Chapter 18

Policy on Toxic and Hazardous Substances

There is a class of pollutants that have come to be called “toxic” substances and “hazardous” materials. While all pollutants are damaging to some extent, these have been singled out for their special short- or long-run potency. Most are chemicals, constructed organic and inorganic compounds that are now ubiquitous throughout all industrialized economies, and even widespread in developing countries. Today, chemicals and chemical products have permeated every corner of the economy. In product improvements, new materials, food safety, health innovations, and many other dimensions, chemicals have enriched the lives of almost everyone. There is, however, a downside. A large number of these substances may cause human and ecosystem damages, certainly from exposure to concentrated doses, but also from long-run exposure to the trace amounts that show up virtually everywhere in workplaces, consumer products, and the environment.

Rachel Carson’s book *Silent Spring* brought public attention the impact of chemicals on the environment. She documented the ecosystem damage caused by the popular pesticide DDT and was largely responsible for getting it banned in Canada, the United States, and many other countries. Other events have multiplied concern. Health damages to workers exposed to chemicals in the workplace, such as vinyl chloride and certain potent agricultural chemicals, have occurred with disconcerting frequency. In various parts of Canada and the United States, people have found chemicals oozing into their yards and houses that have been built on top of abandoned hazardous-waste-disposal sites. Accidental releases of chemicals have become a growing problem, from the large-scale episodes like those in Milan, Italy, in 1976 and Bhopal, India, in 1984 to innumerable smaller airborne and waterborne accidents. There is rising concern about the damages from long-term exposure to chemical residues in food, clothing, and other consumer products.

The primary concern is the impact of chemicals on human health. The EPA, for example, computes the excess cancer deaths per year in the U.S. from different toxic airborne pollutants. Health damages ariseaccidental releases and workplace exposure. Exposure to trace amounts of chemicals in water, air, and soil also affect health, but their impacts are much harder to measure. Toxics in the ecosystem have killed many species and threaten long-term viability of the ecosystem. Accidental waterborne chemical releases have killed fish and other organisms, often with long-term impacts. Agricultural and industrial runoff has substantially damaged ground water and many rivers and estuaries around the world.

In Canada, data on the releases of toxic compounds have been collected since 1994. Table 18-1 provides a snapshot of the 25 compounds that collectively contribute almost 90% of the total tonnes of compounds released from Canadian sources to air, water, land, and underground injection in 2008, . There was a significantincrease in total tonnes released of these pollutants in 2008, compared to 2000, most of which came from three sources: ammonia released to air and water, nitrates releasted into waterways, and ethylene glycol (de-icer of aircraft) released on to land. Releases from most of the other toxic compounds were lower in 2008 than in 2000. Hazardous and toxic materials have characteristics that present unique problems for monitoring and control:

1. They are ubiquitous in the modern economy; each year sees the development of new chemicals. This makes it difficult even knowing what substances are being used and in what quantities. It accounts for the fact that much public policy has been directed at simply getting better information about quantities of hazardous and toxic materials at various places in the system.

2. With the thousands of substances in use, each with different chemical and physical properties, it is virtually impossible to be fully informed about the levels of danger that each one poses to humans and other parts of the ecosystem, let alone what possible effects arise from the multitude of compounds when present together in the ecosystem.

3. In many cases the quantities used are relatively small, as are the quantities that end up as emissions. This substantially increases monitoring problems. It also makes it easier for users to carry out surreptitious disposal. It is easy to see the plume of smoke coming out of the stack of an industrial plant; it is harder to track the much smaller quantities of chemicals used in production.

4. The damages caused by exposure to hazardous materials can often take many years, even decades, to show up. And whenever there is a long time gap between cause and effect, there is a tendency to downgrade the overall seriousness of the problem.

In the next few sections government policy on hazardous and toxic substances and some of the major economic issues in the management of these materials are considered. Canada has only recently begun to develop policies. There is, as always, scope for conflict and co-operation. But all levels of government face a situation where thousands of different substances are in use, hundreds more are introduced each year, massive uncertainties exist about the human and non-human effects of most of them, and public concerns flare up and die down in unpredictable ways.

Table 18-1: Twenty-five NPRI Core Contaminant Pollutants Released On Site in 2008, by Environmental Medium (tonnes)

	2008			2008	2000	% Change
Pollutant	**Air**	**Water**	**Land**	**Total**	**Total**	**2000–01**
Ammonia	21,168	48,232	297	69,709	42,386	64.4
Nitrate ion	2.3	61,921	867	62,791	19,745	218.0
(in solution at pH 6.0)						
Methanol	13,733	1,899	582	15,703	21,808	–28.0
Hydrochloric acid	8,420	0	0.2	8,241	16,209	-49.2
Sulphuric acid	6,164	17	0	6,185	10,472	–40.9
Hydrogen sulphide	3,399	63	0.2	3,464	7,735	–55.2

Xylene (mixed isomers)	5,891	20	0.3	5,931	6,715	–11.7
Toluene	4,437	62	0.3	4,517	6,528	–30.8
Methyl ethyl ketone	1,665	0.1	0	1,671	5,076	–32.8
Carbon disulphide	2,826	0	0	2,827	3,164	-9.2
n-Hexane	5,674	9	1.5	5,691	3,563	59.7
Zinc (and its compunds)	733	320	84	1.141	2,692	-57.6
Hydrogen fluoride	3,329	3.2	0	3,332	3,601	–7.8
Ethylene	1,242	0	0	1,242	2,710	–54.2
Ethylene glycol	211	697	4,650	5,563	2,564	117.0
Manganese (and its compounds)	362	1,348	45	1,765	1,740	1.4
Styrene	1,916	0	4	1,924	1,700	13.2
Dichloromethane	133	0	0	135	2,219	–93.9
Isopropyl alcohol	1,323	31	0	1,365	1,696	-19.5
Formaldehyde	1,233	43	0	1,278	1,803	–29.0
Cyclohexane	988	0.6	0.2	990	1,495	–33.8
2-Butoxyethanol	499	1.2	0	990	1,360	–27.2
Acetaldehyde	1,027	17	0	1,044	955	9.3
Benzene	654	112	0.6	773	1,134	–31.8
n-Butyl alcohol	553	0	0	557	1,216	–54.2
Largest on-site releases	84,402	114,795	6008	205,205	170,285	20.5
National total	102,709	122,201	7608	232,518	182,930	27.1
Percent of national total	82.2	93.9	79.0	88.2	93.1	–5.3

Sources: *Environment Canada,* National Pollutant Release Inventory (NPRI)*, "Twenty-five NPRI Pollutants Released On Site in the Largest Quantities in 2001," Table 3-1 at www.ec.gc.ca/pdb/npri/2003N_Overview/Releases/2001Releases_3_e.cfm.*

Environment Canada "National Pollutant Release Inventory (NPRI) 2008 Facility Data Summary",Summary by Substance: Part 1A, accessed at: http://www.ec.gc.ca/inrp-npri/default.asp?lang=en&n=BF14CADF-1, on 12 October 2010.

