Justin Lacroix 951-2587

Analysis of the

1989 Pollution Abatement and Control Survey

Capital Expenditures Section
Investment and Capital Stock Division
January 1992

Acknowledgment

On behalf of the National Accounts and Environment Division, the 1989 Pollution Abatement and Control survey was conducted by the Capital Expenditures Section of the Investment and Capital Stock Division, under the supervision of Susan Horsley. Coordinated by J. Dominguez, the collection and validation of data reported were also performed by D. Ouellette, E. Roy and R. Saumure. System support was provided by L. Corneau and G. Paquette. R. Newton was responsible for the design of the questionnaire and the reporting guide.

Comments and suggestions on this report were kindly provided by J. Foley, S. Horsley and J. Lacroix of the Capital Expenditures Section and by B. Mitchell and C. Gaston of the National Accounts and Environment Division. The analysis of the data and the report were completed by R. Masse.

Substantial funding for this survey was provided by Industry, Science and Technology Canada.

Executive Summary

The Capital Expenditures Section conducted a special survey to evaluate the financial involvement of most business and social organizations in Canada in their efforts to reduce or eliminate pollutants and wastes emitted to the environment. This financial involvement is measured both in terms of capital and operating expenditures on retrofit facilities and equipment specifically installed for the purpose of abating or controlling pollutants. The Pollution Abatement and Control (PAC) survey, the first comprehensive survey conducted by Statistics Canada on this matter, also included questions on the type of retrofit equipment purchased and the sales and savings made from PAC recovered materials. A response rate of 76% was achieved.

The highlights of the Pollution Abatement and Control survey are:

- Capital expenditures on retrofit facilities and equipment for PAC purposes amounted to $ 916 million in 1989.
- Three sectors: manufacturing, mining and utilities and four provinces : Ontario, Quebec, Alberta and British Columbia accounted respectively for more than 90% of total PAC capital expenditures.
- Operating expenditures for PAC purposes were $ 730 million in 1989.
- Revenues and savings from PAC recovered materials amounted in 1989 to $ 80 million and $ 74 million respectively.

Methodological Note

Data collected for the PAC survey were for facilities and equipment which are **separately** identifiable and which have been installed **exclusively** for pollution abatement and control purposes.

The interpretation of survey results is limited by two factors: (1) the sample selected includes only medium and large firms and (2) there is no estimation for the non-response and the non-sampled portions[1].

Published non-inflated data thus represent a lower limit on PAC spending. See appendix A for more information on the concepts and methods used for this survey.

---

[1] For the capital expenditures only, interested readers will find in Appendix F a summary of the results obtained after estimation for the non-response and the non-sampled portions.

Table of Contents

Survey Analysis

Appendix

Introduction

The aim of this report is to summarize the results of the 1989 Pollution Abatement and Control (**PAC**) survey. This is the first comprehensive survey ever conducted by Statistics Canada attempting to evaluate the financial involvement of business and social organizations in Canada in their efforts to reduce or eliminate pollutants and wastes emitted to the environment. This financial involvement is measured both in terms of expenditures on fixed assets, commonly called capital expenditures, and in terms of current operating and maintenance expenses. In addition, some related statistics, like the type of retrofit equipment purchased and the sales of PAC recovered materials, were also surveyed.

The presentation of survey results constitutes the core of this report. Section 1 examines the response rates. The survey results on PAC capital and operating expenditures are presented in sections 2 and 3 respectively. Section 4 provides for a comparison of PAC capital and operating expenditures. Revenues and savings from PAC recoverable materials are shown in section 5. The experience of conducting this first survey on pollution abatement and control is summarized in section 6. Finally, concluding remarks are presented in section 7. All the results are analyzed by major economic sector and by province.

The definition of the concepts developed for the survey can be found in **Appendix A**. As a first attempt to evaluate PAC capital and current operating expenditures, questionnaire design received much of the attention at the beginning of the project. Documentation of similar experiences conducted in other countries, such as the United States, were closely examined. Likewise, consultations were made both internally, with the Environment and Natural Resources Section of the National Accounts and Environment Division and externally, with industry representatives and associations.

Appendix B presents a brief description of the questionnaire, while **Appendix C** includes copies of the 1989 Pollution Abatement and Control survey questionnaire and of the reporting guide. **Appendix D** analyses the characteristics of the respondents selected for the PAC survey. **Appendix E** describes the imputation method used for the treatment of incomplete responses. **Appendix F** presents a table summarizing the results obtained by sector and by province after estimation for the non-response and the non-sampled portions. Finally, **Appendix G** lists the categories of substances abated.

Symbols

The following symbols are used in the statistical tables of this report:

-	nil or zero.
--	amount too small to be expressed.
x	confidential to meet secrecy requirements of the Statistics Act.

Totals may not add up due to rounding.

Section 1

Response Rate

PAC survey questionnaires were mailed at the beginning of March 1991. The survey collection period spread from mid-March to the end of May 1991. In total, 803 organizations[1] were selected for the 1989 PAC survey. As illustrated in table 1, these organizations reported total capital expenditures of $21.3 billion on the Actual 1989 Capital and Repair Expenditures Survey (**CRES**).

Out of 803 questionnaires mailed for the PAC survey, 610 questionnaires (76.0%) were completed and returned, accounting for 69.3% ($ 14.7 billion) of the total capital expenditures reported by the selected organizations in 1989. Trade and commercial sectors had the lowest response rates, both in terms of number and value. By province, response rates were well below the overall average for Yukon, Saskatchewan and Quebec. One of the main reasons why organizations did not reply to the PAC survey was that they do not maintain environmental costs separately in their accounting records.

Finally, for the two major sections of the questionnaire, we observe that 377 respondents out of 610 (or 61.8%) reported PAC capital expenditures (section A), while 418 (or 68.5%) reported PAC

---

[1] Refer to Appendix D for more information on the scope of survey coverage.

operating and maintenance expenditures (section C).

TABLE 1 : RESPONSE RATES BY SECTOR AND BY PROVINCE
1989 ACTUAL CAPITAL EXPENDITURES, $ MILLION

	SELECTED		RETURNED		% RET. / SEL.	
	UNIT	VALUE	UNIT	VALUE	UNIT	VALUE
BY SECTOR:						
FORESTRY	5	15.0	5	15.0	100.0	100.0
MINING	90	2133.4	70	1487.0	77.8	69.7
MANUFACTURING	534	7324.4	422	5577.6	79.0	76.2
UTILITIES	76	10225.9	60	6695.1	78.9	65.5
TRADE	33	x	15	x	45.5	35.0
FINANCE	3	x	3	x	100.0	100.0
COMMERCIAL	20	484.5	6	157.5	30.0	32.5
INSTITUTIONS	23	509.5	18	446.2	78.3	87.6
GOVERNMENTS	19	318.6	11	212.7	57.9	66.8
TOTAL	803	21284.8	610	14744.9	76.0	69.3
BY PROVINCE:						
NEWFOUNDLAND	17	290.1	9	204.0	52.9	70.3
P.E.I.	5	x	4	x	80.0	91.0
NOVA SCOTIA	23	429.9	19	411.6	82.6	95.7
NEW BRUNSWICK	25	453.9	16	382.6	64.0	84.3
QUEBEC	203	5430.4	142	2077.2	70.0	38.3
ONTARIO	324	7817.7	271	6652.7	83.6	85.1
MANITOBA	20	808.9	16	751.0	80.0	92.8
SASKATCHEWAN	24	578.4	16	201.6	66.7	34.9
ALBERTA	65	3283.8	46	2339.9	70.8	71.3
B.C.	84	1966.2	64	1536.2	76.2	78.1
YUKON	5	x	1	x	20.0	24.1
N.W.T.	8	182.3	6	166.6	75.0	91.4
TOTAL	803	21284.8	610	14744.9	76.0	69.3

