PREVENTING OCCUPATIONAL AND ENVIRONMENTAL CANCER

A Strategy for Toronto

Background Paper
prepared by the
Occupational and Environmental Carcinogens Working Groups

for the
Toronto Cancer Prevention Coalition
May, 2001

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*The views and ideas expressed herein are those of the Occupational and Environmental Working Group of the Toronto Cancer Prevention Coalition and do not necessarily reflect the views or policies of any of the above mentioned participating agencies.*
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Executive Summary

We are all now exposed to a wide variety of cancer-causing substances in the workplace and the environment on a daily basis. Yet this is not inevitable. By combining a scientific approach grounded in the precautionary principle with smart public policies designed to prevent pollution, we can promote health and prevent cancer in a comprehensive, integrated and sustainable way.

Linking the Workplace and the Environment

Since so many environmental carcinogens (cancer-causing substances) originate in the workplace and are then emitted into the air, water or land, replacing these hazardous materials with cleaner products and processes will protect the health of both workers and the surrounding community. In recognition of this fact, the Environmental and Occupational Working Groups of the Toronto Cancer Prevention Coalition are presenting a joint report.

Linking environmental and occupational factors allows us to address the full life cycle of these hazardous substances. A life cycle approach encompasses three stages: manufacture (when workers can be exposed to high levels of carcinogens and when factories emit large quantities into the local environment); use (when the general population can be exposed to these toxins in the air, water and soil); and disposal (when carcinogens escape containment to contaminate the surrounding area and/or become pervasive in the environment).

It is common sense to be concerned that substances, known to cause cancer in adults after higher exposures at work, may cause cancer in children at much lower levels when those exposures are occurring from the moment of conception.

Pollution prevention strategies which eliminate carcinogens at the source are the logical public policy response to such a life cycle analysis, since the current system of attempting to regulate the use, release and disposal of known and suspected carcinogens – rather than preventing their creation in the first place – has proven ineffective.

Citizens of Toronto are exposed to a wide variety of carcinogens in their workplaces, neighbourhoods and homes. Eight substances with clear evidence of negative health effects and widespread exposure in Toronto (benzene, diesel exhaust, polycyclic aromatic hydrocarbons, perchloroethylene, dioxins, pesticides, methylene chloride and asbestos) are highlighted in this report. These, however, represent only a few of the substances of concern to working group members. The creation of a Toronto Exposure Profile has been identified as an important area for future work.
Principal Findings of the Report

The principal findings of this research include:

- Evidence indicates that environmental and occupational factors are important contributors to causing and/or promoting the growth of cancerous tumours.
- People who live and work in Toronto are regularly exposed to a wide variety of known and suspected carcinogens.
- Children are particularly vulnerable to low-level exposures to carcinogens in the environment.
- Workers can face greater exposures to many carcinogens. Recent immigrants are particularly vulnerable to hazardous conditions.
- These exposures are preventable.

We find that preventing exposure to environmental and occupational carcinogens has not been a priority for cancer policy. The decision to allow untested chemicals free access to our bodies, until they are finally proven to be carcinogenic, displays a disregard for human life. A new approach to gathering and assessing scientific data, based on the precautionary principle and weight of evidence, should be adopted as a means of enabling policy-makers to better protect public health.

Cancer agencies, alongside provincial and federal Environment, Health and Labour ministries must take concrete steps to identify and prevent cancer from occupational and environmental factors through regulation, programs, and funding for further research. Preventing exposure to carcinogens will also have a wide variety of other health benefits due to resulting reductions in exposures to toxic substances.

Since the publication of the Report of the Ontario Task Force on the Primary Prevention of Cancer in 1995, a number of advances have been made. These include:

- A better scientific understanding of environmental and occupational factors which cause or promote cancer.
- The Ontario government’s commitment to reducing its Occupational Exposure Limits for many of the substances of concern to the Environmental and Occupational Working Groups.
- The City of Toronto’s decision to phase out the use of pesticides on municipal property.
- The preparation of an Environmental Plan for Toronto by the City’s Environmental Task Force which complements and reinforces the measures recommended in this report.
- Greater community awareness regarding the health benefits, including the primary prevention of cancer, of reducing exposure to toxic substances in the environment and the workplace.

In spite of this work, there are still a number of challenges ahead. Future work in this area should be guided by the following core principles:

**The Precautionary Principle**: When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically. This means that we need to: take action in the face of uncertainty; place the burden of proof of harm on the proponents of the activity instead of the potential victims; explore alternative to possibly reduce harmful actions before allowing activities; and use democratic processes to carry out and enforce this principle.

**The Weight of Evidence Approach**: The weight of evidence approach should be applied when assessing the health risks associated with a product or an activity. It therefore takes into
account the combined results of many kinds of research investigating harm or the potential harm to living organisms to reach a conclusion on the need for action. Conclusions about the risks posed by a contaminant are based on data collected from laboratory animal studies, wildlife studies, human epidemiological studies, studies of more subtle effects on humans from chronic low-level exposures, clinical evidence, and socio-economic data and research.

**Pollution Prevention:** It is cheaper and more effective to prevent environmental and human health damage than to attempt to manage or cure it. Prevention requires examining the entire life cycle of products, from raw-material extraction to ultimate disposal. It encourages the exploration of safer alternatives and the development of cleaner products, technologies and workplaces.

**Just Transition:** Workers and communities have the right to choose both economic security and a healthy environment for themselves, their families and future generations. A healthy environment is of benefit to all and is a precondition to long-term employment security as, in the long run, environmental protection and rehabilitation will produce more and safer jobs. The costs of the transition to more environmentally and socially sustainable livelihoods should not, however, be borne disproportionately by workers in affected industries.

**Community Right to Know:** Community members, workers and consumers have a right to know about the environmental and occupational risks that they are being exposed to, and to participate in making the decisions that affect their health. Access to information through right to know mechanisms and involvement in decision-making, coupled with power and resources, will help ensure democratic control.

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**Implementing an Environmental and Occupational Cancer Prevention Strategy in Toronto**

The City of Toronto has both a duty and the capacity to act to reduce cancers from environmental and occupational factors. The Environmental and Occupational Carcinogens Working Group has made a number of detailed recommendations to the city of Toronto to improve primary prevention of cancer from environmental and occupational sources. These recommendations can be summarized as follows:

1. The City of Toronto should adopt and apply, to all City policies and activities, the precautionary principle, the weight of evidence approach, pollution prevention, the community’s right to know, and just transition to protect jobs as industrial processes are changed. The City should also advocate for their adoption and application by governments and community partners at the federal and provincial levels.

2. The City of Toronto, through the City Solicitor and with input from the Medical Officer of Health, should develop and implement a Community Right To Know bylaw as adopted by City Council in the Environmental Plan in 2000 and report on its development and implementation by the end of 2001. At the same time, the City should encourage other levels of government to develop right to know resources for the public.

3. The City of Toronto should develop a process to support the phase-out of the use and/or release of the eight chemicals — benzene, diesel exhaust, polycyclic aromatic hydrocarbons,
perchloroethylene, dioxins, methylene chloride, asbestos, and pesticides. The City should prepare a specific plan for this purpose by the end of 2001, with clear priorities, steps and timelines.

4. The City of Toronto should be a model employer and demonstrate leadership in cancer prevention by directing its joint health and safety committee(s) to prepare targets and timelines for identifying and eliminating the City’s use and/or release of suspected carcinogens in the workplace.

5. The City of Toronto should: (a) call upon the Ministry of Labour to develop regulations that require the mandatory examination of substitutes for workplace carcinogens; and (b) advocate to the federal and provincial governments for the elimination of carcinogens from our environment.

6. The City of Toronto should encourage Cancer Care Ontario and other relevant agencies and levels of government: (a) to develop appropriate mechanisms for monitoring exposures to occupational and environmental carcinogens; and (b) to educate health professionals and the public about these exposures.

For further information on this report or the Environmental and Occupational Working Groups, contact the Toronto Environmental Alliance, (416) 596-0660, or the Occupational Health Clinic for Ontario Workers, (416) 449-0009.
Introduction

The tragedy of benzene is that it has taken so long for science to be translated into protective action. Many thousands of workers and other persons in nations around the world have suffered unnecessarily and died prematurely while regulatory agencies, industry and the courts debated the carcinogenicity of benzene and argued about the need for protective regulation. In the current era of global proliferation of toxic chemicals and hazardous technologies, all who are involved in the production and use of benzene have a heavy responsibility and a duty to protect their workers and the general public against this highly toxic and carcinogenic compound. The debate over whether benzene is carcinogenic has long since ended, and controversy about the need to protect humans against benzene must not continue.

— Dr. Philip Landrigan
Chair of Community Medicine at Mount Sinai Hospital, New York
Editor-in-Chief, American Journal of Industrial Medicine

Dr. Landrigan’s words regarding benzene apply to the toxic substances of concern to the environmental and occupational working group of the Toronto Cancer Prevention Coalition. A new approach is required to avoid repeating the cycle of unnecessary suffering and premature deaths resulting from exposure to hazardous substances such as benzene, tobacco smoke or asbestos. Currently, substances are assumed to be harmless until ‘proven’ otherwise. In the interest of protecting our health, we must adopt an approach rooted in the right to a clean and safe environment in the workplace and the community.

It is common sense to be concerned that substances, known to cause cancer in adults after higher exposures at work, may cause cancer in children at much lower levels when those exposures are occurring from the moment of conception.

The decision of the occupational and environmental working groups to develop a common position came out of four key insights. First, control of agents known to cause cancer in humans should start at the source, using the methods of pollution prevention. Secondly, workers are often exposed to much higher levels of the same carcinogens that are released into the community. Thirdly, the current system of regulating the use and release of known and suspected carcinogens has been ineffective. Finally, the past neglect of occupational and environmental factors in cancer policy in Ontario has resulted in many missed opportunities for primary prevention.

For too long those concerned about preventing occupational cancer and those
concerned with environmental sources have operated separately and without regard for each others insights despite the fact that these carcinogens are often the same or come from the same source. By working together, we believe the links in the chain of responsibility from source to disease can be made much clearer and the prospect for success to reduce and prevent exposure to these carcinogens becomes stronger.

Prevent Pollution at the Source

First, pollution prevention should start at the source, hazardous, or potentially hazardous, substances with which the environmental and occupational working groups are concerned, largely originate in the workplace. Workers are thus exposed to the highest concentrations of these hazardous substances, which are then released into the air, water or land where they affect the whole community.

Linking environmental and occupational factors allows us to address the full life cycle of these hazardous substances. A life cycle approach encompasses three stages: manufacture (when workers can be exposed to high levels of carcinogens and when factories and energy sources often emit large quantities into the local environment); product use (when the general population can be exposed to these toxic substances in the air, water and soil); and disposal (when many carcinogens can escape containment to contaminate the surrounding area or become pervasive in the environment).

If we can change the processes and materials we use to manufacture goods and services, to eliminate carcinogens at source, we will protect the health of both workers and the surrounding community.

In particular, we will be able to protect the most vulnerable members of that community, our children. Children whose bodies and immune systems are still developing are particularly vulnerable, as are girls at puberty, individuals with genetic predispositions, women in their reproductive years and those with significant prior exposures.

Disproportionate Risks

Secondly, there is a basic issue of equity. We do not all bear equal risks when carcinogens are allowed to circulate within our environment. Workers who work with carcinogens are exposed to higher levels, as are those who live near hazardous waste dumps or incinicators. In Toronto, people of colour and recent immigrants are at greatest risk of ending up in the city’s dirtiest workplaces with less access to institutions which protect workers’ health, such as unions and the Workplace Hazardous Materials Information System. There is evidence that individuals who have low incomes or are of minority status, suffer relatively greater health effects from exposure to environmental contaminants because of where they live and work. (Haynes 1997).

Ontario’s Cancer Prevention Blueprint 2000 from Cancer Care Ontario suggests that occupation only accounts for five per cent of all cancers based on The Harvard Report on Cancer Prevention, 1996. This percentage was taken by the Harvard group from a controversial 1981 study by Doll and Peto which has been disputed many times by authorities in occupational health as an underestimate. Neither Harvard or Cancer Care Ontario acknowledged that Doll and Peto also stated that in men 15 per cent of lung cancer and 10 per cent each of skin and bladder cancer are occupationally caused.

Dr. Philip Landrigan in a 1996 editorial in the American Cancer Society Journal, states that estimates for the fraction of cancer deaths caused by occupational exposures vary from four per cent to over 20 per cent due to the lack of data on the carcinogenic potential of most industrial chemicals and the absence of
effective public health surveillance systems for occupational disease. He suggests that a reasonable lower estimate for the fraction of American cancer deaths caused by occupational exposure appears to be 10 per cent. Even this estimate does not take into account that many people have minimal or no exposure to toxic workplace chemicals, suggesting that a relatively small group of industrial workers bear a very heavy burden of cancer from occupational exposures that are preventable. Averaging the unexposed population in with the exposed group obscures the heavy toll that occupational cancer takes on a specific population of exposed workers.

**Current Regulation versus Prevention**

Thirdly, the working groups are convinced that the current system of regulating the use, release and disposal of known and suspected carcinogens — rather than preventing their generation in the first place — has been used to legitimize continuing exposures. Both working groups are concerned that current pollution control regulation fails to protect public health by not addressing the need to eliminate the production and use of carcinogens. Allowing untested or minimally tested chemicals free access to our bodies, until the time they are definitively proven to be carcinogenic, shows disregard for human life.

**Need for Occupational & Environmental Factors in Cancer Policy**

Finally, both working groups are concerned that past neglect of occupational and environmental factors in cancer policy in Ontario has meant that we have missed many important opportunities for primary prevention. In many jurisdictions in North America and Europe, occupational and environmental factors are an integral part of both research and administration for cancer prevention and management. In many countries the introduction of potentially hazardous substances or processes into workplaces requires a thorough review prior to approval.

Effective cancer prevention requires profound changes in deeply ingrained personal habits, in the business practices of some of our largest corporations, and in the operations of small family businesses. Yet prevention remains, from the perspective of both societal and personal costs, the most cost-effective and humane policy response available to us today.

Any cancer prevention strategy must inform people as to what they can do as individuals to reduce their exposures to cancer-causing agents or activities. It must also, however, provide them with the information and tools required to act collectively to reduce their exposure to carcinogens in their workplace and their environment. If we are to approach cancer prevention in a comprehensive, integrated and sustainable way, we must address all sources of cancer and our approach must include strong public policies that promote health, prevent cancer and protect the most vulnerable members of our society.

To this end, and building on the work of the Ontario Task Force on the Primary Prevention of Cancer, the environmental and occupational working groups of the Toronto Cancer Prevention Coalition propose that cancer prevention requires community empowerment and collective action by governments, unions, environmental and human health groups, and other citizen organizations.

This does not, however, imply that the provincial and federal governments can or should abandon their responsibilities for protecting public health. The federal and provincial governments have regulatory authority over occupational and environmental legislation, right to know...
mechanisms, and research requirements. All levels of government and private industry continue to bear, in Dr. Landrigan’s words, “a heavy responsibility and a duty to protect their workers and the general public.” Action must be taken at all levels and by all sectors of society.