Canadian Policies to Reduce Emissions of Toxic Substances

Toxic emissions come in a great variety of forms, from small airborne releases of cleaning fluid from dry cleaning establishments to large-scale releases of toxics from substantial industrial plants. Also included are the concentrated accidental releases that have helped in the past to spur public concern about toxics in the environment. Not all toxics are chemicals; some, like heavy metals (mercury, cadmium, etc.), are by-products of various industrial and mining operations. Emissions-control policies at the federal and provincial levels have focused largely on the management of conventional airborne and waterborne pollutants. For air this has meant the criteria air contaminants studied in Chapters 1 and 17—SO_2, CO, O_3, NOx, total suspended particulates, and lead—and for water it has meant BOD, suspended solids, coliform count, and so on examined in Chapter 16. However, it was known during the initial regulatory days that there was a potentially serious class of toxic emissions stemming from industrial production operations, as well as from household sources. But the difficulties with even enumerating all of the possible substances involved, and of knowing what impacts each might have, essentially led to postponing coming to grips with the problem. In addition, the control of conventional pollutants has been effective to some extent in controlling toxics, since they are often closely associated. In recent years more effort has gone into specific toxic emissions reduction programs, but as of now, little has been accomplished compared to efforts in other environmental areas.

Canadian Environmental Protection Act, 1999: www.ec.gc.ca/CEPARegistry/the_act

The discussion of toxics policies is divided into two topics—policies dealing with the emission of toxic substances and the management of the disposal and storage of toxic substances. The first section focuses on strategies to reduce emissions. The key federal policy is the *Canadian Environmental Protection Act of 1999* (CEPA, 1999).

CEPA, 1999

The *Canadian Environmental Protection Act of 1999* amalgamates, supercedes, and works in conjunction with other federal regulations dealing with toxic substances.[2] Environment Canada and Health Canada jointly administer the act. CEPA, 1999 is to "provide a framework for protecting Canadians from pollution caused by 'toxic' substances."[3] CEPA, 1999 continues the principles established in CEPA, 1988.[4] Namely, it gives the federal government

[2.] CEPA, 1999 replaces CEPA, 1988, which replaced the *Environmental Contaminants Act of 1975*. Many of the provisions of these earlier acts are carried over to CEPA, 1999. Information about CEPA can be found at the Environment Canada Web site at www.ec.gc.ca/CEPARegistry/default.cfm.

[3.] See Health Canada's information on CEPA, 1999, available at www.hc.gc.ca, under Healthy Living, Assuming and Managing the Health Risks of Existing Substances under the Renewed Canadian Environmental Protection Act, 1999..

[4.] The source for this list and other general information about CEPA, 1988 is Environment Canada and Health and Welfare Canada, *Preparing the Second Priority Substances List*, An Invitation to Stakeholders to Comment on the Federal Government Proposals (April 1993): 2–4.

1. the right to obtain information from manufacturers, processors, and importers of substances Environment Canada considers dangerous;
2. the power to conduct research on dangerous substances in co-operation with provincial governments; and
3. the right to prevent discharges of substances authorized jointly by the Minister of the Environment and Minister of Health and Welfare that "pose a significant danger to human health or the environment."

The federal government's regulatory powers under CEPA stem from the Peace, Order, and Good Government clause in the Canadian Constitution. The federal government argued that regulation of toxic compounds is a national concern. The courts have upheld these powers.[5] The federal government can thus establish national standards under CEPA. It does so in consultation with the provinces.

[5.] The case was *Canada Metal Co. v. the Queen* (1982), 144 D.L.R.(3d) 124 (Man. Q.B.).

Key Features of CEPA, 1999

The key features of CEPA, 1999 are as follows:

Definition of CEPA Toxic. A substance is toxic if it enters or may enter the environment in a quantity or concentration that:

- Has or may have an immediate or long-term harmful effect on the environment or its biological diversity;

- Constitutes or may constitute a danger to the environment on which life depends; or
- Constitutes or may constitute a danger in Canada to human life or health.

  Health Canada determines what is a danger to human health; Environment Canada addresses ecosystem health.

The Domestic Substances List (DSL). This is a list of approximately 23,000 substances that are already being used in Canada (whether produced domestically or imported). CEPA, 1999 requires that *all* of these be categorized by September 2006 as to whether they are toxic or not and, if so, how toxic (i.e., which pose the greatest threats to health and the environment). Those identified to be "of concern" go to a second stage of assessment.

The Priority Substance Assessment Program and List (PSL). The second stage of assessment actually began as part of previous regulation (CEPA, 1988). The first Priority Substances List was established in 1989 and contained 44 chemicals suspected to be toxic. Twenty-five of these were declared toxic. A new PSL was produced in 1995 containing 25 additional substances that were to be completely assessed by 2000. The current PSL is available at both ministries' Web sites (www.ec.gc.ca and www.hc.gc.ca). Once a substance is declared toxic, it is placed on what is called Schedule 1 of the act and regulation of it can begin. Regulations can be in the form of guidelines, codes of practice, and standards. Products can be regulated over their entire life cycle (from development to disposal). Note that neither Environment Canada nor Health Canada has the legislative authority to impose taxes on products. Any formal tax instrument would have to come from the Ministry of Finance. Fees for disposal permits are possible (in co-operation with the provinces). The most dangerous substances—those that are toxic, persistent, or bioaccumulative; that result primarily from human activity (i.e., its release is not due solely to natural forces); and that have no "safe threshold" of emissions—will be slated for "virtual elimination."

Enforcement. Environment Canada has the authority to monitor all sources of toxics to enforce any regulations established. Maximum penalties are up to $1-million per day in fines, imprisonment up to three years, or both. Violators may also have to pay for clean-up costs or forgo profits obtained from polluting activities. One wonders how Environment Canada will be able to establish what profits from polluting activities are.

National Pollutant Release Inventory (NPRI). CEPA, 1999 requires all facilities releasing or transferring a pollutant on the NPRI list (of 268 substances) report annually their on-site releases and off-site transfers.[7] The NPRI is made public as soon as the data can be compiled.[8]

[7.] CEPA, 1988 contained the original legislation for the NPRI.

[8.] The NPRI and information about it is available through Environment Canada's Web site at www.ec.gc.ca/pdb/npri/npri_home_e.cfm.

Assessment of CEPA, 1999

As with all Canadian environmental policy, CEPA, 1999 provides not only some strong opportunities for improving environmental quality and protecting health, but also some significant challenges. These are summarized below.

1. ***Federal authority.*** CEPA 1999 continues to give the federal government a strong legislative basis for regulation that was established in CEPA, 1988. Toxics could have been deemed an area predominantly for provincial authority, but in CEPA, 1988 the federal government argued that toxic substances were a matter of national and international concern. Federal authority will minimize duplication and overlap, provide for public access to data, and ensure that polluters will face the same level of regulation across the country.

2. ***Burden of proof.*** All substances on the DSL are already in the environment. The government's powers under CEPA effectively enable it to act on these substances only after it has shown that a danger to health or the environment exists. This means that the burden of proof is on the government to get information about substances and determine their toxicity. Companies are thus allowed to produce the compounds and release them into the environment without proving that they aren't dangerous. If the government then regulates the substance, it may be years after it has been in use. This is like the old expression "shutting the barn door after the horse is out." The policy is thus *reactive*, not *proactive*. The legislation is very different from that of other chemical compounds entering our environment. For example, pharmaceuticals cannot be licensed for human use until extensive tests are done to show that they deal with the problem they are designed for without endangering human health. Food additives undergo a similar process. Even pest-control products have to be registered before being sold (but do not have to verify safety). While testing prior to release for sale is not foolproof, it is more proactive than waiting until the compound is in use. The precautionary principle would argue to reduce the risk of adverse impacts on health and the environment with a policy that required chemical compounds to go through a similar process. The difficulty is that it is too late for the chemicals that are already in the economy and environment, so the proactive policy cannot be applied to existing substances. CEPA, 1999 gives the government authority to be proactive with regard to new substances. If the substance is not on the DSL, industry will have to provide data certifying its safety before the substance can be produced or used. However, the government will still do its own testing of new substances.