Section 2

PAC Capital Expenditures by Sector and by Province

Based on those respondents selected for the PAC survey and who returned their questionnaire, capital expenditures on retrofit facilities and equipment for pollution abatement and control purposes were $ 915.9 million in 1989. In table 2 below, we observe that a total of $ 495.0 million was spent on construction

TABLE 2 : CAPITAL EXPENDITURES BY SECTOR, 1989
$ MILLION

SECTORS	PAC SURVEY				CRES	
	CONST.	M&E	TOTAL	%DIST.	VALUE	%
	(1)	(2)	(3)	(4)	(5)	(3/5)
FORESTRY	-	x	x	x	15.0	x
MINING	35.8	33.8	69.6	7.6	1487.0	4.7
TOTAL - MANUFACTURING	375.1	326.9	702.1	76.7	5577.6	12.6
Paper & All.	122.1	170.7	292.8	32.0	2368.6	12.4
Prim. Metals	137.2	94.2	231.4	25.3	1132.7	20.4
Petro.& Coal	x	x	63.5	7.0	275.0	23.1
Chemicals	35.7	20.4	56.1	6.1	574.4	9.8
UTILITIES	41.1	43.9	85.0	9.3	6695.1	1.3
TRADE, FINANCE COMMERCIAL	x	x	12.5	1.4	311.3	4.0
INSTITUTIONS	2.2	1.7	3.9	0.4	446.2	0.9
GOVERNMENTS	x	x	x	x	212.7	x
TOTAL	495.0	420.9	915.9	100.0	14744.9	6.2

(CONST.) and $ 420.9 million on machinery and equipment (M&E) specifically installed for the purpose of abating and controlling pollutants emitted to the environment. Major pollution abatement and control facility and equipment purchased include dust control filter system, scrubbers, waste water treatment facilities and hazardous waste storage facilities.

The manufacturing sector was, by far, the largest contributor, accounting for 76.7% ($702.1 M) of the total capital expenditures on PAC. As can be seen above, the main contributors within the manufacturing sector were paper and allied industries, primary metals, petroleum and coal products and chemicals industries. In addition to manufacturing, utilities ($ 85.0 M), mining ($ 69.6 M), and government showed significant expenditures on pollution abatement and control.

Compared to the total capital expenditures reported by the same respondents on the Actual 1989 CRES (columns 5 and 6 of table 2), capital expenditures for pollution abatement and control represented 6.2% of the total capital expenditures reported, 7.5% of the total non-residential construction and 5.2% of the total machinery and equipment. From the PAC respondents selected, we also observe that federal and provincial governments were the sector devoting the largest share of its capital expenditures to pollution abatement and control, followed by the trade sector (18.3%) and the manufacturing sector (12.6%). Within the

manufacturing sector, the petroleum and coal products (23.1%) and the primary metals (20.4%) were the industries allocating the largest share of their investment to PAC.

The results by province are shown in table 3. Four provinces accounted for 90 % of the total capital expenditures on pollution abatement and control: Ontario ($ 328.2 M), Quebec ($ 205.2 M), Alberta ($ 147.8 M) and B.C. ($ 144.0 M). The portion of total capital expenditures allocated to pollution abatement and control expenditures in New Brunswick (15.3%), Quebec(9.9%), British Columbia (9.4%) and Alberta (6.3%) was above the national average,

TABLE 3 : CAPITAL EXPENDITURES BY PROVINCE, 1989
$ MILLION

PROVINCES	PAC SURVEY				CRES	
	CONST.	M&E	TOTAL	%DIST.	VALUE	%
	(1)	(2)	(3)	(4)	(5)	(3/5)
NEWFOUNDLAND	x	x	1.1	0.1	204.0	0.5
P.E.I.	x	x	x	x	x	4.6
NOVA SCOTIA	4.0	4.0	8.0	0.9	411.6	1.9
NEW BRUNSWICK	26.8	31.6	58.5	6.4	382.6	15.3
QUEBEC	103.3	101.9	205.2	22.4	2077.2	9.9
ONTARIO	211.2	117.0	328.2	35.8	6652.7	4.9
MANITOBA	9.6	2.0	11.6	1.3	751.0	1.5
SASKATCHEWAN	x	x	x	x	201.6	x
ALBERTA	66.3	81.5	147.8	16.1	2339.9	6.3
B.C.	66.8	77.2	144.0	15.7	1536.2	9.4
YUKON	-	-	-	-	x	-
N.W.T.	x	-	x	x	166.6	x
TOTAL	495.0	420.9	915.9	100.0	14744.9	6.2

while all other provinces were below the average, including Ontario at 4.9%.

Table 4 presents the distribution of capital expenditures by type of pollutants abated. As expected, reducing air and water pollutant emissions was the focus of most of the activity, accounting respectively for 42.8% and 41.5% of the total capital expenditures on pollution abatement and control. Substances emitted to **air** being abated or controlled most frequently were particulate matter, solvents and other hydrocarbons, while reductions on emissions to **water** focused on suspended solids, metals and metallic compounds. PCB's, solvents and other hydrocarbons were the most stated **liquid waste** removed. Finally, removed **solid wastes** included a large variety of metallic compounds and forest product wastes[2].

The distribution of capital expenditures by type of pollutants abated varies significantly by sector. Compared to the national average, mining sector spent more on solid wastes (18.8% against 9.1%); utilities, on contained liquids and government, on water pollutants. Within the manufacturing sector, paper and allied industries tend to invest more for abating or controlling water pollutants; while primary metals and petroleum and coal industries were mainly interested in reducing air pollutant emissions.

---

[2] Refer to Appendix G for a more complete list of substances abated.

TABLE 4 : CAPITAL EXPENDITURES BY TYPE OF POLLUTANTS ABATED BY SECTOR, 1989

SECTORS	TOTAL ($M)	AIR POLLUTANTS (%)	WATER POLLUTANTS (%)	CONTAINED LIQUIDS (%)	SOLID WASTES (%)
FORESTRY	x	-	x	-	x
MINING	69.6	31.8	35.5	14.0	18.8
TOTAL - MANUFACT.	702.1	45.7	41.3	4.4	8.6
Paper	292.8	23.2	63.4	3.1	10.4
Prim.Met.	231.4	68.9	28.3	0.7	2.1
Pet.&Coal	63.5	x	8.8	x	4.0
Chemicals	56.1	32.4	34.2	12.2	21.2
UTILITIES	85.0	x	x	x	9.1
TRADE, FINANCE, COMMERCIAL	12.5	17.6	x	16.8	x
INSTITUT.	3.9	37.2	-	11.2	51.7
GOVERNMENT	x	x	x	x	x
TOTAL	915.9	42.8	41.5	6.5	9.1

Table 5 presents the distribution by province of capital expenditures by type of pollutants abated. While the provinces of Quebec and Alberta invested more to reduce air pollutants, the provinces of Ontario and British Columbia spent more on controlling water pollutants. Finally, New-Brunswick is the province allocating the largest share of its investment on solid waste (25%).

