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Canada

The Role of Economic Instruments in the Regulation of Water Pollution from the Pulp and Paper Industry in Ontario

Jessica Tilley Burpee

A Thesis

in

The Department

of

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ABSTRACT

The Role of Economic Instruments in the Regulation of
Water Pollution from the Pulp and Paper Industry in Ontario

Jessica Burpee

Economic instruments are tools with a fairly wide application in the field of environmental policy. With these instruments, financial burdens are put on polluters, in some cases to the extent that these costs provide an incentive to reduce pollution; alternatively, polluters are offered financial incentives, e.g. in the form of subsidies, if they modify the environmental impacts of their activities.

This study attempts to define the role that economic instruments could play in the regulation of water pollution from the pulp and paper industry in Ontario. It uses a decision-making flowchart developed by Victor and Van Den Bergh (1991) as a method of determining the potential uses of economic instruments for the regulation of pulp and paper pollution. The application of the flowchart shows that there is potential for the use of effluent charges as a regulatory tool.

The timeliness of this study is reflected in the fact that the Canadian and Ontario governments are currently evaluating the potential of economic instruments as regulatory tools for pollution abatement in the industry.

The use of economic instruments is a recent trend; in the area of water pollution regulation, plans for their use are still at the theoretical stage in Canada, although they have been applied in the U.S. and Europe. This study may interest provincial or federal policy makers who are eager to include economic instruments in their water pollution policy. This thesis consists of a qualitative study of the current regulatory situation in Ontario and Canada, the theoretical use of economic instruments, and the use of a decision flowchart to determine the potential uses of economic instruments for the regulation of water pollution from the pulp and paper industry in Ontario.

The outcome of the assessment is that effluent charges are recommended as an economic instrument that shows potential for use in the regulation of Ontario's pulp and paper mills.

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Mum — for pushing me back into it when it looked like a cavernous lion's mouth; and

Dad — for taking me back when my school loans surpassed the national debt.

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List of Acronyms

AOX	adsorbable organic halogen
BOD	biochemical oxygen demand
CA	Certificate of Approval (Ontario)
CCME	Canadian Council of Ministers of the Environment
CEPA	Canadian Environmental Protection Act
CFCs	chlorofluorocarbons
CPPA	Canadian Pulp and Paper Association
CTMP	chemi-thermomechanical pulp
EPA (U.S.)	Environmental Protection Act
EPA (Ont.)	Environmental Protection Agency
FEI	financial enforcement incentives
GNP	Gross National Product
IEB	Investigations and Enforcement Branch (Ontario)
LSB	Legal Services Branch (Ontario)
MISA	Municipal Industrial Strategy of Abatement
MOEE	Ministry of Environment and Energy (Ontario)
Nox	nitrogen oxide(s)
OECD	Organization for Economic Cooperation and Development
OPPE	Office of Policy, Planning, and Evaluation (U.S.A.)
OWRA	Ontario Water Resource Act
PCBs	polychlorinated biphenyls
TMP	thermomechanical pulp
TSS	total suspended solids
VOCs	volatile organic compounds

Note: See the Glossary on page 110 for complete definitions of some of these terms.

1.0 INTRODUCTION

> "Institutions must be made to flow with the progress of technology and society, not to dam it."
>
> Ontario Society for
> Environmental Management

The pulp and paper industry is one of Canada's most economically important industries. It is a major industrial component "in almost every region of Canada, and crucially important in [...] Northern Ontario" (Sinclair, 1991: 87). The industry is one of the largest contributors to Canada's balance of trade and, with the forestry sector, is Canada's greatest employer (Canadian Pulp and Paper Association, 1991).

The pulp and paper industry is also a major source of water pollution in Canada. Bonsor (1990) notes that it was the first major industrial sector in Canada to be subject to widespread regulations[1] aimed at reducing the flow of pollutants into receiving waters. These regulations have induced mill operators to alter pulp and paper making processes to abate pollution. However, many mills have yet to comply with existing regulations, and so regulators are starting to look for new ways of inducing firms to reduce their effluents.

The objective of this thesis is to provide the pulp and paper industry, government regulators, and others in the private and public sectors with an understanding of the role

[1] A regulation is "the imposition of constraints, backed by government authority, that is intended specifically to modify the behaviour of individuals in the private sector" (Adie and Thomas, 1987: 329-330).

that economic instruments, which currently are not used to regulate the pulp and paper industry, might play in the abatement of conventional[2] pollutants discharged by pulp and paper mills in Ontario. Economic instruments[3] are measures which use market forces to change the behaviour of firms. Some authors and government bodies have been studying the possibility of using economic instruments to reduce further water pollution from the pulp and paper industry (Stephenson, 1977; Bonsor, 1990; Canada, 1990; and Victor and Van Den Bergh, 1991). Economic instruments, though implemented by a regulation, are different from the system of direct regulation, also called "traditional" and "command and control" regulation (Interview with Blain, 1993). Direct regulation is the approach for pollution abatement used currently in Canada. The Canadian Council of Ministers of the Environment (1991:7) defines it as "a process through which a political authority directs private entities to take specified actions or to engage in specified types of behaviour. In this system government enforces directives through standards, limitations and penalties (fines or jail terms)." Unfortunately, what direct regulation could accomplish is often offset by an inability or reluctance of the government to enforce the law. This inability or reluctance may be caused, in the case of pulp and paper, by many factors, including:

- the fact that it is politically unacceptable to threaten a mill in a one-industry town (this includes most mills), because of socio-economic consequences;
- a reluctance by the government to prosecute offending companies

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[2] Organochlorines (including dioxins and furans) are not considered in this thesis because they are not suited to regulation with economic instruments.

[3] Opschoor and Vos (1989) define economic instruments as policies that "affect estimates of costs and benefits of alternative actions open to economic agents, with the effect of influencing decision making in such a way that alternatives are chosen that lead to an environmentally more desirable situation than in the absence of the instrument". They are explained in more detail in Section 2.6.

(Parfitt, 1988; Escobar, 1989; Bohn, 1990; Roberts, 1993);

- the ability of firms to delay the legal process that requires them to achieve compliance with the regulations;
- the fact that it is very difficult to obtain precise information regarding pollution discharged from mills, due to a lack of resources devoted to monitoring and enforcement (Sinclair, 1990);
- inequalities: some mills are older than others, and may not be expected to reach the same standards (this has been cleared up somewhat under the 1992 federal regulations, which are theoretically standard for all mills); and
- many industries, preferring to spend less on pollution control, lobby the government for reduced stringency in legislation (Geddes, 1990; Mittelstaedt and Mahood, 1993). The Canadian Pulp and Paper Association (CPPA) has been successful in its lobbying efforts (Sinclair, 1991) because of the industry's economic importance to Canada and because the CPPA is a well-organized and funded lobby group.

Economic instruments are different from direct regulation in that they provide firms with more flexibility in achieving discharge limits. This flexibility can save firms money in overall pollution abatement costs. The fundamental premise of this thesis is that if economic instruments can be used to curb pollution more efficiently and/or more effectively than the current system in Ontario, then plans for their use are worth pursuing.

Economic instruments can make pollution control look more attractive to the firms that need help to achieve their required levels of abatement. In fact, many economists think, as Tietenberg pointed out, that "the issue is no longer whether they have a role to play, but what kind of role they could play" (Tietenberg, 1990: 105). Economic instruments represent a natural evolution of the regulatory process which is occurring simultaneously in many countries. A survey undertaken by the Organization for Economic Cooperation and Development (OECD) (Opschoor and Vos, 1989) identified the use of 153 economic instruments in member countries as of 1987, and their use has

increased dramatically since then (Canada, 1993b). A report published by the Ontario Round Table on Environment and Economy studied economic instruments and their potential to contribute to the integration of the environment and the economy in Ontario. It recommends that the Ontario government establish a system of economic instruments to determine their effectiveness and efficiency at meeting environmental goals in a river basin (Cassils, 1992).

To determine the potential role of economic instruments, this thesis will:

- describe the different types of economic instruments available to regulators;
- describe some practical applications thus far in North America and Europe;
- focus on water pollution: more specifically on meeting the December 1992 federal and November 1993 Ontario regulations for conventional pollutants;
- illustrate the significance of environmental expenditures to the Ontario pulp and paper industry;
- explain the current and evolving technologies in the pulp and paper industry;
- examine evolving government policy regarding the regulation of the pulp and paper industry in Canada and Ontario, and its enforcement; and
- decide whether any of the instruments included in this report are suitable for the regulation of pulp and paper in Ontario, considering the makeup of the industry and the jurisdiction of the Ontario government.

Ontario was chosen as the area of study because of its importance to the Canadian pulp and paper industry as a whole. In 1987, Ontario produced 24% of the total value of Canadian pulp and paper shipments (Cdn $4.2 billion), as well as 23% of the value added and 25% of total national employment in the industry (Victor and Van Den Bergh, 1991). Furthermore, the Ontario government, through its Municipal Industrial Strategy for Abatement (MISA) program, has put special emphasis on the regulation of

the pulp and paper industry in recent years.

The literature review in Chapter 2 will outline the arguments and experiences that have appeared in the general literature on economic instruments, and on the regulation of the pulp and paper industry in particular, now and in a possible future scenario that uses economic instruments as regulatory tools.

Chapter Three is a review of the past, current, and new regulations in Canada, Ontario, and the United States. It also describes the current regulatory environment surrounding the Ontario pulp and paper industry, in terms of the monitoring and enforcement procedures, the potential economic impact of the 1992 federal and 1993 provincial regulations, and legislative and political "openness" to the use of economic instruments.

Chapter Four will outline Victor and Van Den Bergh's (1991) "decision tree", an evaluation framework that is used to select the optimal form of regulation from various choices that are presented. It allows the evaluator to go beyond the listing of strengths and weaknesses of each candidate instrument and enables the selection of an instrument using more thorough and interrelated criteria, by following the pathways of the decision tree flowchart. The implementation of the decision tree consists of answering questions that follow a pathway until a decision is made regarding the optimal type of instrument to be used. The decision tree will be used in Chapter Five to assess the role of economic instruments in the regulation of conventional pollutants from the pulp and paper industry in Ontario. Chapter Five will also evaluate the strength of this decision in terms of how well it conforms with the criteria that were used to make it. Chapter Six provides a

summary and conclusion of the research, any weaknesses that were encountered in the study, and implications for further research in the area of economic instruments for the regulation of conventional pulp and paper pollutants.

1.1 Methodology

This thesis attempts to decide whether any economic instrument(s) could be used for more effective regulation of conventional water pollutants from the pulp and paper industry in Ontario. Specifically, it attempts to determine which instruments are suitable in certain situations that will be outlined. This is done by applying Victor and Van Den Bergh's (1991) decision tree to the case of Ontario's pulp and paper industry. The decision tree is a dichotomous key in the form of a flowchart of questions and answers that is applied by asking the thirteen questions, using specific criteria, in order to assess the role of economic instruments in the attainment of the federal and provincial regulations for the pulp and paper industry in Ontario.

The information used in making these decisions comes from interviews with Canadian and American federal and Ontario governmental employees (researchers, regulators, etc.), as well as government documents procured from these employees, and journal articles and books. Some documents were also procured from independent researchers (i.e., Novotny, 1984). Industry representatives were also interviewed.

2.0 ECONOMIC INSTRUMENTS AND THE REGULATION OF THE PULP AND PAPER INDUSTRY: A LITERATURE REVIEW

2.1 Economics of the Pulp and Paper Industry in Canada and Ontario

2.1.1 Economic Significance of the Industry

The Canadian pulp and paper industry comprises 82 firms that operate 144 mills (Canadian Pulp and Paper Association, 1990). Of these, 122 discharge their effluent waste directly into an ocean, lake, river, or stream without going through a municipal sewage treatment system (Sinclair, 1990). In Ontario, there are 26 of these direct-discharge mills (see Figure 1, p. 8, and Appendix A, p. 106).

The pulp and paper industry has played a significant role in helping to establish Canada as a nation that can successfully manufacture products that enjoy long-term international market acceptance. Annual production in Canada is valued at $20 billion (Kennedy, 1990). In 1990, pulp and paper exports accounted for 10.8% of total national exports (see Table 1, p.9) and made Canada the largest exporter of pulp in the world. The industry is the most economically important both in terms of value of production and total wages paid in Canada (Canadian Pulp and Paper Association, 1990). In 1990, Ontario pulp and paper mills' production was about six billion tonnes, while employing

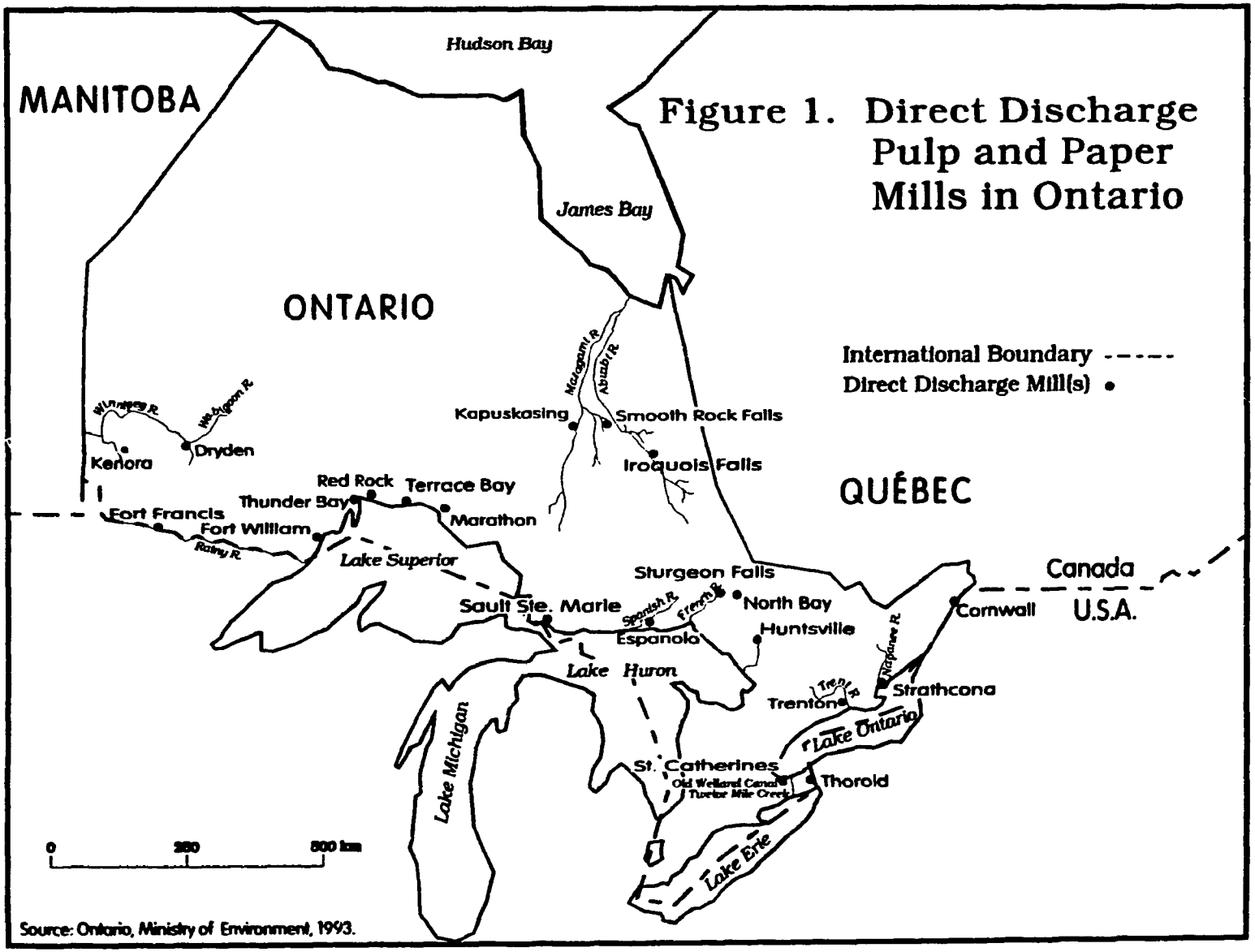

Figure 1. Direct Discharge Pulp and Paper Mills in Ontario

17,000 people in the province (Ontario, 1993). Approximately 2.7% of the Ontario Provincial Gross Domestic Product has historically been generated by the paper and allied industries (Victor and Van Den Bergh, 1991). Ontario's share of Canada's production in tonnes per day (see Table 2) worked out to 20% in 1992. The industry is also important socio-economically, as it is the most important or only source of income for about 175 towns and communities in Canada. Since many of these towns were established as a result of pulp and paper manufacturing operations, many of them are located in isolated areas and would be threatened economically by a mill shutdown.

Table 1

Pulp and Paper Industry's Mills, Employment, and Production

Year	No. of Mills Ont/Can.	Total Employees ('000) Ont./Can.	Gross Production (millions $) Canada	P & P as % of GNP Canada	P & P as % of Total Exports
1975	37/142	21/84	5 159	3.1 %	12.0 %
1980	36/142	23/87	10 991	3.6	11.4
1985	35/142	20/79	13 406	2.9	8.4
1988	36/145	n.a./81	19 850	3.4	11.5
1989	n.a.	n.a./73	21 500	3.4	11.6
1990	37/144	17/73	22 750	3.5	10.8
1991	35/174	n.a./72			
1992	35/180	n.a./67			
1993	36/178	n.a.			

Source: Sinclair, 1990; Canadian Pulp and Paper Association, 1994; Ontario, 1993.
n/a= information not available

Table 2

Total Industry Production by Region (000s tonnes)

Year	B.C.	Prairies	Ontario	Quebec	Atlantic	Total
1975	3 959	705	2 657	5 167	2 210	14 698
1980	5 567	923	4 580	6 813	2 765	20 647
1985	5 911	685	4 660	7 139	2 693	21 089
1988	7 213	816	5 392	8 306	3 150	24 895
1989	7 142	1 035	5 487	8 158	3 141	24 963
1990	6 718	1 117	5 094	8 048	2 943	23 921
1991	6 682	1 647	4 871	8 233	3 052	24 484
1992	6 646	2 057	5 038	8 210	2 961	24 912

Source: Canadian Pulp and Paper Association, 1992: 22.