3. ***Timing and progress to date.*** The government's track record on delivering regulation of toxics is thin. Regulations have been adopted for approximately 50 of the compounds. Among those compounds were dioxins and furans in pulp mill discharges (discussed below). The task of examining and designing regulations for potentially hundreds of substances is daunting and has meant that the federal government has been unable to meet the deadlines CEPA, 1999 imposes.

Comment [NO1]: Got an approximate number from an EC source who works in this division. There is no reference; she went through all the key chemicals to see which ones had meaningful regulations.

4. ***Policy instruments.*** CEPA, 1999 continues with the Canadian tradition of relying on command-and-control policies. While standards make sense when a substance is to be phased out of existence, it makes much less sense for the potentially hundreds of substances that will continue to be produced and used in Canada. Incentives to reduce the use of these substances are needed, and the strongest incentives come in the form of some sort of pricing of pollution. Unless the federal ministries of finance, environment, and health work together to design incentive-based policies, CEPA, 1999 offers no more or no less than other Canadian environment policies that rely on command-and-control regulation.

5. ***The role of public information on polluting activity.*** One of the goals of releasing NPRI data to the public is to provide incentives for polluters to voluntarily reduce their emissions even when there is no regulation requiring them to do so. This is called ***voluntary compliance***.[9] Why would a polluter ever voluntarily reduce its emissions? The logic is twofold: First, it may make good business sense if consumers are sensitive to environmental data. When consumers read that a company is the largest source of some toxic compound that is producing cancer and damaging ecosystems, its sales may fall. Proving to society that it is an "environmentally sensitive" producer may increase revenues by more than it adds to costs. Second, the company may be avoiding future liability or forestalling the introduction of regulations that can be very costly. If government thinks that emissions are falling over time even without regulation, it is less likely to introduce policies such as technology-based standards or performance standards.[10]

[9.] Canada has other examples of voluntary compliance in the toxics area. The *Accelerated Reduction/Elimination of Toxics* (ARET) program set a target of 90-percent reduction in toxic emissions by 2000. Companies have reported progress in reaching this goal. The Canadian Chemical Producers' Association set up a "Responsible Care" program in 1990. Part of the program includes a hazardous-waste management code to deal with handing and disposal of wastes and waste disposal sites.

[10.] For a critical assessment of voluntary compliance that is largely negative, see the special issue on "Voluntary Initiatives" in *Alternatives Journal* 24(2), Spring 1998, pp.8–25.

There have been studies of the impact of "right-to-know" legislation in the United States from its version of the NPRI—the Toxic Release Inventory (TRI), after which Canada's system was modelled. The U.S. studies do find evidence that emission levels have fallen since release of TRI data began in the early 1990s. There is some skepticism that some of the decreases may be "phantom"; that is, neither real nor permanent. Reasons include fraudulent reporting by companies, the result of short-term economic downturns and resulting output reductions, changes in monitoring or accounting techniques, and over-reporting of the initial emissions by companies so that it looks like significant reductions have occurred when in fact they have not.

U.S. EPA Toxic Release Inventory: www.epa.gov/tri

A Canadian study looked at the role the NPRI had on toxic releases over the period 1993–99.[11] Using statistical techniques, the authors found that command-and-control regulation appears to have been a greater stimulus to reductions in toxic emissions than public disclosure. The strongest reductions are associated with industries facing federal regulations such as the *Fisheries Act*. These tend to be large firms in pollution-intensive industries.

[11.] See Kathryn Harrison and Werner Antweiler, "Incentives for Pollution Abatement: Regulation, Regulatory Threats, and Non-Governmental Pressures" *Journal of Policy Analysis and Management* (22), No. 3, (2003): 361-382.

The Toxic Intensity of Canadian Industry

Data from the NPRI allow us to examine the ***toxic intensity*** of Canadian industry. Table 18-2 presents data on aggregate emissions from Canadian industries as a proportion of the value of industry shipments from manufacturing activity. Emissions in tonnes of each of the toxic compounds released into the environment by firms in these industrial sectors are aggregated then divided by the value added in that industry.[12] This gives a ranking of each industry's ***emissions intensity***. In addition, a toxicity index is used to weight releases of all the compounds released from each industry to obtain an estimate of their potential impact on the environment, not just the aggregate tonnes of emissions of all sorts released.[13] A source that emits large quantities of a not-very-toxic substance may have far less deleterious effects on health and the environment than one emitting a small amount of a highly toxic material. Table 18-2 shows that the most toxic-intensive industries are chemicals, mining, rubber, plastics, and fossil fuels, while the least toxic-intensive are food, beverage, machinery, and electrical and electronic. This sort of data can be very helpful in designing regulatory policies. How? Governments can focus attention on the most toxic compounds coming from the most pollution-intensive sectors. This will yield the greatest return in the form of lowering emissions that have the biggest adverse impact on health and the environment.

[12.] See N. Olewiler and K. Dawson (1998) *Analysis of National Pollutant Release Inventory Data on Toxic Emissions by Industry*, Working Paper 97-16, Prepared for the Technical Committee on Business Taxation for more details of the derivation and interpretation of emissions and toxic intensity numbers. Also see *Report of the Technical Committee on Business Taxation*, Chapter 9. This report can be requested from the Ministry of Finance through the following site: http://www.fin.gc.ca/toc/1998/brie_-eng.asp:

[13.] The toxicity index is for data from 1994 rather than 1997. It would still be representative for 1997 unless the types of compounds released by each industry changed considerably over the three years. This was not likely.

Figure 18-1 illustrates the time trend in toxic releases by type of media to which they are released (air, surface water, land).[14] The top half shows aggregate emissions unweighted by toxicity. We see that the largest decline is in discharges to surface water. There have been increases in discharges to air, land, and underground injection since 1993. An implication of this trend is that polluters may be simply reallocating their wastes to another medium—away from water and on to soils in response to differences in the stringency of regulations. Table 18-1 and data from the NPRI shows that this trend has changed. Releases to air declined 24 percent from 2001 to 2008, while those to water rose by 125 percent, and to land increased 24 percent. Shifting releases from one medium to another is a likely response to command-and-control regulation that is media-based. An incentive-based policy, for example waste discharge taxes that reflect marginal damages to the different media, would reduce these incentives.

[14.] The data for this figure and some of the policy conclusions come from Harrison and Antweiler (2003), cited above.

The bottom half of Figure 18-1 presents the toxicity weighted releases. The aggregate levels have risen somewhat over time (up for air and land, down for water and underground injection ignoring 1993 for that medium). This suggests that polluters could be shifting from high-volume but low-toxicity emissions to low-emission– high-toxicity releases. Why might they do this? The NIPR has received substantial publicity, but the data released are not weighted by toxicity (methods for weighting are somewhat controversial). Polluters may think that if they reduce the volume of emissions, this will help convince the public that environmental progress is being made. The NPRI is valuable in that it provides the data for analysis of the emissions and pollution intensity of Canadian industry. However, the data suggest that public disclosure is not a substitute for environmental regulation.

