Statistiska centralbyrån
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Environmental Protection Expenditure in Industry in 1997

- Results of the Swedish Pilot study

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1. Background

This report presents the results of a Swedish pilot study in the area of environmental protection expenditure in industry. The work is part of the implementation process of the regulation on new Structural Business Statistics (SBS), where pilot studies of the non-obligatory variables are made in member countries. The European Commission and Eurostat has supported this project financially.

The first section in the report gives a background to work in this area. Section 2 includes a description of the objective and methodology of the work, including an account of the survey procedure. Section 3 describes the outcome of the survey in terms of response rates, and an analysis of factors affecting the response rate. In section 4 there is a summary of two separate sub-projects made in the evaluation phase of the work. The first centres on the energy sector and the specific characteristics of this activity. The second sub-project focuses on evaluation of the investment variables, and in particular the border-lines between the two investment categories. The statistical results are presented in section 5. The first part contains a description of the statistical methods used in the statistical production, including a discussion of different factors affecting the quality of the data. The second part presents the results in an aggregate form, comparisons of aggregate data, and comments to each variable. Section 5.3 includes tables with detailed data broken down by activities. Section 6 includes a response analysis for the extra variables: labour input, revenues and cost savings, economising with natural resources, and adaptation of products. The report concludes with a summary in which alternative strategies for future work in this area are described.

1.1 Previous surveys

Surveys of environmental protection expenditure in industry in Sweden have been done for the reference years 1981, 1985, 1988 and 1991. These surveys covered SNI sections C and D and survey units were establishments.[1] Total average response rates were 82%, 81%, 81% and 67% respectively. The results of the 1991 survey were deemed to be of inferior quality and were never published as official statistics.

1.2 SBS regulation

Council regulation No 58/97 concerning Structural Business Statistics (SBS) included a section on environmental protection expenditure. Starting from the reference year 1999 statistics on end-of-pipe investments will have to be reported annually. The statistics shall be broken down to a minimum of 13 SNI categories (sections C+D+E) and six size classes according to the number of employees in the enterprises: 1-49, 50-99, 100-249, 250-499, 500-999, 1000+. The variables integrated investments and current expenditure are subject to pilot studies in member countries.

1.3 Environmental accounts

The area of environmental protection expenditure is part of the Swedish environmental accounts. It is important that all the areas of the environmental accounts are compatible, not the least as regards the level of activity breakdown. Data on emissions and waste will in the environmental accounts in the future be presented divided into approximately 50 SNI categories, 30 of which are in sections C-E.

[1] The SNI-code is the same as NACE, but with a last digit added. See Annex 1.

1.4 Developments since the 1991 survey

The definitions of environmental protection expenditure have changed somewhat over the years. In 1991 for example, profitable measures were not deemed to be environmental protection measures, which was identified as problematic in the 1991 evaluation. At the same time environmental considerations are more and more integrated with other activities, which will make it more difficult to account expenditure for the environment separately.

Public interest and awareness of environmental matters have increased over the years. Environmental considerations are today important competitive means. Partly as a response to this, the last few years have seen a rapid increase in the development of environmental management systems in enterprises. Today many large enterprises also put pressure on their subcontractors to set up these kinds of environmental information systems, and to take environmental considerations. More and more enterprises also include environmental information in their annual accounts, or publish separate environmental accounts. But only a few enterprises include information on environmental protection expenditure in the environmental accounts today. These are mainly in the forestry and pulp and paper industry.

Accounting legislation has changed recently. It now includes obligations for many enterprises to report environmental information in the annual accounts. A specification of the required information is discussed at the moment. This information is mainly directed at the financial actors, which are interested primarily on the financial sides of the enterprises' environmental performance: mostly future costs or risks of future costs, and only to a lesser degree actual expenditure incurred. The demand for accounting practices for voluntary environmental reporting is also increasing.

2. Objective and Methodology

2.1 Objective

The 1997 industry survey is a full-scale pilot survey. The result of the work will provide new data in the area of environmental protection expenditure, and is part of the implementation of the SBS regulation. The data should be compatible with both national and international demands, and in particular to the Swedish environmental accounts. The objective is also to investigate what expenditure data in industry is feasible to survey in the future, how we can meet some of the public views and criticisms related to the area, while securing a good quality of the data in a cost-effective way. The results of this work will then form the basis for plans for future work in this area.

There are some specific aspects that we have considered important to test in this survey, which have had influence on the survey design.

1. Data quality.
The earlier surveys have been rather simple in design. The response rate was relatively high but the quality of the data was questioned. We decided it was crucial for a good data quality to give more guidance to enterprises as to what they should include in the questionnaire, including lists of examples. In order to facilitate evaluation of the responses, and to see what was included and what was not, we also wanted as many written comments to the figures as possible. The breakdown of mainly current expenditure into types of costs also facilitates the evaluation and identification of aspects included or left out in the answers.

