

# **toxic nation** : ON PARLIAMENT HILL

## ***A Report on Pollution in Four Canadian Politicians***



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### **Overview**

For the latest round of Toxic Nation body burden testing, four federal politicians volunteered to be tested for over 100 different chemicals. The participating politicians included Rona Ambrose, Minister of the Environment; Tony Clement, Minister of Health; Jack Layton, Leader of the NDP; and, John Godfrey, Liberal Environment Critic.

Each politician was tested for 103 chemicals that fall under the following groups:

- PBDEs (polybrominated diphenyl ethers),
- PFCs (perfluorinated chemicals),
- PCBs (polychlorinated biphenyls),
- PAHs (polycyclic aromatic hydrocarbons),
- OPIMs (organophosphate insecticide metabolites),
- OCPs (organochlorine pesticides), and
- metals such as lead and mercury.

Studies from around the world have documented the presence of these and other chemicals in people everywhere, no matter where they live, work or play. Environmental Defence's previous body burden studies have revealed that these chemicals are present in Canadians young and old from across the country.

### **Summary of Results and Key Findings**

Of the 103 chemicals tested for a total of 61 were detected (59 per cent) in the four volunteers, including 18 PBDEs, five PFCs, 13 PCBs, three OPIMs, 10 OCPs, seven PAHs and five metals (Table 1). The number of chemicals detected in each volunteer ranged from 49 to 55 (Table 1).

Many of the chemicals detected in the politicians are associated with adverse health effects. In total, 54 carcinogens, 37 hormone disruptors, 16 respiratory toxins, 54 reproductive/developmental toxins, and 33 neurotoxins were detected in the study volunteers (Table 2). Three chemicals for which there is no data on health effects were detected in the volunteers (Table 2); all three of these chemicals are PFCs.

**Table 1. Comparison of politician's test results: number of chemicals detected**

Chemical Group	Number of Compounds Tested	Number of Compounds Detected				
		In All 4 People	Jack Layton	Rona Ambrose	Tony Clement	John Godfrey
PBDEs	40	18	17	17	18	18
PCBs	16	13	12	12	13	12
PFCs	13	5	5	4	4	4
OCP	13	10	10	9	10	9
OPIM	6	3	2	1	3	3
PAHs	10	7	4	1	1	4
Metals	5	5	5	5	5	5
<b>Total</b>	<b>103</b>	<b>61</b>	<b>54</b>	<b>49</b>	<b>54</b>	<b>55</b>

**Table 2. Number of chemicals detected in the politicians that are linked to a listed known or suspected health effect**

Chemical's Effect on Health	Total Detected	Number of Chemicals Detected that are Linked to a Listed Known or Suspected Health Effect			
		Jack Layton	Rona Ambrose	Tony Clement	John Godfrey
Carcinogen	54	45	42	47	47
Hormone Disruptor	37	34	35	37	37
Respiratory Toxin	16	11	8	9	9
Reproductive/Developmental Toxin	54	45	42	47	47
Neurotoxin	33	29	29	33	33
No Data on Health Effects	3	3	2	2	2

\*See Appendix 3 for information on how chemicals were categorized according to known or suspected health effects.

All four politicians tested were significantly more polluted than both the child and adult volunteers who participated in Environmental Defence's earlier study, *Polluted Children, Toxic Nation: A Report on Pollution in Canadian Families*. Except for the PBDEs, exactly the same set of chemicals were included in both studies, and the analyses were conducted by the same labs using the same methodology. A comparison of the politicians results to those of the volunteers in the first Toxic Nation study (*Toxic Nation: A Report on Pollution in Canadians*) was not conducted, due to differences in the chemicals that were tested.

The politicians had significantly higher total concentrations than the volunteers in the *Polluted Children, Toxic Nation* study in every comparable chemical group. For instance, the median total concentration for PFCs in *Polluted Children, Toxic Nation* was 17.345 ng/mL in serum, while the politicians total PFC concentrations ranged from 23.9 to 50.3 ng/mL. For OPIMs, the politicians total concentrations ranged from 4.8 to 216 ug/L in urine, compared to a median total OPIM concentration in *Polluted Children, Toxic Nation* of 7.9 ug/L. In addition, every politician had an above normal level of mercury, although none of the mercury levels detected exceeded the alert threshold.

Of the four politicians, Tony Clement had the highest total concentrations for PCBs, PFCs and OCPs; Jack Layton had the highest total concentrations for PBDEs and PAHs, as well as mercury, lead and manganese; John Godfrey had the highest total concentration for OPIMs and cadmium; and Rona Ambrose had the highest concentration of arsenic (Table 3).