TABLE 5 : CAPITAL EXPENDITURES BY TYPE OF POLLUTANTS ABATED BY PROVINCE, 1989

PROVINCES	TOTAL ($M)	AIR POLLUTANTS (%)	WATER POLLUTANTS (%)	CONTAINED LIQUIDS (%)	SOLID WASTES (%)
NFLD	1.1	x	x	x	-
P.E.I.	x	100.0	-	-	-
N.S.	8.0	21.5	57.5	x	x
N.B.	58.5	x	x	2.7	25.5
QUEBEC	205.2	61.8	21.1	6.6	10.5
ONTARIO	328.2	32.6	52.7	8.7	6.0
MANITOBA	11.6	x	x	x	x
SASK.	x	x	x	x	x
ALBERTA	147.8	57.1	23.6	5.1	14.1
B.C.	144.0	30.4	62.4	x	x
YUKON	-	-	-	-	-
N.W.T.	x	x	x	-	x
TOTAL	915.9	42.8	41.5	6.5	9.1

Section 3

PAC Operating Expenditures by Sector and by Province

Operating and maintenance expenditures on retrofit facilities and equipment for pollution abatement and control purposes were estimated at $ 728.8 million in 1989. As depicted in table 6, the four categories of operating and maintenance expenditures were by

TABLE 6 : OPERATING EXPENDITURES BY SECTOR AND BY PROVINCE
1989, $ MILLION

	LABOUR	FUELS & ELECTR.	MATER. & SUP.	PURCH. SERVICE	TOTAL	% DIST
BY SECTOR:						
FORESTRY	x	-	-	x	x	x
MINING	19.5	15.4	32.3	9.6	76.8	10.5
MANUFACTURING	124.4	67.0	138.9	138.3	468.6	64.3
UTILITIES	x	x	x	x	x	x
TRADE, FINANCE COMMERCIAL	0.2	--	--	0.4	0.6	0.1
INSTITUTIONS	0.2	0.1	0.2	0.4	0.8	0.1
GOVERNMENT	x	x	x	x	x	x
BY PROVINCE:						
ATLANTIC PROVINCES	6.1	1.0	10.0	2.9	19.6	2.7
QUEBEC	43.3	11.2	62.9	68.9	186.4	25.6
ONTARIO	116.3	106.6	96.7	99.5	419.1	57.5
MANITOBA	x	x	x	0.2	x	x
SASKATCHEWAN	4.9	x	7.2	x	14.9	2.0
ALBERTA	3.3	11.2	4.1	3.4	22.1	3.0
B.C.	14.7	15.1	24.6	7.8	62.2	8.5
YUKON	-	-	-	-	-	-
N.W.T.	x	--	x	-	x	x
TOTAL	190.4	147.4	207.9	183.1	728.8	100.0
% DISTRIBUTION	26.1	20.2	28.5	25.1	100.0	

and large equally important, ranging from 20% for fuels and electricity to 29% for materials and supplies. Purchased services, i.e. the costs involved in contracting out or hiring outside personnel for pollution abatement and control purposes, attracted a significant portion of PAC operating and maintenance costs. Overall, we observe that (1) the manufacturing, the utilities and the mining industries and (2) the provinces of Quebec and Ontario accounted for more than 90% and 80% respectively of the total PAC operating and maintenance expenditures.

Operating and maintenance expenditures are distributed much more evenly by type of pollutants abated than capital expenditures. As illustrated in table 7, air pollutants, water pollutants and solid wastes were representing respectively 32.4%, 31.7% and 25.2% of the total operating expenditures. In contrast, utilities have devoted more than half of their total PAC operating expenditures for the reduction of air pollutants, while governments (federal and provincial) have mainly allocated their PAC operating budget on water pollutants.

TABLE 7 : OPERATING EXPENDITURES BY TYPE OF POLLUTANTS ABATED BY SECTOR, 1989

SECTORS	TOTAL ($M)	AIR POLLUTANTS (%)	WATER POLLUTANTS (%)	CONTAINED LIQUIDS (%)	SOLID WASTES (%)
FORESTRY	x	-	x	x	x
MINING	76.8	31.2	36.9	18.8	13.0
MANUFACTURING	468.6	30.4	28.8	7.3	33.5
Paper & All.	76.0	8.7	57.7	3.5	30.1
Prim. Metals	258.4	41.9	17.8	3.7	36.5
Trans. Eqp.	35.7	23.5	31.6	15.6	29.3
Petro.& Coal	17.2	x	41.8	x	13.7
Chemicals	44.4	20.4	43.2	13.3	23.0
UTILITIES	x	x	x	x	x
TRADE FINANCE COMMERCIAL	0.6	12.1	19.0	48.3	20.6
INSTITUTIONS	0.8	x	-	x	x
GOVERNMENT	x	--	x	x	--
TOTAL	728.8	32.4	31.7	10.6	25.2

Within the manufacturing sector, the distribution of operating expenditures by type of pollutants abated was generally in line with the distribution observed at the overall manufacturing level. The exceptions were the paper and allied industries and the petroleum and coal industries, which were spending more on water pollutants and on contained liquids respectively as compared to the overall manufacturing sector.

The distribution by province of PAC operating and maintenance costs by type of pollutants abated, as shown in table 8, reveals important differences. While the provinces of Ontario and of Alberta spent mainly on air and water pollutants, the province of Quebec is allocating the largest portion of its expenditures on solid wastes and air pollutants, and British Columbia, on solid wastes and water pollutants. To a large extent, these differences are the reflection of the various distributions by type of pollutants observed for the manufacturing sector across the provinces.

TABLE 8 : OPERATING EXPENDITURES BY TYPE OF POLLUTANTS ABATED BY PROVINCE, 1989

PROVINCES	TOTAL ($M)	AIR POLLUTANTS (%)	WATER POLLUTANTS (%)	CONTAINED LIQUIDS (%)	SOLID WASTES (%)
ATLANTIC PROVINCES	19.6	15.4	40.2	17.8	26.5
QUEBEC	186.4	33.0	9.4	6.6	51.1
ONTARIO	419.1	35.0	38.5	11.7	14.8
MANITOBA	x	x	x	x	x
SASKATCHEWAN	14.9	x	x	x	x
ALBERTA	22.1	45.8	28.8	23.6	1.8
B.C.	62.2	14.7	47.4	5.7	32.1
YUKON	-	-	-	-	-
N.W.T.	x	-	x	x	x
TOTAL	728.8	32.4	31.7	10.6	25.2

Section 4

Comparison of PAC Capital and Operating Expenditures

In this section, we computed the ratio of PAC operating and maintenance cost to PAC capital expenditures by sector and by province. This comparison allows us to measure the intensity of utilization of various resources, mainly labour and capital, involved in PAC activities. The higher the value of this ratio, the more intensive is the utilization of labour and related resources as compared to capital resources for abating or controlling pollution.

However, this ratio cannot be computed by using only the results derived from the 1989 PAC survey. PAC capital expenditures were defined as gross spendings on new retrofit facilities and equipment **acquired in 1989**, while PAC operating expenditures were defined as the variable expenses for all PAC operations which make use of retrofit facilities and equipment **purchased in 1989 or before**.

The more suitable comparison involves the PAC operating expenditures, as defined above, with the total gross value of PAC retrofit facilities and equipment acquired in 1989 or before. Hence, estimates on PAC capital expenditures for the years 1985 to 1988 were derived from a second source of information - the section D of the Capital and Repair Expenditures Survey. These data are available only since 1985.

Table 9 below presents the ratio[3] of 1989 PAC operating expenditures to the combined total PAC capital expenditures (PAC survey and second source) for the period 1985 to 1989. Overall, the ratio of PAC operating to capital expenditures stood at 0.4, indicating a much more intensive use of capital than labour and related resources for abating or controlling pollution. By sector however, we observe some important differences, the ratio ranging from 0.3 in manufacturing to 0.7 in mining and 1.2 in utilities.

TABLE 9 : RATIO OF OPERATING TO CAPITAL EXPENDITURES, 1989
$ MILLION

SECTORS	GROSS PAC CAPITAL EXPENDITURES 1985 - 1989(1)	PAC OPERATING EXPENDITURES 1989(2)	RATIO
FORESTRY	x	x	1.3
MINING	104.9	76.8	0.7
MANUFACTURING	1477.9	468.6	0.3
UTILITIES	x	x	1.2
TRADE, FINANCE COMMERCIAL	41.4	0.6	0.0
INSTITUTIONS	9.4	0.8	0.1
GOVERNMENT	x	x	0.3
TOTAL	1919.8	728.8	0.4

(1) 1985-88 are estimates derived from Section D of the Capital and Repair Expenditures Survey. 1989 data are derived from the PAC survey.

(2) PAC operating and maintenance expenditures are from the PAC survey.

---

[3] Two caveats may affect the results: (1) the PAC survey data and the PAC data collected from the CRES are not fully compatible, and (2), the short period over which capital expenditures are accumulated. Prior to 1985, large PAC expenditures could have occurred.

