians who believe that environmental problems will affect the health of future generations "a great deal" has risen in recent years from one out of two Canadians to two out of three. The top three environmental concerns among Canadians are air quality, climate change, and water quality. Seventy-four to 91 per cent of Canadians state that hazardous chemicals are definitely present at unsafe levels in the air they breathe, the water they drink, and the food they eat.[3] Public opinion polls conducted in late 2006 and early 2007 indicate that the environment is now the overriding concern among Canadians, propelled to the top of the list by a growing unease about our changing climate.[4]

Canadians are concerned about environmental hazards due to:

- The involuntary and unfamiliar nature of the risks;
- The invisible and undetectable aspects that handicap individual efforts to avoid exposure;
- The long latency period between exposure to toxins and the onset of adverse health effects;
- The feelings of dread that people have toward chemical exposure;
- The lack of public participation in decisions about the risks of toxic substances; and
- The lack of trust created by a history of false assurances regarding the safety of hazardous substances (e.g., lead, pesticides) by both government and industry.[5]

Experts agree that Canadians should be concerned about environmental contaminants. New research linking environmental factors to human health is published in medical and scientific journals almost every week (see Table 1.1).[6] Also, Canada's National Advisory Committee on SARS and Public Health, the U.S. Institute of Medicine, the World Health Organization, and Roy Romanow's Commission on the Future of Health Care in Canada have all urged governments to allocate greater attention and resources towards environmental health.

Recent scientific studies reveal that environmental contaminants are insidiously accumulating inside every Canadian's body. Despite repeated calls for action by the public, medical experts, scientists, and environmental groups, the Canadian government has failed to enact strong and effective legislation to protect Canadians from toxic substances that have contaminated our air, water, and food supplies. ]Canada often relies on weak, ineffective, and voluntary measures to manage releases of harmful chemicals. It is unacceptable that our country has fallen so far behind other industrialized nations when it comes to protecting both the health of its citizens and the environment.

As individuals and families, we can take some steps to safeguard our health, but it is impossible to protect ourselves and our children from many environmental threats.

The David Suzuki Foundation urges the federal government to develop and implement a *national environmental health strategy* in order to address these pressing concerns in a coordinated, effective, and timely manner. The top five priorities for a national environmental health strategy include:

I. **Improve research and monitoring.** Canada should conduct regular biomonitoring studies – testing blood, urine, etc. – to identify and track toxic substances that enter our bodies. The federal government and the Province of Alberta recently launched initial, exploratory studies. These programs, however, must be expanded and extended to provide comprehensive and ongoing data on Canadians' exposure to environmental contaminants. This and other information should be fed into a national environmental health tracking system designed to inform the public and health professionals about environmental contamination and to hold industry accountable for toxic products and releases. The government must also increase funding for health and environment research.

II. **Strengthen laws, regulations, and policies.** Canada must consistently apply the precautionary principle and ban potentially dangerous substances, unless industry can prove beyond any reasonable doubt that they are safe. Canada must also apply the substitution principle, requiring manufacturers to replace all toxic products with safer alternatives. Specific amendments to this effect are proposed to the Canadian Environmental Protection Act 1999, the Pest Control Products Act, and the Hazardous Products Act. More broadly, the government should enact legally binding national standards for air quality and drinking water quality, impose pollution taxes, eliminate subsidies and incentives that cause environmental damage, require manufacturers to be responsible for the life-cycle environmental costs associated with their products, and accelerate the transition to an energy-efficient, low-carbon economy.

III. **Build professional capacity and raise public awareness.** Governments must work with educational institutions and medical associations to ensure that training and professional

development programs include an environmental health component. A national environmental health strategy should also support information services for both health professionals and the public at large.

IV. **Confront the unjust distribution of environmental harms and protect vulnerable populations.** The national environmental health strategy must include an explicit commitment to achieving environmental justice. Too often in Canada, environmental health hazards disproportionately impact Aboriginal and poor communities. Environmental health policy must also recognize the heightened vulnerability of children, pregnant women, and people with compromised immune systems.

V. **Prioritize environmental health on the international stage.** Canada must stop exporting toxic substances that are banned in Canada. We must support international laws that are designed to phase out the production, use, and release of toxic substances – such as asbestos and mercury – instead of obstructing such laws. Canada must also acknowledge that all citizens have the right to live in a healthy environment, including the right to clean water.

This report lays out a comprehensive research, law, policy, and public education strategy that our federal and provincial governments must adopt in order to protect the health of all Canadians. These preventative steps will strengthen our economy, improve our quality of life, and ensure the sustainability of the environment for our children's children. Environmental impacts on human health are almost entirely preventable. By recognizing that Canadians have a basic human right to live in a healthy environment, by investing in urgently needed research into environmental impacts on health, by strengthening our environmental laws and regulations, and by requiring a shift from toxic substances to safer alternatives, we can not only reduce but virtually eliminate the majority of environmental threats to human health.

**TABLE 1.1**

## Twelve breakthrough studies in environmental health
**(Published in 2006)**

### 1. YOUR EXPOSURE TO TOXIC SUBSTANCES CAN HARM YOUR GRANDCHILDREN

**JOURNALS:** *Endocrinology* and *Journal of Andrology*

New research has identified multi-generational effects of exposure to environmental toxins that operate not through genetic mutation but through a more subtle process that changes the way that genes work. When pregnant mice were exposed to vinclozolin (a pesticide that is known to disrupt the endocrine system), four generations of male offspring experienced reduced sperm production. The authors observe: "If the exposure of your grandmother at mid-gestation to environmental toxins can cause a disease state in you with no exposure, and you will pass it on to your grandchildren, the potential hazards of environmental toxins need to be rigorously assessed. Trans-generational studies need to be performed in evaluating the toxicology of environmental compounds."[7]

### 2. PESTICIDE EXPOSURES INCREASE RISK OF PARKINSON'S DISEASE

**JOURNAL:** *Annals of Neurology*

A new study examined the relationship between pesticide exposure and Parkinson's disease in more than 140,000 people. Exposure to pesticides, even at low levels, increased by 70 per cent the likelihood that an individual would suffer from Parkinson's disease, compared to individuals who had not been exposed to pesticides.[8]

### 3. LEAD EXPOSURE INCREASES RISK OF HEART ATTACK AND STROKE

**JOURNAL:** *Circulation*

Compared to adults with low levels of lead in their blood, adults with elevated blood lead levels are two-and-a-half times more likely to die of a heart attack, 89 per cent more likely to die of a stroke, and 55 per cent more likely to die of cardiovascular disease. More than one-third of American adults have blood lead levels in the elevated range.[9]

### 4. A CHEMICAL IN ANTIBACTERIAL SOAP DISRUPTS THE ENDOCRINE SYSTEM

**JOURNAL:** *Aquatic Toxicology*

Triclosan is widely used in antibacterial soaps in Canada and in the U.S. However, triclosan is structurally similar to toxic substances such as PCBs and PBDEs. Researchers discovered that exposure to triclosan at very low levels, similar to those found in many streams and rivers, can disrupt the endocrine system of frogs, resulting in abnormal development. Triclosan bioaccumulates in fish and it has also been detected in human breast milk.[10]

### 5. LIVING NEAR MAJOR ROADS AFFECTS CHILDREN'S LUNG DEVELOPMENT

**JOURNAL:** *The Lancet*

A study in California evaluated the effects of traffic-related air pollution on the development of children's lungs. More than 3,600 children were studied for a period of eight years. The researchers concluded that exposure to freeway traffic airborne contaminants harm the development of children's lungs and leads to decreased lung function later in life. The adverse effects were most pronounced among children living within 500 meters of a freeway.[11]

**TABLE 1.1** CONTINUED

**6. NANOTECHNOLOGY PARTICLES CAN HAVE A WIDE RANGE OF TOXIC EFFECTS**

JOURNAL: *Wisconsin Medical Journal*

Nanotechnology is a rapidly growing field that involves the manufacture and use of material at a scale of less than 100 nanometers. (To put this in perspective, consider that a single sheet of paper is 100,000 nanometers thick.) Nanoparticles of titanium dioxide are used in cosmetic products such as sunscreen and toothpaste. Although there is still a dearth of knowledge about the potential adverse effects of nanotechnology, early toxicological evidence raises serious concerns. Nanoparticles can penetrate the skin and the blood-brain barrier. Scientists have observed genetic damage, respiratory disease, cardiovascular disease, and cancer in laboratory animals that are exposed to nanoparticles.[12]

**7. PRENATAL EXPOSURE TO TOXIC CHEMICALS CAN CAUSE CANCER IN ADULTS**

JOURNAL: *Reproductive Toxicology*

Scientists exposed pregnant rats to extremely low doses of Bisphenol A, a substance widely used in plastic products. The prenatal exposure to Bisphenol A resulted in a higher risk of breast cancer among the rats' offspring when they reached adulthood.[13]

**8. TINY METAL PARTICLES IN AIR POLLUTION CAUSE LUNG CANCER**

JOURNAL: *Journal of Thoracic Oncology*

Researchers in Texas discovered that metal particles found in particulate matter air pollution, especially zinc and chromium, are linked to lung cancer.[14]

**9. ORGANIC DIETS LOWER CHILDREN'S EXPOSURE TO PESTICIDES**

JOURNAL: *Environmental Health Perspectives*

This study concluded that children who switch from conventional food grown with pesticides to an organic diet have "immediate and dramatic" protection against the adverse health effects of exposure to pesticides.[15]

**10. MAINTAINING HEALTHY POPULATIONS OF NATIVE BIRD SPECIES PREVENTS SPREAD OF WEST NILE VIRUS**

JOURNAL: *Proceedings of the Royal Society B: Biological Science*

Scientists discovered that higher levels of native bird diversity are strongly associated with lower levels of West Nile virus prevalence in both humans and mosquitoes.[16]

**11. EATING RED MEAT INCREASES THE RISK OF BREAST CANCER FOR YOUNG WOMEN**

JOURNAL: *Archives of Internal Medicine*

A study of more than 90,000 premenopausal women found a strong association between higher red meat consumption and an elevated risk of certain forms of breast cancer.[17]

**12. PARTICLES IN AIR POLLUTION TRIGGER CARDIAC ARRHYTHMIAS**

JOURNAL: *Journal of Occupational & Environmental Medicine*

Studies in the U.S. and in Germany have found that elevated levels of air pollution, especially fine- and ultra-fine particulate matter, can disrupt normal heart functioning and can increase the risk of cardiac arrhythmias.[18]

## Chapter 1 Notes

[1] Boyd and Genuis, "The Environmental Burden of Disease."
[2] Pruss-Ustun and Corvalan, *Preventing Disease through Healthy Environments.*
[3] McAllister Opinion Research, *The Environmental Monitor 2006-1 Report.*
[4] Laghi, "Welcome to the New Climate"
[5] Bocking, *Nature's Experts.*
[6] For an excellent sample of new studies, see the peer-reviewed scientific journal *Environmental Health Perspectives*, available at www.ehponline.org.
[7] Anway and Skinner, "Epigenetic Transgenerational Actions;" Anway et al., "Transgenerational Effect of the Endocrine Disrupter."
[8] Ascherio et al., "Pesticide Exposure and Risk."
[9] Menke et al., "Blood Lead Levels."
[10] Veldhoen et al., "Bactericidal Agent Triclosan."
[11] Gauderman et al., "Effect of Exposure to Traffic."
[12] Powell and Kanarek, "Nanomaterial Health Effects."
[13] Murray et al, "Induction of Mammary Gland Ductal Hyperplasias."
[14] Coyle et al., "An Ecological Study."
[15] Lu et al., "Organic Diets."
[16] Ezenwa et al., "Avian Diversity and West Nile."
[17] Cho et al., "Red Meat Intake."
[18] Berger, "Runs of Ventricular;" Luttmann-Gibson, "Short-Term Effects."


*Genetics loads the gun, but environment pulls the trigger.*

Judith Stern, University of California, Davis

We need to define *environmental impacts on human health*. The failure to clearly define this term has contributed to public misunderstanding — and, in some cases, it has exaggerated fears — about the connection between the environment and health. For example, it has been reported that up to 90 per cent of cancers in Canada and other industrialized nations are due to environmental factors. This potentially misleading statistic originates from medical studies that indicated that less than 10 per cent of cancers are caused by genetic factors unique to specific individuals. Defined as broadly as possible, the remaining 90 per cent of cancers are described as being caused by all factors outside of individual genetic characteristics. Using this broad definition, "environmental" factors would then include factors such as fitness, diet, lifestyle, occupation, and socio-economic status.[1]

This non-specific definition is at odds with the narrower, conventional understanding that defines environmental factors affecting human health as pollution and damage to the natural environment, for example. The latter definition forms the basis of this report. It is important to emphasize that the majority of adverse environmental impacts on human health are preventable.

This report considers the key environmental health issues in Canada, including indoor air pollution, outdoor air pollution, water pollution, industrial chemicals, heavy metals, pesticides,

toxic substances in consumer products, climate change, ozone depletion, and declining biodiversity. It is important to understand that environmental health hazards have cumulative and interactive impacts. Adverse health effects occur as a result of the combined exposure to toxic substances. For example, children may be exposed to lead by drinking water or juice, eating food, ingesting old paint chips, and breathing air contaminated with lead dust. The health effects of lead may be exacerbated by exposure to other toxic substances and vice versa, although little is known about these interactive effects.

Canadians are exposed to environmental contaminants through the air we breathe, the fluids we drink, and the food we eat. It is also possible to absorb some kinds of pollutants through the skin. Even a fetus can absorb toxic substances to which its mother has been exposed. Recent evidence indicates that harmful substances such as heavy metals, flame retardants, and pesticides can penetrate the placenta.[2]

**A. Air Pollution**

> *I can remember when the air was clean and sex was dirty.*
>
> George Burns

i) Outdoor Air Pollution

Air pollution, primarily from burning fossil fuels in vehicles, power plants, and industrial facilities, is composed of many hazardous substances, such as carbon monoxide, nitrogen oxides, sulphur oxides, volatile organic compounds, small airborne particles, lead, and mercury. These pollutants can cause impaired lung function, shortness of breath, wheezing, asthma attacks, cardiovascular disease, cancer, and premature death.[3] There is new evidence, including a study conducted in Vancouver, that prenatal exposure to air pollution may also play a role in adverse birth outcomes, such as early fetal loss, preterm delivery, and lower birth weight.[4]

Some types of air pollution have decreased in Canada in recent decades because federal and

provincial governments have introduced strong regulations. For example, lead emissions fell dramatically after leaded gasoline was banned in 1990. Sulphur dioxide emissions, which cause acid rain, have declined by more than 50 per cent since the 1980s.[5] When the federal government reduced the legal limit of sulphur in gasoline, experts predicted that 11 million cases of croup and pneumonia; five million restricted activity days associated with asthma; 100,000 new cases of bronchitis; 9,000 emergency or hospital admissions; and 2,000 cases of premature mortality would be prevented in Canada's seven largest cities alone over the following 20 years.[6]

Nevertheless, air pollution remains a serious health problem in many parts of the country. Several recent studies estimating the number of deaths caused by air pollution in parts of Canada each year begin to quantify this concern:

- Health Canada estimates that 5,900 people in eight of Canada's largest cities die prematurely as a result of air pollution annually.[7] An extrapolation based on this estimate suggests that air pollution causes more than 11,000 deaths across Canada every year.[8]

- The Ontario Medical Association (OMA) estimates that 5,940 people in Ontario died as a result of air pollution in 2006.[9] This provincial estimate also suggests that there are more than 11,000 premature deaths nation-wide linked to air pollution, based on the populations of urban centres in other provinces. Worse, the OMA estimates that 10,000 people will die prematurely each year in Ontario by 2026 unless effective steps are taken to reduce smog.

- British Columbia's Provincial Health Officer estimates that between 140 and 400 people die prematurely every year due to air pollution in Vancouver (this is somewhat lower than Health Canada's estimate of 680 deaths in the study cited above).

Air pollution exacts a further toll on the health of Canadians in the form of various non-fatal illnesses. The OMA estimated that, in 2006, there were 17,070 hospital admissions and 60,640

emergency room visits in Ontario for respiratory and cardiovascular problems due to air pollution, as well as 29 million “minor illness days”, during which individuals either suffered from asthma symptoms or they had to restrict their activities. Most people affected by “minor illness days” are children and seniors.[10]

British Columbia’s Provincial Health Officer estimated that air pollution causes between 700 and 2,100 hospital visits, and between 900 and 2,750 emergency room visits each year in that province.[11]

The magnitude of air pollution’s adverse health effects will worsen in the coming decades as Canada’s population ages. Elderly people suffer disproportionately from respiratory and cardiovascular problems.

The majority of Canadians are exposed to smog at concentrations that pose a threat to their health. Levels of ground level ozone and particulate matter exceed Canadian health standards many days each summer in southern regions of Ontario and Quebec.[12] In 2005, Ontario had a record 53 smog advisory days, while Quebec had 24 smog advisory days and Atlantic Canada had three smog advisory days. Winter smog advisories were issued for the first time in Canadian history, with Quebec registering 10 winter smog days and Ontario registering five. “It is unacceptable that such days happen, when children with asthma and elderly people with respiratory conditions can't even leave their homes,” observed Rona Ambrose, Canada’s Minister of the Environment at the time.[13]

Ironically, given that motor vehicles are such a major contributor to air pollution, research is beginning to show that people inside vehicles are exposed to more pollution than people outside. For example, studies indicate that children riding in diesel school buses are exposed to significantly higher levels of air pollution inside the bus than outside.[14]

ii) Indoor Air Pollution

Indoor air pollution is often overlooked as an environmental health issue. Yet, Canadians spend close to 90 per cent of their time indoors,[15] meaning that exposure to air pollutants in residential, occupational, institutional, and recreational settings often outweighs outdoor exposure. Even hockey fans, partaking of Canada's great national pastime at indoor arenas, may be exposed to unhealthy levels of air pollution when Zambonis resurface the ice between periods.[16]

Indoor air pollution is caused by combustion (e.g., wood stoves, gas appliances); building materials; furnishings; human activities (e.g., smoking or painting); radon; and biological contaminants. Combustion releases various gases including nitrogen oxides, carbon monoxide, and particulate matter, all of which can contribute to respiratory problems. Furnishings, carpets, adhesives, construction materials, cleaners, and consumer products contaminate indoor air with benzene, formaldehyde, and other volatile organic compounds that can cause cancer, birth defects, and brain damage. Biological contaminants, including molds, bacteria, dust mites, cockroaches, and animal dander, are linked to asthma and allergies.

iii) Radon

Radon is a naturally occurring radioactive gas that comes from the decay of uranium, which is distributed in varying concentrations throughout soil and rocks in Canada. Although it receives little public attention, radon is one of the most harmful forms of indoor air pollution in Canada. Recent studies show that radon is the second most important cause of lung cancer after smoking, accounting for between 9 per cent and 15 per cent of all lung cancer deaths in North America and Europe.[17] In Canada, between 1,700 and 2,900 people die as a result of radon exposure.[18] There are synergistic effects between radon exposure and smoking. The risks of lung cancer due to radon exposure increase at a much higher rate for smokers and ex-smokers. Radon is also the leading cause of lung cancer among non-smokers.

Radon seeps into buildings through cracks and other weaknesses in foundations and floors. To a much lesser extent, radon can enter homes through drinking water. The good news is that it is not expensive to measure radon concentrations in a home and to protect oneself against exposure. Radon can be mitigated effectively, both in new home construction and in retrofitting existing buildings.[19]

iv) Second-Hand Smoke

Smoking and exposure to second-hand smoke remain major public health issues in Canada, despite declining smoking rates. About one-quarter of Canadians are daily or occasional smokers, while another quarter of Canadians are exposed to second-hand smoke on a regular basis in their homes.[20] Burning tobacco produces a complex array of gases, vapors, and particulate matter, including dozens of known or suspected carcinogens. Second-hand smoke is implicated in many respiratory ailments, including asthma, bronchitis, pneumonia, heart disease, and sudden infant death syndrome. More than 1,000 Canadians die each year because of lung cancer and heart disease caused by exposure to second-hand smoke.[21]

v) Volatile Organic Compounds

Volatile Organic Compounds (VOCs) are emitted as gases from certain solids and liquids, including paints varnishes, paint strippers, cleaning supplies, hair spray, windshield washer fluid, liquid fuels, building materials, furnishings, office equipment (e.g., copiers and printers), craft materials (e.g., glues and adhesives), permanent markers, and photographic solutions. VOC levels are generally higher indoors than outdoors. They can be up to 1,000 times higher than normal during activities such as paint stripping. According to the U.S. Environmental Protection Agency, exposure to VOCs can cause eye, nose, and throat irritation; headaches; loss of coordination and nausea; damage to the liver, kidneys, and central nervous system; and cancer. VOCs are particularly problematic for Canadians suffering from chemical sensitivities. Among the most hazardous VOCs are benzene, formaldehyde, toluene, methylene chloride, and perchloroethylene.[22]

***Asthma***

***More than 400 Canadians die from asthma each year. Asthma affects more than 2.7 million Canadians, including one in eight children. Canadian rates of childhood asthma have risen dramatically. From 1978 to 1999, the percentage of children with asthma quadrupled to its current level of more than 12 per cent.[23] Asthma is the leading cause of emergency room visits and school absenteeism. It is the third leading cause of work absenteeism. Asthma costs our health care system $600 million every year.[24]Experts believe that reducing exposure to indoor and outdoor air pollution is one of the five key actions required to reduce the health impacts of asthma.[25]***

**B. Water Pollution**

> *It isn't pollution that's harming the environment. It's the impurities in our air and water that are doing it.*
>
> Dan Quayle, former U.S. vice-president

Walkerton, North Battleford, and Kashechewan attracted national attention after they suffered water contamination problems. While the severity of these public health disasters is uncommon in Canada, water quality problems are not. The major threats to drinking water quality in Canada are microbiological contaminants — bacteria, viruses, and protozoa — such as *E. coli*, *Giardia*, *Cryptosporidium*, and *Toxoplasmosis*. [26] These water-borne pathogens cause adverse effects ranging from mild gastroenteritis (upset stomach) to severe diarrhea and death. Some of these pathogens are not adequately controlled by disinfection with chlorine. Other treatments, such as ultraviolet disinfection, ozonation, or advanced filtration techniques, may be required to protect public health.

The chemical contamination of water poses another serious problem. Industrial pollutants enter the water supply from a multitude of point sources (e.g., factories, sewage treatment plants, gas stations, dry cleaners) and non-point or dispersed sources (e.g., agricultural runoff, airborne deposition). For example, solvents such as perchloroethylene and trichloroethylene (associated with breast cancer and childhood leukemia respectively) have been detected in Canadian water supplies.[27] In other cases, contamination comes from natural sources, such as rock formations that leach arsenic. Arsenic increases the risk of lung cancer and bladder cancer. Arsenic has been measured in drinking water in some areas at levels that exceed Canadian guidelines.[28] Studies also demonstrate that chemicals produced by the disinfection of drinking water with chlorine (i.e., disinfection byproducts) increase the risk of bladder cancer.[29] Although most experts believe that the risks of developing bladder cancer are outweighed by the protective benefits of chlorination, governments responsible for providing safe drinking water should consider alternatives such as ultraviolet disinfection. Potential health effects associated with exposure to chemicals in drinking water include cancer, neurological disorders, damage to internal organs, gastrointestinal illness, reproductive problems, developmental disorders, and disruption of the endocrine or hormone systems.

A recent study revealed that, between 1974 and 2001, there were 288 outbreaks of water-borne diseases in Canada caused by pathogens including *Giardia*, *Campylobacter*, *Cryptosporidium*, Norwalk-like viruses, *Salmonella*, and hepatitis A.[30] The federal government estimates that contaminated drinking water in Canada causes roughly 90 deaths and 90,000 cases of gastrointestinal illness annually.[31] Estimates by independent health experts suggest a much higher number of Canadians suffer from gastrointestinal illness due to contaminated drinking water. One study in Montreal found that contaminants in tap water caused 35 per cent of gastrointestinal illnesses, while a second study in that city found that contaminated tap water caused between 14 per cent and 40 per cent of gastrointestinal illnesses. [32] A study in Vancouver found that variations in drinking water quality explained approximately 17,500 physician visits, 85 hospital admissions, and 138 pediatric hospital emergency room visits.[33] Due to widespread under-reporting, the actual number of cases is probably 10 to 1,000 times higher than the number

of confirmed cases.[34] A study in Edmonton, a city renowned for the high quality of its water treatment system, found no correlation between drinking water and gastrointestinal illnesses.

Hundreds of Canadian communities are plagued by recurring boil water advisories, meaning that residents cannot safely drink the water that comes from their taps. Canada does not have comprehensive national data on boil water advisories.[35] Rural Canadians face even more serious health threats from their drinking water than most city residents. Between 20 per cent and 40 per cent of all rural wells have nitrate concentrations or coliform bacteria occurrences in excess of drinking water guidelines.[36] The situation is most troubling in Aboriginal communities. Seventy-five per cent of the water systems on reserves face significant threats to the quality and safety of drinking water.[37]

Water pollution can also jeopardize the health of Canadians if they participate in aquatic activities at contaminated beaches, or if they eat contaminated shellfish or fish. Canada does not collect national data on beach closures. Yet, each year, thousands of beaches close due to water pollution. Thousands of square kilometers along the coasts of British Columbia, Quebec, and Atlantic Canada are subject to ongoing shellfish closures due to bacterial contamination from municipal waste water and other sources of pollution.[38]

Although eating fish is generally considered to be part of a healthy diet, mercury contamination among some fish species in some regions of Canada has resulted in fish consumption advisories warning Canadians, particularly pregnant women, to limit their intake. Fish in Canadian rivers and lakes may also be contaminated by PCBs, dioxins, and a host of pesticides. The Ontario government warns that “Women of child-bearing age and children under 15 should restrict their consumption of most sport fish caught in Ontario waters [and] some freshwater fish should not be consumed at all.”[39] In the U.S., mercury poisoning adversely affects as many as one in six women, and it causes developmental problems that cost the U.S. economy an estimated US$8.7 billion dollars annually.[40]

## C. Industrial Chemicals

*Plastics are the fifth food group.*

Chemical industry advertising campaign, 1980s

Chemicals created through human ingenuity often have unexpected and highly undesirable consequences. DDT was considered a miraculously effective pesticide until Rachel Carson wrote about its destructive impacts on biological diversity in *Silent Spring*. CFCs were also considered a wonder chemical. They were widely used in refrigeration because they were cheap and "safe". Decades later, scientists discovered that CFCs were destroying the ozone layer that makes life on Earth possible. Industrial society seems reluctant to learn from its mistakes. New chemicals are created and widely used before their potentially harmful effects on human health and the environment are studied.[41]

Studies published by Environmental Defence Canada in 2005 and 2006 revealed that a toxic cocktail of industrial chemicals contaminates the bodies of Canadians in all parts of the country and from all walks of life.[42] Lab tests that screened volunteers for 88 chemicals detected an average of 44 in each person's body. These chemicals included 18 heavy metals, 14 PCBs, 10 organochlorine pesticides, seven volatile organic compounds, five PBDEs (polybrominated diphenyl ethers, used as flame retardands), five organophosphate pesticide metabolites, and one PFC (perfluorochemicals, found in many consumer products). A study involving children produced similar results, with the level of toxins higher in the bodies of some children than in the bodies of their parents.[43] A recent U.S. study found more than 200 industrial chemicals in the cord blood of newborn infants.[44]

These findings indicate that every single Canadian is part of an unprecedented scientific experiment. Blood and urine samples will reveal the presence of dozens, if not hundreds, of man-made chemicals that were unknown to nature a century ago. These chemicals are known or suspected cancer-causing agents. They can also cause birth defects, prevent the normal

development of children, inflict brain damage, and interfere with the respiratory, reproductive, hormone, nervous, and immune systems.

***Cancer***

***One in 3 Canadians will be diagnosed with cancer, partly because people are living longer, partly because other diseases have been vanquished, and partly because we live in a society where carcinogens are ubiquitous. Each year, Canadian industries pump more than 22,000,000 kilograms of carcinogens into our air, water, and soil.[45] Carcinogens are found in many consumer products such as laundry soaps (liquid and powdered), nail polish, air fresheners, hair spray, perfumes, oral contraceptives, toilet cleaners, mothballs, paint strippers, and tile cleaners.[46]***

***Experts are concerned that exposure to environmental contaminants are associated with increasing rates of thyroid cancer and non-Hodgkin's lymphoma in young people. A peer-reviewed report by the Ontario Division of the Canadian Cancer Society found evidence linking arsenic exposure to lung, skin, and bladder cancers; ultraviolet radiation to skin cancer; particulate air pollution and polycyclic aromatic hydrocarbons (PAHs) to lung cancer; asbestos exposure to mesothelioma and lung cancer; drinking water disinfection by-products to bladder cancer; and extremely low frequency electromagnetic fields to childhood leukemia.[47] There is also mounting evidence linking pesticides and cancer.[48]***

**Cancer has been compared to the Black Death as the plague of the twentieth century. Its emergence parallels the gradual industrialization of the world, and the widespread introduction of new synthetic chemicals.**

**Roy Burden, in *The Suffering Gene: Environmental Threats to Our Health*, 2003**

Millions of kilograms of toxic chemicals are discharged into Canadian air, water, and land each year.[49] In 2003, major polluters in Canada released 22 million kilograms of carcinogens, 16 million kilograms of hormone disruptors, 4.3 billion kilograms of respiratory toxins, and more than billion kilograms of reproductive/developmental toxins.[50] These chemicals find their way into our bodies through ingestion (eating and drinking), inhalation (breathing), and absorption through our skin.

In most cases, the concentration of these substances in our bodies is quite small, and they can be measured in parts per billion or parts per trillion. Some chemical companies and a few scientists claim that the small amounts of toxic chemicals found in the bodies of Canadians are harmless, or even good for you. However there is a growing body of toxicological and epidemiological evidence indicating that even tiny amounts of toxic substances can wreak havoc on the exquisitely calibrated and sensitive human body. A recent report noted that "hundreds of studies in the peer-reviewed literature show that adverse health effects from low dose exposures are occurring in the population, caused by unavoidable contamination with PCBs, DDT, dioxin, mercury, lead, toxic air pollutants, and other chemicals."[51] The adage, "the dose makes the poison", is outdated. Other factors determine toxicity, including the timing of the exposure, the combined effects of multiple chemicals, and the genetic vulnerability of some individuals.