Table 18-2: Emissions and Toxic Intensity of Canadian Manufacturing Industries, 1997

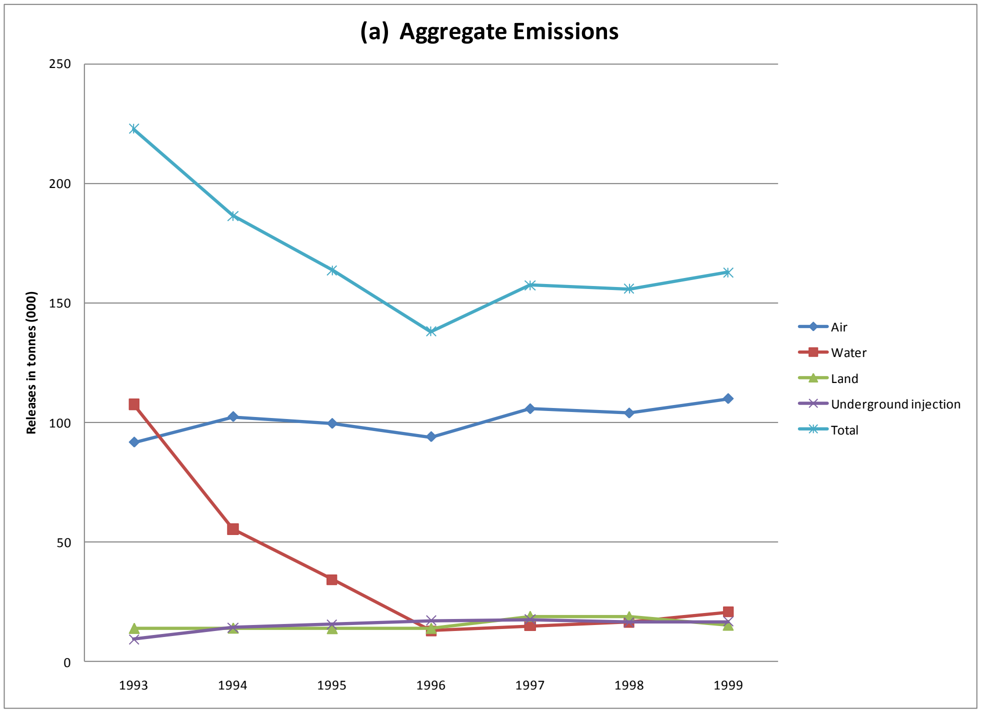
SIC	Industry	Emissions/ $ Output[a]	Toxic Intensity[b]
37	Chemicals	2,345	756
29	Primary metal	1,507	422
15	Rubber	268	305
16	Plastics	1,090	232
36	Refined petroleum & coal	1,027	227
35	Non-metallic mineral	294	157
26	Furniture & fixture	355	51
32	Transportation equipment	153	43
30	Fabricated metal	208	42
28	Printing & publishing	190	39
19	Textile products	365	39
27	Paper & allied products	1,798	33
39	Other manufacturing	189	31
18	Primary textiles	47	23
17	Leather	163	19
25	Wood	155	17
33	Electrical & electronic	12	9
31	Machinery	17	3
10	Food	31	>0.5
Average		556	

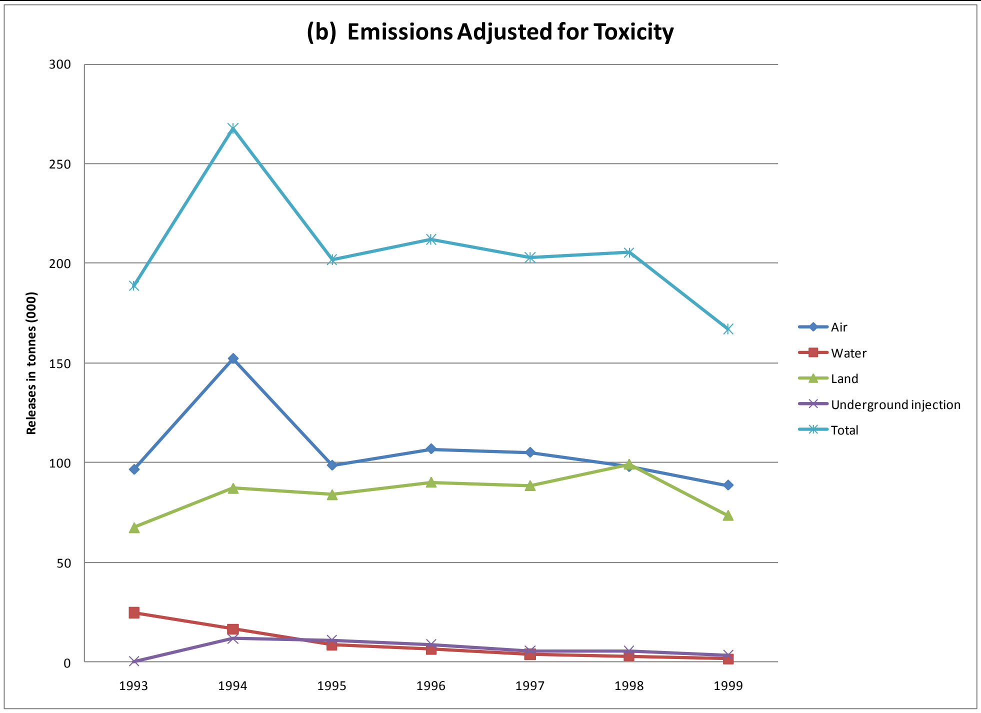
Notes: (a) Emissions/output are the releases of toxic compounds by each industry in pounds divided by the value of industry shipments in millions of Canadian dollars.
(b) Toxic intensity values are based on the compounds released by industry in 1994.

Sources: *Canadian emissions data are from Environment Canada's National Pollutant Release Inventory, Canadian output was value of shipments and other revenue, from Statistics Canada, "Manufacturing Industries of Canada, National and Provincial Areas," Cat. No. 31-203-XPB. Toxic intensity data are from* Report of the Technical Committee on Business Taxation *(1998), Table 9.2, p. 9.9.*

An example of how a pollution-intensive industry—pulp and paper—has been regulated is examined on page 355.

Figure 18-1: Annual Releases and Releases Adjusted for Toxicity, 1993–1999





On-site releases of toxic substances as reported by companies on the NPRI are shown for the period 1993 to 1999. Panel (a) presents emissions unweighted by their toxicity. The decline in emissions to water is large, while releases to the other media increase somewhat. Overall releases decline. Panel (b) weights these releases by an index of their toxicity. While releases to water continue to show a decline over the time period, aggregate emissions now rise due to increases in releases to land and air.

Source: *K. Harrison and W. Antweiler (2001). Data for 2009 in another paper accessed at: http://strategy.sauder.ubc.ca/antweiler/public/npri%2Bregulation.pdf*

Example: The regulation of toxic compounds from Canada's pulp and paper industry

Comment [NO2]: This is another case/example that I cannot update because no follow up study has been done. Either I delete it or leave as is. I've left it in as it is a Canadian example

Much has been written about the regulation of toxic compounds coming from pulp mills. Some governments and environmental organizations offer studies that show that the chlorinated organic compounds in mill effluent are very dangerous compounds that should be banned. The forest industry counters with research that says the other studies are inconclusive; that the chlorine bleaching in their pulping process isn't necessarily the guilty technology, and that they are already spending large amounts of money to control their wastes.