By province (see table 10), Saskatchewan (1.0) and Ontario (0.6) are the only two regions showing a ratio above the national average. The unavailability of historical data on PAC capital expenditures by type of pollutants prevents us from computing ratios of operating to capital expenditures by type of pollutants.

TABLE 10 : RATIO OF OPERATING TO CAPITAL EXPENDITURES, 1989
$ MILLION

PROVINCES	GROSS PAC CAPITAL EXPENDITURES 1985 - 1989(1)	PAC OPERATING EXPENDITURES 1989(2)	RATIO
ATLANTIC PROVINCES	153.0	19.6	0.1
QUEBEC	559.7	186.4	0.3
ONTARIO	695.3	419.1	0.6
MANITOBA	x	x	0.2
SASKATCHEWAN	14.5	14.9	1.0
ALBERTA	195.9	22.1	0.1
B.C.	278.0	62.2	0.2
YUKON	1.2	-	-
N.W.T.	x	x	0.3
TOTAL	1919.8	728.8	0.4

(1) 1985-88 are estimates derived from Section D of the Capital and Repair Expenditures Survey. 1989 data are derived from the PAC survey.

(2) PAC operating and maintenance expenditures are from the PAC survey.

Section 5

Revenues and Savings from PAC Recovered Materials

In section D of the questionnaire, respondents were asked to provide their 1989 revenues from the sales of PAC recovered materials as well as to estimate the savings made by using these recovered materials. Survey results are as follows:

TABLE 11 : REVENUES AND SAVINGS FROM PAC RECOVERED MATERIALS, 1989

	REVENUES ($ M)	SAVINGS ($ M)
BY SECTOR :		
FORESTRY	-	-
MINING	x	x
MANUFACTURING	58.2	70.6
Pulp & Paper	0.9	22.2
Prim. Metals	23.0	20.4
UTILITIES	x	x
TRADE, FINANCE COMMERCIAL	-	-
INSTITUTIONS	-	-
GOVERNMENT	-	--
Total	80.1	73.7
BY PROVINCE :		
Atlantic Provinces	x	x
Quebec	8.6	29.9
Ontario	63.2	21.5
Manitoba	x	x
Saskatchewan	x	x
Alberta	x	-
B.C.	x	11.8
Yukon	-	-
N.W.T.	-	-
Total	80.1	73.7

Revenues and savings from PAC recoverable materials amounted in 1989 to $ 80.1 million and $ 73.7 million respectively. Only three sectors, mining, manufacturing and utilities, have generated revenues from the sales of PAC recovered materials, while more than 95% of the savings made from the use of PAC recovered materials were realized in the manufacturing sector.

In table 12, we have compared, for selected sectors and provinces, revenues and savings from PAC recovered materials (section D) to operating costs (section C) **only for those respondents having reported to both sections of the questionnaire.** Both revenues and savings are representing about 10% of total operating costs. By sector, the ratio of savings to operating costs is significantly higher in manufacturing than in utilities, while the ratios of revenues to operating costs are very similar. By province, Ontario is showing the highest ratio of revenues to operating costs, and British Columbia, the highest ratio of savings to operating costs.

TABLE 12 : RATIOS OF REVENUES AND SAVINGS TO OPERATING COSTS

SELECTED SECTORS AND PROVINCES	OPERATING COSTS ($ M)	REVENUES ($ M)	REVENUES/ OPR.COSTS (%)	SAVINGS ($ M)	SAVINGS/ OPR.COSTS (%)
MINING	76.8	x	x	x	x
MANUFACTURING	468.6	52.9	11.3	69.2	14.8
UTILITIES	x	x	11.9	x	1.5
QUEBEC	186.4	8.2	4.4	20.0	10.7
ONTARIO	419.1	58.4	13.9	31.7	7.6
B.C.	62.2	x	x	11.5	18.5
TOTAL	728.8	74.8	10.3	72.1	9.9

Section 6

Survey Experiences

The aim of this section is to summarize the experience of conducting this first survey on pollution abatement and control expenditures. The first issue relates to the ability demonstrated by the respondents to provide the requested data. A significant number of organizations, small and large, private and public, found it difficult to identify separately in their accounting records those expenditures for pollution abatement and control purposes.

The concepts and definitions used for the PAC survey introduced some difficulties in the collection of the data. We deliberately restricted the collection of capital and operating expenditures on pollution abatement and control to retrofit facilities and equipment only. The idea was to focus on "end-of-pipe" and other clearly identifiable PAC investment, i.e. on what was objectively measurable. This avoided the problem of measuring expenditures on attaining pollution abatement and control through "changes-in-processing techniques". While many industries do attain significant reductions in emissions through the installation of new production equipment for instance, these investments are more often made for a number of reasons such as capacity expansion, replacement and modernization **and** pollution abatement and control. This presents significant statistical problems as these total expenditures would have to be disaggregated in some fashion to

isolate only the portion devoted to the PAC element. A solution that would provide satisfactory results was not possible within the scope of this first PAC survey.

We also encountered cases for which some retrofit facilities and equipment were installed for multiple purposes, in addition to exclusively abating or controlling polluted substances. One example are recovery furnaces or boilers installed in pulp and paper mills. As part of a chemical recovery process, the recovery boiler both increases the productivity and decreases the water pollutants emitted to the environment. According to the definition used in this survey, expenditures on recovery furnaces were not included since they were not installed solely to abate or control undesirable substances.

The format of section B of the questionnaire also raised reporting problems. In section B, we asked respondents to identify the major substances abated or controlled by the installation of retrofit facilities and equipment and to estimate the weight in tonnes. During the collection of the data for this section, it was realized that the unit of measurement chosen (tonnes/year) was not the one used by all organizations. A number of organizations use volume (particles per million) instead of weight (tonnes) as the unit of measurement for the substances abated or controlled. A wide range of substances were also identified by respondents. This explains the limited use of data collected in Section B of the

questionnaire in this report. Further analysis of these data will be required to allow for a wider dissemination of the information reported.

Section 7

Conclusions

The first Pollution Abatement and Control Survey (PAC) was conducted by the Capital Expenditures Section on behalf of the National Accounts and Environment Division of Statistics Canada.

The survey, with a high response rate of 76%, measured the financial involvement both in terms of capital and operating expenditures on retrofit facilities and equipment installed for the purpose of abating and controlling pollutants.

The highlights of the Pollution Abatement and Control survey are:

- Capital expenditures on retrofit facilities and equipment for PAC purposes reached $ 916 million in 1989.
- The PAC expenditures represented about 6% of total capital expenditures reported by the same group of respondents on the 1989 actual Capital and Repair Expenditures survey.
- Three sectors: manufacturing, mining and utilities and four provinces : Ontario, Quebec, Alberta and British Columbia accounted for more than 90% of total PAC capital expenditures.
- Retrofit facilities and equipment purchased included dust control filter systems, scrubbers, waste water treatment facilities and hazardous waste storage facilities.
- Operating expenditures for PAC purposes were $ 730 million in 1989.
- Revenues and savings from PAC recovered materials amounted in 1989 to $ 80 million and $ 74 million respectively.

Appendix A
Concepts and Definitions

The 1989 Pollution Abatement and Control Survey relies on terminology that until recently has been confined to the realm of the scientists and engineers. Environment being a growing concern over the last decade, expressions like BOD, PCB and CFC were seldom heard by or unknown to the public a few years ago. In order to avoid as much as possible the confusion resulting from the use of this terminology, a set of definitions was developed for the concepts used in the PAC survey. These definitions were included in the reporting guide supplied with the questionnaire sent to respondents (see appendix C).

First, **pollution abatement and control** is defined as the reduction or elimination of pollutants and wastes emitted by the operations of business and social organizations. The expression also includes the prevention, treatment and reuse of pollutants and wastes. For the purpose of this survey, pollutants and wastes are classified into four categories: substances emitted to air, substances emitted to water, contained liquid wastes and solid wastes.