2. Definition of environmental protection.
A strict interpretation of this definition leads to the conclusion that it excludes e.g. measures directed towards the company's products and natural resource management activities, including energy saving measures. Users and representatives of enterprises have questioned this delimitation of the concept of environmental protection. Since these aspects are closely connected to environment protection we wanted to test what was possible also in these fields.

3. Environment protection not only expenditure
There has been some criticism that this area focuses too much on the expenditure side when there are huge possibilities of revenues and cost savings through implementation of environmental measures, and that the environment creates new opportunities for enterprises and does not only inflict extra costs. Because of this we have decided to include questions on revenues and cost savings, as well as labour input. The latter is closely linked with environmental industry activities. The labour input is an internal environmental activity in ordinary industry, which should be a part of total environmental industry estimates.

2.2 Pre-study and preparations

We started the first preparation in late autumn 1997. This stage of the work included:

- Discussions with representatives of business associations and agencies.
- Co-operation with department responsible for economic statistics and general industry survey.
- Telephone interviews with 70 enterprises.
- Exchange of experience with Statistics Finland.

- Test of variables and draft questionnaire through long on-sight interviews with about 20 enterprises of varying size and activity.
- Detailed co-operation with a large company that carry out a survey of their own and publish the data in their environmental accounts.

2.3 Population and sample

The survey is a full-scale pilot survey for the reference year 1997. The sample is a stratified simple random sample from Statistics Sweden's business register. The business register includes all legal units or individuals who run an activity regardless of size or ownership. Companies and establishments have unique identification numbers, which are the basis for all registers and surveys involving enterprises or establishments. The register is updated regularly based on registrations from the Swedish Patent and Registration Office, information from the National Taxation Office and the Register for value added tax, and changes in address from the company that handles these changes. The sample was based on the situation the first of March. This means that a few enterprises which started the activity in 1998 could be part of the sample chosen, and that a few enterprises that have closed down in 1998 are not part of the sample.

Survey unit is the enterprise who is asked to aggregate information for all establishments. There are both advantages and disadvantages with using the enterprise as survey unit but in the end it was decided that the advantages dominated (see also section 2.6 for an evaluation).

Advantages

1. Compatibility with SBS Regulation
2. Compatibility with enterprise statistics at Statistics Sweden
3. Economic accounting is linked mainly with the enterprise level
4. Possibility for environmental managers to have the overall picture for the entire enterprise
5. Often necessary in order to capture expenditure and activities in the main office of the enterprise
6. Possibility for the person responsible at the enterprise to decide how to collect the information in the most efficient way

Disadvantages

1. Heavy burden on large enterprises with many establishments, with a risk for more use of estimations.
2. Possibility that the answers does not cover the whole enterprise and for misunderstandings concerning the survey unit
3. Less accurate branch data because
   - Functional establishments with the main activity in these SNI classes but belonging to enterprises with another main activity are excluded.
   - Establishments outside these SNI classes but belonging to enterprises with these kinds of main activities are included
4. More time needed for the survey to find the accurate respondent, especially if there are no environmental manager responsible for the whole enterprise
5. Environmental manager at the establishment level has more detailed knowledge about the environmental measures taken.

The total population consists of enterprises with the main activity in SNI 10-36 and 40 with 20 employees or more, divided into size classes according to number of employees in the enterprise: 20-49, 50-99, 100-249, 250-499, 500-999 and 1000+.

This means that there are two differences between this survey and the demands of the SBS Regulation.

- Enterprises with less than 20 employees are excluded in this survey for practical and resource efficiency reasons. They will be the focus of future work.
- This is also the case with enterprises in SNI 41. This activity is intrinsically linked with wastewater treatment activities (establishments) in SNI 90 conducted by public enterprises.

The desired activity breakdown is 30 branches of industry, along with six size classes. These can be aggregated to 12 groups of branches, which are specified in the Structural Business Statistics Regulation. The sample size is considerably larger than earlier Swedish surveys of this kind. The reason for this is the difficulty of the subject, the fact that environmental investment can be a so-called rare item, and to secure a good basis for the evaluation. In order to increase accuracy in the estimates, the sample has a high representation of large enterprises and enterprises in high-spending industries, as well as some small SNI classes. This means that all enterprises with more than 100 employees are included, as well as all enterprises in eight specific SNI classes.

The original sample included 1 829 enterprises. Some adjustments have been made of this.

- We have included six enterprises to adjust for anomalies in the business register, after discussions with the people responsible for business statistics. These are large enterprises that are registered with zero employees in the business register for technical reasons only, which means that they would not otherwise qualify for the sample. This group includes a few large public enterprises in SNI 40 where the employees technically are registered on the municipal authority for traditional reasons, and a few large private enterprises where the employees technically are registered on a parent company.
- We have decided not to include 16 enterprises in the Samhall group of companies. These are public companies employing handicapped people that have difficulties finding jobs in ordinary enterprises. Samhall is organised regionally where each enterprise consists of a large number of establishments engaged in a number of different industrial activities. The Samhall group of companies is usually kept apart from ordinary business statistics.
- The practical sample has also been reduced by 27 enterprises that were wrongly included in the original sample.