**Wider Benefits to Human Health**

Many carcinogens are known to cause other health problems in addition to cancer. Action to reduce these carcinogens will reduce the burden of ill health in other ways as well.
The Need for Action: Environmental and Occupational Sources of Cancer

Rising Cancer Rates: the Links to Environmental and Occupational Carcinogens

Given the large number of substances of concern to the environmental and occupational working groups and the relatively limited specific and synergistic data which is available on the health effects of these agents, this report cannot provide a comprehensive scientific review of environmental and occupational carcinogens. Rather, we build on the work of the Ontario Task Force on the Primary Prevention of Cancer through a summary of what is known about the health effects of some of these substances and exposures to them in Toronto, a preliminary review of some of the more recent research, and an analysis of how scientific information (or the lack thereof) is translated into public policy.

The number of people suffering from cancer in Ontario and elsewhere in the industrialized world has increased dramatically since the ‘chemical revolution’ in the 1940s and 1950s. Even when we correct for the aging of the population, the incidence of cancer in the United States rose 49.3 per cent between 1950 and 1991. The figures for Ontario are only available for the last 30 years, but once corrected for the aging of the population, they still show an overall increase of 18 per cent for women and 31 per cent for men. Increases in specific cancers are even higher. Breast cancer in women has increased 29 per cent, non-Hodgkin’s lymphoma by 106 per cent, brain cancer by 56 per cent and multiple myeloma by 60 per cent. For men, prostate cancer has risen by 102 per cent, testis cancer by 65 per cent, non-Hodgkin’s lymphoma by 115 per cent, brain cancer by 35 per cent and multiple myeloma by 79 per cent (Schabas 1999, 43).

In the largest study ever conducted among twins (almost 90,000) Scandinavian researchers reported in the New England Journal of Medicine (Lichtenstein et al 2000) that twins developed the same cancer only about 10 per cent of the time. This clearly suggests that 90 per cent of cancer comes not from pre-programmed genes but rather from the conditions and exposures we encounter through our lives. Some cancers such as cervical and uterine showed minimal hereditary genetic component while prostate and colorectal cancers had a higher hereditary genetic component. Meantime a mechanistic approach would suggest that it is the response of genetic material...
to the environment that initiates cancer; we can modify our environment, we cannot change our genes.

The Commission for Environmental Co-operation, the intergovernmental agency created as part of the North American Free Trade Agreement, ranks Ontario as the second worst polluter amongst all Canadian provinces and U.S. states. According to the most recent National Pollutant Release Inventory published by Environment Canada, over 250,000 tonnes of pollutants were released into the air, water and land in Canada in 1997; of this 15,560 tonnes were known or suspected carcinogens. As discussed below, this data significantly underestimates the extent of toxic releases in Canada because relatively few sources have to report on their emissions.

There are many gaps in our knowledge of the causes of cancer, but we do already know a great deal about cancer risks in the workplace. There are many researchers and government agencies working in this area, but the most authoritative source is the International Agency for Research on Cancer (IARC), a division of the World Health Organization. It began a research program in 1971 which relies on international working groups of scientists who are experts in the particular area under investigation. The IARC scientific review process is extremely rigorous.¹ The working groups analyze information from animal studies, other relevant biological data and case reports and epidemiological studies of humans, to determine the cancer risk from various substances and occupations. IARC will be the principal authority cited in this report.

A major concern is that medical research, reflects male presumptions, crucial in the context of primary prevention in females. Most of the thousands of approved chemicals have not been evaluated for their effects on breast development, pregnancy, lactation, hormonal cycles and menopause. Nor have their synergistic effects been examined in view of the likelihood that breast and other cancers arise from multiple factors.

Evidence clearly shows that industrialized countries have higher rates of cancer than do countries with lower levels of exposure to chemical and nuclear contaminants (Kogevinas, Boffetta and Pearce 1994). This difference cannot be explained by genetics, since cancer rates among immigrants will eventually mirror those of their new country. According to IARC, “The most important single conclusion to derive from migrant studies is that, for a group as a whole, it is the new ‘environment’ that determines cancer risk and not the hereditary genetic component associated with the ethnic stock of the migrants.” (Tomatis et al. 1990, 48).

We also know that fish in North America are experiencing increasing cancer rates and that the distribution of these cancer trends tends to be geographically clustered around areas of environmental contamination (Harshberger and Clark 1990). In addition, beluga whales in the highly polluted St. Lawrence river have high rates of bladder, stomach, intestinal, salivary gland, breast and ovarian cancer, while their cousins in the relatively pristine Atlantic ocean are largely cancer-free (Steingraber 1998, 131-138).

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¹ “Tell me, does the St. Lawrence beluga drink too much alcohol and does the St. Lawrence beluga smoke too much and does the St. Lawrence beluga have a bad diet? Is that why the beluga whales are ill? Do you think you are somehow immune and that it is only the beluga whale that is being affected?” — Leone Pippard (1990)
Dying for a Living: Preventable Workplace Exposures Killing Thousands of Ontarians

If we accept Cancer Care Ontario’s historical estimate that nine per cent of cancers in Ontario are a result of workplace exposures — and many members of the environmental and occupational working groups feel that this underestimates the problem — then 2,079 working people died prematurely in 1998 as a result of their exposures to cancer-causing substances at work (Ontario Federation of Labour 1999).

Yet the Ontario Workplace Safety and Insurance Board (WSIB) allowed a total of only 119 fatal claims for all diseases in 1998. This represents a major shifting of the costs of occupational disease from the private sector, which underwrites the cost of the WSIB, to the public health system financed through taxation. To overcome these challenges, we will need educational programs on occupational and environmental cancer risks for the medical community and in the general population. Cancer Care Ontario’s Surveillance Unit will also need to collect occupational and environmental data and case histories much more systematically so that these factors are made ‘visible’ within our cancer registries.

Public policy must also recognize that occupational cancers are not evenly distributed throughout the population. Even if we accept the lowest of estimates for cancers caused by occupational factors within the overall population (four per cent), and consider only that section of the adult population which is exposed to high levels of known carcinogens in the workplace, then the proportion of four per cent in the overall population rises to about 20 per cent among those exposed (Pearce, Boffetta and Kogevinas 1998). That is, even under the most conservative estimate for occupational cancer, one fifth of cancer amongst manual workers in mining, agricultural and industry is due to workplace exposures.

Most of the known carcinogens were first identified by occupational physicians or workers; occupational epidemiological studies subsequently demonstrated the link. There are limits to what we can determine based on epidemiology. Of the 24 substances that IARC has identified as causing lung cancer, all but tobacco were based on the high number of deaths of workers exposed to these substances.

As of 1995, IARC had identified 22 chemicals, groups of chemicals or mixtures as known human carcinogens (IARC Group 1) and for which exposures are mostly occupational, without considering pesticides and drugs (Table 1). Since 1995, dioxin and crystalline silica have been added to the list of known carcinogens.

An additional 20 agents are classified as probably carcinogenic to humans (IARC group 2A, found in Table 2); three additional chemicals have been added to this list based on post-1995 reassessments. There are 93 chemicals or mixtures classified as possible carcinogens.
human carcinogens (IARC group 2B; not shown here due to space constraints). Occupational and environmental exposures also occur during the production and use of some pesticides and drugs and during the nuclear fuel process.

Aside from these substance-specific risk factors, there are 39 occupations which are recognized as presenting a carcinogenic risk. These include occupations such as chemical workers, pesticide manufacturers, dye manufacturers and users, roofers and asphalt workers, insulators and pipe coverers, cabinet makers, leather workers, workers in the rubber industry, agricultural workers, miners and metalworkers, and painters. For some occupations, the exact cause of the higher cancer rates is still unknown.

The important issue from a public health perspective is that exposure to these substances is largely preventable through government regulation and improvements in indus-

Table 1
Chemicals, groups of chemicals or mixtures for which exposures are mostly occupational (excluding pesticides and drugs): Group 1 — Carcinogenic to humans. ¹

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<thead>
<tr>
<th>Exposure ²</th>
<th>Human target organ(s)</th>
<th>Main industry/use</th>
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<tbody>
<tr>
<td>4-Aminobiphenyl [92-67-1]</td>
<td>Bladder</td>
<td>Rubber manufacture</td>
</tr>
<tr>
<td>Arsenic [7440-38-2] and arsenic compounds ³</td>
<td>Lung, skin</td>
<td>Glass, metals, pesticides</td>
</tr>
<tr>
<td>Asbestos [1332-21-4]</td>
<td>Lung, pleura, peritoneum</td>
<td>Insulation, filter material, textiles</td>
</tr>
<tr>
<td>Benzene [71-43-2]</td>
<td>Leukaemia</td>
<td>Solvent, fuel</td>
</tr>
<tr>
<td>Benzidine [92-87-5]</td>
<td>Bladder</td>
<td>Dye/pigment manufacture, laboratory agent</td>
</tr>
<tr>
<td>Beryllium [92-87-5] and beryllium compounds</td>
<td>Lung</td>
<td>Aerospace industry/metal</td>
</tr>
<tr>
<td>Bis(chloromethyl) ether [542-88-11]</td>
<td>Lung</td>
<td>Chemical intermediate/by-product</td>
</tr>
<tr>
<td>Chloromethyl methyl ether [107-30-2] (technical grade)</td>
<td>Lung</td>
<td>Chemical intermediate/by-product</td>
</tr>
<tr>
<td>Cadmium [7440-43-9] and cadmium compounds</td>
<td>Lung</td>
<td>Chemical intermediate/by-product</td>
</tr>
<tr>
<td>Chromium(VI) compounds</td>
<td>Nasal cavity, lung</td>
<td>Dye/pigment manufacture</td>
</tr>
<tr>
<td>Coal-tar pitches [65996-93-2]</td>
<td>Skin, lung, bladder</td>
<td>Metal plating, dye/pigment manufacture</td>
</tr>
<tr>
<td>Coal-tars [8007-45-2]</td>
<td>Skin</td>
<td>Building material, electrodes</td>
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<tr>
<td>Ethylene oxide [75-21-8]</td>
<td>Leukaemia</td>
<td>Chemical intermediate, sterilant</td>
</tr>
<tr>
<td>Mineral oils, untreated and mildly treated</td>
<td>Skin</td>
<td>Lubricants</td>
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<tr>
<td>Mustard gas (sulphur mustard) [505-60-2]</td>
<td>Pharynx, lung</td>
<td>War gas</td>
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<tr>
<td>2-Naphthylamine [91-59-8]</td>
<td>Bladder</td>
<td>Dye/pigment manufacture</td>
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<tr>
<td>Nickel compounds</td>
<td>Nasal cavity, lung</td>
<td>Metallurgy, alloys, catalyst</td>
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<tr>
<td>Shale-oils [68308-34-9]</td>
<td>Skin</td>
<td>Lubricants, fuels</td>
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<td>Soots</td>
<td>Skin</td>
<td>Pigments</td>
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<tr>
<td>Talc containing asbestiform fibres</td>
<td>Lung</td>
<td>Paper, paints</td>
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<tr>
<td>Vinyl chloride [75-01-4]</td>
<td>Liver, lung, blood vessels</td>
<td>Plastics, monomer</td>
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<tr>
<td>Wood dust</td>
<td>Nasal cavity</td>
<td>Wood industry</td>
</tr>
</tbody>
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¹ Evaluated in the IARC Monographs, Volumes 1-63 (1972-1995) (excluding pesticides and drugs).
² Number in square brackets is CAS Registry No.
³ This evaluation applies to the group of chemicals as a whole and not necessarily to all individual chemicals within the group.

trial hygiene practices (Pearce and Matos, 1994).

Moreover, these carcinogens do not stay in the workplace, but escape into the environment and affect the broader community through emissions from manufacturing processes, use of chemicals and disposal of waste products.

**Toronto’s Eight Most “Notorious” Carcinogens in Our Air, Water, Earth and Workplaces**

Citizens of Toronto are exposed to a wide variety of carcinogens in their workplaces, neighbourhoods and homes. For example, recent studies of air-borne toxic substances in Toronto found levels of polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons, and certain types of organochlorines to be between 20 and 60 times higher in downtown Toronto relative to rural levels (Diamond et al. 1999; Gingrich 1999).

It is important to note, however, that in many cases we don’t know many of the carcinogens Torontonians are being exposed to, how much, and how. Easy access to information on actual or potential chemical exposures and their health effects has been a powerful tool for forcing clean-ups of polluting industries and areas in the United States. The right to know is a valuable tool for promoting pollution prevention (House of Commons Standing Committee on Environment and Sustainable Development 1995, 215-216). Ways to expand and entrench right to know mechanisms for Toronto are explored below.

Given the large number of known and suspected carcinogens, as well as the many substances which have never been tested, our report focuses on only a few substances that we believe are particularly significant in Toronto as examples. The Working Group selected the following eight substances because of their notoriety, that is, 1) their carcinogenicity is as well established as tobacco; 2) there is widespread exposure to these carcinogens in throughout the GTA; and 3) many workers and residents are exposed to sufficient amounts of these carcinogens to represent a substantial health concern.

The substances can be divided into three broad groups: (1) **Products of the Transportation Combustion Processes** (benzene, diesel exhaust, PAH’s), (2) **Commercial/Consumer Products** (methylene chloride, perchloroethylene, asbestos, dioxins and (3) **Pesticides** (Pesticides)

(1) **TRANSPORTATION**

**Benzene**

Benzene occurs naturally in petroleum but when lead was banned from gasoline, additional benzene was put in some gasoline as an anti-knock additive. It is also used as a solvent for other petrochemicals (e.g. paint) and as a raw material for certain plastics, foams and pesticides. Benzene is known to have killed many workers and is commonly present in Toronto’s ambient air at levels which are of concern. Benzene is recognized by the International Agency for Research on Cancer as a known human carcinogen (IARC 1990). It is toxic to bone marrow, altering the cells of the marrow which produce white blood cells. Exposure to benzene causes leukaemia and has been linked to multiple myeloma and other cancers. As noted in the quotation from Dr. Landrigan which opened this report, benzene has long been known to be carcinogenic. In response to mounting scientific evidence, the Occupational Safety and Health Administration (OSHA) of the U.S. Department of Labour attempted to lower the permissible exposure limit in 1977 from 10 parts per million to one part per million, but a court battle launched by the American Petroleum Institute delayed implementation until 1987. Government scientists estimate that
this delay resulted in 275 to 1,100 excess deaths in the U.S. and a cost of millions of dollars to the health care system (Moure-Eraso and Tsongas 1990). For workers in the oil and chemical industries, exposure to benzene can occur in the workplace. Fire-fighters face elevated exposure to benzene, as it is one of the most common contaminants in the smoke from fires. IARC also recognizes service station attendants as having high rates of leukaemia and lymphoma due to benzene exposure from evaporating gasoline. A recent Ontario Workplace Safety and Insurance Appeals Tribunal granted entitlement to workers compensation benefits for the pre-leukaemic condition of myelodysplastic syndrome to a worker who had been exposed to benzene as a gas station attendant.