Data on capital and current operating expenditures collected for this survey on pollution abatement and control were for **retrofit** non-residential facilities and machinery and equipment only, i.e. for facilities and equipment which are separately identifiable and which have been installed exclusively for PAC purposes. Retrofit facilities and equipment are not an integral part of the plant's production equipment, having been installed solely to abate or control undesirable substances emitted during the plant's normal production activities. Examples of these are precipitators, dust collectors, scrubbers and other treatment facilities.

Spendings on retrofit facilities and equipment capture only a fraction of the total investment taking place for abating or controlling emissions of pollutant substances. Spendings on processing techniques in the production plant in order to eliminate or reduce pollution constitute another significant portion. Unfortunately, changes in processing techniques can be put in place for various reasons as well as the reduction or elimination of pollution. It is therefore very difficult to measure the spendings on "changes-in-processing techniques" solely attributable to PAC. Consequently, the concept retained for this survey was the "end-of-pipe" investment on facilities and equipment clearly identifiable and measurable.

PAC capital expenditures on non-residential construction refer to gross spendings (including grants and subsidies) on new retrofit facilities installed exclusively for abating and controlling pollutants emitted to the environment. Costs of feasibility studies, architectural, legal and engineering fees are taken into account as well as capitalized interest charges on loans used for financing new PAC construction projects. However, land purchases are excluded.

On the other hand, **PAC capital expenditures on machinery and equipment** refer to gross spendings on new retrofit machinery and equipment installed exclusively for PAC purposes. Capitalized interest charges on loans used for financing the purchase of PAC equipment and addition, expansion or upgrading of existing PAC equipment are included as well as imports from abroad of used equipment. Purchases of used PAC equipment from within Canada are however excluded.

PAC operating and maintenance expenditures are defined as the variable expenses for all PAC operations which make use of retrofit PAC facilities and equipment purchased in 1989 as well as in previous years. This includes mainly salaries and wages, costs of electricity and fuels, costs of materials and supplies and services, i.e. costs for contracting or hiring outside personnel to haul away, store and dispose of wastes, or to clean and maintain equipment. It excludes, however, such costs as for research and development.

Finally, **PAC recovered materials** are defined as materials or their derivatives which have been collected as a direct result of pollution abatement activities. These materials can be subsequently used in the plant's own production process or sold to another organization.

Appendix B

Description of Questionnaire

The Pollution Abatement and Control questionnaire includes six sections (see appendix C). Section A prompts respondents to report their 1989 PAC capital expenditures for retrofit construction and/or machinery and equipment. In addition, section A asks respondents to provide the percentage distribution of their total PAC capital expenditures, first, according to the origin (Canada or outside Canada) of the machinery and equipment purchased, and second, by type of substance to be abated or controlled.

In section B, organizations had to provide the list by name of major substances abated or controlled, and an estimate of their weights in tonnes, both (1) in consequence of the installation of retrofit construction and/or machinery and equipment in 1989 for PAC purposes and (2) as an additional benefit of "Change in Processing" techniques in the production plant in 1989.

Section C focuses on 1989 PAC operating and maintenance costs for retrofit equipment or facilities installed in 1989 or before. The respondents were asked to break down their total operating and maintenance expenses according to four categories: labour, fuels and electricity, materials and supplies and purchased services. In addition, the percentage distribution of total PAC operating and maintenance costs had to be provided by type of substance to be removed.

Section D questions respondents on two related issues: their 1989 revenues from the sales of PAC-recovered materials and the savings (if applicable) made in 1989 by using PAC-recovered materials in their organizations.

Section E prompts respondents to list their major retrofit equipment purchased in 1989 for pollution abatement and control.

Section F provides space for the clarification of the responses.

SPECIFIC INSTRUCTIONS

Please note: PAC refers to Pollution Abatement and Control.

SECTION A:

PAC capital expenditures for construction:

Question A.1

Report the gross PAC capital expenditures (including subsidies, grants), incurred in 1989 for new building and engineering projects for expansion and replacement (contract as well as by own employees), whether for your own use or for lease or rent to others. Any balance owing or holdbacks should be reported in the year in which the cost was incurred.

Include:

- costs of: demolition of buildings; land servicing and site preparation.
- costs of leasehold and land improvement; townsite facilities such as streets, sewers.
- pipe and installation costs for oil or gas pipelines.
- cost of feasibility studies; architectural, legal and engineering fees.
- addition, expansion, or upgrading of existing PAC fixed assets.
- capitalized interest charges on loans used for financing new PAC construction projects.
- materials supplied to construction contractors for building and installation.

Do not include:

- land purchases.

PAC capital expenditure for new, retrofit machinery and equipment:

Question A.1

Report gross PAC capital expenditures (including subsidies, grants) incurred in 1989, for the acquisition of new retrofit (see "Definitions") machinery and equipment for pollution abatement and control purposes, whether for your own use, or for lease or rent to others. Any balance owing or holdbacks should be reported in the year in which the cost was incurred.

Fully manufactured outside Canada:

Only machinery and equipment which have been wholly manufactured outside Canada are reported under this heading. Please note that these items could have entered Canada in "knocked down" form, and assembled on arrival at the plant site.

Include as retrofit PAC capital expenditure:

- only retrofit facilities which are installed exclusively for the purpose of abating and controlling pollutants emitted by your operations.
- capitalized interest charges on loans used for financing the purchase of PAC machinery and equipment.
- addition, expansion, or upgrading of existing PAC assets.
- imports from abroad of used assets.

Do not include as retrofit PAC capital expenditure:

- expenditures for converting the integral structure of existing machinery and equipment to handle changes in processing which will achieve the additional benefit of reducing pollution (e.g. converting equipment to accommodate the use of a fuel which is environmentally friendly).
- expenditures for research and development.
- purchase of used PAC assets from within Canada.
- if as a lessee, you are capitalizing leased machinery and equipment in accordance with the recommendations of the Canadian Institute of Chartered Accountants, please exclude such capitalized totals from PAC capital expenditures.
- if your establishment manufactures equipment and materials (e.g. electrostatic precipitators or desulphurized fuels) to be sold to others for PAC purposes, do not include such expenditures in PAC capital expenditure.

Question A.2:

Please provide the percentage distribution of total PAC capital expenditures (Box A) by type of substance to be controlled.
You are required to match PAC capital expenditures, in percentage form, to the major types of pollutant to be abated. Best estimates are accepted.

SECTION B:

Question B.1

Substances that will be removed as per your design specifications for PAC capital expenditures for "retrofit" construction and/or machinery and equipment.

Please estimate the tonnage of major substances to be abated. It may sometimes be necessary to report smaller quantities of specific pollutants in "decimals of a tonne".

Example for B.1:

Substances emitted to air		*Contained Liquid Wastes*	
Name	*Tonnes per year*	*Name*	*Tonnes per year*
Carbon Monoxide	11.00	Sulphuric acid	27.00
Arsenic	0.81	PCB	13.00
Asbestos	1.24	Solvents	73.00
All other	82.91	All other	197.00

Question B.2

Substances that will be removed as an additional benefit of "change-in-processing" techniques in the production plant in 1989 (i.e, capital expenditures not included in Box A).

If you have made changes in your processing techniques to eliminate or reduce pollution, please provide engineering estimates of the tonnage of abatement to be attained, by type of pollutant. It may sometimes be necessary to report small quantities of specific pollutants in "decimals of a tonne".

Example for B.2:

Substances emitted to water		*Contained Liquid Wastes*	
Name	*Tonnes per year*	*Name*	*Tonnes per year*
Mercury	0.32	Askarel	16.00
Lead	6.00	Sludge	52.00
Aluminum	3.00	Solvents	80.00
All other	52.00	All other	167.00

SECTION C:

Question C.1

Operating and maintenance costs for Pollution Abatement and Control in 1989.

Report the variable expenses incurred in 1989 for all PAC operations which make use of retrofit PAC facilities purchased in 1989, as well as in previous years.