The total practical population consists of 1 792 enterprises divided into 30 branches of industries and 6 size classes. This represents 43 percent of all the enterprises, and 85 percent of all the employees in these branches and size classes. As will be seen in section 5.1, number of employees have been used for statistical estimations.

Apart from the adjustments mentioned above, we sent questionnaires to some enterprises with Research and Development as the main activity, which are kept outside the main survey. These are part of a larger group of companies, where the R&D should be seen as a supporting activity for the other enterprises in the group which have main activities in SNI classes 10-40. This issue is described in more detail in section 5.2.

We have also made some adjustments in the SNI class 40. This branch includes many public enterprises. Some of these enterprises have secondary activities (establishments) in SNI 41 and SNI 90. These enterprises were identified and told not to include any costs associated with these activities. This is opposite to other enterprises, which are told to include costs for all their establishments. Excluded are also nuclear energy production activities. The energy sector has been the focus of a special investigation, which will be described in section 4.1.

Table 1. Population(P) and practical sample(S). Number of enterprises by SBS regulation group, SNI and size classes, and sample as percentage of total population in terms of enterprises(C) and employees(E).

		20-49		50-99		100-249		250-499		500-999		1000+		Total			
SBS	SNI	P	S	P	S	P	S	P	S	P	S	P	S	P	S	C%	E%
	10-12	4	4	2	2	1	1							7	7	100	100
	13					1	1	1	1			2	2	4	4	100	100
	14	13	1	4	3	6	6							23	10	43	74
1	10-14	17	5	6	5	8	8	1	1	0	0	2	2	34	21	62	95
	15	191	19	57	30	32	32	14	14	18	18	11	11	323	124	38	88
	16									1	1			1	1	100	100
2	15-16	191	19	57	30	32	32	14	14	19	19	11	11	324	125	39	88
	17	54	5	21	11	12	12	4	4	1	1			92	33	36	69
	18	19	2	10	5	4	4							33	11	33	52
	19	13	1	4	2			1	1					18	4	22	47
3	17-19	86	8	35	18	16	16	5	5	1	1	0	0	143	48	34	63
4	20	207	21	89	43	35	35	7	7	5	5	4	4	347	115	33	68
	21.11	1	1			3	3	1	1	2	2	3	3	10	10	100	100
	21.12	6	6	2	2	7	7	11	11	10	10	7	7	43	43	100	100
	21.2	35	3	15	7	13	13	3	3	7	7	1	1	74	34	46	87
	22	217	21	88	45	80	80	15	15	7	7	2	2	409	170	42	76
5	21-22	259	31	105	54	103	103	30	30	26	26	13	13	536	257	48	87
6	23	1	1	2	2	2	2	2	2	1	1			8	8	100	100
	24	55	6	42	19	27	27	11	11	7	7	5	5	147	75	51	90
	25	125	13	45	21	32	32	11	11	3	3	1	1	217	81	37	74
7	24-25	180	19	87	40	59	59	22	22	10	10	6	6	364	156	43	83
8	26	60	4	20	13	22	22	7	7	6	6	2	2	117	54	46	88
	27.1	3	3			1	1	4	4	3	3	2	2	13	13	100	100
	27.2-3	17	17	11	11	11	11	4	4	4	4	2	2	49	49	100	100
	27.4-5	13	13	8	8	10	10	5	5	1	1	1	1	38	38	100	100
9	27	33	33	19	19	22	22	13	13	8	8	5	5	100	100	100	100
10	28	488	45	138	71	65	65	15	15	3	3	2	2	711	201	28	61
	29	324	31	139	70	87	87	33	33	25	25	13	13	621	259	42	84
	30	12	1	4	2	7	7	3	3	1	1			27	14	52	86
	31	94	9	35	18	26	26	10	10	4	4	2	2	171	69	40	82
	32	32	3	17	9	11	11	6	6	4	4	5	5	75	38	51	96
	33	60	5	31	15	16	16	6	6	6	6	3	3	122	51	42	88
	34	66	7	37	19	28	28	13	13	9	9	7	7	160	83	52	95
	35	35	4	14	8	14	14	1	1	0		6	6	70	33	47	92
	36	116	11	58	29	32	32	4	4	2	2	1	1	213	79	37	69
11	29-36	1 227	116	473	241	286	286	91	91	54	54	39	39	2 170	827	43	88
12	40	100	10	34	16	37	37	11	11	5	5	2	2	189	81	43	82
	Total	2 361	267	927	481	622	622	203	203	135	135	84	84	4 332	1792	43	85