Historical Background on Regulation

Federal pulp and paper regulation began under the *Fisheries Act* in the early 1970s with standards that divided the pollutants in the mill effluent into three categories: total suspended solids (TSS), biochemical oxygen demand

(BOD), and acute toxicity.[15] TSS and BOD pollutants have been discussed in Chapter 16. The concern here is with toxicity, defined in the regulations as the unknown mix of chemicals lethal to fish and other organisms in the immediate vicinity of the effluent outfall. The federal regulations were in the form of standards based on best practicable technology. The federal government had to be careful not to impinge on provincial powers, so it tried to "sell" the standards to the provinces as minimal national standards that would ensure that no one region of the country would become a haven for polluters. As well, existing mills were exempted from the standards, thus reducing the burden for provinces where pulp mills were a significant contributor to local economies. Once again, the ability to control emissions and political factors were criteria used for regulation, not a balancing of the marginal benefits and costs of control.[16] Throughout this early process the industry remained the source of information on what was practicable technology. It was said that government regulators at the time had no way of checking the industry's information. The toxic regulations were in the form of discharges per unit of output produced. There were no absolute limits on total ***loadings*** to the environment; that is, how the emissions affected toxic concentrations in soils, water, or air. The test of acute toxicity was pass/fail, based on fish mortality.

15. Information for this section comes from Doug Macdonald, *The Politics of Pollution* (Toronto: McClelland & Stewart, 1991), 225–240.

16. Think about whether exemption of old mills is good policy from the viewpoint of economics (e.g., do they have different MAC curves and hence merit different standards?).

Once the regulations were promulgated, implementation was difficult because the pulp and paper industry argued that it could not afford to invest in pollution-abatement processes that did not contribute to output in some way. This continued to be a problem into the 1980s.[17] The standards were enforceable by the provinces. Compliance with the regulations was sought through individual negotiation with each company; prosecution was not used until later years. Over the period 1969 to 1982, a large number of mills were not meeting the toxicity requirements even though the industry received considerable financial assistance from the federal government.[18]

17. See William F. Sinclair, *Controlling Pollution from Canadian Pulp and Paper Manufacturers: A Federal Perspective* (Environment Canada, 1990), for a very detailed examination of the industry's spending on capital improvements to expand production capacity versus expenditures for pollution abatement.

18. Between 1971 and 1979, this amounted to $10.6-million under accelerated capital cost (depreciation) allowances in the federal corporate income tax. Another $3-million was given to the industry in the form of direct support for installing pollution-abatement equipment in a program begun in 1975.

Between 1979 and 1985, the industry received a total of $544-million from the federal government and the provinces of Ontario, Quebec, New Brunswick, Nova Scotia, and Newfoundland under the Pulp and Paper Modernization Program. This program was designed to assist the industry in improving its capital stock to be more competitive with pulp and paper producers in other countries. Of the industry's total spending on capital improvements over this period, 18 percent was spent on pollution-abatement equipment. It is thus somewhat difficult to accept the industry's repeated insistence that it was unable to comply with pollution regulations due to its fierce competitive environment. Significant gains were made in BOD and TSS reductions. This happened in part because of greater technical efficiency in using its wood inputs.

Public pressure against the industry intensified in the late 1980s, when Greenpeace stepped up its campaign to eliminate emissions of chlorine compounds associated with dioxin and other chlorinated organic compounds. A flurry of research was done on dioxin concentrations and their likely impact on ecosystems and human health. An expert committee investigating pulp effluent in Ontario reported in 1988 that the health threat of dioxins and furans was overstated. The real problem was that 97 percent of the chemicals in the waste products had never been analyzed or even identified. The committee recommended that steps be taken to reduce the total quantity of organochlorine emissions. This illustrates an important point with the regulation of any compound when it is released with a number of other contaminants: focusing on a few such compounds may not result in an improvement in the ecosystem and human health if *all* the compounds responsible for adverse effects are not controlled. Environmental policy is then seen as a useless expense. The Ontario committee's recommendation is rarely taken into account in environmental regulation. The committee also found that the cost of pollution control was not prohibitive given the industry's financial situation.

Continued pressure from the public, environmental groups, and a report by Environment Canada on the pulp and paper industry led to an announcement in 1989 of new dioxin and furan regulation under CEPA (1988).[19] Later that year, British Columbia, Ontario, Quebec, and Alberta announced they would be bringing in regulations within several years. In 1990, Environment Canada announced that organochlorine discharges would be added to the regulations and that the *Fisheries Act* would be amended to make these standards or guidelines applicable to all plants, regardless of when built. Environment Canada said the discharge requirements would be met though provincial regulation and enforcement where equivalency of standards for the two levels of government was met. If there were no equivalency, Environment Canada would enforce the requirements.

[19.] This Environment Canada report was known as the Sinclair Report, after its author, William Sinclair, cited above.

Current Regulations

The current federal regulation of the effluent from pulp mills is based on the 1971 amendments to the *Fisheries Act* and as updated in CEPA (1988 and 1999).[20] It is as follows:

[20.] Provinces may impose regulations that are more stringent than the federal ones.

1. Two substances are banned from pulp and paper effluent—dioxins and furans. These compounds are bioaccumulative. They cause reproductive failure in fish-eating birds, contaminate shellfish and other inshore fisheries, and have a number of adverse health effects on laboratory animals. Scientific uncertainty exists about their impact on human health, but they have been declared toxic under CEPA and there is an emission *standard of zero discharges* from pulp and paper mills that use a chlorine bleaching process. These were to be eliminated by 1994; actual elimination took a few more years.
2. Under the *Fisheries Act*, limits for toxic discharges, BOD, and TSS are set and apply to all mills.
3. Other regulations for organochlorine discharges will be developed.

Impact of the Regulations: Compliance Costs

In the early 1990s, the industry estimated that compliance with the regulations would cost $5-billion (in 1989 dollars or $7 billion in 2010 dollars).[New Footnote #1] Statistics Canada estimated the total capital costs of compliance at $2.2-billion ($3.1), with a lot of variation in costs across mills of different sizes and vintages. The costs per mill could vary from more than $100,000 to $100-million ($139 thousand to million).[21] Average annual investment from 1978 to 1989 by mills in the study done by Statistics Canada was $16.8-million per mill ($23.4). The average capital cost of compliance per mill (for those not already in compliance) is estimated at $25.7-million ($35.7) over the life of the equipment. These costs can thus be thought of as consuming about 1.5 years of what would be ordinary investment. This can also be converted into an annualized cost over the life of the capital asset. Statistics Canada estimates the average annualized cost per mill at $4.4-million ($6.1), which represents just under 8 percent of their average annual surplus. Annual surplus is defined as the value of shipments minus the cost of energy, materials, and labour. Surplus therefore includes head-office overhead, some purchased services, depreciation, and profit. The differences in the industry's and government's estimates of compliance costs illustrates some familiar themes and lessons learned:

[New Footnote #1:] Costs adjusted for inflation up to the year 2010 are shown in parentheses following each dollar amount in this section

[21.] Craig Gaston, "Pulp and Paper Industry Compliance Costs" in Statistics Canada, *Environmental Perspectives*, 1993, Catalogue No. 11-528E Occasional (Ottawa: Statistics Canada, March 1993), 20. This is the source for all the numbers reported in this section.