Because the survival of the industry is so important, government representatives are hesitant to inhibit the industry's competitiveness with demands for investments in pollution control.

2.1.2 Capital Spending

The pulp and paper industry's financial status does not always determine capital spending on pollution abatement equipment. A recent downturn in pulp and paper

industry cash flows has led to significant cuts in plans for capital spending in the industry (Victor and Van Den Bergh, 1991). According to a survey done by Pulp and Paper at the end of 1990, Canadian companies had plans to invest Cdn $10.2 billion on mill improvements over the following two years. However, this is 21% less than spending plans made at the end of 1989. Relatively deeper cuts to Canadian investment plans are attributed to weakness in markets for Canada's two most important products, newsprint and market pulp, as well as the high value of the Canadian dollar in the late 1980s. The general state of the industry is reflected in the following quotes.

> The Canadian pulp and paper business, already under pressure to invest billions of dollars to reduce operating costs and pollution, lost a total of $1.3 billion last year, a year when prices hit rock bottom.
>
> Globe and Mail, Oct 22 1992, p. B5

> Public and private Canadian companies making pulp, paper, lumber and related products lost a collective $2.5 billion in 1991, on sales that plummeted almost 10 per cent to just less than $32 billion, according to a new report sponsored by the CPPA.
>
> Globe and Mail, July 15 1992, p. B3

> MacMillan Bloedel, hit by a record-setting $93.4 million loss last year, must restructure its operations....The company closed one of its five newsprint machines at Powell River last month, putting almost 200 people out of work.
>
> Globe and Mail, Apr 10 1992, p. B5

Environment-related investments in the pulp and paper industry, however, have risen significantly (see Table 4, p. 18). These investments are made on such items as pollution-abatement equipment. In Canada in 1991, these investments were projected to rise to 24.9% of all planned investments in the industry, up from 15.9% in 1990 and 5.5% in 1989. Many mills have installed or will be installing paper recycling systems,

including a deinking plant, at their mills. This reduces the need for virgin wood fibres, although pulp must still be made, with the recycled paper. Canadian costs are also driven by the requirement to install secondary water treatment systems (discussed in Section 2.3), already in place at most U.S. mills (Victor and Van Den Bergh, 1991), as well as by the need to meet the 1992 federal and 1993 provincial regulations.

2.2 Sources of Water Pollution in Pulp and Paper Manufacturing

Before regulations pertaining to the pulp and paper industry can be discussed, it is important to understand how pollution is created by the pulp and paper making process. The main sources of information for this section are Sinclair (1990) and Bonsor (1990).

Sinclair (1990) notes that the water pollution problems caused by the pulp and paper industry are largely due to production methods. Enormous quantities of water are used to move wood within a mill, as well as for debarking, cooking and grinding (for wood fibre separation), bleaching, chemical recovery (from cooking and bleaching), and sheet forming. Each of these phases can produce different effluent waste discharges. Two conventional types of pollution discharge are materials that cause biochemical oxygen demand (BOD) and create total suspended solids (TSS). Mill effluents that cause BOD come mainly from wood sugars, lignin (a natural glue that holds wood fibres together), and other natural substances present in wood. The latter are attacked and decomposed by oxygen in the receiving waters, which leaves less oxygen for use by aquatic life.

Suspended solids in the pulp and paper industry are mainly tiny fragments of wood fibre that escape in the liquid effluents from mills. One effect of TSS is that it can smother potential breeding grounds of fish. These two pollutants are measured in terms of "end-of-pipe" standards (i.e., the water discharged from a pipe at the end of the process is sampled).

Different processes produce different amounts of effluent discharge, although the amount that actually leaves the plant depends on the efficiency of the equipment for removing the offending materials. The "liquor" (used chemicals and water) left over from chemical pulping is usually recovered and reused. However, leakages or spills of liquor occur often, and these are a major reason for decreases in dissolved oxygen in water bodies. Bleaching is another major source of BOD; if the pulp entering the bleach plant is not effectively washed, the residual lignin will react with the chlorine, substantially increasing the BOD (McCubbin et al., 1990). The solids that contribute to the level of TSS are produced in mechanical and chemical pulping, and even more so in the paper mill (Sinclair, 1990). Apart from these conventional pollutants, there are always further pollutants being identified as research continues[4]. A recently identified group of pulp and paper pollutants is organochlorines, including dioxins and furans[5]. "In kraft mills, the bleaching stage is the source of about half the BOD [and] all the organochlorines of

---

[4]The Pulp and Paper Research Institute of Canada (PAPRICAN), in Montreal, is responsible for much of the industry's scientific research.

[5] These are two complex classes of organic chemicals that are chlorinated as a result of natural and manufacturing processes, and from the combustion of organic materials. Polychlorinated dioxins and furans have been declared toxic under the Canadian Environmental Protection Act because of their immediate and long-term harmful effects on the environment and human health (Canada, 1990). "Some [organochlorines] cause cancer and birth defects" (Estrin and Swaigen, 1993: 550).

the effluent" (Estrin and Swaigen, 1993: 548). Other sources of organochlorines include defoamers and woodchips that are used in pulp production. Bonsor (1990) explains that the distribution of conventional pulp and paper pollutants is localized in the receiving waters. Although the conventional pollutants do biodegrade fairly rapidly, in doing so they exert a BOD on receiving waters. However, the impact of BOD on receiving waters is, with rare exceptions, limited to an area within a few kilometres from the point of discharge. TSS usually settle very close to the point of discharge while organochlorines can affect a significantly larger area, due to their bioaccumulative nature (they do not biodegrade). In Lake Athabasca, they have been traced 1400 kilometres from their source (Bonsor, 1990).

The seriousness of water pollution often depends on the characteristics of the receiving water itself. For instance, the damage caused by oxygen-depleting substances can depend on the dilution available to the effluent, the extent of other oxygen-depleting discharges, water temperatures (because oxygen dissolves more easily in warm water than cold), and the reoxygenation coefficient in rivers. Furthermore, damage caused by BOD is reversible, i.e., when effluent flow is reduced and river flow increases, BOD may be lessened.

2.3 Methods of Reducing the Effects of Conventional Pollutants

Historically, the pulp and paper industry has been characterized by relatively old

technology (See Table 3, p. 15). Victor and Van Den Bergh (1991: 57) have put forth several causes for this. First, there are "high capital risks involved in applying new manufacturing processes". In other words, "developing a production technology from laboratory testing to bench scale, pilot scale, prototype and finally established use typically is a long (5 to 10 years) and costly process". Secondly, there have been "reductions in

Table 3

Ages of Newsprint Machines Operating in Canada, the United States, and Scandinavian Countries in 1983

Period New or Reconditioned Machines Commenced Operation	Canada (%)	United States (%)	Scandinavian Countries (%)
Before 1950	58	28	7
1950 to 1970	19	45	50
After 1970	23	27	43

Source: Sinclair, 1990: 24.

cash flows resulting from the fact that the pulp and paper industry had about ten lean years before a profit jump in the late 1980s. The fact that equipment and process development tends to be by equipment builders rather than the pulp and paper industry may also be of significance." The industry trend has been toward profit-taking rather than reinvestment in research and development (Interview with Blain, 1993).

Nevertheless, there are a few new systems that have been developed to reduce the

amount of polluting materials and/or to recycle those that are produced back through the recovery processes so that they do not reach the surface waters.

The pollution treatment facilities in a mill could include pretreatment of pulp, primary treatment (which takes place after production), and subsequent treatment phases. Pretreatment consists of "removing grit, coarse materials and debris, neutralising acid or alkaline wastes, and equalizing effluent characteristics and flows by mixing the collected effluent streams" (Canada 1983: 124). The goal of primary treatment is to remove suspended solids from the effluent, normally in a gravity clarifier, and is a prerequisite for most secondary treatment processes. Secondary treatment reduces materials that cause BOD through such processes as aerated stabilisation basin treatment, which is based on long-term growth of microorganisms on the soluble materials in the effluent. When the microorganisms die, the sludge is used as food for other microorganisms, and thus the organic material causing BOD is digested. Finally, tertiary treatment, which is rare in Canada, consists of processes, such as granular filtration or chemically aided coagulation, to remove further contaminants such as colour, odour, taste, and to further reduce TSS and BOD. Of the 26 pulp and paper mills discharging directly to Ontario's waterways (see Appendix B, p. 108), all have primary treatment and seven have some form of secondary treatment (Ontario, 1993).

Treatment facilities can be internal, in the form of in-plant process modifications, or external to the rest of the mill (i.e.: primary and secondary treatment), and both can be equally effective in terms of effluent control. The average mill in Canada has a combination of both internal and external treatment (Canada, 1983).

Innovations have been directed toward improvements in economies of scale, product quality, protection of the environment, or energy conservation. Debarking processes can now be accomplished without water, which means that the effluent BOD and TSS are reduced in the wood preparation stage. Most new mills and some older mills use this dry debarking process to minimise effluents. The most significant change in the production of pulp has been the use of thermomechanical pulping (TMP). Pulp produced by this method makes paper that is strong enough to replace the more expensive and polluting chemical pulp currently in use for the production of newsprint. BOD discharges are reduced significantly with TMP. A further development, chemi-thermomechanical (CTMP) pulping, has been used at the Millar Western mill in Meadow Lake, Alberta. They have designed a near "closed loop": it will have no wastes discharging into the river, although some waste is landfilled. The mill makes CTMP pulp (in part) by chewing and cooking wood chips in a mild brew of caustic (sodium hydroxide) and hydrogen peroxide. The use of hydrogen peroxide, which is recyclable (unlike chlorine which is too corrosive), as a bleaching agent enables the company to close its manufacturing loop. They have designed a way to contain, clean and reuse their dirty water by installing three of the largest evaporators ever built (Collins, 1991). The effluent is boiled dry, and the steam is condensed to pure water to be pumped back into the system. The residue, burned to sodium carbonate ash, will be recausticized and reused as an ingredient in the pulp brew. A small amount of sludge will be landfilled.

Other developments include pulp washing (continuous diffusion washers) and screening (closed pressure screens), which remove "dirt and foreign matters, such as slivers,

knots, grit, bark, sand, uncooked chips, etc., from the pulp" (Canada, 1983: 63). These washers and screens have helped in the reduction of accidental spills and BOD.

Canadian mills have reduced their discharge of conventional pollutants over the last two decades, largely because of new in-plant technologies and the establishment of effluent treatment facilities. Table 4 tracks their progress.

Table 4

Performance and Water Pollution Abatement Expenditures of Canadian Mills

Year	Kg of BOD Matter per Ton of Effluent	Kg of TSS per Ton of Effluent	Water Pollution Abatement Expenditures (millions $)
1980	44	19	87.1
1982	36	16	135.8
1985	29	12	63.4
1987	27	11	48.0
1989	26	10	289.6
1990	23	9	500.7
1991	19	8	553.4
1992	17	7	588.9

Source: Canadian Pulp and Paper Association, 1992: 31.

The large jump in expenses from 1987 to 1989 is not entirely from increased spending on pollution abatement equipment, but rather from a new way of defining such spending.

This means that some types of purchases that were not previously under this heading are now included (Interview with Blain, 1993).

Table 5 shows the comparative levels of compliance in Ontario and other regions in Canada. The level of compliance shown in this table had been achieved primarily through the provincial regulations, which have consisted largely of requirements for specific pollution control equipment, and also through a mill modernization program, discussed in Section 3.3.5, that consisted of subsidies to Ontario pulp and paper companies (Ontario, 1991).

Table 5

Direct Discharge Mills Considered in Compliance with Federal Pulp and Paper Effluent Regulations - 1985 (1993)[1]

Province	No. of Mills[2]	In Compliance for TSS	In Compliance for BOD
B.C.	23	43.4 %	100 %
Prairies	5	40.0	80.0
Ontario	**28 (26)**	**85.7 (38.5)**	**82.1 (96.2)**
Quebec	47	59.6	68.1
Atlantic	19	57.9	73.7
Total	122	61.4	78.6

Source: Sinclair, 1991: 161.

1 The compliance rates for 1985 are based on current regulations, 1993 on the new regulations

2 Direct discharge mills: ie., whose discharges fall into a waterway without being directed through a municipal waste treatment facility

2.4 Federal and Ontario Water Pollution Regulations

2.4.1 Regulations for General Water Pollution and for the Pulp and Paper Industry

Protection of receiving waters is shared between the federal and provincial governments. Both levels of government have negotiated administrative arrangements for the enforcement of Section 33 of the federal Fisheries Act, which makes it an offense to deposit any "deleterious substance of any type in water frequented by fish" (Canada 1984: 7). A comprehensive look at the development of the federal regulations in Canada is seen in Controlling Pollution from Canadian Pulp and Paper Manufacturers (Sinclair, 1990), and in Currents of Change, by Pearse et al. (1985).

Historically, the federal government has sought to create national standards and provincial-federal cooperation. This was inherent in the first two acts protecting Canadian waters, the Canada Water Act of 1970 and the Fisheries Act of 1971. Over time, the federal government accepted the role of setting national goals, while the provinces have been responsible for enforcement in their own jurisdictions. However, recent calls for Canada-wide standardization of regulations have led the federal government to take on a greater role in the regulation of the pulp and paper industry. Accordingly, the federal government has developed some minimum control requirements in amendments to the Fisheries Act and the Environmental Contaminants Act. Canada's Green Plan (1990) contains a National Regulatory Action Plan that commits the federal government to develop new limits for the control of effluents of dioxins and furans and

other types of effluents from pulp and paper mills. Accordingly, the departments of Environment, Fisheries and Oceans, and National Health and Welfare published a package of new regulations in 1992. These regulations, under the Fisheries Act and the Canadian Environmental Protection Act (CEPA), include the Pulp and Paper Mill Effluent Chlorinated Dioxins and Furans Regulations and the Pulp and Paper Effluent Regulations, which cover BOD and TSS. The weekly newsletter Pulp and Paper Week (1991) quotes the federal government as saying that Canada is the first country worldwide to implement national regulations on dioxins and furans in pulp mill effluents. Bonsor (1990) and Sinclair (1990) have commented in a more general sense on the Canadian water pollution abatement policies, noting the Canadian policies' lack of success over the years.

The primary water protection statutes in Ontario are the Ontario Water Resources Act (OWRA) and the Environmental Protection Act (EPA), administered by the Ministry of the Environment and Energy (Muldoon and Valiante, 1989). Bonsor (1990) notes that in addition to the standard limits, the provincial government normally issues a negotiated control to each mill defining permissible effluent loadings and compliance schedules. These negotiations are discussed in a Great Lakes Water Quality Board (1981) document in greater detail. The most recent EPA amendments, of November 1993, are discussed by Mittlestaedt (1993), Mahood (1993), and in the interview with Stewart (1993).

2.5 Economic Instruments for Environmental Regulation

As seen in the federal and Ontario regulations discussed above, direct regulation is still the main tool of trade for the authorities, especially with substances that are publicly viewed as hazardous to human and animal health, as are dioxins and furans. However, the federal government has made a firm commitment to make greater use of economic instruments, rather than or in addition to direct regulation, to achieve its environmental objectives. This is evident in its Green Plan (including the follow-up discussion paper, Economic Instruments for Environmental Protection: Discussion Paper)(Canada, 1991), Nox/VOCs Management Plan (Canadian Council of Ministers for the Environment, 1990), which deals with the control of nitrogen oxide and volatile organic compounds, and Prosperity Initiative (Steering Group on Prosperity, 1992). Canada's Green Plan set out as one of its principles that Canada "must make use of the forces of the marketplace and allow industry as much flexibility as possible in meeting specific environmental goals and targets" (Canada, 1990:15).

Economic instruments are a key part of the sustainable development strategy to which Canada is apparently committed. The stated hope is that economic instruments can use market forces to encourage producers and consumers to incorporate environmental considerations in their decision making processes. Some economic instruments directly affect prices. Others create a market along with a price for access to environmental resources. Economic instruments focus on environmental results, rather than on methods.

2.5.1 Definitions

Economic Instruments

Economic instruments are types of regulatory instruments that are intended to modify behaviour through financial incentives and market forces. Financial incentives may consist of making the polluter pay (by a charge) or limiting the polluter with permits that may be traded with other polluters. Economic instruments are flexible and cost-effective, and they can be an efficient source of government finance (Barde, 1989).

Economic instruments can take various forms including, in the case of water pollution, effluent charges, tradeable permits, and financial enforcement incentives.

Effluent Charges

Effluent charges are designed to counteract an externality[6]. They are prices paid per unit of discharge, whether the discharges are under a desirable level or not, by a polluting firm or individual. These are different from the fines paid in a system of direct regulation in that the fee is paid per unit of discharge, regardless of whether the discharges are above or below the authority's desired limit. This could result in a company's image remaining untarnished, as the fees paid in a charge scheme are not paid as a result of an illegal act.

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[6]An externality reflects a type of market failure. Negative externalities are "cases in which the actions of one individual or firm affect other individuals or firms, where one firm imposes a cost on other firms but does not compensate the other firm" (Stiglitz, 1983: 75). Since a pulp and paper firm usually does not bear the full cost of the water poilution which it generates, that pollution becomes a negative externality to other users of that water. Other uses of that water might be fishing, other manufacturing, and recreation.