Include:

- labour i.e. salaries and wages, as well as pension and health plans for personnel engaged in operating and maintaining PAC machinery and equipment: also include supervisory personnel, as well as training/retraining of personnel.
- costs of electricity and fuels.
- costs of materials and supplies e.g. chemicals, filters, special uniforms, masks etc., leasing payments for PAC machinery and equipment.
- costs for contracting or hiring outside personnel to haul away, store or dispose of wastes, or to clean and maintain equipment.

Do not include:

- costs for research and development.
- costs to reduce occupational and health hazards in the workplace.
- expenditures for environmental aesthetics such as landscaping, or expenditures for employee comfort such as airconditioning.
- if your establishment manufactures equipment and material (e.g. electrostatic precipitators or desulphurized fuels) to be sold to others for PAC purposes, do not include such operating costs.
- interest payments on loans used for financing PAC capital expenditures. (These are reported under Question A.1).

Question C.2

Please provide the percentage distribution of total PAC operating costs (Box B) by type of substance to be removed.
Required here is a percentage breakdown of total operating costs (Box B) to match type of pollutant abated. Best estimates are accepted.

SECTION D:

Question D.1

Please provide your 1989 revenue from the sales of PAC-recovered materials.

If pollution abatement activities in 1989 using retrofit PAC devices(installed in 1989 or in previous years) resulted in the recovery of materials and substances which were subsequently sold, please provide the revenue thus obtained.
Please note: Do not include "prompt" or production scraps.

Questions D.2

Did your organization use any of its own PAC-recovered material in its own production processes in 1989?
Enter "yes" if you made use of materials or substances recovered from PAC.
Please note: Do not include "prompt" or production scraps.

Question D.3

Please estimate how much you saved in 1989 by using PAC-recovered materials in your organization.

If your organization was able to use materials that were recovered in 1989 through the use of retrofit PAC devices (installed in 1989 or in previous years), please provide the "costs recovered".
Please note: Do not include "prompt" or production scraps.

SECTION E:

List the major new retrofit PAC equipment purchased in 1989. Include "imported from abroad" used PAC equipment that your organization purchased in 1989.

SECTION F:

Should you have any comments, or would like to elaborate on the responses you have provided, please record them here, or if space does not permit, on a separate sheet.

Reporting Guide

Pollution abatement and control survey 1989

Form PA2

Français au verso

GENERAL INSTRUCTIONS

1. **Identification of Your Organization:**

The printed label on page 1 indicates the most current identification of your organization on our files. If there are changes that would better describe your organization, please enter them in the Update section below the label.

2. **Information Required from Your Organization:**

a) Report your organization's capital expenditures and operating expenses for pollution abatement and control for 1989. The data provided for this questionnaire should reflect only the pollution abatement activities of the organization identified on the label. If you require forms for organizations other than the one identified on the label, please call collect at (613) 951-2592 or (613) 951-2593.

b) Report only your portion in the case of joint projects with other companies.

3. **Reporting Period: Your Fiscal Year:**

Please report expenditures for your 12 month fiscal period for which the **FINAL DAY** occurs between April 1, 1989 and March 31, 1990. Thus, any of the following would be an acceptable report period:

May	1988	-	April	1989	(04/89)
June	1988	-	May	1989	(05/89)
July	1988	-	June	1989	(06/89)
Aug.	1988	-	July	1989	(07/89)
Sept.	1988	-	Aug.	1989	(08/89)
Oct.	1988	-	Sept.	1989	(09/89)
Nov.	1988	-	Oct.	1989	(10/89)
Dec.	1988	-	Nov.	1989	(11/89)
Jan.	1989	-	Dec.	1989	(12/89)
Feb.	1989	-	Jan.	1990	(01/90)
Mar.	1989	-	Feb.	1990	(02/90)
April	1989	-	Mar.	1990	(03/90)

4. **Dollar Amounts and Percentages:**

a) All dollar amounts reported should be rounded to **THOUSANDS OF CANADIAN DOLLARS** (e.g. $8,555,400.00 rounded to $8,555).

b) Percentages should be rounded to **the nearest unit** (e.g. 4%, 10%, 14%).

c) Please enter your best estimates when precise figures are not available.

5. **For Your Information:**

a) The pre-printed numbers (100 - 403) are for Statistics Canada computer system identification purposes.

b) The symbol * indicates that a definition and/or explanation is provided in the reporting guide.

c) For all questions, if the response is zero for an item, please check the relevant zero box ☑.

d) If you have any questions, please call collect at:

(613) 951-2592 or (613) 951-2593.

6. **Mailing of Questionnaire:**

Please send the completed questionnaire in the enclosed postage-paid envelope to:

Investment and Capital Stock Division
Statistics Canada,
Ottawa, Ontario,
K1A 0T6

or by Fax to:

Investment and Capital Stock Division
fax: (613) 951-0196
or: (613) 951-7473.

Keep the second copy of the questionnaire for your records.

DEFINITIONS

Pollution Abatement and Control (PAC):

The reduction or elimination of pollutants and wastes emitted by your operations. The term includes prevention, treatment and reuse of pollutants and wastes.

Retrofit Construction, Machinery and Equipment :

Note: With the exception of Question B.2, all PAC construction, machinery and equipment alluded to are "retrofit".

Equipment or facilities which are separately identifiable and which have been installed exclusively for PAC purposes. They are not an integral part of the plant's production equipment, having been installed solely to abate or control undesirable substances emitted during the plant's normal production activities. Examples of these are precipitators, dust collectors, scrubbers and other treatment facilities.

Change-in-Processing techniques: Question B.2 only.

An integral change is made in the plant's processing technique such that in the course of its day to day production activities, an additional benefit of reducing or eliminating pollutants generated is achieved. This is done by employing means such as material substitution; using improved catalysts; reusing waste or water in the production process; converting equipment to handle the use of substitute fuels that generate less pollutants; etc.

Please note: In "Change-in-Processing", the PAC aspect in the whole industrial operation is not separately identifiable from the product-making aspect. Thus, engineering estimates may be required to report the PAC portion of pollutants abated.

Substances Emitted to Air: Questions A.2, B.1, B.2, and C.2.

These are airborne substances which are either harmful or objectionable. They include particulates (e.g. dust, smoke, fly ash), sulphur dioxides, nitrogen oxides, carbon monoxide, asbestos, as well as other materials and substances on Environment Canada's Priority Substances List.

Substances Emitted to Water: Questions A.2, B.1, B.2, and C.2.

Harmful or objectionable waterborne substances which run into and adversely alter the quality of water. Examples of these are suspended solids, grease, materials and substances which have high levels of BOD (biochemical oxygen demand) and COD (chemical oxygen demand). Include aluminum, mercury, lead, arsenic, chlorine, cyanide, asbestos, as well as other materials and substances on Environment Canada's Priority Substances List.

Contained Liquids: Questions A.2, B.1, B.2, and C.2.

Liquid wastes, such as paints, mineral oils containing PCBs, askarel fluids, acids, mine tailings, sludge etc. which have been collected and stored in containers, to be transported and disposed of at some future date, or channelled into specially built reservoirs to prevent their run-off into the environment.

Solid Wastes: Questions A.2, B.1, B.2, and C.2.

Unwanted byproducts of economic activity, in solid form, which are collected, transported and disposed of. These include garbage, trash, incinerator residue, wrecked or discarded equipment, as well as residues generated as a result of air and water pollution abatement activities (e.g. dust, fly ash). Solid wastes may be ignitable, corrosive, explosive, and may contain more than allowable concentrations of contaminants such as lead, arsenic, cyanide, styrene and other materials and substances on Environment Canada's Priority Substances List.

PAC-recovered Materials: Questions D.1, D.2, and D.3.

Materials or their derivatives which have been collected as a direct result of pollution abatement activities. These materials can be subsequently used in the plant's own production process, or sold to another company. Please note: If it were not for pollution abatement activities, these materials would be emitted to the environment.

