

A RETROSPECTIVE SOCIOECONOMIC OVERVIEW OF CONTROL MEASURES FOR CHLORINATED SUBSTANCES.

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Introduction.

Environment Canada's Chlorinated Substances Action Plan (CSAP) indicates that the overall Canadian federal approach is to "prune the chlorine use tree, and not cut it down". At the Canadian federal level proposed and applied control measures relative to chlorinated substances follow principally from the "targeted action" component of the CSAP, the Toxic Substances Management Policy, and the legislation of the Canadian Environmental Protection Act (CEPA). In support of the Canadian Federal government's Chlorinated Substances Action Plan, two socio-economic studies have been completed:

- the Chlorine Balance study, which estimated and documented the Canadian chlorine supply and applications, and
- the Chlorine Options study which involved the identification and assessment of selected substitutes for chlorine and chlorinated substances applications in Canada.

In some of the alternatives examined, some companies, and indeed, whole industries, have already started to move away from the use of chlorine and chlorinated substances in their plant operations. For example, due to federal and provincial regulations in the pulp and paper industry, there have been substantial reductions in the use of elemental chlorine in the bleaching process. Furthermore, under the Montreal Protocol, the use of chlorinated refrigerants and certain solvents are being phased out.

Other uses of chlorinated substances are presently under review for regulation and possible reductions and/or phase-outs. These actions have taken place, and are continuing in other countries, such as the United States, Sweden and Germany. Examples include: Sweden's National Chemicals Action Plan calls for mandated phase-outs of chlorinated solvents and all soft/rigid PVC with harmful additives, and actions on all chlorinated pesticides and the use of chlorine in pulp and paper; in Germany, there are proposed policies to limit PVC applications subject to accidental fires; in the U.S., Louisiana Pacific, in agreement with EPA, is planning to move to Total Chlorine Free bleaching at one mill, so as to become the first closed-loop facility. Other initiatives include water and wastewater disinfection systems where UV is being substituted for chlorine. Research and development of alternatives for chlorinated substances as chemical intermediates (so-called Green Chemistry) has been increasing. For example, Dow produces about 1/2 U.S. production of propylene oxide using a chlorine intermediate, whereas, Arco produces the other half using a non-chlorine intermediate.

There are also some market-driven actions to move away from the use of PVC and phthalate plasticizers in toys and electric cable casings. There is also concern about chlorinated solvents and pesticides, and market movements to reduce their use. As well, there is some movement towards chlorine- and additive-free intravenous bags by the medical community. More generally, over the

last 20 years or longer, in North America and elsewhere, there have been production bans, use restrictions, and phase-outs of a number of particularly troublesome industrial chemicals and pesticides, such as PCBs, DDT, and CFCs. In these cases, alternative products have been found, and industry and the economy have adjusted with profitability maintained. Firms and consumers have been able to adapt to these changes because adaptation is the norm for competitive industries and their constituent firms. In some cases, such as the transition away from CFCs, the producing industries were able to adapt without great economic hardship, and the economic dislocations initially predicted did not materialise. Similar results were experienced in the context of the costs of sulphur dioxide emission reductions, and the costs of catalytic converters.

This present report comprises Phase I of a broad retrospective analysis of socio-economic impacts related to chlorinated substance control measures implemented in Canada and in other nations. Its purpose, when complete, is to provide both an international retrospective overview, and detailed case studies of socio-economic impacts associated with control measures for chlorinated substances.

Materials and Methods

Research for this report sought ex-ante and ex-poste socio-economic analysis to support more detailed chlorinated substance implemented measures case studies to be conducted in Phase II of the project.

The methodology employed to obtain the descriptive documentation regarding control measures and socio-economic studies related to chlorinated substances was two fold;

- a) a literature review,
- b) a survey of knowledgeable contacts.

Results and Discussion

The results available at this writing are from the interim report on the Phase I study. Coverage at this stage includes Canada and the United States, which are documented both in terms of control measures and existing socio-economic studies. For Europe, control measures are described for the European Union, Sweden, Netherlands, and Germany, while available socio-economic studies are described in the four governments mentioned above, as well as the United Kingdom and Denmark.

It was found that there are many different types of control measures typically used to regulate chlorinated substances. The emphasis amongst individual types varies from country to country examined.

The large number of chlorinated substances and the myriad laws and agencies used to regulate them, make it impossible to provide a comprehensive report in this extended abstract. However, Table 1 provides representative examples listed in a four part classification system of chlorinated substances which was used to organize the pertinent parts of the Phase I report.

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Table 1. Classification of Commonly Regulated Chlorinated Substances and Control Measures

General Control Type	Chlorinated Substances	Sectors Affected	Specific Control Measures Used
Product Use (Non-Pesticide)	Ozone depleting chemicals (e.g., CFCs, HCFCs, carbon tetrachloride, 111-trichloroethane)	refrigeration, air conditioning, polyurethane foam blowing, industrial de-greasing, consumer products (e.g., aerosols)	use/production phase-out regulations, taxes (U.S.A), tradable permits (Canada, U.S.A)
	PCBs	electric utilities, other large institutions with electrical generators or transformers (e.g., hospitals)	use/ production phase-out regulations, use regulations typically based on allowable PCB concentration limits
	chlorinated solvents (e.g., tetrachloroethylene, trichloroethylene, dichloromethane)	dry-cleaning, industrial de-greasing, paint-stripping, foam-blowing, industrial production	use phase out (Sweden), taxes (Denmark), industrial emission limit regulations (Germany, U.S.A)
	chlorinated paraffin's (e.g., short chain)	metal working	?
	chlorinated flame retardants (hydrocarbons, phosphorus)	plastics, rubbers, textiles, flame extinguishers	some bans/phase-outs (i.e., Denmark) for flame extinguishers ?
	PVC products (e.g., wire and cable, windows, siding, sheet, packaging, etc.)	construction, consumer products (i.e., toys)	phthalates in PVC toys
Product Use (Pesticides)	DDT, aldrin, dieldrin, endrin, chlordane, chlordecone, mirex, heptachlor, toxaphene, pentachlorophenol, hexachlorobenzene, lindane	agriculture, various industry, governmental health control (e.g., malaria)	de-registration, phase-out, restricted uses
Emissions Effluent	dioxins, furans, hexachlorobenzene, AOX, vinyl chloride monomer, ethylene dichloride	pulp and paper, metal smelting and production waste incineration, chemicals production	emission/effluent limit values (ELVs), typically expressed as concentrations
Consumption Quality	dioxins, furans, hexachlorobenzene, trichloromethanes	potable water, food	water and food quality regulations or guidelines, typically expressed as concentrations