According to the most recent National Pollutant Release Inventory, 1,141 tonnes of benzene were released into the environment in Ontario in 1997. In spite of the fact that this makes benzene releases the second highest amongst all substances designated as “toxic” under the Canadian Environmental Protection Act (behind dichloromethane), this still grossly underestimates total emissions. It fails to

Table 2
Chemicals, groups of chemicals or mixtures for which exposures are mostly occupational (excluding pesticides and drugs):
Group 2A — Probably carcinogenic to humans.¹

<table>
<thead>
<tr>
<th>Exposure¹</th>
<th>Suspected human target organ(s)</th>
<th>Main industry/use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acrylonitrile [107-13-1]</td>
<td>Lung, prostate, lymphoma</td>
<td>Plastics, rubber, textiles, monomer</td>
</tr>
<tr>
<td>Benzidine-based dyes</td>
<td>—</td>
<td>Paper, leather, textile dyes</td>
</tr>
<tr>
<td>1, 3-Butadiene [106-99-0]</td>
<td>Leukaemia, lymphoma</td>
<td>Plastics, rubber, monomer</td>
</tr>
<tr>
<td>p-Chloro-o-toluidine [95-69-2] and its strong acid salts</td>
<td>Bladder, lymphoma</td>
<td>Dye/pigment manufacture, textiles</td>
</tr>
<tr>
<td>Creosotes [8001-58-9]</td>
<td>Skin</td>
<td>Wood preservation</td>
</tr>
<tr>
<td>Diethyl sulphate [64-67-5]</td>
<td>—</td>
<td>Chemical intermediate</td>
</tr>
<tr>
<td>Dimethylcarbamoyl chloride [79-44-7]</td>
<td>—</td>
<td>Chemical intermediate</td>
</tr>
<tr>
<td>Dimethy sulphate [77-78-1]</td>
<td>—</td>
<td>Chemical intermediate</td>
</tr>
<tr>
<td>Epichlorhydrin [106-89-8]</td>
<td>—</td>
<td>Plastics/resins monomer</td>
</tr>
<tr>
<td>Ethylene dibromide [106-93-4]</td>
<td>—</td>
<td>Chemical intermediate, fumigant, fuels</td>
</tr>
<tr>
<td>Formaldehyde [50-0-0]</td>
<td>Nasopharynx</td>
<td>Plastics, textiles, laboratory agent</td>
</tr>
<tr>
<td>4, 4’-Methylene- bis- 2-chloroaniline (MOCA) [101-14-4]</td>
<td>Bladder</td>
<td>Rubber manufacture</td>
</tr>
<tr>
<td>Polychlorinated biphenyls [1336-36-3]</td>
<td>Liver, bile ducts, leukaemia, lymphoma</td>
<td>Electrical components</td>
</tr>
<tr>
<td>Silica [14808-60-7], crystalline</td>
<td>Lung</td>
<td>Stone cutting, mining, glass, paper</td>
</tr>
<tr>
<td>Styrene oxide [96-09-3]</td>
<td>—</td>
<td>Plastics, chemical intermediate</td>
</tr>
<tr>
<td>Tetrachloroethylene [127-18-4]</td>
<td>Oesophagus, lymphoma</td>
<td>Solvent, dry cleaning</td>
</tr>
<tr>
<td>Trichloroethylene [79-01-6]</td>
<td>Liver, lymphoma</td>
<td>Solvent, dry cleaning, metal</td>
</tr>
<tr>
<td>Tris (2,3-dibromopropyl phosphate [126-72-7])</td>
<td>—</td>
<td>Plastics, textiles, flame retardant</td>
</tr>
<tr>
<td>Vinyl bromide [593-60-2]</td>
<td>—</td>
<td>Plastics, textiles, monomer</td>
</tr>
<tr>
<td>Vinyl fluoride [75-02-5]</td>
<td>—</td>
<td>Chemical intermediate</td>
</tr>
</tbody>
</table>

¹ Evaluated in the IARC Monographs, Volumes 1-63 (1972-1995) (excluding pesticides and drugs).
² Number in square brackets is CAS Registry No.

account for releases from tailpipes or the evaporation of gasoline which account for approximately 80 per cent of benzene releases and which make up the principal route of exposure for most residents of Ontario.

Benzene is of particular concern because of the exposure levels encountered on a chronic basis. The U.S. EPA estimates that in a population of 1 million people, 2.2 to 7.8 cases of cancer may result from a lifetime exposure to benzene levels of 1 ug/m³. Sampling conducted by Environment Canada indicates that daily benzene levels in Toronto’s air range from 1.3 to 2.8 ug/m³ while the maximum levels range from 4.3 to 77 ug/m³ (Environment Canada, 1999b).

In other words, residents in Toronto can be exposed to benzene in their air on a daily basis at levels that the U.S. EPA calculates as sufficient to cause cancer. Neither the federal, nor the provincial government has ever established an air quality standard for benzene. Many believe that standards have not been set because of the public alarm that could be created by establishing a health based standard that is so much lower than exposures that are common in most urban centres in Canada.

Diesel Exhaust

Diesel exhaust is another carcinogen to which we are all unwillingly exposed. There is extensive literature on diesel exhaust, based on over 40 epidemiological studies and numerous chronic animal toxicity studies. The National Institute for Occupational Safety and Health (1988), the International Agency for Research on Cancer (1989), the International Programme on Chemical Safety (1996), the California Environmental Protection Agency (1998) and the U.S. Department of Health and Human Services (National Toxicology Program, 1998) have all concluded that diesel exhaust should be regarded as a potential or probable human carcinogen. The Canadian mining industry is supporting an intensive multi-year research program into reducing exposure to diesel exhaust underground.

Diesel is used in some workplaces to provide electrical power from generators, but the principle source for most Toronto residents’ exposure is exhaust from diesel-powered vehicles. Toronto Transit Commission employees, taxi and truck drivers, and workers in shipping and handling areas where diesel vehicles idle face particularly high rates of exposure.

Polycyclic Aromatic Hydrocarbons (PAHs)

Polycyclic aromatic hydrocarbons (PAHs) are toxic by-products
of combustion that are pervasive in our environment. While few people in the general public have ever heard of PAHs, there are few, if any of us, who have escaped exposure to them. PAHs are chemicals that are released as by-products whenever fuels such as oil, gasoline, coal and wood are burned. In urban centres such as Toronto, major sources of PAHs include emissions from vehicles, coal-fired generating stations, municipal incinerators, home heating, and industrial furnaces (Simeck et al. 1997). Workers in foundries, in aluminum or coke production, in petroleum refining or engaged in the production and use of asphalt are exposed to high concentrations of PAHs and have excess risks for cancers of the oesophagus, pancreas, prostate gland and lungs (Nadon et al. 1995). Because PAHs always occur as mixtures, it is difficult for epidemiological studies to assess their individual carcinogenic effects on humans. However this chemical family includes 10 different substances, such as benzo[a]pyrene, which are listed as probable or potential human carcinogens. PAHs are not only absorbed into the body by breathing, but can be absorbed through the skin or ingested.

According to the Scientific Criteria Document for Multi-media Standards Development for Polycyclic Aromatic Hydrocarbons (PAHs) produced by the Ontario Ministry of Environment and Energy in February 1997: “PAHs are recognized to be one of the most important groups of environmental pollutants, not only because of the potency of some PAHs and the potency of some complex mixtures which contain them, but also because of the numerous natural and man-made sources which contribute to their ubiquitous presence in the environment. As such, PAHs are on a number of lists of priority pollutants including the MOEE Candidate Substances for Bans, Hazardous Air Pollutants under the US Clean Air Act.”

The principal route of exposure for Toronto residents to PAHs would be in the ambient air, although workers in poorly ventilated areas where fossil fuels are being burned would be exposed to elevated levels. Motor vehicle manufacturers, roofers and asphalt workers are all recognized by IARC as having elevated cancer risks due to high PAH exposures.

(2) COMMERCIAL/CONSUMER PRODUCTS

Perchloroethylene

Perchloroethylene, commonly called perc, but also known as tetrachloroethylene, is a substance used in numerous workplaces that may present a hazard to neighbours and to consumers. It is the chemical most frequently used in dry cleaning establishments. Identified as a probable human carcinogen by IARC, it is associated with cancers of the oesophagus and lymphoma.

Perc is a volatile chemical that causes public health concerns for a variety of reasons. First of all, because perc is used in its vapour or gaseous form to clean clothes, workers in dry cleaning establishments can be heavily exposed (Walker et al. 1997). Secondly, because dry cleaners are often located in multi-use buildings such as apartment buildings and malls, there are many opportunities for
members of the public to be exposed when vapours are not properly contained and/or vented (NYSDEC/DOH 1993). Thirdly, almost all of the perc that is used in dry cleaning establishments escapes directly into the air. This explains why perc is commonly detected in Toronto’s air. Fourth, consumers who have their clothes dry cleaned can be exposed to low levels of perc that off-gas from their clothes (Cantin 1992).

The principal source for perc is the 3,300 dry cleaning establishments in Canada that use 5,500,000 kilograms annually, i.e. half of the total amount used in Canada. Other industries use perc as a metal degreaser and a chemical intermediate. The federal government organized a consultation on dry cleaning in 1994-95 which resulted in recommendations for reducing the use of perc and promoting alternatives to it, but these recommendations have yet to be acted upon (Federal Commissioner of Environment and Sustainable Development 1999, 4-18).

**Dioxins**

Dioxins are persistent and toxic by-products that most, if not all, of us have in our bodies because of contamination of our food supply. Dioxins are among the few substances recognized as a known human carcinogen which raises the risk of cancer at all sites, rather than a specific type of cancer. In 1997, the International Agency for Research on Cancer re-categorized dioxin as a known human carcinogen based on the most recent evidence (IARC 1997). Extensive research has also linked pre- and post-natal exposure to dioxin to hormonal, developmental and reproductive impairment in humans (Colborn et al. 1997). The term dioxins refers to a whole class of toxic compounds which are thought to affect health in similar ways, although the most potent form is a compound called 2,3,7,8-tetrachlorodibenzo-p-dioxin-TCDD. Dioxins are pervasive in the environment, persistent (it lasts for a long time), and accumulates in body fat so that very low-level daily exposures can result in a significant accumulation in human bodies and wildlife.

Dioxins are a by-product of the manufacture and/or burning of chlorinated compounds such as those contained in PVC plastics or chlorine-bleached paper. Municipal and medical solid waste incinerators are the largest source of dioxins released into the air in Canada (Environment Canada 1999a). Ontario’s other major sources of dioxin are steel manufacturing (specifically iron sintering and electric arc furnaces), residential wood burning and diesel fuel combustion. All of these sources exist within or near Toronto. There are also a number of companies in Toronto active in the plastics industry which can be a source of dioxins. Industrial fires such as the 1997 Plastimet fire in Hamilton can also produce large quantities of dioxin. Firefighters, workers in the plastics industry and those who work in incinerators may face elevated exposure to dioxins.

Our newborns, particularly those breast feeding, are receiving unsafe levels of dioxins each day in Great Lakes cities like Toronto. Health Canada has established a Tolerable Daily Intake (TDI) of 10 pg/kg bw/day for dioxins and furans. In the Great Lakes basin, the average daily intake

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**In its Public Health Analysis on emissions from dry cleaning facilities, the New York State Department of Health states:**

“The exposure of people living or working close to operating dry cleaning facilities is a major public health concern”

(NYSDEC/DOH 1993)
for breast-fed infants under six months of age is 57.05 pg/kg bw and 12.56 pg/kg bw for non-breast-fed infants (Health Canada, 1998).

To effectively eliminate dioxins requires phasing out the use of chlorine as an industrial feedstock, as recommended by the 1995 Ontario Task Force on the Primary Prevention of Cancer. Oakland, San Francisco and Berkeley city councils have passed comprehensive dioxins resolutions calling for the phase out of chlorinated chemicals as well as industrial processes which produce dioxins. The City of Toronto’s Environmentally Responsible Procurement Policy offers the opportunity to phase out the use of chlorine-containing products and services.

**Methylene Chloride**

Methylene chloride is a hazardous substance commonly found in the ambient air that is experiencing a revival in some workplaces because of the phase-out of ozone-depleting solvents. Also known as dichloromethane, it can be absorbed through the skin and the lungs. It can produce neurological and respiratory effects and has been classified as a possible human carcinogen by IARC, as a probable human carcinogen by the U.S. EPA and has been determined to be toxic under the Canadian Environmental Protection Act. It is also known to cross the placenta and can affect a child in the womb.

Methylene chloride’s primary uses are in food, furniture and plastics processing, paint removing and degreasing. The greatest exposure in the occupational setting is from its use as a blowing agent in the production of plastic foam blocks. Methylene chloride use is increasing in foam manufacturing because it serves as a substitute for HCFC (hydrogenated chlorofluorocarbons) which is being phased out due to its role in depleting the ozone layer. A 1996 Environment Canada report indicated that carbon diox-

ide injection is a process which can be used to eliminate the use of both methylene chloride and HCFC as a blowing agent in the foam industry. With respect to its use as a cleaner and degreaser, there are a host of effective, non-toxic alternatives currently being promoted by the Canadian Centre for Pollution Prevention.

In 1994, seven of the top 10 companies releasing methylene chloride to the environment were in the Greater Toronto region. As of 1999, according to the National Pollutants Release Inventory, there were still over 779,000 kilograms of methylene chloride released in Toronto alone.

**Asbestos**

Asbestos is an example of a substance that has killed many workers and their family members because action was taken too slowly on health concerns that were identified. IARC classifies asbestos as a known human carcinogen for its role in causing mesothelioma, a cancer of the lungs. It is a naturally occurring mineral that was used to manufacture a wide range of products such as asbestos cement products, fire retardant textiles, paper, brake linings, floor tiles, additives for asphalt, resins, plastics and sealants. Asbestos was once widely used for building insulation and is still found in many buildings in Toronto.

The Johns-Manville plant in Scarborough, which manufactured asbestos-cement pipe from 1948 to 1980, was declared a “world class occupational health disaster” by the Royal Commission on Matters of Health Arising from the Use of Asbestos in Ontario, 1984. A consistent failure to enforce Ministry of Labour Directives at the Holmes Caposite plant in Sarnia resulted in a six-fold increase in lung cancer amongst Holmes workers, an 11-fold increase in respiratory disease mortality and a four-fold excess in all malignancies that have only been recognized in the past few
years because of the activities of the Occupational Health Clinics for Ontario Workers. The families of Holmes workers are also being diagnosed with mesothelioma from exposure to asbestos which was brought home in the worker’s clothes.

Asbestos is still a problem in Toronto, as construction and maintenance workers can be exposed to it while working in older buildings with asbestos insulation, including some Toronto schools. The highest exposures to asbestos occur when asbestos is improperly removed from buildings. Medical experts have predicted that there will be another wave of asbestos-related cancers in 15 to 25 years as a result of the improper asbestos-removal practices of many companies.

The case of asbestos illustrates how corporate and government knowledge of harm does not automatically lead to preventive action. It also illustrates the importance of the public’s right to know about occupational and environmental hazards, so that they can apply pressure where the political will to enforce regulations is lacking.