5-4600-391 1990-11-05 STC/SCT-475-04244

Statistics Canada Statistique Canada

Canada

SECTION A: 1989 Capital Expenditures* for Pollution Abatement and Control* (PAC). If the expenditure is zero for an item, please check the relevant zero box ☑. Where dollar values are required, please report in thousands of dollars.

Did your organization incur any PAC capital expenditures for retrofit* construction and/or machinery and equipment in 1989?

100 ○ YES 101 ○ NO – Please proceed to Question B.2

A.1 Please provide a breakdown of the total PAC capital expenditures in 1989.

CONSTRUCTION*	MACHINERY AND EQUIPMENT*		TOTAL
$'000	Fully manufactured outside Canada* $'000	In part or fully mf'd in Canada $'000	$'000
102 Zero ☐	103 Zero ☐	104 Zero ☐	105 **Box A** Zero ☐

A.2 Please provide the percentage distribution of total PAC capital expenditures (Box A) by type of substance to be controlled.

Substances emitted to air* %	Substances emitted to water* %	Contained Liquid Wastes* %	Solid Wastes* %	TOTAL
106 Zero ☐	107 Zero ☐	108 Zero ☐	109 Zero ☐	100%

SECTION B: Major substances to be abated or controlled - please list by name and estimate the weight in tonnes.

B.1 Substances that will be removed as per your design specifications for PAC capital expenditures for retrofit* construction and/or machinery and equipment (Box A) in 1989.

Substances emitted to air*		Substances emitted to water*		Contained Liquid Wastes*		Solid Wastes*	
Name	Tonnes per yr.	Name	Tonnes per yr.	Name	Tonnes per yr.	Name	Tonnes per yr.
200	201	202	203	204	205	206	207
208	209	210	211	212	213	214	215
216	217	218	219	220	221	222	223
224 All Other	225	226 All Other	227	228 All Other	229	230 All Other	231

B.2 Substances that will be removed as an additional benefit of "Change in Processing" techniques in the production plant in 1989 (i.e. capital expenditures not included in Box A). See Reporting Guide.

Substances emitted to air*		Substances emitted to water*		Contained Liquid Wastes*		Solid Wastes*	
Name	Tonnes per yr.	Name	Tonnes per yr.	Name	Tonnes per yr.	Name	Tonnes per yr.
232	233	234	235	236	237	238	239
240	241	242	243	244	245	246	247
248	249	250	251	252	253	254	255
256 All Other	257	258 All Other	259	260 All Other	261	262 All Other	263

SECTION C: 1989 PAC Operating and Maintenance Costs* for retrofit* equipment or facilities installed in 1989 as well as in previous years.

C.1 Operating and maintenance costs for Pollution Abatement and Control in 1989:

Labour $'000	Fuels and Electricity $'000	Materials and Supplies $'000	Purchased Services (e.g. Waste Haulage and Disposal) $'000	TOTAL $'000
300 Zero ☐	301 Zero ☐	302 Zero ☐	303 Zero ☐	304 **Box B** Zero ☐

C.2 Please provide the percentage distribution of total PAC operating costs (Box B) by type of substance to be removed.

Substances emitted to air* %	Substances emitted to water* %	Contained Liquid Wastes* %	Solid Wastes* %	TOTAL
305 Zero ☐	306 Zero ☐	307 Zero ☐	308 Zero ☐	100%

SECTION D: Sales and Own Use of PAC-recovered Materials in 1989.

D.1 Please provide your 1989 revenue from the sales of PAC-recovered materials* . . . . 400 $'000 Zero ☐

D.2 Did this organization use any of its own PAC-recovered materials in its own production processes in 1989? 401 ○ Yes 402 ○ No

D.3 Please estimate how much you saved in 1989 by using PAC-recovered materials in your organization . . . 403 $'000 Zero ☐

SECTION E: Major Retrofit Equipment Purchased in 1989 for Pollution Abatement and Control.

Please list by name the major PAC retrofit equipment purchased in 1989 (e.g. scrubbers, chemical-recovery systems.)

SECTION F: COMMENTS, or clarification of your responses. Please attach additional pages if desired.

THANK YOU FOR YOUR CO-OPERATION

Appendix C

Pollution Abatement and Control Survey 1989

Please return to Statistics Canada before March 15, 1991

Form PA2

Français au verso

Confidential when completed

PLEASE UPDATE ABOVE INFORMATION, IF NECESSARY

Identification of Operations: ______________________

Name of organization: ______________________

____

Division: ______________________

Contact Name and Title: ______________________

Address: ______________________

____

______________ Postal (ZIP) Code: __________

Telephone Number: ______________________

Fax Number: ______________________

Name of Telephone Contact: ______________________

Your 1989 Fiscal Year End: (see guide) Month ☐☐ Year ☐☐

For Statistics Canada Use Only

☐	☐	☐	☐	☐	☐	☐	☐	☐
D Type		H R'd	SMO V.	P.Sh.		A	B	C

IMPORTANT: Please consult the Reporting Guide when you complete the questionnaire.

Instructions, definitions and examples can be found in the Reporting Guide. Reading these before completion can save you both time and effort in filling out this questionnaire. The symbol * indicates that a definition or further instructions are provided in the Reporting Guide.

If you have not received a Reporting Guide and would like one, please call collect at (613) 951-2592 or (613) 951-2593.

Submit your completed questionnaire to Investment and Capital Stock Division, Statistics Canada, Ottawa, Ontario K1A 0T6 in the postage-paid envelope supplied or fax it to (613) 951-0196 or (613) 951-7473.

USE OF DATA REPORTED

This survey is designed to measure the economic aspects of pollution abatement and control. The data collected by this survey will increase the understanding of the economics of environmental protection and will provide analysts with an information base to assist in the development of environmental policies.

CONFIDENTIALITY

Statistics Canada is prohibited by law from publishing any statistics which would divulge information obtained from this survey that relates to any identifiable business without the previous written consent of that business. The data reported on this questionnaire will be treated in confidence, used for statistical purposes and published in aggregate form only. Totals are published in a format that safeguards confidentiality as required by the Statistics Act. The confidentiality provisions of the Statistics Act are not affected by either the Access to Information Act or any other Legislation.

LEGAL REQUIREMENT

The information sought in this questionnaire is collected under the authority of the Statistics Act, Revised Statutes of Canada, 1985, Chapter S19.

IN CONCLUSION

Thank you for your participation in this survey.
As this is the first survey on environmental protection costs conducted by Statistics Canada, we invite your suggestions on other aspects of environmental protection costs that you feel should be addressed.

____

____

____

____

Name of person responsible for this report (Print or type)	Official position	Date of this report Day	Month	Year
Business address (if different from mailing address)		Telephone number		

5-4600-390 1990-10-02 STC/SCT-475-04244

Statistics Canada Statistique Canada

Canada

Appendix D

Characteristics of Selected Respondents

The organizations selected for the 1989 Pollution Abatement and Control (**PAC**) survey constitute a very specific sub-group of respondents to the Capital and Repair Expenditures survey (**CRES**). Briefly summarized, the CRES survey provides data for a wide range of investment and fixed asset statistics from all types of organization in all sectors of the Canadian economy and for each province and territory. Respondents to the CRES actual survey from 1985 to 1989 having stated "pollution abatement and control" as one of the reasons to explain their capital expenditures were selected for the 1989 PAC survey.

In total, 803 organizations were selected for the 1989 PAC survey. They cover the same industries as the CRES, except for the municipal governments and the waste management industry. Two other surveys conducted by Statistics Canada, the Local Government Waste Management Practices and the Waste Management Industry Survey, are already covering the investment spendings for pollution abatement and control purposes taking place in these respective areas.

By computing the capital expenditures reported by these 803 organizations for the 1989 actual CRES, we observe in table D-1 that they represent 23.7% of the total[4] capital expenditures published for the 1989 actual survey. By sector, we observe that the Manufacturing and the Utilities sectors represent a higher proportion of the PAC survey than the CRES, at the expense mainly of the Finance, Commercial and Government sectors. Interestingly, the distribution by province of the selected respondents is quite similar to the one observed for the 1989 Actual survey.

