Chlorinated Substances *Action* Plan

Progress Report

October 1996

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Executive Summary

This second progress report on the Chlorinated Substances Action Plan outlines Canada's approach to the management of chlorinated substances. The approach is to "prune the chlorine-use tree, not cut it down". It is based on the scientific community's conclusion that a complete ban on all chlorine uses or chlorinated substances is not supportable.

However, there is clear evidence supporting immediate and aggressive action to restrict or ban those chlorinated substances that are highly persistent, bioaccumulative and toxic – threatening human health and the environment. Other toxic chlorinated substances are to be managed throughout their life cycles to prevent or minimize their releases to the environment.

The Chlorinated Substances Action Plan has five components. Following are some examples of our progress in each.

Targeting critical uses and products

Regulatory actions taken in the past are now bearing fruit. For example, the Pulp and Paper Effluent Chlorinated Dioxins and Furans Regulations (1992) under the *Canadian Environmental Protection Act* have cut releases of chlorinated dioxins and furans from that source by more than 98 per cent. Approximately 46 per cent of commercial fisheries previously closed as a result of dioxin contamination in coastal British Columbia are now open again.

More recently, chlorinated substances such as methyl chloroform (1996), carbon tetrachloride (1995), chloromethyl methyl ether and bis(chloromethyl)ether (1996) and chlorofluorcarbons (1993/1996) were banned in Canada. A number of other chlorinated substances are slated for virtual elimination or significant reduction.

Nonregulatory initiatives, including the Accelerated Reduction/Elimination of Toxics (ARET) program, formal environmental agreements and memoranda of understanding with industries such as automotive and auto parts manufacturing, printing and graphics, metal finishing and dry cleaning, are complementary to existing or new regulatory actions. Significant reductions of emissions of toxic chlorinated substances have been achieved under these initiatives.

The Chlorinated Substances Action Plan is part of an overall federal strategy to protect human health and the environment. This science-based action plan includes both regulatory and nonregulatory measures, targeting over 100 chlorinated substances of concern. It is part of Canada's domestic and international efforts to address those substances that threaten our health and the environment.

Improving scientific understanding

Extensive wildlife studies are helping monitor and better understand the effects of chlorinated substances on Canada's ecosystem. Collaborative studies between universities, industry and federal departments include topics ranging from immune function suppression in shore birds to reproductive effects of DDE on robins, ospreys and painted turtles.

National environmental quality guidelines for soil, marine and freshwater ecosystems, and tissue residues have been or are under development. Environmental Effects Monitoring studies of pulp and paper effluents are being assessed, and the results will help determine the effectiveness of regulations on chlorinated dioxins.

Studying public health and socio-economic effects

Various studies are underway to explore the health, social and economic implications of chlorinated substances and their alternatives.

To protect the health of Canadians, Health Canada has published tolerances for organochlorines in foods and guidelines for drinking water. Health Canada is also measuring the levels and effects of chlorinated substances in foods and human tissue. The results of these and other studies will help identify high-risk groups and formulate health protection and risk reduction measures.

Better informing the Canadian public

The first National Pollutant Release Inventory (NPRI) was released in 1995 and will be updated annually. Environmental information such as NPRI data, the State of the Environment report, ARET reports and this publication are available electronically on Environment Canada's Green Lane web site (http://www/doe.ca).

Promoting and leading international efforts

Canada's domestic Chlorinated Substances Action Plan is an illustration of the federal government's leadership in promoting and leading international efforts to curtail harmful substances and to promote the wise use of chlorine-containing compounds.

Canada is co-chairing a task force to develop a protocol to control the atmospheric transport of persistent organic pollutants under the United Nations Economic Commission for Europe Convention on Long-Range Transboundary Air Pollution. Canada is also playing a lead role within the Intergovernmental Panel on Chemical Safety to develop a global strategy on persistent organic pollutants, including chlorinated compounds.

Canada and the United States are developing a binational strategy for the virtual elimination of 11 persistent and toxic chlorinated substances in the Great Lakes. This work should be complete by winter 1996/1997.

Progress through cooperation

The progress cited in this report is the result of purposeful cooperation and partnership between both federal and provincial governments, industry, scientists, universities and other stakeholders. It penetrates the full spectrum of Canada's geography and economy, and has earned international attention. Through their determination, participants in all the related projects have demonstrated that positive change is possible where there is a will.

Canada's approach to chlorinated substances

Canada has committed to work towards creating a healthy environment and a prosperous economy. Our work, both nationally and internationally, with chlorinated substances that pose a threat to human health and the environment is part of that commitment.

The federal Toxic Substances Management Policy released in June 1995 calls for the virtual elimination from the environment of all toxic, persistent and bioaccumulative substances that result from human activity. The policy also calls for complete life cycle management of all other substances of concern that are released to the environment. Some, but not all, chlorine-containing substances fall into one of these two categories.

Under the framework of this science-based policy, the Chlorinated Substances Action Plan has achieved significant results. This report summarizes the progress achieved in the second year since its announcement in October 1994.

"Pruning" The Chlorine-Use Tree

Canada's Chlorinated Substances Action Plan targets the most harmful chlorinated substances for virtual elimination or significant reduction from the environment. Measures to do so are already underway and, in many cases, completed.

Appendices 1 to 8 list chlorinated substances covered by various programs. Appendix 9 shows how these programs relate to and complement each other.

The chlorine industry, through the Canadian Chlorine Coordinating Committee (C4) which includes 10 industry associations and 22 companies devoted to the responsible use of chlorine chemistry, supports the Chlorinated Substances Action Plan and its comprehensive approach to the management of chlorinated substances.

The chlorine industry has voluntarily initiated a number of programs and studies focusing on the five areas identified in the Chlorinated Substances Action Plan. A summary report describing industry's initiatives and results, was provided to Environment Canada and is included for information purposes only as Appendix 10 of this report.

Not all chlorinated substances or chlorine uses pose a threat to human health or the environment. Chlorine also has beneficial uses. It is commonly used for drinking water disinfection and in the manufacture of pharmaceutical products. Principal industrial uses are in the polyvinyl chloride (PVC), pulp and paper, and solvent sectors.

The chlorine industry's contribution to the Canadian economy is estimated at $2.1 billion a year, excluding the pesticide and pharmaceutical industries. The industry directly employs approximately 28,000 people.

Current scientific opinion, including findings of the International Society of Environmental Toxicology and Chemistry, holds that a complete ban on all chlorine uses cannot be supported by the present scientific evidence – although a number of dangerous substances should be eliminated. The Chlorinated Substances Action Plan reflects these findings by moving aggressively to cut harmful uses of chlorine, while ensuring that the Canadian public and industry can continue to enjoy its benefits.

The Action Plan

The body of this report details Canada's progress on each part of the Action Plan. The Chlorinated Substances Action Plan is a comprehensive five-step approach to eliminating or significantly reducing toxic chlorinated substances within a set timetable using both regulatory and non-regulatory tools. It also addresses other aspects of chlorine use.

1. **Targeting critical uses and products** by:

   (i) eliminating the most harmful chlorinated substances

   (ii) taking a sectoral approach to the management of chlorinated substances

   (iii) entering into environmental performance agreements with key industrial sectors representing the largest sources of releases of targeted chlorinated toxic substances.

2. **Improving scientific understanding** of chlorinated substances and their impacts on human health and the environment.

3. **Studying public health and socio-economic effects** of chlorinated substances and their alternatives.

4. **Better informing the Canadian public** about chlorine and chlorine-related issues.

5. **Promoting and leading international efforts** for global action on chlorinated substances.

How the plan is being implemented

TARGETING CRITICAL USES AND PRODUCTS

Targeted actions for the following substances under the Chlorinated Substances Action Plan were either completed on schedule, or are on track for completion on schedule.

Carbon tetrachloride - Action completed

Ozone-depleting substance, primarily used as a feedstock for the production of chlorofluorocarbons [CFCs]

Production and importation were phased out in January 1995 under the Ozone-depleting Substances Regulations of the *Canadian Environmental Protection Act* (CEPA), except for use in feedstock, explosion suppression and laboratory uses, which are permitted under the Montreal Protocol.

1,1,1 Trichloroethane [" methyl chloroform"] - Action completed

Ozone-depleting substance; primarily used as a degreasing solvent

Production and importation were phased-out in January 1996 under the CEPA Ozone-depleting Substances Regulations, except for laboratory uses permitted under the Montreal Protocol.

Chloromethyl methyl ether [CMME] and bis (chloromethyl) ether [BCME] - Action completed

Used as water repellents and in the manufacture of polymers

These substances were assessed and declared toxic under CEPA. They are not manufactured, imported or used in Canada. As a precautionary pollution prevention measure, the Prohibition of Certain Substances Regulations under CEPA, which came into effect on April 30, 1996, ban the manufacture, importation and use of these substances in Canada.

Trichloroethylene and tetrachloroethylene ["perchloroethylene"]

Primarily used as degreasing and cleaning solvents

Trichloroethylene is used for solvent degreasing; tetrachloroethylene is used as a cleaning solvent by the dry-cleaning industry, as a degreasing agent in degreasing operations and in the manufacturing sector as a feedstock for the production of hydrochlorofluorocarbons (HCFCs). Both substances were assessed and declared toxic under CEPA, and will be managed using the Toxic Substances Management Policy.