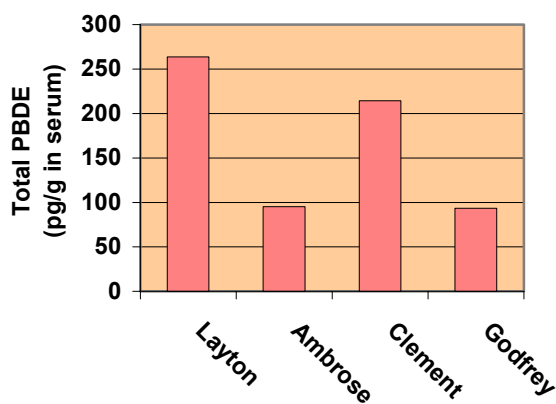
**Table 3. Comparison of politician's test results: total concentrations per group of chemicals**

Chemical Group	Total Concentration			
	Jack Layton	Rona Ambrose	Tony Clement	John Godfrey
<b>PBDEs</b> (pg/g in serum)	263.813	95.354	214.29	93.377
<b>PCBs</b> (µg/L in plasma)	6.046	2.155	7.819	3.96
<b>PFCs</b> (ng/mL in serum)	41.906	32.64	56.609	41.551
<b>OCP</b> (µg/L in plasma)	1.862	2.8349	4.077	1.505
<b>OPIM</b> (µg/L in urine)	39	4.8	131	216
<b>PAHs</b> (ug/L in urine)	1.345	0.13	0.12	1.06
<b>Metals</b>				
<b>Mercury</b> (nmol/L in whole blood)	29	17	17	19
<b>Lead</b> (µmol/L in whole blood)	0.16	0.085	0.1	0.12
<b>Arsenic</b> (nmol/L in whole blood)	59	77	20	19
<b>Cadmium</b> (nmol/L in whole blood)	3.2	2.7	2	3.5
<b>Manganese</b> (nmol/L in whole blood)	250	130	170	81

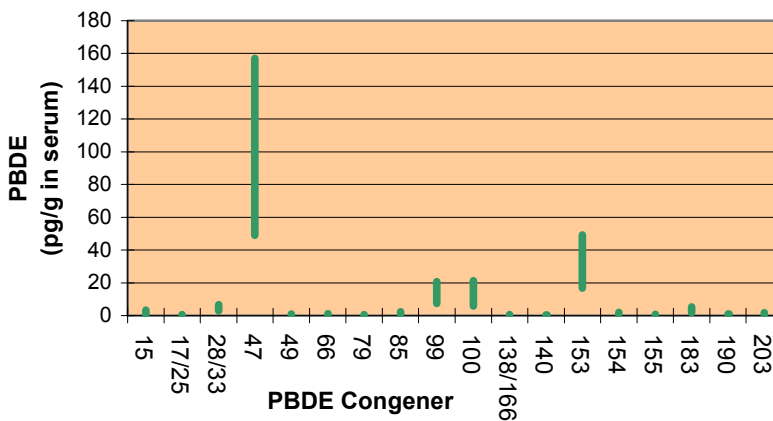
**Results by Chemical Group**

*PBDEs (Polybrominated Diphenyl Ethers)*

**18 of 40 PBDEs tested for were detected** (Table 1, Figure 1), including PBDE congeners 15, 17/25, 28/33, 47, 49, 66, 79, 85, 99, 100, 138/166, 140, 153, 154, 155, 183, 190, 203; everyone of these congeners was detected in all four people tested, except for congeners 140 (detected in two people) and 190 (detected in three people). The PBDE congeners detected at the highest levels in all volunteers were PBDE 47 (49 - 157 pg/g), 99 (7.43 - 20.7 pg/g), 100 (5.86 - 20.7 pg/g), and 153 (16.8 - 49.2 pg/g) (Figure 2). These congeners are primarily used in the commercial mixture PentaBDE. The total PBDE concentrations ranged from 93.377 - 263.813 pg/g in serum (Table 3, Figure 1); the highest total PBDE concentration was detected in Jack Layton (Table 3, Figure 1).



**Figure 1. Comparison of total PBDE concentrations in four politicians**



**Figure 2. Range in PBDE congener concentrations in four politicians**

### PCBs (Polychlorinated Biphenyls)

**13 of 16 PCBs tested for were detected** (Table 1). All 13 of these were detected in every person tested, except for PCB 101 (detected in one person) and PCB 105 (detected in three people). The three PCBs that were not detected are PCB 128, 28, and 52. The total PCB concentrations ranged from 2.155 - 7.819 µg/L in plasma (Table 3, Figure 3), which is significantly higher than the total median PCB concentration detected in *Polluted Children, Toxic Nation* (1.041 µg/L in plasma). For individual PCB congeners, the greatest differences between levels detected in the politicians and those detected in *Polluted Children, Toxic Nation* were for PCB Aroclor 1260, PCB 118, 138, and 163. The highest total PCB concentration was detected in Tony Clement (Table 3, Figure 3).

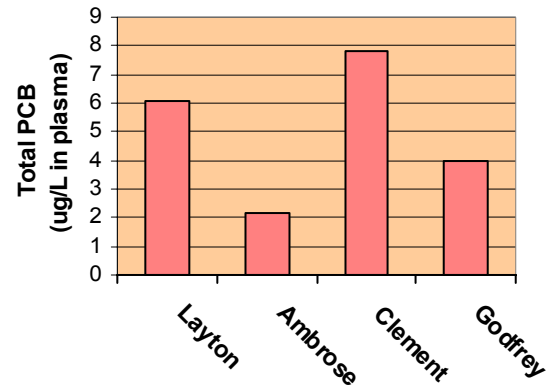


Figure 3. Comparison of total PCB concentrations in four politicians

### PFCs (Perfluorinated Chemicals)

**5 of 13 PFCs tested for were detected** (Table 1), including PFOA, PFNA, PFUnA, PFHxS and PFOS. All five of these PFCs were detected in every person, except for PFUnA, which was detected in one person. The total PFC concentrations ranged from 32.64 - 56.609 ng/mL in serum (Table 3, Figure 4), which is significantly higher than the total median PFC concentration detected in *Polluted Children, Toxic Nation* (17.345 ng/mL). In particular, the concentrations for PFHxS and PFOS were significantly higher than the medians in *Polluted Children, Toxic Nation*. Among the politicians, PFHxS levels ranged from 3.18 - 3.93 ng/mL, compared to the *Polluted Children, Toxic Nation* median of 1.11 ng/mL; PFOS levels among the politicians ranged from 23.9 - 50.3 ng/mL, compared to the *Polluted Children, Toxic Nation* median of 13.8 ng/mL. The highest total PFC concentration detected among the politicians was in Tony Clement (Table 3, Figure 4).