Other results indicate that relative to North America, and particularly the United States, applied socio-economic analysis appears to be relatively scarce in Europe. Socio-economic Impact Analysis prior to environmental regulation, including benefit- cost analysis has been mandated in Canada since 1990 under the Federal Regulatory Policy. Under this policy each final published regulation in Canada is accompanied by a RIAS (Regulatory Impact Analysis Statement) which specifies variables such as;

- a) alternatives considered;
- b) cost and benefits of the proposed control measures; and consultations held.

Table 2 shows examples of chlorinated substances and sectors using such substances that have been put through the RIAS process component called the strategic options process.

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The United States is the world's leading country in terms of applied environmental economics, with mandatory benefit-cost analysis of regulations resulting from an executive order dating back to 1981, and later extended by executive order in 1993. Both ex-ante and ex-post studies can also be found from the 1970s, even for the older banned pesticides (i.e., chlordane). The role of risk assessment and management is noticeable in terms of toxic management, with a good example being VOC ambient levels specified for air quality attainment zones, and the complex trading schemes used to achieve them. Table 3 provides examples of chlorinated substance that are regulated as air toxics.

Table 2. Canadian Chlorinated Substances Strategic Options Processes

Industrial Sectors	Substances	Principal Recommendations
Sectoral Approach		
Dry Cleaning	tetrachloroethylene (PERC)	mandatory technology, mandatory waste disposal by PERC sellers, levy
Metal De-greasing	trichloroethylene (TCE)	import quota, tradable permits
Wood Preserving	pentachlorophenol (PCP), creosote	
Substance Approach		
Paint stripper, polyurethane foam, pharmaceuticals production	dichloromethane	labeling for consumer products, voluntary agreements for industrial uses
Metal working	short chain chlorinated paraffin's	
PVC production	ethylene dichloride (DCE)	voluntary agreement
Natural Gas Extraction	dichlobenzidine	voluntary agreement
Municipal Sewage Treatment	chlorinated municipal effluent	

Table 3. Air Toxic Sources with Promulgated Standards

Principal Pertinent Source	Chlorinated Substance Examples
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Categories	
Dry Cleaning	tetrachloroethylene
Organic Chemicals Production	In total over 350 chemicals, including EDC, VCM.
Inorganic Chemicals Production	chlorine, mercury
Metal Degreasing	trichloroethylene
Magnetic Tape Manufacturing	dichloromethane
Aerospace Industry	dichloromethane (paint stripper)
Polymers and Resins	epichlorohydrin,
Wood Furniture Manufacturing	dichloromethane (paint stripper)
Polyurethane Foam Production	dichloromethane
Printing and Publishing	chlorinated solvents
Off-site Waste Operations	dioxin/furan
Municipal and Medical Waste	dioxin/furan
Pulp and paper	dioxin/furan

The body of EU environmental law (primarily command and control) is dense, comprising over 70 directives and 21 regulations, with the directives having been amended many times. As an example, a particularly pertinent directive (76/769/EEC, related to restriction on marketing and use of hazardous substances) has been amended 23 times since its introduction in 1996. Table 4 reflects an EU directive regarding tightly controlled or prescribed substances, with Europe-wide standards.

Table 4; EU Black List of chlorinated substances in Effluent

Chlorinated Substance	Black List
1,2 dichloroethane	X
Drins (aldrin, dieldrin etc.)	X
Carbon tetrachloride	X
Chloroform	X
DDT (all isomers)	X
HCH	X
HCB	X
Hexachlorobutadiene	X
PCP	X
PERC	X
TCE	X
Trichlorobutadiene	X

Germany is a country whose control measures are based almost exclusively on BAT, or state-of-the-art technology, where as a rule, risk assessment and benefits quantification are not used in

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making regulatory decisions. The Netherlands chlorinated substances pollution control approach is essentially based on BAT based permits, with a heavy emphasis on voluntary measures (covenants) arrived at through negotiation with industry. The Netherlands does use some risk assessments, primarily in the setting of certain ambient quality standards based on risks to the most exposed individual. Control measures for chlorinated substances in Sweden are also based primarily on BAT permits, substance bans and use restrictions, with risk assessment integrated to a limited degree through ambient quality guidelines, or priority lists.

In summary, at the time of writing this abstract, the Phase I work is being reviewed and finalized. Based on that, the case studies will be chosen for the completion of the Phase II analysis.

References : CHEMinfo Services Inc., and Gaia Economic Research. 1999. Retrospective Socio-Economic Overview of Chlorinated Substance Control Measures. Phase I Draft Report: Identification of Potential Case Studies. Prepared for Environment Canada-Ontario Region, Burlington and Ottawa, Canada.