1. There is always uncertainty about the costs of complying with a new policy.
2. Initial compliance cost estimates (of MACs) are generally much higher than they turn out to be in practice.
3. MACs tend to fall over time *if* polluters are not regulated by a technology-based standard.[22]

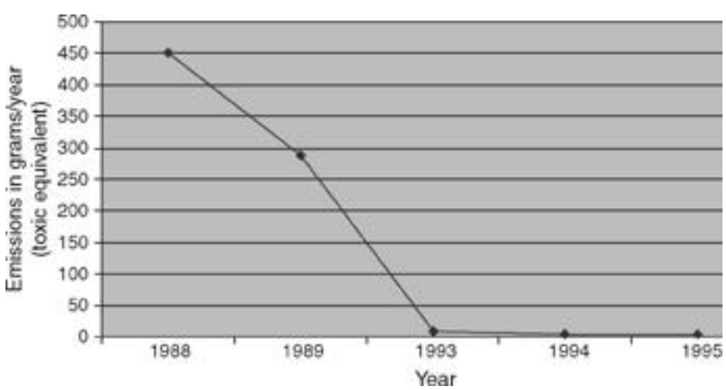
[22.] Recall from Chapter 17 what happened in the U.S. sulphur dioxide TDP system: MACs fell considerably over time because polluters were not constrained to use a particular technology to meet emission targets.

4. The ban has led to a change in technologies used for bleaching pulp. New plants use non-chlorine processing that produces no dioxin or furans. Technological changes induced by regulation have lowered compliance costs over time.
5. Remember that compliance costs (the MAC curves) are only one-half of a full estimate of the net benefits of a policy. Damages forgone (the MD curve) should also be calculated.

Environmental Impact of the Regulations

Figure 18-2 shows the decline in emissions of dioxins and furans to virtually zero by 1995. In 2008, total emissions of dioxins and furans from all sources in Canada were 32 grams. These banned substances have been eliminated from the effluent of pulp and paper mills. In this sense, the policy is a success. But the real question that must be answered is this: Does the elimination of these toxics improve measured environmental quality? The answer is not clear, because these compounds bioaccumulate. Their impact on ecosystems and species took time to be recognized and understood; their elimination from the waste stream does not mean that they are no longer present in the ecosystem. There will continue to be impacts as long as the *stock* of these compounds still is present in plants and animals. A key feature of toxics is that many decompose or dissipate very slowly. Government policy therefore also needs to consider waste management—intercepting toxics before they enter the waste stream and remediation (cleanup) of toxic sites. Dioxins and furans from pulp effluent are too dispersed in the environment to be "cleaned up," but other toxics can be. We turn now to issues of waste management.

Figure 18-2: Annual Releases of Dioxins and Furans from Canadian Pulp and Paper Mills



Dioxin and furan emissions from Canadian pulp and paper mills that use a chlorine bleaching process declined from 450 grams per year in 1988 to 5 grams per year in 1995 as a result of regulations introduced in the late 1980s. Emissions from pulp and paper operations are now effectively zero, while total emissions from all sources for 2008 were 32 grams.

Economic Issues in Hazardous Waste Management

What are Hazardous Wastes?

Not all toxic compounds on the DSL will be so damaging to health and the environment that they will ultimately have to be banned. How can a government manage its wastes that are hazardous but not Schedule 1 CEPA toxics?

Each year millions of tonnes of hazardous waste are produced in Canada. Hazardous waste consists of a diverse set of materials. In liquid form there are waste oils, solvents, and liquids containing metals, acids, and so on. There are hazardous wastes in solid form (metals dust, polyvinyls, and polyethylene materials). There are many materials between liquid and solid, called sludges (sulphur sludge, heavy metal, solvent and cyanide sludges, and dye and paint sludges). Then there are a variety of mixed substances such as pesticides, explosives, lab wastes, and the like.

Hazardous-waste generation is not spread evenly over the country. As expected, areas where the most manufacturing and resource processing occurs will produce the most waste. The industrialized provinces, Ontario and Quebeccontribute to the largest percentage of Canada's hazardous waste. Hazardous wastes can be disposed of in injection wells—that is, deep wells driven into underground geologic formations (salt caverns and aquifers). From an industry standpoint this method is relatively cheap and flexible. However, a substantial proportion of these wastes are no doubt discharged in wastewater, either directly into a stream or river or into a municipal waste treatment plant. Surface impoundment and landfill disposal, into both hazardous waste (lined) landfills and unlined landfills, accounted for most of the remaining hazardous waste. Disposal of hazardous wastes through chemical treatment is probably a relatively small proportion of the total. Most hazardous waste is probably disposed of on-site; that is, at the site of the industrial plant where it was manufactured and/or used.

The two major pathways leading to damage are through accidental releases and through releases stemming from improper handling, either at the site of use or at waste-disposal facilities. A Quebec study found, for example, that approximately one-third of the hazardous wastes sent off-site for processing or disposal could not be accounted for. Wastes are obviously not being controlled properly either through mismanagement or deliberate avoidance. Accidents have led to severe and obvious damages, to humans and to other parts of the ecosystem. It has been less easy to document the damages coming from long-run exposure to small amounts of hazardous wastes. Ecosystems in the vicinity of industrial-waste dumps are sometimes visibly affected. Human health effects have been harder to show, particularly when what is at issue is long-run exposure to small quantities of hazardous materials. Much more epidemiological and laboratory work remains to be done.

In this section, two regulatory issues are examined:

- the disposal of toxic wastes
- the cleanup of toxic waste sites

Canada is only beginning to address the problems associated with toxic waste disposal and storage. Federal jurisdiction over hazardous waste disposal and management is limited to interprovincial and international flows. Provincial and municipal governments regulate the disposal of hazardous wastes. The federal government has called for better harmonization of definitions of waste, tests, and criteria for classification of hazards from waste products across the country. There is concern that Canada is importing an increasing amount of hazardous waste from other countries because of a perception that our standards of waste management are less stringent then those in the United States.

The early policies on hazardous waste were aimed at managing the flow of hazardous emissions coming from firms to reduce potential impacts, especially on human health. In this respect it mirrored the approach taken in conventional pollutants. But hazardous emissions are more difficult to manage. Smaller quantities make them much more difficult to monitor, even though in many cases small quantities can be quite damaging. This has led policy-makers to think about attacking the problems by "moving back up the line"; that is, by trying to reduce the amounts of material that are in need of disposal. This can be done in two ways: (1) by recycling residuals back into the production process, and (2) by shifting technologies and operations so that the amount of residuals actually generated by firms is reduced. These methods can be called ***waste reduction***.[25]

25. Some people prefer to distinguish between "waste reduction" and "recycling" as separate processes, but in our discussion we will lump them together.

Waste Reduction

The thought behind waste reduction is that by changing production processes and adopting new technologies and operating procedures firms can substantially reduce the quantities of hazardous waste they produce per unit of final product. For example, a firm might find a new way to operate a materials cleaning process to get the same effect but with less cleaning solvent. Or a firm might shift from using a process requiring a toxic material to one involving a non-toxic substance. Or an end product might be redesigned in a way that permits its fabrication using smaller quantities of hazardous materials. These are industrial counterparts to our discussion on "green" consumer goods in Chapter 10.

Waste reduction is obviously very complicated and firm-specific. This means it is essentially impossible to achieve efficient controls by having a regulatory agency dictate particular technology choices for firms using toxic substances. The technical aspects of production processes and the situation of each firm are too heterogeneous for this approach. Instead, more effective means need to be found that will give firms themselves strong incentives to reduce toxic emissions in cost-effective ways. What are some options?