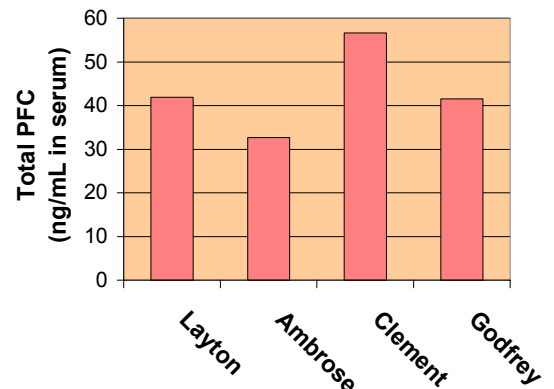


Figure 4. Comparison of total PFC concentrations in four politicians

### OCPs (Organochlorine pesticides)

**10 of 13 OCPs tested for were detected** (Table 1); all 10 of these OCPs were detected in every person, except for p,p'-DDT, which was only detected in one person. The three OCPs that were not detected are aldrin, α-chlordane and γ-chlordane. The total OCP concentrations ranged from 1.862 - 4.077 µg/L in plasma (Table 3, Figure 5), which is significantly higher than the total median OCP concentration detected in the *Polluted Children, Toxic Nation* study (0.602 µg/L). The highest total OCP concentration detected among the politicians was in Tony Clement (Table 3, Figure 5).

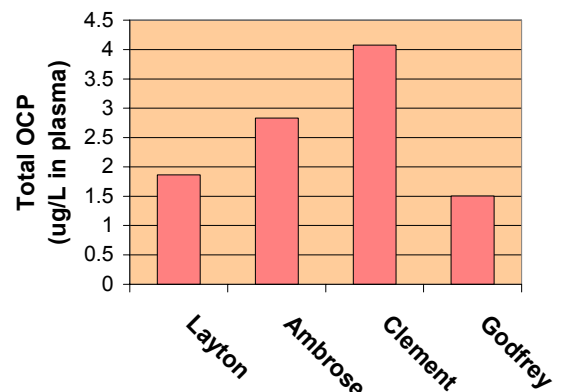


Figure 5. Comparison of total OCP concentrations in four politicians

### OPIM (Organophosphate Insecticide Metabolites)

**3 of 6 OPIMs tested for were detected** (Table 1), including DMPTP (dimethyldithiophosphate), DMP (dimethylphosphate) and DMTP (dimethylthiophosphate); only DMTP was detected in all four people tested, at a range of 4.8 - 100 µg/L in urine; the median DMTP level detected in *Polluted Children, Toxic Nation* was 7.7 µg/L. The total OPIM concentrations among the politicians ranged from 4.8 - 216 µg/L (Table 3, Figure 6), and all but one were significantly higher than the median total OPIM concentration detected in *Polluted Children, Toxic Nation* (7.9 µg/L). The highest total OPIM concentration detected among the politicians was in John Godfrey (Table 3, Figure 6).

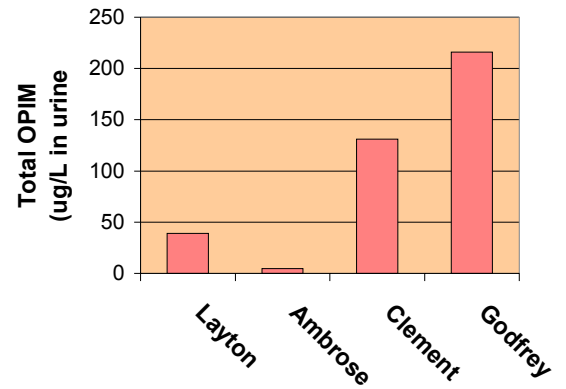


Figure 6. Comparison of total OPIM concentrations in four politicians

### PAHs (Polycyclic Aromatic Hydrocarbons)

**7 of 10 PAHs tested for were detected** (Table 1). The three PAHs that were not detected are 2-OH-phenanthrene, 3-OH-benz(a)-anthracene and 3-OH-chrysene. None of the PAHs were detected in all the volunteers; each one was detected in one to two people. The PAH levels vary significantly among people, most likely because they are quickly metabolized and do not stay in the body for very long, which complicates the use of a sample as a representation of general exposure; as a result it is difficult to make comparative observations. Regardless, the results clearly show that the highest total PAH concentration detected among the politicians was in Jack Layton (Table 3, Figure 7).