(3) PESTICIDES

Pesticides are chemicals commonly applied to indoor and outdoor environments. Over 7,000 pesticide products are registered for agricultural, commercial and household applications. The generic term pesticide as used here includes insecticides, herbicides and fungicides designed to kill insects, plants, and micro organisms such as fungus. There is strong scientific evidence linking pesticides to health effects such as cancer, abnormalities in physical development, reproductive effects, neurotoxic effects, immune system suppression and disruption of the endocrine (hormone) system (see summary in Toronto Public Health 1998). Some pesticides are persistent (they stay in the environment for a long period of time, particularly indoors) and bio-accumulative (they become concentrated as they move through the food chain).

“With pesticides, there is sufficient evidence to warrant concern about potential health impacts, and there are sufficient gaps in our knowledge to warrant caution in our use of them. The range and nature of the health effects that have been suggested for pesticides and the size of the population potentially exposed, demand action on the City’s part to significantly reduce the use of pesticides.”

(Toronto Public Health, 1998)

Recent evidence includes a 1999 Swedish study which found that the 400 patients with non-Hodgkin’s lymphoma were 60 per cent more likely to report exposures to herbicides and three times more likely to report exposures to fungicides when compared to 800 control subjects (Hardell and Erikson 1999). The incidence of non-Hodgkin’s lymphoma has more than doubled in Canada in the last 30 years. An important study from Denmark, following more than 7,700 women from 1976 until 1993, found that residues in the blood of the persistent organochlorine pesticide dieldrin were associated with an increased risk of breast cancer that was dose-related, and with more aggressive forms of breast cancer (Hoyer et al. 1998).

People can be exposed to pesticides by inhalation, ingestion, or absorption through the skin. Those who work with pesticides in the pesticide manufacturing industry, farmers, agricultural and greenhouse
workers, pesticide applicators, golf course workers, veterinarians, etc. clearly have the highest exposure to pesticides. Environmental exposure to pesticides can occur from eating pesticide contaminated food, drift from nearby applications, and the use of pesticides in homes, gardens, lawns and public spaces. As discussed below, there is strong scientific evidence that children are particularly vulnerable to environmental exposures to pesticides.

Sampling conducted in Toronto in 1998 found six different pesticides in either or both the Don and Humber rivers, indicating that pesticides used on lawns, gardens and agricultural crops in and around Toronto are entering the larger ecosystem. A 1990 survey of pesticide use in the former City of Toronto suggested that one half of residents used some form of pest control in their homes (Toronto Public Health 1999, 24).

**Protecting the Most Vulnerable: The Case of Recent Immigrants in Toronto**

We have relatively little data on the extent and routes of exposure to carcinogens in Toronto. Anecdotal evidence, however, suggests that recent immigrants work in some of the “dirtiest” workplaces in the city where exposure to carcinogens may be routine. These include jobs such as dry cleaning (perchloroethylene), construction and maintenance (asbestos), machine and mechanics shops (benzene, PAHs, metal degreasers), driving taxi, and shipping and receiving (diesel), etc. Due to linguistic and socio-economic barriers, recent immigrants often have less access to institutions for protecting workers’ health, such as unions and less ability to make use of the Workplace Hazardous Materials Information System.

According to the Science Advisory Board of the International Joint Commission (Science Advisory Board 1999, 6-7), the urban poor, Native Americans and ethnic groups such as Vietnamese immigrants are amongst the groups which “continue to be exposed, primarily through the consumption of Great Lakes fish, to levels of persistent toxic substances sufficient to cause adverse health effects.”

Recent immigrants and the urban poor are also more likely to live in poorer quality housing where toxic chemicals are used to control cockroaches, mice and other pests. Even the conservative American Conference of Governmental Industrial Hygienists in their introduction to the Threshold Limit Values for Chemical Substances states that “individuals may also be hypersusceptible or otherwise unusually responsive to some industrial chemicals because of genetic factors, age, personal habits, medication or previous exposures.” They also note that the exposure values are not for “use by countries whose working conditions or cultures differ from those in the United States of America and where substances and processes differ.” Implicit in this statement are issues of adequate diet, housing and medical care.

The creation of a Toronto Exposure Profile, which assesses the extent and routes of exposures of Toronto’s citizens to carcinogens, is an important area for future work identified by the Occupational and Environmental Working Groups of the Toronto Cancer Prevention Coalition. A Toronto Exposure Profile would help to determine which groups in the City are most exposed to carcinogens and how this exposure occurs. This would be an important first step towards reducing and ultimately eliminating these exposures.

Given the unique needs of Toronto’s diverse multicultural population, cancer prevention programs must take into account the cultural and socio-economic characteristics of the City, and develop appropriate regulatory, educational and public involvement programs.
The Need for Action: Rising Rates of Childhood Cancer

The increase in childhood cancer is particularly alarming. Cancer rates among Canadian children less than 15 years in age have increased by about 25 per cent in the last 25 years, with the highest rates among children who are less than five years of age (NCIC 1995). Cancer is now the second major cause of death for children after accidents. The cause of this increase is still uncertain, but there is a strong possibility that it is linked to environmental factors.

“The lifestyle of toddlers has not changed much over the past half century. Young children do not smoke, drink alcohol or hold stressful jobs. Children do however, receive a greater dose of whatever chemicals are in the air, food and water because, pound for pound, they breathe, eat, and drink more than adults do” (Steingraber 1998, 39).

One of the terrible truths of environmental carcinogens is that breast-feeding infants are at the top of the food-chain. Contaminants such as PCBs and dioxins are concentrated in body fat and particularly in breast milk, so the child receives a large share of the accumulated toxic substances in the mother’s body. By 1976, 99 per cent of breast milk sampled in the United States was found to contain PCBs, and roughly one quarter contained levels so high that it would have been illegal to be bottled and sold in a store (Steingraber 1998, 238). Fortunately levels have declined since the 1970s due to banning or regulatory restrictions imposed on some contaminants. However the decline appears to have levelled off and new action is required. The health benefits of breast-feeding still outweigh the disadvantages, but to even have to compare the benefits of breast-feeding versus bottle feeding, in other words to weigh the known risks of infectious diseases against the possible risks of childhood or adult cancers, is completely unacceptable. We should have a right to a clean environment and uncontaminated breast milk.

An elevated cancer risk has been associated with preconceptual or prenatal exposure to certain chemicals such as chlordane, heptachlor and nitrosamines and with the parental occupations including motor vehicle driver, mechanic, machinist, painter, farmer or miner. Animal experiments have demonstrated an elevated cancer risk with preconceptual or prenatal exposure to a variety of chemicals such as benzo[a]pyrene (a component of polycyclic aromatic hydrocarbons), vinyl chloride, DDT and 3,3’-dichlorobenzidine (Frazier and Hage 1998, 320).

While there is still a great deal of research required in this area, an emerging concern relates to the capacity of certain chemicals, such as dioxins and other organochlorines, which are present in the body of the mother, to disrupt the immune system.
and reproductive systems of the developing foetus and breast-feeding infants at very low doses. These doses are similar to levels currently found in the human population (Colborn et al. 1997, 120). Classes of herbicides, fungicides, insecticides, nematocides, and industrial chemicals, such as dioxins, PCBs and other chlorinated chemicals, such as octylphenol or bisphenol A, may bind to estrogen or other hormone receptors, either imitating the action of the hormone or blocking its activity. By interfering with the normal functioning of receptors, these chemicals can disturb the growth and development of the exposed organism. Other chemicals, i.e. some phthalate esters, glycol ethers and “peroxisome proliferators,” appear to be endocrine disruptors by indirectly altering steroid hormone activity at a post receptor site of action (National Institute for Environmental Health Sciences 1999a).

Possible human health effects of these agents include breast cancer and endometriosis in women, testicular and prostate cancers in men, abnormal sexual development, reduced male fertility, alteration in pituitary and thyroid gland functions, immune suppression, and neurobehavioural effects (Environmental Protection Agency 1997, vii). For many years, the focus of research has been on disruptions of normal endocrine function of adults. However more recent research has started to focus on the hypothesis that adverse effects of endocrine disrupting chemicals can be caused by exposure to relatively small doses during a unique window of vulnerability for the foetus during development, with subsequent adverse effects that may not be detectable until much later in life (National Institute for Environmental Health Sciences 1999b).

Children’s rapidly growing bodies are particularly vulnerable to low-level exposures to environmental toxic substances. They also often have much higher relative or absolute exposures to environmental carcinogens than do adult males, whose bodies serve as the model for regulators setting exposure limits. In addition, children can be unintentionally exposed to occupational carcinogens brought home in their parent’s clothes, hair, lungs or skin, as in the case of asbestos.

Canada is a signatory to the 1997 Declaration of the Environment Leaders of the Group of Eight on Children’s Environmental Health. In that declaration, Canada pledged to establish national policies regarding environmental hazards that “take into account the specific exposure pathways and dose-response characteristics of children when conducting environmental risk assessments and setting protective standards.” Action thus far has been minimal, leading public health advocates to call for governments to honour their commitments and take these factors into account in regulatory and standard-setting processes (Canadian Environmental Law Association and the Ontario College of Family Physicians, forthcoming).

“While promulgating carcinogen risk assessment guidelines that do not adequately address the special exposures, susceptibility, and vulnerability of infants and children would be ineffective and possibly harmful, i.e. conveying a false sense of protection, it can be further argued that it would violate basic notions of human rights. All persons have a right to health, including a safe environment and protection from exposures that may undermine their health. For infants and children, who cannot act on their own behalf, a special obligation is incurred.”
— Patricia A. Buffler and Amy D. Kyle
School of Public Health
University of California Berkeley (1999)
Positive Steps:
The Children’s Environmental Protection Act

A bill introduced in the U.S. Senate proposes to protect children by Acting with Caution. It proposes that all environmental and public health standards set by the U.S. Environmental Protection Agency “must, with an adequate margin of safety, protect children and other vulnerable subpopulations.” If data on children’s special susceptibilities or exposures are missing, an additional safety margin of at least 10-fold must be used. The bill addresses the exposure of children to pesticides in schools and day care facilities, the reporting of toxic chemicals of risk to children, the review of standards to protect children, the establishment of a Children’s Health Protection Advisory Committee, and new research programs on the health effects and toxicity of environmental contaminants on children.

In the proposed bill, the EPA is directed to: 1) develop a list of “safer for children” products and substances recommended by the agency; 2) develop a list of environmental pollutants commonly used in areas that are reasonably accessible to children and that offer them “known or likely health risks”; 3) establish guidelines to reduce and eliminate children’s exposure to environmental pollutants, including advice on establishing integrated pest management programs; 4) create a “family right to know information kit” and widely disseminate this information; and 5) update the lists in 1 and 2 above annually.

Children and Pesticides

The case of children’s exposure to pesticides is instructive (for more detail, see Cooper, Keenan and Vanderlinden 1999). Pesticides are of particular concern because they are among the few inherently toxic materials that are routinely introduced to spaces inhabited by children (Toronto Public Health 1998). Pesticides are used in homes, apartment buildings, day care facilities, schools, parks, on family pets, and sometimes on children’s bodies. Generally speaking children are more susceptible than adults to the toxic effects of chemicals because their bodies are still developing. For example, human newborns are more susceptible to chlorpyrifos, an insecticide commonly used on lawns and in homes, because they have very low concentrations of the enzyme needed to detoxify it in their bodies (Grossman 1995).

Children, particularly younger children, can be exposed to greater quantities of pesticides than adults in the general population because of their size and behaviour (Toronto Public Health 1998). Children spend more time near to, on the ground and floor than adults, so they have more skin contact with, and potentially more opportunity to inhale, pesticides that are applied to lawns or which settle or accumulate on floors. In addition, young children can experience greater exposure from ingestion because they put their hands and other items in their mouths more often than adults (Lowenherz 1997). In one study of exposure to pesticide residues in a house treated for fleas, it was determined that a child playing on the floor could absorb four to six times as much pesticide as an adult by inhalation and 30 times as much pesticide by absorption through the skin (Hoar Zalm 1997).

Urban children of low income families are an additional group at risk of exposure to pesticides. Living in poor neighbourhoods and poorer quality...
homes that may have cockroach or rodent problems raises concerns that children of low income families are more likely to be exposed to pesticides applied in their homes and surroundings. Pesticide residues persist much longer indoors than outdoors, where sunlight, flowing water and soil microbes help to break them down. Some researchers now believe that infants and toddlers experience significant exposure to pesticides by crawling on carpets and ingesting house dust and that this may be linked to childhood cancer (e.g. Davis et al. 1993; Leiss and Savitz 1995).

A recent report by Daniels and colleagues (1997) analysed the results of 31 previous studies examining the association between pesticide exposure and incidence of various childhood cancers. Despite significant problems with lack of standardization in the methods used in these studies, the authors conclude that there is reason to suspect pre-conceptual, prenatal and early childhood exposures to pesticides are associated with moderate increases in childhood brain tumours and leukaemias. Home use of pesticides appeared to account for the greatest risk of these cancers (Daniels et al. 1997; Leiss and Savitz 1995).

A large retrospective cohort study of Norwegian farm families has determined that there was increased risk of developing certain brain tumours, non-Hodgkin’s lymphoma, Wilm’s tumour and other cancers of infancy in farm children, associated with various proxy measures of parental exposure and use of pesticides (Kristensen et al. 1996).

“The sad message is that children’s health is being impacted because of our inadequate regulatory system, a system the federal government promised to fix as far back as 1994. Our study finds that the great majority of prior commitments remain unfulfilled. Canadians don’t really have a regulator. Rather, industry has a customer service department. The message is not only that children are being impacted by pesticides but that the federal government is knowingly refusing to act to make legislative changes and spend the necessary resources. What can be more important than the health of young Canadians?”

— Kathleen Cooper
senior researcher
Canadian Environmental Law Association

“Our study (Cooper, Keenan and Vanderlinden 1999) warns that every parent should be concerned about exposure of their children to pesticides. The potential for children’s health to be affected by pesticides is undeniable. Although more research needs to be done, this does not exonerate pesticides as human toxins, especially when one considers that children are far more vulnerable to pesticides than adults. Not only is there potential for harm, but in all likelihood some Canadian children are now enduring the negative effects of pesticides. We believe that the cumulative effects of being exposed to many different pesticides over a lifetime represents an unacceptable risk to all Canadian children.”

— Dr. Loren Vanderlinden
Environmental Health Committee
Ontario College of Family Physicians
Current State of Prevention

Background

Current Canadian environmental and occupational health legislation has long been recognized as limited in its ability to protect both human and environmental health. This is due partly to inappropriate and ambiguous language as well as a lack of resources, particularly evident in the current political climate, to administer and enforce this legislation. But perhaps the most glaring limitation of current legislation is its predominately reactive approach. Almost every mandated initiative in this area has made provisions for assessment, reporting and control of exposures and emissions but few provide measures to prevent pollution at the source.