As a result of multi-stakeholder consultation with both the degreasing and dry cleaning sectors, two separate reports were completed in early 1996. These reports, which contain stakeholders' recommendations on options for reducing use and improving control of environmental releases of these substances, will be presented to the Ministers of Environment and of Health in the fall of 1996. After consideration of the stakeholders' recommendations, it is expected that pollution prevention measures will be developed and implemented based on the Ministers' decisions.

Under the auspices of the Canadian Council of Ministers of the Environment (CCME) NO_X/VOC Management Plan, Environment Canada, in collaboration with provincial governments and other stakeholders, has developed two environmental Codes of Practice for dry cleaning and degreasing facilities to prevent/reduce solvent emissions from these facilities. The province of Ontario has established regulations that require dry cleaning operators to take a training course based on the CCME dry cleaning Code of Practice. Other provinces are considering adopting regulatory initiatives similar to those existing in Ontario.

Dichloromethane ["methylene chloride"]

Used for paint removing and foam blowing, as a solvent for cleaning metal and electronic components, and as an additive in paints and adhesives

This substance was assessed and declared toxic under CEPA. Control options are being developed through a multi-stakeholder consultation process. A report containing stakeholders' recommendations will be presented for consideration to the Ministers of Environment and of Health in the fall of 1997.

3,3 dichlorobenzidine

Used in the production of pigments

This substance was assessed and declared toxic under CEPA. Following a multi-stakeholder consultation process, a report containing stakeholders' recommendations will be presented for consideration to the ministers of Environment and of Health in the winter of 1996/1997.

Candidate substances identified for virtual elimination

Environment Canada has identified 13 persistent, bioaccumulative and toxic substances as candidates for virtual elimination under the Toxic Substances Management Policy. These substances are all highly chlorinated. Environment Canada is initiating public consultations on whether these substances meet the criteria for virtual elimination. Stakeholders have an opportunity to present scientific evidence supporting or refuting the proposed conclusions. After review of the comments, a final decision on the 13 substances will be made public.

Virtual elimination from the environment of these substances will be achieved through strategies tailored to take into account whether substances are commercial products, by-products, contaminants or wastes, or substances present at contaminated sites.

Specifically, the federal government will:

- place the responsibility on those who use or generate these substances to demonstrate that releases are below the limit of quantification
- for substances cited under federal jurisdiction, promote the implementation of management plans to eliminate emissions of such substances, based on an analysis of risks, costs and benefits
- pursue through international initiatives the elimination of their releases from sources outside Canada.

Candidate substances for virtual elimination under the Toxic Substances Management Policy include: aldrin, dieldrin, chlordane, DDT, enrin, heptachlor, hexachlorobenzene, Mirex, PCBs, polychlorinated dibenzo-p-dioxins, polychlorinated dibenzofurans, short chain chlorinated paraffins, toxaphene.

'Tier I and Tier II' chlorinated substances

These substances are listed in appendix 1

Ten Tier I chlorinated substances are targeted for virtual elimination under the Canada-Ontario Agreement (COA) respecting the Great Lakes Basin Ecosystem. Five Tier II chlorinated substances are targeted for significant reduction.

Following are the targets and schedules (1996 to 2000) for these substances, and progress to date.

- Confirm by January 1996, that zero discharge within the basin for Tier I chlorinated substances has been achieved:

  A comprehensive review of five banned pesticides (aldrin/dieldrin, chlordane, DDT, Mirex and toxaphene) is complete. These pesticides are no longer used in Ontario. However, old stock may still be retained inadvertently as household hazardous wastes. Additional work is needed to quantify and collect any inadvertently stored stock.

- In cooperation with PCB owners, prepare an inventory and explore options for PCB destruction. Set up decommissioning and destruction targets and time lines for high- and low-level PCBs:

  An inventory of PCBs in Ontario shows that as of December 1994, more than 35 per cent of Ontario's high-level PCBs have been decommissioned and placed into storage, along with associated wastes such as transformer carcasses and contaminated soils. Progress on the destruction of high level PCBs has been slow.

  By mid-1995, Public Works and Government Services Canada, General Motors Canada and Ontario Hydro had only destroyed 240 tonnes of

PCBs, just 2 per cent of the 10,500 tonne total.

- Achieve a 90 per cent reduction by 2000 in the use or release of four other Tier I chlorinated substances (hexachlorobenzene, octachlorostyrene, polychlorodibenzodioxins and polychlorodibenzofurans) and, in the same time frame, significantly reduce the use, generation and release of 26 less toxic 'Tier II' pollutants, which include five chlorinated organic compounds: 1,4-dichlorobenzene, 3,3-dichlorobenzidine, hexachlorocyclohexane, 4,4-methylenebis[2-chloroaniline], and pentachlorophenol.

As of April 1996, the sources of non-pesticide Tier I and Tier II substances have been updated, and preliminary release estimates established. Ten key sectors are identified for targeted actions. Officials from Environment Canada and the Ontario Ministry of Environment and Energy (MOEE) are working with key industry sector associations and are visiting the major emitters to promote reduction and pollution prevention actions to achieve COA targets.

Chlorofluorocarbons [CFCs] - Action completed

Ozone-depleting substances

Production in Canada of these ozone-depleting substances was prohibited in 1993 under the CEPA Ozone-depleting Substances Regulations. As of January 1996, their importation was phased out under the same regulations, except for use in inhalers for treating asthma and for certain laboratory uses, as permitted under the Montreal Protocol.

Hydrochlorofluorocarbons [HCFCs]

Ozone-depleting substance used as transitional chemicals to replace CFCs

In January 1996, consumption of HCFCs was frozen at base level (equivalent to 887 ozone-depleting potential (ODP) tonnes) under the Ozone-depleting Substances Regulations. HCFCs are scheduled for 35 per cent reduction by January 2004, 65 per cent by January 2010 and 90 per cent by January 2015, with a phase-out by January 2020.

Short chain chlorinated paraffins [SCCPs]

Primarily used in metal working oil and as plasticizers for making flexible PVC

Assessed and declared toxic under CEPA, SCCPs are proposed for virtual elimination under the Toxic Substances Management Policy (TSMP). A multi-stakeholder consultation process to identify options for reducing use and improving control of SCCPs is underway and a report containing stakeholders' recommendations is expected in 1997.

Polychlorinated dibenzodioxins and dibenzofurans [PCDDs and PCDFs]

Highly persistent and toxic compounds from industrial and natural sources

PCDDs and PCDFs enter the environment as complex mixtures from such sources as commercial chemicals like pentachlorophenol, from incineration, pulp and paper mills using chlorine bleaching, accidental industrial fires and spills involving PCBs, and forest fires.

Assessed and declared toxic under CEPA, PCDDs and PCDFs are candidates for virtual elimination under the TSMP. A federal/provincial task force will identify anthropogenic sources of chlorinated dioxins and furans (except from pulp and paper manufacturing), and will develop an action plan consistent with the Toxic Substances Management Policy.

In 1992, stringent federal Pulp and Paper Effluent Regulations under CEPA addressed chlorinated dioxin and furan releases in effluents from pulp and paper mills using a chlorine bleaching process. The regulations resulted in mills changing their processes and raw materials to ensure that chlorinated dioxins and furans are not formed during pulp and paper manufacture. Releases of dioxins and furans from pulp and paper mills are down by more that 98 per cent – from 350 grams in 1988 to about five grams per year in 1996. Other chlorinated organic substance releases in pulp mill effluents have also been reduced significantly. Contamination of fisheries by dioxin/furan releases in pulp mill effluents has stopped and significant environmental improvements achieved. Approximately 46 per cent of commercial fisheries previously closed by dioxin contamination in coastal areas of British Columbia have now been reopened.

Chlorinated Wastewater Effluents(CWWE)

Chlorinated effluents from municipal wastewater treatment plants and industrial sources were assessed and declared toxic under CEPA in January 1994. Due to insufficient information on industrial discharges, the focus of CWWE was Chlorinated Municipal Effluents (CME). The CME issue is currently being addressed through the CEPA-Federal Provincial Advisory Committee (FPAC). Current changes in provincial policies show a trend toward effluent dechlorination and alternate forms of disinfection.

Recent discussions through CEPA-FPAC have centered around the development of federal-provincial agreements under which each province would outline a plan of action for municipalities to reduce or eliminate their discharges of chlorinated effluents. The agreements would also establish a time frame for implementation and would require a periodic progress review.

Non-Regulatory Initiatives

Through formal environmental agreements and memoranda of understanding (MOUs), governments are pursuing non-regulatory approaches to achieve environmental protection goals. These are agreements between parties to establish reduction targets and to use best efforts to reduce or eliminate toxic substance emissions.

The following agreements and MOUs with industrial sectors and provinces have already been signed or are expected to be signed in the near future:

Accelerated Reduction/Elimination of Toxics (ARET) Program

ARET is a multi-stakeholder initiative aimed at reducing the potential adverse effects of toxic substances on health and the environment by accelerating the reduction or elimination of emissions of toxic substances. Under the ARET program, targets are set for voluntary reduction of emissions of more than 100 toxic substances, 32 of which are chlorinated compounds (see Appendix 2). Nine of these thirty-two chlorinated substances are on ARET's List A-1, which includes persistent, bioaccumulative and toxic substances targeted for virtual elimination.