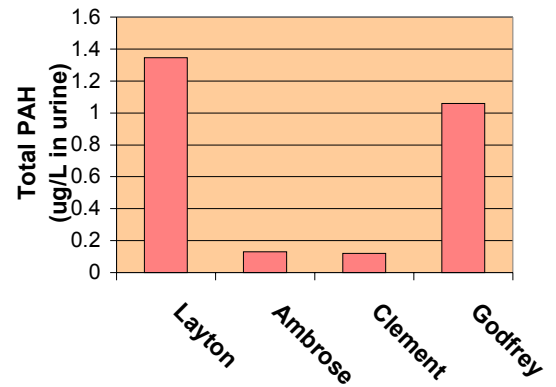


Figure 7. Comparison of total PAH concentrations in four politicians

### Metals (Mercury, Lead, Arsenic, Cadmium, Manganese)

**5 of 5 metals tested for were detected** (Table 1), and all five were detected in every person tested. As with the other groups of chemicals, the politicians had significantly higher concentrations of some metals than those detected in the *Polluted Children, Toxic Nation* study.

The mercury levels detected in the politicians ranged from 17 - 19 nmol/L in whole blood, and all were above the normal level (0 - 15 nmol/L) as established by the Centre de toxicologie at the Institut national de santé publique de Québec (INSPQ) (although none of them exceeded the alert threshold). The levels were also significantly higher than the median detected in *Polluted Children, Toxic Nation*, 3.5 nmol/L.

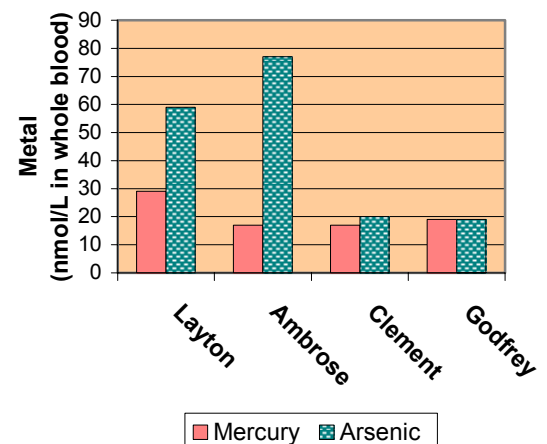


Figure 8. Comparison of mercury and arsenic concentrations in four politicians

In the politicians, arsenic was detected at a range of 12 to 77 nmol/L in whole blood, which was significantly higher than the median arsenic concentration in *Polluted Children, Toxic Nation*, 3.2 nmol/L. All of the arsenic levels were within the normal range (0 to 80 nmol/L as established by INSPQ).

## **Conclusion and Recommendations**

In December 2006, the federal government announced a new Chemical Management Plan that promises to take action on a list of harmful substances that includes several of the chemicals included in this report.

The most harmful chemicals, as identified in the "categorization" exercise recently completed by Health Canada and Environment Canada, should be phased out of use, except in rare instances (i.e. essential products for which less harmful substitutes are not available).

Canada's overarching pollution law, the Canadian Environmental Protection Act (CEPA), is currently being reviewed by Parliament. The federal government should amend CEPA in the following ways:

- Mandatory and tight timelines should be in place at each stage of the chemicals management process, from assessment to regulation.
- A special section of CEPA should deal with vulnerable ecosystems such as the Great Lakes-St. Lawrence basin, where 45 percent of Canada's toxic air pollution is generated.
- CEPA should place the onus on industry to demonstrate that products in the marketplace are safe, as Europe is currently implementing with their new toxics law.
- CEPA should explicitly provide protections against harmful substances in consumer products, which are the source of an increasing number and volume of toxic chemicals.
- The system of industry reporting of toxic emissions, known as the National Pollutant Release Inventory, should be made mandatory and more comprehensive.

For background information on toxic chemicals and body burden testing, please refer to previous Toxic Nation Reports:

- Environmental Defence. (2006, June). Polluted Children Toxic Nation: A Report on Pollution in Canadian Families.
- Environmental Defence. (2005, November). Toxic Nation: A Report on Pollution in Canadians.

All Toxic Nation Reports are available online at [www.toxicnation.ca](http://www.toxicnation.ca)



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## **APPENDIX 1. OVERVIEW OF CHEMICAL GROUPS INCLUDED IN THE TESTING**

### **PFCs (perfluorinated chemicals)**

PFCs and their precursors are a group of chemicals widely used in a range of consumer products for their resistance to environmental breakdown. PFCs are used to make non-stick coatings on items such as cooking pans, and stain repellent coatings on everything from carpets and furniture to microwave popcorn bags and fast-food packaging. Two of the most well-known PFCs are PFOS and PFOA. PFOA belongs to the subgroup of PFCs known as perfluorinated carboxylic acids (PFCAs), and PFOS to the subgroup known as perfluorinated alkyl sulfonates.