Health experts are particularly concerned about toxic substances that are persistent and bioaccumulative. Persistent means that a substance breaks down slowly or not at all in the environment. Bioaccumulative means that a substance builds up in the environment, and ultimately, in the bodies of living organisms, including humans. Some industrial chemicals are deliberately engineered so that they cannot be broken down or metabolized. Persistent and bioaccumulative substances can become widely dispersed across ecosystems and work their way up the food chain and into humans. Examples of these substances include:

- **Hexachlorobenzene,** which contaminate commercially-harvested fish in the Great Lakes region at concentrations as high as 17 parts per billion. Hexachlorobenzene also accumulates in both human breast milk and in fetal tissue. [52]

- **PCBs,** which are **c**ommon in virtually every ecosystem on the planet. PCBs are highly persistent. Studies show that PCBs can impair memory and learning in both adults and children who regularly eat fish from the Great Lakes. [53]
- **PFCs,** which persist in the environment for up to 50,000 years and which are detectable in human blood samples around the world. Predators such as bald eagles show levels of PFCs several times higher than their prey as a result of bioaccumulation. [54]
- **PBDEs,** which increased by 7,000 per cent in marine mammals from 1984 to 2003, and concentrations continue to double every three-and-a-half to four years. PBDEs have also been detected in samples of Canadian women's breast milk. [55]

Endocrine disruptors, a class of chemicals that imitate or block hormones, also pose serious health risks. Exposure to endocrine disruptors—even at levels once presumed safe—can result in reproductive and neurodevelopmental problems such as infertility and reduced sperm count.[56] Scientists have found that exposure to industrial chemicals and pesticides including Bisphenol A, methoxychlor, and atrazine, at levels previously regarded by regulators as the "no effect" levels, can still cause negative health impacts.[57]

New research suggests that exposure to toxic chemicals—particularly those that disrupt the endocrine system—can change the way that genes are expressed and, therefore, they can profoundly affect not just individuals, but also future generations. Computers provide a useful analogy. Genes, or the human genome, constitute the computer's hardware, whereas the epigenome is like the software. Endocrine disruptors affect the software—how genes express themselves—but not the hardware (the genes themselves).

For example, breast cancer researchers studied a protein called HOXA9 that plays a critical role in fighting breast cancer cells. Half of the women suffering from breast cancer lack the HOXA9 protein, making them genetically vulnerable to breast cancer. But half of the women suffering from breast cancer do have the HOXA9 protein—except it is not active. This protein has been turned off, possibly by exposure to an environmental contaminant. Even more startling,

experiments with mice show that once the HOXA9 protein is turned off in a mouse, the protein stays turned off in future generations of mice, thus making them more vulnerable to breast cancer.

The other dramatic discovery about epigenetics is that exposure to levels of a chemical that experts consider inconsequential to an adult can have profound consequences in the future for the developing fetus, the young child, and even adolescents.[58]

Individuals have different levels of susceptibility to environmental health impacts. Dramatic advances in our understanding of the human genome have opened the door to studying gene-environment interactions. Some individuals may have variations in a gene that metabolizes toxins, suggesting that while certain toxins may be harmless to some people, they can make others sick.[59] For example, a recent study in the U.S. found that some individuals are 10,000 times more sensitive to certain types of particulate air pollution.[60]

***Cover-Up***

***In 2005, DuPont agreed to pay US$16.5 million for failing to report to the U.S. government the results of studies showing grave threats to human health from exposure to PFOA. DuPont also agreed to pay US$107.6 million to settle a class action lawsuit involving PFOA contamination of drinking water from its Teflon manufacturing plant in Virginia. In 2006, the U.S. Environmental Protection Agency asked eight manufacturers to voluntarily reduce the production of PFOA by 95 per cent by 2010, and to eliminate the production of PFOA by 2015. The eight manufacturers, including DuPont, have agreed.[61]***

## D. Heavy Metals

*We've got to pause and ask ourselves: How much clean air do we need?*
Lee Iacocca, CEO, Chrysler Corporation, 1979-1992

Some Canadians are exposed to elevated levels of naturally occurring, yet dangerous heavy metals as a result of industrial activities. Lead and mercury poisonings are of particular concern. Lead poisoning causes a range of chronic health impacts, especially among children, menopausal women, and the elderly. Lead poisoning can cause cognitive deficits, developmental delays, hypertension, impaired hearing, attention deficit disorder, reduced intelligence, and learning disabilities in children.[62] We have known for many years that lead is a major threat to children's health; now there is accumulating evidence that lead poses a threat to adults too, especially to menopausal women, and the elderly.[63] As bones thin with age, lead is released into the blood, contributing to an array of negative health effects, including cataracts, Alzheimer's disease, Parkinson's disease, other forms of dementia, high blood pressure, cardiovascular disease, and impaired kidney function.

The good news about lead is that emissions and ambient air concentrations declined dramatically when Canada belatedly phased out leaded gasoline in 1990. However, lead continues to be a concern because of lead contamination in soil and dust, industrial lead emissions, lead-based paint in older houses, lead in drinking water from plumbing, and lead in consumer products (e.g., crystal, costume jewelry, and make-up). Lead shot ammunition also contributes to lead poisoning, particularly among Aboriginal people whose diets are more dependent on wild fish and game.[64]

The level of lead deemed "safe" in children's blood has decreased over the decades. This reflects a common pattern for environmental contaminants. Over time, the acceptable levels of specific contaminants decline as we better understand their health impacts. Medical experts and the U.S. Environmental Protection Agency now recognize that harmful health effects may occur at very

low blood lead levels and that there is no safe level of exposure to lead (although risks are lower with lower exposures).[65]

Mercury is another heavy metal that can harm the development of fetuses and young children at very low concentrations, causing brain damage and impairing the nervous system. In a recent study, 95 per cent of lakes surveyed in Ontario had fish that were contaminated with mercury at levels that were higher than the World Health Organization's guideline of 0.5 mg/kg to 1.0 mg/kg of fish body weight, resulting in widespread fish consumption warnings, especially for pregnant women.[66] Most of the mercury pollution in Canada is generated by Canadian and U.S. coal-fired electricity generating facilities.[67]

Exposure to other heavy metals, such as arsenic, chromium and cadmium, also pose a threat to the health of Canadians.

**E. Pesticides**

> *"He's committed pesticide!"*
>
> The Grasshopper, in *James and the Giant Peach*, by Roald Dahl

The health impacts of pesticides can be divided into two main categories: acute effects and chronic effects. Acute effects, i.e., poisonings, occur after heavy exposure and are well-documented in the medical literature.[68] Chronic effects develop in response to lower levels of exposure over longer periods of time. Conclusively proving a cause and effect relationship between pesticides and chronic health impacts is challenging because so many potential factors are involved. As mentioned earlier, it is likely that all Canadians have pesticide residues in their bodies. The health concerns associated with chronic exposure to pesticides include an increased risk of cancer (e.g., non-Hodgkin's lymphoma, childhood leukemia, and breast cancer); neurological impairment (e.g., Parkinson's disease, Alzheimer's disease); developmental effects (e.g., autism); reproductive effects (e.g., sperm abnormalities, birth defects); organ damage, and interference with the hormone system.[69] In July 2006, a study published in the *Annals of*

*Neurology* examined the relationship between pesticide exposure and Parkinson's disease in more than 140,000 people.[70] Exposure to pesticides—even at low levels—increased the likelihood that an individual would suffer from Parkinson's disease by 70 per cent compared to individuals not exposed to pesticides.

We do not know the precise number of Canadians suffering from acute impacts from pesticides because pesticide poisoning data are not systematically reported or monitored in Canada. However, statistics collected from provincial poison control centres indicate that at least 6,000 Canadians are victims of unintentional pesticide poisonings each year.[71] This figure includes more than 2,800 cases where the victim is a child aged five or under. In the U.S., poison control centres report more than 100,000 cases of pesticide poisonings each year, the majority of which involve children.[72]

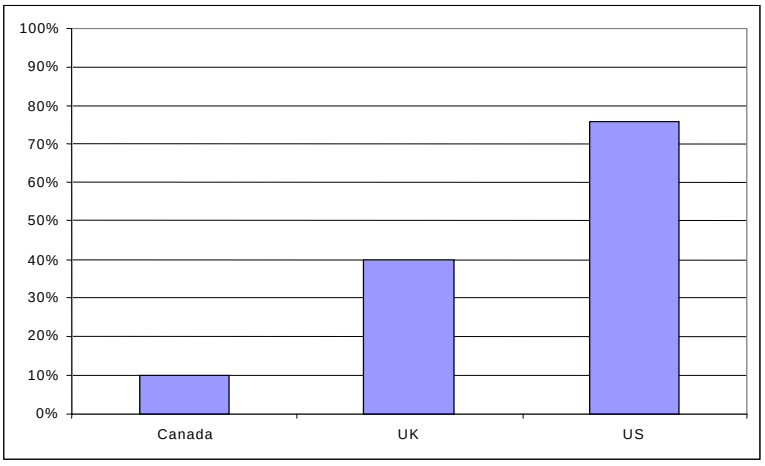
***Canada's Pesticide Rules Are Weaker than Wal-Mart's Policies***

***In 2006, Wal-Mart announced plans to eliminate the use of 20 hazardous chemicals used in pesticides, cleaning products, and other household items. Wal-Mart will work with its suppliers to find safer substitutes for these hazardous chemicals. Wal-Mart has specifically targeted the elimination of permethrin and propoxur because of their threats to human health.[73] These pesticides are still approved for use by the Canadian government and are found in more than 300 commercially available products in Canada.[74]***

Canadian data—collected by monitoring pesticide residues in the food supply—are strikingly inconsistent with similar sampling programs conducted in the U.S. and the United Kingdom, as shown in Chart 2.1. Between 2004 and 2005, the Canadian Food Inspection Agency found pesticide residues on 10 per cent of produce samples tested.[75] In contrast, in 2004, the U.S. Department of Agriculture found pesticide residues on 76 per cent of fresh fruit and vegetables tested.[76] In the United Kingdom, a study published in 2006 by the Government Pesticide Residues Committee found 40 per cent of fresh fruit and vegetables sampled were contaminated

with pesticides.[77] The Canadian Food Inspection Agency reported a decrease in detectable residues of organophosphate pesticides on produce from 12 per cent to 3 per cent between 1995 and 2002.[78] In the U.S., the percentage of fruits and vegetables with detectable residues of organophosphate pesticides ranged from 19 per cent to 29 per cent between 1994 and 2001. The American and British statistics are much higher than the Canadian statistics. It is difficult to believe that fruits and vegetables in Canada are so much cleaner than produce in the U.S. or the United Kingdom, especially when a substantial proportion of Canadian produce is imported from the U.S. The David Suzuki Foundation has asked the Auditor General of Canada to investigate these glaring inconsistencies.

**Chart 2.1 – Slipping Through the Cracks? Results of Canadian, British, and American Pesticide Sampling Programs**




## F. Climate Change

*Kyoto is essentially a socialist scheme to suck money out of wealth-producing nations.*
Stephen Harper, then leader of the Canadian Alliance, 2002

Medical experts believe that climate change will cause wide-ranging, mostly adverse consequences for human health.[79] Health Canada identifies eight major categories of negative health-related impacts associated with climate:

- illnesses and deaths caused by hotter and colder temperatures;
- deaths, injuries, and illnesses caused by extreme weather events;
- increased exposure to outdoor and indoor air pollutants;
- water-borne and food-borne contamination;
- increased exposure to ultraviolet radiation;
- the spread of vector-borne diseases to previously unaffected areas;
- disproportionate impacts on vulnerable populations; and
- socio-economic impacts.[80]

Predictions about water shortages caused by, or exacerbated by, global warming also have serious health implications for affected populations.

Globally, the three primary health concerns are weather-related mortality, infectious diseases, and the health effects of air pollution, including respiratory and cardiovascular diseases, and exposure to allergens.[81]

- **Weather-Related Mortality**: Extreme temperatures can aggravate health problems, particularly for the old, the young, and the ill. For example, the heat wave that plagued Europe in the summer of 2003 killed more than 22,000 people.[82] Toronto and Montreal each experience approximately 120 heat-related deaths annually. According to the World Health Organization, these figures could climb to between 290 and 560 deaths, and between 460 and 725 deaths, respectively, by 2020 due to climate change.[83] Storms are expected to increase in frequency and severity. Hurricanes increase in intensity when surface sea temperatures rise.[84]

- **Air Pollution Impacts:** Climate change will cause air quality in Canada to worsen as warmer temperatures exacerbate the formation of ground level ozone and smog.[85] Climate change may also increase the risks associated with respiratory diseases because

grasses and allergenic pollens grow more profusely in warmer environments. A 2002 study by researchers at Harvard University showed that ragweed, a potent allergen producer, grew 61 per cent faster under climatic conditions expected by 2050.[86]

- **Infectious Diseases:** Vector-borne diseases, such as West Nile virus, Lyme disease, hantavirus, and malaria, may spread to new regions due to climate change.[87] Over the past five years, West Nile virus in Canada has caused approximately 15 deaths and hundreds of illnesses annually.[88] A tropical fungus invaded Vancouver Island in recent years, resulting in several deaths and dozens of illnesses.[89]

The combined effects of extreme heat and air pollution will be particularly deadly and expensive for urban residents. Government researchers studying the links between mortality and extreme heat, cold, and air pollution estimated that more than 2,500 people in Toronto, Montreal, Ottawa and Windsor would die prematurely due to air pollution and extreme heat. Under climate change scenarios, the number of deaths could climb by 30 per cent in 2050 and by 45 per cent by the 2080s. Estimating the value of lives lost, researchers predicted the cost would be $3.5 billion a year by the 2050s and $4.4 billion by the 2080's. In addition to these economic losses, it will cost more than $7 million a year to tend to people with heart or lung failure. [90]

**G. Declines in Biological Diversity**

*Trees cause more pollution than automobiles.*
Ronald Reagan, former U.S. President

The connections between biodiversity and human health are not well understood. However, we do know that healthy ecosystems and native species contribute to human health. Ecosystems detoxify soils and sediments, maintain water quality, produce oxygen and sequester carbon, and control pests naturally. Wild species also facilitate biomedical research and provide medicinal products ranging from morphine to taxol (a cancer-fighting drug derived from the bark of yew trees).[91] Approximately 40 per cent of pharmaceuticals in North America are derived from wild

plants and animals. The contributions of biodiversity to human health and well-being are substantial, so much so that World Health Organization researchers claim that "ecological integrity is emerging as a cornerstone of public health."[92]

New research indicates that disturbances to ecosystems and declines in biological diversity alter patterns of infectious diseases, thus posing a threat to human health. For example, scientists have discovered that West Nile virus is less likely to threaten human health in areas where there is a higher diversity of native bird species that are poor hosts for West Nile virus.[93] Higher levels of native bird diversity are strongly associated with lower levels of West Nile virus prevalence in both humans and mosquitoes. A similar situation is believed to exist with respect to other vector-borne diseases, such as Lyme disease, which is carried by ticks.[94]

Extensive damage to ecosystems will also cause indirect damage to human health. For example, overfishing in the Maritimes led to the collapse of the Atlantic cod industry. This ecological catastrophe led to widespread unemployment and major social problems, which in turn contributed to various negative health effects.[95]

**H. Depletion of the Ozone Layer**

> *Ozone Man, Ozone. He's crazy, way out, far out, man.*
>
> George Bush, Sr., referring to Al Gore, 1992

Industrial chemicals, such as CFCs have damaged the Earth's protective ozone layer. The resulting higher levels of UVB radiation could cause extensive damage to both the environment and human health.[96] Potential health impacts include sunburn, skin cancer, other skin disorders, cataracts, other forms of eye damage, and reduced efficiency of the human immune system.

Canada is one of the countries most at risk from ozone depletion because of its northern location. Between 1969 and 1992, there was a threefold increase in melanoma cancer rates in Canada,

partly due to ozone depletion.[97] The latest statistics from the Canadian Cancer Society and the National Cancer Institute of Canada indicate that 753 Canadians died of melanoma skin cancer in 2002, while approximately 4,000 new cases of melanoma skin cancer were diagnosed. An estimated 68,000 new cases of non-melanoma skin cancer were diagnosed in 2006.[98]

Thousands of Canadians are diagnosed with cataracts every year.[99] American researchers estimate that by 2050, cataract rates will increase by 1.3 per cent to 6.9 per cent, partly due to ozone depletion. This could amount to as many as 830,000 new cases in the U.S. by 2050, which could cost the health care system close to US$3 billion.[100]

## I. Other Environmental Threats to Health in Canada

### A) Asbestos

Asbestos was once considered a "miracle mineral" for its ability to withstand heat. It was used in thousands of products, including fireproofing and insulating material in ships, buildings, and consumer products; and in wallboard, flooring, cement, automobiles, clothing, home appliances, and children's toys. Asbestos exposure causes a form of cancer called mesothelioma, which kills hundreds of Canadians every year.[101] Asbestos also increases the risk of lung cancer and causes asbestosis, a degenerative lung disease. These diseases may develop 20 to 40 years after exposure.

Conclusive evidence that all forms of asbestos are carcinogenic has led most industrialized nations—including all 25 members of the European Union—to ban the use of this hazardous substance.[102] There are now strict restrictions on the use of asbestos in Canada. However, Canada is one of the world’s largest asbestos exporters and it has fought international efforts to restrict the export of asbestos. Canada’s claim that the specific type of asbestos that is mined in Quebec is “safe” does not withstand scientific scrutiny.[103]

Although widely perceived as an occupational health problem, exposure to asbestos could affect thousands of Canadians. The spouses and children of men who worked with asbestos in mining, manufacturing, or construction are at risk because of exposure to asbestos fibres that were unwittingly brought home from the workplace. As well, between 200,000 and 300,000 Canadian homes contain vermiculite insulation that is contaminated by asbestos.

In the U.S., more than 600,000 individuals have filed lawsuits about asbestos exposure against more than 6,000 defendants. To date, defendants and insurers have spent an estimated US$54 billion to resolve claims. It is estimated that between 1.1 million and 3 million people will eventually file asbestos claims. The eventual cost of asbestos litigation is estimated at between US$200 billion and US$265 billion.[104]

B) Noise

Noise is another widely overlooked environmental factor that can harm people's health. Health impacts associated with excessive noise include hearing loss, high blood pressure, heart disease, changes in hormone levels, and circulatory problems.[105] Noise receives much more attention as an environmental health issue in Europe than it does in Canada.[106]

C) Radiation

Exposure to radiation from radon and sunlight were addressed under the *Indoor Air Quality* and *Ozone Depletion* sections of this report. However there is also concern about the health impacts of exposure to extremely low frequency electromagnetic fields. There is evidence indicating that children exposed to extremely low frequency electromagnetic fields are at risk of childhood leukemia.[107] As well, a portion of the population seems to suffer from electrohypersensitivity—an allergic reaction to the electromagnetic fields produced by cell phones, appliances, power lines, and other electrical devices.

D) Consumer Products

Each year, thousands of Canadians—predominantly children—become ill after being exposed to ordinary household products that contain toxic chemicals. The top two reasons for calls to poison control centres in the U.S. are for cleaning products (230,000 cases annually) and cosmetics or personal care products (225,000 cases annually). Since Canada does not have a comparable national poisonings database, figures are not available for Canadian poisonings caused by cleaning products, cosmetics, and personal care products.

In Canada, cleaning products such as laundry detergents, rust removers, and air fresheners may contain carcinogens and other hazardous substances, but the labels do not provide any warnings. Cosmetics, which people apply directly to their skin, may contain carcinogens, neurotoxins, and suspected endocrine disruptors, again without any warning to the consumer. Pressure-treated lumber, found in many Canadian playgrounds, may contain arsenic and chromium, two known carcinogens. These carcinogens increase children's risk of developing neurological damage, lung cancer, and bladder cancer.

Thousands of other chemicals of concern are found in a dizzying array of consumer products. Baby pacifiers and plastic water bottles may leach Bisphenol A, a reproductive toxin; perfumes and hairsprays contain DEHP, a suspected endocrine disruptor; and lip balm contains cyclotetrasiloxane, which poses reproductive and developmental risks.[108] Canada simply is not doing enough to understand and control toxic exposures resulting from the routine use of consumer products.

**Chapter 2 Notes**

[1] Lippman, Cohen, and Schlesinger, *Environmental Health Science.*
[2] Knox, "Childhood Cancers and Atmospheric Carcinogens," "Roads, Railways," and "Oil Combustion."
[3] Curtis et al., "Adverse Health Effects;" Krewski et al., "Mortality and Long-Term Exposure."

[4] Liu, Chen, and Burnett, "Gaseous Ambient Air Pollutants;" Schwartz, "Air Pollution."
[5] Env. Canada, *Canadian Acid Rain Assessment.*
[6] Jessiman and Burnett, "Sulphur in Gasoline."
[7] Judek et al., "Estimated Number of Excess Deaths."
[8] The Health Canada study considered the health effects of pollution in specific census divisions covering parts of Windsor, Hamilton, Ottawa, Toronto, Montreal, Quebec City, Calgary, and Vancouver, representing 8.9 million Canadians. The total population of these eight cities, plus London, Winnipeg, and Edmonton (all among the 10 most populous cities in Canada and thus likely to be affected by urban air pollution) is 17.3 million – roughly double the population considered in the study (See Statistics Canada, *Population of Census Metropolitan Areas*).
[9] OMA, *Smog's Excess Burden* and *Illness Costs of Air Pollution*.
[10] OMA, *Smog's Excess Burden* and *Illness Costs of Air Pollution*.
[11] B.C. Prov. Health Officer, *Every Breath You Take*.
[12] Env. Canada, *National Air Pollution Surveillance.*
[13] Ambrose, A Breath of Fresh Air.
[14] Behrentz et al., "School Bus-Related Microenvironments."
[15] Health Canada, Indoor Air Quality.
[16] Levy et al., "Nitrogen Dioxide Concentrations;" Rundell, "High Levels."
[17] Krewski et al., "Residential Radon;" Darby et al., "Radon in Houses."
[18] Boyd, *Radon: An Unfamiliar Killer*.
[19] Samet, Spengler, and Mitchell, "Indoor Air Pollution,"
[20] CIHI, Can. Lung Assoc., Health Canada, and Stat. Can., *Respiratory Disease in Canada.*
[21] de Groh and Morrison, "Environmental Tobacco Smoke;" Makomaski Illing and Kaiserman, "Mortality Attributable to Tobacco Use."
[22] Pollution Probe, *Volatile Organic Compounds*; U.S. EPA, Introduction to Indoor Air.
[23] CIHI, Can. Lung Assoc., Health Canada, and Stat. Can., *Respiratory Disease in Canada*..
[24] Can. Lung Assoc., *Asthma.*
[25] Masoli et al., "Global Burden of Asthma."
[26] Hrudey and Hrudey, *Safe Drinking Water*; Krewski et al., "Managing Health Risks"
[27] Aschengrau, Rogers, and Ozonoff, "Perc-Contaminated Drinking Water;" Costas, Knorr, and Condon, "Childhood Leukemia."
[28] IARC, "Arsenic in Drinking-Water."
[29] Cantor et al., "Drinking Water Source."
[30] Schuster et al., "Infectious Disease Outbreaks."
[31] Health Canada, Environmental Sustainability and Health.
[32] Payment et al., "Prospective Epidemiological Study" and "Gastrointestinal and Respiratory Diseases."
[33] Aramini et al., "Drinking Water Quality."
[34] Edge et al., Waterborne Pathogens.
[35] Gov. of Canada, *Children's Health and the Environment.*
[36] van der Kamp and Grove, Well Water Quality.
[37] Commissioner of the Environment, Drinking Water.
[38] Environment Canada, Shellfish Water Quality Protection.

[39] Ont. Min. of Environment, *Guide to Eating Ontario Sport Fish.*
[40] Trasande, Landrigan, and Schechter, "Public Health;" Schober et al., "Blood Mercury Levels;" Mahaffey, Clickner, and Bodurow, "Blood Organic Mercury."
[41] Harremoës et al, *Late Lessons from Early Warnings.*
[42] Environmental Defence Canada, *Toxic Nation.* For a study with a much larger sample size, conducted biannually in the U.S., see U.S. CDC, *Third National Report.*
[43] Environmental Defence Canada, *Polluted Children.*
[44] Environmental Working Group, *Body Burden: Newborns.*
[45] Environmental Defence Canada, *Toxic Nation.*
[46] Labour Env. Alliance Society, *CancerSmart.*
[47] Cancer Care Ontario, *Insight on Cancer.*
[48] Sanborn et al, *Pesticides Literature Review*; Evans, *State of the Evidence;* Sears et al., "Pesticide Assessment."
[49] Environmental Canada, National Pollutant Release Inventory.
[50] Environmental Defence Canada, *Toxic Nation.*
[51]Environmental Working Group, Mt. Sinai, and Commonweal, *Body Burden: People.*
[52] Newsome and Andrews, "Organochlorine Pesticides."
[53] Schantz et al., "Impairments of Memory."
[54] Giesy and Kannan "Global Distribution of Perfluorooctane Sulfonate."
[55] Boyd and Wallace, *Fireproof Killer Whales.*
[56] Choi, Yoo, and Lee, "Toxicological Characteristics."
[57] Thornton, McCally, and Houlihan, "Biomonitoring of Industrial Pollutants."
[58] Watters, "DNA is Not Destiny;" Fischer, "Breast Cancer."
[59] Wilson, Genetics and Environmental Health.
[60] Hattis et al., "Human Inter-Individual Variability."
[61] U.S. EPA, Perfluorooctanoic Acid (PFOA).
[62] Lanphear et al., "Low-Level Environmental Lead;" U.S. EPA, *America's Children and the Environment.*
[63] Spivey, "The Weight of Lead."
[64] Gov. of Canada, *Children's Health and the Environment.*
[65] Canfield et al, "Intellectual Impairment;" Lanphear et al., "Cognitive Deficits;" Rothenburg and Rothenberg, "Testing the Dose-Response Specification."
[66] Environment Canada, *Status of Mercury in Canada.*
[67] Lourie, *Mercury in the Environment.*
[68] Reigart and Roberts, *Recognition and Management of Pesticide Poisoning.*
[69] Evans, *State of the Evidence;* Buckley, et al., "Pesticide Exposures;" Gilliland, Salam, and Langholz, "Early Life Risk Factors;" Ziaomei et al., "Critical Windows;" Sears et al., "Pesticide Assessment;" Sanborn et al., *Pesticides Literature Review.*
[70] Ascherio et al., "Pesticide Exposure and Risk."
[71] Boyd, *Northern Exposur*e.
[72] Watson et al., "2004 Annual Report."
[73] Wal-Mart, Wal-Mart Launches Innovative Program.
[74] Boyd, *The Food We Eat.*

[75] Can. Food Inspection Agency, *Report on Pesticides.*
[76] U.S. Dept. of Agriculture, Annual Summary Calendar Year 2004.
[77] U.K. Pesticide Residues Committee, *Pesticide Residues Monitoring Report.*
[78] CEC, *Children's Health and the Environment.*
[79] Martens and McMichael, *Environmental Change.*
[80] Health Canada, *Climate Change and Health.*
[81] Epstein and Mills, *Climate Change Futures.*
[82] Kovats, Wolfe, and Menne, "Heatwave of August 2003"
[83] McMichael, Haines, Slooff, and Kiovats, *Climate Change and Human Health.*
[84] Emanuel, "Increasing Destructiveness;" Knutson and Tuleya, "Impact of $CO_2$."
[85] Bernard et al., "Potential Impacts of Climate Variability."
[86] Wayne et al., "Production of Allergenic Pollen."
[87] Charron, "Potential Impacts of Climate Change."
[88] Public Health Agency of Can., Annual Summaries of Human Surveillance.
[89] Bartlett et al., Cryptococcus Gattii.
[90] Cheng et al., Differential and Combined Impacts.
[91] Chivian, *Biodiversity and Its Importance.*
[92] Soskolne and Bertollini, *Global Ecological Integrity.*
[93] Ezenwa et al., "Avian Diversity and West Nile."
[94] Ostfeld and Keesing, "Biodiversity Series" and "Biodiversity and Disease Risk."
[95] F/P/T Advisory Cmte. on Pop. Health, *Toward a Healthy Future.*
[96] de Gruijl and van der Leun, "Environment and Health 3."
[97] Auditor General of Can., Ozone Layer Protection.
[98] CCS and NCIC, Canadian Cancer Statistics.
[99] Adviware, Statistics by Country. Estimate of cataract incidence in Canada, based on U.S. cataract rates of 47,805 cases annually, based on a population of 32,507,874.
[100] West, "Model of Risk of Cortical Cataract."
[101] CCS and NCIC, Canadian Cancer Statistics.
[102] Cancer Care Ontario, *Insight on Cancer.*
[103] Landrigan, Nicholson, Suzuki, and Ladou, "Hazards of Chrysotile Asbestos."
[104] White, *Asbestos and the Future of Mass Torts.*
[105] Ising and Kruppa, "Health Effects and Noise;" Stansfeld and Matheson, "Noise Pollution."
[106] Rosenberg, "Jets over Labrador and Quebec."
[107] Cancer Care Ontario, *Insight on Cancer.*
[108] Pelley, "Chemicals Management."


*Currently there are many gaps in the knowledge base regarding the toxicity of chemicals and Canadians' exposure to them.*

House of Commons Standing Committee on Environment and Sustainable Development, 2007

*Effective policy and program decisions urgently require "(1) research to better define environmental hazards, susceptible populations, and dose-response relationships and (2) tracking systems to monitor population exposure levels."*

Dr. Donald Wigle in *Child Health and the Environment,* 2003

The preceding information raises disturbing questions about the impact of environmental degradation on human health and well-being in Canada. To make matters worse, the extent of our knowledge about environmental impacts on human health is dwarfed by what we do not know. There are three general categories of information that are required to protect the health of Canadians from environmental threats. First, we need data on environmental hazards. What harmful substances, in what quantities, and in what locations, are present in our environment, and where are they coming from? Second, we need data on human exposures to environmental hazards. What harmful substances are entering our bodies, in what concentrations, and along which pathways (e.g., air, water, food, skin)? Third, we need to understand the relationships between human exposures to environmental threats and the adverse health effects that may occur as a result. Canada faces serious gaps in its knowledge of these three categories.