---

[4] Total excluding Capital Items Charged to Operating Expenses, residential construction, Agriculture, Fishing and Construction industries.

TABLE D-1 : 1989 ACTUAL CAPITAL EXPENDITURES ($ MILLION)

	SELECTED RESPONDENTS		CRES SURVEY (*)		SEL./ CRES %
	REPORTED	%DIST.	PUBLISHED	%DIST.	
BY SECTOR:					
FORESTRY	15.0	0.1	282.8	0.3	5.3
MINING	2133.4	10.0	7373.2	8.2	28.9
MANUFACTURING	7324.4	34.4	18942.2	21.1	38.7
UTILITIES	10225.9	48.0	19486.3	21.7	52.5
TRADE	x	x	3232.3	3.6	x
FINANCE	x	x	11218.8	12.5	x
COMMERCIAL	484.5	2.3	11960.4	13.3	4.1
INSTITUTIONS	509.5	2.4	4466.9	5.0	11.4
GOVERNMENT	318.6	1.5	12759.2	14.2	2.5
BY PROVINCE:					
NEWFOUNDLAND	290.1	1.4	1354.9	1.5	21.4
P. E. I.	x	x	236.8	0.3	x
NOVA SCOTIA	429.9	2.0	2469.2	2.8	17.4
NEW BRUNSWICK	453.9	2.1	2009.8	2.2	22.6
QUEBEC	5430.4	25.5	19511.9	21.7	27.8
ONTARIO	7817.7	36.7	35755.5	39.9	21.9
MANITOBA	808.9	3.8	2548.8	2.8	31.7
SASKATCHEWAN	578.4	2.7	2819.7	3.1	20.5
ALBERTA	3283.8	15.4	11702.2	13.0	28.1
B. C.	1966.2	9.2	10309.6	11.5	19.1
YUKON	x	x	145.0	0.2	x
N.W.T.	182.3	0.9	858.7	1.0	21.2
TOTAL	21284.8	100.0	89722.1	100.0	23.7

* Total excluding Capital Items Charged to Operating Expenditures, residential construction, Agriculture, Fishing and Construction industries.

Appendix E

Imputation Method for Incomplete Responses

In order to analyze and present an integrated set of basic data, some adjustments were performed on the detailed data reported under sections A.2, C.1 and C.2 of the questionnaire. In these sections, respondents were required to break down their total capital and repair expenditures on pollution abatement and control according to various categories. In some cases, a number of respondents reported their total capital and repair expenditures without providing the detailed information. By adjusting the data reported by category to section's totals, the sum of expenditures over all categories will then equal the total expenditures reported for the section.

Two adjustment methods were used. First, the data by category for a given sector and a given province were adjusted to the section's totals using the percentage distribution observed from those respondents having reported the detailed data. Second, in provinces for which no detailed data were reported at all, the percentage distribution observed at the sector level was used to distribute the total expenditures among the various categories. In most cases, adjustments were performed using the first method.

In table E-1 below, the percentages of reported data over total adjusted data are computed by section and by major sector. As we can see, these percentages are in all cases very high, so that the impact of the imputation adjustments made for incomplete responses is very limited. This constitutes the only type of adjustments performed on the reported data.

TABLE E-1 : RATIO OF REPORTED TO ADJUSTED DATA SECTIONS A.2, C.1 AND C.2

SELECTED SECTORS	REPORTED DATA ($M)	ADJUSTED DATA ($M)	RATIO (%)
Section A.2			
MANUFACTURING	668.5	702.1	95.2
MINING	69.6	69.6	100.0
UTILITIES	85.0	85.0	100.0
GOVERNMENTS	x	x	100.0
TOTAL	882.4	915.9	96.3
Section C.1			
MANUFACTURING	446.6	468.6	95.3
MINING	66.7	76.8	86.9
UTILITIES	x	x	94.4
GOVERNMENTS	x	x	100.0
TOTAL	689.6	728.8	94.6
Section C.2			
MANUFACTURING	461.6	468.6	98.5
MINING	75.1	76.8	97.8
UTILITIES	x	x	98.8
GOVERNMENTS	x	x	100.0
TOTAL	718.4	728.8	98.6

Appendix F

Summary of the Results after Estimation for Non-Response and Non-Sampled Portions

Table F-1 shows the capital expenditures on pollution abatement and control (PAC) by sector and by province including estimates for the non-response and the non-surveyed portions of the survey universe. For the non-response estimate, data were available from the Capital and Repair Expenditure Survey (CRES). These data were considered potentially incompatible due to the absence of a definition of PAC in the CRES.

The PAC capital expenditures for the non-surveyed portion were estimated by assuming proportionality between PAC expenditures and total capital expenditures. In fact, this ratio seems to be fairly stable for different size strata. However, the contribution of this estimate was low, accounting for about 8% of the 30% adjustment in total PAC expenditures.

TABLE F-1 : REPORTED VERSUS ADJUSTED PAC CAPITAL EXPENDITURES

	REPORTED $ MILLION	ADJUSTED $ MILLION	INCREASE (%)
BY SECTOR :			
FORESTRY	x	x	x
MINING	69.6	79.7	14.5
TOTAL - MANUFACTURING	702.1	918.0	30.8
Paper & all.	292.8	368.0	25.7
Prim. Metals	231.4	287.5	24.2
Petro. & Coal	63.5	70.5	11.0
Chemicals	56.1	71.1	26.8
UTILITIES	85.0	105.5	24.1
TRADE, FINANCE COMMERCIAL	12.5	23.4	86.9
INSTITUTIONS	3.9	6.8	74.7
GOVERNMENTS	x	x	x
BY PROVINCE :			
NEWFOUNDLAND	1.1	1.3	17.9
P.E.I.	x	x	x
NOVA SCOTIA	8.0	16.1	100.7
NEW BRUNSWICK	58.5	130.6	123.2
QUEBEC	205.2	255.4	24.5
ONTARIO	328.2	434.7	32.4
MANITOBA	11.6	12.9	11.1
SASKATCHEWAN	x	x	x
ALBERTA	147.8	182.2	23.3
B.C.	144.0	200.2	39.0
YUKON	-	-	-
N.W.T.	x	x	x
TOTAL	915.9	1187.5	29.7

Appendix G

List of Substances Abated

You will find in table G-1 the list of substances abated according to the answers provided to Section B of the questionnaire. Unfortunately, there was not enough consistency in the reported units to permit the aggregation of the quantities into meaningful categories. However, the number of organizations reporting the abatement of various groups of substances gives some perspective of the nature of the pollutants in question.

It was difficult to arrive at an ideal classification of substances due to the very diverse nature of the responses. Some respondents provided very precise information whereas others indicated rather broad categories of substances abated. The following categories represent, therefore, a compromise between the fine detail and some of the very all-inclusive categories such as "effluent".

TABLE G-1 : LIST OF SUBSTANCES ABATED

	NUMBER OF REPORTERS
Substances emitted to air	
Acid gases	8
Fluorocarbons	10
Metals and metallic compounds	8
NOX	5
Particulate matter	75
SOX	23
Toxic materials	3
Solvents and other Hydrocarbons	50
All other substances	23
Substances emitted to water	
Acids	8
Biological oxygen demand (BOD5)	28
Caustics	11
Forest product wastes	8
Solvents and other hydrocarbons	20
Inorganic salts	10
Metals and metallic compounds	47
Oil and grease	22
SOX	3
Suspended solids	53
Toxic materials	8
All other substances	49
Contained liquids	
Caustics	3
Solvents and other hydrocarbons	44
Inorganic salts	3
Metals and metallic compounds	5
Mining Wastes	10
Oil and grease	28
PCBs	43
Pulp and paper industry waste	5
Sewage sludge	9
All other substances	29
Solid waste	
Particulate matter	12
Forest product wastes	20
Glass and ceramic materials	4
Metals and metallic compounds	25
Mining wastes	10
PCBs	13
Paper and cardboard waste	13
All other substances	69