Existing studies show that perfluorinated chemicals are extremely persistent and bioaccumulative, as well as probably cancer-causing, hormone disrupting and toxic to reproduction and development. Recent research indicates that a major source of PFCs in the environment is the migration of PFC precursors from consumer products. In the first-ever cross-Canada measurement of PFOS levels, Environmental Defence detected PFOS in all volunteers tested for *Toxic Nation: A Report on Pollution in Canadians*.<sup>1</sup> Similar findings have been reported from numerous other countries.<sup>2</sup>

Many concerned people and organizations around the world have called for the phase-out of specific compounds within the group of PFCs. Sweden has proposed that PFOS be banned globally under the Stockholm Convention on Persistent Organic Pollutants, and along with Britain, has applied to the European Commission for a national ban on the substance. As of 2005, the EC had initiated a Directive requiring EU-wide restrictions on PFOS. In the US, the 3M company (the major manufacturer of PFOS) voluntarily agreed to stop using the chemical by 2003 after receiving pressure from the US Environmental Protection Agency (EPA). In

February 2006, concerns about the possible health threats of PFOA led US regulators to reach a voluntary agreement with eight companies to phase-out the use of this controversial substance. Under the agreement, companies will reduce emissions of PFOA from their facilities and consumer products by 95 per cent by 2010, and work toward eliminating sources of PFOA by no later than 2015.

In June, 2006, Canada announced an Action Plan for PFCAs, and proposed a permanent ban on four fluorotelomer-based substances (precursors to PFCAs). The Action Plan aims to prevent the introduction of new PFCAs and their precursors to the market, and to work with industry to address PFCAs and precursors that are already on the Canadian market. However, the federal government has not yet completed its risk assessment of PFOA, and has excluded this compound from the PFCA Action Plan.

In July, the federal government also announced that PFOS, its salts and its precursors, will be added to the List of Toxic Substances (Schedule 1) of the Canadian Environmental Protection Act (CEPA). In December, the government proposed regulations to prohibit the manufacture, use, sale and import of PFOS and products containing PFOS.

### **PBDEs (polybrominated diphenyl ethers)**

PBDEs are used in flame retardants, which are applied to upholstered furniture, mattresses, curtains, carpets and electronics to slow the spread of fire. PBDEs can migrate from products, and have been detected in house dust, human blood and breast milk.

PBDEs are highly persistent and bioaccumulative in the environment and in people. As a group of chemicals, PBDEs are suspected of disrupting hormones, causing cancer and developmental disorders. These chemicals are suspected of having particularly damaging effects on the thyroid (which controls brain development), and as a result, PBDEs may cause learning disabilities and behaviour problems.

<sup>1</sup> Environmental Defence. (2005, November).

<sup>2</sup> Kannan, K. et al. (2004).

Perfluorooctanesulfonate and related fluorochemicals in human blood from several countries. *Environmental Science and Technology*. v. 38, n.17, pp. 4489-4495.

Research on human levels of PBDEs has found that the breast milk of Canadian women contains the second-highest levels of PBDEs in the world, second only to the US, and five to 10 times higher than that of breast milk from women from other industrialized countries, such as Japan and Germany.<sup>3</sup>

On July 1, 2006, the federal government announced that the seven types of PBDEs registered for use in Canada will be added to Schedule 1 of CEPA. The government also proposed that pentaBDE, tetraBDE and hexaBDE (used in the commercial PBDE mixtures PeBDE and OBDE) be slated for virtual elimination. In December, the government proposed regulations to prohibit the manufacture of PBDEs, and to prohibit the use, sale, offer for sale and import of the three PBDE mixtures identified for virtual elimination. In addition, the government has given notice that PBDEs in imported consumer products will be addressed some time in the future.

In light of the ubiquitous nature of PBDEs, and their potential health effects, other jurisdictions have also taken precautionary action. In Europe, penta and octaBDE are banned, and the use of decaBDE is restricted. By the end of 2006, certain types of PBDEs will be banned in Maine and California; in Hawaii, they will be banned by 2008.

### **PCBs (polychlorinated biphenyls)**

PCBs have been banned in Canada since 1977, yet they continue to be released into the environment from sources in other countries and from PCB-containing industrial equipment that is still in use here in Canada.

PCBs are highly toxic and persistent chemicals that build up in wildlife and people through the process of bioaccumulation. PCBs cause many types of cancer, as well as reproductive and developmental disorders.

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<sup>3</sup> Ryan, Jake. (2004). Polybrominated Diphenyl Ethers (PBDEs) in Human Milk: Occurrence Worldwide. Health Canada, Health Products and Food Branch, Ottawa, Ontario, Canada. Mittlestaedt, Martin. (2004, June 7). Flame retardant in breast milk raises concern: Canadian women have second-highest level in world, Health Canada finds. Globe and Mail. Toronto.

These chemicals damage the nervous, immune and cardiovascular systems, leading to birth defects, brain damage and decreased immune function. PCBs are also suspected of being hormone disruptors.

Under the Stockholm Convention on Persistent Organic Pollutants, Canada is required to phase out the remaining uses of PCBs (in electrical transformers and other equipment) by 2025 and to dispose of these PCBs in an environmentally sound manner by 2028.

### **Organochlorine pesticides**

Organochlorine pesticides are mainly used on agricultural crops—the fruits and vegetables we all eat. Canada still allows the use of many organochlorine pesticides, even though research has shown that these chemicals are persistent and bioaccumulative. As a group of chemicals, organochlorine pesticides are recognized carcinogens and reproductive/developmental toxins; they are also suspected hormone disruptors and respiratory toxins. The most notorious organochlorine pesticide, DDT, is banned in Canada, but continues to be used in other countries.