***Responding to Scientific Uncertainty: the Precautionary Principle***

***Historically, the Canadian approach to regulation has been to consider chemicals "innocent until proven guilty." Toxic substances are allowed to remain in use until conclusive evidence shows that they cause negative health impacts. Canada is slow to protect our health from environmental impacts because there is still scientific uncertainty surrounding some of the connections between environmental degradation and disease or death. The uncertainty is caused by several factors:***

- ***Many toxic substances have never been tested to determine their impacts on human health;***
- ***Research focuses on exposure to a single substance, but real life involves exposure to complex mixtures of substances;***
- ***Individuals may differ in their susceptibility to environmental harms;***
- ***There is often a long latency period between exposures and ill effects; and***
- ***Many environmental impacts on health occur at the subclinical level. These impacts affect the body's function, but they are not detectable in routine physical exams.***

***Experience has shown time and again, that putting the burden of proof on governments to conclusively demonstrate risk as a prerequisite to regulating suspected toxins is a dangerous way to proceed. The precautionary principle is a more preferable approach. It is predominant in Europe and it is gaining momentum in Canada. The precautionary principle basically means that it is better to be safe than sorry. If there is some scientific evidence that a substance is causing adverse health effects, then governments should move expeditiously to restrict the use or release of the substance, instead of waiting for elusive certainty. Thus, the onus of proof is shifted to industry to provide conclusive proof that a substance is safe. For example, the pesticide active ingredient atrazine has been banned in the European Union. Studies show that this chemical causes reproductive abnormalities in frogs that are exposed to very low doses (i.e., at levels exceeded in some Canadian groundwater). Atrazine is one of the most heavily used pesticides in Ontario.***

## A. Missing Information Part 1: Environmental Hazards

Canada established the National Pollutant Release Inventory (NPRI) in the 1990s to track the release of toxic chemicals by major polluters. Although the NPRI is a step in the right direction, it covers just a fraction of the total pollution produced in Canada each year. The NPRI is limited because it:

- Covers only about 300 out of the thousands of chemicals used in Canada;
- Ignores pollution from mobile sources such as cars and trucks;
- Does not include pollution from sources such as dry cleaners, gas stations, and small manufacturing facilities;
- Does not include chemical threats posed by consumer products;
- Does not include pollution from agricultural operations or urban runoff; and
- Treats all substances as equally harmful.

***Neglected by NPRI***

***Canada's National Pollutant Release Inventory fails to require reporting on the following toxic substances:***

- ***Poly-brominated diphenyl ethers (PBDEs), which have accumulated rapidly in Canadian women's breast milk in recent years;***
- ***Endocrine disrupting substances;***
- ***Aldehydes produced by the combustion of ethanol, a gasoline additive;***
- ***Ethanol's use will likely grow rapidly in coming years as we attempt to address climate change;***
- ***New products generated by nanotechnology and biotechnology.***

More ominously, because, the NPRI may encourage companies to switch to chemicals which are not covered by the NPRI, or to lower volume but more toxic chemicals. Finally, polluters self-report data to the NPRI; no independent audits are carried out.[1]

There are also serious concerns about new and emerging environmental hazards which are not covered by the NPRI but which nonetheless pose a threat to human health. Because Canada does not comprehensively monitor the release of these chemicals into the environment, we lack key information on their potential health and environmental consequences.

**B. Missing Information Part 2: Environmental Exposures**

Canadian governments do not have basic data about the public's exposure to environmental hazards, let alone the subsequent health risks. In a recent report on children's health and the environment in North America, Canada was unable to report on half of the indicators chosen by experts to measure environmental impacts on health.[2] For example, Canada was unable to provide information on the percentage of children living in areas where air pollution levels exceed air quality standards. Canada was also unable to identify the percentage of children living in areas where drinking water violates local standards. The lack of studies may reflect the fact that, for government and industry, "it is preferable not to know."[3]

Health experts point out that "without exposure information, we are poorly equipped to detect causal exposure-disease relationships, monitor trends, recognize disproportionately affected communities, or determine if interventions are effective.[4] Until very recently, Canada had no national or provincial biomonitoring programs. Biomonitoring studies measure the environmental pollutants in people, including the substances formed when these chemicals are metabolized, and the substances formed through chemical reactions in the body. In other words, Canada did not systematically collect information about the chemicals that enter our bodies and the routes of exposure. As the House of Commons Standing Committee on Environment and Sustainable Development observed in a recent report to the House of Commons:

> "Nowhere is the information gap more evident than with respect to the quantities and trends in body-burden of synthetic chemicals. Biomonitoring studies, wherein blood and/or urine samples are taken to establish levels of synthetic chemicals and to monitor

> them over time, is particularly important in establishing policy direction as well as monitoring success in pollution prevention."[5]

The province of Alberta recently began the largest biomonitoring study of its kind in Canada. Alberta is testing the blood of more than 30,000 children and pregnant women to determine which pollutants are contaminating their bodies, and it expects to release the results later in 2007.[6] The federal government has announced an initial national study, beginning in 2008, on a limited subset of chemicals of concern. In contrast, since the 1990s, the U.S. has conducted an extensive national biomonitoring program for hundreds of environmental contaminants, with comprehensive reports produced biannually by the highly respected Centres for Disease Control and Prevention.[7]

Canada lags behind other nations in gathering basic data— even for lead exposure—to the detriment of our children's health. Solid medical evidence regarding the health impacts of lead exposure dates back decades. Yet, Canada has not conducted a national survey of children's exposure to lead since 1978-1979.[8] The recently announced Canadian biomonitoring program fails to address this problem because it does not test children under the age of six for lead or any other contaminants. In contrast, the U.S. tests almost one million children every year to monitor lead exposure, which can cause severe developmental problems.[9] In 1994, the Federal-Provincial Committee on Environmental and Occupational Health recommended that investigations be undertaken to determine the extent of lead contamination in Canadian homes from decades of use of lead paints.[10] Thirteen years later, this recommendation has yet to been acted upon.

As described in Section C, studies by Environmental Defence Canada, a non-profit organization, indicate that the bodies of Canadians are contaminated by hundreds of industrial chemicals, pesticides, heavy metals, phthalates, and flame retardants.[11] These contaminants are found in Canadians of all ages, occupations, and regions. While it is not known whether these contaminants are having adverse health effects at the low concentrations found in Canadians'

bodies, these findings point to the need for larger-scale, publicly-funded biomonitoring programs to track chemical exposures on an ongoing basis.

### C. Missing Information Part 3: Environmental Impacts on Health

> *What proportion of infertility today is environmentally induced is a question of profound human, scientific and public policy significance. Existing animal and human data suggest that a greater proportion is environmentally caused than has yet been generally realized or can be demonstrated with scientific certainty.*
>
> Vallombrosa Consensus Statement on Contaminants and Human Fertility Compromise, 2005.

The majority of chemicals used in Canada have never been tested for their human health impacts. According to experts, "little data are currently available regarding chronic adverse health outcomes, such as reproductive toxicity, mutagenicity, effects on the immune system, and neurological impairment. The potential for substantial compromise of health is undeniable."[12] The Organization for Economic Co-operation and Development confirms that "there is a lack of adequate safety information about the great majority of chemicals on the market."[13]

Even for the minority of substances that have been studied, experiments and observations tend to focus on a single chemical or substance. This narrow approach cannot identify the cumulative and synergistic effects of our daily exposure to thousands of different substances and the resulting complex chemical mixtures. Groundbreaking medical studies suggest that exposure to a mixture of chemicals at levels regarded as safe for one individual chemical can have significant health impacts.[14] The majority of research to date also fails to take into account the different genetic inheritance of individual human beings.

Canada also fails to systematically track chronic diseases with proven and suspected environmental causes. For example, the lack of a national standardized surveillance system for water-borne diseases means that policy-makers lack important information on risks and on the

effectiveness of different drinking water policies and programs.[15] A report published by Health Canada in 1999 concluded that "At present, the very limited and heterogeneous data sets collected by Canadian poison control centres do not allow for surveillance of acute poisonings in Canada. This severely impairs the development and implementation of effective prevention, regulatory, and information/education programs."[16] The situation has deteriorated, rather than improved, since 1999 because of cuts to the funding of provincial poison control centres.

In contrast, the U.S. is preparing to launch the National Children's Study, the world's largest longitudinal birth cohort study on children's health and the environment (see box).[17] This initiative will provide an extraordinary wealth of information that will save lives, reduce illness, and generate substantial social and economic dividends. Canada has declined to participate in this project, despite repeated invitations from the U.S. Canada has never conducted a national study to estimate the magnitude of deaths, disabilities, and illnesses attributable, in whole or in part, to environmental hazards. Environmental health experts have identified such a study as a priority of high importance to policy-makers.[18] Resources for environmental health research in Canada are relatively meagre compared to other wealthy industrialized nations. Because of the knowledge gaps described in this chapter, the government is unable to rationally establish priorities or to make the informed policy and regulatory decisions necessary to protect Canadians from environmental threats.

***The U.S. National Children's Study***

***Many crucial questions about childhood disease remain unanswered, despite advances in children's health over the past century. Thousands of Canadian children continue to suffer from preventable illnesses such as asthma, leukemia, and developmental disorders. The U.S. National Children's Study, designed by the world's leading experts – including Canadian researchers – hopes to answer these questions. Researchers will follow more than 100,000 children, their families, and their environment from before birth until the age of 21. Researchers will examine natural and man-made environmental factors, biological and chemical factors, social factors, behavioural influences and outcomes, cultural differences, and geographic locations in order to better understand the role that these factors play in the development of disease.[19] The study results will likely inform child health policies and practices for generations to come, and help us better understand what can harm and what can help children's health. This is a timely and vital study, especially considering the increasing rates of asthma and developmental disorders (e.g. attention deficit disorder), increasing concerns about widely used chemicals such as PBDEs and phtalates (i.e., fire retardants and plasticizers), and recent insights into children's vulnerability to environmental contaminants.***

***The Canadian government has not agreed to participate in the study, even though the U.S. has repeatedly invited its northern neighbour to do so. Canada is environmentally, socially, culturally, and economically distinct from the U.S. Involving Canadian children in the study would provide special Canadian insights and it would strengthen the study results. The U.S. National Children's Study will cost approximately US$100 million per year, suggesting that the Canadian component (a cohort of 10,000 Canadian children) would cost between C$10 million and C$12 million per year.44 This is a small price to pay to fulfill every child's right to grow up in a healthy environment. It is also less expensive than having Canada pursue a similar, but independent study. The expected benefits from health care savings, increased productivity, and improved quality of life will dwarf the costs of the study.***

## Chapter 3 Notes

[1]Harrison and Antweiler, "Incentives for Pollution Abatement."
[2] CEC, *Children's Health and the Environment.*
[3] W. Leiss cited in Schrecker,Using Science in Environmental Policy.
[4] Schettler, *Generations at Risk.*
[5] Standing Cmte. on Env. and Sustainable Devt., *CEPA 1999 – Five-year Review*, 19.
[6] Harding, "Huge Study to Show Impact."
[7] U.S. CDC, *National Report on Human Exposure.*
[8] Tsekrekos and Buka, "Lead Levels"
[9] U.S. CDC, Nat. Ctr. for Health Statistics, *National Health and Nutrition.*
[10] Fed–Prov. Cmte. on Env. and Occupational Health, *Update of Evidence.*
[11] Environmental Defence Canada, *Toxic Nation.*
[12] Hertz-Picciotto, Environmental Risk Assessment.
[13] OECD, *Environmental Outlook*
[14] Wade, et al., "Subchronic Exposure" and "Thyroid Toxicity."
[15] Schuster, et al., "Infectious Disease Outbreaks"
[16] F/P/T Natl. Health Surveillance Network WG and Integration Design Team, *Proposal to Develop a Network.*
[17] See: www.nationalchildrensstudy.gov
[18]Chociolko, Copes, and Rekart, *Needs, Gaps, and Opportunities Assessment.*
[19] U.S. National Children's Study, *Growing Up Healthy.*


> *The burden of preventable death and disease has been growing, reducing the quality of life, increasing wait times for health care, and challenging the sustainability of the health care system.*
>
> Public Health Agency of Canada, *Departmental Performance Report 2005-2006*

Canada's poor record in reducing the environmental impacts on people's health results in elevated health care costs, social impacts such as school absenteeism and reduced quality of life, and economic costs such as reduced productivity and large liability claims. The Organization for Economic Co-operation and Development estimated that in 2001, these environmental impacts cost Canada between $35 billion and $40 billion annually.[1] Health Canada estimated that the direct health care costs and lost productivity caused by environmental factors add up to between $46 billion and $52 billion annually.[2]

The direct and indirect costs of air pollution alone on the health of Canadians are estimated to be in the billions of dollars. In 2005, the Ontario government estimated the health and environmental costs of air pollution in that province at more than $9 billion annually.[3] The Ontario Medical Association reached a similar conclusion, estimating that each year in Ontario air pollution causes:

- $374 million in lost productivity and work time
- $507 million in direct health care costs

- $537 million in pain and suffering due to non-fatal illness
- $6.4 billion in social welfare loss due to premature death.[4]

In addition, asthma is the main cause of school absenteeism in Canada, threatening children's ability to participate in the knowledge economy.[5]

These huge cost figures are conservative compared to the estimates of the cost of air pollution in the U.S. and Europe. A recent study estimated the total health costs of air pollution in the European Union at between EUR305 billion and EUR875 billion, or between C$442 billion and C$1,269 billion.[6] A study by researchers at the Massachusetts Institute of Technology estimated that air pollution cost the U.S. approximately US$200 billion in 2000.[7]

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***South of 49: The Economics of Environmental Regulation in the U.S.***

***Various U.S. studies have also concluded that the net economic impact of environmental regulation is positive. A recent study conducted by the Bush Administration's Office of Management and Budget analyzed major regulations administered by the U.S. Environmental Protection Agency. The study concluded that while environmental regulations cost industry and government between US$24 billion and US$26 billion annually, the health, environmental, and economic benefits were between US$59 billion and US$394 billion annually.[8] A study by researchers at the Massachusetts Institute of Technology estimated that air pollution regulations in the U.S. created benefits totalling US$5.4 trillion, while imposing costs of less than $1 trillion.[9] A U.S. study on the economic impacts of phasing out lead in gasoline found benefits ranging from US$110 billion to US$318 billion over the lifetime of a yearly birth cohort based solely on increases in expected lifetime earnings.[10]***

***An independent peer-reviewed study of the U.S. Acid Rain Program, published in 2005, identified annual benefits of US$122 billion and annual costs of just US$3 billion.[11] The study suggested that Canada would gain $6 billion in health and environmental benefits annually by 2010, including 1,000 avoided premature deaths,***

***because of the American program. New federal regulations introduced in 2005 requiring American power plants to reduce air pollution (nitrogen oxides, sulfur dioxide, and particulate matter) are projected to provide between US$85 billion and US$100 billion in annual health benefits by 2015, an amount roughly equal to 25 times the cost of implementation.[12]***

***Another American study estimated that the health care costs associated with just four categories of childhood environmental health impacts—lead poisoning, asthma, developmental disorders, and childhood cancer—amount to US$55 billion annually.[13] Eliminating mercury exposure in the U.S. could save an estimated US$8.7 billion annually (range US$2.2 billion to US$43.8 billion) by preventing IQ loss and the resulting diminished economic productivity.[14] Similarly, studies indicate that for every dollar invested in reducing pollution from diesel engines, society gains approximately $13 in health and environmental benefits.[15]***

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It has been demonstrated repeatedly that the benefits of environmental health regulations generally outweigh the costs. For example, it is estimated that new regulations requiring reduced sulphur content in gasoline will cost less than $3 billion over 20 years, but it will deliver health benefits worth twice as much—at least $6 billion[16]—based on the economic value of avoiding illnesses and premature mortality in select urban areas.[17] Cost-benefit analysis of laws mandating the elimination of lead in gasoline similarly concluded that the net economic impact is positive. Government estimates of the potential health benefits of achieving better overall air quality in Canada range from $8 billion to $24 billion over 20 years.[18] Worldwide, Environment Canada reports that full implementation of the international agreements to protect the Earth's ozone layer would deliver over $200 billion in net benefits.[19]

A recent study conducted at McMaster University explored the costs of pollution from another angle. Researchers found strong correlations between levels of pollution, municipal expenditures on environmental protection, and health care costs. The higher the level of pollution in an area (using data from Canada's National Pollutant Release Inventory), the higher the health care

costs, by as much as $355 per capita annually. The higher municipal expenditures on protecting the environment, the lower the health care costs, by as much as $200 per capita annually. These findings provide compelling support for the economic benefits of reducing pollution and protecting the environment. In fact, because the researchers looked only at the direct health care costs, they substantially underestimated the overall costs imposed by pollution.[20]

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***Prevention: A Common Sense Approach***

***The Commission on the Future of Health Care in Canada had this to say about environmental impacts on our health:***

***"Keeping people well, rather than treating them when they are sick, is common sense. And so it is equally common sense for our health care system to place a greater emphasis on preventing disease and on promoting healthy lifestyles. This is the best way to sustain our health care system over the longer term. The health care system must be on the front lines of this effort. However, we must also invest in related areas of public life to create community mobilization, a sense of social inclusion and provide the infrastructure that enables healthier lifestyle choices. Investing in public housing, a clean environment and education are all part of the solution leading to a healthier Canada. But we need more than rhetoric; we need action. I am therefore recommending a greater emphasis on prevention and wellness as part of an overall strategy to improve the delivery of primary care in Canada, the allocation of new moneys for research into the determinants of health, and that governments take the next steps for making Canadians the world's healthiest people."[21]***

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Health care spending, on a per capita basis, has increased more than 60 per cent in Canada since 1984. Canada spends over $130 billion on health care—more than $4,000 per capita. This represents more than 10 per cent of Canada's total economic output (GDP).[22] Only a tiny fraction of this massive expenditure is directed at improving public health through primary prevention and the control of risk factors that would reduce the incidence of disease. The Romanow

Commission on the Future of Health Care in Canada concluded that the health care system will become unsustainable unless greater emphasis is placed on cultivating good health and preventing unnecessary health costs.

Like investments in pollution prevention, funding environmental health research has economic benefits. An economic analysis of the U.S. National Children's Study found that an investment of US$100 million on environmental health research would generate savings of between US$4 billion and US$9.7 billion.[23] In other words, for every dollar invested in the National Children's Study, American society will save between US$40 and US$97. The Framingham Heart Study, which has been running for more than 50 years, and which involves more than 10,000 participants, has contributed to breakthrough research on cardiovascular disease, saving hundreds of billions of dollars in the U.S.[24]

These studies all point to one irrefutable conclusion:  it will cost less to prevent environmental impacts on our health than to pay for the enormous costs of illness, disease, and death caused by exposure to environmental hazards.

**Chapter 4 Notes**

[1] OECD, *Environmental Outlook*, 243.
[2] Health Canada, Environmental Sustainability and Health.
[3] Ont. Ministry of Environment, *Transboundary Air Pollution.*
[4] OMA, *The Illness Costs of Air Pollution.*
[5] Can. Lung Assoc., *Asthma.*
[6] Euro. Commission, European Environment Agency, *Environment and Health.*
[7] Yang, et al., *Economic Benefits of Air Pollution Regulation.*
[8] U.S. Office of Management and Budget, *Draft 2006 Report to Congress.* These figures are being refined over time, but they consistently demonstrate that the benefits of environmental regulations exceed the costs by a wide margin.
[9] Yang, et al., *Economic Benefits of Air Pollution Regulation.*
[10] Grosse, et al., "Economic Gains."
[11] Chestnut and Mills, "A Fresh Look."
[12] American Lung Assoc., *State of the Air*.

[13] Landrigan et al., "Environmental Pollutants and Disease."
[14] Trasande, Landrigan, and Schechter, "Public Health and Economic Consequences."
[15] Union of Concerned Scientists, "The Carl Moyer Program."
[16] This estimate is based on an assessment of the effects of reduced sulphur dioxide emissions in select urban areas representing 40 per cent of the total Canadian population. Actual health benefits nationwide are therefore expected to be greater.
[17] Jessiman, Burnett, and de Civita, "Sulphur in Gasoline."
[18] Boyd, *Unnatural Law*, 99.
[19] Applied Research Consultants, *Global Benefits and Costs.*
[20] Jerrett, Eyles, Dufournaud, and Birsch,"Environmental Influences," 33.
[21] Commission on the Future of Health Care, *Building on Values*, 21.
[22] CIHI and Stat. Can., *Health Care in Canada 2005.*
[23] U.S. National Children's Study, Economic Impact.
[24] Oster and Thompson, "Estimated Effects."


> *I think the economic logic behind dumping a load of toxic waste in the lowest wage country is impeccable . . . I've always thought that under-populated countries in Africa are vastly UNDER-polluted.*
>
> Lawrence Summers, then vice-president of the World Bank, in an internal memo written in 1991

There is significant injustice in the distribution of environmental benefits and the risks associated with environmental hazards. The Government of Canada recently admitted "we know that some segments of our population are exposed to unacceptably high levels of environmental pollutants."[1] Vulnerable groups of Canadians include children, Aboriginal people, individuals with environmental sensitivities or compromised immune systems, and people experiencing social and economic disadvantages such as poverty and homelessness. Often these factors operate in combination. Environmental hazards can have particularly dire consequences for the health of individuals facing compounded vulnerabilities. For example, authorities have known since the mid-1980s that children in Ontario who live in poverty are at greater risk of exposure to harmful levels of lead.[2] Similarly, Aboriginal children in northern Canada are exposed to high levels of PCBs, mercury, lead, pesticides, and other harmful environmental contaminants. Statistics Canada recently reported that 2.4 per cent of Canadians—more than 640,000 people—suffer from doctor diagnosed multiple chemical sensitivities.[3]

It is also critical to understand the devastating magnitude of environmental impacts on health in developing nations. Canada has an international role to play in promoting sustainability.

**A. Children**

Children are especially vulnerable to environmental impacts on their health for a number of reasons. First, they face disproportionate levels of exposure to toxic substances because of their unique behaviour, diet, physiology, and metabolism. Relative to their size, children breathe more air, drink larger volumes of fluids, and consume more food than adults. Children are also more active. They crawl and tend to put things in their mouths, further increasing their exposure to environmental contaminants. Second, environmental exposures can cause developmental damage during windows of vulnerability, which are key stages of the developmental process when children are particularly sensitive. Third, children will live longer than adults, so they will be exposed to environmental chemicals for a longer period of time. This, in turn, could result in adverse consequences, such as cancers that have long latency periods. Fourth, the natural defences of children's bodies, such as their ability to metabolize toxic substances into less harmful substances, are less developed. Fifth, children have limited knowledge of potential risks, and so they have limited ability to avoid risks to their health.[4]

Experts agree that the most important environmental threats to the health of children are lead, indoor air quality, outdoor air quality, water contaminants, asthma, environmental tobacco smoke, and pesticides.[5]

Growing evidence points to the urgency of addressing threats to children's environmental health:

- Cancer is now the second leading killer of children in Canada, behind accidents.
- In the Great Lakes Region, breastfed infants who are less than six months old are likely to be exposed to six times the Tolerable Daily Intake of dioxins (potent carcinogens).[6]

- West Nile virus primarily affects older people, yet control efforts using the pesticide malathion, a neurotoxin, pose the greatest risks to children.
- The National Academy of Sciences in the U.S. estimates that 28 per cent of learning disabilities and developmental disorders are caused by environmental factors and the interactions between genes and environmental factors.[7]
- In Canada, the dramatic 400 per cent increase in the prevalence of childhood asthma between 1978 and 1995 is linked to environmental factors. Although asthma is a complex disease, evidence suggests that environmental threats including pesticides, nitrogen dioxide, plasticizers, volatile organic compounds, dust mite antigen, and second-hand smoke cause asthma exacerbations, and they may also play a role in the development of the disease.[8]

Governments continue to drag their feet on children's environmental health issues, despite the advocacy efforts of many Canadian medical organizations and non-governmental organizations.[9] Most Canadian environmental standards—to the extent that they incorporate health considerations—are designed to protect adults, not children, for whom more stringent standards are often required.[10] The North American Commission for Environmental Cooperation recently published a report that concluded: "If we create an environment that is safe and healthful for children, possibly the most sensitive and vulnerable among us, we create an environment safe and healthful for all."[11]

**B. Aboriginal People**

If there is a Canadian analogy to the American experience of pollution and other environmental hazards disproportionately affecting poor, minority communities (mainly African-American and Hispanic-American), then it lays in the toxic burden carried by Aboriginal people. Traditional diets make them especially vulnerable to mercury and to other contaminants in fish, as well as other toxic chemicals in wildlife. Also, many Aboriginal communities are located close to contaminated sites.

Northern Canadians, especially Inuit living a traditional lifestyle, have body burdens of toxic chemicals that threaten both their health and the health of their children. For example, seventy-three per cent of Inuit mothers have PCBs in their blood at levels that exceed Health Canada's level of concern.[12] Certain pesticides, now banned for health and environmental reasons, also persist in the blood of Inuit mothers at levels that may harm the developing fetus. The Northern Contaminants Program found that oxychlordane and trans-nonachlor levels in Inuit maternal/cord blood are 6 times to 12 times higher than levels in Caucasians, Dene, Metis, and other ethnic groups. Similar patterns were observed for PCBs, HCB, mirex, and toxaphene. Recent research has also revealed significantly higher levels of mercury in the blood of Inuit women compared with other mothers.[13] Mercury levels in Inuit children are 10 times to 20 times higher than the general Canadian population and are high enough to cause neurological damage.[14]

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***Where Have All the Boys Gone?***

***Researchers are learning more about the disturbing long-term effects of toxic substances on the human reproductive system. A team of researchers is studying an Aboriginal community that lives downwind of Sarnia, Ontario, one of Canada's most notorious pollution hotspots because of its concentration of petrochemical, polymer, and chemical industries. The proportion of male babies born on the Aamjiwnaang Reserve has fallen from normal levels (slightly more than half of all births) since the early 1990s, to less than 35 per cent of births between 1999 and 2003. Researchers suspect that individuals in this community have been exposed to chemicals that have disrupted their reproductive systems. Many studies have demonstrated that exposure to environmental contaminants such as dioxins, PCBs, pesticides, and mercury can affect sex ratios.[15]***

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Aboriginal people living on reserves also face severe drinking water contamination and indoor air quality problems.[16] Boil water advisories in Aboriginal communities last an average of six

months. Housing conditions on Aboriginal reserves are generally terrible. Severe indoor air quality problems caused by mould, poor construction, and overcrowding are common.

### C. Low-Income Communities in Canada

Canadian studies confirm that poor communities in both rural and urban areas tend to face higher levels of pollution. For example, the steel- and coal-producing communities of Cape Breton County in Nova Scotia are both socio-economically disadvantaged, and among the most polluted areas in North America. The steel-producing communities have cancer rates that are far above national averages, while the coal-producing regions have lung disease and lung cancer rates that are far above national averages.[17] Low-income neighbourhoods in Hamilton suffer a disproportionate amount of air pollution.[18] Similar studies spawned the environmental justice movement in the U.S., which has become a potent force in promoting the equal protection of all Americans from environmental hazards, regardless of their economic status or the colour of their skin.[19] The time has come for Canada to incorporate environmental justice into its policy decisions.

### D. Environmental Impacts on Health in Developing Countries

One of the most troubling aspects of environmental injustice involves the environmental damage inflicted upon citizens of the world's poorest countries. One-quarter of the total burden of disease (calculated as years of healthy life lost to premature mortality, illness, and disability) in developing countries is attributable to environmental factors.[20] The environmental impacts on health experienced in Canada, although substantial, pale in comparison to the more severe and widespread impacts in developing countries. Problems with outdoor air quality, indoor air quality, and drinking water quality are far more egregious. Acute exposures to pesticides and industrial chemicals are far more pervasive.

The World Health Organization estimates that, every year, nearly two million people in poor countries die of diarrheal diseases due to unsafe drinking water and inadequate sanitation facilities. Two million people die every year as a result of indoor air pollution caused by burning fuels for cooking and heating. Outdoor air pollution from motor vehicles, energy generation, and industry kills another million people each year.[21] Lead exposure causes hundreds of thousands of deaths each year. Exposure to lead also harms the development of at least one third of the world's children.[22] Poisonings by pesticides and other toxic chemicals kill about 355,000 people each year.[23] The short-term impacts of climate change, such as more extreme weather events, changing patterns of diseases, and changing agricultural patterns, cause about 150,000 deaths per year.[24] A study published by the British medical journal, *The Lancet*, estimates that 700,000 people around the world will die prematurely by 2020 if policies to mitigate climate change are not successfully implemented.[25]

As developing countries increase their populations and experience rapid economic growth, the already enormous toll of preventable environmental hazards on global health will likely increase in the decades ahead – unless preventive and remedial steps are taken immediately. As one of the wealthiest and healthiest nations in the world, Canada has a moral responsibility, to foster collaboration and common purpose around a sustainable future. To the government's credit, Canada led the development of the Health and Environment Linkages Initiative, which is now run by the World Health Organization and the United Nations Environment Program. The Health and Environment Linkages Initiative is a global effort to reduce environmental threats to human health in developing nations. Still, Canada must do more.

Canada is behaving unconscionably in one particular area of environmental health. Conclusive evidence that every type of asbestos is carcinogenic has led many industrialized nations—including Australia and all 25 members of the European Union—to ban the import, sale, and use of asbestos. The International Labour Organization also supports a global ban on the use of asbestos because exposure to asbestos causes mesothelioma, asbestosis, and lung cancer. Despite these well-established health hazards, Canada vigorously opposes international efforts to restrict global trade in asbestos and continues to export more than 90 per cent of its mined asbestos to

developing countries, such as India and the Philippines, where adequate health and safety regulations either do not exist or are not enforced. Canadian asbestos will kill thousands of people in Asia, Africa, and South America.

In 2006, Canada helped to block an effort to restrict international trade in chrysotile asbestos pursuant to the *Rotterdam Convention*. The Canadian government also subsidizes the Chrysotile Institute, an industry lobby group, pouring in roughly $20 million in taxpayers' money over the past 20 years. The Chrysotile Institute downplays the health risks of chrysotile asbestos and promotes its use in developing countries. It is ironic that Canada exports an extremely hazardous substance to developing countries while sponsoring environmental health programs—such as the Health and Environment Linkages Initiative—in developing countries. The continued export of Canadian asbestos, with its inevitable by-products of disease and death, tarnishes our good name with the stain of hypocrisy.

**Chapter 5 Notes**

[1] Gov. of Canada, *Children's Health and the Environment*, 58
[2] Duncan et.al., *Blood Lead and Associated Risk.*
[3] Park and Knudson, "Medically Unexplained Physical Symptoms"
[4] Wigle, *Child Health and the Environment.*
[5] Wigle, *Child Health and the Environment.*
[6] Haines et al., *Persistent Environmental Contaminants.*
[7] Commission on Life Sciences, *Scientific Frontiers.*
[8] U.S. EPA, *America's Children and the Environment.*
[9] The Canadian Partnership for Children's Health and the Environment includes the Canadian Association of Physicians for the Environment, the Canadian Child Care Federation, the Canadian Environmental Law Association, the Canadian Institute of Child Health, the Environmental Health Clinic at Sunnybrook and Women's College Hospital, the Learning Disabilities Association of Canada, the Ontario College of Family Physicians, the Ontario Public Health Association, Pollution Probe, the South Riverdale Community Health Centre, and Toronto Public Health. See: www.healthyenvironmentforkids.ca
[10] Hancock, Children's Environmental Health.
[11] CEC, *Making the Environment Healthier for Our Kids*, 4.
[12] INAC, Northern Contaminants Program, *Canadian Arctic Contaminants Assessment.*
[13] Gov. of Canada, *Children's Health and the Environment*, 39.