In response to the ARET challenge launched in early 1994, 142 organizations from 8 major industrial sectors and 5 government departments submitted action plans to reduce their emissions of ARET substances significantly. Between the base year (post 1988) and December 1995, emissions of chlorinated substances on ARET's List A-1 were reduced by 530 kilograms or 98 per cent. A 67 per cent reduction was achieved for other chlorinated compounds. Based on action plans received as of September 1996, an additional reduction of 440,494 kg (41 per cent) of chlorinated substance emissions is expected between January 1996 and December 2000 (see Appendix 2).

Automotive Industry

Significant environmental results are being achieved under the memorandum of understanding between by the Motor Vehicle Manufacturers Association (MVMA), Ontario Ministry of Environment and Energy (MOEE), and Environment Canada. Signed in May 1992, this MOU entitled Canadian Automotive Manufacturing Pollution Prevention Project was the first environmental agreement of its kind in the Great Lakes Basin in Canada. The MOU commits the MVMA members (Ford, Chrysler, General Motors) to reducing, eliminating and preventing the use, generation and release of 29 substances of concern, including six chlorinated substances (see Appendix 1) from automotive operations.

The fourth progress report on the Pollution Prevention Project was released in June 1996. The report provides details on the proactive efforts being taken by the automotive industry to reduce voluntarily pollution at its source.

Ford Canada has completely eliminated its use and emission of 1,1,1 trichloroethane (3,200 kg/year), previously used as a mould-release agent, from its Windsor Casting Plant. General Motors Canada (GMC) also targeted 1,1,1 trichloroethane in the Oshawa Truck Assembly Complex, and has eliminated the use and emission of 12,268 litres (approximately 16 tonnes) since 1993. GMC plans to eliminate another 11 tonnes per year of trichloroethane.

Chrysler Canada has completely eliminated emission of methylene chloride (approximately 95 tonnes) from all of its assembly plants where it was used as a solvent.

Automotive Parts Industry

In 1993, an MOU was signed by the Automotive Parts Manufacturing Association, Environment Canada and the Ontario Ministry of Environment and Energy. Under this MOU, automotive parts manufacturers commit to reducing, eliminating or preventing the use, generation or release of targeted toxic substances including chlorinated substances. Some noteworthy results have been achieved. For example, Bundy Canada completely eliminated its emissions of methyl chloroform which is used as a solvent cleaner by 300 kg/year. Similarly, Dana Canada has eliminated all of its 1,1,1 trichloroethane emissions (2700 kg/year). Long Manufacturing has eliminated the use and emissions of 1,1,1 trichloroethane from all its die-stamping operations.

Chloranil

Used for dye and pigment production

Chloranil is only imported into Canada. It is not produced here. To prevent the release of the chlorinated dioxins and furans present as impurities in chloranil, MOUs between Environment Canada and five importers of chloranil and chloranil-based dyes and pigments were signed in the fall of 1995. The MOUs establish a framework for voluntary conversion to "low-dioxin chloranil". Publication of a CEPA subsection 16(1) notice in Part I of the Canada Gazette on May 18, 1996, resulted in five additional importers identifying themselves. MOUs with these importers are expected by December 1996.

Dry cleaning sector

Under the Green Clean MOU between Environment Canada, Ontario Ministry of Environment and Energy, the Ontario Fabricare Association and the Korean Dry Cleaners Association, Environment Canada is now collecting 1995-1996 data and information from cleaners participating in the Green Clean Demonstration Project. Green Clean uses a water-based cleaning system without chlorinated solvents. A report comparing water-based cleaning to tetrachloroethylene in the fabricare industry will be released in 1997.

Polyvinyl Chloride [PVC] sector

The drafting of an MOU on Environmental Performance and Competitiveness between the Vinyl Council of the Society of the Plastics Industry of Canada, Environment Canada and Industry Canada is complete. The MOU includes a detailed action plan for companies belonging to the Vinyl Council to meet objectives outlined in the Toxic Substances Management Policy, the Canada/Ontario Agreement and the ARET program. Member companies would also implement responsible environmental management and product stewardship practices to address the environmental impact of their industry, ensuring that releases from various stages in the life cycle of PVC plastics are assessed and managed appropriately.

The proposed MOU includes the establishment of a public advisory committee comprised of a range of individuals from environmental organizations to academia.

Printing and graphics sector

In 1995, an MOU on Pollution Prevention focusing on reduction of releases of toxic and persistent toxic substances from this sector was signed by Environment Canada, the Ontario Ministry of Environment and Energy and the printing and graphics industry. More than 15 major corporations and industry associations are participating. The MOU establishes a list of targeted substances for reduction and/or elimination, including two chlorinated substances: aluminum chloride (which is on the CEPA PSL II list) and 1,1,1 trichloroethane. Pollution prevention opportunities are being identified and implemented by participating companies.

IMPROVING SCIENTIFIC UNDERSTANDING

Under the Chlorinated Substances Action Plan, the federal government is leading scientific and technical research to improve knowledge of how chlorinated substances affect human health and the environment. Several major efforts, some of them in partnership with others, are advancing understanding:

Wildlife studies

Through the Wildlife Toxicology Program under CEPA, the Canadian Wildlife Service (CWS) conducts research and monitoring at its National Wildlife Research Centre (NWRC) in collaboration with partners from universities, other government agencies and private organizations. By detecting and measuring the effects of toxic substances on wildlife, CWS researchers can assess the overall health of species, predict the impact of pollutants, and provide an early warning system for potential environmental and human health problems. Appendix 3 provides a list of wildlife studies related to chlorinated substances. Over the past year, research has focused on biological effects attributed to chlorinated substances, including dioxins and furans, PCBs, and other organochlorine compounds:

- The influence of chlorinated compounds on liver enzyme activity in polar bears was studied. PCBs and chlordane were implicated in enzyme induction.
- Université du Québec à Montréal is collaborating on research with Uppsala University in Sweden to discover potential effects of PCBs, DDE and their metabolites on endocrine disruption in polar bear (immune system, steroid metabolism).
- Studies have demonstrated the bioaccumulation of PCB metabolites in the arctic marine food chain.
- The Canadian Chlorine Coordinating Committee (C4) is funding a collaborative study with Carleton University to develop methods for analysis of PCB metabolites and to examine their pattern in high-PCB exposed Inuit in the Arctic.
- Carleton University's collaborative study is identifying naturally produced halogenated compounds that bioaccumulate in wildlife.
- Trent University's collaborative study is developing a model for bioaccumulation of chlorinated compounds in birds.
- A four-year collaborative study of immune functions in prefledgling Caspian terns and herring gulls in the Great Lakes is complete. Suppression of immunity was most severe in colonies in Lake Ontario and Saginaw Bay for both species and in western Lake Erie for herring gulls.
- Field work was completed on investigations of exposure of wildlife to toxic chemicals at five Atlantic Coastal Action Program (ACAP) sites
- Dioxins and furans were shown to bioaccumulate in tissues of mink collected downstream from a pulp mill on the St. Maurice River, Quebec.
- Monitoring of the clean-up of contamination in the St. Lawrence River is being implemented using the great blue heron and the mudpuppy as wildlife indicators for contaminant levels.
- A University of Guelph investigation of embryonic deformities in ring-billed gulls shows higher infertility and deformity rates in polluted Great Lakes sites.
- The Great Lakes Herring Gull Eggs Monitoring Program continued. No significant change in organochlorine/PCB contaminants was recorded over the 1991-1995 period.
- An ongoing study of Saskatchewan rivers is evaluating indirect impacts of pulp mill effluents and the adequacy of existing EEM Guidelines to protect wildlife. Biochemical, hormonal and reproductive wildlife endpoints are being monitored.
- It has been shown that dioxins, furans and PCBs that originate from pulp mills and other industries are declining in the British Columbia environment to levels below the range that is lethal to local wildlife.

- High levels of the persistent contaminant DDE in the Okanagan food chain are under investigation to determine their effects on the developing reproductive system of robins, ospreys and painted turtles.

Dioxins from incinerators

The American Society of Mechanical Engineers study correlating chlorine content of feedstocks including polyvinyl chloride with dioxin levels in incinerator stacks is complete. This study was co-funded by Environment Canada and the Vinyl Institute in the USA. The findings show that no statistically significant correlation exists between dioxin levels in incinerator stacks and the amount of PVC in feedstocks.

National environmental quality guidelines

These guidelines are being developed under the auspices of the Canadian Council of Ministers of the Environment (CCME):

- One additional freshwater water quality guideline on a chlorinated substance for the protection of freshwater aquatic life has been published, bringing the total number to 30 (see Appendix 4). Four new guidelines and the revision of the chlorinated phenol and chlorinated benzenes guidelines are still under development.
- Four new marine water quality guidelines are expected by the spring of 1997.
- Sediment quality guidelines for both marine and freshwater ecosystems are still being developed for 12 chlorinated substances (see Appendix 4). They should be complete by the end of 1996.
- Soil quality guidelines for five chlorinated substances are being developed (see Appendix 4). They should be complete by the end of 1997.
- Finally, five tissue residue guidelines for chlorinated substances are being developed to protect wildlife consumers of aquatic biota (see Appendix 4). They should be complete by the end of 1997.

Polychlorinated dioxin emissions from power boilers

Studies have shown that dioxins and furans are emitted when bark from logs floated in sea water is burned by coastal British Columbia pulp and paper mills to generate power.

Environment Canada is providing technical assistance to Natural Resources Canada for a Pulp and Paper Research Institute of Canada (PAPRICAN) study. Pilot tests are determining the mechanism by which chlorinated dioxins and furans are formed, and will seek ways to prevent their formation. The results will guide pulp mills in developing measures to prevent dioxin and furan formation during combustion.