The Canadian Environmental Protection Act (CEPA) and Ontario’s Regulation Controlling Exposure to Physical, Chemical and Biological Agents are two such examples. To some extent, the new CEPA attempts to address current legal shortfalls with a commitment, as prescribed in the Toxic Substances Management Policy, to reduce releases of the most dangerous toxic substances to a level below that which can be accurately measured. Interestingly, this legislation uses measurement as criteria to reduce levels of toxic substances rather than adverse impact on human and environmental health and assumes that levels below that which can be measured with some degree of sensitivity and reliability pose no harm to either. This assumption endangers human and environmental health.

The Regulation Controlling Exposure to Physical, Chemical and Biological Agents, made under Ontario’s Occupational Health and Safety Act, outlines maximum levels of particular agents to which workers can be exposed over specific periods of time. There is strong evidence to suggest that the majority of these exposure limits are not health based but derived from what is commonly being achieved in larger well established workplaces. At these levels, it is expected the majority will not experience short term health effects, such as irritation. Unfortunately, these levels may not prevent long term health effects. In addition, these have been established for young, healthy, fit males who may not be representative of the current workforce. Consequently, many workers have, and continue to suffer, negative health impacts both at and below what the government has prescribed as “safe” levels. In fact, for many of these substances, there are no safe levels of exposure.

Indeed, when it comes to gender, a scientific bias against female biology exists in the ways regulatory agencies review chemical substances for toxicity, relying on reports of exposure in chemical plants, an industry in which workers are overwhelmingly male, and perform lab tests using male rats and mice. Conclusions are drawn from such methods and presented as official doctrine that the levels of toxins in women’s bodies present little or no danger.

There have been several attempts by city and municipal governments across Canada and elsewhere to improve this situation, however, progress to date remains limited. Some have been successful in implementing pollution prevention policy and
programs designed to protect the local populace and the surrounding environment. In fact, the current trend, partly driven by provincial downloading in education and health, is toward community-based initiatives, where residents of local communities, with intimate knowledge of their particular problems are empowered to identify and adopt a solution best suited to meeting their specific needs.

Progress to Date

The City of Toronto has proven progressive on this front with development in 1988 of the Healthy Toronto initiative, adoption of the recommendations from the Ontario Primary Prevention of Cancer Task Force in 1995, and endorsement earlier this year of Toronto’s environmental plan, Clean, Green and Healthy Plan for a Sustainable Toronto.

The Healthy Toronto 2000 initiative empowered the Department of Health, through the Environmental Protection Office, to “challenge those in the city who produce, distribute and market known carcinogens” to ensure there was “no discharge of such chemicals into the community or the ecosystem.” To this end, the Department was charged with developing a comprehensive cancer prevention strategy that includes “minimizing the use of and exposure to toxic chemicals at work, at home, in schools and in the community.”

The Ontario Primary Prevention Task Force was struck in 1994 and mandated to advise the Minister of Health on an “action-based, effective and feasible plan for the primary prevention of cancer.” One of the most important recommendations of the Task Force involved use of the precautionary principle “as the only prudent approach to safeguarding the health of the public from known and suspected carcinogens” realizing that “no dose of a carcinogen can be deemed to be safe.” To this end, the Task Force proposed that those persistent, bio-concentrating toxic substances be addressed first through a number of actions including:

1. Integrating pollution prevention with industrial policy so that business modernization initiatives and research and technology assessment programs foster progress towards the objective of gradual elimination of these substances;
2. Adopting the most stringent standards for controlling environmental carcinogens as provided by member nations of the Organization for Economic Cooperation and Development; and,
3. Establishing realistic and measurable timetables for phasing out those substances that are known or suspected carcinogens.

Toronto’s environmental plan supports these previous initiatives by providing a concrete framework within which to move the city toward a more environmentally healthy and sustainable future. The plan advocates pollution prevention planning with “actions based on preventing, or at the very least, minimizing to the greatest extent possible, the release of pollutants into the environment.” The plan also recognizes the Community Right to Know or need of citizens to know the location, source and health effects of toxins in their communities.

Understanding that air, water and land free of pollutants is critical to the social, economic and environmental well being of this city is the first step — implementing the necessary changes to achieve these objectives is the second. The challenge now faced by the City of Toronto is to move from policy to practice. Fortunately, this task is not as daunting as it might first appear, as much has been accomplished by the city already and much can be learned from initiatives implemented by other jurisdictions, particularly when it comes to addressing occupational and environmental
cancerogens and in particular, the eight identified earlier in this report.

The Toronto City Council has made significant progress to date from a policy perspective in appreciating the importance of addressing citizen and community exposure to carcinogens. In many cases, recommendations put forth by both the Ontario Cancer Primary Prevention of Cancer Task Force support and/or converge with those proposed by the current Toronto Environmental Plan. For example, both reports:

1. Recognize the health risks posed by vehicle emissions and advocate a reduction in emissions from sources such as cars, trucks, motorcycles as well as lawn mowers, chainsaws and motor boats;
2. Support additional research on the development of alternative, environmentally sustainable fuels such as electric hybrids and hydrogen fuel cells;
3. Acknowledge the importance of citizen and worker right to know about occupational exposures and environmental releases. The Primary Prevention of Cancer Task Force support current endeavors in Ontario to reduce occupational exposure to carcinogens through workers’ right to know as secured by the Workplace Hazardous Materials Information System (WHMIS). The Toronto Environmental Plan encourages adoption of a Community Right to Know bylaw that would ensure residents know the location, sources and health effects of toxins in their communities;
4. Appreciate that effective public awareness and education initiatives are central to creating and maintaining the health of humans and the environment and that increased resources are required for public education campaigns and materials to support pollution prevention;
5. Recognize and support community action plans developed and implemented by multi-stakeholder groups in an effort to identify, assess and prevent exposure to and release of carcinogens in the workplace and the community; and
6. Support establishment of a Community Right to Know by-law, allowing citizens timely and appropriate access to critical information about chemical hazards in the community.

**Future Challenges**

**Carcinogens generated through transportation combustion**

Transportation is one of the largest generators of a number of carcinogens now found on a regular basis in Toronto’s ambient air. These include benzene, the 20 different carcinogens found in the gaseous and particulate fractions of diesel exhaust and polycyclic aromatic hydrocarbons (PAHs).

**Benzene**

The Analysis and Air Quality Division of the Environmental Protection Service of Environment Canada has measured levels of benzene in ambient air since 1989. Toronto city levels of benzene are considered high enough to compromise the respiratory health of some of its most vulnerable residents including the elderly and children. Automobile and truck exhaust, emissions at the fuel pump and evaporative gasoline fumes from commercial and residential garages account for the most substantial sources of benzene in urban centres.

By far the most comprehensive initiative established to date to reduce airborne emissions of benzene is the nation-wide standard for benzene emissions proposed in 1988 by the Canadian Council of Ministers for the Environment (CCME). Phase I of this program recommended, among others, a reduction in the percentage of
benzene added to gasoline at the source and vehicle emission testing, to identify and remove the most polluting vehicles from the road. Both initiatives have contributed to a decline in benzene emissions by close to 30 per cent since 1995. The new Environmental Protection Act also makes provisions for the development of regulations that will limit benzene in gasoline to a maximum of one per cent by volume. It is estimated that this initiative would reduce emissions of benzene from vehicles by approximately 20 per cent.

Another program forwarded by the CCME in an effort to reduce ambient air concentrations of volatile organic compounds, including benzene, are the Environmental Codes of Practice for the recovery of gasoline vapours during transfers in the distribution network (Stage I) and vehicle refueling at service stations (Stage II). In Canada, Stage I recovery systems, or recovery along the pipeline where gasoline is pumped and at the distribution centre where it is transferred from the pipeline to the tanker truck, are many years into operation and have proven successful in capturing gasoline vapours. With Stage II controls, or controls at the pump, a significant portion of vapours are recovered at the vehicle fill pipe by a vapour recovery nozzle and returned to the service station’s underground storage tank. For every 1,000 litres dispensed, approximately one to two litres of gasoline are recovered. Few stations currently have Stage II vapour recovery systems in place, partly because of the cost and difficulty of implementation, but also because there is currently no legal requirement to implement them. The federal government is in the process of drafting directives to assist the provinces and territories in adopting Stage II recovery systems, similar to those already in place in Australia, California and British Columbia.

A number of these initiatives have been captured in the list of actions to be taken as part of phase 1 of the Canada Wide Standard (CWS) for benzene that was agreed upon in 2000, and will become mandatory across the country. Others will be captured in discussions related to phase 2 of the CWS for benzene. The implementation of the new CWS for benzene may involve the development of multi-pollutant strategies for each industrial sector.

Other jurisdictions, closer to home have either drafted or passed anti-idling by-laws prohibiting the idling of personal or commercial vehicles for a pre-established period of time. While a small measure, such bylaws have proven effective, but only where there is consistent and effective enforcement.

Diesel Exhaust

In Ontario, the Regulation Respecting Control of Chemical and Biological Agents establishes a maximum exposure limit for diesel exhaust in the workplace. No similar legislation currently exists to protect residents from the greatest source of diesel exhaust — heavy and light duty trucks that travel our streets and highways.

Approximately 20 of the 40 constituents of diesel exhaust have been recognized as carcinogenic to humans. The majority of heavy and light duty trucks, transit buses, garbage trucks and law enforcement vehicles owned and operated by the City of Toronto use diesel fuel. And while some new purchases of the same are powered by cleaner natural gas, they remain in the minority. Diesel exhaust emitted from vehicles in the city’s fleet along with private commercial vehicles, significantly impact the quality of ambient air in and around the city. Toronto’s Board of Health has recently requested the Medical Officer of Health to investigate the health impacts associated with environmental exposure to diesel exhaust. The city need not wait, however, for a profile of this issue before taking decisive and protective
action. Many municipalities across Canada and the United States have completed comprehensive assessments of the same and much can be learned from both the evidence collected and the solutions implemented.

One of the most effective solutions implemented to date in an effort to address concerns associated with diesel exhaust has been use of alternative fuels by local transit authorities. Many have successfully introduced cleaner alternatives, predominately natural gas (CNG) into daily bus fleet operations with impressive improvements in air quality.

A recently released report entitled, *Bus Futures — New Technologies for Cleaner Cities*, completed by INFORM, a New York based non profit environmental research group, compared the major bus engine technologies and concluded that the only fully commercial buses available today are those based on conventional engines — fuelled by diesel or natural gas and of the two, natural gas powered buses emitted significantly fewer pollutants than their diesel counterparts — up to 86 per cent less particulate and many fewer toxins. Natural gas is also considered a good choice because natural gas fuelled vehicles can also be easily adapted to other transportation technologies, such as electric hybrids and fuel cells once these become economically viable.

Sixty-five transit agencies in the U.S. now operate natural gas buses and even more are committed to the purchase of this technology in future. The Los Angeles Metropolitan Transit Authority has the world’s largest CNG bus fleet. Early in 2000 it received its 1,000\(^{th}\) CNG bus with an additional 370 CNG buses on order for the next year, bringing the total fleet to 1,570 by 2001/2002. Still others have committed to hydrogen fuel cell technology with a small but growing number currently comprising the urban bus fleet in Vancouver, British Columbia and Chicago, Illinois. Yet other municipalities have applied the same technology in their refuse haulers or garbage trucks. One of the most successful ventures to date in this area occurred in Washington, D.C., in 1991 when a private waste company assumed operation of the town’s primary landfill and working with the federal government and a truck manufacturer, added natural gas powered trucks to its fleet. Currently, the fleet has seven liquefied natural gas refuse trucks. In 1992, New York City purchased six CNG garbage haulers with 10 more added since then.

With many of the Toronto Transit Commission’s diesel bus fleet deteriorating and costing millions of dollars a year to repair and maintain just to meet minimum operational and safety standards, perhaps the time is right to consider replacing those nearing the end of their life cycle with buses powered by cleaner alternative fuels and the necessary fuelling infrastructure. Movement away from diesel buses would certainly have a huge and positive impact on improving the ambient air quality and protecting human respiratory health in Toronto.

**Polycyclic Aromatic Hydrocarbons**

There is significant scientific evidence to indicate that the average city dweller is exposed to substantial levels of PAHs in ambient and indoor air. Spread over a large urban population, this level of PAH exposure carries a small but significant
risk of lung cancer. While residents may be exposed to the highest levels of PAHs when commuting, the greatest exposure occurs in indoor environments because that is where people spend the greatest number of hours each day. The level of PAHs in indoor environments reflects outdoor levels of PAHs, as well as sources such as wood stoves and smoking.

There is no legislation in Canada or Ontario that governs human exposure to or environmental release of the class of chemical compounds referred to as PAHs. PAHs are among the 44 substances listed on the Priority Substances List under CEPA, but there has been no specific regulation adopted as of yet to control PAHs in ambient air. It is believed that vehicle emission standards established under the Canada Transportation Act in 1997 that are directed at particulate matter may result in reduced emissions of PAHs as well because the controls for one may impact on the other.

A voluntary initiative co-managed by the federal government and industry entitled Accelerated Reduction/Elimination Toxins (ARET), started in 1993, saw participating companies from nine key industrial sectors and four federal departments reduce emissions of 117 toxic chemicals, including PAHs by close to 30 per cent from 1995 to 1996.

A similar initiative within the boundaries of Toronto, coupled with the use of cleaner, alternative fuel technology could substantially reduce the presence of cancer-causing PAHs in Toronto’s air.

Carcinogens Used as Commercial or Consumer Products

Perchloroethylene

While perchloroethylene is no longer produced in Canada it continues to be used extensively as a solvent in dry cleaning and metal cleaning operations throughout the country. Unfortunately, in both industries, more of the solvent escapes to the environment than is used in the cleaning task, hence, Toronto, along with other urban and industrialized centers, have constant concentrations of perchloroethylene in ambient air. There are many instances of perchloroethylene contaminants in soil and groundwater as well. In 1998, perchloroethylene was deemed “toxic” under CEPA because of its potential to harm the environment. Under CEPA, strategic options for the management of perchloroethylene have been developed for the dry cleaning and solvent degreasing industries, and regulations have been drafted for public consultation. These regulations are supposed to reduce the release of perchloroethylene by 65 per cent.

In 1995, a comprehensive study of the dry cleaning sector was done by Environment Canada in participation with the City of Toronto. This study found most facilities had in place adequate solvent recovery systems that limited the amount of solvent either spilled or evaporated but that not all machinery was well maintained or properly repaired, leading to leakage. Adoption of more stringent controls, such as those advocated by the CCME Environmental Code of Practice for the Reduction of Solvent Emissions from Dry Cleaning Facilities would reduce emissions by between 66 and 77 per cent.

Additional research was completed by the same group regarding possible alternatives including wet cleaning and hydrocarbon dry cleaning. It is estimated that approximately 45 per cent of clothes currently dry cleaned could be wet cleaned. In Germany, significant research and development by washing and drying machine manufacturers has allowed commercialization of wet cleaning techniques. In 1995, between 30 and 50 per cent of clothes cleaned at dry cleaning facilities were wet cleaned. Multi-process wet cleaning is now commercialized in New York with more facili-
ties being established annually in other states. Several establishments now operate in Chicago and Los Angeles. And while this process requires additional labour and is somewhat more expensive, these are not the barriers to wide spread use. It is the lack of facilities in local communities that bars residents from fully embracing this alternative. Of those facilities that currently exist in the city of Toronto, most are well used and are moving toward profitability.