[14] Saint-Amour et al., "Alterations of Visual Evoked Potentials."
[15] Mackenzie, Lockridge, and Keith, "Declining Sex Ratio."
[16] Commissioner of the Environment, Drinking Water.
[17] Veugelers and Read, "Health Deficiencies in Cape Breton County."
[18] Buzzelli et al., "Spatiotemporal Perspectives on Air Pollution;" Jerrett et al., "A GIS-Environmental Justice Analysis."
[19] Agyeman, Bullard, and Evans, *Just Sustainabilities*; Ringquist, Environmental Justice.
[20] Prüss-Üstün and Corvalan, *Preventing Disease through Healthy Environments.*
[21] WHO, *The World Health Report 2002.*
[22] Fewtrell, Kaufmann, and Prüss-Üstün, *Lead.*
[23] Goldman and Tran, *Toxics and Poverty.*
[24] McMichael et al., *Climate Change and Human Health.*
[25] Davis and WG on Public Health and Fossil-Fuel Combustion, "Short-term Improvements."


*Canada's environmental performance is, by most measures, the worst in the developed world. We've got big problems*.

Prime Minister Stephen Harper, 2006

Canada lags behind other wealthy, industrialized nations, such as the U.S. and Australia, in addressing the environmental impacts on health. European nations such as Sweden, Finland, Germany, the United Kingdom, and the Netherlands are even farther ahead, having made health and the environment cornerstones of their national sustainable development strategies.[1] For example, Sweden's ambitious strategy for achieving sustainability within a generation is based on five fundamental principles, the first of which is the "promotion of human health."[2] Canada must urgently dedicate substantial time, energy, and resources to responding to environmental threats to health. In so doing, we can learn from the experiences of other industrialized nations.

**A. Health and Environment Strategies**

*United States*

In 1988, a committee of health experts appointed by the Institute of Medicine in the U.S. published a report that criticized the lack of attention paid to the health dimensions of environmental problems.[3] In 1993, the National Research Council published a book entitled *Pesticides in the Diets of Infants and Children*, which focused national attention on children's environmental health.[4] In 2000, the U.S. Department of Health and Human Services released

*Healthy People 2010*, a report that identified environmental factors as one of the three top threats to the health of Americans.[5] These landmark publications prompted the development of a national environmental health strategy, the formulation of environmental health indicators, the initiation of the National Children's Study, and other vital research initiatives. The U.S. has become a world leader in assessing the public's exposure to environmental chemicals.[6] Research and public outreach efforts in the U.S. are led by two organizations, the National Institute of Environmental Health Sciences and the National Center for Environmental Health.[7] In 1986, the U.S. passed "community right-to-know" legislation, providing citizens with access to detailed information about chemical hazards in their communities.

The Massachusetts *Toxic Use Reduction Act* of 1989 has successfully brought a preventive approach to the industrial use of toxic chemicals. Since 1990, releases of chemicals covered by the U.S. Toxics Release Inventory have dropped by 90 per cent in Massachusetts, while saving industry millions of dollars.[8]

The U.S. Department of Health and Human Services and the U.S. Environmental Protection Agency established these short- and long-term environmental health goals:

- Protect and improve air quality in order to reduce the risk to human health and the environment. Air throughout the country should meet national clean air standards for carbon monoxide, sulfur dioxide, nitrogen dioxide, and lead by 2050; for ozone by 2012; and for particulate matter by 2018.
- By 2005, protect human health so that 95 per cent of the population served by community water systems will receive water that meets health-based drinking water standards.
- By 2005, reduce pollutant loadings from key point and non-point sources by at least 11 per cent from 1992 levels.
- By 2010, eliminate elevated blood lead levels in children.
- By 2010, reduce exposure to pesticides as measured by urine concentrations of metabolites.

- By 2010, reduce asthma hospitalizations among children under the age of five.
- By 2020, eliminate unacceptable risks for cancer and other significant health problems arising from toxic air emissions for at least 95 per cent of the population, with particular attention to children and other sensitive subpopulations.[9]

*Australia*

Australia's comprehensive national environmental health strategy recognizes that "all Australians are entitled to live in safe and healthy environments."[10] This principle is enshrined in the Australian Charter for Environmental Health, which establishes both the rights and the responsibilities of citizens, industry, and government related to the protection and enjoyment of a healthy environment. The government appointed the multi-stakeholder National Environmental Health Council to implement the National Environmental Health Strategy. The National Environmental Health Strategy aims to:

- Develop an environmental health information system
- Report on environmental health indicators
- Invest in environmental health research
- Assess the health impacts of proposed developments.

The National Environmental Health Strategy focuses on vulnerable populations, including socially and economically disadvantaged groups, children, and indigenous Australians. Perhaps most importantly, Australia acknowledges that a preventive approach is more effective, more efficient, and more equitable than a "pollute now and pay later" approach.

*Europe*

The European Union has a comprehensive health and environment action plan. Almost all of the individual European Union nations have also adopted national strategies.[11] The *European Health and Environment Action Plan 2004-2010* focuses on addressing current knowledge gaps, strengthening existing policies, and improving communication so that citizens can make better

health choices. Specific actions underway include: the development of environmental health indicators; biomonitoring programs to assess human exposure to environmental hazards; and targeted research on priority hazards, exposures, and diseases.

Sweden, a world leader in reducing environmental impacts on health, has established national objectives to phase out:

- Human releases of mercury by 2003;
- Human releases of lead by 2010;
- Carcinogenic, mutagenic, and reproductive toxins by 2007;
- Very persistent and very bioaccumulative substances by 2010; and
- Other persistent and bioaccumulative substances by 2015.[12]

***Good News for a Change: Strong Regulations Produce Positive Results***

***Strong regulatory action can produce swift results. Sweden banned the use of PBDEs after Swedish scientists discovered that concentrations of PBDEs in women's breast milk were doubling every five years.[13] Subsequently, there was a rapid decline in the concentration of PBDEs in the breast milk of Swedish women, and no noticeable negative economic impacts on Swedish society.[14] Furthermore, Swedish cancer experts believe that early regulatory action on pesticides and other toxic substances by the Swedish government may have contributed to declining rates of some cancers, particularly non-Hodgkins lymphoma.[15]***

***A study on pollution levels and asthma exacerbations in Atlanta before, during, and after the 1996 Summer Olympic Games showed that reducing vehicular traffic could reduce the number of children going to hospital with breathing difficulties. The city took extensive measures to reduce traffic and to enhance public transportation. It added 1,000 buses and closed downtown roads to private vehicles. As a result, ozone levels fell by 28 per cent and asthma exacerbations fell by 44 per cent.[16]***

The European Union has already prohibited the use of carcinogens, mutagens, and reproductive toxins in cosmetics and personal care products.[17]

Europe also leads the way on extended producer responsibility (EPR) laws, which require manufacturers to assume responsibility for their products when consumers no longer want them. Manufacturers internalize the life-cycle environmental costs of their products, thus driving innovation in manufacturing processes and packaging that, in turn, reduce these costs. European EPR laws cover a wide range of items, including motor vehicles, computers, appliances, electronics equipment, and office furniture. Some explicitly require manufacturers to eliminate the use of toxic substances, to reduce packaging, and to ensure that an increasing percentage of their products are recycled. For example, by 2015, 95 per cent of the materials used to manufacture European motor vehicles must be recyclable, reusable, or recoverable.[18] Similarly, a law that came into force throughout the European Union in 2006 prohibits the use of hazardous substances including lead, mercury, and cadmium in computer and electronic equipment.

European environmental health strategies have included more traditional "polluter-pay" policies, as well. For example, Sweden used a tax on sulphur to reduce sulphur dioxide emissions by more than 80 per cent – to levels that are one-eighth of the per capita level of sulphur dioxide emissions in Canada.[19]

*Canada*

Canada does not have an environmental health strategy, despite repeated government promises over the years. In 1999, the Federal Cabinet approved, in principle, a health and environment strategy which Health Canada and Environment Canada were to develop and implement, along with a promised budget of $600 million over a five-year period.[20] The strategy was never developed and the funds were never allocated. In 2001, the Speech from the Throne included a promise to safeguard children from environmental threats to their health. Cabinet subsequently approved a strategy designed to protect children's health from environmental threats, with a promised budget of $90 million over four years. Again, the strategy was neither developed nor

funded. Instead, Health Canada has an office of Children's Environmental Health with just three employees and a shoestring budget. Canada's National Collaborating Center for Environmental Health, is designed to facilitate the exchange of knowledge, identify gaps in research, and practice and build capacity among health practitioners, policy-makers, and researchers. However, at $1.5 million, its annual budget is a mere fraction of the resources invested in parallel U.S. institutes. In 2006, the American National Center for Environmental Health Sciences budget was US$647,608,000, while the U.S. National Center for Environmental Health budget for 2006 was US$148,000,000.

**B. Health and Environment: Laws, Regulations, and Policies**

Canada lags behind the U.S., Europe, and Australia in formulating, implementing, and enforcing policies to prevent environmental impacts on health. Canada's national air quality and drinking water quality guidelines are voluntary, whereas the U.S., the European Union, and other industrialized nations have mandatory drinking water quality guidelines. Moreover, Canada's air and water quality guidelines are numerically weaker than the mandatory standards in other nations. Canadian regulations and policies are also weaker or even non-existent for many other hazardous substances including asbestos, pesticides, lead, mercury, PBDEs, PFCs, phthalates, nonylphenols, radon, and PAHs.

This section highlights the key areas in which Canada lags behind other industrialized countries in preventing environmental threats to health.

*Outdoor Air Quality*

Unlike the U.S., Australia, and Europe, Canada does not have legally binding national standards for ambient air quality, Instead, Canada has voluntary guidelines that set less protective targets compared to the legally binding standards of other industrialized nations for ozone, particulate matter, sulphur oxides, nitrogen oxides, and carbon monoxide (see Table 6.1 at the end of this chapter). Canada's air quality guidelines are weaker than the European Union's standards on five out of six air pollutants. Canada's air quality guidelines also are weaker than Australia's

standards on five out of six air pollutants. Lastly, Canada's air quality guidelines are weaker than the World Health Organization's recommendations for all five air pollutants with WHO standards. (Neither the WHO nor Canada has a guideline for lead).[21]

*Indoor Air Quality*

Canada also has weaker indoor air quality guidelines compared to other jurisdictions.[22] According to Pollution Probe, Canada's guidelines may not be adequate to protect vulnerable populations such as children and seniors, and the guidelines have not kept pace with standards established by other countries.[23] For example, Health Canada only recently revised the Canadian radon guideline, which dated back to 1970, and which was four to five times higher than in other Western countries. However, the new threshold for mitigation (200 $Bq/m^3$) still allows for radon concentrations 33 percent higher than the U.S. action level (150 $Bq/m^3$).[24] A wide range of stakeholders, including industry, recently called for a complete overhaul of Canada's *Exposure Guidelines for Residential Indoor Air Quality*.[25]

*Drinking Water*

Canada does not have mandatory national guidelines for drinking water. Instead, it has voluntary guidelines that are numerically weaker and less comprehensive than those in other jurisdictions. A recent study identified 55 contaminants for which Canada has weaker guidelines compared to at least one other jurisdiction (the U.S., the European Union, or Australia) or compared to the World Health Organization's recommendation (see Table 6.2 at the end of this chapter). These contaminants include bacteria, pesticides, carcinogenic industrial chemicals, disinfection by-products, naturally occurring toxic substances, and radioactive discharges from nuclear reactors.[26]

Canadian guidelines for many chemical contaminants are 50, 100, or even 1,000 times (in the case of the pesticide 2,4-D) weaker than the corresponding European Union standards or the Australian guidelines. For example, the European Union has stricter limits for atrazine, benzene, cyanide, tetrachloroethylene, vinyl chloride, and dozens of other hazardous chemicals. Some of

the substances which the European Union regulates more stringently are classified as known or probable human carcinogens by the International Agency for Research on Cancer.

*Pesticides*

Canada still permits the use of at least 50 active ingredients in pesticides that other nations have banned for health and environmental reasons. These active ingredients include 1,3-dichloropropene, atrazine, 2,4-D, carbaryl, endosulfan, and permethrin (see Table 6.3 at the end of this chapter). These active ingredients are used in approximately 1,000 commercial pesticide products in Canada. Exposure to these pesticides can cause adverse health effects, including cancer, impaired reproduction, developmental disorders, and organ damage.[27] Despite promising amendments to Canada's Pest Control Products Act that came into effect in 2006, the federal government refuses to initiate special reviews of these pesticides.

Canadian Maximum Residue Limits, which determine the quantity of pesticides permitted on food, are significantly weaker than pesticide residue limits for other nations—in some cases, by several orders of magnitude. For example, Canada allows up to 1,400 times the European limit for a specific pesticide on particular foods (e.g., methoxychlor on fruits and vegetables). The Canadian limit for permethrin on leaf lettuce and spinach is 400 times the European limit.[28]

*Asbestos*

Canada continues to mine and export chrysotile asbestos, which most industrialized nations—including Australia and all 25 nations of the European Union—have banned because of health concerns. Canada is one of the world's leading asbestos exporters, despite banning most domestic uses. Canada is one of a small group of countries opposing the listing of chrysotile asbestos under the *Rotterdam Convention*, a step that would restrict the trade of this hazardous substance.

*PBDEs*

Polybrominated diphynel ethers are a group of industrial chemicals widely used as flame retardants. These chemicals are accumulating in the environment, wildlife, and humans at an

alarming rate. While European countries and some U.S. states now regulate PBDEs, Canada does not.[29] Canada recently published a proposal to prohibit the import of a subgroup of PBDEs, but the proposal applies only to PBDEs that are no longer commercially available. The most widely used chemical in this class, decaBDE, would not be subject to this regulation. The federal government is proposing an ineffective and possibly unlawful voluntary approach to "manage" the use of decaBDE, instead of a ban. The proposed regulations also fail to address imported products that contain PBDEs, which are potentially the most significant source of these chemicals in the environment.

*PFCs*

Perfluorochemicals are a complex group of chemicals (including PFOS and PFOA) widely used as stain repellents and in non-stick coatings. PFCs are linked to cancer, birth defects, damage to organs, the immune system, and the reproductive system in animal studies and is likely to cause cancer.[30] Many PFCs are toxic, persistent, and bioaccumulative. The PFCs that have been detected in the bodies of Canadians most likely come from consumer products.[31] Sweden and the United Kingdom have already banned PFOS, and Sweden is advocating a global ban. Other European nations and the U.S. are phasing out PFOA.[32]

Initially, Canada showed leadership in this area by temporarily banning four chemicals that are precursors to PFCs, meaning that they transform into PFCs through decay or chemical reaction. However, the proposed regulations that would make this prohibition permanent are narrow in scope, and they will continue to allow imported products that contain these precursors.[33]

Canada's action plan for other PFCs is undermined by several weaknesses, including the failure to address consumer products or PFOA.

*PAH Emissions*

Polycyclic aromatic hydrocarbons are a mixture of organic compounds that are released into the atmosphere as gases or particles during the incomplete combustion of organic materials,

including fossil fuels. One of the most toxic PAHs is benzo(a)pyrene. The U.S. Environmental Protection Agency has identified 16 priority PAHs that do or might cause cancer in animals and humans. Other adverse health effects include cardiovascular and respiratory problems, and negative impacts on birth outcomes. Unlike California,[34] Australia,[35] and the European Union,[36] Canada does not regulate PAH emissions from diesel fuel.

*Phthalates and Nonylphenols*

There are growing concerns that phthalates and nonylphenols can disrupt the normal functioning of the human hormone system. The European Union has banned the use of phthalates in cosmetic products, toys, and other children's products, and it has also banned nonylphenols in cleaning products because of concerns about their adverse effects on human health.[37] Wal-Mart is phasing out cleaning products containing nonylphenols. Canada has not enacted regulatory restrictions on either phthalates or nonylphenols.

*Mercury*

Canada's "acceptable" level of mercury in blood (<20 µg/L) is much weaker than the corresponding U.S. standard (<5.8 µg/L). Sixteen per cent of the Inuit women in Nunavik (Northern Quebec) have mercury in their blood in excess of Health Canada's acceptable level. Using the stronger U.S. standard, 79 per cent of the Inuit women in Nunavik have mercury in their blood in excess of the acceptable level.[38]

*Lead*

> *Despite progress, lead poisoning remains one of the top childhood environmental health problems today. Without further action, over the coming decades, large numbers of young children may be exposed to lead in amounts that could impair their ability to learn and to reach their full potential.*
>
> U.S. President's Task Force on Environmental Health Risks and Safety Risk to Children, 2000

Despite the known hazards of low-level lead poisoning, Canada still does not have a national program to reduce children's exposure to lead. In contrast, the U.S. President's Task Force on Environmental Health Risks and Safety Risks to Children developed a strategy to eliminate, by 2010, lead paint hazards in housing occupied by children under the age of six. This strategy includes:

- Federal grants for low-income housing;
- Leveraging private, state, and municipal funds to control lead paint hazards;
- Promoting lead-safe painting, renovation, and maintenance work;
- Enforcing lead paint laws.

Canada has no comparable programs to address lead paint hazards, despite the fact that one in four Canadian children under the age of five lives in a home where lead paint may pose a threat.[39]

Canada allows lead in juices at a level 20 times higher than permitted in drinking water.[40] Since some children consume significant volumes of juice and are particularly vulnerable to long-term adverse health effects caused by lead exposure, this regulatory anomaly demands urgent corrective action. Despite the potential adverse health effects, Canada has few maximum residue limits for lead, mercury, cadmium, and other hazardous heavy metals that are found in food.[41]

Although Health Canada has developed a Lead Risk Reduction Strategy, it has been slow to develop regulations. Health Canada promised to regulate five categories of consumer products that contain lead and that pose a threat to children, including:

- Products that children are likely to eat (e.g., crayons);
- Products that children are likely to place in or near their mouths (e.g., crib toys);
- Products intended for children (e.g., toys, furniture);
- Products used to prepare, cook, and store food; and

- Products that are burned in enclosed spaces (e.g., candles, incense).

To date, Health Canada has regulated just two out of these five categories. Glazed ceramics and children's jewellery are now regulated.

**Signs of Hope for Canada?**

Although this report details a number of environmental threats to health for Canadians, there are some signs of hope. Before the Conservative Party of Canada was elected in 2006, federal budgets in Canada allocated substantial funds for environmental programs, including:

- $3 billion for climate change programs;
- $4 billion to clean up contaminated sites;
- $600 million to improve drinking water quality throughout Aboriginal communities; and
- $120 million for various clean air initiatives.

In 2005, the federal government finally enacted regulations to protect Canadian children from lead in paint (27 years after the U.S. passed a similar regulation), and lead in children's jewellery.[42] In 2006, the federal government approved a stronger guideline for arsenic in Canadian drinking water. The *Pest Control Products Act*, which was passed in 2002, and which came into effect in 2006, offers, on paper, a significantly stronger regime to regulate pesticides in Canada.

In 2006, Health Canada and Environment Canada completed the preliminary assessment of 23,000 chemicals. Canadian regulators had never previously scrutinized these chemicals for their adverse health and environmental effects. They identified approximately 4,000 chemicals of concern that they will examine more closely. A new chemical substances management plan, unveiled in 2006, begins immediately to tackle 500 of the most hazardous substances. For 200 of these dangerous chemicals, industry must provide evidence that the chemicals can be used safely

and that safer alternatives are not available. The government will prohibit these substances unless industry meets the burden of proof. There are no current Canadian uses for 150 of the 500 chemicals, and the government will not permit new uses for these chemicals unless industry can prove that they are safe and that safer alternatives do not exist. The government will permit the limited use of another 150 chemicals, but it will not permit new uses and it will encourage industry to find safer alternatives.[43]

The Canadian government plans to complete this gargantuan risk management exercise within three years. Then, it will repeat the process with another 500 chemicals on the high priority list, and so forth, until it addresses the entire list of almost 4,000 chemicals of concern. Canada's timeline to regulate these chemicals is comparable to the European Union's plan to phase in its new chemical regulation, known as REACH (Registration, Evaluation, and Authorization of Chemicals). REACH will be phased in between 2007 and 2018.

Health Canada also recently revised the Canadian radon guideline to be more protective of human health, lowering the threshold for mitigation from 800 Bq/m3 to 200 Bq/m3. The previous Canadian radon guideline dated back to 1970, and it was four to five times higher than guidelines in other western countries. While we recommend in this report that the guideline be further strengthened, the recent revision was long overdue and points in the right direction.[44]

Although these developments indicate good intentions, they are made in the absence of an overall health and environment framework, making it difficult, if not impossible to rationally establish priorities. The federal government continues to move in an ad hoc, fragmented, and reactive manner.

**TABLE 6.1**

**International Comparison of Ambient Air Quality Standards and Guidelines, as compared with recommendations of the World Health Organization (WHO)**

| POLLUTANT | WORLD | EUROPEAN HEALTH | AUSTRALIA UNION ORG | UNITED | CANADA STATES |
|---|---|---|---|---|---|
| **Ozone** 8 hour, parts per billion | 50 | 60 | 80 | 80 | 65 |
| **Fine particulate** 24 hour, micrograms per cubic meter | 25 | 50 | 25 | 65 | 30 |
| **Sulphur dioxide** 24 hour, ppb | 8 | 48 | 80 | 140 | 115 |
| **Nitrogen dioxide** Annual, ppb | 21 | 21 | 30 | 53 | 53 |
| **Carbon monoxide** 8 hour, ppm | 9 | 9 | 9 | 9 | 13 |
| **Lead** Micrograms per cubic meter | – | 0.5 | 0.5 | 1.5 | – |

NOTE: A dash (–) indicates that no standard or guideline has been established for a particular

**TABLE 6.2**
CONTAMINANTS FOR WHICH CANADA HAS WEAKER DRINKING WATER GUIDELINES THAN AT LEAST ONE OTHER JURISDICTION OR WORLD HEALTH ORGANIZATION RECOMMENDATION

2,4-D
aldicarb
aldrin and dieldrin
antimony
arsenic
atrazine
azinphos-methyl
barium
bendiocarb
benzene
boron
bromoxynil
cadmium
carbaryl
carbofuran
carbon tetrachloride
chlorpyrifos
cyanazine
cyanide
cyanobacterial toxins
diazinon
dicamba
1,2-dichlorobenzene
1,4-dichlorobenzene
1,2-dichloroethane
1,1-dichloroethylene
dichloromethane
2,4-dichlorophenol
diclofop-methyl
dimethoate
dinoseb
diquat
diuron
glyphosate
malathion
methoxychlor
metolachlor
metribuzin
nitrilotriacetic acid
paraquat
parathion
pentachlorophenol
phorate
picloram
simazine
terbufos
tetrachloroethylene
total coliforms
trifluralin
trihalomethanes
tritium
2,4,6-trichlorophenol
2,3,4,6-tetra-chloro-phenol
uranium
vinyl chloride

**TABLE 6.3**

## Pesticide active ingredients registered in Canada but prohibited in other OECD nations

**1. 1,3-DICHLOROPROPENE** [CAS# 542-75-6]

**BANNED BY:** Austria, Germany, Sweden, registration cancelled in Australia
**HEALTH EFFECTS:** According to the U.S. Environmental Protection Agency, 1,3-dichloropropene is a probable human carcinogen and is highly toxic. The International Agency for Cancer Research classifies it as a possible human carcinogen. Exposure to 1,3-dichloropropene causes irritated skin and eyes, as well as damage to the lungs, stomach, liver, and kidneys.[15]
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING 1,3-DICHLOROPROPENE:** 4

**2. 2,4-D** [CAS# 94-75-7]

**BANNED BY:** Denmark, Norway, Sweden
**HEALTH EFFECTS:** 2,4-D is a possible human carcinogen and a suspected endocrine disruptor.[16]
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING 2,4-D:** 182

**3. AMITRAZ** [CAS# 33089-61-1]

**BANNED BY:** Norway, European Union
**HEALTH EFFECTS:** The U.S. EPA has classified amitraz as a possible human carcinogen. Amitraz is toxic to the central nervous system and impairs development and reproduction.[17]
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING AMITRAZ:** 5

**4. AMITROLE** [CAS# 61-82-5]

**BANNED BY:** Finland, Norway, Sweden
**HEALTH EFFECTS:** Action was taken in these three Nordic nations because of risk of carcinogenic effect on humans. The U.S. EPA describes amitrole as a relatively potent carcinogen. Amitrole is also a suspected endocrine disruptor.[18]
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING AMITROLE:** 5

**5. ATRAZINE** [CAS# 1912-24-9]

**BANNED BY:** Denmark, Germany, Norway, Sweden, European Union
**HEALTH EFFECTS:** Atrazine is an endocrine disruptor. Adverse effects include low birth weight, impaired development, and possible organ damage. There is evidence of carcinogenicity in other animals but data on cancer risk to humans are inconclusive.[19]
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING ATRAZINE:** 17

**6. BROMACIL** [CAS# 314-40-9]

**BANNED BY:** Germany, Sweden
**HEALTH EFFECTS:** The U.S. EPA classifies bromacil as a possible human carcinogen. Other health effects include negative effects on development, the thymus, the thyroid, and eye irritation.[20]
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING BROMACIL:** 6

**7. BROMOXYNIL** [CAS# 1689-99-2, 1689-84-5]

**BANNED BY:** Norway, Sweden
**HEALTH EFFECTS:** The U.S. EPA considers bromoxynil to be a possible human carcinogen and a developmental toxin. Fetuses, infants, and children are particularly vulnerable.[21]
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING BROMOXYNIL:** 33

**TABLE 6.3** CONTINUED

**8. CAPTAN** [CAS# 133-06-2]

**BANNED BY:** Denmark, Finland, Norway
**HEALTH EFFECTS:** Captan is a severe eye irritant and is classified by the U.S. EPA as a probable human carcinogen.[22]
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING CAPTAN:** 29

**9. CARBARYL** [CAS# 63-25-2]

**BANNED BY:** Austria, Germany, Sweden
**HEALTH EFFECTS:** The U.S. EPA classifies carbaryl as a likely human carcinogen. It affects the nervous system, causing nausea, dizziness, confusion, and at high exposures, respiratory paralysis, and death. Carbaryl is also a suspected endocrine disruptor.[23]
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING CARBARYL:** 56

**10. CARBOFURAN** [CAS# 1563-66-2]

**BANNED BY:** Sweden, U.S.
**HEALTH EFFECTS:** Exposure to carbofuran can over-stimulate the nervous system, causing nausea, dizziness, confusion, and at very high exposures (e.g., accidents or major spills), respiratory paralysis and death. Carbofuran is a suspected endocrine disruptor.
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING CARBOFURAN:** 3

**11. CHLOROPICRIN** [CAS# 76-06-2]

**BANNED BY:** Austria, Germany, Sweden
**HEALTH EFFECTS:** Chloropicrin is highly toxic and can cause abdominal pain, cough, diarrhea, dizziness, headache, nausea, and sore throat.
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING CHLOROPICRIN:** 5

**12. CHLOROTHALONIL** [CAS# 1897-45-6]

**BANNED BY:** Sweden
**HEALTH EFFECTS:** The U.S. EPA classifies chlorothalonil as a likely human carcinogen, while the International Agency for Research on Cancer rates it as a possible human carcinogen. Chlorothalonil is also a severe eye irritant.
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING CHLOROTHALONIL:** 15

**13. CHLORPYRIFOS** [CAS# 2921-88-2]

**BANNED BY:** Finland, Sweden
**HEALTH EFFECTS:** Chlorpyrifos can cause nausea, headaches, vomiting, blurred vision, difficulty breathing, memory impairment, and damage to the central nervous system. High exposures can result in respiratory paralysis and death. Chlorpyrifos is suspected of being genotoxic. Children, the elderly, and people with respiratory problems are particularly vulnerable.[24]
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING CHLORPYRIFOS:** 28

**14. DAZOMET** [CAS# 533-74-4]

**BANNED BY:** Denmark
**HEALTH EFFECTS:** Denmark banned dazomet because of concerns about developmental and reproductive problems.
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING DAZOMET:** 21

**TABLE 6.3** CONTINUED

**15. DELTAMETHRIN** [CAS# 52918-63-5]

**BANNED BY:** Denmark
**HEALTH EFFECTS:** Deltamethrin is a suspected endocrine disruptor.
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING DELTAMETHRIN:** 6

**16. DIAZINON** [CAS# 333-41-5]

**BANNED BY:** Denmark
**HEALTH EFFECTS:** Symptoms include nausea and vomiting, abdominal cramps, diarrhea, difficulty in breathing, and damage to the pancreas. Central nervous system toxicity includes respiratory depression, anxiety, insomnia, headache, apathy, drowsiness, dizziness, loss of concentration, confusion, tremors, convulsions, and coma. At very high exposures (e.g. accidents or major spills), it may cause respiratory paralysis and death. Diazinon is a suspected endocrine disruptor with adverse developmental and reproductive effects.[25]
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING DIAZINON:** 19

**17. DICHLOBENIL** [CAS# 1194-5-6]

**BANNED BY:** Denmark, Norway, Sweden
**HEALTH EFFECTS:** Dichlobenil is generally of low acute toxicity, but causes systemic, developmental and reproductive toxicity effects in animal studies and has been classified as a possible human carcinogen.[26]
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING DICHLOBENIL:** 13

**18. DICHLORPROP** [CAS# 120-36-5, 7547-66-2]

**BANNED BY:** Denmark
**HEALTH EFFECTS:** Dichlorprop is a possible human carcinogen and has adverse effects on the mental and physical developmental processes of young children.
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING DICHLORPROP:** 18

**19. DICHLORVUS/DDVP** [CAS# 62-73-7]

**BANNED BY:** Denmark, Sweden, United Kingdom
**HEALTH EFFECTS:** The U.S. EPA concluded that dichlorvos is a *probable* human carcinogen while the International Agency for Research on Cancer ranks dichlorvos as a *possible* human carcinogen. Dichlorvos affects the central nervous system and can cause symptoms ranging from nausea and loss of bladder control to respiratory failure and coma.[27]
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING DICHLORVOS:** 13

**20. DICOFOL** [CAS# 115-32-2]

**BANNED BY:** Finland, Netherlands, Norway, Sweden
**HEALTH EFFECTS:** The U.S. EPA classifies dicofol as a possible human carcinogen. An organochlorine pesticide, dicofol is persistent, bioaccumulative, and a suspected endocrine disruptor.[28]
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING DICOFOL:** 3

**21. DINOCAP** [CAS# 39300-45-3]

**BANNED BY:** Sweden. In the U.S., the manufacturer of dinocap voluntarily withdrew all product registrations for the U.S. market; hence there are no registered dinocap products used in the U.S.
**HEALTH EFFECTS:** Dinocap is a developmental toxin.[30]
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING DINOCAP:** 2