2.4 Variables and questionnaire design

The design of the questionnaire is important both for the response rate and for the quality of the data. At the beginning of the survey we ask the respondents to fill in a short description of the production process and the number of employees. The latter is used as a consistency check to see if all establishments are included in the answer. For the main body of the questionnaire, we decided to have tables with a minimum of written instructions on the right hand side, with examples and more detailed instructions on the opposite side. Every row in the tables is coded with a number. The respondents are asked to fill in written comments to each row after each table. At the end of the questionnaire there is additional space for general comments and suggestions for improvement. Here the respondents also can indicate if he/she wants a short summary of the result of the survey free of charge. Annex 2 includes an English translation of the questionnaire. A description of what is included and the objectives under each variable is outlined below.

The main body of the questionnaire relates to environmental protection expenditure. This section includes end-of-pipe investments, integrated investments, current expenditure and operational benefits. The definition of environmental protection as well as individual variables is based on the SERIEE manual, SBS regulation, Eurostat Questionnaire and other

international sources. The list of examples in this pilot study is based on the Eurostat questionnaire with additional examples gathered in company interviews. Some comments to our intentions are made below.

Environmental protection investments (variables 1a and 1b)
In earlier Swedish surveys the enterprises have been asked to fill in total investment figures per domain, and the enterprises had some space for comments at the back of the questionnaire. It was considered vital to ask for individual investments and written comments to each large investment, in order to provide a good basis for the evaluation of the quality of the data. The majority of the enterprises also did supply a brief description of the nature of the investment. Since we ask for individual investment figures the enterprises can mark the main environmental domain by a cross in the respective column. For integrated investments we ask for the share of the total investment expenditure. This was based on the belief that process-integrated investments are normally seen as only a part of a larger investment.

Current expenditure (variable 1c)
For current expenditure we have identified eight major cost types which should be included under this definition. We wanted the enterprises to split their current expenditure between these cost types, so that we could see what is included and what is left out. We also wanted a division of expenditure between environmental domains. Since some of the cost types refer only to one specific domain, there was only need to ask for a division for the variables Maintenance and Control, and Cleaner inputs. Indeed, the breakdown into cost-types allows a more detailed breakdown into the environmental domains of CEPA, as R&D and general administration are separate cost types. Another objective was to have a breakdown between own expenditure and pure payments of charges and other bought services. We therefore added a column and asked for payments for each cost type. The drawback with this is that for payments other than waste and wastewater charges we have no immediate information on the breakdown on domains. These payments are therefore part of the domain other for current expenditure. It is also worth mentioning that we have decided to put soil sanitation under current expenditure. In a separate section we ask the enterprises to separate the labour input costs included under current expenditure, and to estimate what this equals in terms of full time employees. It was deemed interesting to include such a separation because of the large interest in ”environmental” employment.

Revenues and cost savings (variable 1d)
This is the first of the ”extra variables”, which were deemed to be interesting to include in this pilot survey, but where only half of the sample were asked to supply actual figures. These enterprises received the main version of the questionnaire, whilst the other half received a simplified version. The only difference in the simplified version relates to pages 9 and 11, which are included at the end of Annex 2. The definition of revenues and cost saving is more limited than that used in the Eurostat Questionnaire. We wanted to focus on the more tangible parts and therefore omitted operational benefits resulting from ”productivity gains”.

Economising with natural resources (variable 2)
It was believed that the strict definition of environmental protection excluded some important items that many consider being part of environment expenditure. We therefore introduced the concept of economising with natural resources and environmental adaptation of products. For the alternative questionnaire we included general questions on whether the enterprises viewed these variables as a natural part of environment expenditure surveys.

Economising is closely related to the term Management of natural resources which is described in the SERIEE manual. It was decided only to include R&D directed at economising, and investments with this purpose, as they seem to be the comparatively easiest parts of this variable.

Environmental adaptation of products (variable 3)
Several enterprises and representatives of branch associations mentioned adaptation of products to be very important in terms of expenditure, and something they believe is a serious omission in the concept of environmental protection expenditure. This variable also has connections with environmental industry and to process-integrated investments. Environmental adaptation is an environmental industry activity, and measurement of the costs associated with the adaptation has been mentioned as an alternative way of estimating the environmental share of integrated investments (and adapted products).