Charges create an incentive for abatement by increasing the cost of a polluting activity. Charges in general are normally expressed as dollars per unit of effluent discharged. The rate may vary according to the quality of the discharge (as measured by the concentration of contaminants), the fluctuations in its flow, the time at which it is discharged, and the state of the receiving water and its alternative uses. The level of the charge is set by the authority, which approximates what level would induce firms to control pollution to the desired level. The level of the charge is then adjusted over time, through trial and error, until the firms' reactions lead to compliance. Effluent charges are applied to pollution effluents. Product charges operate by the same pay-per-unit system, but are applied to inputs to a production process or final products.

Tradeable Permits

Tradeable permits[7] are "exchangeable property rights to discharge specified quantities of waste into the environment or to degrade environmental quality by a specific amount" (Novotny, 1984: 1). The permits are allocated or auctioned to firms by the governing authority. They can then be sold by one firm to other firms (hence, the "trade"). For instance, if Source A wants to expand its activities (which usually necessitates more effluents), it may buy "rights" to pollute from Source B, if the latter has unused credits to sell. Source B is then required by law to have the lower levels of waste that correspond to its remaining number of permits. The result is that economic development is reconciled with environmental protection by allowing firms to operate in a

[7] Tradeable permits are sometimes referred to as transferable discharge permits, marketable permits, or emissions or effluents trading. These terms are synonymous for the purpose of this thesis.

given area without increasing the total amount of polluting effluents within that area. It is also possible to lower the ceiling on allowable effluents gradually, by retiring permits. This system can provide firms with flexibility in timing their capital expenditures (on pollution abatement).

Trading can be applied in a several ways: netting allows a firm that creates a new source of effluents in a plant to avoid the regulations which would normally apply, by reducing effluents from another source in the plant so that net effluents do not change significantly.

Offsets are used by new effluent sources in an area that has reached the maximum pollution output limit. Normally, the new source may be refused entry to that area. However, it can make use of this method if it "offsets" its new effluents by reducing effluents from existing sources by equal or larger amounts, either internally or with other firms.

Bubbles are imaginary structures placed over a plant, with all effluents exiting at a single point from the bubble. A bubble allows a plant manager to make effluent control decisions in aggregate for all sources covered by the imaginary bubble rather than on a source-by-source basis. Most bubbles cover a single plant, but they can apply to multiple facilities with the same or different owners (Canadian Council of Ministers of the Environment, 1991).

Finally, banking allows a firm to save its surplus pollution credits over time, for future use in effluent trading.

Financial Enforcement Incentives

This type of economic instrument takes two forms. Non-compliance fees are imposed when polluters do not comply with certain regulations. If these fees are proportional to the degree of non-compliance, as measured by discharges in excess of the authorized level, they become equivalent to an effluent charge imposed above some limited level of discharge. Performance bonds are payments to authorities in expectation of compliance with regulations. The payments are refunded when compliance is achieved.

2.5.2 The Benefits of Using Economic Instruments for Environmental Regulation

Economic instruments have several potential advantages over the present system of direct regulation for the control of environmental problems. These are summarized below.

Equity

"Equity describes the degree to which a fee or fee system exacts payments from polluters in proportion to their contribution to total pollution (the Polluter-Pays Principle)" (Washington, 1992: 8). In 1985, OECD Environment Ministers stated that they would "seek to introduce more flexibility, efficiency and cost-effectiveness in the design and enforcement of pollution control measures in particular through a consistent application of the Polluter-Pays Principle and a more effective use of economic

instruments in conjunction with regulations" (Barde, 1989:15).

Competitiveness/Cost-Savings

The most important advantage of economic instruments is that their greater flexibility often leads to cost savings (Canada, 1992; Cassils, 1992; Pearce and Turner, 1990; Tietenberg, 1990). If limits are set on effluents without specifying the technology to be used to achieve these limits (as would be the case with direct regulation), firms may have an incentive to develop cheaper methods of abatement. Tradeable permits, for instance, can take account of differences in the costs of pollution clean-up and control faced by different sources of pollution. It can be more cost-effective to cut back on the discharges at the mills where it is cheapest to clean up than to require all sources to meet the same pollution standard.

A number of studies have attempted to estimate the cost savings associated with a least cost approach (using an economic instrument) as compared to direct regulation of a specific pollutant in a specific area. These studies generally show cost savings of 20% to 80% of the abatement cost that would be incurred under a traditional (direct) regulatory policy (Tietenberg. 1985, Chapter 3; Hahn, 1989).

Growth

Some economic instruments can be structured in such a way as to more easily accommodate entry into and growth within an industry (through offsets) without generating an increase in effluents (Canada, 1992).

Flexibility

Another possible advantage of economic instruments is that they may provide an economic incentive for firms to cut back pollution (e.g., to avoid an effluent charge) by developing new technologies and processes (Canada, 1992; Ontario, 1990; Hahn, 1989). Economic instruments leave the specific, detailed decisions about how to achieve the environmental objective to producers and consumers. This flexibility can stimulate creativity and innovations by acting as an incentive to decision-makers to develop and implement cleaner technologies and ways of operation. Direct regulation does not allow for this flexibility except in a limited way, in the case of a firm using the legal system to delay compliance.

Speed

Flexibility, in turn, may lead to environmental goals being reached faster than would have been the case with direct regulation (Portney, 1990).

Lower Government Administration Costs

Barde (1989) argues that economic stagnation and budgetary constraints have led the authorities to consider cheaper approaches than direct regulation, and that economic instruments can save the government in administration costs. Cassils (1992) agrees, saying that economic instruments could cost the Ontario Ministry of Environment and Energy (MOEE) much less than their current system (under MISA) of researching and selecting the appropriate technology for each mill, which is one requirement of direct

regulation.

2.5.3 *Economic Instruments in Practice in Europe and North America*

Economic instruments are now widely used in Europe and to a lesser extent North America to achieve environmental protection objectives. There is a general trend toward using charges in Europe and tradeable permits in North America (Opschoor and Vos, 1989). Water pollution has been controlled more often with charges than with tradeable permits in both regions.

Effluent Charges

Australia, France, Germany, Italy, the Netherlands and the United States apply water effluent charges (Opschoor and Vos, 1989; Washington. 1992). Of these, the German and Italian charge systems are the only ones with a clearly stated incentive purpose (as opposed to revenue-raising), whereby the charge is doubled when the discharge is more than the minimum standards.

The German system was first implemented in 1981, and effected a significant degree of pollution reduction. Administered by provincial authorities, this system is national in scope, and is closely linked with direct regulations. The charge base comprises six groups of pollutants, including oxygen depleting substances (i.e., related to BOD),

discharges toxic to fish, and organochlorines (Victor and Van Den Bergh, 1991). In this system, a fee is levied on every unit of discharge depending on the quantity and noxiousness of the effluent. Germany increased the charge per unit of discharge from about $5 per damage unit in 1981 to $16 in 1986. A damage unit is a specified amount of effluent, such as a specific number of kilograms of BOD. The charge per damage unit is uniform across regions and polluters. Dischargers not meeting or bettering the German effluent standards must pay twice the rate of those that do. Because of this system's combination of economic instruments and direct regulation, it is hard to assess the charges' effectiveness in isolation from direct regulation.

The Netherlands is one of the few nations in which enough research has been conducted to know whether the system is working. The consensus is that the high charges placed on effluent streams there have led to a significant decrease in pollutants (Hahn, 1989). An interesting aspect of the Netherlands' system, as with some others, is that in general, newer plants face more stringent regulation than older plants (Hahn, 1989). This is called "grandfathering", and applies to the Canadian pulp and paper industry as well. The older plants in Eastern and Central Canada are usually given more lenient time schedules in their abatement programs, whereas plants built since 1990 (which are mostly in the West) must comply more quickly. This approach may endear regulators to the industry, but it is a disincentive to replace older plants with newer, cleaner ones.

In the United States, water pollution is controlled by the Environmental Protection Agency (EPA), through the Clean Water Act. Accordingly, charges are made

on any discharge of any pollutant into U.S. waters from a point source (including pulp and paper mills) under the National Pollution Discharge Elimination System (NPDES). Based on the mills' own discharge monitoring reports, as well as on the findings of inspections, the EPA or approved state agencies take enforcement actions against violators (Magat and Viscusi, 1990).

Effluent charge rates may be established in legislation, set by regulation, or triggered by some specified variable such as ambient water quality[8].

Tradeable Permits

Tradeable permits have been allowed under the Clean Water Act for many years. In 1981, The Wisconsin Department of Natural Resources instituted regulations allowing the transfer of BOD discharge permits among ten pulp and paper mills and four municipalities located along a 22-mile stretch of the Fox River (Novotny, 1984). Marginal abatement costs[9] varied widely between dischargers, and each discharger had a number of options for producing incremental reductions in BOD discharge. Based on studies which concluded that BOD control costs could be lowered by 40% (producing a predicted annual saving of US$ 6.7 million), permits were issued to each of the fourteen establishments. Novotny (1984) reports that the results of this experiment have proved disappointing; since the first trade was made in 1981, none have followed. He suggests

[8] Not representative of the maximum amount of a contaminant that a specific source of pollution may emit, but the amount or concentration of such a contaminant in the water at any particular time as a result of the combined effluents from all the sources in the area (Estrin and Swaigen, 1993).

[9] Marginal abatement cost is the change in total clean-up costs associated with the abatement of each additional unit of pollutant.

that the unwillingness of dischargers to trade is attributable to both the design and administration of the trading structure. Problems arose because:

- permits expired after five years - this lessened the firms' sense of security
- discharge rights could be sold only upon demonstration that no additional abatement technology could be installed by the seller
- administrative approval of trades was slow
- there was an unwillingness of business competitors to give up permits that could be necessary to future expansion

Most of these problems are inherent to any tradeable permit scheme. The regulating authority must put limits on trading in order to protect the environment, and business competitors must feel financially secure in the trading scheme (by hoarding banked credits) in order for it to work at all.

Meanwhile, research continues in many areas. The American EPA's Office of Policy, Planning and Evaluation (OPPE) have examined various innovations that make greater use of a water body's capacity to assimilate wastes. These innovations include seasonal permits that raise the cost of trading during seasons of low water flow (and, thus, low diffusion capabilities of the water) (Downing, 1985).

Table 6 (on p. 33) lists the various charge and trading schemes that have been used in Wisconsin and Europe, along with their level of success, as judged by Victor and Van Den Bergh (1991).

TABLE 6: EFFLUENT CHARGES IN USE

Country	Since	Purpose	Use of funds	Target	Fee	Revenue	Evaluation
FRANCE	1969	Revenue	Operate river basin agencies. Agencies finance local and industrial effluent treatment.	Fee per unit of various matter, including suspended matter, oxidizable matter.	Varies	ECU 240 million.	Low incentive effect. Subsidies lower industry abatement cost by an average of 12%. Subsidies do have incentive effect on some firms. Rates have not kept pace with inflation.
GERMANY	1981	Incentive	Administrative expenses for water quality management and to subsidize projects which improve water quality.	Fee per unit of settling substances, oxidizing substances, AOX, toxicity to fish, and others.	ECU 19.20/damage unit (varies with substance). Fee reduced if meet or exceed standard or if use "state of the art technology."	ECU 135 million (1984)	Average treatment costs are about 4 times average charges. There is evidence of incentive effects: many firms have increased abatement to earn fee discounts and one-third of municipalities claim to have improved treatment in response to charge system. German water quality is said to have improved considerably since charges were put into effect.
ITALY	1976	Incentive		Varies with plant	Fees 9X higher if fail to comply with standards		Too little information. Charge is intended to end upon achieving full compliance with standards.
NETHERLANDS	1972	Revenue	Subsidy for abatement (direct dischargers). Pay full cost of STPs (indirect dischargers)	Fee per unit of BOD, suspendable solids, toxic substances, and heavy metals	Households: set fee. Medium size firms: per unit, set with coefficients. Large firms: direct monitoring.	ECU 473 million (1985)	Strong incentive impact on certain industries. Pollution levels for included parameters are significantly lower. Charges have risen steadily. Anticipation of further increases has a significant incentive effect. Administrative costs are low.
U.S.A. (Wisconsin)		Revenue	Covers 35% of state water pollution program costs.	37 substances	Varies	U.S. 1.2 million	Not a disincentive to pollute.

$1/Canadian = 0.65 ECU = $1/U.S. (June 1, 1987)
Source: Victor and Van Den Bergh, 1991; based on Opschoor and Vos, 1989.

2.5.4 The Results of Implementing Economic Instruments

According to Tietenberg (1990), the environmental results of the effluent charges varied among the European countries. Despite being designed mainly to raise revenue, effluent charges have improved water quality, particularly in Germany. Initiated in 1976, roughly 50% of dischargers met the federal minimum standards by 1987. Furthermore, one third of all affected municipalities claim that the effluent charge was their main reason for intensifying wastewater treatment (Victor and Van Den Bergh, 1991).

In most of the cases studied by Hahn (1989), cost savings to the industry due to charges appear to have been small. Two of his explanations were:

- The major motivation for implementing effluents fees is to raise revenues, which are then usually earmarked for activities that promote environmental quality (so the firms know that they do not have to do as much work toward environmental protection). This can be solved by discontinuing the trend of regarding charge revenues as a source of income for the government, and instead as a resource base to pay for the administrative duties of the program.

- Most charges are not large enough to have a dramatic impact on the behaviour of polluters. In fact, writes Hahn (1989: 108), "they are not designed to have such an effect". The effectiveness of charges is improving with time, however, as regulators increase the minimum charge amounts.

The examination of tradeable permits and charges reveals that they are rarely implemented in their theoretical form. Most environmental regulatory systems mentioned above rely on a combination of instruments - the permit system grafted onto existing standards. As a result, the level of cost savings using tradeable permits is usually far below expectations, although there are usually more cost savings with tradeable permits than with charges. Tradeable permits do not induce as much of an improvement in

environmental quality as charges, but are more likely to be directed toward promoting cost savings (Hahn, 1989). Many authors have qualified their preference for permits by noting that their preference depends on the nature and combination of instruments being used.

2.5.5 Possible Uses of Economic Instruments in Canada

Environment Canada has funded research that studies the possibility of using economic instruments (in addition to its current system of direct regulation) for the control of polychlorinated biphenyls, mercury, and persistent toxics in the Great Lakes (Victor and Van Den Bergh, 1991). The Canadian Council of Ministers of the Environment (CCME) has funded projects studying the use of economic instruments for the control of nitrogen oxides (NOx) and volatile organic compounds (VOCs) in Canada (Canadian Council of Ministers of the Environment, 1990; Ontario, 1992). The proposed CCME plan for NOx and VOCs allows provinces to substitute alternative approaches, such as emission trading, that achieve at least as much environmental improvement as the proposed standards. The plan includes a study funded by the Ontario Ministry of Energy (Ontario, 1992) to design an emission trading plan for stationary sources of NOx in the Ontario portion of the Windsor-Quebec Corridor to assess its likely costs and benefits. This study concluded that emission trading appears to offer a cost-effective and environmentally beneficial strategy for managing emissions of

NOx from stationary sources in Southern Ontario.

> If all of the gains from trading are put into cost reduction, our results suggest that control costs would be reduced by 35 to 42 percent, an annual savings of $100 to $130 million compared to [a system of direct regulation] (Ontario, 1993).

The study notes that this system could potentially be put in place by 1995.

2.6 Summary

It is clear that the formulation of effective environmental regulations for the pulp and paper industry is no easy task. There are many factors to be considered, including the nature of the pollutants, at which step in the process they are created, how they will affect the receiving waters (considering their concentration), and so on. Some factors must be given priority over others in the formulation of a regulation.

The literature presented in the thesis will help in choosing among the various instruments presented and recommending those best suited to the regulation of the Ontario pulp and paper industry. The handbooks on the pulp and paper making process (i.e., Canada, 1983; Canada, 1984) will help to determine what the instruments should be regulating. The new regulations for Ontario, Canada and the United States are necessary, as they are the basis onto which the system of economic instruments would be grafted. The European and American charge schemes and tradeable permit programs can serve as an example for the Ontario situation, within certain limits. The Canadian Council of Ministers of the Environment's (1991) study of atmospheric emission trading programs in

the United States, though it is limited to the regulation of air pollution, provides useful information regarding the practical application of economic instruments. Finally, Victor and Van Den Bergh's (1991) document provides an evaluation framework in the form of a decision tree. This is a flowchart that is used to assess the role of economic instruments for environmental control in a given situation. It is used in this thesis in the context of the control of conventional water pollution from the pulp and paper industry in Ontario.

3.0 THE REGULATORY ENVIRONMENT FOR PULP AND PAPER IN CANADA, ONTARIO, & THE UNITED STATES

3.1 Regulations for Water Pollution from the Pulp and Paper Industry

The primary control mechanism for pulp and paper pollution in Ontario is and has always been one of direct regulation. The responsibility is shared between the federal and provincial governments, which regulate the pulp and paper industry through their respective legislation. The federal government has developed some minimum national pollution control requirements in amendments to the Fisheries Act (1971) and the Canadian Environmental Protection Act (1988) that act as guidelines for the provinces. The provinces are responsible for the formulation and enforcement of their own specific pollution laws. The provinces may enforce the federal regulations as well as their own, under an agreement between the two levels of government.

3.2 Federal Regulations for Water Pollution

The first regulations for the pulp and paper industry were in the form of direct

regulation, and are contained in the Fisheries Act of 1971. These regulations were based on the best available technology of the time, and so are very outdated now. In addition, they only applied to the approximately 13 mills that were built after 1971. Many provincial regulations have taken priority in their respective regions since, creating disparities in the stringency of limits for pollutants.