Environment Canada has compiled estimates of dioxin emissions from steam-generating boilers at pulp and paper mills in coastal British Columbia to ascertain the significance of releases from this source. A meeting was held with British Columbia pulp and paper companies and PAPRICAN in September 1996 to discuss next steps on a research program and the development of control measures for the power boilers.

Environmental Effects Monitoring (EEM) studies

Under the 1992 *Fisheries Act* Pulp and Paper Effluent Regulations, all pulp mills are required to conduct Environmental Effects Monitoring (EEM) on a three-year cycle according to prescribed protocols. In addition to conducting physical, chemical and biological tests on effluents, receiving water and biota, chemical pulp mills using a chlorine bleaching process must measure and report their releases of chlorinated dioxins and furans.

In some cases, depending on the location and process used at the mills, other chlorinated substances (such as chlorophenols, chloroguacols, chlorocatechols, and chlorinated fatty and resin acids) in mill effluents, receiving water and in the tissue of selected fish species must be measured and reported. Based on the results of the EEM studies, additional control options may be developed to protect sensitive ecosystems.

All mills submitted results of the first EEM cycle on April 1, 1996. A national compilation of the findings, including a federal-provincial evaluation of the results, is expected by the spring of 1997.

Sub-acute effects of pulp and paper mill effluents

Environment Canada is conducting research to identify which compounds in pulp and paper mill effluents are responsible for subacute effects in fish, and to develop means to control their formation and release. Previously, these effects were believed to be caused by chlorinated compounds, but ongoing research shows that nonchlorinated compounds also have a major effect. Results will allow pulp and paper mills to develop effective pollution prevention programs.

Organochlorines in organisms and sediment

Environment Canada, in collaboration with university and industry partners, is conducting research to identify the sources and chemical composition of approximately 80 per cent of the extractable organochlorines in organisms and sediments, which are currently unidentified. Initially, the study is focusing on the relative contributions from natural and anthropogenic organochlorines, and the sources and importance of chlorinated lipids in ecosystems. Results will be available in 1999.

Atmospheric transport, deposition and accumulation of persistent chlorinated substances

Through the Northern Contaminants Program under the Arctic Environmental Protection Strategy, Environment Canada, in cooperation with the Departments of Indian and Northern Development, Health, and Fisheries and Oceans, participated in a multi-year study on the atmospheric transport, deposition and accumulation in biota of persistent chlorinated substances in the Arctic. This study is complete. A report is being prepared and will be released in March 1997.

Chlorinated substances in the Great Lakes

As part of the Great Lakes-2000 Program, and through the International Atmospheric Deposition Network (IADN), Environment Canada continued to monitor the atmospheric transport and deposition of persistent chlorinated substances in the Great Lakes. New studies were initiated to determine sources of toxaphene, a persistent chlorinated pesticide, to the Great Lakes, in particular Lake Superior. These studies are due for release by March 1998.

STUDYING PUBLIC HEALTH AND SOCIO-ECONOMIC EFFECTS

Work by Health Canada to identify exposure levels and associated adverse effects, and to evaluate the risks to human health posed by a wide array of chemical substances, continues. This work, which is undertaken through such mandates as CEPA, the *Food and Drug Act* (FDA), the *Hazardous Products Act* (HPA) and the *Pest Control Products Act* (PCPA), frequently focuses on chlorinated substances.

Health studies

- Studies of the uptake, metabolism and excretion or of short-, medium-, or long-term toxicity of the following chlorinated substances are being carried out:
  - ▲ chlorobenzenes
  - ▲ chloroform
  - ▲ chlorinated or brominated drinking water by-products
  - ▲ dioxins (TCDD)
  - ▲ octachlorostyrene
  - ▲ PCBs
  - ▲ pentachlorophenol
  - ▲ toxaphene
  - ▲ tri- and tetrachloroethylene
- To protect human health, Health Canada has developed tolerances for organochlorine substances in foods and guidelines for drinking water. A list of such substances can be found in Appendix 5.
- Recent Health Canada research that examines the effects of chlorinated substances on community health and social structure includes:
  - ▲ the occurrence of chlorinated by-products in drinking water
  - ▲ the levels of organochlorine pesticides, PCBs, polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDDs and PCDFs) in foods and in human tissues, blood, milk and other body fluids
  - ▲ the effects of chlorinated substances in laboratory animal studies
  - ▲ the possible role chlorinated substances play in causing cancer, birth defects, reproductive and other health effects
- The results of these and other studies are used to identify high-risk groups and to formulate appropriate health protection and risk reduction measures, which include public information and education initiatives. Some studies have already been published. Others are expected to be published shortly. These studies are listed in Appendix 6.
- Under CEPA, Health Canada and Environment Canada are conducting risk assessments on five chlorinated substances (aluminum chloride, chloramines, chloroform, hexachlorobutadiene and road salts) on the second Priority Substance List (PSL II).
- The most recent market food basket analysis on contaminants in commercial food is underway, and the levels of chlorinated compounds detected in food samples will be reported in 1999.
- Studies on several fish-eating populations are underway. In one study, the levels of chlorinated pesticides among Great Lakes anglers tended to be only slightly above population averages.
- Three major health assessment reports, one for the Great Lakes Basin, one for the Arctic and one for the St. Lawrence River ecosystem, are nearing completion. Prepared in partnership with other agencies in Canada, the reports provide up-to-date information on contaminant levels in these populations. Levels of chlorinated substances are highest in Arctic populations and support the call for international control of persistent chlorinated compounds. The reports will be available in technical and summary formats and in electronic and print form over the next three years.

Socio-economic studies

Studies are underway to explore the social and economic implications of using chlorine and chlorinated substances and their alternatives.

- A chlorine supply and applications study completed in 1994 provides basic technical and economic data on chlorine use and supply in Canada.
- A socio-economic study on options and alternatives to the use of chlorine and chlorinated products in Canada is in draft form and is being reviewed by a multi-stakeholder group. A final report is expected by the end of 1996.

BETTER INFORMING THE CANADIAN PUBLIC

Informed Canadians are better equipped to make important environmental decisions. An important element in the Chlorinated Substances Action Plan is ensuring that the latest and best information is made available to Canadians in the most efficient manner.

Environment Canada's Green Lane on the Internet

Environmental information, including information on chlorine-containing substances, is now available electronically via Environment Canada's Green Lane. The Green Lane is the department's World Wide Web site on the Internet. It provides interactive access to Environment Canada services, products, information holdings, policies and programs. In addition to the *National Pollutant Release Inventory* and the *National State of the Environment Report*, the *Chlorinated Substances Action Plan Progress Report* is now available on the Green Lane. The URL (Uniform Resource Locator) for the Green Lane is: http://www/doe.ca

The National Pollutant Release Inventory (NPRI)

The NPRI is a national, comprehensive and publicly available database providing information on releases and transfers of 178 substances to air, water and land. The first summary report (1993) contains information on 35 chlorinated substances that enter the Canadian environment (see Appendix 7). Information on environmental releases reported to the NPRI will be published annually. The second NPRI report will be released in November 1996.

Consultations have begun on proposals to add more substances to the NPRI and to modify the criteria for reporting on existing and proposed additional substances. These proposed changes will increase by 32 the number of chlorinated substances for which reporting is required.

The National State of the Environment Report

The *National State of the Environment Report* is a comprehensive five-year overview of the state of Canada's environment. The third edition (*The State of Canada's Environment – 1996*) includes information on chlorinated substances such as PCBs, dioxins and pesticides in discussions of specific regional ecosystems, national perspective and toxic substances.

As of September 1996, over 2100 Internet users had browsed the electronic version of the third report and there were advance sales of over 2500 copies of the CD-ROM and print versions.

PROMOTING AND LEADING INTERNATIONAL EFFORTS

The Chlorinated Substances Action Plan provides a firm basis for Canada to establish a leadership role in international efforts to curtail harmful substances and to promote the wise use of chlorine-containing compounds. Chlorinated substances targeted for action through international protocols are listed in Appendix 8.

Action on POPs through UNECE and UNEP

After several years of effort by Canada, work is now underway to develop a protocol under the United Nations Economic Commission for Europe (UNECE) to control the atmospheric transportation of persistent organic pollutants (POPs). The protocol will require parties to undertake actions to reduce or eliminate certain POPs, including some chlorine-containing compounds. Negotiations should be complete by the winter of 1997/1998.

In May 1995, the United Nations Environment Program (UNEP) Governing Council agreed on the preparation of a global strategy for managing POPs. The Council invited the Intergovernmental Forum on Chemical Safety (IFCS) and other international organizations to develop such a strategy.

At a meeting held in June 1996 in the Philippines, socio-economic and other issues associated with the production and use of 12 targeted POPs (see Appendix 8) were examined. Information and recommendations on international action were also developed and will be considered at the 1997 sessions of the UNEP Governing Council and the World Health Assembly.

Canada-US binational virtual elimination strategy

Canada and the United States are developing a binational strategy for the virtual elimination of persistent toxic substances in the Great Lakes Basin. This initiative will promote reductions in the production, use and release of specific chlorinated substances, and will build on existing initiatives such as the Canada-Ontario Agreement and remedial action plans under the Great Lakes Program. The strategy should be complete by the winter of 1996/1997.