2.5 Data gathering and processing

The original questionnaire was sent out on April 15, 1998 along with instructions and a letter of introduction addressed to ”the environmental manager”. The respondents were asked to send in the questionnaires by the middle of May

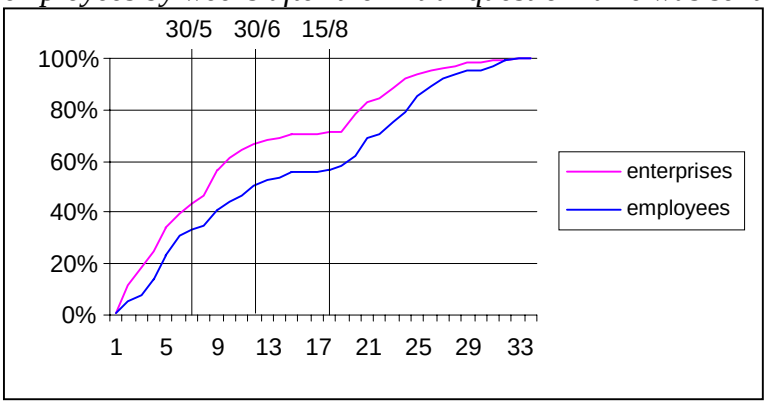
A first reminder was sent out at the end of May along with a new questionnaire. At this point we had received 43 percent of the final responses as can be seen in the figure below. This represents 34 percent of the total employees of the responding enterprises.

This time the enterprises were asked to send in their answers by the end of June. At the end of this period we had received 66 percent of the final responses, representing 51 percent of the employees.

The low response rate and the oncoming summer holidays lead to a decision to start anew after the holidays. A second reminder along with a new questionnaire was sent out in the middle of August. We also decided to focus the attention on large enterprises (with more than 500 employees) and a few selected industries, which were believed to be high spending and which had relatively high response rates at the time. These enterprises were singled out and contacted by phone. Apart from reminding the enterprises of the importance of their response, and asking them if there were any problems or other things we could help them with, we also made interviews on their views on the subject and their difficulties. The results of these interviews are presented in the next section.

As can be seen from the figure below this last effort was relatively successful. About 30 percent of the final responses came after this reminding procedure. Even more importantly, in the last stages we received a relatively high share of large enterprises, which are crucial for the final results. The enterprises answering after this second reminder represented 43 percent of the employees of the total responding enterprises.

Figure 1. Percentage of final response in terms of number of enterprises and number of employees by weeks after the initial questionnaire was sent out



Registration and analysis of in-coming questionnaires was made continuously as the questionnaires were received.

- First the enterprise identification number and registration date was registered in a simplified registration system. Here the number of employees in the business register was checked with the information given by the respondent on the first page of the questionnaire.

- If there was a large difference in number of employees, we printed out a detailed specification of the enterprise from the enterprise register (CFAR). This included information on number of establishments, and number of employees and SNI code for each individual establishment. Through this procedure we were able to identify a number of answers that referred only to a single establishment and not to the whole enterprise. We then contacted the respondent to confirm this, to get contact persons for the other establishments, and to ask if there were any of the other establishments that had no (or insignificant) environmental expenditure. Many enterprises have a few production establishments and some establishments for retail and trade or warehouse activities that could be sorted out through the activity codes from the business register, and through the contacts with the respondents. We then proceeded to send out new questionnaires directly to the individual establishments of relevance. A total of 55 enterprises were discovered to have answered only for one establishment. This is equal to 10 percent of all responding enterprises that have reported environmental expenditure. For 35 of these, we were able to collect information from all other establishments of relevance. For the remaining 20 enterprises we usually got information from additional establishments, but did not capture the whole enterprise. The information gathered for these have been used for statistical estimations of the rest of the enterprise, see section 5.1.

- After the initial registration, each questionnaire was examined in detail. Around half of the enterprises passed this examination without any changes or contacts made. Most enterprises included a short description in conjunction with the figures given and these descriptions were the basis for corrections and for contacts with the respondents. In many cases the information given was sufficient to indicate which adjustments that were needed: expenditure that was clearly outside the definitions given which could be removed, or expenditure that did qualify but under a different heading which could be transferred. For about ¼ of the enterprises that reported expenditure we made corrections based only on the written comments.

- The respondents were contacted for each questionable entry in order to get more background information before we could decide to do any adjustments. We also singled out enterprises that did not report any current expenditure associated with waste, neither own activities nor waste charges. It was assumed that most enterprises must have some costs associated with waste, at least payments of waste charges. All in all around ¼ of the enterprises that reported expenditure were contacted.

- Only a first analysis of the investment variable was made at this stage. This variable was the main topic of a special analysis made by an external consultant. The result of that study is described in section 4.2.

- After the answers have passed these checks they were registered and the information was entered into an ACCESS database. This database includes detailed background information on each individual enterprise from the enterprise register, and all information given on the questionnaires including contact persons etc but excluding the descriptive part. The database now has been complemented with information on total turnover for each individual enterprise from the Register for value added tax. We will also include gross investment figures for individual enterprises as soon as these figures are ready from the general business statistics survey.

2.6 Interviews with large enterprises

In order to improve the response from large enterprises and to secure good results from a few selected industries, a number of enterprises were singled out and contacted by phone. The enterprises that were singled out consisted of:

- all enterprises with more than 100 employees in SNI classes 21.11, 24, 27.2-3, and 27.4-5
- all enterprises with more than 200 employees in SNI class 40,
- all enterprises with more than 500 employees in other SNI classes.