**TABLE 6.3** CONTINUED

**22. DIQUAT** [CAS# 85-00-7]

**BANNED BY:** Denmark
**HEALTH EFFECTS:** Diquat is a neurotoxin and causes abdominal pain, diarrhea, disorientation, nausea, and vomiting.
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING DIQUAT:** 3

**23. DIURON** [CAS# 330-54-1]

**BANNED BY:** Sweden
**HEALTH EFFECTS:** The U.S. EPA classifies diuron as a known/likely human carcinogen. Diuron is also a suspected endocrine disruptor.[31]
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING DIURON:** 8

**24. ENDOSULFAN** [CAS# 115-29-7]

**BANNED BY:** Netherlands, Norway, Sweden, European Union
**HEALTH EFFECTS:** High acute oral and inhalation toxicity. Adverse effects on the central nervous system and harmful effects on the stomach, blood, liver, and kidney. Endosulfan is highly persistent, causes neurotoxic effects, and acts as an endocrine disruptor.[32]
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING ENDOSULFAN:** 10

**25. ETHYLENE OXIDE** [CAS# 75-21-8]

**BANNED BY:** Austria, Czech Republic, Finland, Germany, Sweden, United Kingdom, European Union
**HEALTH EFFECTS:** The International Agency for Research on Cancer classifies ethylene oxide as carcinogenic to humans. Ethylene oxide also causes irritation of the eyes, skin, and mucous membranes and problems in the functioning of the brain, central nervous system, and reproductive system.[33]
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING ETHYLENE OXIDE:** 1

**26. FERBAM** [CAS# 14484-64-1]

**BANNED BY:** European Union
**HEALTH EFFECTS:** Ferbam is toxic to the liver, kidneys, and lungs.[34]
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING FERBAM:** 5

**27. HEXAZINONE** [CAS# 51035-04-2]

**BANNED BY:** Denmark, Norway, Slovenia, Sweden
**HEALTH EFFECTS:** Hexazinone is a severe eye irritant and has adverse effects on developmental and reproductive systems.[35]
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING HEXAZINONE:** 6

**28. IPRODIONE** [CAS# 36734-19-7]

**BANNED BY:** Denmark
**HEALTH EFFECTS:** The U.S. EPA classifies iprodione as a likely human carcinogen. Iprodione is also a suspected endocrine disruptor.[36]
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING IPRODIONE:** 10

**29. LINURON** [CAS# 330-55-2]

**BANNED BY:** Norway, Sweden
**HEALTH EFFECTS:** The U.S. EPA classifies linuron as a possible human carcinogen. Linuron is also a suspected endocrine disruptor with adverse developmental and reproductive effects.[37]
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING LINURON:** 8

**TABLE 6.3** CONTINUED

**30. MALEIC HYDRAZIDE** [CAS# 123-33-1, 10071-13-3]

**BANNED BY:** Austria, Denmark, Germany, United Kingdom
**HEALTH EFFECTS:** According to the U.S. EPA, maleic hydrazide appears to be genotoxic at high doses in some mutagenicity tests.[38]
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING MALEIC HYDRAZIDE:** 4

**31. MANEB** [CAS# 12427-38-2]

**BANNED BY:** Sweden
**HEALTH EFFECTS:** The U.S. EPA indicates that maneb harms the thyroid and impairs neurological development. Ethylene thiourea (ETU) is a metabolite of mancozeb, maneb, and metiram. ETU causes developmental defects, with effects seen in the central nervous system, urogenital and skeletal systems. The U.S. EPA classifies ETU as a probable human carcinogen and a possible endocrine disruptor.[40]
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING MANEB:** 7

**32. METALAXYL** [CAS# 57837-19-1]

**BANNED BY:** European Union
**HEALTH EFFECTS:** Metalaxyl can cause nausea, vomiting, respiratory difficulties, severe eye irritation and liver damage.
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING METALAXYL:** 5

**33. METIRAM** [CAS# 9006-42-2]

**BANNED BY:** Denmark, Finland
**HEALTH EFFECTS:** The U.S. EPA indicates that metiram harms the thyroid and impairs neurological development. Ethylene thiourea (ETU) is a metabolite of mancozeb, maneb, and metiram. ETU causes developmental defects, with effects seen in the central nervous system, urogenital and skeletal systems. The U.S. EPA classifies ETU as a probable human carcinogen and a possible endocrine disruptor.[41]
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING METIRAM:** 4

**34. PCNB (AKA QUINTOZENE)** [CAS# 82-86-8]

**BANNED BY:** Austria, Finland, Germany, European Union
**HEALTH EFFECTS:** The U.S. EPA classifies PCNB as a possible human carcinogen. PCNB is a suspected endocrine disruptor.
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING PCNB:** 9

**35. PACLOBUTRAZOL** [CAS# 76738-62-0]

**BANNED BY:** Sweden
**HEALTH EFFECTS:** Paclobutrazol can cause eye irritation, headaches, respiratory problems, liver damage, and harm to reproduction and development. Inadequate data exists to determine whether exposure to paclobutrazol causes an increased risk of cancer.
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING PACLOBUTRAZOL:** 6

**36. PARA-DICHLOROBENZENE (AKA 1,4-DICHLOROBENZENE)** [CAS# 106-46-7]

**BANNED BY:** Sweden
**HEALTH EFFECTS:** Both the U.S. EPA and the International Agency for Research on Cancer classify para-dichlorobenzene as a possible human carcinogen. It is toxic to the liver, and irritates both the eyes and the respiratory system.
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING PARA-DICHLOROBENZENE:** 9

**TABLE 6.3** CONTINUED

**37. PARAQUAT** [CAS# 1910-42-5, 4685-14-7]

**BANNED BY:** Austria, Denmark, Finland, Sweden
**HEALTH EFFECTS:** Paraquat exhibits high acute toxicity and can cause lung damage, nausea, abdominal pain, vomiting, and impair normal development.
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING PARAQUAT:** 3

**38. PENTACHLOROPHENOL (PCP)** [CAS# 87-86-5]

**BANNED BY:** Germany, Netherlands, New Zealand, Sweden, Switzerland
**HEALTH EFFECTS:** PCP can cause harmful effects on the liver, kidneys, blood, lungs, nervous system, immune system, and gastrointestinal tract. Low-level long-term exposure can also result in damage to the immune system and the endocrine system. The International Agency for Research on Cancer has determined that pentachlorophenol is possibly carcinogenic to humans, and the U.S. EPA has classified pentachlorophenol as a probable human carcinogen.[42]
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING PENTACHLOROPHENOL:** 3

**39. PERMETHRIN** [CAS# 52645-53-1, 54774-45-7, 51877-74-8]

**BANNED BY:** European Union
**HEALTH EFFECTS:** The U.S. EPA classifies permethrin as a possible human carcinogen. Permethrin is a suspected endocrine disruptor. Permethrin is also linked to Parkinson's disease.[43]
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING PERMETHRIN:** 256

**40. PICLORAM** [CAS# 1918-02-1]

**BANNED BY:** Sweden
**HEALTH EFFECTS:** Picloram contains hexachlorobenzene, an impurity that is a probable human carcinogen. As well, picloram is extremely persistent and is structurally similar to DEHP, a plasticizer that causes cancer in rodents. Picloram is also a suspected endocrine disruptor.[44]
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING PICLORAM:** 6

**41. PROPOXUR** [CAS# 114-26-1]

**BANNED BY:** Sweden
**HEALTH EFFECTS:** The U.S. EPA classifies propoxur as a probable human carcinogen. It is highly toxic and has adverse effects on the brain and central nervous system.[46]
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING PROPOXUR:** 78

**42. SIMAZINE** [CAS# 122-34-9]

**BANNED BY:** Norway, European Union
**HEALTH EFFECTS:** Simazine is described by the U.S. Environmental Protection Agency as a possible human carcinogen. Simazine is also a suspected endocrine disruptor.
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING SIMAZINE:** 11

**43. SODIUM CHLORATE** [CAS# 7775-09-9]

**BANNED BY:** Norway, Sweden
**HEALTH EFFECTS:** Exposure to sodium chlorate can cause confusion, cough, dizziness, headaches, nausea, sore throat, convulsions, and unconsciousness.
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING SODIUM CHLORATE:** 5

**TABLE 6.3** CONTINUED

**44. TERBACIL** [CAS# 5902-51-2]

**BANNED BY:** Sweden
**HEALTH EFFECTS:** Terbacil is harmful to the mental and physical developmental processes of young children.[47]
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING TERBACIL:** 2

**45. THIABENDAZOLE** [CAS# 148-79-8]

**BANNED BY:** Denmark
**HEALTH EFFECTS:** The U.S. EPA classifies thiabendazole as a likely human carcinogen. Thiabendazole also causes damage to the liver, thyroid, and developmental processes.[48]
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING THIABENDAZOLE:** 8

**46. THIOPHANATE-METHYL** [CAS# 23564-05-8]

**BANNED BY:** Denmark
**HEALTH EFFECTS:** The U.S. EPA classifies thiophanate-methyl (TM) as a likely human carcinogen. TM harms the liver, thyroid and testes and also causes adverse developmental and reproductive effects.[49]
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING THIOPHANATE-METHYL:** 13

**47. THIRAM** [CAS# 137-26-8]

**BANNED BY:** Sweden
**HEALTH EFFECTS:** The U.S. EPA describes thiram as a neurotoxin and a developmental toxin. Thiram harms the liver, blood, and urinary systems. Thiram is also a suspected endocrine disruptor.[50]
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING THIRAM:** 27

**48. TRIADIMENOL** [CAS# 55219-65-3]

**BANNED BY:** Sweden
**HEALTH EFFECTS:** The U.S. EPA classifies triadimenol as a possible human carcinogen. Triadimenol is also a suspected endocrine disruptor with adverse developmental and reproductive effects.
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING TRIADIMENOL:** 2

**49. TRIALLATE** [CAS# 2303-17-5]

**BANNED BY:** Sweden
**HEALTH EFFECTS:** The U.S. EPA classifies triallate as a possible human carcinogen and a neurotoxin. Triallate also harms the mental and physical developmental processes of young children.[51]
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING TRIALLATE:** 6

**50. TRIBUTYLTIN OXIDE** [CAS# 56-35-9]

**BANNED BY:** Denmark, Japan, United Kingdom
**HEALTH EFFECTS:** Highly toxic, with impacts on the immune system and developmental processes. Tributyltin oxide is also a suspected endocrine disruptor.
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING TRIBUTYLTIN OXIDE:** 7

**TABLE 6.3** CONTINUED

**51. TRIFLURALIN** [CAS# 1582-09-8]

**BANNED BY:** Denmark, Norway, Sweden
**HEALTH EFFECTS:** The U.S. EPA classifies trifluralin as a possible human carcinogen. Nordic nations banned trifluralin because of its persistence in the environment and toxicity to aquatic species. Trifluralin is also a suspected endocrine disruptor.[52]
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING TRIFLURALIN:** 19

**52. VINCLOZOLIN** [CAS# 50471-44-8]

**BANNED BY:** Denmark, Finland, Norway, Sweden
**HEALTH EFFECTS:** Vinclozolin disrupts hormonal systems resulting in developmental and reproductive problems, including sex organ malformations. The U.S. EPA classifies vinclozolin as a possible human carcinogen.[53]
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING VINCLOZOLIN:** 2

**53. ZINEB** [CAS# 12122-67-7]

**BANNED BY:** European Union. Zineb is not registered for use in the U.S.
**HEALTH EFFECTS:** Zineb is a suspected endocrine disruptor.
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING ZINEB:** 4

**54. ZIRAM** [CAS# 137-30-4]

**BANNED BY:** Denmark, Sweden
**HEALTH EFFECTS:** Ziram is a severe eye irritant and harms the nervous system, liver, and thyroid. The U.S. EPA classifies ziram as "suggestive of carcinogenicity." Ziram is also a suspected endocrine disruptor.[54]
**NUMBER OF REGISTERED PESTICIDE PRODUCTS IN CANADA CONTAINING ZIRAM:** 3

**Chapter 6 Notes**

[1] Gov. of Germany, *Perspectives for Germany;* Gov. of Sweden, Env. Objectives Council, *Sweden's Environmental Objectives;* H.M. Gov., *One Future – Different Paths.*
[2] The other four fundamental principles are preservation of biological diversity, preservation of long-term productive capacity of ecosystems, wise management of natural resources, and preservation of cultural heritage assets. Gov.of Sweden, Ministry of the Environment, *The Swedish Environmental Objectives,* 2.
[3] Inst. of Medicine, *Future of Public Health.*
[4] U.S. Natl. Research Council, *Pesticides in the Diets.*
[5] U.S. Dept. of Health and Human Services, *Healthy People.*
[6] See http://www.cdc.gov/nceh
[7] See http://www.niehs.nih.gov and http://www.cdc.gov/nceh
[8] Toxics Use Reduction Institute, *Five Chemicals Alternatives Assessment.*
[9] U.S. Dept. of Health and Human Services, *Healthy People;* U.S. EPA, *2000-5 Strategic Plan.*
[10] Australian Inst. of Env. Health, *National Environmental Healthy Strategy.*
[11] European Commission. *European Environment and Health Action Plan.*
[12] Gov. of Sweden, Env. Objectives Council, *For the Sake of Our Children.*
[13] Meironyte, Noren, and Bergman, "Analysis of Polybrominated Diphenyl Ethers."
[14] Darnerud et al., "Time Trend of Polybrominated Diphenyl Ethers."
[15] Hardell and Eriksson, "Decline of the Increasing Incidence."
[16] Friedman et al., "Impact of Changes in Transportation."
[17] European Parl. and Council, *Directive 2003/15/EC.*
[18] European Parl. and Council, *Directive 2000/53/EC.*
[19] Boyd, *Canada vs. Sweden.*
[20] Cabinet Cmte. for the Economic Union, Human Health and the Environment.
[21] Boyd, *The Air We Breathe.*
[22] Magee, Won, and Lusztyk, *Indoor Air Quality Guidelines.*
[23] Pollution Probe, *Healthy Indoors.*
[24] Boyd, *Radon: The Unfamiliar Killer.*
[25] Kassirer, Morton, and Hills, *Promoting Solutions.*
[26] Boyd, *The Water We Drink.*
[27] Boyd, *The Food We Eat.*
[28] Boyd, *The Food We Eat.*
[29] Boyd and Wallace, *Fireproof Killer Whales.*
[30] Mabury, "Thermolysis of fluoropolymers."
[31] Environmental Defence Canada, *Toxic Nation.*
[32] Environmental Defence Canada, Regulation of PFCs.
[33] Environment Canada, Regulations Amending the Prohibition of Certain Toxic Substances.
[34] California Air Resources Board, *California Diesel Fuel Regulations.*
[35] New South Wales (Australia) DECC, Polycyclic Aromatic Hydrocarbons.
[36] European Parl. and Council, Directive 2003/17/EC.
[37] European Parl. and Council, Directive 2003/53/EC and Directive 2005/84/EC.
[38] INAC, Northern Contaminants Program, *Canadian Arctic Contaminants Assessment.*

[39] CEC, *Children's Health and the Environment.*
[40] Health Canada, Food and Drug Regulations; F/P/T Cmte. on Drinking Water, Guidelines for Canadian Drinking Water Quality.
[41] Health Canada, Food and Drug Regulations.
[42] Health Canada, Surface Coating Materials Regs. and Children's Jewellery Regs.
[43] Gov. of Canada, Chemical Substances.
[44] Boyd, *Radon: The Unfamiliar Killer.*

# The Prescription: Proposal for a National Environmental Health Strategy

*We increasingly understand that the health and well-being of our families depends on a clean and healthy environment.*

Declaration by the Leaders of the G-8 on Children's Environmental Health, 1997

Canadians deserve a level of protection from environmental threats to health that is on par with the leading international standards. Yet, as detailed in the preceding sections of this report, Canada lags behind other industrialized countries in many respects when it comes to promoting environmental health.

To bridge this gap and to ensure a healthy future for Canadians and our environment, the David Suzuki Foundation calls for the immediate development and effective implementation of a national environmental health strategy. This strategy must embody a commitment to catching up: environmental hazards known to adversely impact Canadians' health require immediate attention. It must be a *national* strategy to ensure collaboration and coordination among all levels of government.

This report identifies five priority areas that a national environmental health strategy should address:

I. Improve research and monitoring
II. Strengthen laws, regulations, and policies
III. Build professional capacity and raise public awareness
IV. Confront the unjust distribution of environmental harms and protect vulnerable populations
V. Prioritize environmental health on the international stage

Achieving real progress in these five priority areas will require a commitment to funding and implementing a national environmental health strategy over the course of several decades. Protecting the health of present and future Canadians is a wise investment. A well-designed and well-executed national environmental health strategy will save thousands of lives; will prevent millions of illnesses and disabilities; will strengthen Canada's economy by increasing productivity and enabling people to reach their full potential; and will improve the quality of life for all Canadians, particularly those individuals in our society who are the most vulnerable. These benefits cannot be adequately calculated in dollars and cents. Yet even reduced to cold monetary terms, the contributions to well-being will dwarf the costs.

After all, if we cannot take the modest steps that are necessary to protect ourselves and our children from the adverse health effects of environmental hazards, how will we ever tackle the monumental challenges posed by global warming and the decline of biodiversity? An environmentally healthier, more socially equitable, more genuinely prosperous future is within our reach. Eliminating preventable environmental impacts on our health and our children's health is a cornerstone of the David Suzuki Foundation's vision of achieving sustainability within a generation.

**Elements of a National Environmental Health Strategy for Canada**

This report highlights specific shortcomings in Canadian policies related to health and the environment. A national environmental health strategy would translate these shortcomings into action items, as summarized below. Of course, this list is not exhaustive. We call on the prime

minister and the federal ministers of health and environment, in collaboration with their provincial and territorial counterparts, to initiate a process for developing and implementing a national environmental health strategy. This process should engage the expertise of key civil society groups (e.g., health professionals, academics, environmentalists, Aboriginal communities, labour unions, and community organizers). It should also include opportunities for broad, public involvement. Canada's national environmental health strategy should provide for the regular review of priorities and achievements.

As noted in this report, most industrialized nations including the US, Australia, and all western European countries have already committed to the development and implementation of environmental health strategies or action plans. These international examples can serve as models for Canada.

We recognize that the process of refining a national environmental health strategy will take time. Nonetheless, implementing the action items highlighted below should not be delayed. Many of these recommendations are not new. Medical experts, scientists, environmental groups, the Canadian Lung Association, the Canadian Cancer Society, the Canadian Institute for Child Health, the Learning Disabilities Association of Canada, the North American Commission for Environmental Cooperation, the Commission on the Future of Health Care in Canada, [1] and concerned citizens have been urging governments to take action on environmental health for years. Governments, industry, medical professionals, and individuals must undertake a sustained and coordinated effort over the course of the next generation in order to alleviate the substantial environmental impacts on health from which Canadians are already suffering. In the absence of a sustained effort, the implication is that our children and grandchildren will inherit a nation, and indeed a world, where environmental impacts on health will be even worse than they are today. Surely we can do better.

## PRIORITY AREA I
## KEY ACTIVITIES TO IMPROVE MONITORING AND RESEARCH

**1.1 Conduct comprehensive, national biomonitoring studies**. The House of Commons Standing Committee on Environment and Sustainable Development has recommended that Canada conduct regular, national biomonitoring studies (e.g., blood and urine tests) to identify and track Canadians' exposure to industrial chemicals and other toxic substances.[2] The new biomonitoring studies being launched by Statistics Canada and the Province of Alberta are steps in the right direction. These studies should be expanded and extended to provide comprehensive, ongoing exposure data. A critical weakness of the new national study is the exclusion of children under the age of six. Biomonitoring studies should be designed to enable the analysis of environmental exposures impacting vulnerable subpopulations, such as young children and Aboriginal communities, as well as the general population.

A national study of lead levels in the blood of Canadian children is an urgent priority.[3] Such a study should focus on children living in environments known to present elevated risks of exposure, including older homes (lead paint in older homes has been linked to elevated blood lead levels in U.S. studies), [4] areas where there are known problems with lead pipes in the drinking water infrastructure; and Aboriginal communities.

The biomonitoring program should also study individuals newly diagnosed with diseases having suspected or confirmed environmental causes (e.g., some cancers, neurological and developmental problems, etc.,) in order to assess patients' environmental exposures.

The results of biomonitoring studies should be published regularly and they should be easily accessible to researchers, health professionals, governmental agencies, and the public at large.

**1.2 Establish a national environmental health tracking system.** The federal government, in partnership with the provinces, should establish a national environmental health tracking system to monitor environmental hazards, environmental exposures, and health impacts. [5] This tracking system should include national databases to integrate provincial records of:

- Boil water advisories and water-borne disease outbreaks (as recommended by Environment Canada[6] and the Walkerton Inquiry [7]); and,
- Poisonings caused by pesticides, cosmetics, household cleaners, and other products (as recommended by the Commission on Environmental Co-operation[8]).

The national environmental health tracking system should also capture information about hospital admissions for cardiovascular and respiratory illnesses that are related to air quality, learning and behavioural disabilities, childhood cancers, reproductive health outcomes, and other health issues. This information should be publicly accessible to help inform and shape public health policies and actions. The U.S. recently began building a national environmental health tracking system and it also maintains a poisoning database – both of which could serve as models for Canada.[9]

**1.3 Pursue real-time, continuous monitoring of air quality and water treatment processes.** Environment Canada's Air Quality Health Index, now being piloted in Toronto, should be expanded to urban centres across Canada, as planned. This tool will help to assess health risks from air pollution , based on hourly air quality readings and forecasts.[10]

Federal funding should also be provided to develop cost-effective, real-time continuous monitoring of water treatment processes to provide early warning of possible treatment failure. The Walkerton Inquiry recommended real-time continuous monitoring.[11] The U.S. Environmental Protection Agency is already investing significant resources in this area,[12] and Canadian research could be designed to be complementary.

**1.4 Conduct a national study to assess the overall environmental burden of disease in Canada.** A national study that would estimate the magnitude of mortality and morbidity caused by environmental hazards would provide valuable information that could be used to direct research, to inform public education efforts, to assist physicians in providing advice to their patients, and to guide health and environmental policy-making. Environmental health specialists across Canada identified this recommendation as a research priority of "high importance" to policymakers.[13]

**1.5 Increase funding for health and environment research.** Canada must increase funding for research on health and environment issues that is conducted by the Canadian Institutes for Health Research, the National Research Council, Health Canada, the Social Sciences and Humanities Research Council, and the Natural Science and Engineering Research Council. Research should focus on informing public policy and assisting medical professionals by: identifying pathways from hazards to exposures; understanding the effects of these exposures on health; identifying vulnerable subpopulations; and exploring the health effects of new substances, substances in combination, and gene-environment interactions. Research grants should promote theoretical and methodological diversity, and the interdisciplinary study of the complexity of influences on environmental health (e.g. socio-economic factors, governance issues).

In addition, Canada should significantly increase support for the National Collaborating Centre for Environmental Health (NCCEH), which the federal government established with minimal funding in 2004. Ongoing support for the work of the NCCEH is critical, as is action on the environmental hazards NCCEH identifies as major risk factors for illness in Canada.

As part of this enhanced environmental health research agenda, Canada should participate in the U.S. National Children's Study in order to ensure that the wealth of information that this study will generate can be analyzed for Canadian context.

**1.6 Develop and publicize environmental health indicators.** Canada should develop a robust set of environmental health indicators, building on research conducted in the U.S., Europe, and Australia.[14] Publicizing these indicators would ensure accountability by enabling Canadians to monitor progress, and it would also educate the public about health and environmental issues.

## PRIORITY AREA II
## KEY ACTIVITIES TO STRENGTHEN LAWS, REGULATIONS, AND POLICIES

**2.1 Establish ambitious goals and timelines for environmental health.** Canada's national environmental health strategy must include a comprehensive set of short-term, medium-term, and long-term environmental objectives, including specific targets and timelines for environmental health outcomes. The federal government should regularly report on progress made towards meeting the targets and objectives, and it should incorporate new information that is generated by the monitoring and research agenda as outlined above.

**2.2 Strengthen laws to protect all Canadians from environmental hazards in air, water, food, and consumer products.** Canadian environmental laws need to be strengthened, effectively implemented, and aggressively enforced in order to adequately protect human health from environmental hazards. Two over-arching principles should guide this process:

- *The precautionary principle.* This means that, "where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation."[15] Because it is often challenging to reach definitive conclusions about environmental impacts on human health, the application of the precautionary principle is critical in addressing uncertainty. Canada must consistently apply the precautionary principle in decisions involving potential health and environmental effects.

- *The substitution principle.* All environmental laws in Canada should explicitly require that safer alternatives replace toxic products, processes, and inputs. The substitution principle is found in Swedish chemical legislation and was recently endorsed by the parliamentary committee that led the five-year review of the *Canadian Environmental Protection Act* (CEPA).[16] Even large corporations, spurred on by imminent regulatory changes, are beginning to apply this principle. For example, the cosmetics industry is shifting away from certain chemicals; the electronics industry is shifting away from some hazardous substances; Wal-Mart has decided to phase out 20 chemicals of concern used in pesticides, cleaning products, and other household items; and Loblaws no longer sells chemical pesticides at its garden centres — it markets natural alternatives instead.

  For almost every application or use of every toxic chemical described in this report, there are less hazardous and yet economically affordable alternatives. A study commissioned by the State of Massachusetts found that there are economically cheaper substitutes for five commonly used but hazardous materials (lead, formaldehyde, perchloroethylene, di(2-ethylhexyl) phthalate or DEHP, and hexavalent chromium).[17] Researchers at the University of Massachusetts identified viable alternatives to the world's most widely used brominated flame retardant or PBDE (decaBDE).[18] The State of Illinois's Environmental Protection Agency reached the same conclusions regarding alternative flame retardants.[19]

In particular, amendments are needed to three cornerstones of environmental/consumer safety legislation: he *Canadian Environmental Protection Act 1999*, the *Pest Control Products Act*, and the *Hazardous Products Act*.

***a) The Canadian Environmental Protection Act, 1999***

Canada should use the *Canadian Environmental Protection Act, 1999* to phase out the manufacture, use, production, sale, import, or release of substances when it is known or probable that these substances cause cancer; birth defects; abnormal development;

damage to the brain; damage to the nervous, reproductive, or immune systems; or interference with the hormone system. In 1995, the Ontario Task Force on the Primary Prevention of Cancer recommended that the government set timetables to eliminate carcinogens, chlorine, and persistent, bioaccumulative toxic substances. As the Task Force concluded, "the only prudent approach to safeguarding the health of the public from known and suspected environmental carcinogens is to be precautionary while the necessary research efforts are being made to resolve the uncertainty."[20]

The government should also follow Sweden's example and prohibit substances that have not been tested for health impacts. [21] This measure would reverse the burden of proof and require a toxicological evaluation of safety *before* substances are permitted on the market. All products should be tested for their carcinogenic, mutagenic, endocrine-disrupting, neurotoxic, and developmental effects.

In addition, the National Pollutant Release Inventory should be expanded to cover a broader range of toxic substances and Environment Canada should be required to conduct audits of the releases reported by industry.

Parliament should endorse these initiatives to improve the effectiveness of CEPA, in the context of the *Act's* five-year review, which is currently underway.

### *b) The Pest Control Products Act*

Pending a mandatory special review by a panel of independent experts, the *Pest Control Products Act* (*PCPA*) should be amended to require the immediate suspension of the registration of pesticides that are prohibited by another member country of the OECD for health or environmental reasons. This would result in the suspension and study of at least 50 active ingredients used in approximately 1,000 pesticide products in Canada.

The *PCPA* should also be amended to phase out the registration of lawn and garden pesticides, as recommended by the Canadian Cancer Society.[22] More than 125 Canadian municipalities, as well as the Province of Quebec, have passed laws restricting the use of lawn and garden pesticides.[23] All Canadians deserve the same level of protection from pesticides.

***c) The Hazardous Products Act***

The *Hazardous Products Act* is badly outdated and needs a major overhaul. The *Act* should be amended to authorize the mandatory recall of consumer products that Health Canada deems hazardous to human health (e.g., electronics and home furnishings containing PBDEs, non-stick cookware containing perfluorochemicals, asbestos insulation, products containing lead and mercury).

As an interim step, Canada should require the mandatory labelling of all consumer products (including foods), with particular emphasis on synthetic chemicals and heavy metals known or suspected of causing: cancer; birth defects; abnormal development; damage to the brain; damage to the nervous, reproductive, or immune systems; or interference with the hormone system—pending the elimination of these substances from the consumer market. The Canadian Strategy for Cancer Control has recommended legislation that would require the full disclosure of all known and probable carcinogens in consumer products, including pesticides.[24] Similar labelling requirements already exist in Europe and California, and they could serve as models for Canada.

**2.3 Raise all health and environmental standards to meet or exceed international best practices.** Canada should take immediate steps to raise health and environmental standards that currently fail to reflect international best practice. A comprehensive comparative review of regulatory standards may be necessary to identify areas in which Canadian environment and health standards are less protective that those of other industrialized

countries. As a starting point, this report highlights Canada's failure to regulate the following substances:

- ***Pesticides:*** Canada continues to register pesticides that other nations have banned for health and environmental reasons. This signals a systematic weakness in the pesticide evaluation process that should be addressed. Also, maximum residue limits for pesticides on foods should be upgraded if they are found to be less protective than the standards that other countries enforce.

- ***Ambient air quality:*** The federal government should replace existing voluntary guidelines with health-based, national standards that are legally binding – as in the U.S., Australia, and the European Union. The new standards should be at least as stringent as the leading international standard.

- ***Drinking water:*** The federal government should replace existing voluntary guidelines with health-based, national standards that are legally binding – as in the U.S. and the European Union. The new standards should be at least as stringent as the leading international standard.

- ***PBDEs:*** Environment Canada's proposed PBDE regulations should be extended to prohibit the import, use, and sale of *all* congeners (i.e., tetra, penta, hexa, hepta, octa, nona, and deca), and all products containing them – as in Sweden and the U.S. states of Maine and Washington.

- ***PFC's:*** Canada should replace the current piecemeal approach to PFCs with a regulation that prohibits the manufacture, import, sale, and use of *all* PFCs, including their precursors.

- ***Radon:*** **R**adon protection measures should be incorporated into all building codes in Canada – as in Denmark, Ireland, Sweden, and the United Kingdom.[25] In addition, Health Canada should further strengthen its new radon guideline by lowering the threshold for recommended mitigation from 200 Bq/m³ to 100 Bq/m³.

- ***Lead.*** Canada should follow the U.S. example and implement a national lead exposure reduction program if the proposed national screening program for blood lead levels in Canadian children indicates that some children are exposed to harmful levels of lead. The lead exposure reduction program should focus on older housing stock in low-income areas and other hotspots. Also, regulations under the *Food and Drug Act* that allow lead concentrations in apple juice at levels 20 times higher than permissible in drinking water should be amended immediately.