Global Programme of Action through UNEP

In November 1995, Canada and 110 other nations adopted the UNEP Global Programme of Action (GPA) for the Protection of the Marine Environment from Land-Based Activities and the Washington Declaration. POPs were among the eight source categories identified for action. Canada is planning to release its national Programme of Action in 1998, the International Year of the Oceans.

NAFTA-CEC

Under the North American Free Trade Agreement (NAFTA) Commission for Environmental Cooperation (CEC) Resolution on the Sound Management of Chemicals, Canada, the United States and Mexico have agreed to develop country-specific action plans to address the release of three targeted chlorinated substances (PCBs, DDT, chlordane) and mercury by December 1996.

Arctic Monitoring and Assessment Program

Under the Arctic Monitoring and Assessment Program (AMAP), a major assessment of the levels and effects of chlorinated contaminants by the eight circumpolar nations in the Arctic region is underway. A report will be available in 1997. Canada is playing a major role in the preparation of this report.

Appendix 1

SUBSTANCES LISTED IN APPENDIX 2 OF THE CANADA-ONTARIO AGREEMENT OF JULY 6, 1994

Tier I Substances	Tier II Substances
Aldrin/dieldrin*	Anthracene
Benzo(a)pyrene	Cadmium
Chlordane*	1,4-dichlorobenzene*
Dichlorodiphenyl Trichloroethane (DDT*	3,3'-dichlorobenzidine*
Hexachlorobenzene*	Dinitropyrene
Alkyl-lead	Hexachlorocyclohexane*
Mercury	4,4'-methylenebis(2-chloroaniline)*
Mirex*	Pentachlorophenol*
Octachlorostyrene*	Tributyl tin
PCBs*	17 PAHs as a group, including but not limited to:
Polychlorinated dibenzodioxins*	Benz(a)anthracene
Polychlorinated dibenzofurans*	Benzo(b)fluoranthene
Toxaphene*	Benzo(g,h,i)perylene
	Perylene
	Phenanthrene

* chlorinated substance

MOTOR VEHICLE MANUFACTURERS ASSOCIATION MEMORANDUM OF UNDERSTANDING

Chlorinated substances targeted

Polychlorinated biphenyls (PCBs)
Dichlorobenzenes
Hexachloroethane
Methylene chloride (dichloromethane)
Tetrachloroethylene
Trichloroethylene

Appendix 2

CHLORINATED SUBSTANCES TARGETED UNDER ARET

Substance	Annual Emissions (kg)		
	Base year	1995	2000 (projected)
LIST A-1			
Hexachlorobenzene	2.11	1.01	0.4
Alpha-hexachlorocyclohexane	*	*	*
Gamma-hexachlorocyclohexane	*	*	*
Octachlorostyrene	0.7	0	0
2,3,7,8-Tetrachloro-dibenzofuran	1.16	1.33×10^{-1}	1.74×10^{-1}
2,3,7,8-Tetrachloro-dibenzo-p-dioxin	0.13	1.70×10^{-2}	2.10×10^{-2}
Pentachlorophenol	539	11.7	3.8
4,4'-Methylenebis (2-chloroaniline)	RNEE	RNEE	RNEE
Polychlorinated biphenyls (PCBs)	0	4.15×10^{-4}	0
SUB-TOTAL	**543.1**	**12.7**	**4.22**
REDUCTION ACHIEVED		**98%**	**99%**

* None Reported
RNEE = Reported but no emission estimates

CHLORINATED SUBSTANCES TARGETED UNDER ARET

Substance	Annual Emissions (kg)		
	Base year	1995	2000 (projected)
LISTS A-2 and B			
1,4-Dichlorobenzene	27,706	10,822	10,004
3,3'-Dichlorobenzidine	RNEE	RNEE	RNEE
Hexachlorocyclopentadiene	6	6	6
2,4,6-Trichlorophenol	4,211	933	319
Alpha-chlorotoluene	*	*	*
Bis (2-chloroethyl) ether	8	ND	ND
Bromodichloromethane	127	18	18
Carbon tetrachloride	81,286	9,785	385
Chloroform	568,476	245,297	156,753
Chlorodibromomethane	301	298	300
1,2-Dichloroethane	71,329	7,995	7,117
Methylene chloride	56,905	44,427	25,278
1,1,2,2-Tetrachlroethylene	266,124	120,311	8,200
2,3,4,6-Tetrachlorophenol	361	72	58
Bis (chloromethyl) ether	*	*	*
1-Bromo-2-chloroethane	*	*	*
1-Chloro-4-nitrobenzene	*	*	*
1,2-Dibromo-3-chloropropane	*	*	*
1,2-Dichlorobut-3-ene	*	*	*
2,4-Dichlorophenol	1,161	379	5
1,3-Dichloropropene	RNEE	RNEE	RNEE
Epichlorohydrin	751	1	1
1,1,2-trichloroethylene	126,957	30,696	26,026
Chlorine dioxide	2,052,896	592,612	388,967
SUB-TOTAL	**3,258,606**	**1,063,652**	**623,437**
REDUCTION ACHIEVED		**67%**	**81%**
TOTAL	**3,259,148**	**1,063,665**	**623,441**
REDUCTION ACHIEVED		**67%**	**81%**

* None Reported
RNEE = Reported but no emission estimates
ND = Nondetectable

Appendix 3

WILDLIFE PUBLICATIONS RELATED TO CHLORINATED SUBSTANCES

Bishop, C.A., M.D. Koster, A.A. Chek, D.J.T. Hussell and K.Jock. 1995. Chlorinated hydrocarbons and mercury in sediments, Red-winged Blackbirds (Agelaius phoaniceaus) and Tree Swallow (Tachycineta bicolor) from wetlands in the Great Lakes -St.Lawrence River Basin Environmetal Toxicology Chemistry 14(3): 491-501 Published

Chu, I.,D.C.Villeneuve,A Yagminas, P.LeCavalier, H.Hakansson, U.G. Ahlborg, V.E. Valli, S.W.Kennedy, A.Bergman, R.F.Seegal and M.Feeley.1995. Toxicity of PCB 77 (3,3=, 4,4=-tetrachlorobiphenyl) and PCB 118 (2,3=, 4, 4=-pentachlorobiphenyl) in the rat following subchronic dietary exposure. Fundamental Applied Toxicology 26: 282-292 Published

Chu, I.,D.C.Villeneuve,A Yagminas, P.LeCavalier, R. Poon, M.Feeley, S.W.Kennedy, R.F.Seegal, H.Hakansson, U.G.Ahlborg and V.E.Valli. 1995. Subchronic toxicity of 3,3=,4,4=,5-pentachlorobiphenyl in the rat. I. Clinical, biochemical, hematologial, and histopathologial changes. Fundamental Applied Toxicology 26: 457-468 Published

Harfenist, A., P.E. Whitehead, W.J.Cetney and J.E. Elliott. 1995. Food chain sources of polychlorinated dioxins and furans to Great Blue Herons (Ardea herodias) foraging in the Frasier River Estuary, British Columbia CWS Technical Report Series No.169, Pacific and Yukon Region Published

Herbert, C., M. Gamberg, L. Mychasiw, B.T.Elkin, M.Simon and R.J.Norstrom. 1995. Polychlorinated dibenzodioxins, dibenzofurans and non-ortho polychlorinated biphenyls in Caribou (Rangifer tarandus) from Canadian Artic Science of the Total Environment. At press

Hensel, D.S.J.W. Martin, R.Norstrom, P.Whitehead, J.D.Steeves and K.M Cheng. 1995. Morphometric abnormalities in brains of great blue heron hatchlings exposed in the wild to PCDDs Environmental Health Perspective 103(Suppl 4): 61-66 Published

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Letcher, R.J., R.J.Norstrom and . Bergman. 1995. An integrated analytical method for determination of polychlorinated aryl methyl sulfone metabolites and polychlorinated hydrocarbon contaminants in biologial matrices Anal. Chem. 67: 4155-4163 Published

Lorenzen, A. and S.W. Kennedy. 1995. Sensitivities of chicken and pheasant embryos and cultured embryonic hepatocytes to cytochrome P4501A induction and porphyrin accumulation by TCDD, TCDF and PCBs Organohalogen Compounds 25: 65-68 Published

Ludwig, J.P., H.J.Auman, D.V.Weseloh, G.A. Fox, J.P. Giesy and M.E. Ludwig. 1995. Evaluation of the effects of toxic chemicals in the Great Lakes cormorants; Has causality been established. In: Nettleship,D.N. and D.C. Duffy (Eds.), pp.60-69 The Double-crested Cormorant: Biology, conservation and management. Colonial Waterbirds 18 (special publication 1: 1-256) Published

Martin, P.A., D.V.Weseloh, C.A.Bishop, K.Legierse, B.Braune and R.J.Norstrom. 1995. Organochlorine Contaminants in Avian Wildlife of Severn Sound Water Quality, Research Journal of Canada 30(4): 693-711 Published

Phaneuf, D., J.L.DesGranges, N. Plante and J.Rodrigue,1995. Contamination of local wildlife following a fire at a PCB warehouse in St-Basile le Grand, Quebec Archives Environmental Contamination and Toxicology. 28: 145-153 Published

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Wayland, M..1995. Environmental Contaminants in Prefledged Common Mergansers Wapiti River, August,1992. Report to the Northern River Basins Study No.48, Edmonton, Alberta Published