We were able to contact the vast majority of these enterprises and reminded them of the importance of their answer for the final results of the survey. We also pointed out that this was a pilot survey and the first stage of building up new statistics in this area. Because of this we were especially interested in their views on the subject and difficulties in answering. The views of the contacted enterprises can be divided into six categories.

1. Time for sending out the questionnaire
A number of enterprises reported that the questionnaire was sent out in the middle of a hectic period with work on budgets, environmental certification or other tasks. This meant that answering the survey was of low priority. Some enterprises put it away for a calmer period, others put it straight into the wastepaper basket. There are also indications that the workload eased off somewhat after the summer holidays.

2. Voluntary survey
Clearly the most dominating reason why the enterprises have not answered is the fact that participation for this year was voluntary. This in combination with the other reasons outlined here leads to a refusal to answer. It is worth mentioning that statistics on environmental protection is part of official statistics, but this does not automatically mean that the surveys are mandatory. The SBS regulation also has no paragraph enforcing this. It is up to the member

countries. Statistics Sweden is now acting to open up the possibility to make all variables mentioned in the SBS regulation mandatory: i.e. end-of-pipe investments, integrated investments and current expenditure.

3. Time needed for completing the questionnaire
A common remark is that it would take too long time to answer the survey which was considered to be too comprehensive, especially since it is difficult for the respondents to produce the actual figures. Many respondents also put a quality criterion on the figures that they were going to fill in. In many cases a reasonable time for completing the questionnaire would mean very uncertain figures based on rough estimations, and many enterprises then decided not to answer the survey.

4. The structure of the enterprise
One major problem is linked to the fact that the survey unit and the sample is based on enterprises and not establishments as in earlier Swedish surveys. Enterprises can consist of a number of establishments sometimes spread all over the country. Hopes were set on the possibility that the environmental manager on the enterprise level would have overall information of environmental measures taken and their costs. If this is not the case, he/she also has the choice to collect the information needed from the different establishments directly, e.g. through sending on a copy of the questionnaire. Some enterprises also contacted Statistics Sweden and wanted us to send the questionnaire directly to the establishments.

It is clear that in some cases there was a misunderstanding as to the survey unit. As has been mentioned above, some of the answers were discovered to relate to a single establishment. The respondents seem to be more familiar with answering only for their establishment. Many people pointed out that it is difficult to have the overall picture, since the enterprise can consist of so many different activities, or simply because the enterprise consists of such a large number of establishments. The workload needed for supplying informtion for the whole enterprise also becomes all the more apparent.

5. Basis for supplying information
One of the most common remarks and reasons that the enterprises hesitate to answer the questionnaire is that at the moment there does not exist a bookkeeping system for supplying information. And the information that exists does not correspond to the variables in the questionnaire, or the details needed, or the definitions given. Environmental reports or environmental accounts produced today e.g. do not very often contain information on costs. Another problem is that enterprises often do not make a distinction between outer environment, health and workplace environment. Answering the survey would mean making rough estimations or spending very much time and resources, and many enterprises then decided not to participate.

Some enterprises also mentioned that especially difficult in these respects are every day environmental activities. It is very difficult to estimate these costs since much of the environmental activities are part of everyday production activities. In these respects we could mention that we have had suggestions to focus on the types of costs that are the most easily identified. When it comes to costs for own personnel e.g. this would mean only including costs for the people with environment as the main (or a substantial) part of their occupation, and maybe clearly identified actions such as education of the staff etc.

At the same time many enterprises reports that they expect it will be easier to supply this kind of information in the future as they are currently working on environmental information systems and environmental certification. And there is a possibility to adjust bookkeeping systems if the enterprises know that this survey becomes a regular one.

6. Content of the questionnaire

Many enterprises pointed to the difficulty of separating the environmental measures and costs from ordinary production costs and from e.g. quality improvement measures, especially for process-integrated investments. Investments in end-of-pipe technology are considered to be easier, but the definitions given as to what is end-of-pipe and what is integrated seem to differ somewhat from the views of the enterprises (se section 4.2). Problems for current expenditure are mainly costs for own personnel as was mentioned above, but there are also problems to separate wastewater charges from costs for consumption of water as these are both included in one Water and wastewater fee.

3. Response rates

3.1 Response rate per strata

The table below summarises the response rates per strata. The overall response rate in terms of enterprises is as low as 42 percent and this equals 45 percent of the employees of the practical sample. Because of the large sample chosen, this nevertheless constitutes 17 percent of the total population of enterprises and 38 percent of the employees.