Recent calls ("Ottawa Aims", 1990) for Canada-wide standardization of regulations (to avoid pollution havens) have led the federal government to take on a greater role in the regulation of the pulp and paper industry. Canada's Green Plan (1990) contained a National Regulatory Action Plan that included a section on dioxins and furans. The government made the following commitment:

> The proposed federal regulations for the control of effluents of dioxins and furans from pulp and paper mills, and amendments to the Fisheries Act regulations setting new limits on other pulp and paper industry effluents, will be issued in 1991 and will be in full force by 1994.
>
> (Canada, 1990: 47)

Having completed a period of public consultation, the Canadian government (Ministries of the Environment, Fisheries and Oceans, and National Health and Welfare) published a package of new environmental regulations for the pulp and paper industry in the Canada Gazette, Part I, in December 1991. After a further 60-day public review, this Pulp and Paper Regulatory Package was published in the Canada Gazette, Part II, and went into effect. This package consists of four sets of direct regulations: two under the Canadian Environmental Protection Act (CEPA), and two under the Fisheries Act. Under CEPA, which centres on toxics prevention, there are the Pulp and Paper Mill Defoamer and Wood Chip Regulations, and the Pulp and Paper Mill Effluent Chlorinated Dioxins and

Furans Regulations. The latter require that effluents of dioxins and furans must be reduced to non-detectable levels in mills that use chlorine bleaching:

> Effective July 1, 1992, no operator shall release or permit to be released into the environment final effluent that contains any measurable concentration of [dioxins or furans].
>
> (Canada Gazette, 1992, Part II: 4131)

It is expected that the process of achieving this goal will also result in reductions of other organochlorine pollutants, and could affect conventional pollutants (BOD and TSS) as well, depending on the technology adopted.

The Pulp and Paper Effluent Regulations, under sections 34, 36, 37, 38 and 43 of the Fisheries Act, place effluent discharge limits on TSS and BOD, the subjects of this thesis. The government states that, although industry is free to choose which technology it installs to meet the requirements, this part of its program would probably entail the installation of primary and secondary treatment systems (secondary treatment is common in U.S. mills now) or equivalent control processes at some mills. Mills were to comply by July 1, 1992, although extensions to December 1995 have been assured for about half of the mills in Canada (Mahood, 1994).

These 1992 regulations are universal, more stringent, and less complex than the 1971 regulations. The allowable effluent levels for BOD and TSS have been significantly reduced. Unlike the 1971 regulations, the new regulations apply to all mills. Under the amended Fisheries Act, the maximum fine for a summary (less serious) offence is $300,000 for the first offence, and the additional possibility of a six-month jail term for subsequent offenses. For an indictable (more serious) offence, the maximum fine is $1,000,000 for the first offence, and the additional possibility of a one-year jail term for

subsequent offenses.

Table 7

Comparison of Limits for Ontario, Canada, and the U.S.A. (kg/tonne)

	Ontario	Canada	U.S.A.
BOD	2.9 - 5.0*	7.5	2.8 - 8.1
TSS	4.6 - 7.9	11.25	4.6 - 16.4

* Limits vary with category of mill.
Note: Limits for Ontario are not effective until 1995
Source: Ontario, 1993.

3.2.1 Federal Enforcement Procedures

Inspection under federal regulations in Ontario is carried out by five project engineers who visit each of the 26 mills at least twice a year, barring any problems or complications (Interview with Pounds, 1994). These engineers are certified to inspect on behalf of the Federal Enforcement Branch. When visiting a mill, if anything is not according to regulation, they will talk directly to a environmental representative at the mill, and follow shortly thereafter with a letter outlining the complaint. If the mill does not respon', a formal letter is then sent to the manager of the mill, and if the problem is not dealt with, legal proceedings may be undertaken. In fact, Gavrel said in 1994, "few if any charges have ever been laid against an Ontario mill by the federal government."

3.2.2 Environmental Success of the Federal Regulations

In the past, the federal regulatory system has had its successes. Between 1970 and 1989, discharges of TSS in Canada fell from 2,106 to 816 tonnes per day, and discharges of BOD fell from 3,337 to 1,961 tonnes per day (Forum, 1993). Of course there were many other factors involved in this reduction, such as advances in technology and public pressure. In 1991, according to Pulp and Paper Week (1991), about a quarter of the mills already had systems in place to meet the 1992 federal standards.

However, Bonsor (1990: 172) suggests that the pre-1992 Canadian policies for reducing water pollution by the pulp and paper industry have not been very successful, nor does he think that "one should expect them to have been, given the manner in which the regulations have been designed": Sinclair (1990) notes that the problems encountered by those responsible for administering the enforcement of the regulations are substantial. There are jurisdictional ambiguities (federal vs. provincial vs. municipal), definitional uncertainties, legal difficulties (such as proving a company's intent to pollute), technical limitations (many of the old mills cannot accommodate new pollution abatement technology), and discretional dilemmas. Webb (1988) notes that there is an "implementation gap"; i.e., that regulators are reluctant to invoke penalties for noncompliance. Some of these problems would not be present in a system of economic instruments.

3.2.3 Potential Economic Impact of the 1992 Federal Regulations

In an analysis of the economic impact of the (then proposed) regulation of the pulp and paper industry, McCubbin et al. (1990) show that there is a considerable variation in compliance costs across Canadian regions, both in terms of absolute compliance costs and in terms of relative costs. The differences in costs reflect differences in:

- each region's share of total Canadian pulp and paper capacity;
- overall age of existing facilities in the region;
- the type of product produced in the region; and
- the degree to which provincial authorities have regulated effluents in the past (McCubbin et al., 1990).

As can be seen in Table 8, Ontario's estimated compliance costs are below the average for

Table 8

Average Compliance Costs for Traditional Pollutants per Tonne of Product by Region

Region	Costs per Tonne of Product	Number of Vulnerable Mills
B.C. Coast	$ 27.13	1
B.C. Interior	4.68	0
Prairie	8.97	1
Ontario	**13.11**	0
Quebec	21.75	many
Atlantic	15.68	at least 1

National Average	$ 17.49

Source: McCubbin et al., 1990: 67.

Canada; that is, they will not need to spend as much money as most other provinces on abatement equipment in order to fulfil the federal regulatory requirements. In effect, the "across-the-board" regulations place Ontario at a competitive disadvantage compared to the mills in the British Columbia (B.C.) Interior and the Prairies, and at an advantage compared to the B.C. Coast, Quebec, and Atlantic mills. It is interesting to note that average regional compliance costs are highly correlated with average regional BOD discharges (high in Quebec and B.C. Coastal regions) and with the incidence of secondary treatment (high in the B.C. Interior, low in the B.C. Coastal and Quebec regions) (McCubbin et al., 1990).

McCubbin et al. show that although there are a number of mills which are financially vulnerable to closure in Canada, none of these is in Ontario. High compliance costs do not necessarily mean vulnerability to closure. According to Sinclair (1991), most of the mills in Canada can afford the changes required by the 1992 federal regulations, despite the fact that the compliance costs will be quite high. Vulnerable mills are for the most part smaller than average and/or have very dated equipment (the worst scenarios were in Quebec and the B.C. Coastal region). In the absence of the regulations, McCubbin et al. argue,

> ...a considerable number of [these mills] would have faced serious long run survival problems. It is our view the proposed regulations will not be the cause of the mills exiting the industry. The proposed regulations will

speed up the exit decision (McCubbin et al., 1990: 68).

Furthermore, they believe that the compliance costs are comparable to those faced by producers in the Norscan (Nordic/Scandinavian) countries. They are not aware of any U.S. producers that, though required to meet tighter conventional effluent quality standards, have ceased operations as a direct result of meeting the American EPA (Environmental Protection Agency) effluent limitations.

Regardless of the Ontario mills' invulnerability to closure, the abatement costs needed for them to achieve the 1992 general limits are significant. Furthermore, the fact that the compliance cost per tonne of output is different for each mill (McCubbin et al., 1990) suggests that resource allocation is not as efficient as it might be under an economic instruments approach.

3.3 Environmental Regulatory Instruments and Policies in Ontario

The Ontario Ministry of Environment and Energy (MOEE) has two acts of legislation at its disposal to deal with water pollution from the pulp and paper industry. These are the Ontario Water Resources Act (OWRA) and the Environmental Protection Act (EPA). The OWRA includes a general prohibition against the discharge into water of polluting materials "that may impair the quality of the water" (Estrin and Swaigen, 1993: 531). Section 14(1) of the EPA contains a general prohibition against the discharge of contaminants into the natural environment (water is included in the definition of "natural

environment"). Section 7 "control orders", section 8 "stop orders", section 17 "remedial orders", and section 18 "preventive orders" may be used to address water pollution (Estrin and Swaigen, 1993). In the past decade, the following instruments have been used in Ontario to regulate the pulp and paper industry.

Certificates of Approval

A Certificate of Approval (CA) is basically a licence to discharge that is given to each mill by the MOEE. It outlines the levels of discharge that the mill and the MOEE have agreed upon. The certificates are in essence guidelines, but there is discretionary enforcement. If, over a period of time, the terms agreed upon in the CA prove inadequate for the protection of the receiving waters of the mill, a Control Order may be issued, outlining new requirements for the mill. CAs are issued under the OWRA and the Ontario EPA, administered by the Water Resources Branch of the MOEE (Interview with de Barros, 1994).

Control Orders

Control Orders are usually made under Section 6 and Part 4 of the Ontario EPA (R.S.O. 1990) and Section 16 of the OWRA, and are the most important part of the Ministry's industrial abatement program (Sims, 1984). They are enforceable under the law.

After a survey of the point source by regional technical staff, the MOEE issues a Notice of Intent for a Control Order. This specifies the desired quantity and

concentration of effluent loadings, the type of abatement activity, and the timing of compliance actions (Bonsor, 1990). This is usually followed by a period of negotiation, review, and amendment, after which the Control Order is issued. A grace period is then allowed for the launching of an appeal to the Environmental Appeals Board or the Minister. The Minister may confirm, alter or revoke the Board's decision. Once the Control Order has taken effect, a company in compliance with the Order during its duration (sometimes up to five years) cannot be prosecuted with respect to those items covered in the Order, even if they prove inadequate in dealing with the intended pollution problem. It may, however, be prosecuted for non-compliance if it fails to comply with terms of the Control Order.

Sims (1984) points out that the main advantage of this approach is that while it may be difficult to prove that a specific source violated a particular standard at a particular time, it is simpler to prove that the source violated certain elements of a Control Order.

The drawback of this approach is that with appeals, the process could in theory be extended by a source ad infinitum. During such appeals the Control Order is not enforceable. As Sims (1984) points out, "one might conclude that a Control Order only becomes enforceable when the polluter allows it to become enforceable".

In practice, the Ontario EPA and the OWRA have been used interchangeably by the ministry in abating water pollution through preventive or clean-up orders and prosecuting pollution offences. However, the OWRA has been used when issuing approvals for new or significantly altered processes and/or discharges. The OWRA does not prescribe enforceable effluent limitations for every mill. Instead, "water quality

objectives" have been set which are used in prescribing the terms of the approval on a case-by-case basis. These are to ensure that the quality of the province's surface waters "is satisfactory to aquatic life and recreation" (Muldoon and Valiante, 1989: 38).

In October 1989 the Ontario Ministry of Environment issued a control order that required all kraft mills[10] to meet chlorinated organic discharge levels of 2.5 kilograms per tonne of bleached pulp by December 31, 1991. All kraft mills in Ontario now comply with that order (Wilson, 1992).

In November 1993, the ministry released new regulations, this time under Part 4 of the EPA, for the 26 direct discharge pulp and paper mills in Ontario (See Appendix A, p. 106, for a list of these mills). They call for a sharp reduction and eventual phase-out of chlorine use. The Environment Minister, Ruth Grier, said that by November 1995, the deadline for adherence to the regulations, chlorine discharge limits will drop 40 percent (from 2.5 kg to 1.5 kg, as requested by the industry) for each tonne of pulp produced, and by a total of 68% (to 0.8 kg) by December 1999. Ontario's final limit for chlorinated compounds will be in line with regulations in Quebec and the U.S (Mahood, 1993). British Columbia has set a more stringent target, requiring industry to eliminate chlorine use by 2002.

The 1993 Ontario regulations also require cuts in TSS and BOD in pulp mill effluent, and set several other specific discharge limits. For sulphite kraft and sulphite mechanical mills, the draft limits for BOD and TSS are 5.0 and 7.9 kg/ton of production, respectively (Interview with Stewart, 1993).

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[10] a particular type of chemical pulping

The new rules have been under development by the Water Resources Branch of the MOEE since 1986, as part of the province's Municipal/Industrial Strategy for Abatement (MISA) program. Under this program, the mills are required to meet discharge limits based on the "best available technology economically achievable" (BATEA).

The two means of enforcing control orders are injunctions[11] and prosecution[12]. Injunctions were cited by Sims (1984) as the most effective means of inducing compliance currently available in Ontario. Injunctions are used when a control order fails to achieve compliance. Section 144 of the Ontario EPA provides for the issuance of an injunction order by the courts specifying the type and timing of abatement actions which must be undertaken by the relevant source. Failure to comply with the injunction could lead to prosecution.

Legislation often implies that the chief method of ensuring compliance is through prosecution, which may take the form of a charge, determined in court, or possibly closure. In fact, prosecution is used only as a last resort; the implied threat of prosecution, and resulting adverse publicity and fines, does provide much of the "muscle" behind persuasion and control orders. However, there have been cases of fines and even jail terms for corporate executives (see Section 3.3.2, "Enforcement Procedures"). The maximum fines for an individual who violates the OWRA are $10,000 for the first

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[11] An injunction, according to the Yogis Canadian Law Dictionary (1990:110), is "a judicial remedy requiring a party to refrain from doing a particular act or thing."

[12] The definition of prosecution, according to the Yogis Canadian Law Dictionary (1990:178) is: "the act of pursuing a criminal trial by the Crown."

offence and $25,000 for each subsequent offence (OWRA, RSO 1990, section 108(1)); the maximum corporate fines are $50,000 for the first offence and $100,000 for each subsequent offence (Section 108(2)); the violation of some provisions of the Act may result in imprisonment and fines of up to $200,000 (Section 109).

3.3.1 Non-regulatory Instruments for Pollution Control

There are non-regulatory instruments used at the provincial level as well as the federal level, especially that of persuasion. Persuasion has taken the form of verbal presentations, along with written correspondence by the Ministry, which describe the condition, its causes and possible solutions. Persuasion has been useful where low cost, short duration alterations in equipment or procedures can overcome the environmental problem (Sims, 1984).

These are the tools used most often for the control of pollution in Ontario. The direct regulation approach is often supplemented by certain types of financial assistance that are intended to reduce the economic burden of compliance. The most popular types are accelerated depreciation on capital expenditures for pollution control, refunds of provincial sales tax on pollution control equipment, direct subsidies on pollution control equipment, and loans.

3.3.2 Opportunity for Delay in the Ontario Regulatory System

Since prosecution is only used as a last resort and appeals are used as a delaying tactic, the tough standards established in law or in regulations are at times only symbolic. As Sims (1984: 10) explains:

> When setting objectives, deadlines, and enforcing compliance, exceptions are made through bargaining and negotiations. Agreements which may be less restrictive than the letter of the law are made. Implementation deadlines are often deferred. Enforcement through court action and fines is viewed only as a last resort.

A mill will usually fight for fewer equipment requirements, because of the cost of pollution control devices. Often, it will claim that the compliance costs are so large that the firm's economic viability would be threatened, and that it may even be forced to close down. At times, such threats have resulted in negotiated compliance orders that have led to little improvement in effluent quality (Bonsor, 1990). One of the problems with the direct regulation approach, then, is that it has not resulted in compliance as per the schedules developed by the Ministry. It has been argued that this type of regulation, instead of providing an incentive to abate, has provided an incentive to delay expenditures on pollution abatement (Sims, 1984; Bonsor, 1990). As stated earlier, the regulations provided for extensions to December 31, 1995; about half the mills in Canada were granted such extension (Mahood, 1994). Those companies that expect to meet the deadline do not want their competitors to get any "breaks". "Anybody getting an extension beyond the compliance date or any money to help them meet the compliance date represents a competitive advantage" (Mahood, 1994: B3).

Sims (1984) points out the possible cost savings resulting from non-compliance:

- research and development may ultimately produce lower-cost methods of abatement
- more generous financial assistance from governments may become available in the future
- any delay allows a firm to use scarce capital for profit-making investments instead of pollution control equipment
- gains accrue from the savings of operating and maintenance costs which would have been incurred had the appropriate abatement equipment been in place.

The costs of non-compliance, on the other hand, are adverse public reaction (which is becoming more of a persuasion tactic in today's "green" political climate) and fines which result from prosecution. Even if a fine is issued, however, it is unlikely to exceed the cost savings from delaying compliance; therefore, its impact is likely to be small.

This opportunity for delay is one of the inherent flaws in direct regulation that may be remedied by the use of economic instruments.

3.3.3 Monitoring Procedure for the Ontario Environmental Protection Act

The 1993 regulations in Ontario also include monitoring requirements, for the direct discharge pulp and paper mills, which are specified under two sections:

- "Effluent Monitoring - General" which specifies common sampling, analysis, toxicity testing, flow measurement, recording and reporting protocols and procedures for all MISA sectors; and
- "Effluent Monitoring - Pulp and Paper Sector" which defines monitoring requirements specific to the pulp and paper sector.

Each mill must have technical staff who must test TSS everyday and BOD at least three times per week (Interview with Ruthman, 1993). This monitoring data must be assembled, recorded, stored, and reported to company management and to the MOEE. MISA policy requires that industry perform the monitoring at its own cost. The Monitoring Regulation for the Pulp and Paper Sector ensures that the monitoring of individual discharges is carried out under the required conditions and for the required parameters, under threat of penalties for non-compliance as prescribed under the Ontario EPA (Ontario, 1989b).

3.3.4 Enforcement Procedures for the Ontario Environmental Protection Act

Investigations leading to enforcement through administrative action or prosecution under these laws can be triggered in many ways. Public complaints, the reporting of spills, notification of an incident by industry, discovery by MOEE investigators, and inspection by MOEE officers can all lead to investigations.