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Zhu, J, R.J.Norstrom, D.C.G.Muir,L.A.Ferron, J-P.Weber, and E.Dewailly. 1995. Persistent chlorinated cyclodiene compounds in Ringed seal, polar bear and human plasma from Northern Quebec, Canada: Identification and concentrations of photoheptachlor Environ. Sci. Technol. 29: 267-271 Published

Appendix 4

ENVIRONMENTAL QUALITY GUIDELINES FOR PRIORITY CHLORINATED SUBSTANCES

Water quality guidelines (fresh water)

Aldrin
Atrazine
Chlordane
Chlorinated benzenes (under revision)
Chlorinated ethanes
Chlorinated phenols (under revision)
Chlorinated methanes
Chlorothalonil*
Cyanazine
Dichlorodiphenyltrichloroethane (DDT)
Dicamba
Diclofop-methyl
Dieldrin
Endosulfan
Endrin
Heptachlor
Heptachlor epoxide
Hexachlorobutadiene
Hexachlorocyclohexane
Lindane
Linuron
MCPA*
Metolachlor
Phenoxy herbicides (2,4-d)
Picloram
Polychlorinated biphenyls (PCBs)*
Simazine
Tetrachloroethylene
Toxaphene
Triallate
Trichloroethylene

Water quality guidelines under development (fresh water)

1,2,3,4-tetrachlorobenzene
1,2,4,5-Tetrachlorobenzene
1,2,3,5-Tetrachlorobenzene
1,2,3-Trichlorobenzene
1,2,4-Trichlorobenzene**
1,2-Dichlorobenzene**
1,3,5-Trichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
Chloramines**
Chlorine**
Chloropyrifos
Hexachlorobenzene
Monochlorobenzene**
Pentachlorbenzene
Polychlorinated dibenzodioxins**
Polychlorinated dibenzofurans**

Sediment quality guidelines under development

Chlordane
Dichlorodiphenyldichloroethane (DDD)
Dichlorodiphenyldichloroethylene (DDE)
DDT (total)
Dieldrin
Endrin
Heptachlor epoxide
Lindane
PCBs
Polychlorinated dibenzodioxins
Polychlorinated dibenzofurans
Toxaphene

Soil quality guidelines under development

Dichlorodiphenyl trichloroethane (DDT)
PCBs
Pentachlorophenol
Tetrachloroethylene
Trichloroethylene

Tissue residue guidelines under development

DDT (total)
PCBs
Polychlorinated dibenzo-p-dioxins
Polychlorinated dibenzofurans
Toxaphene

* Marine quality guidelines also available

** Marine quality guidelines also under development

Appendix 5

CHLORINATED SUBSTANCES FOR WHICH DRINKING WATER QUALITY GUIDELINES AND/OR FOOD TOLERANCE HAVE BEEN ESTABLISHED BY HEALTH CANADA

1,1-Dichloroethylene
1,2-Dichlorobenzene
1,2-Dichloroethane
1,4-Dichlorobenzene
2,3,4,6-Tetrachlorophenol*
2,4,6-Trichlorophenol*
2,4-Dichlorophenol*
Aldrin + dieldrin
Atrazine + n-dealkylated metabolites
Atrazine + metabolites*
Carbon tetrachloride
Chloramines
Chlorpyrifos*
Cyanazine*
Dicamba*
Dichlorophenoxyacetic acid, 2,4- (2,4-d)*
Dichlorormethane
Diclofop-methyl*
Methoxychlor*
Metolachlor*
Pentachlorophenol*
Picloram*
Simazine*
Trichloroethylene
Trihalomethanes (total)
Vinyl chloride

* Food Tolerances established under the Food and Drug Act

Appendix 6

HEALTH PUBLICATIONS RELATED TO CHLORINATED SUBSTANCES PRIOR TO 1995

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Conacher, HBS,; Mes, J.; (1993) Assessment of human exposure to chemical contaminants in foods. Food Additives and Contaminants, 10 (1): 5-15

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Mes, J.; Davies, D. J.; Doucet, J.; Weber, D.; McMullen, E.; (1993) Specific polychlorinated biphenyl congener distribution in breast milk of Canadian women. Environmental Technology, 14(6):. 555-565

Mes, J.; Davies, D. J.; Doucet, J.; Weber, D.; McMullen, E.; (1993) Levels of chlorinated hydrocarbon residues in Canadian human breast milk and their relationship to some characteristics of the donors. Food Additives and Contaminants, 10(4): 429-441

Mes, J.; Malcolm, S.; (1992) Comparison of chlorinated hydrocarbon residues in human populations from the Great Lakes and other regions of Canada. Chemosphere, 25(3): 417-424

Moir, D.; Marwood, T. M.; Moody, R. P.; (1994) In vitro cutaneous metabolism of DDT, in human and animal skins. Bulletin of Environmental Contamination and Toxicology, 52(3): 474-478

Moody, R. P.; Nadeau, B.; (1994) Nitrile butyl rubber glove permeation of pesticide formulations containing 2, 4-D-amine, DDT, DEET, and diazinon. Bulletin of Environmental Contamination and Toxicology, 52(1): 125-130

Newsome, W. H.; Davies, D.; Doucet, J.; PCB and organochlorine pesticides in Canadian human milk, 1992. Chemosphere 30 (11): 2143-53

Poon, R.; Chu, I.; Lecavalier, P.; Bergman, A.; Villeneuve, D. C.; (1994) Urinary ascorbic acid--HPLC determination and application as a noninvasive biomarker of hepatic response. Journal of Biochemical Toxicology. 9 (6): 297-304

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Appendix 7

CHLORINATED SUBSTANCES ON THE NATIONAL POLLUTANT RELEASE INVENTORY (NPRI)

Inorganic Acids
Hydrochloric acid

Other Inorganic Substances
Chlorine
Chlorine dioxide
Titanium tetrachloride

Qualified Organic Substances - Colourants
C.I. Food Red 15 ($C_{18}H_{31}ClN_2O$)
C.I. Basic Green ($C_{23}H_{25}ClN_2$)

Metals (and their compounds)
Antimony chloride oxide
Antimony dichlorotrifluoride
Antimony pentachloride
Antimony trichloride
Arsenic trichloride
Cadmium chloride
Chromic chloride
Chromous chloride
Chromyl chloride

Halogenated Organic Substances
1,1,2,2-Tetrachloroethane
1,1,2-Trichloroethane
1,2-Dichloroethane
1,2-Dichloropropane
2,4-Dichlorophenol
4,4'-Methylenebis (2-chloroaniline)
Allyl chloride
Alpha chlorotoluene
Benzyl chloride
Carbon tetrachloride
Chloroacetic acid
Chloroethane
Chloroform
Chloromethane
Chloromethyl methyl ether
Dichloromethane
Epichlorohydrin
Ethyl chloroformate
Hexachlorocyclopentadiene
Hexachloroethane
Phosgene
Tetrachloroethylene
Trichloroethylene
Vinyl chloride
Vinylidene chloride
Chlorobenzenes
1,2,4-Trichlorobenzene
Chlorobenzene
o-Dichlorobenzene
p-Dichlorobenzene

Appendix 8

CHLORINATED SUBSTANCES TARGETED FOR INTERNATIONAL ACTION

Substances	UN ECE LRTAP	UNEP	Proposed CAN/U.S. Bilateral Strategy	NAFTA/CEC
Aldrin	●	●	●	
Chlordane	●	●	●	●
Chlorodecone	[●]			
Short-chain chlorinated paraffins	[●]			
DDT (+DDD+DDE)	●	●	●	●
Dieldrin	●	●	●	
Endosulfan	[●]			
Endrin	●	●		
Heptachlor	[●]	●		
Hexachlorobenzene	●	●	●	
Lindane	[●]			
Mirex	●	●	●	
Octachlorostyrene			●	
PCBs	●	●	●	●
PCDDs (dioxins)	●	●	●	
PCDFs (furans)	●	●	●	
Pentachlorophenol	●			
Quintozene (pentachloronitrobenzene)	[●]			
Toxaphene	●	●	●	

[●] Decisions have not been taken on whether to include these substances in the initial POPs Protocol
UN ECE = United Nations Economic Commission of Europe
LRTAP = Long Range Transportation of Air Pollutants
UNEP = United Nations Environmental Program
NAFTA = North American Free Trade Agreement
CEC = Commission for Environmental Cooperation

Appendix 9

PROGRAMS & MEASURES DEALING WITH CHLORINATED SUBSTANCES

CHEMICAL SUBSTANCE	PROGRAMS/MEASURES IN PLACE OR UNDER DEVELOPMENT						
	CEPA	ARET	NPRI	AGREEMENTS	GUIDELINES / CODES	REGULATIONS	INTERNAT'NL ACTIONS
ORGANIC							
1,1-Dichloroethylene					●		
1,1,1-Trichloroethane (methyl chloroform)	●			●	●	●	●
1,1,2,2-Tetrachloroethane			●		●		
1,2-Dibromo-3-chloropropane		●					
1,2-Dichlorobenzene					●		
1,2-Dichlorbut-3-ene	●	●					
1,2-Dichloroethane		●	●	●	●		
1,2-Dichloropropane			●	●			
1,2,4-Trichlorobenzene			●		●		
1,3-Dichloropropylene		●					
1,4-Dichlorobenzene		●	●	●	●		●
1-Bromo-2-chloroethane		●			●		
1-Chloro-4-nitrobenzene		●			●		
2,3,4,6-Tetrachlorophenol		●			●		
2,3,7,8-Tetrachlorodibenzodioxin	●	●		●	●	●	●
2,3,7,8-Tetrachlorodibenzofuran	●	●		●	●	●	●
2,4,6-Trichlorophenol		●		●	●		
2,4-Dichlorophenol		●	●		●		
3,3'-Dichlorobenzidine	●	●		●			●
4,4'-Methylenebis(2-chloroaniline)		●	●				
Allyl chloride			●				
Alpha-chlorotoluene		●	●	●			
Alpha-hexachlorocyclohexane		●					●
Benzoyl chloride			●				
Bis(chloromethyl)ether	●	●				●	
Bis(2-chloroethyl)ether		●					