Table 2. Response rates in terms of number of enterprises(R) and percentage response of practical sample by SBS regulation group, SNI and size classes, and percentage response in terms of employees of the practical sample(S) and of the whole population(P)

		20-49		50-99		100-249		250-499		500-999		1000+		Total		Employees	
SBS	SNI	R	%	R	%	R	%	R	%	R	%	R	%	R	%	S%	P%
	10-12	3	75			1	100							4	57	56	56
	13					1	100	1	100			1	50	3	75	54	54
	14	1	100	2	67	1	17							4	40	33	10
1	10-14	4	80	2	40	3	38	1	100			1	50	11	52	51	45
	15	3	16	11	37	14	44	7	50	5	28	3	27	43	35	34	30
	16									1	100			1	100	100	100
2	15-16	3	16	11	37	14	44	7	50	6	32	3	27	44	35	35	31
	17	4	80	3	27	7	58	3	75	1	100			18	55	63	43
	18	2	100	2	40	2	50							6	55	53	28
	19		0	1	50			1	100					2	50	79	37
3	17-19	6	75	6	33	9	56	4	80	1	100			26	54	62	39
4	20	10	48	16	37	18	51	3	43	3	60	4	100	54	47	64	44
	21.11	1	100			3	100		0	1	50	3	100	8	80	89	76
	21.12	2	33	1	50	3	43	4	36	6	60	4	57	20	47	52	56
	21.2	1	33	1	14	10	77	1	33	3	43		0	16	47	41	36
	22	11	52	20	44	28	35	7	47	2	29	2	100	70	41	41	32
5	21-22	15	48	22	41	44	43	12	40	12	46	9	69	114	44	50	44
6	23		0	1	50		0		0	1	100			2	25	36	36
	24	1	17	7	37	11	41	6	55	2	29	3	60	30	40	53	48
	25	2	15	7	33	10	31	6	55	1	33		0	26	32	36	26
7	24-25	3	16	14	35	21	36	12	55	3	30	3	50	56	36	47	39
8	26		0	3	23	7	32	3	43	3	50	2	100	18	33	46	41
	27.1	1	33			1	100	4	100	2	67	1	50	9	69	77	76
	27.2-3	8	47	4	36	7	64	3	75	2	50	1	50	25	51	66	66
	27.4-5	3	23	3	38	4	40	1	20		0	1	100	12	32	46	46
9	27	12	36	7	37	12	55	8	62	4	50	3	60	46	46	67	67
10	28	23	51	26	37	32	49	6	40	1	33	2	100	90	45	51	31
	29	11	35	28	40	41	47	10	30	14	56	5	38	109	42	42	34
	30	1	100	1	50	2	29	2	67		0			6	43	39	57
	31	4	44	11	61	15	58		0	3	75	1	50	34	49	51	42
	32	1	33	4	44	2	18	2	33	4	100	2	40	15	39	39	38
	33		0	7	47	5	31	2	33	1	17	2	67	17	33	44	39
	34	1	14	5	26	13	46	5	38	4	44	2	29	30	36	32	30
	35	2	50	5	63	4	29	1	100			2	33	14	42	35	31
	36	1	9	8	28	12	38	1	25	1	50		0	23	29	27	20
11	29-36	21	30	69	41	94	43	23	30	27	53	14	38	248	40	38	34
12	40	5	50	12	75	16	43	7	64	3	60	1	50	44	54	58	47
	Total	102	38	189	39	270	43	86	42	64	47	42	48	753	42	45	38

The response rate is around 40 percent in all size classes, but the response rates differ widely between different SNI classes. The highest response rates are in Textile industry (SNI17), Wood products (SNI20), Pulp and Paper industry (SNI21) and Iron and Steel industry (SNI 27). The lowest response rates are mainly in the traditional manufacturing industries (SNI 29-36). It is possible that the form of the questionnaire is more adapted to traditional process industries and less suited for manufacturing enterprises.

The varying response rates will lead to very uncertain results for some of the industries and much better quality for others. Contributing to the statistical quality of individual variables is of course also response rates per variables, which will be described in section 5.2.

3.2 Analysis of response rates

There are a larger number of different factors affecting the response rate for this pilot study. In order to secure good data in future surveys it is vital to increase the response rates. In this section we have listed 9 factors affecting the response rate, with no particular ranking, based on experience gained throughout the project. We have also made some suggestions of what can be done in the future to come to terms with the problems listed.

Table 3. Problems affecting the response rate and suggestions of possible ways to take account of these in future surveys.