Potential Cost-Effective Policies to Reduce Waste

1. ***Changes in hazardous-waste disposal laws.*** If waste disposal is made more difficult and costly, firms will be motivated to search for better ways of reducing the quantities of waste requiring disposal. A major flaw in this approach, however, is that the vast majority of hazardous waste is not subject to disposal regulations because it never leaves the premises of the firms where it is used. A second problem is that it will encourage illegal discharges of wastes.
2. ***Liability and compensation laws.*** Requiring polluters to compensate those harmed induces firms to take the external costs into account in making their decisions (review Chapter 10). Polluters will either modify their actions to minimize the risk of damage (i.e., they "self-insure"), or insurance markets may develop. Polluters will pay an insurance premium that reflects the probability of damage and costs if damage occurs. As illustrated in Chapter 10, a major problem is whether enough is known about risks to be able to develop an efficient insurance market and compensation system. Although there are thousands of chemicals in use, very little hard information exists on exactly how much damage they may cause to humans; most of the dose–response information comes from laboratory studies, not human data. This lack of information also impedes the use of all regulatory instruments.
3. ***Incentive-based mechanisms.*** A tax on hazardous emissions could be very difficult to implement. In principle, the federal government could use the NPRI data to levy a tax on emissions. However, two problems emerge. First, the NPRI data are self-reported by each source of emissions. There is little (if any) monitoring of emissions by government regulators at present. The incentive to under-report emissions is strong when a tax is levied. The costs of monitoring could be quite high. Second, if monitoring occurs, emission taxes increase the incentive to illegally dump one's toxics. However, a waste tax may be highly feasible for undifferentiated wastes in a bulk form, levied at a discharge site. Canadian municipalities often have differentiated fees for waste disposal based on the nature of the waste. Another possibility is to levy a tax on the inputs used to manufacture chemicals, since these would be fewer in number and easier to measure than the chemicals themselves. Still another possibility might be to institute deposit–refund systems for chemicals. Firms would pay a deposit along with the purchase price when the chemicals were bought. They could recover that deposit, or a portion of it, by documenting a reduction of emissions—that is, of the recovery of the chemical from the normal waste stream.
4. ***Public release of pollution data.*** As discussed above, the release of NPRI data may create incentives for voluntary reduction of waste flow even in the absence of regulation on emissions.

This list shows that governments have a number of potential incentive-based options when it comes to waste management. They need not rely solely on command-and-control regulation. What have Canadian governments been doing to reduce waste?

Canadian Policies on the Management of Hazardous Waste

Federal Waste-Disposal Policies

Federal policies are now covered by CEPA, 1999. They pertain to ocean dumping, transportation of dangerous goods, and radioactive wastes. The policies are basically command-and-control regulations that cover things such as providing lists of items that can be disposed (for ocean wastes and radioactive materials) and specifying requirements for equipment, procedures, training personnel, emergency preparations for accidents and spills, and documentation of waste shipments. Generators of hazardous waste are responsible for its proper handling at all stages. Canada is the tenth country to sign an international treaty on pollution prevention,[27] and is working toward creation of a "National Action List" that establishes maximum levels of discharge for interprovincial and international shipments of hazardous wastes. Fees are set for waste-disposal permits, but they have no environmental incentive effects. They are meant to cover a share of administrative costs (about one-half since 1993).

[27.] This is the 1996 Protocol to the Land Convention of 1972.

Provincial Waste-Disposal Policies: B.C.'s Waste-Disposal Permits and Fees

Each province regulates how hazardous wastes are stored and specifies security measures, fire protection, labelling, container design, and other aspects that relate to environmental safety. Provinces may require all waste dischargers to have a permit that specifies the quantities allowed and where disposal can occur. A fee may or may not be levied. British Columbia's *Environmental Management Act of 2004* illustrates this type of policy. The *Environmental Management Act* establishes strict liability against the discharge of wastes into the environment without a permit. The B.C. Ministry of Environment issues and manages the permit system. Each permit specifies the maximum quantity of pollutants allowed for discharge. There may also be other specific provisions connected to individual permits.[28]

[28.] The permit can also require the permit-holder to repair, improve, or construct new works; post security; monitor the method of landing, treating, transporting, discharging, and storing wastes; conduct studies and report information; use specified procedures in waste handling; or recycle certain wastes to recover certain resources (e.g. energy). See Ministry of Environment, Environmental Protection Division, "Waste Discharge Regulation Implementation Guide", available at: http://www.env.gov.bc.ca/epd/main/pdf/WDR_implement_guide.pdf. Accessed 12 October 2010.

In designing these permits, the government had to set maximum discharge levels. These are called "pollution-control objectives," and they have been set for five industrial groups: chemicals and petroleum; mining, smelting, and related activities; forest products; food processing and miscellaneous agriculture; and municipal waste. A permit is needed for each environmental medium into which wastes are discharged (air, water, land), and there is also a permit for special waste storage. The provincial government monitors discharges and enforces the scheme.

Fees for the permits were introduced in 1987 under the original legislation called the *Waste Management Act (1982).* The system in place until September 1992 for industrial sources based fees on industry production levels rather than wastes discharged from individual sources. The industrial fees covered only a small proportion of the government's costs of administering the system, not any measure of the economic and environmental costs of waste disposal. Fees that are not only low but also unconnected to actual discharges provide no incentive to reduce (or recycle) wastes. The old fee system was also based on increasing block charges. This meant that average and marginal fees per unit volume fall as volume increases. This fee structure likewise provides no incentive on the margin to reduce wastes.

In 1992, a new system was introduced that moved the province much closer to effluent taxes, and the *Environmental Management Act* continued that system. There is now a two-part fee. The first is a flat-rate annual fee that is like a licensing charge of $100 per medium for authorized discharges into air, water, for refuse, and storage . The second part is a variable fee based on discharges authorized by the ministry times a unit fee per tonne discharged. Fees are set for each waste product. Tables 18-2 and 18-3 list the fees that came into effect April 1, 2006, for contaminants released into air and water. Fees are now based on the government's assessment of the risks of the contaminant to the environment, as well as the administrative costs of the program. They will be adjusted as information about environmental impacts improves. For some industries, there was a substantial increase in fees. Revenues from the permits are being placed in a special fund, the Sustainable Environment Fund, rather than deposited into general revenues. The fund is to be used to address environmental problems and develop environmental protection projects.

Table 18-3: Contaminant Fees for Air Emission Permits in B.C., Effective April 1, 2006

Comment [NO3]: Table updated, sent by FAX; note it now needs to be renumbered back to Table 18-3.

CATCH REVISED TABLE 18-3

Table 18-4: Contaminant Fees for Effluent Permits in B.C., Effective April 1, 2006

Comment [NO4]: Table updated, sent by FAX, renumber back to 18-4.

CATCH REVISED TABLE 18-4

One problem not yet addressed by the fee structure is that the permits are based on the volume of discharges, not loadings (concentration, time, volume) to the environment. Under a volume-based system, dischargers have an incentive to increase the concentration of the waste material per unit volume. Higher concentrations of wastes generally lead to more environmental problems. Of course, if loadings became the unit for the permit, monitoring of discharges would become essential to ensure compliance. This could raise the costs of the program substantially. Despite these concerns, the B.C. waste-permit fees represent a substantial movement by a Canadian government toward an incentive-based system where the fees are essentially a tax on releases.