ARET = Accelerated Reduction / Elimination of Toxics
CEPA = Canadian Environmental Protection Act
NPRI = National Pollutant Release Inventory
CODES = Code of Practice
Guidelines: Technical, Environmental Quality, Drinking Water Quality, or Food Tolerances
● Programs / Measures in place or under development

CHEMICAL SUBSTANCE	PROGRAMS/MEASURES IN PLACE OR UNDER DEVELOPMENT						
	CEPA	ARET	NPRI	AGREEMENTS	GUIDELINES / CODES	REGULATIONS	INTERNAT'NL ACTIONS
ORGANIC							
Carbon tetrachloride	●	●	●	●	●	●	●
Chloranil (tetrachlorobenzoquinone)				●			
Chloroacetic acid			●				
Chloromine	●						
Chlorobenzene			●				
Chlorodibromomethane		●					
Chloroethane			●	●			
Chloroform	●	●	●	●	●		
Chloromethane			●	●	●		
Chloromethyl methyl ether	●		●			●	
Dechlorane	●						
Dichlorobromomethane		●					
Dichlorophenoxyacetic acid					●		
Dichloromethane (methylene chloride)	●	●	●	●	●		
Ethyl chloroformate			●				
Epichlorohydrin	●	●	●	●			
Hexachlorobutadiene	●				●		
Hexachlorocyclopentadiene		●	●				
Hexachloroethane			●	●			
Octachlorostyrene		●		●			●
Polychlorinated biphenyls (PCBs)	●	●		●	●	●	●
Pentachlorobenzene							●
Quintozene (pentachloronitrobenzene)							●
Polychlorinated terphenyls	●					●	
Phosgene (carbonyl chloride)			●				
Tetrachlorobenzene							●
Tetrachloroetyhlene (perchloroethylene)	●	●	●	●	●		
Trichloroethylene	●	●	●	●	●		
Trihalomethanes					●		
Chlorinated paraffins	●						●
Bromochlorodifluoromethane	●					●	●
Chlorofluorocarbons	●					●	●
Chlorinated wastewater effluents	●			●			●
Vinyl chloride	●		●		●	●	
Vinylidene chloride			●				

CHEMICAL SUBSTANCE	PROGRAMS/MEASURES IN PLACE OR UNDER DEVELOPMENT						
	CEPA	ARET	NPRI	AGREEMENTS	GUIDELINES / CODES	REGULATIONS	INTERNAT'NL ACTIONS
INORGANIC							
Aluminum chloride	●						
Antimony dichlorotrifluoride			●				
Antimony chloride oxide			●				
Antimony trichloride			●				
Antimony pentachloride			●				
Arsenic trichloride			●		●		
Cadmium chloride			●		●		
Chlorine			●				
Chlorine dioxide		●	●	●			
Chromic chloride			●		●		
Chromous chloride			●		●		
Chromyl chloride			●		●		
Hydrochloric acid			●		●		
Nickel chloride	●						
Titanium tetrachloride			●	●			

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Guidelines: Technical, Environmental Quality, Drinking Water Quality, or Food Tolerances
● Programs / Measures in place or under development

CHEMICAL SUBSTANCE	PROGRAMS/MEASURES IN PLACE OR UNDER DEVELOPMENT						
	CEPA	ARET	NPRI	AGREEMENTS	GUIDELINES / CODES	REGULATIONS	INTERNAT'NL ACTIONS
PESTICIDES (governed by the Pest Control Product Act)							
Aldrin (no longer registered – 1985)				●	●		●
Atrazine (registered 1985)					●		
Chlordane (discontinued – 1990)				●	●		●
Chlordecone(discontinued – 1995)							●
Chlorothalonil (registered)					●		
Cyanazine (registered)					●		
Chlorpyrifos(registered)					●		
DDD (DDT metabolite)					●		●
DDE (DDT metabolite)					●		●
DDT (discontinued)				●	●		●
Dicamba (registered)					●		
Diclofop-methyl (registered)					●		
Dieldrin (discontinued – 1990)					●		●
Endosulfan (registered)					●		●
Endrin (discontinued – 1990)					●		●
Heptachlor (discontinued)					●		●
Heptachlor epoxide (never registered)					●		●
Hexachlorobenzene (discontinued – 1976)	●	●		●	●		●
Hexachlorocyclohexane (lindane) (registered)		●		●	●		●
Linuron (registered)					●		
MCPA (registered)					●		
Methoxychlor (registered)					●		●
Metolachlor (registered)					●		
Phenoxy herbicides (2,4-D) (registered)					●		
Pentachlorophenol (limited registration – 1990)		●		●	●		●
Picloram (registered)					●		
Simazine (registered)					●		
Mirex (never registered)				●		●	●
Toxaphene (discontinued)				●	●		●
Triallate (registered)					●		

ARET = Accelerated Reduction / Elimination of Toxics
CEPA = Canadian Environmental Protection Act
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Guidelines: Technical, Environmental Quality, Drinking Water Quality, or Food Tolerances
● Programs / Measures in place or under development

Appendix 10

Industry progress relative to the Chlorinated Substances Action Plan*

1.0 Overview

The participants in the Canadian Chlorine Coordinating Committee (C4) support Environment Canada's Chlorinated Substances Action Plan and its comprehensive approach to the management of chlorinated substances. This support is demonstrated through both voluntary and regulated action.

The Vision of C4 is "The Responsible Use of Chlorine Chemistry Resulting in Societal Benefit Recognized by the Public". The Mission and Principles of C4 are available from the C4 office.

2.0 Targeted Action

2.1 Stewardship Case Studies

In order to demonstrate company stewardship in a concise readable form, C4 is producing a series of brief case studies of industrial action.

A sample case study involves Dupont Canada at their Kingston plant. Sampling under Ontario's Municipal and Industrial Strategy for Abatement program revealed for the first time in 1992 dioxin in the effluent at a level which would total less than one gram per year. Since technically dioxin could not be created in the process, raw materials for the fibre spinning process were tested and the source was found to be a biocide used in cooling water.

Within 48 hours of this finding, the biocide was replaced and subsequent effluent testing confirmed the absence of dioxins in the effluent. This was in compliance with the Dupont company policy to eliminate toxics from effluents and was recognized under Ontario's P4 program.

Copies of this and other case studies are available from the C4 office.

2.2 Responsible Care ®

Responsible Care, an ethic of the Canadian Chemical Producers' Association (CCPA), is backed up by 6 codes of practice with 156 elements of sound environmental and safety management in all phases of a company's operations and products. Many C4 participants are also CCPA members. A leadership group of company CEO's are key to the ethical focus and peer pressure support.

Each member company of the CCPA has subscribed to the following guiding principles:

- ensure that its operations do not present an unacceptable level of risk to employees, customers, the public or the environment
- provide relevant information on the hazards of chemicals to its customers, urging them to use and dispose of products in a safe manner, and make such information available to the public on request
- make Responsible Care an early and integral part of the planning process leading to new products, processes or plants
- increase the emphasis on the understanding of existing products and their uses and ensure that a high level of understanding of new products and their potential hazards is achieved prior to and throughout commercial development
- comply with all legal requirements which affect its operations and products
- be responsive and sensitive to legitimate community concerns
- work actively with and assist governments and selected organizations to foster and encourage equitable and attainable standards.

Six codes have been developed focusing on the following areas:

- Community awareness and emergency response (includes a policy on community right-to-know)
- Research and development
- Manufacturing
- Transportation
- Distribution
- Hazardous waste management (includes a policy on hazardous waste management)

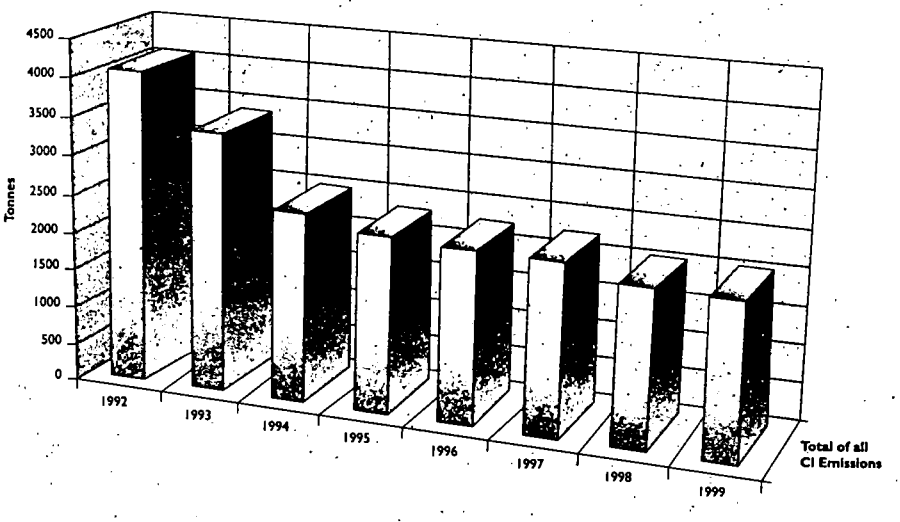
*This appendix, prepared by the Canadian Chlorine Committee, an alliance of 10 industry associations and 22 companies, is included in this report for information purposes only.