Two branches of the MOEE are responsible for enforcing Ontario's environmental protection laws. These are the Investigations and Enforcement Branch (IEB), and the Legal Services Branch (LSB).

The Investigations and Enforcement Branch

This branch (IEB), created in 1985, is responsible for the enforcement of all the ministry's environmental legislation. Its mandate requires it to :

- conduct investigations of illegal environmental activities; and
- provide sufficient evidence to Crown prosecutors to bring cases before the courts (Ontario, 1993).

The investigations and enforcement branch's current complement includes: 54 investigators, 11 enforcement officers and 10 technical support specialists. Its role is to act upon allegations of illegal activities that "may have been preventable or wilful" (Ontario, 1993:24). In addition to the regular investigative and technical activities, the branch operates an aerial surveillance program known as Operation Skywatch (Ontario, 1993).

The Legal Services Branch

This branch (LSB) is composed largely of lawyers specializing in environmental law. The branch's role is to determine which cases should go forward for prosecution. These decisions are based on evidence collected by IEB officers. Branch lawyers conduct prosecutions under the provincial environmental legislation, counsel at environmental hearings, and provide solicitors' services, including the drafting and settling of claims.

The LSB has made some convictions in 1991 and 1992; the following table lists all Ontario pulp and paper companies convicted under the Ontario EPA or the OWRA in 1991 and 1992.

Table 9 shows that convictions of pulp and paper mills increased between 1991 and 1992 (2 convictions in 1991 and 8 in 1992). There is one case in particular that provides an example of the MOEE's innovative ways of dealing with offenders. On October 13, 1992, CP Forest Products Ltd. was ordered to make a $25,000 contribution to a graduate scholarship in environmental and forestry management at Lakehead

University in Thunder Bay. The company had pleaded guilty to one charge under the

Table 9

Convictions Under the Ontario EPA and the OWRA, 1991 and 1992

Company Name	Act and Section under which charges laid	Fine for Each Charge ($)	Description of the Offence
1992			
Abitibi-Price Inc. (Thunder Bay)	OWRA, 16(1)	No Fine	Non-compliance of Control Order
Abitibi-Price Inc. (Toronto)	OWRA, 16(1)	2,000	Discharging waste into environment and onto shore of lake
Boise Cascade Canada Ltd. (Toronto)	EPA, 40	7,500	Transporting liquid industrial waste without a licence
Canadian Pacific Forest Products Limited (Toronto)	OWRA, 16(1)	5,000	Discharging black liquor into drain and Wabigoon River
Domtar Inc. (Cornwall)	EPA, 13(1) and 77	30,000	Emitting sawdust into air causing adverse effect
Domtar Inc. (Trenton)	EPA, 146(1B)	25,000	Failing to comply with conditions in a Certificate of Approval
Domtar Inc. (Trenton)	EPA, 146(1B)	3,000	Same as above
MacMillan Bloedel Ltd. (Sturgeon Falls)	OWRA, 16(1)	2,000	Discharging caustic liquid into Sturgeon Falls
1991			
Domtar Inc.*	EPA, 6 & 146(1A)	40,000	Exceeded their biochemical oxygen demand daily average discharge
Domtar Inc.*	OWRA, 16(1)	3,500	discharge of black liquor into storm drainage
Total Convictions for 1991 and 1992: 10		Total Fines: $118,000	

Source: Ontario, 1993.

* Locations for 1991 convictions are not available.

OWRA for failing to report a discharge of weak, black liquor into the Wabigoon River. In addition to the environmental scholarship, CP Forest Products was fined $5,000. The case involved an employee who was not properly trained and who mistakenly opened a valve that should have been closed, leading to the leak. The court found that the employee should not have been left with the responsibility which eventually led to the offence (Ontario, 1993). By ordering a fine to be paid in the form of an environmental scholarship, this conviction illustrates an innovative way to directly serve the interests of the environment in the community where the offence occurred.

3.3.5 Environmental Success of the Ontario Regulations

While traditional pollutant levels have declined steadily during the past decade, some of this success has to be attributed to the mill modernization program initiated in 1979 which has led to installations of environmental equipment in several mills (Ontario, 1991). However, it is fair to say that direct regulation has had successes at some mills. The success of Ontario's regulatory system can be measured in terms of reductions in pollutant discharges in the recent past. Ontario recorded a decrease in TSS of 55.7% and in BOD of 38.3% between 1978 and 1985 (Canadian Pulp and Paper Association, 1990). Meanwhile, production rose in the same period.

Limits for conventional pollutants are becoming more stringent worldwide, and Canada must keep in line with other nations' environmental efforts if it is to be welcome

in the market. Therefore, despite Ontario's success in the past through direct regulations, further abatement will be demanded of the mills, and the government must help find the cheapest way for the mills to achieve increasingly stringent limits.

3.3.6 Potential Economic Impact of the 1993 Ontario Regulations

The provincial government estimates that it will cost the Ontario industry $585 million to meet improvements required by both provincial and federal regulators by 1999. Industry officials, on the other hand, believe that the cost might be closer to $1.2 billion (Mittelstaedt, Feb. 3 1993). The different estimates may simply reflect inconsistent definitions of "pollution abatement expenditures". Some of these expenditures will be made regardless of the regulations, so that mills can remain competitive.

3.4 U.S. Regulations for Water Pollution from the Pulp and Paper Industry

The U.S. regulations must be mentioned here because they have a particular bearing on the Canadian pulp and paper industry, due to the fact that the U.S. receives 56% of Ontario's pulp and paper shipments, putting Ontario mills in direct competition with their U.S. counterparts (Victor and Van Den Bergh, 1992). In the 1970s and 1980s, U.S. enforcement was more stringent than that in Canada; in this way, Canadian

mills have historically had an advantage. The U.S. regulations, as they stand now, are approximately equivalent to the 1992 Canadian federal regulations (see Table 7, p. 41). However, the proposed BOD and TSS guidelines for the U.S. (due in November 1995, for compliance by 1998) are about twice as stringent as the current federal regulations in Canada (McCubbin and Owen, 1993). It is difficult to imagine that U.S. pulp producers and/or customers will allow pulp mills that do not at least approach their chlorine limitation standards to sell their products in the U.S. on any scale, especially if trade is more open between Canada and the U.S. as a result of the NAFTA. Canadian mills that cannot comply with this requirement are liable to find themselves excluded from much of the U.S. market.

3.5 Possibility of the Use of Economic Instruments in Future Canadian and Ontario Water Protection Policy

A desire to explore the possible uses of economic instruments for the control of pollution has been expressed in the federal Green Plan (1990), and for the Ontario pulp and paper industry, in studies such as Victor and Van Den Bergh's (1991). However, because the provincial governments are more deeply involved than the federal government in the regulation of the pulp and paper industry, they will probably be the more likely body to implement an economic instrument scheme.

The MOEE has had previous experience with the use of economic instruments, in the form of a tire tax and a gas guzzler tax/gas sipper rebate to control carbon dioxide and

nitrous oxide (Cassils, 1992). This system places a charge on less fuel-efficient cars and a rebate on the "cleaner" cars. An example of a "bubble" tradeable permit program (defined in section 2.5.1) also exists in the Countdown Acid Rain Program. This imposes a unified cap on SO_2 emissions from Ontario Hydro's plants, allowing trading within that company. It also allows limited inter-pollutant trading between Nitrogen Oxides and Sulphur Dioxide for Ontario Hydro (Ontario, 1992).

With the new pulp and paper regulations, and consistent with other MISA initiatives and expert committee recommendations, the Ontario Ministry of Environment will now allow mills to choose how to achieve the specified limits. The options include manufacturing process changes, substitution of chemicals, and recycling of waste by-products, options that the MOEE realizes will offer opportunities for profit improvement (Ontario, 1989a). This willingness to let companies choose their own method of abatement shows a possible desire on the part of the Ministry to explore the use of market-based regulatory tools. Furthermore, the Ministry's universal standards (they have not assigned individual standards to each mill) allow for more opportunity for the effective use of economic instruments. According to Bonsor (1990), Ontario mills range from among the cleanest in the world to some with very high discharge rates, which results in differences in effluents reduction cost functions[13]; these differences are conducive to the use of economic instruments.

[13]This concept is explained further in Chapter Four, in the discussion of Question Four.

3.6 Summary

This chapter summarized the current trends in water pollution abatement policy in Canada, Ontario, and (briefly) the U.S. The amendments to the federal Fisheries Act and CEPA will see many mills regulated by federal legislation for the first time, while the amendments to Ontario's EPA will effect a tightening of limits over the previous standards. The trend is certainly towards stricter limits for both traditional pollutants and persistent toxics[14]. The new Ontarian limits are slightly lower than the Canadian, but both of these limits are only about half as stringent as the U.S. limits for kraft mills (to be released by the end of 1996).

The economic impact of these regulations is very important, considering the prominence of the pulp and paper industry in the Canadian and Ontario economies. There is no question that the new regulations will necessitate major capital investments and operating costs, affecting the financial health of the industry for years to come. Economic instruments, with their economic advantages, could be very useful to the industry in meeting these new limits at the lowest cost possible. This fact, if no other, is reason seriously to consider the use of economic instruments in Ontario. For if economic instruments prove to save money for the industry, they will probably induce more effective compliance to the regulation as a result.

Research in the area of economic instruments has grown tremendously in the last two or three years, and both the federal and provincial governments are committed to

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[14] substances that are persistent in, and toxic to, the environment

exploring their use in the regulation of water pollution. However, neither government has yet indicated a readiness to apply an economic instruments scheme to the pulp and paper industry. Until such time, research and the experiences of other countries must serve to help us determine whether economic instruments are an appropriate regulatory tool for the regulation of water pollution from the pulp and paper industry in Ontario.

4.0 THE DECISION TREE: AN EVALUATION FRAMEWORK OF ECONOMIC INSTRUMENTS FOR ACHIEVING ENVIRONMENTAL OBJECTIVES

4.1 Introduction

In 1991, VHB Research and Consulting, with head economist Peter Victor, prepared a report called Virtual Elimination of PCBs, Mercury and Persistent Toxics from the Pulp and Paper Industry in the Great Lakes Basin: A Role for Economic Instruments? under the direction of the Virtual Elimination Task Force of the International Joint Commission. This report considered the use of economic instruments for the virtual elimination of mercury and PCBs, as well as persistent toxins from the pulp and paper industry, in the Great Lakes Basin. Victor and Van Den Bergh's (1991) decision tree, an evaluation framework used to assess the role of economic instruments for achieving environmental objectives in a wide range of circumstances, is presented in this thesis. Their decision tree (see Figure 2, back cover) was chosen for its relevance to the study of economic instruments and because of its academic credentials. Also, it is unique in its thoroughness as an evaluation framework for assessing the role of economic instruments in environmental programs. Generally, other authors simply use the

following list of standard criteria to evaluate the instruments (as well as the systems of direct regulation that they are intended to complement or replace):

- legality of the instrument: whether it violates any previously existing laws;
- effectiveness: capacity to meet environmental objectives; i.e., the ability to change the behaviours that contribute to the pollution problem;
- efficiency in resources allocation by polluters: i.e. the extent to which the policy has directed the resources of polluters in a cost effective manner towards abatement and control, and takes into account the differences in abatement costs and environmental damage per unit of discharge;
- administrative practicality, i.e. requirements for the cost and frequency of monitoring, enforcement and administrative activities; this includes compatibility with the existing legislative framework;
- fairness: whether the perpetrators are responsible for an environmental infraction assuming the costs (i.e.: following the "Polluter Pays" ideology);
- intrusiveness: whether it interferes more than is absolutely necessary;
- visibility: whether it will make the government look good;
- speed: if the results will come quickly;
- responsiveness: the degree of support or resistance to a particular approach to regulation from the public, the private sector and interest groups; and
- implications for international trade competitiveness, which relates to the impact of pollution control costs on the ability of firms to compete against others in jurisdictions with differing environmental policies (Ernst & Young, 1991; Washington State Department of Ecology, 1992; Canada, 1993a).

One study that gives a more detailed list of criteria is that done by the Washington State Department of Ecology, Alternative Strategies Unit (Washington, 1992). In addition to listing an instrument's strengths and weaknesses, this study provides a list of conditions that lead to the most effective application of that instrument; it includes effluent charges and charges on input products.

Although the efficacy of Victor and Van Den Bergh's decision tree stems from its

order and organization, there are many other (less apparent) factors beyond its mere form to be considered. These are no less important in reaching a decision and drawing a valid conclusion even though they are "understood" rather than specifically mentioned. Victor and Van Den Bergh's (1991) decision tree is superior to the evaluation schemes mentioned above in that it shows how the criteria bear on the choice of instruments, rather than simply listing their strengths and weaknesses. It systematically evaluates the options through a series of linked questions. Depending on the answers to the questions, the selection of direct regulation or any one of several types of economic instruments is suggested.

> The decision tree is simply a way to organise the issues and criteria into a framework that is helpful in answering a relatively simple set of questions to which yes or no answers can be given (Victor and Van Den Bergh, 1991: 19).

Victor and Van Den Bergh's decision tree is not used here to evaluate the present system of direct regulation in Ontario (although that topic is touched upon). Rather, it is used as a vehicle for assessing the role of economic instruments in Ontario. Specifically, the application will be limited to the current compliance goals as determined by the limits in the 1992 federal (current) and 1993 Ontario (new) regulations for degradable pollutants.

There are advantages to the decision tree. Firstly, it shows how the various considerations can be prioritized. Secondly, it helps to determine the suitability of a particular instrument or approach. Finally, the decision tree is general enough to be of use in evaluating the role that economic instruments might play in a wide range of circumstances, a very important factor, considering that this study is generalizing for the whole of Ontario.

Victor and Van Den Bergh's (1991) decision tree will provide a good basis on which to establish the suitability of economic instruments for the Ontario situation.

It should be noted that the decision tree does not show how decisions are, or should be, made. Rather, write Victor and Van Den Bergh, "it is simply a way to organize the issues and criteria into a framework that is helpful for comparing the alternative regulatory options" (1991: 19).

This thesis includes an explanation of how the decision tree operates, and discusses the problems that can arise when trying to answer the decision tree questions. This discussion is based on information gathered from many sources, including experience in the use of economic instruments for the regulation of pollution problems elsewhere.

The main considerations that emerge from the decision tree questions will be used to evaluate the application of economic instruments to the abatement of conventional pollutants discharged by the pulp and paper industry in Ontario.

4.2 Presentation and Discussion of Victor and Van Den Bergh's Decision Tree

Victor and Van Den Bergh's (1991) decision tree consists of 13 questions and sets of criteria (C1 to C13). Movement down one branch or another depends on the answers to these questions. If the decision tree is used to assess the control of a pollutant that is incompatible with the use of economic instruments, the study will be aborted after the first two questions, and the pollutant will be dismissed as not suitable. If, however, the

pollutant can effectively be controlled using economic instruments, the study will use most of the questions of the decision tree, in order to identify a particular instrument and clearly define how to apply it.

Question 1: Is virtual elimination the objective?

The question is whether virtual elimination is the intent of the governmental policy for the pollutant. For the purposes of this thesis, virtual elimination of a substance is reached when there is no discharge of that substance (the definition of "no discharge" being limited by the ability of technology to measure the discharge).

If virtual elimination is desired, continue to question 2.

Question 2: Is virtual elimination to be achieved immediately?

If the answer to Question 2 is yes, and virtual elimination is to be achieved immediately, then direct regulation is the only option, in which case the application of the decision tree is completed at this point. If the answer is no, and a gradual reduction is the only option, then there may be a role for economic instruments, so continue to question 3.

Discussion

The time frame within which reductions are to occur is a critical factor. "Effluents trading and effluent charges can only play a useful role if the objective of virtual elimination is to be achieved over a considerable period of time. Only then can

advantage be taken of differences in control costs and the added stimulus that these instruments can give to the development of new, cost effective technologies to be developed" (Victor and Van Den Bergh: 76). Furthermore, authorities need time in a system of charges to adjust the price of the charge until it is at the right level to act as an incentive without pushing water quality below the required limits. The timing will also be determined by "the health and environmental risks which continued discharge of a contaminant into [Ontario waters] is expected to bring". If a discharge is too hazardous (i.e., the discharge of dioxins and furans, or of polychlorinated biphenyls), the command-and-control framework will be deemed more appropriate for rapid results (Ontario, 1991). Further considerations are "the magnitude and impact of compliance costs and opportunity for learning from experience as virtual elimination is approached" (Victor and Van Den Bergh, 1991: 21).

Question 3: Should direct regulation be used exclusively?

The decision to use direct regulation may be based on factors other than the need for immediate elimination, which are explored here, in Question 3. A yes answer to Question 3, then, leads to the exclusive use of direct regulation, in which case the decision tree must be aborted at this point. A no answer leads to Question 4, which deals with the use of economic instruments in addition to direct regulation.

Discussion

Pearce and Turner believe that direct regulation has the advantage over economic

instruments only if a pollutant is "so damaging that an outright ban on its use is called for" (Pearce and Turner, 1990: 107). In other cases, economic instruments may have the advantage.

The complicated issue of choosing between direct regulation and economic instruments entails a detailed analysis of the advantages and disadvantages of economic instruments as compared to direct regulation (See Chapter 2). Listed very briefly, some of the advantages of direct regulation are:

- familiarity with the system;
- symbolism - people approve of the message that direct regulation sends forth: that if something is threatening to human health and the environment, it should be declared illegal;
- monitoring and administrative requirements are well known; and
- flexibility to take account of each individual source's circumstances.

Some of the advantages of economic instruments are:

- efficiency for the government and industry (Interview with Blain, 1993);
- flexibility: sources determine their own share of total loadings;
- cost minimization;
- stimulus for technological progress; and
- virtual elimination can be achieved more rapidly, for two reasons: 1) shifting the responsibility of abating to those who pay the least for it (for whom abatement costs less, because they have modern facilities, etc.), thereby sparing those who cannot afford it, and 2) the traditional system has led to many delays and generally failed to bring compliance at the rate expected.