- ***Phthalates and Nonylphenols:*** Canada should ban the use of phthalates in cosmetic products, toys, and other children's products and ban nonylphenols in cleaning products – as in the European Union.

- ***PAHs:*** Canada should regulate PAH emissions from diesel engines, as in California, Australia, and the European Union.

**2.4 Implement a national tax on polluters and eliminate perverse subsidies.** We need to overcome the market's failure to put a price on environment damage and to reflect the inherent value of environmental and human health. Pollution taxes are the most effective, efficient, and equitable way of addressing the first failure and implementing the "polluter pays" principle. European countries have successfully used pollution taxes to reduce the release of toxic chemicals into water bodies, the use of pesticides, and air pollution. [26] Data on pollutant releases gathered by National Pollutant Release Inventory could serve as the basis for such a policy in Canada. Pollution taxes could initial be modest and increase with time. The revenue collected from a Canadian pollution tax could be used to finance a just

transition strategy for workers who lose jobs due to the elimination of toxic substances. The Ontario Task Force on the Primary Prevention of Cancer recommended this kind of pollution tax and transition strategy in 1995.[27] Alternatively, the pollution tax could be made revenue neutral by concurrently reducing income taxes and employment taxes.

In addition, the government must end programs that support or encourage activities that cause environmental harm (i.e. perverse subsidies). For example, Canada should remove the current GST exemption for agricultural pesticides and impose a special charge on pesticides. This would help to finance programs that support organic agriculture, assist farmers in reducing pesticide use, and promote local food distribution systems, such as farmers' markets. Similarly, the government should end tax breaks that benefit oil and gas development, and redirect subsidies to zero or low emission sources of energy (e.g., wind, geothermal, solar, tidal, and micro-hydro).

**2.5 Enact extended producer responsibility legislation.** Canada should enact extended producer responsibility legislation, based on the successful laws implemented throughout Europe and in Japan.

**2.6 Require health assessment of proposed developments, policies, and programs.** The *Canadian Environmental Assessment Act* should be amended to require that all environmental assessments consider the human health impacts of proposed developments, policies, programs, and legislation; and to require the evaluation of the potential environmental impacts on disadvantaged populations.[28]

**2.7 Implement healthy procurement policies at all levels of government.** Governments at all levels should adopt procurement policies require healthy purchases, such as chlorine-free recycled paper; hybrid and other ultra-low or zero emission vehicles; buildings that meet Leadership in Energy and Environmental Design (LEED) standards; appliances,

computers, and other electrical equipment with ENERGY STAR ratings; plastic products that do not contain polyvinyl chloride or Bisphenol A; and green cleaning products.

**2.8 Implement effective policies to address climate change and to accelerate the transition to an energy-efficient, low-carbon economy.** Canada must stop treating the atmosphere like a free dumping ground for greenhouse gas emissions. Strong regulations that limit emissions from all sectors should be immediately implemented immediately, along with economic policies that put a price on carbon and that make polluters pay. Canada must immediately start reducing total greenhouse gas emissions in order to achieve at least an 80 per cent reduction below 1990 levels by 2050. As well, Canada should play a constructive role in ensuring that international agreements in the post-2012 era are strong enough to achieve global reduction goals.

**2.9 Adopt "Community Right-to-Know" legislation and bylaws.** All levels of government should recognize that citizens have the right to know about the toxic chemicals used, stored, and released in their neighbourhoods, and should collaborate in order to ensure that this information is easily accessible. The proposal for a Community Right-to-Know (CRTK) bylaw in Toronto could serve as a model for other municipalities, while CRTK legislation in U.S. states could serve as a model for Canadian provinces. At the federal level, improvements to the National Pollutant Release Inventory, as recommended in section 2.2, would facilitate CRTK efforts. Canadian environmental laws should be amended to require corporations to publicize the results of all epidemiological, toxicological, and other health studies related to their products.

**2.10 Recognize that Canadians have the right to live in a healthy environment.** The federal government should recognize that all Canadians enjoy a basic human right to breathe clean air, to drink clean water, and to live in a healthy environment. The Supreme Court of Canada has endorsed the recognition of the right to live in a healthy environment.[29] More than 70 nations, including at least 20 European nations, have explicitly acknowledged in their constitutions that all citizens have the right to a healthy environment. Constitutional

rights provide the most powerful form of protection in our legal system; they reinforce core values, educate newcomers, and they can have a profound influence on government policy. In 1990, the Canadian Bar Association recommended that:

> The Government of Canada should adopt a long-term strategy to entrench the right to a healthy environment in the Canadian Constitution. In the interim it should enact a statute enunciating the right of every Canadian to a healthy environment. No statute should be enacted that is inconsistent with that right.[30]

Canadians also need procedural rights, including access to information, participation in government decision-making, and access to judicial remedies.

## PRIORITY AREA III
## KEY ACTIVITIES TO BUILD PROFESSIONAL CAPACITY AND RAISE PUBLIC AWARENESS

**3.1 Promote the study of environmental health in training programs for health professionals.** The federal and provincial governments should support the development of curricula and teaching capacity in the field of environmental health. They should work with medical associations and academic institutions to integrate environmental health in medical, nursing, and public health study programs, as well as graduate programs specializing in environmental health.

**3.2 Increase the number of environmental health specialists.** Canada needs more medical professionals with specialized training in environmental health. The national environmental health strategy should encourage universities, hospitals, public health departments, and industry to hire appropriately trained environmental health specialists.

***Environmental Health at Canadian Universities***

***In recent years, universities across the country have developed nodes of expertise in environmental health research and education:***

- ***The McMaster Institute of Environment & Health (MIEH) was established in 1996 to facilitate, promote, and publish environmental health research. MIEH fosters an interdisciplinary approach to the study of the complex relationships between the environment and human health. Its mandate focuses on facilitating environmental health education for students, academics, and the broader community.***
- ***The Institute of Population Health at the University of Ottawa was established in 2000. It brings together researchers in the arts, education, engineering, environmental science, and other disciplines, recognizing that "population health depends on a wide range of inter-related determinants." Students learn from specialists in environmental health risk assessment and environmental epidemiology. The University of Ottawa's PhD program in population health is closely linked to the Institute of Population Health, and it draws upon its expertise.***
- ***The Centre for Health and Environment Research at the University of British Columbia was established in 2003. It hosts a multidisciplinary team that focuses on the research and prevention of diseases caused by hazards in outdoor and indoor environments. The Centre for Health and Environment Research also employs a communications manager who advises researchers on "knowledge translation" i.e., communicating research findings to the appropriate audiences.***
- ***The Community Health program at McGill University trains specialists to identify health problems in populations; to plan, implement, and evaluate programs to promote health and to control diseases; and to apply this knowledge to community-oriented clinical practice. The program of study includes a field placement in environmental health.***

**3.3 Support professional development in the field of environmental health and application in clinical practices and public health programs.** Health Canada should approach medical associations and academic institutions to develop and promote opportunities for practising health professionals to receive training in environmental health issues, and information about how to integrate knowledge of these issues into day-to-day practice. Health Canada is currently developing modules for public health professional development; this project should be expanded to include a module on environmental health.

**3.4 Educate Canadians about environmental health.** Citizens must have access to information about environmental threats to health, in a user-friendly format, so that they can make better everyday decisions. The Public Health Agency of Canada, Health Canada, Environment Canada, and their provincial/territorial counterparts should make the dissemination of health and environmental health information a priority.[31] All levels of government should publicize information gathered from the enhanced research and monitoring efforts that are outlined in this report.

A user-friendly government website that posts pollution information by postal code should be developed.[32] The federal government should provide pollution data from the National Pollutant Release Inventory. The provincial and territorial governments should provide information on issues such as contaminated sites and landfills. Municipalities should post reports on drinking water quality, which provincial laws are beginning to require following the Walkerton disaster. Over time, such a website could develop into a single window, with all levels of government, businesses, and non-governmental organizations across the country sharing information on environmental health issues.

All levels of government should support organizations and coalitions that conduct outreach programs on environmental health. These include the Canadian Cancer Society, the

Canadian Lung Association, the Canadian Institute for Child Health, the Learning Disabilities Association of Canada, the Canadian Association of Physicians for the Environment, the Canadian Partnership for Children's Health and the Environment, the Canadian Public Health Association, Pollution Probe, the Labour Environmental Alliance Society, and other allied national, provincial/territorial, and local groups.

## PRIORITY AREA IV: KEY ACTIVITIES TO CONFRONT THE UNJUST DISTRIBUTION OF ENVIRONMENTAL HARMS AND PROTECT VULNERABLE POPULATIONS

**4.1 Strengthen laws to protect vulnerable populations from toxic substances.** When it comes to establishing priorities, setting standards, and assessing health and environmental impacts, all Canadian health, safety, and environmental legislation should be amended to explicitly require the protection of children, pregnant women, people with compromised immune systems, migrant farm workers, Aboriginal communities and other vulnerable populations. The Canadian government should develop a working definition of, and guiding principles for, environmental equity, and apply these to current and future legislation.

**4.2 Conduct or fund studies to clearly identify populations at risk.** Health Canada and Environment Canada should collaborate and support research that will identify populations that face elevated risks from environmental hazards. Studies should be designed to promote and improve partnerships between governments, researchers and communities. Environment Canada's Northern Contaminants Program and the Vulnerable Populations Office within Health Canada's Safe Environments Programme have started conducting such research. This work should continue and be expanded to inform priorities and assess progress towards achieving environmental justice.

**4.3 Clean up known environmental threats that pose a risk to vulnerable populations.** All levels of government must work together to establish ambitious targets and timelines need

to clean up contaminated sites that threaten the health of children, minorities, and economically disadvantaged communities. Examples cited in Chapter 6 include the chemical contamination in Sarnia; dioxins that contaminate the Great Lakes; and air pollution in Cape Breton County, Nova Scotia.

**4.4 Take urgent steps to provide adequate drinking water on Aboriginal and Inuit reserves.** The federal and provincial governments must effectively invest in drinking water infrastructure, training, distribution systems, testing, and monitoring. The Commissioner for the Environment and Sustainable Development noted in her 2005 audit that a regulatory regime is required to ensure that people who live on reserves enjoy the same level of protection for drinking water quality as people who live off of reserves. The Commissioner recommended the development of regulations that set forth roles and responsibilities, water quality requirements, technical requirements, operator training and certification, compliance and enforcement, and public reporting requirements.[33] The appointment of a respected special envoy for drinking water on reserves, comparable to Stephen Lewis's role as the United Nations' special envoy for HIV/AIDS, could ensure that this issue receives the attention and resources that are urgently needed.

## PRIORITY AREA V: KEY ACTIVITIES TO PROMOTE ENVIRONMENTAL HEALTH ON THE INTERNATIONAL STAGE

**5.1 Prioritize environmental health in Canadian foreign policy.** Canada's development assistance programs should reduce environmental impacts on health. These programs should focus on clean water, adequate sanitation, and air quality. Canada should establish a strategy with a legislated requirement to meet the internationally accepted target of 0.7 per cent of the GDP for development assistance programs by 2015. Canada should conduct an environmental audit of our international trade profile to ensure that we are not shifting polluting industries to developing nations that have less stringent health and environmental

policies. Canada should continue to play a key role in efforts to cancel the debt of developing nations that meet human rights and anti-corruption criteria.

**5.2 Promote environmental health in international negotiations.** Canada should re-evaluate its positions in international negotiations where we are interfering with global efforts to reduce environmental impacts on health. Canada should be a champion, not oppose, the recognition of the human right to clean water. Canada should lead, not oppose, global efforts to eliminate exposure to mercury. Canada should advocate for a new international agreement to phase out the production, use, and release of developmental neurotoxins (e.g., lead, mercury, arsenic, PCBs, toluene), which can cause irreparable brain damage to millions of babies and young children around the world.[34] The new agreement would be similar to the widely supported *Stockholm Convention on Persistent Organic Pollutants*. Finally, Canada should support, rather than oppose, the listing of chrysotile asbestos under the *Rotterdam Convention*.

**5.3 Prohibit the export of substances and products that are banned in Canada.** It is morally indefensible for Canada to export toxic substances to other nations when our governments have determined that these substances should not be used in Canada. This is particularly true of exports to developing countries that do not undertake adequate safety precautions.

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***Sustainability within a Generation***

***In 2004, the David Suzuki Foundation published a series of short-term, medium-term, and long-term targets, that were developed by environmental experts on issues including climate change, air pollution, water pollution, and the release of toxic substances.[35] The targets were based on the best available scientific evidence as well as the objectives set (and in some cases already achieved) by nations leading the race to a sustainable future. The goal of this agenda is to make Canada a world leader in sustainability by 2030.***

***Sustainability means living within Earth's limits. In a sustainable future, no Canadian would think twice about drinking a glass of tap water. Food would be free from pesticide residues, antibiotics, and growth hormones. Air, water, and soil would be uncontaminated by toxic substances. In a sustainable future, it would be safe to swim in every Canadian river and lake, and it would be safe to eat fish wherever they would be caught.***

***Canada must concentrate its efforts on nine critical goals and associated targets in order to become sustainable within a generation:***

- ***Generate genuine wealth: Canada supplements the narrow goal of economic growth with a Genuine Wealth Index that measures the state of its natural, social, human, manufactured and financial capital.***

  **Key target:** ***By 2007, Canada develops a set of indicators and annual reports on the health and well-being of people, communities, and ecosystems by.***

- ***Improve efficiency: Canada reduces energy and material use by at least 75 per cent in order to live within the capacity of the Earth's natural systems, while maintaining its quality of life.***

  **Key target:** ***By 2030, Canada reduces its material consumption by 30 per cent of current levels, and it reduces its water and energy consumption by 50 per cent.***

- ***Shift to clean energy: Canada replaces fossil fuels with clean, low-impact renewable sources of energy. Canada has fallen far behind other countries in addressing the threat of climate change.***

  **Key target:** ***By 2030, Canada generates at least 50 per cent of its electricity from low-impact renewable sources.***

- ***Reduce waste and pollution: The smart design of Canada's production and consumption processes would reduce health and environmental threats.***

  **Key target:** ***By 2020, Canada cuts by 60 per cent the volume of toxic substances which it releases. Nitrogen oxide, sulphur oxide and volatile organic compound emissions are down by at least 75 per cent.***

- ***Protect and conserve water:*** *Canada implements comprehensive water policies that protect freshwater systems from the threats of climate change and of industrial, agricultural, and municipal pollution.*

  **Key target:** *By 2020, the Canadian Constitution enshrines the right to clean water and a healthy environment. All Canadian municipalities have at least secondary sewage treatment.*

- ***Produce healthy food:*** *Canada ensures that its food supply is healthy and produced in ways that do not compromise its land, water, and energy sources.*

  **Key target:** *By 2020, 30 per cent of Canada's agricultural products are certified organic and total pesticide use decreases by 90 per cent.*

- ***Conserve, protect, and restore Canada's natural environment:*** *Canada effectively protects species and ecosystems by strengthening endangered species legislation and by ensuring that land- and marine-use decisions protect biodiversity.*

  **Key target:** *By 2020 Canada removes at least 80 species from the endangered species list as a result of successful recovery plans.*

- ***Build sustainable cities:*** *Canadian cities are vibrant, clean, livable, prosperous, safe, and sustainable.*

  **Key target:** *By 2030, per capita trips on public transit in Canada's major cities increase by 50 per cent.*

- ***Promote global sustainability:*** *Canada is once again one of the most compassionate and generous nations on Earth; a global leader in securing peace, alleviating poverty, and promoting sustainability in the developing world.*

  **Key target:** *By 2015, Canada spends 0.7 per cent of its GDP on foreign aid.*

## Chapter 7 Notes

[1] Wigle, *Child Health*; CEC, *Children's Health and the Env.*; Frumkin, *Environmental Health.*.
[2] Standing Cmte. on Env. and Sustainable Devt., *CEPA, 1999 – Five-year Review*, 19.
[3] Tsekrekos and Buka, "Lead Levels;" CEC, *Children's Health and the Environment.*
[4] Gov. of Canada, *Children's Health and the Environment*, 25.
[5] Gov. of Canada, *Children's Health and the Environment*, 57.
[6] Gov. of Canada, *Children's Health and the Environment*, 56.
[7] O'Connor, *Report of the Walkerton Inquiry*.
[8] CEC, *Children's Health and the Environment*, 69.
[9] U.S. CDC, *CDC`s Strategy;* Watson et al., "2004 Annual Report."
[10] Gov. of Canada, *Air Quality Health Index.*
[11] O'Connor, *Report of the Walkerton Inquiry*.
[12] U.S. EPA, *Water Distribution System Analysis.*
[13] Chociolko, Copes, and Rekart, *Needs, Gaps, and Opportunities*, 37.
[14] U.S. CDC, *CDC's Strategy*; Gosselin and Furgal "Challenges and Directions."
[15] Fifth Intl. Conf., Bergen Ministerial Declaration. Endorsed by the Supreme Court of Canada: 114957 Canada Ltee (Spraytech, Société d'arrosage) v. Town of Hudson (2001), 40 C.E.L.R. (N.S.) 1 (S.C.C.).
[16] Standing Cmte. on Enviro. and Sust. Devt., *CEPA, 1999 – Five-year Review*, 39.
[17] Toxics Use Reduction Inst., *Five Chemicals Alternatives Assessment*.
[18] Pure Strategies, *Decabromodiphenylether: An Investigation of Non-Halogen Substitutes*.
[19] Illinois Environmental Protection Agency. 2006. DecaBDE Study: A Review of Available Scientific Research.
[20] Ont. Task Force on the Primary Prev. of Cancer, *Recommendations*, 29
[21] Gov. of Sweden, Ministry of Environment, *New Guidelines on Chemicals Policy.*
[22] Canadian Cancer Society's Position Statement: http://www.cancer.ca/ccs/internet/standard/0,3182,3172_335143__langId-en,00.html
[23] Christie, *Private Property Pesticide By-laws.*
[24] CSCC, National Committee, *Prevention of Occupational and Environmental Cancers.*
[25] Åkerblom, *Radon Legislation and National Guidelines*, 8.
[26] Boyd, *Unnatural Law*.
[27] Ont. Task Force on the Primary Prev. of Cancer, *Recommendations.*
[28] Kemm, Parry, and Palmer, *Health Impact Assessment.*
[29] *Ontario* v. *Canadian Pacific*.
[30] Can. Bar Assoc., *Sustainable Development*, 27.
[31] At the present time, environmental health is not even listed on the A-Z index of topics found on the Public Health Agency's website: http://www.phac-aspc.gc.ca.
[32] See for example the U.S. Environmental Protection Agency's web site, Surf Your Watershed: http://www.epa.gov/surf.
[33] Commissioner of the Environment, Drinking Water in First Nations Communities.
[34] Grandjean and Landrigan, "Developmental Neurotoxicity of Industrial Chemicals."
[35] Boyd, *Sustainability Within a Generation.*

## GLOSSARY

**1,3 dichloropropene** is an agricultural pesticide. It is registered for use in Canada as a fumigant. It is highly toxic to the liver and to the kidneys, and is classified as a possible human carcinogen. Several countries, including Austria and Germany, have banned its use due to its carcinogenicity and its high mobility in soils.

**2,4-Dichlorophenoxyacetic Acid (2,4-D)** is a chlorinated phenoxy herbicide that inhibits plant growth. In Canada, it is commonly used in homes and gardens, on turf, in forestry, and in agriculture. Canada currently registers 211 products that contain 2,4-D as an active ingredient. Studies show that 2,4-D is toxic to the nervous system and the reproductive system. It can also suppress the immune system and cause cancer.

**Aldehydes** are air pollutants linked to respiratory illnesses. Vehicle exhaust is a major emissions source. The combustion of ethanol produces higher levels of aldehydes than the combustion of gasoline. Products such as plywood, particleboard, fiberboard, permanent press clothing and draperies, some types of foam insulation, fiberglass, carpets, carpet glues, and some paints and floor finishes can also off-gas **formaldehyde**. Exposure to formaldehyde can trigger asthma attacks. It is also a known carcinogen.

**Arsenic** occurs naturally in the environment and also as a result of anthropogenic sources, such as industrial releases, pesticides and pressure-treated wood. Certain areas of Canada have naturally occurring arsenic water contamination at levels above Canada's drinking water standard, which is 0.01mg/L. Exposure to arsenic increases the risk of lung cancer and bladder cancer. Anthropogenic arsenic is generally in a form that is more toxic to humans than naturally occurring arsenic.

**Asbestos** is a naturally occurring fibrous silicate mineral. It is used as insulation because it is resistant to heat and corrosion. There is conclusive evidence that every type of asbestos is carcinogenic. In particular, exposure to asbestos is associated with *mesothelioma***,** an incurable form of cancer that affects the membrane linings (mesothelium) of the bodies' organs. The inhalation of asbestos fibres can also cause a lung disease called *asbestosis*.

**Atrazine** is a highly persistent triazine herbicide. In Canada, atrazine is registered for use in 17 agricultural pesticides, particularly for corn crops. The European Union has banned the use of atrazine because it disrupts the endocrine system; it interferes with the hormone system; and it causes limb deformities, abnormal sexual changes, and weakened immune systems. Studies also link the use of atrazine to declining frog and amphibian populations.

**Benzene** is a known human carcinogen. This air pollutant is produced by vehicle exhaust and tobacco smoke, and by burning coal and oil.

**Benzo[a]pyrene (BaP)** is one the most toxic of the polycyclic aromatic hydrocarbons (PAHs). BaP is present in gas and diesel exhaust, and in tobacco smoke.

**Bioaccumulation** is a process, in which a substance builds up in the environment, and ultimately, in the bodies of living organisms, including humans.

**Biomonitoring** is the direct measurement of environmental chemicals; the substances formed when these chemicals are metabolized, and the substances that are formed through chemical reactions in the body.

**Bisphenol A (BPA)** is a substance used in the production of polycarbonate plastic, a hard plastic used in many consumer products, including water bottles, baby pacifiers, and dental sealants. Studies show that exposure to Bisphenol A affects the reproductive system and the immune system, and it is linked to prostate cancer. It can also affect the chemistry of the brain, resulting in behavioural changes such as hyperactivity.

**Cadmium** is a naturally occurring heavy metal. It is found in many consumer goods, including photovoltaic cells, infrared windows, paints, and plastics (primarily polyvinyl chloride or vinyl). It is also found in Teflon®. Exposure can occur as a result of eating contaminated shellfish, liver, and kidney; or by breathing air polluted by tobacco smoke, incinerated waste, or by the burning of coal, diesel, and gasoline. Cadmium is carcinogenic. It also causes reproductive and developmental problems.

***Campylobacter*** bacteria are a major cause of diarrheal illness in humans. It is spread through contaminated food and water.

**Carbaryl** is an insecticide used in agriculture, in the home and garden, and in pet products used to control fleas. It is a known carcinogen and an endocrine disruptor.

**Carbon monoxide** is an air pollutant that is produced during combustion. Vehicle exhaust is the predominant source of carbon monoxide emissions. It contributes to the formation of smog, which causes serious respiratory problems, such as asthma.

**Chlorofluorocarbons (CFCs)** were widely used for decades in refrigeration. They were considered the perfect chemical because they were non-toxic, non-flammable, and nonreactive. However, studies since the 1970s showed that they contributed to the destruction of the Earth's ozone layer. The Montreal Protocol, signed in 1987, resulted in near zero production of CFCs.

**Chromium** is an elemental metal. It is released into the environment through fossil fuel consumption (this accounts for more than half of the Canadian releases); iron and steel production; chemical processing; chromium-based automotive catalytic converters; and chromated fine powders that are used as toners in copying machines. Hexavalent chromium is more toxic than other forms of chromium. It is a known carcinogen.

***Cryptosporidiosis*** is a diarrheal disease caused by a water-borne, microscopic parasite.

**Cyanide** is any one of the highly poisonous salts or esters of hydrocyanic acid. It usually joins with other chemicals to form compounds such as hydrogen cyanide, sodium cyanide, and potassium cyanide. Cyanide compounds can occur in plants and in bacteria. It is used in

electroplating, metallurgy, organic chemical production, and in some mining processes. It is also used to develop photographs, to manufacture plastics, and to fumigate ships. Cyanide is a contaminant in cigarette smoke. Exposure to cyanide can cause damage to the heart and the brain.

**Cyclotetrasiloxane** (D4) is a synthetic chemical belonging to a group of compounds found in volatile, low-viscosity silicone fluids. It is used in various cosmetic products, including shampoos, lip balms, and antiperspirants. The European Commission classifies D4 as a reproductive toxin. Studies show that it is persistent and bioaccumulative.

**Decabromodiphenyl ether (DecaBDE)** – *See* Polybrominated diphenyl ethers.

**Dichloro-Diphenyl-Trichloroethane** (DDT) is one of the most famous "dirty dozen" persistent organic pollutants (POPs) identified under the *Stockholm Convention*. DDT was widely used during World War II to protect soldiers and civilians from malaria, typhus, and other diseases. It was later used as an agricultural insecticide, although this use was eventually banned. Several countries continue to use DDT as a control against malaria. DDT and its metabolites are endocrine disruptors and probable carcinogens.

**Di(2-ethylhexyl) phthalate (DEHP)** is found in perfumes, hair sprays, building products, food packaging, children's products, and medical devices. Like most phthalates, exposure to DEHP is ubiquitous and thus unavoidable. Studies show that DEHP is a developmental and reproductive toxin.

**Dioxins**, or **Polychlorinated dibenzodioxins (PCDDs)**, are a group of organochlorine chemicals. Dioxins are classified as one of the "dirty dozen" persistent organic pollutants (POPs) under the *Stockholm Convention*. These chemicals are produced unintentionally due to incomplete combustion and they are found in automobile exhaust, tobacco smoke, and wood and coal smoke. They are also produced during the manufacture of certain pesticides and other chemicals. Certain kinds of metal recycling, and pulp and paper bleaching can also release dioxins. Dioxins can cause damage to the brain and to the central nervous system. They are known carcinogens.

**Dust mite antigens** are common indoor pollutants from the feces and shed exoskeletons of dust mites. They can cause severe allergic reactions and trigger asthma attacks.

***E. coli*** (Escherichia coliO157:H7) is an intestinal bacteria that occurs naturally in animals. E. coli infections in humans can cause severe abdominal cramping, and in some cases, kidney failure, and death.

**Endosulfan** is a persistent organochlorine pesticide used in agriculture in Canada. It is an estrogenic endocrine disruptor.

**Formaldehyde** is one of the most hazardous volatile organic compounds. It is also a common indoor air pollutant. Products such as plywood, particleboard, fiberboard, permanent press clothing and draperies, some types of foam insulation, fiberglass, carpets, carpet glues, and

some paints and floor finishes can off-gas formaldehyde fumes and contaminate indoor air. Exposure to formaldehyde can trigger asthma attacks. It is also a known carcinogen.

***Giardia*** is a water-borne parasite that infects the gastrointestinal tract, causing giardiasis or "beaver fever."

**Hepatitis A** is an infectious liver disease that can be contracted through various means, including contaminated water and food. It can cause fever and jaundice.

**Hexachlorobenzene** (HCB) is an organochlorine pesticide and industrial by-product. It is classified as one of the “dirty dozen” persistent organic pollutants (POPs) under the *Stockholm Convention*. It accumulates in humans and biomagnifies up the food chain. It is a known carcinogen and suspected endocrine disruptor.

**Lead** is a highly toxic heavy metal, once used in paint, gasoline, PVC, and pipes. Lead isstill used in the production of batteries, ammunition, metal products (solder and pipes), jewellery, devices to shield X-rays, and computer monitors (to block radiation). Lead poisoning causes a range of chronic health effects. Lead exposure in children can cause cognitive deficits, developmental delays, hypertension, impaired hearing, attention deficit disorder, reduced intelligence, and learning disabilities. In the elderly, accumulated lead is released into the blood, contributing to various health effects, including cataracts, Alzheimer’s disease, Parkinson’s disease, other forms of dementia, high blood pressure, cardiovascular disease, and impaired kidney function.

**Malathion** is an organophosphate insecticide used in the home; on lawns, gardens, trees, and shrubs; and on cotton crops and some food crops. Malathion is also sprayed aerially to control mosquitoes. As malathion reacts and breaks down within an organism or in sunlight, it releases a chemical called malaoxon, which is 40 times more toxic than malathion. Malaoxon is the primary source of malathion’s toxicity. Malathion is linked to vision loss, kidney damage, lung damage, DNA abnormalities, childhood leukemia, aplastic anemia, and adult leukopenia.

**Mercury** is a toxic heavy metal. It is known to contaminate fish and animals. It is also a potent neurotoxin that can cause permanent damage to the brain and to the central nervous system, especially in young children. In pregnant women, mercury can pass through the placenta and harm the fetus.

**Mesothelioma** is an incurable form of cancer that affects the membrane linings, or mesothelium, of the bodies' organs. It is associated with exposure to asbestos.

**Methoxychlor**, an organochlorine pesticide, is neurotoxic and a potent endocrine disruptor. It is no longer registered for use in Canada. However, Canada continues to import food that is treated with methoxychlor.

**Methylene chloride**, or dichloromethane, is a colorless liquid used as an industrial solvent and as a paint stripper. It is also used in the manufacture of photographic film and in the

decaffeination process. It is found in some aerosol and pesticide products. It is a known carcinogen and a suspected endocrine disruptor.

**Mirex** (perchlordecone) is an organochlorine insecticide. It is classified under the *Stockholm Convention* as one of the "dirty dozen" persistent organic pollutants (POPs). It is one of the POPs that persists for the longest time in the natural environment. It is no longer used as a pesticide. Exposure occurs by breathing, touching, or ingesting dust or soil particles near hazardous waste sites that contain mirex, and by eating contaminated fish and other animal products. It is a reproductive and developmental toxin, as well as a carcinogen.

**Nitrogen oxides** are one of the major air pollutants produced during fuel combustion. This group of chemicals is linked to increased levels of smog and to increasing rates of asthma.

**Nonylphenols** are potent endocrine disruptors. They are used as "inert" ingredients in pesticide formulations and in cleaning products. They have been found to contaminate many food products.

**Organophosphate pesticides (OPs)** are a group of insecticides that are esters of phosphoric acid. They block a neurotransmitter that destroys the enzyme responsible for stimulation. Exposed insects die as a result of over stimulation. Humans can be exposed to OPs by drinking water or by eating fresh food or processed vegetables that are contaminated with OPs; by touching surfaces that are contaminated with OPs; or by breathing contaminated air following pesticide applications. OPs are among the most acutely toxic pesticides. Some OPs cause developmental or reproductive harm, some are carcinogenic, and some are known or suspected endocrine disruptors.