To ensure perchloroethylene levels are at their lowest possible, Toronto could encourage all current and new establishments adhere to the Environmental Code of Practice for solvent recovery. To minimize human exposure to this chemical, Council could also consider by-laws prohibiting establishment of a solvent based dry cleaner in a location adjacent to residential living space, restaurants, food markets and other shops. Thirdly, the city could encourage, through future financial incentives, establishment of alternative cleaning operations that have less of an impact on human health and the environment.

Dioxins

Dioxins are one of a class of chemicals referred to as organochlorines in which chlorine is bound to different organic compounds. Other chemicals in this group include DDT, PCBs, chlorodane and hexachlorobenzene. Dioxin exposure from industrial sources continues to place Canadian citizens at significant risk of cancer, compromised immunological function and impaired estrogenic activity leading to birth defects and reproductive disorders. Environment Canada’s most recent inventory of emission confirms that incineration, and particularly, the burning of solid and medical waste, as the largest sector source of atmospheric dioxin releases. Canada-wide standards for dioxin emissions from these sources have been proposed by the CCME and are to be adopted in the spring of 2001. These standards will focus considerable scrutiny on Ontario’s aging stock of incinerators, particularly the estimated 56 facilities burning biomedical waste.

Eliminating releases of dioxins to the environment requires that all jurisdictions, including municipalities, reduce their reliance on products and services that produce dioxin. In recent years, Oakland, San Francisco and Berkeley city councils have passed resolutions aimed at preventing dioxin pollution. San Francisco’s 1998 resolution requires “dioxin pollution prevention practices to be part of all waste management and recycling activities” and to ensure that “less toxic, non-chlorinated, sustainable alternative products and processes such as chlorine-free paper and polyvinyl chloride (PVC)-free plastics are supported and used by the city.

Methylene Chloride

In 1990, methylene chloride was listed as a toxic air contaminant by California’s South Coast Air Quality Management District. The same year, the Environmental Protection Agency declared methylene chloride as a hazardous air contaminant in Title III of the Clean Air Act. Since these developments, use of methylene chloride has diminished sharply worldwide. Under CEPA, methylene chloride has been deemed “toxic” because of its potential to cause harm to human health and the environment.

In 1997, under Environment Canada’s Strategic Options Process (SOP), recommendations for the voluntary reduction of methylene chloride were published for the following applications: adhesives, aircraft depainting, paint stripping, cleaning, pharmaceutical and polyurethane foam manufacturing. These recommendations included specific emission reduction targets, based on projections of current use trends and
developed in consultation with industry and environmentalists, to be achieved over a five to 10 year period. At the time, these reduction targets did not apply to furniture refinishing and other stripping industries, but did require Environment Canada to develop work practice guidelines. Since then, a draft code of practice dated August 2000 has been prepared which includes recommendations for equipment and work practice changes to minimize exposures and releases to the environment. This code of practice refers to furniture refinishing and building restoration operations, auto body shops and commercial metal parts stripping facilities.

In September 2000, Environment Canada issued a call for companies importing or exporting methylene chloride or using 1,000 kilograms (2,200 pounds) or more of this solvent to provide information on their efforts to control releases of methylene chloride to the environment in the years 1998 and 1999. This information was to be submitted by the end of December 2000.

Increasing regulation and requirements to report such as these, coupled with mounting concerns regarding exposure to chemicals, have prompted several companies to initiate research into prospective safe alternatives. Industry has also investigated and instituted substitutes for methylene chloride in a number of processes.

This is particularly true in the United States. American Converters, based in Findley, Minnesota, specializes in fabricating foam components like packaging material and used methylene chloride based adhesives to join components. With the Occupational Safety and Health Administration lowering the exposure limit of methylene chloride to 24 parts per million, the company calculated that the capital outlay for application equipment and higher raw material costs of substitute adhesives would offset increased regulatory costs. And they were right. Use of a water-based adhesive, applied by spray gun for regular packaging, and a roller applied adhesive or hot melt, for parts with special configurations has saved the company money and protected workers against exposure to this potential carcinogen.

Similarly, an eyeglass manufacturer, also based in Minnesota, has recently replaced methylene chloride, used in its ultrasonic vapour degreaser to remove pitch and other contaminants from lenses, with a water based terpene solvent saving the company thousands of dollars in regulatory reporting and worker training requirements.

In protecting its citizens and the surrounding environment from unnecessary releases of methylene chloride, the city of Toronto could actively support Environment Canada’s code of practice for furniture and other stripping activities, requiring all such operations within city boundaries adhere or surpass to these guidelines within a specific time frame. Second, the city could also examine other means, such as financial incentives or positive publicity, to encourage companies to phase out the use of methylene chloride in their processes.

**Asbestos**

Asbestos has long been recognized as a potent human carcinogen, and while production of products containing asbestos fibers has been prohibited in Canada for several years, asbestos remains as a component in insulation and in cement in many of our community buildings, including schools, hospitals and libraries. The greatest potential for asbestos exposure today is not during manufacture, but during the repair and removal of asbestos products, and during the demolition of buildings in which asbestos products have been used.

In Ontario, there are two regulations,
established under the *Occupational Health and Safety Act*, more than a decade ago that govern worker exposure to asbestos fibres from particular products and operations. When asbestos removal is done without regard for the proper procedures however, there is the potential for significant exposure of both workers and members of the public.

To ensure its workers and its residents are knowledgeable about the hazards of asbestos and appropriate control measures, the city should investigate the ways in which the City might ensure that asbestos removal and repair are done in such a fashion that protects the health of workers and the public.

**Carcinogens Used as Pesticides**

There is no legislation either at the federal or provincial level that adequately protects human and environmental health from exposure to pesticides. Even proposed reforms to Canada’s pesticide law, requiring that more information be made available to the public about the health risks posed by chemicals in pesticides and the re-evaluation of certain chemical components of pesticides, do little to offer any concrete protection to adults, let alone the most vulnerable — pregnant women and children.

In fact, Canada’s pesticide legislation has not been changed substantially in more than 30 years with few of the pesticides used today ever having undergone extensive assessment for health risk. One positive outlined in the new reforms is recognition by the government of the precautionary principle and a proposal to either state the principle in the preamble or incorporate it in the legislation itself. Regardless, it appears obvious the focus remains on minimization of risk, rather than pesticide reduction or elimination, or better yet, use of alternate strategies to combat pests. The lack of progress is particularly distressing in light of a 1999 Standing Committee on the Environment report that called for stricter pesticide regulation.

Many municipalities in Canada, including the City of Toronto, have demonstrated much more foresight and for the most part, adopted integrated pest management (IPM) approaches, thereby reducing, if not eliminating most pesticide applications on City-owned parks, sports fields and road sides. In 1998, the City committed to phase out pesticides on city property. In the first year of the City’s pesticide reduction commitment, the Parks & Recreation Division reduced its use of pesticides by 97 per cent. And the City continues to explore further reductions in other departments.

Nepean City Council recently approved an integrated turf management program for city owned property, committing to a natural approach to managing pests with the intent of eliminating pesticide use altogether in future as has the Ottawa-Carlton municipal government.

But while pesticide use is on the decline on city and municipal properties, use on private and commercial spaces continues unabated. This includes both indoor and outdoor use, with applications typically occurring on a regular basis rather than in response to a particular problem.

Data on patterns of pesticide use and alternatives are critical for the purposes of developing public awareness, policy and programs. Canada is one of the few countries in the world that has yet to mandate the collection and dissemination of information on non-agricultural pesticide use. According to a 1990 survey completed by
the Public Health Department of the former City of Toronto, 50 per cent of residents used some form of pest control in their homes.

A 1991 Environment Canada study of pesticide applications to lawns in two urban subdivisions in Hamilton and Guelph found 66 per cent of lawns received a single application of pesticides every season. Homeowners that used lawn care companies tended to use more compounds and at a greater frequency than those that did not.

In response to increased awareness and evidence of the link between pesticides and cancer, municipalities have recently increased their public education programs and are giving serious consideration to by-laws that ban pesticide use on private property. All municipalities, including Toronto, that have adopted an integrated pest management program for city green space have also published detailed information on safe and healthy pesticide alternatives for home and business owners. For example, Toronto Public Health’s Roach Coach project produced a public information booklet and train-the-trainers resource guide designed to minimize the use of pesticide sprays used in the home to control cockroach infestations.

The Toronto Healthy Lawns is one such initiative that has distributed non-toxic strategies to creating a healthy residential lawn. This approach is supported by the Pest Management Regulatory Agency of Health Canada, who advocate a Healthy Lawns Strategy intended to reduce reliance on pesticide use for lawn care through the application of IPM principles, with a particular emphasis on pest prevention, the use of reduced risk products and the application of pesticides only when necessary.

Other municipalities have gone further and passed by-laws instituting a complete ban on pesticide use. The City of Hudson, Quebec has taken the lead in this area and is currently fighting a Supreme Court challenge by pesticide companies about the legality of its nine-year-old pesticide by-law. Regardless of the final decision, the City of Toronto should implement a more comprehensive and wide reaching media campaign communicating to residents the harm caused by pesticide use and the safe and economical alternatives. This initiative could be followed by a city wide ban on residential pesticide use in future.

Several jurisdictions in the United States have regulated the integrated pest management approach and report significant success with implementation supported by education. In New York State, IPM has proven easy, effective and economical in many different settings, including homes, schools, hospitals and offices. The United States General Services Administration has recently established a successful program for 30 million square feet of government office space in Washington, D.C. The New York State Office of General Services has banned pesticide spraying in more than 40 different use buildings. Local governments from Nassau to Erie Counties are doing the same.

As of 1995, Texas State legislation required all school districts to establish an IPM program. Through the Toxic Coalition Model Schools Program, schools in the Bainbridge Island, Mulkiteo and Olympia school districts in Washington, D.C. have adopted safer pest management policies that emphasize pest prevention, least toxic alternatives and the phase-out of those pesticides that can cause cancer, damage to the nervous system, disrupt the endocrine system or affect the reproductive system.

These successes, among others, clearly demonstrate, regardless of whether the legislated or non-legislated approach is taken, how it is both possible and practical for municipal governments to effectively manage pests and safeguard human health and the environment without use of chemical pesticides.
The Precautionary Principle and Weight of Evidence Approach

To move beyond the debate on assigning percentages to causes of cancer, we must start by recognizing that to do so is to ask the wrong question. There are three main reasons for re-thinking our understanding of cancer’s causes. First, there are the methodological limits of current scientific models for understanding occupational and environmental carcinogens. Secondly, there is the false assumption that causes are independent of one another. Thirdly, there is the replacement of the single cause model of cancer with an understanding of it as a multi-stage, multi-factorial disease. The implication of this new understanding of causation is that we should shift our approach to cancer prevention from one based exclusively on individual lifestyle choices to one which recognizes that public poisons require collective responses.

1. The methodological limits of current scientific models for understanding occupational and environmental carcinogens:

There is so much uncertainty and guess work involved in assigning percentages for various factors that the International Agency for Research on Cancer (Tomatis 1990, 6) has largely shied away from the whole exercise due to the “difficulty of quantifying accurately the portion of risk that can be attributed to exposure to environmental agents.” Even the authors of one of the studies which argued for lower percentages for environmental and occupational causes — and which perhaps inadvertently fuelled the anti-regulatory agenda of the Reagan and Bush administration in the U.S. — recognized that “important occupational hazards may quite possibly exist that have yet to be detected.

On present knowledge, it is impossible to make any precise estimate of the proportion of the cancers of today that might be attributable to hazards at work, let alone future cancers or determining the extent of industrial contribution in environmental causes of cancers.

There are some very real and pervasive limits to our understanding of occupational environmental carcinogens rooted in the two principle means employed to study them: epidemiology and toxicology. The Ontario Task Force on the Primary Prevention of Cancer identified three major limitations of epidemiol-

“The key question for cancer policy is not “What percentage of cancer can be attributed to factor X?” but “What percentage of cancer might be reduced by changing factor X?”

ogy with regard to environmental carcinogens. **Accuracy in exposure assessment:** Humans are exposed to an enormous variety of environmental pollutants on a daily basis in social contexts (poverty, workplace environment, unhealthy lifestyles) that create added health risks. Assessing the impact of these confounding exposures is difficult.

**Lack of control populations:** Everyone has detectable levels of known or suspected carcinogens in their bodies such as DDT, dioxins and PCBs. Therefore there are no ‘clean’ or unexposed control groups available for the purposes of comparison. Some analysts have argued, however, that the marked increase in cancer over the last century (even when corrected for the aging of the population) is evidence for the effect of ubiquitous contaminants.

**Core Principle: The Precautionary Principle**

When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically. This means that we need to: take action in the face of uncertainty; place the burden of proof of harm on the proponents of the activity instead of the potential victims; explore alternatives to possibly reduce harmful actions before taking action; and use democratic processes to carry out and enforce this principle.

**Epidemiology is good at revealing certain kinds of hazards and bad at revealing others:** Due to its methodological biases, epidemiological studies can most effectively identify strong carcinogens affecting large numbers of people. These tend to be lifestyle factors such as smoking, or clear-cut occupational hazards like asbestos and uranium mining. Low-grade occupational or toxic hazards, on the other hand, are “epidemiologically invisible” because the methodology is insensitive to individual carcinogens which raise risks by less than 30 per cent, and due to the way in which exposures tend to vary over time and space (Proctor 1995, 263).

**Absence of Clinical Data Results in Research bias:** Epidemiology’s research methodology not only makes it easier to prove lifestyle factors, but the success of epidemiology has meant that other research avenues are seldom funded or undertaken. In essence, clinical data on occupational and environmental histories (as opposed to whether or not a patient smokes or drinks) is currently not being gathered. As a result, we are left with “less of a clinical eye for unrecognized cancer hazards, especially from limited and localized exposures in the workplace” (Sellers 1997, 1824).

The limitations of toxicology were identified by the 1995 Task Force report as:

**Logistical considerations:** There is a dearth of toxicological data on the acute and chronic effects of over 80 per cent of the 45,000 to 100,000 chemicals in common use; data on chronic effects are especially limited.

**Lack of consensus on the validity of existing data:** Much of the existing data on the effects of toxic chemicals are disputed due to disa-
greements over interpretation of the high doses to which animals are exposed, the inter-species significance of the results, and the extrapolation/models/assumptions used to impute human health risks.

An additional limitation of both epidemiology and toxicology, from a public health perspective, is the type of conservatism embedded in their methodology and practice (Proctor 1995, 261). In epidemiology and toxicology, a substance is assumed to be “innocent” (non-harmful) unless it is proven to be “guilty” (cancer-causing). In order to guard against over-estimating hazards, epidemiology will not identify a substance as carcinogenic (even when exposure to the substance is consistently related to higher chances of getting a specific form of cancer) unless there is a 95 per cent (and in some cases 99 per cent) chance that the relationship is not a product of random chance. To attain this level of statistical certainty requires a large sample size, i.e. lots of dead bodies, which (thankfully) isn’t often achieved for specific substances and/or specific forms of cancer. We should not have to await tragedies on the level of the Holmes asbestos factory or the uranium miners at Elliot Lake before we take action.