### **Organophosphate insecticide metabolites (a.k.a. dialkyl phosphate metabolites)**

Dialkyl phosphate metabolites are breakdown products of organophosphate insecticides such as parathion, diazinon, malathion, and chlorpyrifos, which have a variety of applications for lawns, agricultural crops, and mosquito and pest control. These chemicals are suspected of causing cancer and reproductive, developmental and neurological disorders.

In Canada, a variety of restrictions apply to the use of these chemicals, especially in residential settings. Many of these chemicals, however, are used extensively in agriculture in Canada and in other countries from which we import fresh produce.

### **Metals (lead, mercury, arsenic, cadmium, and manganese)**

Metals in our environment include lead, mercury, arsenic, cadmium and manganese; some occur naturally, but most come from human-made sources. Overall, the most

common source of exposure to metals is through food.

As a group, metals are known to cause cancer and reproductive and developmental disorders. Many metals are also suspected hormone disruptors and respiratory toxins. Canada has a variety of tools in place to regulate the production, use and disposal of these chemicals, but much stronger regulations are needed.

Releases of metals by Canadian industry are reported annually to the NPRI. The most recent data available through PollutionWatch is for emissions in 2003 and shows that industry continues to contaminate the environment with dangerous metals.<sup>4</sup>

**Table 1. Total on and off-site releases for selected metal compounds, as reported by Canadian industry to NPRI in 2003**

<b>Metal</b>	<b>Total On and Off-Site Releases</b>
Arsenic (and its compounds)	580,838 kg
Cadmium (and its compounds)	183,024 kg
Lead (and its compounds)	3,535,270 kg
Manganese (and its compounds)	12,317,246 kg
Mercury (and its compounds)	112,287 kg

Source: PollutionWatch. (May 2006).

Exposure to arsenic can also come from wood that is pressure treated with chromated copper arsenate (CCA), which is found in playgrounds, fences, decks and other constructions. (Manufacturers of CCA-treated wood voluntarily agreed to stop producing it for consumer use by the end of 2003; however, CCA-treated wood will still be available in stores until existing stock is sold, and CCA-treated wood could remain on residential and public properties indefinitely.)

Exposure to lead comes from old lead paint and emissions from industrial facilities such

as metal smelters. Mercury is emitted by coal-fired power plants, but it is also found in batteries, fluorescent light tubes, thermometers and related equipment. The main sources of cadmium are pigments and cigarette smoking; cadmium emissions also come from industrial sources such as lead and copper smelting and municipal waste incineration. While manganese is naturally occurring, it is also emitted through the burning of fossil fuels and by the steel industry. Although manganese is an essential element necessary for good health, at elevated levels it can become a neurotoxin.

### **PAHs (polycyclic aromatic hydrocarbons)**

PAHs come from both natural and human-made sources, and are formed during the incomplete burning of coal, oil, gas, garbage, or other organic substances; some PAHs are manufactured.

Forest fires are the largest natural source of PAHs in Canada. The greatest human-made sources of PAHs in air, water and soil are aluminum smelters, coking plants, creosote-treated products, spills of petroleum products, and transportation.

PAHs have been identified as 'probably carcinogenic to humans', and are suspected reproductive and respiratory toxins. In Canada, some PAHs have been assessed under the Priority Substances List of CEPA, and 17 of them are subject to reporting under the NPRI, Canada's national pollution reporting program.

<sup>4</sup> Environmental Defence. (2006, May 23). Pollution Summary for Canada, 2003. Available online at <http://www.pollutionwatch.org/country.do;jsessionid=44185392FEE45F8649B5CDA887EC6D4A>

## **APPENDIX 2. LIST OF CHEMICALS TESTED**

### **Metals (5)**

Cadmium  
Lead  
Manganese  
Arsenic  
Mercury

### **PCBs (Polychlorinated Biphenyls) (16)**

PCB Aroclor 1260  
PCB-101  
PCB-105  
PCB-118  
PCB-128  
PCB-138  
PCB-153  
PCB-156  
PCB-163  
PCB 170  
PCB-180  
PCB-183  
PCB-187  
PCB-28  
PCB-52  
PCB-99

### **OCPs (Organochlorine Pesticides) (13)**

Aldrin  
a-chlordane  
Cis-nonachlor  
g-chlordane  
Hexachlorobenzene  
Mirex  
Oxychlordane  
toxaphene parlar 26  
toxaphene parlar 50  
p,p'-DDE  
p,p'-DDT  
b-HCH  
Trans-nonachlor

### **PBDEs (Polybrominated Diphenyl Ethers) (40)**

Br2-DPE-7  
Br2-DPE-8/11  
Br2-DPE-10  
Br2-DPE-12/13  
Br2-DPE-15  
Br3-DPE-17/25  
Br3-DPE-28/33  
Br3-DPE-30  
Br3-DPE-32  
Br3-DPE-35  
Br3-DPE-37  
Br4-DPE-47  
Br4-DPE-49  
Br4-DPE-51  
Br4-DPE-66  
Br4-DPE-71  
Br4-DPE-75  
Br4-DPE-77  
Br4-DPE-79  
Br5-DPE-85  
Br5-DPE-99  
Br5-DPE-100  
Br5-DPE-105  
Br5-DPE-116  
Br5-DPE-119/120  
Br5-DPE-126  
Br6-DPE-128  
Br6-DPE-138/166  
Br6-DPE-140  
Br6-DPE-153  
Br6-DPE-154  
Br6-DPE-155  
Br7-DPE-181  
Br7-DPE-183  
Br7-DPE-190  
Br8-DPE-203  
Br9-DPE-206  
Br9-DPE-207  
Br9-DPE-208  
Br10-DPE-209