Economic instruments will never be used exclusively, because of the unpredictable nature of pollution control. Even when economic instruments are used, direct regulation will still be required to deal with unusual events such as leaks and spills (Ernst & Young, 1991).

Question 4: Should discharges be limited by quantity or maximum abatement cost? (i.e. tradeable permits or charges?)

The main difference between effluents trading and an effluent charge is that the regulatory authority limits the total quantity in the former and sets the price of effluents in the latter. Under an effluents trading system, the authority establishes a limit on total allowable effluents and the market in tradeable effluents sets their price. Under an effluent charge, the authority sets the price of discharging an additional unit of effluent and the sources themselves decide on their discharges.

If trading is an option, then Questions 5 through 7 must be answered. However, if trading is not an option, then one would proceed to Question 8 to consider the use of charges.

Discussion

The participants in a trading system must be operating under the same market conditions in order for trades to take place fairly. In the case of water pollution, this means that trades can only take place between mills that share the same receiving waters. This brings us to the most important consideration for Question 4, which is whether there are enough mills sharing the same receiving waters to create a competitive market between them.

Victor and Van Den Bergh (1991) state that other important criteria for deciding whether waste effluents should be limited directly (i.e., under a trading scheme) relate to

the effluent reduction cost functions[15] in material and energy inputs in production, different technologies, differences in the age and condition of equipment, differences in plant size and differences in operating efficiency, and the damage function[16]. If the effluent reduction cost function is high, a small change in allowable effluents can have a dramatic effect on the costs of compliance, which will be reflected in the prices of tradeable permits. However, the damage function may be characterized by critical thresholds, in which case it may be less costly to set limits just below these thresholds. For instance, once TSS or BOD is reduced below a certain threshold, some uses of the water may be considered safe.

It is necessary for differences of the sort described above to exist between mills for trading to take place. This is because some mills will be in a position to invest in pollution abatement equipment, while others will not, requiring these latter to buy permits from those who have spent and therefore do not need their permits.

Effluent charges do not require thresholds and/or indications of steeply rising discharge reduction cost functions. Since charges serve a different set of circumstances,

> the use of thresholds would not work as well in an effluent charge scheme. Responses to an effluent charge can only be estimated and may prove to be insufficient to meet the interim threshold. There may be delays before this is known and it may be administratively difficult, if not impossible, to raise the effluent charge quickly to secure the desired result (Victor and Van Den Bergh, 1991: 25).

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[15] The effluent reduction cost function is a quantified relationship between reductions in emissions and the costs of those reductions.

[16] A damage function is a quantified relationship between a cause and a consequence. The cause might be the level of discharge and the consequence might be the increased incidence of mortality or morbidity in any living species.

Nor do charges require a large number of sources to ensure competition as in the effluents trading market. This means that sources in a market need not share the same receiving waters for a charge to be effective.

Question 5: Should permits be reduced gradually or issued all at once as an exhaustible resource?

There are two ways of designing a system of effluent trading. The first requires the regulatory agency to limit the total quantity of tradeable effluents available over time. This can be accomplished by issuing permits for a fixed period of time after which the allowable quantities of effluents are decreased until the desired abatement levels are reached. The second system, suggested by Hahn (1989), requires the regulatory agency to issue permits that must be retired (removed from circulation) once they are used. The number of permits issued corresponds to the total allowable discharge between the time the system is initiated and the desired level of abatement is achieved.

Discussion

Question 5 deals with the issue of whether permits should be reduced gradually or issued all at once. When the U.S. EPA initiated a trading program to reduce chlorofluorocarbons (CFCs) in 1988, they used the first system, whereby allowable emissions are decreased over time. The permits are good for one year, and the number of permits available has declined on a regular basis over time, to meet the timetable set by the Montreal Protocol (Canadian Council of Ministers of the Environment, 1991).

One drawback of the second system, issuing permits all at once and requiring that they be retired once they are used, is that it limits total tons of discharge, rather than tons per month or year, so that it has no control over the seasonality of effluents, which is critical in the control of water pollution.

Question 6: Should the initial permits be based on current permitted or current actual discharge?

Both systems mentioned in question 5 require a method for distributing the initial allowable effluents permits. These must be either allotted or auctioned. The simplest way is to allow existing sources to start trading the lesser of either their permitted or actual quantities.

In the case of the CFC trading program mentioned above, the permits were allotted rather than auctioned, and were based on historical data on production of imports, i.e. actual quantities.

Question 7: Should limits on trades be imposed to protect local areas?

Additional limits to protect local areas may be imposed to ensure that ambient concentration standards are met and/or that ambient concentration levels do not increase. This is done to ensure that, in the absence of special measures to protect local environments, ambient concentrations do not rise unacceptably. One risk of trading systems is that if the sources in one small area buy all the permits, that area's ambient concentration will go up unacceptably.

This concludes the section of the decision tree that deals specifically with effluent trading. The following "branch" of the decision tree, consisting of Questions 8 to 10, deals with the use of charges.

Question 8: Should an effluent charge be imposed on effluents?

This question applies if the answer to Question 4 is to use a charge scheme rather than a trading system. A no answer to Question 8 leads to the consideration of charges on products in Question 11. A yes answer to Question 8 leads to the issue of the revenues generated by charges, which is discussed in Questions 9 and 10.

Discussion

An effluent charge may be advantageous for the following reasons:

- the administrative requirements may be more modest, especially if trades are to be regulated (Yes to Question 7);
- an effluent charge does not require a minimum number of sources; all sources, regardless of size or number, have to pay the charge and all will have an economic incentive to reduce their discharges; and
- an effluent charge will generate revenues for the regulating authority.

Charges also have some advantages that are common to all economic instruments: they may provide potential incentive effects, great flexibility to respond, and savings in compliance costs.

But there can be disadvantages to using a charge. There may be a need to impose different charge rates for different contaminants, different concentrations, different locations (to take account of local conditions), different times of the year (to take account of the seasonality of ecosystem processes), as well as different total quantities of effluent

(to take advantage of damage functions). Secondly, the short-term financial burden of abatement costs plus an effluent charge may have adverse effects on a sector's competitiveness.

Monitoring is another important consideration. It may be more difficult to monitor the exact discharges of a source, as is required for a charge, than simply to determine if a source is in compliance with a specified level of effluent, as with direct regulation.

Charges are most effective when:

- there is a variation in marginal abatement cost between polluters;
- monitoring effluent is feasible and of reasonable cost;
- potential exists for polluters to reduce wastestream/wastestream concentration and change behaviour;
- potential exists for technical innovation (Washington, 1992).

Question 9: Should the charges be revenue neutral?

An effluent charge can be revenue neutral, i.e. cover only the costs of administering the program, with no additional revenues for the government. Although effluent charges are often used because of their revenue-generating capabilities, one of the dangers of these "green taxes" is that the government will lose revenues when the mills achieve their goals, as the need for charges is removed. This may act as a disincentive to government to encourage abaters. If the effectiveness of a charge is threatened by revenue generation in this way, then revenue neutrality can be an important alternative.

If revenues are generated, one must consider the possible uses of these revenues,

which are addressed in Question 10.

Discussion

An important issue must be noted for Question 9. If the regulatory authority's dependence on the revenue generated is high, the program may not ultimately achieve its goal, because the authority would then lose this source of income as a result. In this case, the charge should be revenue neutral, and the authority must find another source of income.

Question 10: Should revenues from charges be used to fund specific programs?

The revenues from an effluent charge can be tied to specific government expenditures or go into the consolidated fund as one of many categories of revenue out of which the government funds its programs.

Discussion

The public opinion, according to Victor and Van Den Bergh (1991), is probably that funds should be tied to specific programs. One problem with this approach is that when the abatement goal is achieved, the supported program will lose its funding. Another consideration is that the type of program to be funded must be known, to determine if the revenues will be enough to support that program.

This ends the section on charges. Question 11 addresses an alternative to the use of charges, and is the next step from a no answer given to Question 8.

Question 11: Should non-refundable product charges be used?

If effluent monitoring is too unreliable or expensive to support an effluent charge, an alternative is to put a charge on products that are used as inputs of production, providing that they are closely correlated with the emission of TSS and BOD. An example would be a charge on chlorine, an input to the bleaching process that causes discharges of BOD (Estrin and Swaigen, 1993). If the answer to Question 11 is yes, then product charges can be recommended, and financial enforcement incentives (FEIs) may still be considered, for comparison purposes, as an alternative tool. If the answer is no, and product charges are deemed inappropriate for the control of the pollutant, one last type of economic instrument is financial enforcement incentives, discussed in Question 12.

Question 12: Should financial enforcement incentives be used?

Financial enforcement incentives can complement direct regulation. Two types of financial enforcement incentives are performance bonds and effluent charges imposed on excess quantities of discharge. If the answer to Question 12 is yes, then FEI's may be recommended as a regulatory tool. A no answer leads to Question 13, which reverts to the consideration of direct regulation, since the conditions for economic instruments have not been met.

Discussion

Financial enforcement incentives (FEIs) are discussed in Washington (1992). This study shows that where ambient water quality remains below standards even after all regulated discharges comply with applicable regulations, FEIs may offer a means of achieving the standards without increasing their stringency. FEIs can be applied as a supplemental fee to the regulations. Charges on excess effluents, for instance, are used in conjunction with direct regulation. Whereas an effluent charge would be placed on all discharges, an FEI would be placed only on those discharges that are in excess of the regulated limits. In this way, they operate as an effluent charge on all illegal discharges.

One feature of FEIs is that their effectiveness is inversely related to the revenues that they generate. If they work as intended so that sources comply with their permitted limits, they will not generate any revenue. This removes the issues of revenue neutrality and the allocation of revenues.

Question 13: Should process and control technologies be specified?

Question 13 reverts to the question of using direct regulation, if economic instruments are not appropriate for use in Ontario. Here one must decide whether a set of regulations should specify those processes (including raw materials and product characteristics) and/or control technologies that are allowed or prohibited. Alternatively, the regulations could limit the allowed quantity a source may discharge, but leave it to the individual sources to determine how they will meet these limits.

Discussion

The current federal and new Ontario regulations specify those processes and/or control technologies that are allowed or prohibited. The U.S. Environmental Protection Agency, however, has promulgated regulations that limit the allowed quantity a source may discharge, but leave it to the individual sources to determine how they will meet these limits. This system requires that:

1) discharges can be monitored adequately by the regulating authority (for purposes of enforcement); and
2) the industry has sufficient expertise in the technology needed to achieve the limits.

Should direct regulation and economic instruments be considered unnecessary to achieve the desired results, there are non-regulatory policy instruments available to governing authorities. These include symbolic gestures and persuasion/exhortation, formal voluntary abatement programs, spending (i.e. subsidies), and public ownership (Adie and Thomas, 1987, and Sims, 1984).

This discussion of Victor and Van Den Bergh's decision tree questions and related considerations are summarized in Table 10, on p. 79.

Table 10

Criteria for Assessing Economic Instruments

Question		Criteria
1)	Is virtual elimination the objective?	- is the government aiming for virtual elimination?
2)	Is virtual elimination to be achieved immediately?	- are health and environmental risks high?
3)	Should direct regulation be used exclusively?	
4)	Should discharges be limited by charges or tradeable permits?	- is the number of participants on the receiving water body high? - are the emissions reduction cost functions high? - are there differences in mill technologies, the age and condition of equipment, plant size, operating efficiency of the mills? - do any thresholds exist in the damage function?
5)	Should permits be reduced gradually or issued all at once?	- do the pollutants mix uniformly? - is the damage function high? - how many sources are there? - where are they located? - is the timing of discharges important?
6)	Should initial permits be based on current permitted or current actual discharge?	- would allotment of allowable emissions be equitable? - could any other distribution be introduced without strong opposition?
7)	Should limits on trades be imposed to protect local areas?	- is a specific location deemed to be at risk if ambient concentrations rise? - are the mills near sensitive ecological areas?
8)	Should an effluent charge be imposed on effluents?	- can emissions be monitored reliably? - is there variation in marginal abatement cost between polluters? - is there potential for polluters to change behaviour? - is there potential for technical innovation?
9)	Should charges be revenue neutral?	- is revenue generation threatening to compromise the effectiveness of an effluent charge? - are charges used because of their revenue-generating capabilities?
10)	Should revenues be used to fund a specific program?	- does the public favour funds being tied to specific programs? - do effluent charges generate enough funds to support the chosen program?

11)	Should non-refundable product charges be used?	-	is effluent monitoring problematic? - is there a close correlation between the quantity of a product purchased and the quantity of a pollutant released?
12)	Should financial enforcement incentives be used?	-	have compliance rates historically been inadequate?
13)	Should process control technologies be specified?	-	can discharges be monitored to the level required for enforcement? - does the authority have more expertise on the various technologies which cannot easily be transferred to sources?

4.3 Summary

Victor and Van Den Bergh's evaluation framework is intended to assist in deciding whether, and in what way, economic instruments can help in achieving the federal and provincial limits for BOD and TSS from the pulp and paper industry. The means of achieving of this goal will be examined by applying the decision tree to the Ontario situation, i.e., by applying the criteria of the decision tree to the information presented in Chapter 3.0 (The Regulatory Environment in Canada, Ontario, and the U.S.A.)

5.0 THE APPLICATION OF VICTOR AND VAN DEN BERGH'S DECISION TREE TO THE ENVIRONMENTAL REGULATORY SYSTEM FOR PULP AND PAPER MILLS IN ONTARIO

5.1 Introduction

This section considers the Ontario regulatory process, using Victor and Van Den Bergh's (1991) decision tree as a tool, to find out if there is an economic instrument or instruments that should be considered for effective regulatory use in Ontario. Use of the decision tree involves answering questions about the aims of the regulation; as discussed previously, the decision tree leads one through a pathway of decision making factors that lead to the optimal type of instrument to be used. This discussion will not explore the entire potential of the decision tree, but only the aspects that apply to the situation in Ontario. This exercise will use the decision tree as a vehicle to develop a recommendation for the use of economic instruments in Ontario.

The final recommendation that emerges from this work will be evaluated in terms of the number of pertinent criteria that are met in making the decision that led to the recommendation.

5.2 Application of the Decision Tree

1) Is virtual elimination the objective?

Canada and Ontario have both been trying to limit conventional pollutants for two decades now. However, virtual elimination is not a goal of the MOEE. Virtual elimination is not considered necessary, since BOD and TSS do degrade, or leave the system over time, if discharged at a low enough level. The goal for conventional pollutants is "to find 'safe' levels of pollutant discharges and to prohibit discharges beyond those levels" (Muldoon and Valiante, 1989: 42). Generally, the goal is to meet discharge limits based on the "best available technology economically achievable" (BATEA).

Since the answer is no, and virtual elimination is not the objective, Question 2 need not be answered.

2) Is virtual elimination to be achieved immediately?

A no answer to Question 1 means that Question 2 is not answered.

3) Should direct regulation be used exclusively?

The Ontario government has determined that direct regulation alone has not induced companies to reach the required levels of abatement. For instance, the Boise Cascade kraft pulp mill in Fort Frances had levels of pollutants above the provincial objectives during a total of 431 hours in 1988, at one point reaching ten times the objectives (Escobar, 1989). Furthermore, "regulation suffers from the inability to make

proper allowances for the different opportunities and costs of each mill." (Victor and Van Den Bergh, 1991: 76). Ontario is still operating under a system of direct regulation. However, because of the admitted failures of direct regulation, the option of economic instruments should be considered as an alternate or additional regulatory tool. Several groups are studying the possibility of using economic instruments in Ontario (Victor and Van Den Bergh, 1991; Ernst & Young, 1991; Stephenson, 1977). (Many of these have been funded or partially funded by the Canadian and Ontario governments.) The fact that the cost per tonne of output and tonne of BOD is different for each mill (McCubbin et al., 1990) suggests that resource allocation is not as efficient as it might be under an economic instruments approach. As an example, the E.B. Eddy Forest Products mill at Espanola, despite its 1,100 tonnes of output per day, has a BOD output of less than 2 tonnes per day, compared with a federal limit of 13 tonnes per day (this is largely because it has a secondary treatment system). Meanwhile the James River mill at Marathon (with a production of 440 tonnes per day) discharges 15 tonnes of BOD a day, and the federal limit is 6 tonnes per day. The combined output of the two mills is 17 tonnes of BOD per day, while the combined limit under the federal regulations is 19 tonnes per day. Theoretically under a tradeable permit system (i.e. disregarding the requirement for a minimum number of players in a watershed area), the two mills might be able to meet the limits for BOD without any additional investment in secondary treatment.

There are certain supposed advantages of direct regulation, cited in Chapter Two, that can be disputed. For instance, it is true that the pulp and paper industry is familiar with the current system of direct regulation, and it does not like policy changes because of

the ensuing uncertainties and the cost of new abatement equipment that is associated with the changes. However, with economic instruments, the industry actually has more control over the rate of technological change than it has under direct regulation, as the mills will only install equipment when it is financially preferable to paying for permits or a charge.

The independence inherent in an economic instruments scheme is also an advantage to government, in terms of monitoring and administration, because its responsibility for the development of abatement equipment will be turned over to the industry. (Also, the increase in effluent monitoring needed for charges will be felt only by the industry.) Nor will the government need to spend time and money on research and development of abatement equipment; it need only concern itself with periodic "check-up" monitoring and analysis of mill discharge samples.

One final advantage of using economic instruments for the regulation of the pulp and paper industry is the flexibility involved in sources determining their own share of the total loadings. Bonsor (1990) argues that industry-wide blanket standards promote inefficiency in terms of over- and under-control at different sites, due to the failure to account for differences in the cleanliness and dilution capabilities of different receiving waters.