Public health proponents generally place the burden of proof on those who want to introduce potentially harmful substances into our ecosystems and bodies. Conservatism in the context of promoting public health implies a measure of caution in exposing ourselves to a hazard, even if the magnitude of the risk is uncertain. This type of conservatism is embodied in the precautionary principle, which has been endorsed by many governments and organizations as a prudent response to acting in the midst of uncertainty.

Due to these limitations, many researchers and governmental agencies (including the Ontario Task Force on the Primary Prevention of Cancer and the International Joint Commission) are now calling on policy-makers to adopt an approach based on what is known as the weight of evidence as a means of operationalizing the precautionary principle.

“The need for more than cause-effect science does not mean abandonment of science... but it does require a willingness to act on an integrated body of evidence rather than to wait for irrefutable evidence of a cause-effect link.”

— Science Advisory Board of the International Joint Commission (1991)

2. Causes are not mutually exclusive:

The second reason for wanting to move beyond the debate on relative percentages is the fact that (outside of the laboratory) there are no clear-cut divisions between categories. For example, a high-fat diet is identified as a major contributor to cancer in the lifestyle category. Yet we know that synthetic toxic substances, many of which have been proven to cause cancer and thousands of which have never been tested, ‘bio-accumulate’ in fatty tissue (International Joint Commission 1992). This raises a question as
Core Principle: The Weight of Evidence Approach

The weight of evidence approach to human health risks from exposure to environmental contaminants recognizes the limitations of each branch of science. It therefore takes into account the combined results of many kinds of research investigating harm or the potential harm to living organisms to reach a conclusion on the need for action. Conclusions about the risks posed by a contaminant are based on data collected from laboratory animal studies, wildlife studies, human epidemiological studies, studies of more subtle effects on humans from chronic low-level exposures, clinical evidence, and socio-economic data and research.

to whether it is fat itself (i.e. an inappropriate diet) or the toxic substances which have been concentrated in the fat (i.e. environmental carcinogens), which cause cancer. The contemporary food system is heavily dependent upon synthetic fertilizers, insecticides, fungicides and herbicides. Many of these are known or suspected carcinogens but no lifestyle choice, not even eating only organic food, will enable a citizen of Toronto to avoid taking in these toxic substances because they are pervasive in our water, air and soil. Nor is purchasing organic food a choice which is equally accessible to all, given that lower income individuals may not be able to afford the higher costs currently associated with it.

Tritium, for example, is a radioactive isotope known to cause cancer and mutations and is emitted into the water and air by nuclear reactors. We receive chronic exposure to the organically bound tritium through the ingestion of plants and animals exposed in the effluent pathway, in addition to direct uptake through bathing in or drinking contaminated water.

Ultraviolet radiation from the sun is recognized as a major cause of skin cancer and sunbathing is often cited as a principal cause for the increase in melanoma. Yet the intensity of ultraviolet rays reaching the earth’s surface has increased due to environmental contaminants weakening the ozone layer (which absorbs ultraviolet). Furthermore, being out in the sun, particularly at midday when it is most dangerous, is not entirely a matter of choice for farmers, construction workers and other outside workers, who clearly face increased risks of skin cancer (IARC 1992). So is cancer from exposure to sunlight a lifestyle, environmental or occupational risk?

Smoking is recognized as a major risk factor for lung cancer and should be treated as a serious health issue. Nevertheless, cigarettes contain not only tobacco, but a cocktail of other carcinogenic substances which are sprayed on the crop or added during manufacturing. Furthermore, when smoking is combined with occupational exposures, such as exposure to asbestos, the risk factors are not simply added together, but multiply (Royal Commission on Matters of Health and Safety Arising from the Use of Asbestos in Ontario, 1984). Exposure to second-hand smoke can also be considered an environmental factor and to regulate it we need many of the same tools as for dealing with other toxic substances entering the public domain.

In short, the percentages game tends to define causes as physical substances (tobacco, dietary fat, sunlight, asbestos, dioxins, etc.) and ignores the social and ecological contexts in which we are, often unwillingly and/or
unknowingly, exposed to these risk factors. If we want to prevent cancer, we need to recognize how exposures and risk factors are interconnected and develop a more integrated and holistic policy approach to addressing each of these.

3. Cancer is a multi-stage, multi-factorial disease:

The third reason why the percentages debate is asking the wrong question about cancer, relates to our understanding of how the disease works. Scientists used to believe in the ‘single hit’ theory where a single source affecting a single cell eventually leads to cancer taking hold in the body (hence the earlier search for single causes which can be neatly divided in a pie chart). We now know that the development of the disease is a multi-stage process. The human body is equipped with a variety of protective mechanisms to fend off both mistakes in cell reproduction and carcinogens, but these can be sabotaged or overwhelmed by various means.

To become a full-blown malignancy, a cancer cell must pass through each of three stages: initiation, promotion and progression. During initiation, a cell is damaged (mutated), but is still likely to be removed or repaired by the body. Before an initiated cell becomes full-blown cancer, however, it must still be promoted by agents (such as radiation or chemicals) which interfere with the ordinary messages being transmitted back and forth between the cell and the body it inhabits so that it becomes an expanded cluster of abnormal cells. Progression, which again can be caused by radiation or certain chemicals, causes these abnormal cells to multiply uncontrollably, i.e. become a cancer. The whole process can take decades to be completed.

Thus, occupational and environmental exposures can increase the risk of developing cancer either by causing mutations in the cell’s DNA or by various “epigenetic” mechanisms of promotion (those not involving damage to the DNA), including increased cell proliferation. In recent years, there has been increasing interest in exposures (e.g. arsenic, and phenoxy herbicides) which do not appear to be mutagens, but which may act as promoters (Pearce, Boffetta and Kogevinas 1998). That is, some substances play a role at one of these stages while others, such as ionizing radiation, are “complete” carcinogens which can initiate, promote and stimulate the progression of cancer. Dioxins appear to act as promoters in low doses, but as complete carcinogens at higher doses. Others initiate at low doses, but promote and progress as their concentration in the body rises. In addition, workers exposed to low levels of mutagens in the environment may thus be more vulnerable to high level promoters in the workplace.

Other environmental pollutants may not be carcinogenic in themselves, but may facilitate a cancer’s development by suppressing the body’s immune system and thus its capacity to cleanse itself of cancerous cells. For example, a recent study found that chronic ozone exposure could lower blood antioxidant levels, which could increase the risk of acquiring cancer from other environmental hazards such as smoking (Saintot et al., 1999).

Endocrine disruptors (synthetic chemicals with imitate hormones or interfere with the various systems that regulate the body’s production and metabolism of natural hormones) have been shown to contribute to birth defects in wildlife and infertility in humans (Colborn et al. 1997). They may also, however, play a role in promoting cancer. According to the National Institute for Environmental Health Studies (1998) “Disruptions in the endocrine system and hormone levels it produces can lead to cancers and irregularities in the reproductive system. Some
scientists propose that hormones can induce cancers by directly altering genetic material (DNA) or can induce cancers indirectly through cellular activities. Many researchers think that hormone imbalance can lead to increased rates of cancers and reduced fertility.”

Evidence on the links between breast cancer and organochlorines has been contradictory and further research is required on the relationship between endocrine disruptors and testicular and prostate cancer (Environmental Protection Agency 1997, 30-32). A 1998 study did find a strong link between the pesticide dieldrin and breast cancer (Hoyer 1998). In Ontario, the incidence of testicular germ cell cancer increased by nearly 60 per cent between 1964 and 1996; the increase has been greatest in the youngest group (age 15 to 29). Candidate risk factors include age at puberty, which has declined among more recently born cohorts of men, and estrogen and estrogen-like substances, whose prevalence may have increased in the environment (Weir, Marrett and Moravan 1999).

This new biological understanding offers insight into appropriate public policy. First, similar exposures can pose very different degrees of danger to different people. It highlights the way in which carcinogens and other contaminants act in concert or cumulatively to increase the risk of cancer.

Thus as cancer historian, Neil Proctor observes, the key question for cancer policy is not “What percentage of cancer can be attributed to factor X?” but “What percentage of cancer might be reduced by changing factor X?” What is at stake is not a debate over numbers, but what it means to act prudently in the face of uncertainty. This includes implementing the precautionary principle through pollution prevention.

IMPLEMENTING POLLUTION PREVENTION

It has become clear that the pollution control approach pioneered in the 1970s has reached its limit and won’t be able to deliver a clean environment or healthy workplaces (Commoner 1990; Ontario Ministry of Environment and Energy 1993b). With the traditional pollution control approach, companies try to trap contaminants and wastes after they have been produced. This is limited for a number of reasons. First, not all pollutants can be captured completely. Second, even those that are partly captured need to be destroyed. Unfortunately, this is often impossible, so the collected pollutants need to be stored or disposed of and they often leak out into the environment. Third, the pollution control approach may simply transfer pollutants from one medium to another, such as from water to air. However, the contaminant is still present and able to do damage.

The pollution prevention approach does not suffer from these limitations. The Ontario Ministry of Environment and Energy has defined pollution prevention “as any action which reduces or eliminates the creation of pollutants or wastes at the source, achieved through activities which promote, encourage or require changes in the basic behavioural patterns of industrial commercial and institutional generators or individuals.”

Pollution prevention focuses on preventing the creation of the pollution in the first place, so that the problems of
Core Principle: Pollution Prevention

It is cheaper and more effective to prevent environmental and human health damage than to attempt to manage or cure it. Prevention requires examining the entire life cycle of products, from raw-material extraction to ultimate disposal. It encourages the exploration of safer alternatives and the development of cleaner products, technologies and workplaces. For example, prevention requires changes in processes and products — designing non-toxic products from materials that can be safely recycled or composted — in order to avoid the generation of waste that is incinerated.

capturing, transporting, disposing, or transferring pollutants and wastes do not occur.

Pollution prevention methods or techniques include:

- input substitution — replacing a toxic substance used in a process with a non-toxic or less toxic one, or using a raw material which does not lead to toxic products or other wastes;
- product reformulation — changing the formulation of the final product to reduce or eliminate the amount of waste formed during the process;
- production process redesign — modifying or redesigning the production process to reduce or eliminate the use or release of harmful substances or other wastes;
- production process modernization — replacing the existing production method or equipment with different less polluting methods;
- improved operation and maintenance — improving housekeeping methods, system adjustments, and product and process inspections to reduce the use and generation of harmful substances and other wastes; and
- in-process recycling — re-using the wastes within closed-loop processes.

The pollution approach can result in a number of significant advantages. These include:

- reducing waste and resource use;
- minimizing waste disposal costs;
- reducing the need for pollution control equipment;
- increasing productivity;
- easing compliance with regulations;
- reducing environmental problems and associated liability;
- improving worker’s health and safety while reducing associated liability;
- improving the company’s image in the community; and
- improving competitiveness through increased efficiency (Mausberg et al., 1994).

Ultimately, the goal is to move beyond the pollution prevention model to a system of clean production. Clean Production is rooted within a circular concept of product life and integrates environmental concerns with goals of maintaining quality of life, assuring sustainable work, and protecting both biological and social diversity (Thorpe 1999a). The concept of clean production is an important one, for it offers an alternative which environmental, labour, community groups, academics and governments can come together to work for rather than simply be against unhealthy and ecologically destructive practices.
Figure 1: Conventional Industrial practices

![Figure 1: CONVENTIONAL INDUSTRIAL PRODUCTION IS LINEAR](Thorpe 1999a)

- Non-Renewable/Unsustainably Managed Renewable Resources → Base Materials → Manufacturing → Short Life Toxic Products → Toxic Waste Mountains
- Hazardous Waste

Figure 2: Clean Production

![Figure 2: CLEAN PRODUCTION IS BASED ON A CIRCULAR VISION FOR THE ECONOMY](Thorpe 1999a)

- Non-Toxic, Minimal Waste
- Renewable
- Minimal extraction or harvest
- Produkte are: Reused, repaired, composted, or recycled
- Necessary

Resources

Utilization
Positive Steps:
The University-Public Interest Partnership for Clean Production

The Partnership has been a two-year project among the Center for Clean Products at the University of Tennessee Knoxville, the Lowell Centre for Sustainable Production at the University of Massachusetts Lowell, and environmental, environmental justice, consumer, and labour organizations. Its most recent publication, the Citizen’s Guide to Clean Production, was developed to provide background, tools, and support for environmental and other advocates looking for a new, proactive way to campaign for change. The Partnership is now developing into a Clean Production Network that includes activists and university researchers throughout North America. This Network will advocate for policies that support clean production, provide technical assistance, and link environmental, environmental justice, labour, community organizations and academics around clean production.

The transition to clean production will provide numerous social and environmental benefits for Canadians. It will also entail significant costs for certain sectors. In advocating and planning for the transition to clean production, we must ensure that the workers in the affected industries do not bear a disproportionate share of the costs. To this end, the Canadian Labour Congress, the Ontario Environment Network and Great Lakes United have all endorsed the principle of just transition.

Core Principle:
Just Transition

Workers and communities have the right to choose both economic security and a healthy environment for themselves, their families and future generations. A healthy environment is of benefit to all and is a precondition to long-term employment security as, in the long run, environmental protection and rehabilitation will produce more and safer jobs. The costs of the transition to more environmentally and socially sustainable livelihoods should not, however, be borne disproportionately by workers in affected industries.
The Need for Community Right to Know

Right to know is based on the premise that citizens should be able to easily access information which affects them both directly and indirectly. The right to know about environmental and occupational health issues is an important tool for furthering health promotion. Some of the results that have come from right to know include the following:

- Information can be a powerful incentive tool for action. Since the release of toxic pollution inventories in the U.S. and Canada, many companies have reduced their emissions because they were prominently featured as top polluters. Similarly, many citizen groups have formed good neighbour agreements with polluting facilities spelling out how reductions in toxic pollution releases will be achieved in their community.
- Information can lead to legal actions/clean up activities. Love Canal is one such an example.
- Information publicizes government inaction. For example, recent revelations have shown that Ontario is the second largest polluter in North America.
- Information about environmental conditions can provide a context for identifying priorities and tracking progress. For example, government “State of the Environment” reports are useful in identifying needed environmental actions.

The principal existing right to know mechanism in Canada is the National Pollutants Release Inventory (NPRI). The NPRI was created by Environment Canada in 1993 to provide Canadians with information, through a publicly accessible database, on pollutants released into the environment or transferred off-site for disposal. Facilities that manufactured, processed or otherwise used more than 10 tonnes of any of the 176 NPRI listed substances are required to file a report with Environment Canada.

Positive Steps: Access to Information Leads to Action

“We want off the list” declared David Camozzi, senior vice-president of Whitby-based Co-Steel Incorporated. Co-Steel had been stung by negative publicity due to its status, according to the inter-governmental Commission for Environmental Cooperation, as Canada’s biggest polluter. In response, Co-Steel is planning to stop landfilling its zinc and lead-laden dust. Instead, their hazardous wastes will be sent to a special metal-recovery facility. The ranking of big polluters by the Commission for Environmental Cooperation is based on information collected by the National Pollutant Release Inventory in Canada and the Toxic Release Inventory in the United States.
Core Principle:
Community Right to Know

Citizens, workers and consumers have a right to know about the environmental and occupational risks that they are being exposed to, and to participate in making the decisions that affect their health. Access to information through right to know mechanisms and involvement in decision-making, coupled with power and resources, will help ensure democratic control.