The measure of performance of the CCPA's National Emission Reduction Master Plan is a 50% reduction in the total emissions (except carbon dioxide) since 1992 with a projection of a further 50% reduction from current levels by 1999. In addition, the trend is to fewer transportation incidents with lower impact and fewer and less severe occupational injuries. On-going work involves development of measurement for product stewardship and community involvement performance. Verification of Responsible Care implementation, by peers and the public, is mandatory for participants.

2.3 Memoranda of Understanding (MOU)

Industry has made voluntary commitments to emission reduction and pollution prevention and has confirmed these commitments through Memoranda of Understanding with federal and provincial Governments. CCPA has MOU's with the governments of Canada, Quebec, B.C. and Alberta. The polyvinyl chloride (PVC) industry has an MOU with the Government of Canada under development.

Total Emissions of Chlorine Compounds from CCPA Sites



3.0 Improving Scientific Understanding

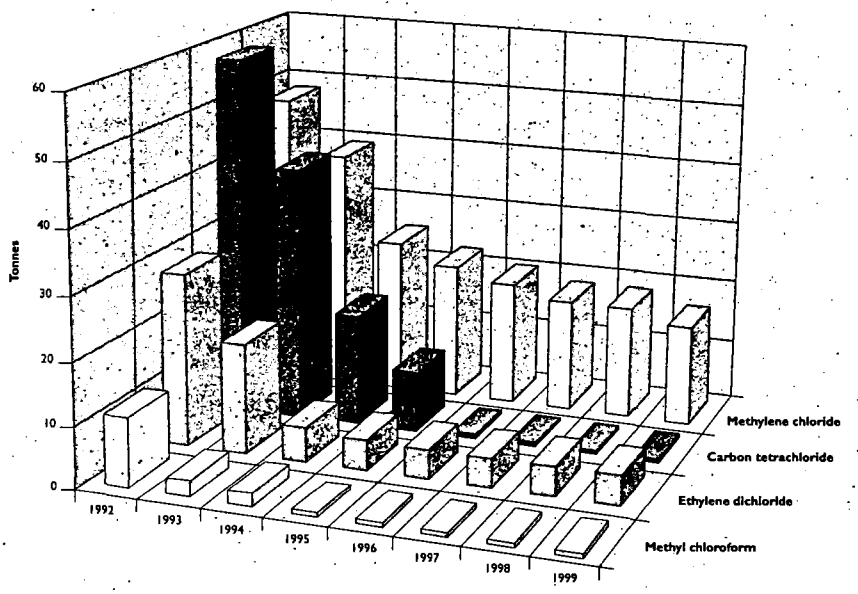
As part of a program to increase knowledge regarding chlorine chemistry and to promote science based decision making, C4 embarked on a research program beginning in 1994. A team of volunteer researchers from universities, hospitals and government was assembled as a Science Advisory Group. This group assisted in identifying gaps in research and in establishing key research areas for the program. A Research Advisor was engaged and research guidelines developed.

To date, thirteen projects have been funded at a cost of $620,000. over two years. Wherever possible, these funds are leveraged through joint funding with government, university or other industrial contributors. In order to avoid duplication, the program is coordinated with an extensive program of research funded by the Chlorine Chemistry Council in the USA.

Projects have been funded in the areas of environmental effects, endocrine effects, reproductive toxicology, risk assessment, risk communication, and dose response for dioxin-like compounds. Short descriptions of the projects and the project leaders are as follows:

- A government and industry-sponsored chair at Trent University for Dr. D. Mackay allows him to continue to develop, enhance, and apply computer models for use in assessing, evaluating, and regulating both existing priority chemicals and new substances.
- Dr. T. Zacharewski of the University of Western Ontario is examining certain natural and man-made compounds to determine if they produce some effects similar to the female hormone estrogen.
- Dr. G. van der Kraak of the University of Guelph is investigating the environmental effects of a number of chemicals, using fish biochemical tests, as well examining their reproductive activity.

Examples of Chlorine Compound Emissions from CCPA Sites



■ Dr. C. Metcalfe of Trent University is working on development of chemical-specific risk assessment methodologies. Initial work will be carried out on about a dozen chemicals to examine the variations in environmental risk posed by related compounds.

■ Dr. R. J. Norstrom of Carleton University is working on developing a chemical analysis protocol for determining PCB metabolites in human blood plasma and milk.

■ Dr. D. Muir of the University of Manitoba is conducting biological investigations, using fish, to determine the bioaccumulation and toxicity characteristics of several types of chlorinated compounds.

■ Dr. J. Zhu of JP Ztech Company and Dr. L. Chan of McGill University are examining the family of chlorinated compounds known as toxaphene (also known as chlorobornanes or chlorocamphenes) to determine the major compounds present in traditional foods of the Canadian Arctic. These compounds will also be tested to assist in evaluation of possible health effects.

■ Dr. P. J. Silk of the Research and Productivity Council of New Brunswick is examining the occurrence and sources (natural and man-made) of several chlorinated substances in peatlands in Maritime Canada.

■ Dr. M. T. Scholtz of ORTECH Corporation, and interim Director of the Canadian Global Emissions Inventory Centre, is completing a project reviewing available literature summarizing atmospheric emissions of chlorinated compounds in North America.

■ A jointly funded (industry, government, and university) chair in risk communication and public policy expected to be in place in 1997, is to be established to study a wide range of health and environmental issues, to evaluate the issues from the prospective of both experts and the general public, and to recommend improvements in the risk communication process in order to facilitate efficient and effective public decision making.

■ Dr. T. Watson of Triton Environmental Consultants Ltd. is examining available Canadian data on organochlorines in human breast milk and information concerning possible health effects.

■ Dr. D. Avard of the Canadian Institute of Child Health is coordinating a national study on the impact of the environment on children's health. Environmental chemicals in general, and organochlorines in particular, represent one of the many areas of potential concern that will be evaluated.

■ Drs. R. M. Moore and R. L. White of Dalhousie University are studying sources and estimating amounts of selected organochlorine compounds which are produced by natural oceanic processes and may contribute to stratospheric ozone depletion.

4.0 Socio-economic and Public Health studies

C4 has cooperated and provided input as appropriate to two Environment Canada Studies entitled, "Chlorine Supply and Applications" (complete), and "A Technical and Socio-economic Evaluation of Options to the Use of Products derived from the Chlor-Alkali Industry" (draft). The latter study is currently under review.

To supplement these government funded studies, industry sponsored a study by Charles River Associates entitled "Assessment of the Economic Benefits of Chlor-Alkali Chemicals to the United States and Canadian Economies" (1993), and more recently, "Assessment of the Impact on the Automotive Industry of a Potential Ban on the use of Chlorine Chemistry" (1996).

Because of the complexity of the 12,500 components, 100 sub-systems and 12 major systems in the typical automobile, the latter study focused on three materials, namely steel, PVC, and titanium dioxide. For the limited portion of automobiles studied, a move away from chlorine chemistry suggested an initial cost of $147.23 per vehicle or a $2.2 billion annual cost in North America, in addition to an additional 25 million pounds per year of waste to landfills.

The research program related to public health studies is covered under Section 3.0 – Improving Scientific Understanding.

5.0 Better Information to Canadians

C4 is committed to providing more information to Canadians to assist in better environmental decisionmaking.

Researchers supported by the organization's research program are encouraged to publish results in the technical literature with the results available to all.

Emission reporting is also encouraged through participation in programs such as CCPA National Emissions Reduction Masterplan (NERM), the National Pollutant Release Inventory, and the Accelerated Reduction and Elimination of Toxics Program.

For results of these programs, reference is made to CCPA's 1994 Reducing Emissions Report, the ARET Environmental Leader's Report and the summary report of the National Pollutant Release Inventory.

Exhibits 1 and 2, taken from NERM data, indicate the total emissions of chlorine based compounds from CCPA sites during 1992, with projections to 1999. Similar graphs are available for other substances.

6.0 International Action

Industry representatives support the principles and risk based decision making approaches underlying Canada's Toxic Substances Management Policy and its Chlorinated Substances Action Plan and have worked cooperatively with Environment Canada to promote the Canadian approach in international negotiations and discussions. Specifically, in relation to the discussions regarding persistent organic pollutants (POPs), Canadian industry worked with its international counterparts in the International Council of Chemical Associations and the World Chlorine Council to support implementation of the Canadian approach to POP's in discussions at the United Nations Economics Commission for Europe and the International Forum on Chemical Safety/United Nations Environmental Program.

Industry supports the Canadian policy approach as well in discussions involving the Bi-national Virtual Elimination Strategy for the Great Lakes, and the North American Commission for Environmental Cooperation.

7.0 Conclusions

C4 participants have accepted the challenge to industry based on identified areas of concern and are happy to showcase progress in these areas and their compliance with the Chlorinated Substance Action Plan.

The industry believes the public would be better served through greater recognition of the role of responsible initiatives such as Responsible Care program, the Accelerated Reduction and Elimination of Toxics program, and reporting mechanisms such as NERM and NPRI.

Continued support can be expected for sound policies based on good science and risk-based decisionmaking.