### **PFCs (Perfluorinated Chemicals) (13)**

PFBA  
PFPeA  
PFHxA  
PFHpA  
PFOA  
PFNA  
PFDA  
PFUnA  
PFDoA  
PFBS  
PFHxS  
PFOS  
PFOSA

### **OPIM (Organophosphate Insecticide Metabolites) (6)**

DEDTP (Diethyl dithiophosphate)  
DEP (Diethyl phosphate)  
DETP (Diethyl thiophosphate)  
DMDTP (Dimethyl dithiophosphate)  
DMP (Dimethyl phosphate)  
DMTP (Dimethyl thiophosphate)

### **PAHs (Polycyclic Aromatic Hydrocarbons) (10)**

1-OH-benz(a)-anthracene  
1-OH-phenanthrene  
1-OH-pyrene  
2-OH-phenanthrene  
3-OH-benz(a)-anthracene  
3-OH-chrysene  
3-OH-fluoranthene  
3-OH-phenanthrene  
4-OH-phenanthrene  
6-OH-chrysene

### **APPENDIX 3. CATEGORIZING CHEMICALS ACCORDING TO EFFECTS ON HEALTH**

All chemicals included in the study were categorized according to five groups of health effects: carcinogens, hormone disruptors, respiratory toxins, neurotoxins and reproductive/developmental toxins. The chemicals were categorized according to information obtained from Scorecard Chemical Profiles in April 2006.

<sup>1</sup> Scorecard differentiates between chemicals that are recognized and suspected of causing adverse health effects; in our study we included both in our total count of health effects. Our result, for example, of 54 carcinogens detected includes both recognized and suspected carcinogenic chemicals.

For many of the chemicals in the study, information was available on the health effects of individual compounds; however, this was not the case for organophosphate insecticide metabolites, PBDEs, PAHs or PFCs. Scorecard does provide a group assessment for organophosphate insecticide metabolites, PBDEs and PAHs, so all the compounds within each of these groups are coded for the same health effects. For PFCs, data on health effects is only available for two compounds, PFOA and PFOS (perfluorooctane sulfonate), the rest of the PFC compounds are coded as having 'no data on health effects'. The health effect data for PFOA and PFOS is based on the work of the Environmental Working Group, which for these two compounds, has more up-to-date data than Scorecard.

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<sup>1</sup>Green Media Toolshed. (2005). Scorecard: Chemical Profiles. Retrieved online April 16, 2006 from <http://www.scorecard.org/chemical-profiles/>

## **APPENDIX 4. SAMPLING AND ANALYTICAL METHODOLOGY**

Laboratories:

- Centre de Toxicologie, Institut National de Santé Publique du Québec (INSPQ) in Ste-Foy, Quebec, conducted the analysis for:
  - metals, polychlorinated biphenyls (PCBs), organochlorine pesticides, organophosphate insecticide metabolites, and polycyclic aromatic hydrocarbons (PAHs)
- AXYS Analytical Services in Sidney, British Columbia, conducted the analysis for:
  - perfluorinated chemicals (PFCs) and polybrominated diphenyl ethers (PBDEs).

### **Polychlorinated Biphenyls (PCBs) and Organochlorine Pesticides**

<b>Compounds</b>	<b>PCBs:</b> PCB Aroclor 1260, PCB-28, PCB-52, PCB-99, PCB 101, PCB-105, PCB-118, PCB 128, PCB 138, PCB-153, PCB-156, PCB 163, PCB-170, PCB-180, PCB 183, PCB 187 <b>Organochlorine pesticides:</b> Aldrin, $\alpha$ -chlordane, $\gamma$ -chlordane, $\beta$ -HCH, Cis-nonachlore, p,p'-DDT, p,p'-DDE, Hexachlorobenzene, Oxychlordane, Mirex, Trans-nonachlore, toxaphene 26, Toxaphene 50
<b>Specimen</b>	Plasma
<b>Specimen collection container</b>	10 mL glass Lavender top (EDTA) Becton Dickinson Vacutainers
<b>Specimen collection</b>	Immediately invert tube 8 to 10 times. Cool slowly to 4°C. Centrifuge for 10 minutes. Transfer plasma using a plastic transfer pipette into shipping container.
<b>Shipping container</b>	Pre-cleaned 7 mL screw-cap glass tube with Teflon disc
<b>Storage</b>	4°C (samples to reach laboratory within 3 days)
<b>Shipping</b>	Shock-resistant cooler. Include ice pack.
<b>Methodology</b>	Gas Chromatography Mass Spectrometry (GC-MS)
<b>Detection limit</b>	0.01 µg/L (ppb)

### **Metals**

<b>Compounds</b>	Arsenic, Cadmium, Manganese, Lead, Mercury
<b>Specimen</b>	Whole blood
<b>Specimen container</b>	6 mL Lavender top (EDTA) Becton Dickinson Vacutainers (plastic)
<b>Specimen collection</b>	Immediately invert tube eight to 10 times.
<b>Storage temperature</b>	4°C (maximum 1 month)
<b>Shipping</b>	Shock-resistant cooler. Include ice pack.
<b>Methodology</b>	Inductively Coupled Plasma Mass Spectrometry (ICP-MS) Graphite furnace atomic absorption spectrometry (Manganese)
<b>Detection limits</b>	Arsenic 3 nmol/L Cadmium 0.4 nmol/L Lead 0.001 µmol/L Manganese 7 nmol/L Mercury 0.5 nmol/L