According to the most recent data, toxic releases in Canada increased by 12 per cent in 1997 relative to 1996. A search of industries located in Toronto finds the following data on releases, disposal or recycling of known or suspected carcinogens.

<table>
<thead>
<tr>
<th>Substance (known or suspected carcinogen)</th>
<th>Release</th>
<th>Disposal</th>
<th>Recycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dichloromethane (Methylene chloride)</td>
<td>779.16</td>
<td>4.89</td>
<td>32.83</td>
</tr>
<tr>
<td>Chromium (and its compounds)</td>
<td>0.3</td>
<td>44.42</td>
<td>247.13</td>
</tr>
<tr>
<td>Nickel (and its compounds)</td>
<td></td>
<td>12.2</td>
<td>216.15</td>
</tr>
<tr>
<td>Lead (and its compounds)</td>
<td>0.91</td>
<td>73.44</td>
<td>478</td>
</tr>
<tr>
<td>Formaldehyde</td>
<td>14.33</td>
<td>0.12</td>
<td></td>
</tr>
<tr>
<td>Perchloroethylene</td>
<td>7.84</td>
<td>2.51</td>
<td></td>
</tr>
<tr>
<td>Trichloroethylene</td>
<td>85.65</td>
<td>1.16</td>
<td>3.82</td>
</tr>
<tr>
<td>Benzene</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Toluene diisocyanate</td>
<td>0.36</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bis(2-ethylhexyl) phthalate</td>
<td>0.82</td>
<td>0.23</td>
<td></td>
</tr>
</tbody>
</table>

This information, however, substantially understates the extent of cancer-causing substances released into the environment as there are a number of serious limitations with the current NPRI (Environment Canada 1996; CELA/ CIELAP 1996; Standing Committee on Environment and Sustainable Development 1995). These limitations include:

**Thresholds are too high:** Reporting thresholds (10 tonnes, or more than twice the threshold in the U.S.) for the amount of substance that may be manufactured, processed or otherwise used without reporting releases and transfers are so high that many facilities using these substances do not have to report.

**Many Substances are Not Included:** Many priority substances of concern for human health reasons, such as PCBs, dioxins and pesticides, are not on the list of substances that
must be reported. The U.S. Toxic Release Inventory, for example, lists over 350 substances as compared to the NPRI’s 176.

Many Facilities are Exempt: Facilities with fewer than 10 full-time employees are exempted from the reporting requirements, as are educational and research facilities, facilities engaged in vehicle repair, the distribution, storage or sale of fuels, the retail sale of listed substances or products containing listed substances, renewable resource (forestry, fisheries and agriculture) growing, harvesting or management, mining, and the drilling and operating of oil and gas wells.

Amounts of Hazardous Substances Used at a Facility not Reported: NPRI reporting does not include the amounts of hazardous substances used at a facility, only the amounts released or transferred. Access to the information on total amounts used would assist pollution prevention initiatives and encourage and track progress on reducing the use and production of hazardous substances. It is also essential for addressing accident prevention and occupational health problems that may arise in the workplace using these substances.

The Definition of Transfer: The definition of materials transfer does not include hazardous materials transferred to consumers in products. This information is essential because these hazardous materials will eventually be released into the environment either when they are used or when they are disposed of.

The NPRI: Missing Toronto’s Noxious Nine

Due to the various limitations of the National Pollutant Release Inventory, only two of the “noxious nine” chemicals identified earlier in this report are reported as being released in Toronto. And even these are substantially under-reported. For example, according to the NPRI only three facilities in Toronto releases perchloroethylene (perc), but other data gathered by the Federal Commissioner for Environment and Sustainable Development (1999, 4-18) suggests that there are probably at least 500 tonnes of perc released annually by dry cleaners into Toronto’s air and water. No benzene is reported as being released, yet there are high levels of benzene in Toronto’s air and individuals are exposed to high levels every time they fill their tank with gas or breathe in tail pipe emissions of benzene.

Off-site Recycling: Polluters are not required to report on materials transferred off-site for recycling, including energy recovery (i.e. incineration) at facilities such as cement kilns. This category is listed on the NPRI form, but reporting is voluntary.

Existing Right to Know Mechanisms: the Workplace Hazardous Materials Information System

Occupational health and safety legislation in Canada is based on providing workers with three rights: the right to know, the right to participate, and the right to refuse unsafe work. The Workplace Hazardous Materials Information System (WHMIS) was created to provide workers with information about the hazardous chemicals with which they work, i.e. the right to know. They can then use this information to better exercise their rights to participate and to refuse to work.
WHMIS is, at heart, a system of information delivery with three key elements:

- **Labels** on hazardous materials and their containers which alert employers and workers to the dangers of products and basic safety precautions;
- **Material Safety Data Sheets (MSDS)** — technical bulletins which provide detailed hazards and precautionary information on the product;
- **Worker Education** programs which provide instruction on hazards and training in work procedures (Workers’ Compensation Board of British Columbia 1989).

One of the principal challenges with WHMIS lies in effective implementation. In small or non-unionized workplaces, it can be particularly difficult for workers to exercise their rights to access information or to refuse unsafe work. In addition, manufactured articles and effluents/byproducts from work processes and operations are excluded from WHMIS requirements.

The right to know provisions of WHMIS are greatly weakened by the fact that the provincial government has never written the regulations specifying what information must be included in inventories of hazardous materials and hazardous physical agents present in the workplace. Such inventories are required under section 36 of Ontario’s *Occupational Health and Safety Act*; section 38 of the Act requires this information to be made available on request to workers, the local medical officer of health and the local fire department. Community right to know of this information is implicit since the inventory must also be made available to “any person” who requests it of the medical officer of health. Yet without the regulation specifying what must be in the inventories maintained by the employer, these mechanisms are of limited usefulness — the employer has to provide the inventory on request, but what is contained in this inventory is left to the discretion of the employer.

WHMIS also needs to be linked to strategies, for not just educating workers about workplace hazards, but also actively involving them in developing and implementing pollution prevention strategies for replacing hazardous and/or cancer-causing materials with safer ones. (The Canadian Auto Workers included this in their most recent collective agreement with the Big Three automakers). This could be achieved by changes to the Ontario *Occupational Health and Safety Act*, in particular changes granting greater authority to the joint health and safety committees.

“Mere knowledge of a danger doesn’t overcome it, but knowledge does give workers an understanding of how to deal with it. WHMIS — if we use it properly — is a significant step on the path to a healthy and safe workplace.”

— Workers Health and Safety Centre
Recommendations

Introduction

In 1999, the Occupational and Environmental Working Groups of the Toronto Cancer Prevention Coalition recognized that there are well-documented carcinogens such as benzene and asbestos, which affect both workers (occupationally) and the general public (environmentally) whose elimination is long overdue. We recognize the need for the ultimate elimination of these and the other six occupational and environmental carcinogens as discussed in the Occupational and Environmental Working Group Report. We urge action now.

Purpose

The fundamental purpose of the recommendations is to promote the recognition and ultimate elimination of the eight chemicals in Toronto. With the Right to Know Principle and the need for an interdisciplinary approach to cancer prevention both being recognized by the PPCTF (Primary Prevention of Cancer Task Force) and the authors of Toronto’s Environmental Plan, a consensus foundation is laid for preventive action. The Environmental Plan’s comprehensive air strategy for reducing emissions and monitoring air quality sets an example for the reduction of our identified transportation chemicals as does its recommendations for the elimination of the use of pesticides. To build on the past successes and promote further action, we urge the adoption and implementation of the following recommendations by the Toronto Board of Health.

1) Adopt the Principles

The Precautionary Principle and Right to Know laws are widely used internationally and applied in situations involving human health and safety. By implementing these recommendations, the City has an opportunity to become a leader in protecting public health. The City should make cancer prevention a priority, based on the core principles identified by the environmental and occupational working groups. These include: Precautionary Principle, the Weight of Evidence Approach, Pollution Prevention, Right to Know, and Just Transition. The Board of Health and City Council should:

a) Make primary prevention of cancer a priority.

b) Adopt the precautionary principle, the weight of evidence approach, pollution prevention, right to know, and just transition as defined in the Occupational and Environmental Working Group Report as principles that guide all of the City’s activities.

c) Encourage Ontario and Canadian Public Health Associations, provincial and federal governments to adopt the core principles in standard setting.

2) Community Right to Know

We fully endorse the principle of Right to Know. In its broadest sense, Community Right to Know is a system of public access to information on toxic chemical use and their release into the environment as well as their impact on human and environmental health. In encouraging the development of Community Right to Know, the Board of Health and City Council should:

a) Encourage the Medical Officer of Health to support the City Solicitor in the development of the community right to know bylaw, and report back to the
Board of Health on its development and implementation by the end of 2001.

b) Inform workers of their rights to obtain MSDSs through the Medical Officer of Health as required by the OH&S Act, WHMIS Regulation 1980, Section 22c. (2)

“The medical officer of health, at the request of any person, shall request an employer to furnish a copy of the most recent version of the inventory or of an unexpired material safety data sheet, as the case may be.”

c) Call upon the federal government to develop an electronic database providing on-line MSDSs including their sources and locations, ensuring public access to depersonalized data, updated annually. This database would be linked to the CEPA electronic registry, provincial and national Cancer Registries and birth defect registries, with the Canadian Center for Occupational Health and Safety (CCOHS) having the mandate for delivery using the City of Toronto as a pilot.

d) Call upon the Ontario Minister of Labour to establish the regulations needed under Section 36 of the Occupational Health and Safety Act to require inventories of hazardous materials present in the workplace.

e) Call upon the Ministry of Labour to require mandatory IARC, Health Canada and EPA classification listings on all MSDSs where applicable.

3) City Cancer Prevention Plan

The City should recognize the eight chemicals as key priorities for action, and advocate for their phase out or substitution. We recommend the recommendations in the Environmental Plan contributing to the reduction of carcinogens in our environment, particularly those supporting sustainable energy and public transport. To take this a step further, the Board of Health and City Council should:

a) Request that the Ministry of Health (MOH), in consultation with the Commissioner of Works and Emergency Services, develop a cancer prevention plan that identifies plans, priorities, steps and timelines to support the phase-out of the use of the eight chemicals — benzene, diesel exhaust, polycyclic aromatic hydrocarbons, perchloroethylene, dioxins, methylene chloride, asbestos, and pesticides. This is carried out in consultation with the community and other government agencies. (Consultation should include representatives from Public Health, Works and Emergency Services, MOH, Ministry of Labour (MOL), Ministry of Environment (MOE), Toronto Fire Department, occupational health clinics, industries, labour, environmental organizations and citizens on the development of this plan),

b) The MOH should report back to council on the progress by December 2001.

4) City as a Model Employer

The Board of Health and City Council should make the City a model employer by developing and implementing a cancer strategy for its employees through its joint health and safety committee(s). Using the IARC, EPA, and Health Canada classifications of known and/or probable carcinogens as a minimum standard, the cancer strategy should include the following elements:

a) Identification and quantification of all products and substances used or produced by City employees that may be capable of producing or promoting
Preventing Cancer

A Strategy for Toronto

- Identification of pollution prevention strategies with targets and timelines to eliminate the use and/or release of suspected carcinogens into the workplace and/or environment,
- Substitution of those chemicals identified in a) and b) with less hazardous products,
- An education program to support cancer prevention initiatives,
- An annual report to City employees and the public on progress made on cancer prevention,
- Encouragement of other Toronto employers to adopt the city's lead in these examples.

5) Substitution of Known or Probable Human Carcinogens

We applaud the City for the adoption of the principles of sustainable transportation and sustainable energy as articulated in Toronto's Environmental Plan and ask the Toronto Board of Health to encourage the provincial and federal regulatory bodies to examine mandatory substitution of substances identified as known or probable human carcinogens starting with substances identified by the IARC. The Board of Health and City Council should:

- Call upon the Ministry of Labour to develop regulations that require the mandatory examination of substitutes for carcinogens and adopt the legal language used in the Canada Labour Code, OH&S Regulations 86-304 Section 10.16, “No person shall use a hazardous substance in a workplace where it is reasonably practicable to substitute a substance that is not a hazardous substance.”
- Encourage other municipal Boards of Health to do the same.

6) Monitoring, Exposure and Education

Monitoring of workers and their exposures is an essential step in the secondary prevention, identification, recognition and compensation of occupational disease. In addition, education enables the recognition and secondary prevention of occupational disease. To facilitate a system supporting these goals, the Board of Health and City Council should:

- Encourage Cancer Care Ontario (CCO) to work with organizations such as the Ontario College of Family Physicians, WSIB, Ontario Medical Association (OMA), MOH, MOL, Physician Education Project in Workplace Health and medical schools to educate family physicians about occupational carcinogens and require the documentation of the occupational histories of their patients,
- Encourage CCO to collect potential occupational exposures in records of cancer victims,
- Encourage the Ontario Ministry of Labour to document the extent, nature and frequency of worker exposure to IARC known and/or probable carcinogens in Ontario,
- Request the Medical Officer of Health to collaborate with the Toronto Board of Education in developing educational modules on occupational and environmental carcinogens.

Conclusion

We envision the City of Toronto as a leader in the ultimate elimination of the eight chemicals. Additionally, we believe the City can build on this success by using the eight to gain understanding of and experience with the policies and practices to eliminate and reduce the impact of other chemical products harmful to workers and the environment in the future. With these recommenda-
tions implemented, a significant step is taken to reduce the detrimental impact of Occupational and Environmental carcinogens in Toronto.

1. Approximately one year prior to a meeting of a working group, participants are selected by IARC staff in consultation with other experts. Subsequently, relevant biological and epidemiological data are collected from published scientific literature. Using this, IARC staff and working group members prepare first drafts of monographs that are sent to all members. The working group meets for 7 or 8 days to discuss and finalize the texts of the monographs and formulate the evaluations. The tasks of this group are (1) to ascertain that all appropriate data has been collected (2) to select the data relevant for the evaluation on the basis of scientific merit (3) to prepare accurate summaries of the data to enable the reader to follow the reasoning of the working group (4) to evaluate the results of experimental and epidemiological studies and (5) to make an overall evaluation of the carcinogenicity of the agent to humans. The U.S. Department of Health & Human Services, Public Health Service, National Toxicology Program uses these evaluations as part of the basis for their Annual Reports on Carcinogens.

2. The precise percentage of cancers which can be attributed to environmental and occupational sources has been a source of great controversy. Estimates for occupational sources alone range from a low of four per cent in Doll and Peto (1981) to a high of 20 to 40 per cent in the Estimates Paper published jointly by the National Cancer Institute, the National Institute of Environmental Health Sciences and the National Institute for Occupational Safety and Health in 1978. The range for environmental factors varies from two per cent to 90 per cent, depending on your definition of environment.
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