Considering the relative ineffectiveness of direct regulation in the past in Canada, the potential of economic instruments must be explored in the remaining decision tree questions. Therefore, the answer is no; direct regulation should not be used exclusively.

4) Should discharges be limited by quantity or maximum abatement cost?

This question is essentially asking whether to use trading or charges as a regulatory tool. The pivotal criterion for this decision is:

a) *are there a large number of participants discharging to the same receiving waters, so that a competitive market can be assured?*

The potential for trading permits is limited by the number of mills within a given watershed. Water quality is best protected if a permit system is limited to single watershed areas, by setting an overall limit for pollution discharges from all mills in each area. The limits that would be set in a universal tradeable permit system, while appropriate for some areas, may compromise ambient water quality in other watershed areas in which the receiving waters have lower diffusional abilities.

As seen in Figure 1, p. 8, and Appendix B, p. 108, there are three areas where mills are congregated such that their effluent empties into the same water system. These are:

- the Niagara region where five mills empty into the Welland Canal/12 Mile Creek System;
- the Trenton area where three mills empty into the Bay of Quinte; and
- Lake Superior where four mills empty directly into the lake at various points.

None of the mills in the Niagara region require capital investment to meet the federal regulations (McCubbin, 1990) and, therefore, it can be assumed that there would be no need for a tradeable permit program in this circumstance. In the Trenton area, there are two mills, one of which emits BOD levels considerably below the allowable limit, and the other which is currently well above that limit. However, the failure of the Fox River permit system (see Chapter 2), which involved 14 participants (including 5 pulp and

paper mills), suggests that these numbers are insufficient for a competitive market to develop.

This consideration of mills and river systems leads to the realization that the number of sources on any one river system in Ontario is not large enough to ensure competition in the effluent trading market. Therefore the answer to Question 4 is no, and the trading option is rejected, making the remaining issues in this question irrelevant (they will not be assessed here). Also, since the tradeable permit option is rejected, Questions 5 to 7, which deal with trading-related issues, will not be answered.

5) Should permits be reduced gradually or by issued all at once as an exhaustible resource?

Questions 5 to 7 will not be answered since they pertain to the use of tradeable permits, and it was determined in Question 4, on p. 85, that tradeable permits are not a feasible alternative for the regulation of BOD and TSS from the Ontario pulp and paper industry.

Since a trading system is not feasible in Ontario, the next consideration is a charge scheme, discussed in Question 8.

6) Should permits be based on current permitted or current actual discharge?

Answer: Not applicable

7) Should permits be limited to protect local areas?

Answer: Not applicable

8) Should an effluent charge be imposed on effluents?

One of the advantages of an effluent charge is revenue generation. This is one of the main objectives for many successful charge systems in Europe, including France, Germany, Italy and the Netherlands. The Ontario government could benefit from initiating a charge system, both for the purpose of revenue generation, and to make the new, stringent regulatory goals more economically "palatable" to the industry in the long term, due to the added flexibility it would give them.

An important consideration in assessing the feasibility of a charge system is whether the industry will react negatively to differentiated charge rates. Past schemes have indicated that differentiated charge rates are necessary to protect water quality. If the charge is dependent on water quality, then it must be mill-specific, which means it must contain different charge rates for each mill. This will probably be viewed as an unfair advantage for the mills on more assimilative waterways (because they will be charged less). The mills on less assimilative waterways that must spend more on abatement will claim a loss of competitiveness, compared with the other mills, because of the charge. However, the mills in Ontario are already operating under a mill-specific system with the Control Orders (the new regulations will also differentiate between mill types). Therefore, they may not oppose this option strenuously. Also, the possibility that the requirement to pay an effluent charge in addition to abatement equipment costs may have an adverse effect on the sector's competitiveness with the U.S. is less threatening now that the industry is

coming out of its recent economic slump - in fact, Sinclair (1991) demonstrated the industry's ability to pay for additional control three years ago, in the middle of the slump. Therefore, the industry will be less likely to have a negative reaction to the introduction of a differentiated effluent charge.

The criteria for a successful effluent charge, outlined by the Washington report (Washington, 1992), are all met in the Ontario situation. There is variation in marginal abatement cost between polluters, as shown in the McCubbin et al. study (1990). This study also shows that the Ontario mills can afford to change their behaviour for the better in terms of "cleanliness". The firms' additional monitoring requirements for a charge scheme will not be significant, as much of that information is already being collected. Therefore, effluents can be monitored reliably. The potential for technical innovation is seen in the fact that many mills do not have the secondary treatment that is so common in the United States.

The differentiated effluent charge shows promise as a potential instrument. Thus, the answer to Question 8 is yes, and the issues that are related to the use of charges will be considered in Questions 9 and 10.

9) Should an effluent charge be revenue neutral?

An effluent charge program can be revenue neutral (i.e. generate no additional revenues for government) if other taxes that are charged to the company are revised downwards so that total government revenues remain unchanged.

Revenue generation is one the main objectives of charge systems in Europe.

France, Germany, Italy and the Netherlands apply water effluent charges. Of these, the German water pollution charge is the only known effluent charge system with a clearly stated incentive purpose (as opposed to revenue-generating), whereby the charge is reduced if the discharge is less than the minimum standards (Cassils, 1992).

Victor and Van Den Bergh (1991) point out that if one of the main purposes of the charge scheme is to generate revenue, then revenue neutrality is not appropriate. However, the main goal of the differentiated charge explored here is not to generate revenue but to counteract externalities created by the mills. Therefore the purpose of the charge would theoretically be to cover the cost of a mill's pollution to other users of the water (the cost of correcting the externality). The level of this type of charge would not lead to revenue neutrality, except by coincidence. The answer to Question 9, then, is no; charges should not be revenue neutral.

10) Should revenue be tied to specific programs?

It is generally accepted that the public and industry alike prefer that the revenue be tied to specific programs. Industries may suggest that the revenues should be targeted back at the subjects of the charge, through environmental investment in those subjects. However, if the firms know the funds will be directed back at them, they will have less incentive to make the initial abatement investments. Furthermore, the idea of targeting charge revenues back to these mills does not fit the Polluter-Pays Principle. Therefore, the answer to Question 10 is no; revenues should not be tied to specific programs.

11) Should a non-refundable charge be placed on specific products?

This question asks one to decide whether product charges should be used. There are two types of products that can be charged, input products and end products. These will be compared to effluent charges in terms of efficacy, to decide whether they should be used instead of an effluent charge.

The Washington (1992) study states that effluent charges have a higher potential to reduce pollution than input charges.

> Effectiveness, flexibility, and efficiency tend to increase the farther down the production process (from input to output in the manufacturing process) fees are placed. The closer a charge is to the act of pollution [output], the more effective it is likely to be (Washington, 1992).

In other words, a charge is more effective if it correlates to the polluting substance. For instance, if the input of 10 tonnes of product A into the production process is known to lead to the output of 5 tonnes of pollutant B, then a charge on product A will certainly be effective in controlling pollutant B. However, inputs in the pulp and paper making process are not highly correlated to the output of conventional pollutants, so a charge on the input in this case does not send as clear and direct a price signal to polluters.

Similarly, it would be impractical to place a charge on end products, because of the extremely high number of purchasers (i.e., all those who purchase pulp or paper) that would have to be charged. An effluent charge would not pose such a problem, as the number of charges would be limited to the number of mills in Ontario, which is much lower than the number of pulp and paper purchasers.

Because of the disadvantages of product charges, the answer to Question 11 is no.

12) Should financial enforcement incentives be used?

Financial enforcement incentives are only needed if no other type of economic instrument is suitable for the control of a pollutant. Since the use of charges is a feasible option, there is no need for financial enforcement incentives. Therefore the answer to Question 12 is no.

13) Should process and control technologies be specified? (ie. assuming that economic instruments will not be used)

Question 13 reverts back to the question of using direct regulation if all economic instrument options are rejected. Since the use of charges is a feasible option, Question 13 is irrelevant and will not be answered.

Table 11 (p. 92) provides a summary of the answers to the 13 questions in Victor and Van Den Bergh's decision tree.

5.3 Summary

It was noted, in the first questions of Victor and Van Den Bergh's (1991) decision tree, that the Ontario pulp and paper industry is not legally required to virtually eliminate conventional pollutants. This lead to the question of whether the goals that have been set can be achieved through the use of direct regulation, or if tradeable permits could be used. Direct regulation has not achieved the governments' abatement goals in the past,

and so economic instruments should be assessed as an alternative tool. A tradeable permits scheme was not regarded to be feasible because of the requirement for a minimum

Table 11

Answers to Questions for Assessing Economic Instruments

Question		Answer
1)	Is virtual elimination the objective?	No
2)	Is virtual elimination to be achieved immediately?	Not answered
3)	Should direct regulation be used exclusively?	No
4)	Should discharges be limited by charges or tradeable permits?	Discharges should be limited by charges
5)	Should permits be reduced gradually or issued all at once?	Not answered
6)	Should initial permits be based on current permitted or current actual discharge?	Not answered
7)	Should limits on trades be imposed to protect local areas?	Not answered
8)	Should an effluent charge be imposed on effluents?	Yes
9)	Should charges be revenue neutral?	No
10)	Should revenues be used to fund a specific program?	No
11)	Should non-refundable product charges be used?	No
12)	Should financial enforcement incentives be used?	No
13)	Should process control technologies be specified?	Not answered

number of market players. The rejection of the permit option leads to the question of using a charge system. The option of using effluent charges is feasible, since all the criteria

were met:

- effluents can be monitored reliably;
- there is variation in marginal abatement costs between polluters
- there exists potential for polluters to change their behaviour; and
- there is potential for technological innovation, as evidenced by the fact that many mills could install secondary treatment, like many mills in the U.S. have done.

The options of product charges and financial enforcement incentives were rejected, and it was deemed unnecessary to deal with the question of specifying control technologies.

This study is limited in scope because of its theoretical nature, but it has value as an indicator for possible uses of economic instruments for pulp and paper in Ontario. The work reviewed both the criteria and the situational concerns, and examined the interrelationships between these.

The instrument that is recommended as a result of this study is the effluent charge, based on a very strong "yes" answer to Question 8, which asked whether an effluent charge should be used. All the criteria listed in Washington (1992) for the use of an effluent charge are met by the Ontario situation, which means there is a 100% fit for the use of charges. The indications are that effluent charges may serve very well in the regulatory system for pulp and paper in Ontario. The strength of the fit is indicated by the fact that the conclusion results from using a wide range of decision characteristics; i.e., the tree was used almost to its full "potential", the process did not finish after one or two questions. For instance, if the pollutants in question were dioxins rather than BOD and

TSS, the process would have been finished after Question 2, because dioxins are subject to a policy of immediate elimination both federally and in Ontario, making them unlikely candidates for an economic instruments scheme.

The conclusion is that effluent charges are an excellent potential option for the regulation of TSS and BOD in Ontario. The charges would need to be differentiated to protect the receiving waters according to their diffusional abilities, seasonality, and so on. The price of the charge, therefore, should be adjusted over time to assure that water quality in all the receiving waters of Ontario mills approximates the standards that the current provincial and federal regulations are designed to achieve.

6.0 THE APPLICABILITY OF ECONOMIC INSTRUMENTS FOR THE CONTROL OF CONVENTIONAL POLLUTANTS FROM PULP AND PAPER MILLS IN ONTARIO

This thesis has attempted to show a possible role for economic instruments in the regulation of conventional water pollutants from the pulp and paper industry in Ontario. The pulp and paper industry is very important to the Ontario economy, but it also produces some of the greatest discharges of conventional pollutants in the province. The pollutants included in this study are those materials that cause biochemical oxygen demand (BOD) and contribute to total suspended solids (TSS). Mill effluents that cause BOD are decomposed by oxygen when they reach the receiving waters, leaving less oxygen for use by aquatic life. Suspended solids are mainly tiny wood fragments that can coat the floor of a lake or river, smothering potential breeding grounds of fish (among other things).

The technology needed to reduce these pollutants exists and is in use today, in the form of secondary treatment. Of the 26 direct discharge mills in Ontario, seven have secondary treatment, while most mills in the U.S. and the Nordic and Scandinavian countries use this treatment. Many mills in Ontario will need to spend large sums of money to install the secondary treatment that will eventually be needed at every mill.

The differences in cleanliness among the Ontario mills shows both a lack of success in enforcing the regulations and a possible role for economic instruments. In the current "green" political climate, neither the provincial nor the federal government can afford to let the mills "delay their way out of" the legislated requirements for the treatment of water discharges. Furthermore, the Canadian mills may have to achieve even more stringent standards if they want to remain in the American market, because the U.S. mills will cry foul if the Canadian mills are not required to meet the same standards as their own. This would require major financial investments. Economic incentives are a regulatory option that could complement direct regulation and help to achieve these goals over time, while saving the industry pollution abatement expenditures in the long run.

The federal and provincial authorities have historically relied on direct regulation for water protection. However, this system has not proved sufficient in persuading all mills to adhere to the limits. Direct regulation has suffered because of the opportunity for delay that it offers, and because of its lack of flexibility, among other reasons. As a result, only 38% of Ontario mills now meet the federal limits for TSS. The pulp and paper industry claims that the cost to the remaining mills of meeting these limits will have a significant economic impact, and these firms are already requesting extensions to the regulated deadlines.

Economic instruments, especially effluent charges, have been applied in many European countries for the regulation of water pollution. They have brought some success in Germany and the Netherlands. Some of the advantages of economic instruments over direct regulation are equity, competitiveness as a result of cost savings,

opportunity for growth, flexibility in the method and timing of abatement, speed of achieving environmental goals, and lower government administration costs. These advantages have encouraged the federal and Ontario governments to take a closer look at the use of economic instruments. This is evident in the federal government's Green Plan (Canada, 1990), NOx/VOCs Management Plan (Canadian Council of Ministers for the Environment, 1990), and Prosperity Initiative (Steering Group on Prosperity, 1992). The Ontario government has funded studies such as Victor and Van Den Bergh's (1991) and Potential Uses of Economic Environmental Policies in Ontario (Ontario, 1990).

For these reasons, it was deemed worthwhile to assess the possible use of economic instruments in Ontario, using Victor and Van Den Bergh's (1991) decision tree as an evaluation framework. A decision tree is a flowchart that demands the user answer questions which use specific criteria in order to assess the role of economic instruments and direct regulation in any pollution control scenario. In this study, the decision tree was used to determine the role of economic instruments in the attainment of the federal and provincial regulations for the pulp and paper industry in Ontario. It was decided that there is potential for the use of at least one of the economic instruments.

Of the three types of economic instruments finally considered, the only feasible option is the use of effluent charges. Effluent charges are fees placed on units of pollution discharged to water. This instrument fits all the requirements discussed in Chapter Four, which outlined and discussed Victor and Van Den Bergh's decision tree, and is by far the most appropriate option according to the decision tree framework.

Further research in this area may concentrate on the specific design of a

differentiated charge scheme in Ontario. The questions that need to be asked include whether other industries that emit BOD or TSS will be included in the program and what the initial charge should be for each mill. Data from the conditions of the receiving water at each mill should be applied to further studies. Furthermore, it should be determined whether the mill discharges are already monitored in a manner that would meet the needs of an effluent charge scheme.

It is to be hoped that the use of economic instruments will become a reality for the regulation of water pollution from pulp and paper mills in Ontario in the near future. They offer many opportunities for easing the path to cleaner waters in Ontario, Canada, and elsewhere.

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APPENDIX A

Direct Discharge Pulp and Paper Mills in Ontario, 1993

Plant Name	Product	Tonnes of Product/yr	Flow of discharge m³/tonne	BOD kg/t	TSS kg/t	Age of Facilities
Abitibi-Price Inc Fort William Division Thunder Bay	newsprint	142,350	73	35.79	3.31	73 (1921)*
Abitibi-Price Inc Iroquois Falls	newsprint	321,200	81	62.49	9.70	80 (1914)
Abitibi-Price Inc. (Provincial Papers) Smooth Rock Falls	fine papers	182,500 (ch2 p2)	112	10.06	3.77	29 (1918)
The Beaver Wood Fibre Co. Ltd. Thorold	paperboard	107,310	67	8.53	3.06	(1914)
Boise Cascade Canada w. Fort Frances kraft	kraft pulp/ groundwood	355,875	83	9.72	11.33	(1914) gr.- (1971)
Boise Cascade Canada Ltd. Kenora	newsprint	346,750	55	35.66	3.63	
CP Forest Products Ltd. Dryden	kraft pulp/ fine papers	365,000	92	2.86	5.19	(1913)
CP Forest Products Thunder Bay	kraft pulp/ newsprint	930,385	77	21.23	6.70	(1966)
Domtar (Packaging) Inc. Trenton	corrugating medium	123,370	12	15.69	1.91	(1926)
Domtar (Packaging) Inc. Red Rock	linerboard/ newsprint	328,500	118	18.71	7.36	23 (1945)
Domtar Inc. St. Catharines	fine papers	73,000	63	6.37	2.35	
Domtar Inc. Cornwall	fine papers	301,125	178	28.74	13.43	(1883)
E.B. Eddy Forest Products Ltd. Espanola	kraft pulp/ fine papers	332,150	108	1.92	2.75	

E.B. Eddy Forest Products Ltd. Ottawa	fine papers	62,050	45	6.92	2.71	(1905)
Fraser Inc. Thorold	fine papers	116,800	82	12.83	5.81	
James River-Marathon Ltd Marathon	kraft pulp	182,500	142	28.21	6.24	48 (1945)
Kimberly-Clark of Canada Ltd. Huntsville	tissues	33,580	8	0.03	0.04	
Kimberly-Clark of Canada Ltd. St. Catharines	tissues/ fine papers	43,800	81	2.95	0.61	
Kimberly-Clark of Canada Ltd. Terrace Bay	kraft pulp	438,000	83	1.31	3.48	
MacMillan Bloedel Ltd. Sturgeon Falls Ottawa	corrugating medium	129,575	47	116.83	9.58	70+
Malette Smooth Rock Falls	kraft pulp	117,165	172	26.88	5.87	
Quebec and Ontario Paper Co. Thorold	newsprint	317,915	73	1.65	3.63	(1913)
Sonoco Trenton	paperboard	118,625	12	4.95	1.72	
Spruce Falls Power and Paper Co. Kapuskasing	newsprint	365,000	85	36.24	7.39	
St. Mary's Paper Inc. Sault Ste. Marie	groundwood specialties	200,750	69	13.54	11.49	(1898)
Strathcona Paper Co. Strathcona (Napanee)	boxboard	123,370	19	2.17	1.20	

* dates in parentheses indicate the year that the mill was built originally.