### Polycyclic Aromatic Hydrocarbons (PAHs)

<b>Compounds</b>	3-OH-benz(a)-anthracene, 3-OH-chrysene, 6-OH-chrysene, 3-OH-fluoranthene, 1-OH-phenanthrene, 2-OH-phenanthrene, 3-OH-phenanthrene, 4-OH-phenanthrene, 1-OH-pyrene
<b>Specimen</b>	Urine
<b>Specimen container</b>	125 mL Nalgene bottle
<b>Specimen collection</b>	Collect a spot sample preferably the first morning sample.
<b>Storage temperature</b>	Maintain frozen at -20°C
<b>Shipping</b>	Shock-resistant cooler. Include ice pack.
<b>Methodology</b>	Gas Chromatography Mass Spectrometry (GC-MS)
<b>Detection limit</b>	~0.1 µg/L

### Organophosphate Insecticide Metabolites

<b>Compounds</b>	Diethyl phosphate, Dimethyl phosphate, Diethyl thiophosphate, Dimethyl thiophosphate, Diethyl dithiophosphate, Dimethyl dithiophosphate
<b>Specimen</b>	Urine
<b>Specimen container</b>	125 mL polyethylene bottle
<b>Storage</b>	4°C (-20°C)
<b>Shipping</b>	Shock-resistant cooler. Include ice pack.
<b>Methodology</b>	Gas Chromatography Mass Spectrometry (GC-MS)
<b>Detection limit</b>	1 µg/L

### Perfluorinated Chemicals (PFCs)

<b>Compounds</b>	PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFNA, PFDA, PFUnA, PFDoA, PFBS, PFHxS, PFOS, PFOSA
<b>Specimen</b>	Serum
<b>Specimen collection container</b>	7 mL Red top (EDTA) Becton Dickinson Vacutainers (plastic)
<b>Specimen collection</b>	Avoid all contact of samples with Teflon, glass surfaces, sticky labels and adhesive tape. For each lot of number of vacutainers retain a single vacutainer unused and sealed to send to laboratory as a blank. Clot at room temperature for 60 minutes. Centrifuge vacutainer as soon as possible (same day). Decant/pour the serum into lavender top plastic vial. If using glass pipettes do not pipette the serum out.
<b>Storage temperature</b>	Refrigerate if sending within 24-48 hours, otherwise freeze.
<b>Shipping</b>	Place cool or frozen samples upright in shock-resistant cooler with ice packs.
<b>Methodology</b>	Liquid chromatography Mass spectrometry (LC-MS/MS)
<b>Detection limit</b>	0.5 - 0.8 ng/mL for a 0.5 mL serum sample

### Polybrominated Diphenyl Ethers (PBDEs)

<b>Compounds</b>	Br2-DPE-7, Br2-DPE-8/11, Br2-DPE-10, Br2-DPE-12/13, Br2-DPE-15, Br3-DPE-17/25, Br3-DPE-28/33, Br3-DPE-30, Br3-DPE-32, Br3-DPE-35, Br3-DPE-37, Br4-DPE-47, Br4-DPE-49, Br4-DPE-51, Br4-DPE-66, Br4-DPE-71, Br4-DPE-75, Br4-DPE-77, Br4-DPE-79, Br5-DPE-85, Br5-DPE-99, Br5-DPE-100, Br5-DPE-105, Br5-DPE-116, Br5-DPE-119/120, Br5-DPE-126, Br6-DPE-128, Br6-DPE-138/166, Br6-DPE-140, Br6-DPE-153, Br6-DPE-154, Br6-DPE-155, Br7-DPE-181, Br7-DPE-183, Br7-DPE-190, Br8-DPE-203, Br9-DPE-206, Br9-DPE-207, Br9-DPE-208, Br10-DPE-209
<b>Specimen</b>	Serum
<b>Specimen collection container</b>	5 x 10 ml glass red tops (vacutainers)
<b>Specimen collection</b>	Collect blood in glass vacutainer tubes that do not contain any anti-coagulant (red top usually); only take what is a safe amount for the individual. Retain a single vacutainer unused and sealed to send with the shipment. Clot at room temperature for 60 minutes. Centrifuge each vacutainer as soon as possible (same day) to separate the serum. Decant the serum into an amber glass vial topped with Teflon-lined lids.
<b>Storage temperature</b>	Store the serum refrigerated if you are sending within 24-48 hours, otherwise freeze as soon as possible.
<b>Shipping</b>	When shipping, place cooled or frozen samples UPRIGHT in the cooler with ice packs.
<b>Methodology</b>	High Resolution Gas Chromatography Mass Spectrometry (HR/GC/MS)
<b>Detection limit</b>	Congener 7 to 79, 99,100, 126, 138 to 203: 0.167 pg/g Congener 85: 0.176 pg/g Congener 105,128: 0.225 pg/g Congener 116: 0.313 pg/g Congener119 and 120: 0.177 pg/g Congener 206 to 208: 1.00 Congener 209: 10.0