**Oxychlordane** is the primary metabolite of trans-nonachlor, a major ingredient in chlordane, a persistent organic pollutant. Traditional food sources in the Arctic are contamined with trans-nonachlor and oxycholordane. Oxycholordane is a suspected endocrine disruptor.

**Perchlotoethylene** or tetrachloroethylene (PERC) is mainly used as an industrial metal degreaser and as a dry cleaning fluid.

**Perfluorochemicals (PFCs)** are man-made chemicals used in many consumer products, including household cleaners, cosmetics, food packaging, non-stick coatings on pots and pans, and stain repellents on furniture and clothing. PFCs are linked to cancer, birth defects, damage to organs, and damage to the immune system and the reproductive system. **Perfluorooctanic acid (PFOA)** is a highly persistent PFC used in the production of Teflon. Body burden studies conducted in different parts of the world reveal that humans are contaminated with PFOA. **Perfluorooctane sulfonate (PFOS)** was a key ingredient in 3M's Scotchguard and other stain repellents. It is a persistent organic pollutant. Studies show that it is very accumulative in humans.

**Perfluorooctanic acid (PFOA)** – *See* Perfluorochemicals (PFCs).

**Perfluorooctane sulfonate (PFOS)** – *See* Perfluorochemicals (PFCs).

**Permethrin** is a synthetic pyrethroid insecticide used to control ticks, mosquitoes, head lice, and scabies. It is synthesized from pyrethrum, a naturally occurring pyrethroid insecticide. This synthetic chemical is an endocrine disruptor. It is also linked to an increased risk of prostate cancer.

**Phthalates** are used predominantly as softeners, or plasticizers, in PVC plastic products. They are found in a wide range of consumer products, including perfumes, hair sprays, building products, food packaging, children's toys, and medical devices. The World Health Organization identifies phthalates as a probable carcinogen. Phthalates can also disrupt the endocrine system, and cause reproductive disorders and developmental effects.

**Polybrominated diphenyl ethers (PBDEs)** are used extensively as fire retardants in many consumer products, including clothing, computers, televisions, and furniture. Although the human health impacts of exposure to PBDEs are not well understood, tests on animals indicate that they can impair the development of the brain, affect hormone and reproductive systems, and cause cancer. **Decabromodiphenyl ether (DecaBDE)** is the most widely used chemical in this class. Studies show that it can affect the brain, alter sex hormones, reduce male fertility, and disrupt the development of ovaries. It is classified as a possible human carcinogen.

**Polychlorinated biphenyls (PCBs)** are a group of non-flammable, stable, organochlorine persistent organic pollutants (POPs). At one time, they were widely used as coolants and lubricants in fire retardants, hydraulic fluids, transformers, capacitors, and other electrical equipment; and in liquid seals, paints, varnishes, inks, and pesticides. PCBs are known carcinogens and neurotoxins. They are also suspected endocrine disruptors.

**Polycyclic aromatic hydrocarbons (PAHs)** are a mixture of organic compounds that are released into the atmosphere as gases or particles during the incomplete combustion of organic materials, such as fossil fuels. PAHs are linked to cancer, cardiovascular and respiratory problems, and negative impacts on birth outcomes.

**Polyvinyl Chloride (PVC)** is a thermoplastic polymer. It is used to make a wide variety of building materials and consumer products, including pipelines, vinyl siding, blinds, gramophone records, and furniture. Vinyl chloride, a toxic gas, is used in the production of PVC. It causes brain, liver, and lung cancers. Consumer products made from PVC offgas vinyl chloride.

**Propoxur** is an insecticide. It is registered for use in many household pest control products, such as flea collars. As a result, humans are exposed to this insecticide. Toxic effects include blurred vision, nausea, vomiting, sweating, and a rapid heart beat. Its reproductive and development effects are not understood, but adverse effects have been shown in research.

**Radon** is a ubiquitous, naturally occurring radioactive gas resulting from the decay of uranium. Uranium is distributed in varying concentrations throughout soil and rocks in Canada. Radon is one of the most harmful forms of indoor air pollution in Canada and the second most important cause of lung cancer, after smoking.

***Salmonella*** is a group of bacteria that cause food poisoning. It is spread through contaminated food and water, and by infected individuals or animals.

**Sulphur dioxide (SO2)** is an industrial air pollutant. It is a main precursor of acid rain, along with nitrogen oxides. Prolonged exposure to sulphur dioxides can cause respiratory and cardiovascular diseases.

**Tolerable Daily Intake** (TDI) is an estimate of the amount of chemical contaminants that can be taken in daily over the course of a lifetime without posing any significant health risks.

**Toluene** is a volatile organic chemical found in consumer products such as paints, varnishes, pesticide formulations, printing inks, adhesives, sealants, and cleaning agents. It is also found in tobacco smoke and car exhaust. It is a known developmental neurotoxin. It can also damage the liver, disrupt the endocrine system, and trigger asthma attacks.

**Toxaphene** is an organochlorine pesticide that was predominantly used in Canada in the 1970s. Canada discontinued its use in the 1980s due to growing concerns over its persistence and its health impacts. Toxaphene is a persistent organic pollutant that accumulates in fatty tissues and biomagnifies up the food chain, especially in the northern regions of Canada. It is a carcinogen and probable endocrine disruptor.

**Toxoplasmosis** is a disease caused by a single-celled parasite. This parasite can cause flu-like symptoms, brain damage, and organ damage. Many individuals carry the parasite without showing any symptoms, although individuals with compromised immune systems are at increased risk of developing symptoms.

**Trans-nonachlor** is a major ingredient in chlordane (heptachlor), an organochlorine pesticide and a persistent organic pollutant. Canada stopped registering this pesticide in 1990. Traditional food sources in the Artic are contaminated with trans-nonachlor. It can disrupt the endocrine system and cause reproductive problems.

**Trichloroethylene** (TCE) is a non-flammable volatile liquid used in industrial, commercial, and consumer products. It is used in dry cleaning, and it is found in paint removers, rug cleaners, and spot removers. It is linked to childhood leukemia and to birth defects.

**Triclosan** is a chlorophenol, a class of chemicals that is suspected of causing cancer in humans. This chemical is widely used in antibacterial soaps. It is structurally similar to PCBs and PBDEs. It is known to disrupt the endocrine system.

**Triclosan** is a chlorophenol, a class of chemicals that is suspected of causing cancer in humans. This chemical is widely used in antibacterial soaps. It is structurally similar to PCBs and PBDEs. It is known to disrupt the endocrine system.

**Vinyl chloride** is a toxic gas used in the production of polyvinyl chloride (PVC). Occupational workers are at highest risk of exposure to vinyl chloride. Consumer products made of PVC off gas vinyl chloride. It causes brain, liver, and lung cancers.

**Volatile organic compounds** (VOCs) are emitted as gases from certain solids and liquids. These include: paints; varnishes; paint strippers; cleaning supplies; hair spray; windshield washer fluid; liquid fuels; building materials; furnishings; office equipment (e.g., copiers and printers); craft materials (e.g., glues and adhesives); permanent markers; and photographic solutions. The most hazardous VOCs include benzene, formaldehyde, toluene, methylene chloride, and perchloroethylene. Exposure to VOCs can cause eye, nose, and throat irritation; headaches; loss of coordination; nausea; damage to the liver, kidneys, and central nervous system; and cancer. VOCs pose a particular risk for Canadians suffering from chemical sensitivities.

**Zinc** is a heavy metal. It is a major component of industrial air pollution. It is linked to lung cancer.

## BIBLIOGRAPHY

*114957 Canada Ltee (Spraytech, Société d'arrosage) v. Town of Hudson* [2001], 40 C.E.L.R. (N.S.) 1 (S.C.C.)

Adviware. Statistice by Country for Cataracts. *Cure Research.Com.* http://www.cureresearch.com/c/cataracts/stats-country.htm.

Agyeman, J., R.D. Bullard, and B. Evans, eds. *Just Sustainabilities: Development in an Unequal World.* London: Earthscan, 2003.

Åkerblom, G. *Radon Legislation and National Guidelines.* SSI Rapport: 99:18. Stockholm: Swedish Radiation Protection Institute, 1999.

Ambrose, R. A Breath of Fresh Air. Address at GLOBE 2006, Vancouver, BC, March 31, 2006. http://www.ec.gc.ca/minister/speeches/2006/060331_s_e.htm.

American Lung Association. *State of the Air 2006: Protect the Air You Breathe.* New York, American Lung Assoc., 2006. http://lungaction.org/reports/stateoftheair2006.html

Anway, M.D., M.A. Memon, M. Uzumcu and M.K. Skinner. "Transgenerational Effect of the Endocrine Disruptor Vinclozolin on Male Spermatogenesis." *Journal of Andrology* 27, no. 6 (2006): 868-79.

Anway, M.D. and M.K. Skinner. "Epigenetic Transgenerational Actions of Endocrine Disruptors." *Endocrinology* 147, no. 6 (2006): s43-9.

Aramini, J. et al. "Drinking Water Quality and Health Care Utilization for Gastrointestinal Illness in Greater Vancouver." *Canada Communicable Disease Report* 26, no. 24 (2000): 211-3. http://www.phac-aspc.gc.ca/publicat/ccdr-rmtc/00pdf/cdr2624.pdf

Applied Research Consultants. *Global Benefits and Costs of the Montreal Protocol on Substances that Deplete the Ozone Layer*. Ottawa: Environnent Canada, 1997.

Aschengrau, A., S. Rogers and D. Ozonoff. "Perchloroethylene-Contaminated Drinking Water and the Risk of Breast Cancer: Additional Results from Cape Cod Massachusetts." *Environmental Health Perspectives* 111, no. 2(2003): 167-73.

Ascherio, A. et al. "Pesticide Exposure and Risk of Parkinson's Disease." *Annals of Neurology* 60, no. 2(2006): 197-203.

Auditor General of Canada. Ozone Layer Protection: The Unfinished Journey. In *1997 Report of the Auditor General*, OAG, chap. 27. Ottawa: OAG, 1997. http://www.oag-bvg.gc.ca/domino/reports.nsf/html/ch9727e.html

Australian Institute of Environmental Health. *The National Environmental Health Strategy*. Canberra: Commonwealth of Australia, 1999. http://www.dia.wa.gov.au/Policies/EnvironmentalHealth/files/National Environmental Health Strategy.pdf.

B.C. Provincial Health Officer. *Every Breath You Take: Air Quality in British Columbia – A Public Health Perspective. 2003 Annual Report.* Victoria: Ministry of Health Services, 2004.

Bartlett, K.H. et al. Cryptococcus Gattii: A Tropical Pathogen Emerging in a Temperate Climate Zone. Paper presented at the 16th Conference on Biometeorology and Aerobiology of the American Meteorological Society, Vancouver, August 23-27, 2004. http://ams.confex.com/ams/AFAPURBBIO/techprogram/paper_80027.htm.

Behrentz, E. et al. "Relative importance of school bus-related microenvironments to children's pollutant exposure." *Journal of the Air & Waste Management Association* 55, no. 10(2005): 1418-30.

Berger, A. et al. "Runs of Ventricular and Supraventricular Tachycardia Triggered by Air Pollution in Patients with Coronary Heart Disease." *Journal of Occupational and Environmental Medicine* 48, no. 11(2006): 1149-58.

Bernard, S.M. et al. "The Potential Impacts of Climate Variability and Change on Air-Pollution Related Health Effects in the United States." *Environmental Health Perspectives* 109, supp. 2(2001): 199-209.

Bocking, S. *Nature's Experts: Science, Politics, and the Environment*. New Brunswick, NJ: Rutgers University Press, 2004.

Boyd, D.R. *The Air We Breathe: An International Comparison of Air Quality Standards and Guidelines.* Vancouver: David Suzuki Foundation, 2006. http://www.davidsuzuki.org/Publications/Air_we_breathe.asp

Boyd, D.R. *Canada vs. Sweden: An Environmental Face-Off*. Victoria: POLIS Project on Ecological Governance, 2002. http://www.polisproject.org/publications/author/boyd

Boyd, D.R. and S.J. Genuis. "The Environmental Burden of Disease in Canada: Respiratory Disease, Cardiovascular Disease, and Congenital Affliction." *Environmental Research.* In press.

Boyd, D.R and S.S. Wallace. *Fireproof Killer Whales and Contaminated Mother's Milk: The Inadequacy of Canada's Proposed PBDE Regulations*. Vancouver: David Suzuki Foundation, 2006. http://www.davidsuzuki.org/files/SWAG/DSF_PBDE_report_2006.pdf

Boyd, D.R. *The Food We Eat: An International Comparison of Pesticide Regulations.* Vancouver: David Suzuki Foundation, 2006. http://www.davidsuzuki.org/Publications/Food_we_eat.asp

Boyd, D.R. *Northern Exposure: Acute Pesticide Poisonings in Canada*. Vancouver: David Suzuki Foundation, 2007. http://www.davidsuzuki.org/health/food/poisoning.asp

Boyd, D.R. *Radon: The Unfamiliar Killer*. Vancouver: David Suzuki Foundation, 2006. http://www.davidsuzuki.org/files/SWAG/DSF_Radon_Report_revised-Jan-07pdf.pdf

Boyd, D.R. *Sustainability Within a Generation: A New Vision for Canada.* Vancouver: David Suzuki Foundation, 2004. http://www.davidsuzuki.org/Economy/Sustainability/

Boyd, D.R. *Unnatural Law: Rethinking Canadian Environmental Law and Policy*. Vancouver: UBC Press, 2003.

Boyd, D.R. *The Water We Drink: An International Comparison of Drinking Water Guidelines and Standards.* Vancouver: David Suzuki Foundation, 2006. http://www.davidsuzuki.org/files/SWAG/DSF-HEHC-water-web.pdf

Branchi, I. et al. "Polybrominated Diphenyl Ethers: Neurobehavioral Effects Following Developmental Exposure." *Neurotoxicology* 24, no. 3 (2003): 449-62.

Briggs, D. "Environmental pollution and the global burden of disease." *British Medical Bulletin* 68, no.1 (2003):1-24.

Buckley, J.D. et al. "Pesticide Exposures in Children with Non-Hodgkin Lymphoma," *Cancer* 89, no. 11 (2000):11.

Burdon, R. *The Suffering Gene: Environmental Threats to Our Health.* Montreal/Kingston: McGill-Queen's University Press, 2003.

Buzzelli, M. et al. "Spatiotemporal Perspectives on Air Pollution and Environmental Justice in Hamilton, Canada, 1985-1996." *Annals of the Association of American Geographers* 93, no. 3 (2003): 557–73.

Cabinet Committee for the Economic Union. Human Health and the Environment: A Strategy for Reducing Human Health Risks from Environmental Hazards. Report of Committee Decision, 1999.

California Air Resources Board. *The California Diesel Fuel Regulations.* Sacramento: CARB, 2004. http://www.arb.ca.gov/fuels/diesel/081404dslregs.pdf.

Canadian Bar Association. Sustainable Development Committee. *Sustainable Development in Canada: Options for Law Reform*. Ottawa: CBA, 1990.

Canadian Cancer Society/National Cancer Institute of Canada. *Canadian Cancer Statistics 2006* Ottawa: NCSN/NCIC, 2006. http://www.cancer.ca/ www.ncic.cancer.ca.

Canadian Food Inspection Agency. *Report on Pesticides, Agricultural Chemicals, Environmental Pollutants, and Other Impurities in Agri-food Commodities of Plant Origin*, vol. 2. Ottawa: CFIA, 2005. http://www.inspection.gc.ca/english/fssa/microchem/resid/reside.shtml#resid

Canadian Institute for Health Information. *Health Indicators, 2003*. Ottawa: CIHI, 2004. http://secure.cihi.ca/cihiweb/products/indicators2003_e.pdf

Canadian Institute for Health Information, Canadian Lunch Association, Health Canada, and Statistics Canada. *Respiratory Disease in Canada*. Ottawa: Health Canada, 2001. http://secure.cihi.ca/cihiweb/products/RespiratoryComplete.pdf

Canadian Institute for Health Information and Statistics Canada. 2006. *Health Care in Canada 2005*. Ottawa: CIHI, 2005. http://secure.cihi.ca/cihiweb/products/hcic2005_e.pdf

Canadian Lung Association. *Asthma: A Resource for Canadian Journalists*. Ottawa: CLA, 2005. http://www.lung.ca/_resources/2005_04_28_asthma_media_guide_v3.pdf

Canadian Strategy for Cancer Control. National Committee on Environmental and Occupational Exposures. *Prevention of Occupational and Environmental Cancers in Canada: A Best Practices Review and Recommendations*. Ottawa: CSCC, 2005. http://209.217.127.72/cscc/pdf/BestProactiseReview.pdf

Cancer Care Ontario and Canadian Cancer Society. *Insight on Cancer: Environmental Exposures and Cancer*, vol. 4. Toronto: CCO/CCS, 2005. http://www.cancer.ca/ccs/internet/standard/0,3182,3543_53945662_464975447_langId-en,00.html

Canfield, R.L. et al. "Intellectual Impairment in Children with Blood Lead Concentrations Below 10 ug per Deciliter." *New England Journal of Medicine* 348, no. 16 (2003): 1517-26.

Cantor, K.P. et al. "Drinking Water Source and Chlorination Byproducts. I. Risk of Bladder Cancer." *Epidemiology* 9 (1998): 21-8.

Charron, D.F. "Potential Impacts of Climate Change on the Epidemiology of Zoonotic Diseases in Canada." *Canadian Journal of Public Health* 93, no. 5 (2002): 334-35.

Cheng, C.S. et al. Differential and Combined Impacts of Winter and Summer Weather and Air Pollution due to Global Warming on Human Mortality in South-central Canada. Technical report on a study undertaken by Toronto Public Health and Environment Canada, funded by Health Canada, 2007. http://www.toronto.ca/health/hphe/pdf/weather_air_pollution_impacts.pdf.

Chestnut, L.G. and D.M. Mills. "A Fresh Look at the Benefits and Costs of the U.S. Acid Rain Program." *Journal of Environmental Management* 77, no. 3 (2005): 252-66.

Chivian, E., ed. *Biodiversity and Its Importance to Human Health*. Cambridge, MA: Harvard Center for Health and the Global Environment, 2003.

Cho, E. et al. "Red Meat Intake and Risk of Breast Cancer among Premenopausal Women." *Archives of Internal Medicine* 166, no. 20 (2006): 2253-9.

Chociolko, C., R. Copes, and J. Rekart. *Needs, Gaps, and Opportunities Assessment for the National Collaborating Centre for Environmental Health*. Vancouver: National Collaborating Centre for Environmental Health, 2006. http://www.ncceh.ca/en/needs_gaps/assessment_report

Choi, S.M., S.D. Yoo, and B.M. Lee. "Toxicological Characteristics of Endocrine-disrupting Chemicals: Developmental Toxicity, Carcinogenicity, and Mutagenicity." *Journal of Toxicology and Environmental Health, Part B*, 7, no. 1 (2006): 1-32.

Christie, M. 2007. *Private Property Pesticide By-laws in Canada: Population Statistics by Municipality*. www.flora.org/healthyottawa/Bylawlist.pdf (last updated Aug. 3, 2007).

Commission for Environmental Cooperation. *Children's Health and the Environment in North America: A First Report on Available Indicators and Measures.* Montreal: CEC, 2006. http://www.cec.org/files/PDF/POLLUTANTS/CEH-Indicators-fin_en.pdf

Commission for Environmental Cooperation. *Making the Environment Healthier for our Kids: An Overview of Environmental Challenges to the Health of North America's Children.* Montreal: CEC, 2002. http://www.cec.org/files/PDF/POLLUTANTS/CEHPaper-final-28-ii-02_en.pdf

Commission on Life Sciences. *Scientific Frontiers in Developmental Toxicology and Risk Assessment.* Washington, DC: National Academy of Sciences, 2000.

Commission on the Future of Health Care in Canada. *Building on Values: The Future of Health Care in Canada – Final Report.* Ottawa: Commission on the Future of Health Care in Canada, 2002. http://www.hc-sc.gc.ca/english/pdf/romanow/pdfs/HCC_Final_Report.pdf

Commissioner of the Environment and Sustainable Development. Drinking Water in First Nations Communities." In *Report of the Commissioner of the Environment and Sustainable Development to the House of Commons*, chap. 5. Ottawa: OAG, 2005. http://www.oag-bvg.gc.ca/domino/reports.nsf/html/c20050905ce.html

Costas, K., R.S. Knorr, and S.K. Condon. “A Case Control Study of Childhood Leukemia in Woburn Massachusetts: The Relationship Between Leukemia Incidence and Exposure to Public Drinking Water” *Science of the Total Environment* 300, no. 1 (2002): 23-5.

Coyle, Y. et al. “An Ecological Study of the Association of Metal Air Pollutants with Lung Cancer Incidence in Texas.” *Journal of Thoracic Oncology* 1, no. 7 (2006): 654-61.

Curtis L., W. et al. “Adverse Health Effects of Outdoor Air Pollutants.” *Environment International* 32, no. 6 (2006): 815-30.

Darby, S.C. et al. “Radon in Houses and Risk of Lung Cancer: Collaborative Analysis of Data from 13 European Case-control Studies.” *British Medical Journal* 330 (2005): 223-26.

Darnerud, P.O. "Toxic Effects of Brominated Flame Retardants in Man and Wildlife." *Environment International* 29 (2003): 841-53.

Darnerud, P.O. et al. "TimeTrend of Polybrominated Diphenyl Ether (PBDE) Levels in Breast Milk from Uppsala, Sweden, 1996-2001.” *Organohalogen Compounds* 58 (2002): 233-236.

Davis, D.L. and Working Group on Public Health and Fossil-Fuel Combustion. “Short-term Improvements in Public Health from Global-climate Policies on Fossil-fuel Combustion: An Interim Report.” *The Lancet* 350, no. 9088 (1997): 1341-9.

de Groh, M. and H. Morrison. “Environmental Tobacco Smoke and Deaths from Coronary Heart Disease in Canada.” *Chronic Disease in Canada* 23, no. 1 (2002): 13-6.

de Gruijl, F.R. and J. van der Leun. “Environment and Health: 3. Ozone Depletion and Ultraviolet Radiation.” *Canadian Medical Association Journal* 163, no. 7 (2000): 851-5.

Douglas, M. and A. Wildavsky. *Risk and Culture: An Essay on the Selection of Technical and Environmental Dangers*. Berkeley: University of California Press, 1982.

Duncan, C.E. et.al. *Blood Lead and Associated Risk Factors in Ontario Children, 1984*. Toronto: Ontario Ministry of Health/Ministry of Labour/Ministry of the Environment, 1985.

Edge, T. et al. Waterborne Pathogens. In *Threats to Sources of Drinking Water and Aquatic Ecosystem Health in Canada*, ed. Environment Canada. Burlington, ON: National Water Research Institute, 2001.

Emanuel, K. “Increasing Destructiveness of Tropical Cyclones Over the Past 30 Years.” *Nature* 436 (2005): 686-8.

Environment Canada. *Canadian Acid Rain Assessment. Vol. I, Summary of Results*. Gatineau: Environment Canada, 1998.

Environment Canada. *National Air Pollution Surveillance (NAPS) Network.* http://www.etc-cte.ec.gc.ca/NAPS/index_e.html.

Environment Canada. *National Pollutant Release Inventory.* http://www.ec.gc.ca/pdb/npri

Environment Canada. "Regulations Amending the Prohibition of Certain Toxic Substances Regulations, 2005 (Four New Fluorotelomer-based Substances)." *Canada Gazette I* 140, no. 24 (2006). http://canadagazette.gc.ca/partI/2006/20060617/html/regle2-e.html

Environment Canada. Shellfish Water Quality Protection Program. http://www.ns.ec.gc.ca/epb/sfish/sfish.html

Environment Canada, Transboundary Air Issues Branch. 2000. *The Status of Mercury in Canada Report #2 – A Background Report to the Commission for Environmental Cooperation North American Task Force on Mercury.* Montreal: CEC. http://www.cec.org/programs_projects/pollutants_health/smoc/pdfs/hgcan-e.pdf.

Environmental Defence Canada. *Polluted Children, Toxic Nation: A Report on Pollution in Canadian Families.* Toronto: Environmental Defence, 2006. http://www.environmentaldefence.ca/reports/toxicnationFamily.htm

Environmental Defence Canada. Regulation of PFCs Gaining Momentum. http://www.environmentaldefence.ca/toxicnation/whatGovDo/PFCs.htm.

Environmental Defence Canada. *Toxic Nation: A Report on Pollution in Canadians.* Toronto: Environmental Defence, 2005. http://www.environmentaldefence.ca/toxicnation/resources/publications.htm

Environmental Health Tracking Project Team. *America's Environmental Health Gap: Why the Country Needs a Nationwide Health Tracking Network.* Baltimore: Pew Environmental Health Commission, John Hopkins School of Hygiene and Public Health, 2000.

Environmental Working Group. *Body Burden: The Pollution in Newborns.* Washington, D.C.: EWG, 2005. http://archive.ewg.org/reports/bodyburden2

Environmental Working Group. *PFCs—Global Contaminants*. Washington, D.C.: EWG, 2003. http://www.ewg.org/reports/pfcworld

Environmental Working Group, Mt. Sinai School of Medicine, and Commonweal. *Body Burden: The Pollution in the People*. Washington: EWG, 2003. http://archive.ewg.org/reports/bodyburden1

Epstein, P. and E. Mills. *Climate Change Futures: Health, Ecological and Economic Dimensions.* Cambridge, MA: Harvard Center for Health and the Global Environment, 2005.

European Commission. The European Environment and Health Action Plan 2004-2010. Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee, Brussels, July 9, 2004. http://www.ec.europa.eu/environment/health/pdf/com2004416.pdf.

European Commission. European Environment Agency. *Environment and Health*. Luxembourg: Office for Official Publications of the European Communities, 2005. http://reports.eea.europa.eu/eea_report_2005_10/en/EEA_report_10_2005.pdf

European Parliament and Council. Directive 2000/53/EC. September 18. *Official Journal of the European Union* L 269 (2000): 42.

European Parliament and Council. Directive 2003/15/EC. February 27. *Official Journal of the European Union* L 66 (2003): 26-35.

European Parliament and Council. Directive 2003/17/EC. March 3. *Official Journal of the European Union* L 76 (2003): 10-9.

European Parliament and Council. Directive 2003/53/EC. June 18. *Official Journal of the European Union* L 178 (2003): 24-7.

European Parliament and Council. Directive 2005/84/EC. December 14. *Official Journal of the European Union* L 344 (2005): 40-3.

Evans, N. ed. *State of the Evidence: What is the Connection Between the Environment and Breast Cancer? 4th ed.* San Francisco: Breast Cancer Fund and Breast Cancer Action, 2006.

Ezenwa, V.O., M.S. Godsey, R. J. King, and S.C. Guptill. "Avian Diversity and West Nile Virus: Testing Associations Between Biodiversity and Infectious Disease Risk." *Proceedings of the Royal Society B: Biological Sciences* 273, no. 1582 (2006): 109-17.

Federal–Provincial Committee on Environmental and Occupational Health. *Update of Evidence for Low-level Effects of Lead and Blood Lead Intervention Levels and Strategies – Final Report of the Working Group.* Ottawa: Health Canada, 1994.

Federal-Provincial-Territorial Advisory Committee on Population Health. *Toward a Healthy Future: Second Report on the Health of Canadians*. Ottawa: Health Canada, 1999.

Federal-Provincial-Territorial Committee on Drinking Water. Guidelines for Canadian Drinking Water Quality – Summary Table. March. Ottawa: Health Canada. http://www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/doc_sup-appui/sum_guide-res_recom/index_e.html (last updated March 2007).

Federal-Provincial-Territorial National Health Surveillance Network Working Group and Integration Design Team. *Proposal to Develop a Network for Health Surveillance in Canada.* Ottawa: Health Canada, Office of National Health Surveillance, 1999. http://www.phac-aspc.gc.ca/csc-ccs/pdf/Propos17.pdf

Fewtrell, L., R. Kaufmann, and A. Prüss-Üstün. *Lead: Assessing the Environmental Burden of Disease at National and Local Levels*. No. 2 in *Environmental Burden of Disease Series*, eds. A. Prüss-Üstün et al. Geneva: World Health Organization, 2003. http://www.who.int/quantifying_ehimpacts/publications/en/leadebd2.pdf

Fifth International Conference on the Protection of the North Sea. Bergen Ministerial Declaration on Sustainable Development. *1 Yearbook on International Environmental Law* 429 (1990): 4312.

Fischer, D. "Breast Cancer May be Linked to Mother's Childhood: Chemical Exposure in Past Generations Could Affect Present Ones, Scientists Say." *Oakland Tribune*. November 3, 2006.

Food and Agriculture Organization and United Nations Environment Program. *Pesticide Poisoning: information for advocacy and action*. Geneva: UNEP, 2004.

Friedman, M.S. et al. "Impact of Changes in Transportation and Commuting Behaviors During the 1996 Summer Olympic Games in Atlanta on Air Quality and Childhood Asthma." *JAMA* 285 (2001): 897-905.

Frumkin, H., ed. *Environmental Health: From Global to Local*. San Francisco: Jossey-Bass, 2005.

G8 Environment Leaders. 1997 Declaration on Children's Environmental Health. Environment Leaders' Summit of the Eight, Miami, Fl., May 5-6, 1997. http://www.g8.utoronto.ca/environment/1997miami/children.html.

Gauderman, W.J. et al. "Effect of Exposure to Traffic on Lung Development from 10 to 18 Years of Age: A Cohort Study." *The Lancet* 369, no. 9561 (2007): 571-7.

Giesy, J.P. and K. Kannan. "Global Distribution of Perfluorooctane Sulfonate in Wildlife," *Environmental Science and Technology* 35, no 7 (2001): 1339-42.

Gilliland, F.D., M.T. Salam, Y. Li and B.M. Langholz. Risk Factors for the Development of Asthma in Childhood (Hygiene Hpothesis) – Early Life Risk Factors for Asthma: Findings from the Children's Health Study. Paper presented at the American Thoracic Society 99th International Conference Mini-Symposium, Seattle, May 21, 2003.

Goldberg, M.S. et al. "Risks of Developing Cancer in Relation to Living Near a Municipal Solid Waste Landfill Site in Montreal, Quebec: Results from a Population-Based Case-control Study." *Archives of Environmental Health* 54, no. 4 (1999): 291-6.

Goldman, L. and N. Tran. *Toxics and Poverty: The Impact of Toxic Substances on the Poor in Developing Countries.* Washington, DC: World Bank, 2002. http://siteresources.worldbank.org/INTPOPS/Publications/20486400/TOXICStext917w.pdf

Gosselin, P. and C.M. Furgal. "Challenges and Directions for Environmental Public Health Indicators and Surveillance," *Canadian Journal of Public Health* 93, no. 5 (2002):S5-8.