Source: Ontario, 1993 (Draft Development Document): pp. 2-5 to 2-13, 5-40.

APPENDIX B

Receiving Waters of Pulp and Paper Mills in Ontario, 1993

Plant Name and Location	Receiving Waters of Mill	External Treatment
Abitibi-Price Inc. Fort William Div., Thunder Bay	Thunder Bay, Lake Superior	Primary
Abitibi-Price Inc. Iroquois Falls	Abitibi River, to James Bay	Primary
Abitibi-Price Inc. (Provincial Papers) Smooth Rock Falls	Thunder Bay, Lake Superior	Primary
The Beaver Wood Fibre Co. Ltd. Thorold	Twelve Mile Creek, Lake Ontario	Primary
Boise Cascade Canada Fort Frances	Rainy River	Primary and Secondary
CP Forest Products Ltd. Dryden	Winnipeg River	Primary and Secondary
CP Forest Products Thunder Bay	Wabigoon River, to the Winnipeg River	Primary and Secondary
Domtar (Packaging) Inc. Trenton	Trent River, Lake Ontario	Primary
Domtar (Packaging) Inc. Red Rock	Nipigon Bay, Lake Ontario	Primary
Domtar Inc. St. Catharines	Twelve Mile Creek, Lake Ontario	Primary
Domtar Inc. Cornwall	St. Laurent River	Primary
E.B. Eddy Forest Products Ltd. Espanola	Spanish River, Lake Huron	Primary and Secondary
E.B. Eddy Forest Products Ltd. Ottawa	Ottawa River, to the St. Laurent River	Primary
Fraser Inc. Thorold	Twelve Mile Creek, Lake Ontario	Primary
James River-Marathon Ltd. Marathon	Peninsula Harbour, Lake Superior	Primary
Kimberly-Clark of Canada Ltd. Huntsville	Blackbird Creek, to Lake Superior	Primary

Kimberly-Clark of Canada Ltd. St. Catharines	Old Welland Canal, to Twelve Mile Creek, to Lake Ontario	Primary
Kimberly-Clark of Canada Ltd. Terrace Bay	Jackfish Bay, Lake Superior	Primary and Secondary
MacMillan Bloedel Ltd. Sturgeon Falls, Ottawa	French River, to Lake Huron	Primary
Malette Smooth Rock Falls	Mattagami River, to James Bay	Primary
Quebec and Ontario Paper Co. Thorold	Twelve Mile Creek, to Lake Ontario	Primary and Secondary
Sonoco Trenton	Trent River, to Lake Ontario	Primary
Spruce Falls Power and Paper Co. Kapuskasing	Kapuskasing River	Primary
St. Mary's Paper Inc. Sault Ste. Marie	St. Mary's River, to Lake Huron	Primary
Strathcona Paper Co. Strathcona (Napanee)	Napanee River, to Lake Ontario	Primary and Secondary

Sources: MISA (1993) and Victor and Van Den Bergh (1991).

GLOSSARY

AOX. In the context of pulp mills using chlorine bleaching, AOX (Adsorbable Organic Halogen) is a measure of the total organic chlorine concentration in effluents or receiving waters.

Biochemical Oxygen Demand (BOD). Mill effluents that increase biochemical oxygen demand (BOD) come mainly from wood sugars, lignin (a natural glue that holds wood fibres together), and other natural substances present in wood. The latter are attacked and decomposed by oxygen in the receiving waters, which leaves less oxygen for use by aquatic life.

Chemi-thermomechanical Pulp (CTMP). Same as thermomechanical pulp (see below), except that CTMP has added chemical pulp to supplement its strength.

Clorofluourocarbons (CFCs). CFCs are ozone-depleting substances that have persistent and devastating impacts on the upper atmosphere. Because of their non-toxic and non-flammable nature, they have been used as coolants in refrigerators and freezers, in air conditioners for automobiles and large buildings, and in the manufacture of foam.

Dioxins and Furans. These are two complex classes of organic chemicals that are chlorinated (known as organochlorines), as a result of natural and manufacturing process, and from the combustion of organic materials. Polychlorinated dioxins and furans have been declared toxic under the Canadian Environmental Protection Act (CEPA) because of their immediate and long-term harmful effects on the environment and human health (Canada, 1990).

Direct Regulation. This is the traditional regulatory approach for pollution abatement. Canadian Council of Ministers of the Environment (1991: 7) define it as "a process through which a political authority directs private entities to take specified actions or to engage in specified types of behaviour. In this system government enforces directives through standards, limitations and penalties."

Economic Instruments. An instrument can be labelled as "economic" insofar as they affect the costs and benefits of various options, thereby guiding individuals towards behaviour and actions more desirable for the environment. An economic

instrument can take the form of a financial transfer (tax, charge) or modification of relative prices (i.e. taxation on certain products). Economic instruments operate as financial incentives to polluters, who select the most advantageous solution: polluting and paying for their pollution, or investing in pollution control to avoid paying, or some combination of the two. Types of economic instruments including effluent charges, transferable discharge permits and financial enforcement incentives (see this section for definitions).

Effluent Charges. Effluent charges are designed to counteract an externality (see below). They are prices paid by a polluting firm or individual that create an incentive for abatement by increasing the cost of a polluting activity. Charges in general are normally expressed as dollars per unit of effluent discharged. The rate may vary according to the quality of the discharge (as measured by the concentration of contaminants), the fluctuations in its flow, the time at which it is discharged, and the state of the receiving water and its alternative uses. Effluent charges can be applied to pollution effluents, inputs to a production process, or final products.

Externality. An externality reflects a type of market failure. Negative externalities are "cases in which the actions of one individual or firm affect other individuals or firms, where one firm imposes a cost on other firms but does not compensate the other firm" (Stiglitz, 1983: 75). Since a pulp and paper firm usually does not bear the full cost of the water pollution which it generates, that pollution becomes a negative externality to other users of that water.

Financial Enforcement Incentives. This type of economic instrument takes two forms: non-compliance fees are imposed when polluters do not comply with certain regulations. If these fees are proportional to the degree of non-compliance, as measured by discharges in excess of the authorized level, they become equivalent to an effluent charge imposed above some limited (the regulated) level of discharge. Performance bonds are payments to authorities in expectation of compliance with regulations. The payments are refunded when compliance is achieved.

Nitrogen Oxide (NOx). NOx forms in the air from the nitric oxide created by combustion. NOx contributes to ground-level ozone and acid deposition (i.e., acid rain), and can be hazardous to human, animal, and plant health. Automobiles and other mobile sources are by far the largest source category of NOx emissions in Ontario, although many emissions come from the heating of buildings.

Polychlorinated Biphenyls (PCBs). PCBs are odourless, colourless organic chemical compounds synthesized from the reaction of biphenyl with anhydrous chlorine. Characterized by a high degree of stability and resistance to heat and pressure, PCBs make excellent lubricants and hydraulic fluids for industrial processes.

Subsidies. Subsidies provide financial assistance to encourage changes in behaviour, i.e. actions to reduce pollution. Subsidies can take the form of a grant of money (non-repayable), soft loans (at reduced interest rates) and tax allowances (e.g. accelerated depreciation on pollution control equipment.)

Thermomechanical Pulp (TMP). This pulp, produced by the TMP process, is stronger than mechanical pulp, although it is more expensive and energy-consuming.

Total Suspended Solids (TSS). Suspended solids in the pulp and paper industry are mainly tiny fragments of wood fibre that escape in the liquid effluents from mills, measured as "the oven dry weight of material which can be removed from a sample of known volume by filtration through a standard filter paper" (Canada, 1983: 202). One effect of total suspended solids is that it can smother potential breeding grounds of fish.

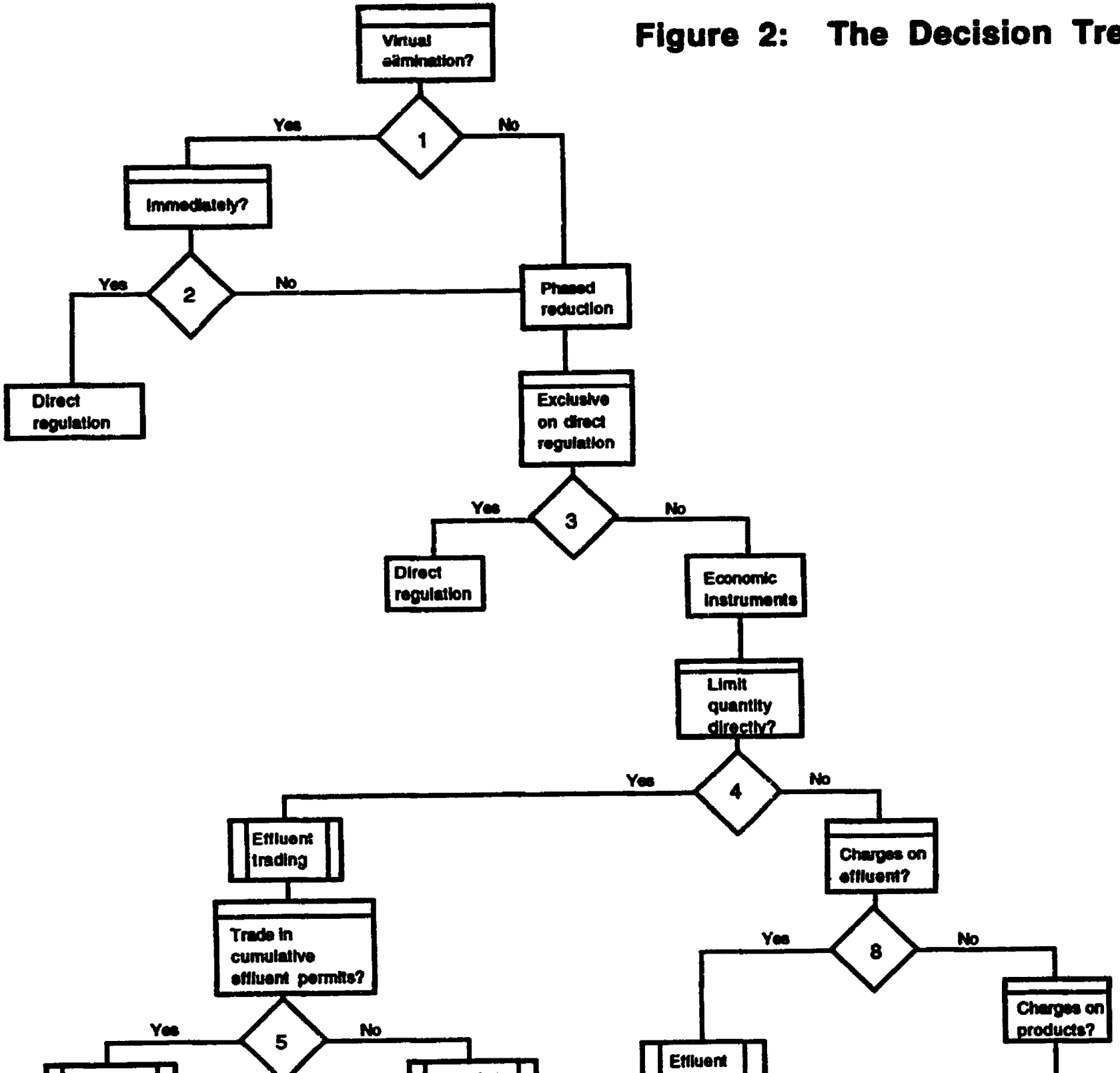
Toxicity. Toxicity refers to "acute lethality" to fish as defined by a 96-hour test which measures the mortality of a sample of at least five fish (Canada, 1983). Unlike BOD and TSS, which have a very short-term impact on water quality, the chemical substances that cause toxicity are "highly persistent in - and often highly toxic to - the environment" (Bonsor, 1990: 156). Though toxicity is referred to as a "conventional" pollutant, it is not addressed in this paper.

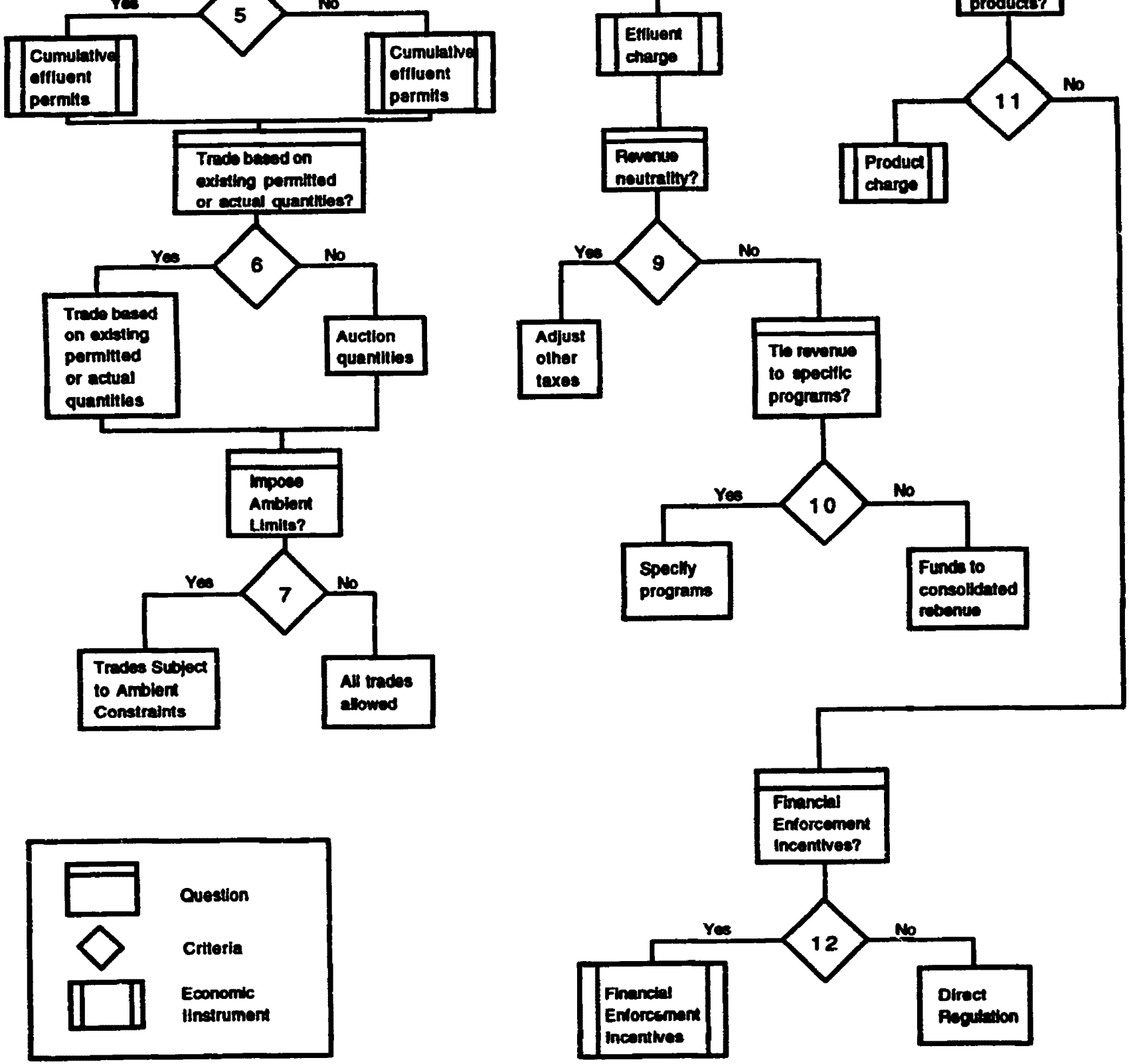
Tradeable Permits. A type of economic instrument, these permits[17] are "exchangeable property rights to discharge specified quantities of waste into the environment or to degrade environmental quality by a specific amount" (Novotny, 1984: 1). The permits can be sold by one firm to other firms (hence, the "transfer"). Trading can be applied in a few ways, including netting, offsets, and bubbles. Banking allows a firm to save its surplus pollution credits over time, for future use in effluent trading.

Volatile Organic Compounds (VOCs). Thousands of volatile organic compounds may be in the air at any time. VOCs come largely from car engines, but also from solvents, paint, glue, dry-cleaning fluid, and many other products. VOCs contribute to ground-level ozone.

[17]Tradeable permits are sometimes referred to as transferable discharge permits, marketable permits, or emissions trading. These terms are synonyms.

Figure 2: The Decision Tree




Yes
5
No
Cumulative effluent permits
Cumulative effluent permits
Trade based on existing permitted or actual quantities?
Yes
6
No
Trade based on existing permitted or actual quantities
Auction quantities
Impose Ambient Limits?
Yes
7
No
Trades Subject to Ambient Constraints
All trades allowed
Effluent charge
Revenue neutrality?
Yes
9
No
Adjust other taxes
Tie revenue to specific programs?
Yes
10
No
Specify programs
Funds to consolidated rebenue
products?
11
No
Product charge
Financial Enforcement Incentives?
Yes
12
No
Financial Enforcement Incentives
Direct Regulation
Question
Criteria
Economic Instrument