The Cleanup of Toxic Waste Sites

Canadian governments have been coming to terms with the management of toxic waste sites slowly. There have been various cleanups of waste sites, but these tend to be on an ad hoc basis. No government in Canada has an explicit program to deal with waste sites. There are no identified sources of revenue to fund these very expensive activities, no procedures to establish priorities for which sites to clean up, and no legislation governing any of these activities. Determining where and how to dispose of ongoing toxic waste being generated is also an extremely contentious and unresolved issue in Canada, and very little progress has been made over the past three decades.

Existing toxic waste sites are located primarily in urban areas. They are the result of past industrial activity, such as coal gasification in the 19th century. Many of these sites are known as "orphans" because the company or person responsible for the waste discharge is no longer in business. Site remediation is required by municipal laws before a piece of land can be used for redevelopment. Many sites in major cities across Canada have had to be cleaned before new residential and commercial development could occur. One reason why federal and provincial action on waste sites has been minimal could be because these sites have been construed as "local" problems. Federal policies apply only to federal and some aboriginal lands.

The identification of toxic sites in Canada began in the 1980s, stimulated by the revelations at the Love Canal—a location in New York State where homes were constructed on a reclaimed toxic waste site. The toxicity of the land was so high that the homes were deemed unfit for habitation and their occupants relocated. The Atlantic and western provinces and the territories joined the federal government in attempting to locate problem sites. Ontario and Quebec carried out their own surveys. The federal government was not involved because Environment Canada did not have the budget or personnel to work with the provinces. By 1990, 10,000 sites had been identified—of these, 719 were classified "Priority 1," which essentially meant that they represented a high risk to health and the environment and should be immediately assessed. The Canadian Council of Ministers of the Environment (CCME) studied these sites, and has guidelines and criteria for identifying sites at risk, but has not made public any list of priorities for cleanup.[31] Cleaning up toxic sites is very expensive – tens of millions per site, and billions to address major sites across Canada such as the Sydney tar ponds. There are now lots of guidelines for cleanup priorities and activities, but there is still little in the way of concrete action on many sites across the country. Recent federal and provincial budgets promise more funding for waste-site cleanup.

31. The CCME has published a number of studies on the science of waste-site identification and remediation principles, for example the *National Classification System for Contaminated Sites,Guidance Document2008*. Available at: http://www.ccme.ca/assets/pdf/pn_1403_ncscs_guidance_e.pdf, accessed 12 October 2010.

Sydney Tar Ponds Agency: http://www.tarpondscleanup.ca/index.php?sid=1

One further set of actions regarding remediation of damaged areas involves the International Joint Commission (IJC). As noted in Chapter 16, the IJC is a binational organization set up to deal with Canada–U.S. border issues. It has identified 43 sites around the Great Lakes that require decontamination and ongoing efforts to reduce further discharges. Twelve of these sites have been in Canada, 26 in the U.S., and 5 shared. The IJC facilitates coordination among all of the involved governments, the public, and industry to accomplish what are called Remedial Action Plans (RAPs), established by these groups. Statistics Canada estimated that the total cost of implementing all the RAPs could range between $100-billion and $500-billion for Canada and the U.S. combined. These costs include not just remediation of sites but also, for example, construction and upgrading of sewage treatment plants to prevent further damage to health and the ecosystem. The RAP process reported some success when measured against benchmarks in the late 1960s to 1970s. For example, through the initiatives of all levels of government coordinated by its RAP, Hamilton Harbour in Ontario has seen a marked improvement in water quality and improvement in habitat for fish and other species. As of 2010, four sites (three in Canada and one in the US) have been delisted because their remediation goals established by their RAP have been achieved. However, there are still many challenges. Once of the biggest is the lack of funding for remedial measures identified by the RAPs and for data-collection and scientific studies. The IJC, in reviewing Hamilton's RAP, found some disturbing trends in the past decade. Monitoring of concentrations of some key toxins including cyanide ended in the 1993. It is therefore impossible to tell if progress has been made since then. The IJC also noted an increase in concentrations of nitrogen (from ammonia), phosphorus, and suspended solids since the late 1980s. This suggests a U-shaped time trend. These are partly due to inadequate wastewater treatment—again, a victim of insufficient funding and inadequate pricing of wastewater services.

Canadian Remedial Action Plans: www.on.ec.gc.ca/water/raps/intro_e.html

SUMMARY

The coming of the chemical society has led to new sources of environmental damage and opened up new requirements for managing toxic and hazardous materials. Canadian policy is only beginning to come to terms with the problems of toxic materials. Federal regulation of toxic compounds involves the identification and regulation of dangerous contaminants once they have entered the ecosystem. While thousands of potentially dangerous compounds are in everyday use, very few have been banned or strictly regulated. The cornerstone of federal policy is CEPA, 1999 and the commitment to study the toxicity of substances on the Domestic Substances List and design appropriate regulations. But this task is enormous and the built-in bias toward using command-and-control regulation for all hazardous substances, whether they should be banned or not, may lead to an unwieldy system with high compliance costs. The collection and publication of toxic releases in the NPRI is an important component of our regulatory policies, but it is not a replacement for other regulation. Attention has to be paid to the toxicity of substances, not just aggregate emissions unweighted by toxicity.

Waste management in Canada is primarily a provincial responsibility, except for the interprovincial and international waste flows. Some provinces use permits to regulate disposal. These permits do not yet have fees attached that reflect the external costs of disposal. There is scope for incentive-based policies to complement CAC regulation and provide continuous incentives to reduce wastes.

Canada lags in its management of hazardous-waste sites. No Canadian government has an explicit and funded program to deal with the cleanup of existing sites.

KEY TERMS

Emissions intensity, 352

Loadings, 355

Toxic intensity, 352

Voluntary compliance, 351

Waste reduction, 360

DISCUSSION QUESTIONS

1. Handlers of hazardous wastes—that is, firms that accept hazardous materials and transport them for disposal—sometimes dispose of the materials illegally or in unapproved landfills. How might a deposit–refund system be designed to provide incentives to dispose of hazardous materials in approved ways?

2. What are the advantages and disadvantages of using a limited liability approach to cleaning up hazardous waste sites; that is, an approach whereby firms that dumped material in a site are held liable only for their own wastes?

3. The cost of cleaning up toxic waste sites is thought to be enormous. At present there is no dedicated funding for this task. How might Canadian governments finance remediation while simultaneously providing incentives to reduce waste generation?

4. What type of fee structure would you recommend for provincial disposal permits?

5. It has frequently been suggested that taxes be placed on toxic materials at point of production; these would be easier to administer (as compared to taxes in intermediate-use stages) and would discourage overall use of the chemicals taxed. What are the efficiency implications of this approach?

6. What toxic substances are released in your city? What has happened to their emissions over time? Consult the NPRI (www.ec.gc.ca/npri). Choose two substances and see what types of industries produce them and what their potential damages might be. The Environment Canada and NPRI Web sites have a number of good links that might be helpful to you.

7. The House of Commons Environment Committee has recommended the phasing out and ultimate ban on using lawn chemicals and other pesticides for "cosmetic" purposes on household lawns and gardens. Evaluate this policy proposal. Consider its likely cost effectiveness, administrative costs, compliance issues, and social efficiency.