Government of Canada. *Air Quality Health Index.* http://www.cas-aqhi.gc.ca.

Government of Canada. *Chemical Substances.* http://www.chemicalsubstances.gc.ca.

Government of Canada. *Children's Health and the Environment in North America: A First Report on Available Indicators and Measures. Country Report: Canada.* Gatineau: Environment Canada, 2005. http://www.cec.org/files/PDF/POLLUTANTS/CountryReport-Canada-CHE_en.pdf

Government of Germany. *Perspectives for Germany: A National Sustainable Development Strategy.* Berlin: Federal Government of Germany, 2002. http://nachhaltigkeitsrat.de/service/download_e/pdf/Perspectives_for_Germany.pdf.

Government of Sweden. Environmental Objectives Council. *For the Sake of Our Children: Sweden's National Environmental Quality Objectives, A Progress Report.* Stockholm: Swedish Environmental Protection Agency, 2005. www.naturvardsverket.se/Documents/publikationer/620-1241-X.pdf

Government of Sweden. Environmental Objectives Council. *Sweden's Environmental Objectives: Are We Getting There? de Facto 2004.* Stockholm: Swedish Environmental Protection Agency, 2004. http://www.naturvardsverket.se/Documents/publikationer/620-1238-X.pdf

Government of Sweden. Ministry of the Environment. *New Guidelines on Chemicals Policy: Non-hazardous products.* Stockholm: Ministry of the Environment, 2000.

Government of Sweden. Ministry of the Environment. *The Swedish Environmental Objectives: Interim Targets and Action Strategies (Summary of Gov. Bill 2000/01:130).* Stockholm: Ministry of the Environment, 2001. http://www.regeringen.se/content/1/c4/11/97/2aa978ad.pdf.

Grandjean P. and P.J. Landrigan. "Developmental Neurotoxicity of Industrial Chemicals," *The Lancet* 369, no. 9564 (2007): 821.

Grosse, S.D., T. Matte, J. Schwartz, and R. Jackson. 2002. "Economic Gains Resulting from the Reduction in Children's Exposure to Lead in the United States." *Environmental Health Perspectives* 110: 563-569.

Guidice, L.C., J. Peterson Myers, S.H. Swan, and A. Carlson. 2005. Vallombrosa Consensus Statement on Contaminants and Human Fertility Compromise. Statement issued by expert participants in meeting convened by Standford Women's Health and Collaborative on Health and the Environment. Vallombrosa Center, Menlo Park, Cal. February 27- March 1. http://www.ourstolenfuture.com/Consensus/2005/2005-1030vallombrosa.pdf

H.M. Government (U.K.). *One Future–Different Paths: The UK's Shared Framework for Sustainable Development*. London: Department for Environment, Food and Rural Affairs, 2005. http://www.sd-commission.org.uk/publications.php?id=215.

Haines, D. et al. *Persistent Environmental Contaminants and the Great Lakes Basin Population: An Exposure Assessment.* Ottawa: Health Canada, Great Lakes Health Effects Program, 1998.

Hancock, T. Children's Environmental Health. In *The Health of Canada's Children: A CICH Profile*, 3rd ed., ed. Canadian Institute of Child Health. Ottawa: CICH, 2000.

Hardell, L. and M. Eriksson. "Is the Decline of the Increasing Incidence of Non-Hodgkin Lymphoma in Sweden and Other Countries a Result of Cancer Preventive Measures?" *Environmental Health Perspectives* 111, no. 14 (2003): 1704-6.

Harding, K. "Huge Study to Show Impact of Contaminants on Albertans." *The Globe and Mail*. April 17.

Harremoës, Poul et al, eds. *Late Lessons from Early Warnings: The Precautionary Principle 1896-2000.* Copenhagen: European Environment Agency, 2002. http://reports.eea.europa.eu/environmental_issue_report_2001_22/en

Harrison, K. and W. Antweiler. "Incentives for Pollution Abatement: Regulation, Regulatory Threats, and Non-Governmental Pressures." *Journal of Policy Analysis and Management* 22, no. 3 (2003): 361–82.

Hattis, D. et al. "Human Inter-individual Variability in Susceptibility to Airborne Particles." *Risk Analysis* 21 (2001): 585-99.

Health Canada. Children's Jewellery Regulations, SOR/2005-132.

Health Canada. *Climate Change and Health and Well-being: A Policy Primer*. Ottawa: Health Canada, 2001. http://www.hc-sc.gc.ca/ewh-semt/pubs/climat/policy_primer-abecedaire_en_matiere/index_e.html

Health Canada. Environmental Sustainability and Health. Presentation to the Ad Hoc Cabinet Committee on Sustainability and the Environment, 2004.

Health Canada. Food and Drug Regulations. C.R.C. c. 870, Division 15: Adulteration of Food.

Health Canada. Government of Canada Radon Guideline. http://hc-sc.gc.ca/ewh-semt/radiation/radon/guidelines_lignes_directrice_e.html (last updated July 18, 2007).

Health Canada. Indoor Air Quality. http://www.hc-sc.gc.ca/ewh-semt/air/in/index_e.html (last updated Sep 4, 2007).

Health Canada. Surface Coating Materials Regulations, SOR/2005-109

Hertz-Picciotto. Environmental Risk Assessment. In *Introduction to Environmental Epidemiology*, eds. E.O. Talbott and G.F. Craun. New York: CRC Lewis Publishers, 1995.

Hrudey, S.E. and E.J. Hrudey. *Safe Drinking Water: Lessons from Recent Outbreaks in Affluent Nations*. London, UK: IWA Publishing, 2004.

Illinois Environmental Protection Agency. *DecaBDE Study: A Review of Available Scientific Research.* Springfield: Illinois EPA, 2006. http://www.epa.state.il.us/reports/decabde-study/available-research-review.html.

Indian and Northern Affairs Canada. Northern Contaminants Program. *Canadian Arctic Contaminants Assessment Report II: Human Health.* Gatineau: INAC, 2003. http://www.ainc-inac.gc.ca/ncp/pub/pdf/hea/hea_e.pdf.

Institute of Medicine. *The Future of Public Health*. Washington, DC: National Academy Press, 1988.

International Agency for Research on Cancer. "Arsenic in Drinking-water." *Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans* 84 (2004): 39-267.

Ising, H. and B. Kruppa. "Health Effects and Noise: Evidence in the Literature from the Past 25 Years" *Noise and Health* 6, no. 22 (2004): 5-13.

Jerrett, M. et al. "A GIS-environmental Justice Analysis of Particulate Air Pollution in Hamilton, Canada." *Environment and Planning* A33, no. 33 (2001): 955-73.

Jerrett, M., J. Eyles, C. Dufournaud, and S. Birch. "Environmental Influences on Healthcare Expenditures: An Exploratory Analysis from Ontario, Canada." *Journal of Epidemiology and Community Health* 57, no. 15 (2003): 334-8.

Jessiman, B., R. Burnett, and P. de Civita. "Sulphur in Gasoline." *Health Policy Research Bulletin* 4 (2002). http://www.hc-sc.gc.ca/sr-sr/pubs/hpr-rpms/bull/2002-4-environ/index_e.html

Judek, S., B. Jessiman, D. Stieb, and R. Vet. Estimated Number of Excess Deaths in Canada Due to Air Pollution. Published online by Health Canada, April 2005. http://www.hc-sc.gc.ca/ahc-asc/media/nr-cp/2005/2005_32bk2_e.html#top.

Kassirer, J, I. Morton, and S. Hills. *Promoting Solutions for Healthy Indoor Environments – Abridged Report*. Ottawa: Healthy Indoors Partnership, 2005. http://www.healthyindoors.com/english/resources/PSHIE-condensed.pdf

Kemm, J., J. Parry, and S. Palmer. *Health Impact Assessment: Concepts, Theory, Techniques, Applications*. Oxford: Oxford University Press, 2004.

Knox, E.G. "Childhood Cancers and Atmospheric Carcinogens," *J. Epidemiol Community Health* 59, no. 2 (2005): 101-5.

Knox, E.G. "Oil Combustion and Childhood Cancers." *J Epidemiol Community Health* 59, no. 9 (2005): 755-60.

Knox, E.G. "Roads, Railways, and Childhood Cancers" *J Epidemiol Community Health* 60, no. 2 (2006): 136-41.

Knutson, T.R. and R.E. Tuleya. "Impact of $CO_2$-induced Warming on Simulated Hurricane Intensity and Precipitation: Sensitivity to the Choice of Climate Model and Convective Parameterization." *Journal of Climate* 17 (2004): 3477–95.

Kovats, S., T. Wolfe, and B. Menne. "Heatwave of August 2003 in Europe: Provisional Estimates of the Impact on Mortality." *Eurosurveillance Weekly,* March 11, 2004.

Krewski, D. et al. "Managing Health Risks from Drinking Water: A Report to the Walkerton Inquiry." *Journal of Toxicology and Environmental Health, Part A*. 65 (2002): 1635-823.

Krewski, D. et al. "Residential Radon and Risk of Lung Cancer: A Combined Analysis of 7 North American Case-control Studies." *Epidemiology* 16, no. 2 (2005): 137-45.

Krewski D., R. Burnett, M. Jerrett, et al. 2005. "Mortality and Long-Term Exposure to Ambient Air Pollution: Ongoing Analyses Based on the American Cancer Society Cohort." *Journal of Toxicology and Environmental Health, Part A* 68: 1093-1109.

Labour Environmental Alliance Society. *The CancerSmart Consumer Guide*. Vancouver: LEAS, 2005.

Laghi, B. "Welcome to the New Climate: Special Series on Climate Change." *The Globe and Mail*. Special series on climate change, January 27 to February 2, 2007.

Landrigan, P.J. et al. "Environmental Pollutants and Disease in American Children; Estimates for Morbidity and Costs for Lead Poisoning, Asthma, Cancer, and Developmental Disabilities." *Environmental Health Perspectives* 110 (2002): 721-8.

Landrigan, P.J., W.J. Nicholson, Y. Suzuki, J. Ladou. "The Hazards of Chrysotile Asbestos: A Critical Review." *Industrial Health* 37 (1999): 271-80.

Lanphear, B. et al. "Low-Level Environmental Lead Exposure and Children's Intellectual Function: An International Pooled Analysis" *Environmental Health Perspectives* 113, no. 7 (2005): 894-9.

Lanphear, B.P., K. Dietrich, P. Auinger and C. Cox. "Cognitive Deficits Associated with Blood Lead Concentrations <10 microg/dL in U.S. Children and Adolescents." *Public Health Reports* 115, no. 6 (2000): 521-9.

Levy, J.I. et al. "Determinants of Nitrogen Dioxide Concentrations in Indoor Ice Skating Rinks." *American Journal of Public Health* 88, no. 12 (1998): 1781-6.

Lippman, M., B. Cohen, and R.B. Schlesinger. *Environmental Health Science: Recognition, Evaluation, and Control of Chemical and Physical Health Hazards*. Oxford: Oxford University Press, 2003.

Liu, S. et al. "Association Between Gaseous Ambient Air Pollutants and Adverse Pregnancy Outcomes in Vancouver, Canada." *Environmental Health Perspectives* 111 (2003): 1773-8.

Lourie, B. *Mercury in the Environment: A Primer*. Toronto: Pollution Probe, 2003.

Lu, C. et al. 2006. "Organic Diets Significantly Lower Children's Dietary Exposure to Organophosphate Pesticides." *Environmental Health Perspectives* 114(2): 260-63.

Luttmann-Gibson, H. et al. 2006. "Short-Term Effects of Air Pollution on Heart Rate Variability in Senior Adults in Steubenville, Ohio." *Journal of Occupational and Environmental Medicine* 48(8): 780-88.

Mabury, S.A. "Thermolysis of Fluoropolymers as Potential Source of Halogenated Organic Acids in the Environment." *Nature* 412 (2001): 321-4.

Mackenzie, C.A., A. Lockridge, and M. Keith. "Declining Sex Ratio in a First Nation Community." *Environmental Health Perspectives* 113, no. 10$ (2005.): 1295-8.

Magee, R.J., D. Won, and E. Lusztyk. *Indoor Air Quality Guidelines and Standards*. Ottawa: National Research Council Canada, 2005. http://irc.nrc-cnrc.gc.ca/pubs/rr/rr204/rr204.pdf

Mahaffey, K.R., R.P. Clickner, and C.C. Bodurow. “Blood Organic Mercury and Dietary Mercury Intake: National Health and Nutrition Examination Survey, 1999 and 2000.” *Environmental Health Perspectives* 112, no. 5 (2006):562-70.

Makomaski Illing, E.M., and M.J. Kaiserman. “Mortality Attributable to Tobacco Use in Canada and Its Regions, 1994 and 1996.” *Chronic Disease in Canada* 20, no. 3 (1999): 64-7.

Martens, P. and A.J. McMichael. *Environmental Change, Climate and Health*. Cambridge: Cambridge University Press, 2002.

Masoli, M., D. Fabian, S. Holt, and R. Beasley. “The Global Burden of Asthma.” *Allergy* 59 (2004): 469-78.

McAllister Opinion Research. *The Environmental Monitor 2006-1 Report.* Vancouver: McAllister Opinion Research, 2006.

McDonald, T. "A Perspective on the Potential Health Risks of PBDEs." *Chemosphere* 46 (2002): 745-55.

McMichael, A.J. et al. *Climate Change and Human Health – Risks and Responses.* Geneva: World Health Organization, 2003. http://www.who.int/globalchange/publications/cchhbook/en/

McMichael, A.J., A. Haines, R. Slooff, and S. Kovats, eds. *Climate Change and Human Health*. Geneva: World Health Organization, 1996.

Meironyte, D., K. Noren, and A. Bergman. "Analysis of Polybrominated Diphenyl Ethers in Swedish Human Milk, A Time-related Trend study, 1972-1997." *Journal of Toxicology and Environmental Health, Part A* 58, no. 6 (1999): 329-41.

Menke, A., P. et al. “Blood Lead Levels Below 0.48umol/L (10ug/dL) and Mortality among US Adults,” *Circulation* 114, no. 13 (2006):1388-94.

Murray, T.J. et al. “Induction of Mammary Gland Ductal Hyperplasias and Carcinoma In Situ following Fetal Bisphenol A Exposure.” *Reproductive Toxicology* 23, no. 2 (2007): 383-90.

New South Wales(Australia) Department of Environment and Climate Change. Polycyclic Aromatic Hydrocarbons. Management Strategies. http://www.environment.nsw.gov.au/air/dopahhm/pahmanagement.htm

Newsome ,W.H. and P. Andrews. “Organochlorine Pesticides and Polychlorinated Biphenyl Congener in Commercial Fish from the Great Lakes” *Journal of AOAC International* 76, no. 4 (1993):707-10.

O'Connor, D.R. *Report of the Walkerton Inquiry.* Toronto: Ontario Ministry of the Attorney General, 2002. http://www.attorneygeneral.jus.gov.on.ca/english/about/pubs/walkerton.

*Ontario* v. *Canadian Pacific* [1995] 2 S.C.R. 1031 at 1076

Ontario Medical Association. *The Illness Costs of Air Pollution: 2005-2026 Health and Economic Damage Estimates*. Toronto: OMA, 2005. http://www.oma.org/Health/smog/report/ICAP2005_Report.pdf

Ontario Medical Association. *Smog's Excess Burden on Baby Boomers: Aging Population Most Vulnerable to Smog*. Toronto: OMA, 2006. http://www.oma.org/Health/Smog/report/Smog_Boomers_Report.pdf

Ontario Ministry of Environment. *Guide to Eating Ontario Sport Fish, 2005-2006*. Toronto: OME, 2005.

Ontario Ministry of Environment. *Transboundary Air Pollution in Ontario*. Toronto: OME, 2005. http://www.ene.gov.on.ca/envision/techdocs/5158e.pdf

Ontario Task Force on the Primary Prevention of Cancer. *Recommendations for the Primary Prevention of Cancer*. Toronto: Queen's Printer, 1995.

Organization for Economic Co-operation and Development. *Environmental Outlook*. Paris: OECD, 2001.

Oster, G. and D. Thompson. "Estimated Effects of Reducing Dietary Saturated Fat Intake on the Incidence and Costs of Coronary Heart Disease in the United States." *Journal of the American Dietetic Association* 96, no. 2 (1996): 127-31.

Ostfeld , R.S. and F. Keesing. . "Biodiversity and Disease Risk: the Case of Lyme Disease." *Conservation Biology* 14 (2000): 722–8.

Ostfeld, R.S. and F. Keesing. "Biodiversity Series: The Function of Biodiversity in the Ecology of Vector-borne Zoonotic Diseases." *Canadian Journal of Zoology* 78 (2000): 2061–78.

Park, J. and S. Knudson. "Medically Unexplained Physical Symptoms." *Health Reports* 18, no. 1 (2007): 43-7.

Payment, P. et al. "A Prospective Epidemiological Study of Gastrointestinal Health Effects Due to the Consumption of Drinking Water." *International Journal of Environmental Health Research* 7 (1997): 5-31.

Payment, P. et al. "Epidemiology of Endemic Gastrointestinal and Respiratory Diseases: Incidence, Fraction Attributable to Tap Water and Costs to Society," *American Journal of Public Health* 81 (1991): 703-8.

Pelley, J. "Chemicals Management May Be Getting Tougher," *Environmental Science and Technology Online News.* November 2, 2006. http://pubs.acs.org/subscribe/journals/esthag-w/2006/nov/policy/jp_cachemicals.html

Pollution Probe. *Healthy Indoors: Achieving Healthy Indoor Environments in Canada.* Toronto: Pollution Probe, 2002. http://www.healthyindoors.com/english/resources/Healthy Indoors - Phase II Final Draft Report.doc

Pollution Probe. *Volatile Organic Compounds: A Primer.* Toronto: Pollution Probe, 2005. http://www.pollutionprobe.org/Reports/vocprimer.pdf

Powell, M.C. and M.S. Kanarek. "Nanomaterial Health Effects, Part I: Background and Current Knowledge." *Wisconsin Medical Journal* 105, no. 2 (2006): 16-20.

Public Health Agency of Canada. Analysis By Strategic Outcome And Key Program. In *Departmental Performance Report 2005-2006.* Ottawa: Treasury Board of Canada Secretariat, 2006. http://www.tbs-sct.gc.ca/dpr-rmr/0506/PHAC-ASPC/PHAC-ASPC_e.asp

Public Health Agency of Canada. Annual Summaries of Human Surveillance Table. 2002-2005. *West Nile Monitor – West Nile Virus Surveillance Program*. http://www.phac-aspc.gc.ca/wnv-vwn/index.html

Prüss-Üstün, A. and C. Corvalan. *Preventing Disease through Healthy Environments: Towards an Estimate of the Environmental Burden of Disease.* Geneva: World Health Organization, 2006. http://www.who.int/quantifying_ehimpacts/publications/preventingdisease/en/index.html

Pure Strategies. *Decabromodiphenylether: An Investigation of Non-Halogen Substitutes in Electric Enclosure and Textile Applications*. Lowell: Lowell Center for Sustainable Production, 2005.

Reigart, R. and J. Roberts, eds. *Recognition and Management of Pesticide Poisoning.* 5th ed. Washington: EPA, 1999.

Ringquist, E.J. Environmental Justice: Normative Concerns, Empirical Evidence, and Government Action. In *Environmental Policy: New Directions for the Twenty-first Century*, eds. N. Vig and M. Kraft, 249-73. Washington, D.C.: CQ Press, 2003.

Rosenberg, J.1. "Jets over Labrador and Quebec: Noise effects on human health." *Canadian Medical Association Journal* 144, no. 7 (199): 869-75.

Rothenburg, S.J. and J.C. Rothenberg. "Testing the Dose-response Specification in Epidemiology: Public Health and Policy Consequences for Lead." *Environmental Health Perspectives* 113 (2005): 1190-5.

Rundell, K.W. "High Levels of Airborne Ultrafine and Fine Particulate Matter in Indoor Ice Arenas." *Inhalation Toxicology* 15 (2003): 237-50.

Saint-Amour, D. et al. "Alterations of Visual Evoked Potentials in Preschool Inuit Children Exposed to Methylmercury and Polychlorinated Biphenyls from a Marine Diet." *Neurotoxicology* 27, no. 4 (2006): 567-78.

Samet, J.M., J. Spengler, and C. Mitchell. Indoor Air Pollution. In *Environmental and Occupational Medicine*, ed. William N. Rom. Philadephia: Lippincott-Raven Publishers, 1998.

Sanborn, M. et al. *Pesticides Literature Review*. Toronto: Ontario College of Family Physicians, 2004. http://www.ocfp.on.ca/local/files/Communications/Current Issues/Pesticides/Final Paper 23APR2004.pdf

Schantz, S.L. et al. "Impairments of Memory and Learning in Older Adults Exposed to Polychlorinated Biphenyls via Consumption of Great Lakes Fish." *Environmental Health Perspectives* 109, no. 4 (2001): 605-1.

Schettler, T. et al. *Generations at Risk: Reproductive Health and the Environment.* Cambridge: MIT Press, 1999.

Schober, S.E. et al. "Blood Mercury Levels in US Children and Women of Childbearing Age, 1999-2000." *JAMA* 289 (2003): 1667-74.

Schrecker, T. Using Science in Environmental Policy: Can Canada do Better? In *Governing the Environment: Persistent Challenges, Uncertain Innovations*, ed. E. Parson. Toronto: University of Toronto Press, 2001.

Schuster, C.G. et al. "Infectious Disease Outbreaks Related to Drinking Water in Canada 1974-2001." *Canadian Journal of Public Health* 96, no. 4 (2005):254-8.

Schwartz, J. "Air Pollution and Children's Health." *Paediatrics* 113, no. 4 (2004): 1037-43.

Sears, M., C.R. Walker, R. van der Jagt, and P. Claman. "Pesticide Assessment: Protecting Public Health on the Home Turf." *Paediatrics and Child Health* 11, no. 4 (2006): 229-35.

Soskolne C.L. and N. Bertollini. *Global Ecological Integrity and Sustainable Development: Cornerstones of Public Health.* Rome: World Health Organization European Centre for Environment and Health, 1999.

Spivey, A. "The Weight of Lead: Effects Add Up in Adults." *Environmental Health Perspectives* 115, no. 1 (2007): A30-6.

Standing Committee on Environment and Sustainable Development. *The Canadian*

*Environmental Protection Act, 1999 – Five-year Review: Closing the Gaps.* Ottawa: House of Commons Canada, 2007. http://cmte.parl.gc.ca/cmte/CommitteePublication.aspx?SourceId=204099

Stansfeld, S.A. and M.P. Matheson. "Noise Pollution: Non-Auditory Effects on Health." *British Medical Bulletin* 68 (2003): 243-257.

Statistics Canada. *Population of Census Metropolitan Areas (2001 Census Boundaries)*. http://www40.statcan.ca/l01/cst01/demo05a.htm (last updated Jan 31, 2007).

Thornton, J.W., M. McCally, and J. Houlihan. "Biomonitoring of Industrial Pollutants : Health and Policy Implications of the Chemical Body Burden." *Public Health Report* 117 (2002): 315-23.

Toxics Use Reduction Institute. *Five Chemicals Alternatives Assessment Study*. Lowell: TURI, 2006. http://www.turi.org/library/turi_publications/five_chemicals_study

Trasande, L., P. Landrigan, and C. Schechter.. "Public Health and Economic Consequences of Methylmercury Toxicity to the Developing Brain." *Environmental Health Perspectives* 113, no. 5 (2005): 590-6.

Tsekrekos, S.N. and I. Buka. "Lead Levels in Canadian Children: Do We Have to Review the Standard?" *Paediatrics & Child Health* 10, no. 4 (2005): 215-20.

U.K. Pesticide Residues Committee. *Pesticide Residues Monitoring Report – Fourth Quarter Report, 2005*. London: Pesticide Residues Committee, 2006. http://www.pesticides.gov.uk/prc.asp?id=1673

U.S. Centers for Disease Control and Prevention. *CDC's Strategy for the National Environmental Public Health Tracking Program*. Washington: Department of Health and Human Services, 2005. http://www.cdc.gov/nceh/tracking/pdfs/strategy.pdf

U.S. Centers for Disease Control and Prevention. *Third National Report on Human Exposure to Environmental Chemicals*. Atlanta: CDC, 2005. http://www.cdc.gov/exposurereport/report.htm.

U.S. Centers for Disease Control and Prevention, National Center for Health Statistics. *National Health and Nutrition Examination Survey*. http://www.cdc.gov/nchs/nhanes.htm. (Last updated January 11, 2007).

U.S. Department of Agriculture. Annual Summary Calendar Year 2004. *Pesticide Data Program*. http://www.ams.usda.gov/science/pdp.

U.S. Department of Health and Human Services. *Healthy People 2010*. http://www.health.gov/healthypeople

U.S. Environmental Protection Agency. *America's Children and the Environment: Measures of Contaminants, Body Burdens, and Illnesses*. Washington: EPA, 2003.

U.S. Environmental Protection Agency. An Introduction to Indoor Air Quality. http://www.epa.gov/iaq/voc.html.

U.S. Environmental Protection Agency. *EPA 2000-2005 Strategic Plan*. Washington, D.C: EPA, 2000. http://www.epa.gov/ocfo/plan/2000strategicplan.pdf.

U.S. Environmental Protection Agency. Perfluorooctanoic Acid (PFOA) and Fluorinated Telomers. http://www.epa.gov/opptintr/pfoa/index.htm.

U.S. Environmental Protection Agency. *President's Task Force on Environmental Health Risks and Safety Risks to Children, Eliminating Childhood Lead Poisoning; a Federal Strategy Targeting Lead Paint Hazards*. Washington, D.C.: EPA, 2000. http://www.epa.gov/lead/fedstrategy2000.pdf.

U.S. Environmental Protection Agency. Radon, A Cancer-causing Natural Radioactive Gas. http://www.epa.gov/radon.

U.S. Environmental Protection Agency. *Water Distribution System Analysis: Field Studies, Modeling, and Management: A Reference Guide for Utilities.* Cincinnati: EPA, 2005. http://www.epa.gov/nrmrl/pubs/600r06028/600r06028prelithruchap4.pdf

U.S. Institute of Medicine. *The Future of the Public's Health in the 21st Century*. Washington, DC: National Academies Press, 2002. http://www.iom.edu/?id=16741

U.S. National Children's Study. Economic Impact of the National Children's Study. Powerpoint presentation. http://www.nationalchildrensstudy.gov/research/analytic_reports/upload/Economic-Impact-of-the-National-Children-s-Study-PowerPoint-Presentation.pdf .

U.S. National Children's Study. *Growing Up Healthy: Overview of the National Children's Study*. Washington, DC: National Children's Study, 2006. http://www.nationalchildrensstudy.gov/get_involved/learn_more/upload/ncs_guh_brochure_101906.pdf

U.S. National Research Council. *Pesticides in the Diets of Infants and Children.* Washington, D.C.: National Academies Press, 1993.

U.S. Office of Management and Budget. *Draft 2006 Report to Congress on the Costs and Benefits of Federal Regulations.* Washington, D.C.: OMB, 2006. http://www.whitehouse.gov/omb/inforeg/reports/2006_draft_cost_benefit_report.pdf

Union of Concerned Scientists. The Carl Moyer Program: Cost-effective Cleanup that Saves Lives. http://www.ucsusa.org/clean_vehicles/big_rig_cleanup/carl-moyer-diesel-cleanup-program.html

van der Kamp, G. and G. Grove. Well Water Quality in Canada: An Overview. In *An Earth Odyssey*. *Proceedings of the 54th Canadian Geotechnical Conference*, eds. M. Mahmoud and R. van Everdingen. Richmond, B.C.: Bitech Publishers, 2001.

Veldhoen, N. et al. "The Bactericidal Agent Triclosan Modulates Thyroid-associated Gene Expression and Disrupts Postembryonic Anuran Development." *Aquatic Toxicology* 80, no. 3 (2006.): 217-27.

Veugelers, P.J. and J.R. Read. "Health Deficiencies in Cape Breton County, Nova Scotia, Canada, 1950-1995." *Epidemiology* 10, no. 5 (1999): 495-9.

Wade, M.G. et al. "Effects of Subchronic Exposure to a Complex Mixture of Persistent Contaminants in Male Rats: Systemic, Immune, and Reproductive Effects." *Society of Toxicology* 67 (2002): 131-43.

Wade, M.G. et al. "Thyroid Toxicity Due to Subchronic Exposure to a Complex Mixture of 16 Organochlorines." *Society of Toxicology* 67 (2002): 207-18.

Wal-Mart. Wal-Mart Launches Innovative Program to Inspire Use of Preferred Substances in Chemical Intensive Products. http://www.walmartfacts.com/articles/4556.aspx (accessed Oct. 30, 2006).

Watson, W.A. et al. "2004 Annual Report of the American Association of Poison Control Centers Toxic Exposure Surveillance System." *Am J Emerg Med*. 23, no. 5$ (2005): 589-666. http://www.poison.org/prevent/documents/TESS Annual Report 2004.pdf

Watters, E. "DNA Is Not Destiny: The New Science of Epigenetics Rewrites the Rules of Disease, Heredity, and Identity." *Discover* 27, no. 11 (2006).

Wayne, P. et al. "Production of Allergenic Pollen by Ragweed Is Increased in $CO_2$ Enriched Atmospheres." *Annals of Allergy, Asthma, & Immunology* 88 (2002): 279-82.

West, S.K. et al. "Model of Risk of Cortical Cataract in the US Population with Exposure to Increased Ultraviolet Radiation due to Stratospheric Ozone Depletion." *American Journal of Epidemiology* 162, no. 11 (2005): 1080-8.

White, M.J. *Asbestos and the Future of Mass Torts*. National Bureau of Economic Research Working Paper 10308, February 2004.

Wigle, D. *Child Health and the Environment*. Oxford: Oxford University Press, 2003.

Wilhelm, M., U. Ewers, and C. Schulz. “Revised and New Reference Values for Some Persistent Organic Pollutants (POPs) in Blood for Human Biomonitoring in Environmental Medicine.” *International Journal of Hygiene and Environmental Health* 206 (2003):
223-9.

Wilson, S.H. Genetics and Environmental Health. In *Environmental Health: From Global to Local*, ed. H. Frumkin. San Francisco: Wiley, 2005.

World Health Organization. *The World Health Report 2002: Reducing Risks, Promoting Healthy Life*. Geneva: WHO, 2002. http://www.who.int/whr/2002/en

Yang, T., K. Matus, S. Paltsev, and J. Reilly. *Economic Benefits of Air Pollution Regulation in the USA: An Integrated Approach*. Boston: Massachusetts Institute of Technology, 2004.

Ziaomei, M. et al. "Critical Windows of Exposure to Household Pesticides and Risk of Childhood Leukemia." *Environmental Health Perspectives* 110 (2002): 9.

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