	Problems	**Possible measures**
1	*First survey* The last survey on environmental protection referred to the reference year 1991. Although we flagged for it in advance, it is clear that the vast majority of enterprises did not know it was coming.	• Increase co-operation with branch associations • Announce a new survey preferably before the start of the new reference year (for 1999 this could be done in connection to presentation of a Swedish report on the results of this survey, and when the summery of the results are sent to enterprises) • If/when the survey becomes regular this problem will diminish.
2	*Voluntary survey* Many enterprises mentioned that a major reason why they did not answer the survey, was the fact that participation was voluntary. It is clear that many enterprises (in particular large ones) have a policy only to participate in mandatory surveys.	• Make participation mandatory (at least for the key variables). Work on this has already started.
3	*Contact person* This survey was addressed to a non-specific ”environmental manager”. This creates problems when there are no one person responsible in large enterprises, when it could take long time before the survey ends up at the appropriate person. There are also problems in smaller enterprises when there are no such person.	• Address future surveys to the names of the respondents of earlier surveys, maybe in connection with the title environmental manager (in anticipation of personnel changes).
4	*Wrong point in time* We choose to send out the questionnaire in the middle of April. It was believed that by this time the work on budgets and annual accounts would be completed, but still in fresh memory. The plans were also not to coincide with the very large enterprise survey. As it turns out the enterprise survey was delayed and sent out at the same time as this survey. It also coincided with a number of other surveys, which meant that enterprises received several surveys from Statistics Sweden at approximately the same point in time. Many enterprises also mentioned that the workload was particularly large in late spring, and that this eased off somewhat after the summer holidays. Because of the long period of data gathering, the closeness to the summer holidays created a problem. This forced us more or less to start anew in August.	• Investigate the possibility to send out the questionnaire in the middle of August. • Make sure that the period of sending out the questionnaire does not coincide with many and large other surveys
5	*No environmental problems or expenditure of significance* Several enterprises contacted us and wondered if they really had to answer the questionnaire, as they did not have any environmental problems or costs, or that they did not consider themselves to be part of ”the industry”. It is likely that several enterprises that did not have any expenditure refrained from answering the survey.	• Stress more the importance of answers also for enterprises with no environmental costs.

6 *Questionnaire* The subject is difficult and many enterprises thought the questionnaire was too comprehensive. The examples and layout probable suit traditional (process) industries better than e.g. manufacturing and energy sector. An analysis of the answers shows that several enterprises made similar kinds of misinterpretations.	• Limit the coverage of the survey to the most important variables, adjust the layout and instruction in order to avoid the same misunderstandings. • Investigate the possibility of making more branch specific questionnaires, with examples more related to the specific branch. • Use the written information to update the examples given under each variable.
7 *Absence of book-keeping systems* There are no bookkeeping systems for these variables. This means that the workload of the enterprises, and the demands on the respondents are considerable. The respondent needs to have good knowledge of the environmental measures taken, remember them all at the point of answering the questionnaire, and estimate how large the expenditures are. This clearly must affect the quality of the data supplied, but also affects the willingness to respond. Many enterprises did not want to fill in figures that are too uncertain, and several large enterprises found that it would take far too much time to supply figures of decent quality. A few enterprises have set up a kind of bookkeeping system and organised surveys of environmental expenditure for their establishments. These enterprises have an interest in these variables themselves, partly to supply information to their environmental accounts.	• Many enterprises make adjustments of their bookkeeping systems in anticipation of regular surveys, by introduction of a special account for statistical purposes. Thus, a regular survey could ease the problems somewhat, although it is hard to see any practical bookkeeping system covering all the details of environmental protection expenditure. • A focus on the more easily captured parts of environmental expenditure would increase the possibility of setting up bookkeeping systems. • Co-operation with agencies responsible for recommendations in bookkeeping affairs. First contacts have been made in connection to new demands on enterprises to include environment-related data in their annual accounts.
8 *Survey unit* The survey unit itself has created problems. It becomes evident for the enterprises the time needed to supply appropriate data. In many cases there are no single person that have all the information needed. In most cases the appropriate respondent seems to be the environmental manager at the establishment level. Some large enterprises, however, favour the enterprise level. Then they have the option to choose themselves the most efficient way of obtaining the data, and the environmental manager at the enterprise level sometimes are the person with most knowledge of environmental measures and costs.	• Investigate the possibility to send questionnaires directly to establishments • If the questionnaires are sent to the enterprise level, it should be even more clearly stated that the figures asked for should cover the whole enterprise. • Make it easier for the enterprises to send on questionnaires to their establishments e.g. by including a list of all establishments of the enterprise that should be covered, or make access to questionnaires more easy (copies on the web-site?). • Stress that the use of estimations are allowed, and that the information could still be of much value.
9 *No interest in the subject* A number of enterprises have expressed that they are not interested in the subject. They view these kinds of expenditures as necessary production expenditure and have no incentive to account them separately.	• Survey more focused on the variables that are of concern for the respondents. • Good account of the importance and use of the data.

4 Special investigations

4.1 Energy sector

This is the first time this SNI class is included in the Environmental protection in industry survey.[2] The energy sector has many special features that pose problems for this kind of survey. These refer to

- the structure of the sector and the activities involved,
- the occurrence of public enterprises and the links to specialised production in the waste and wastewater domains,
- and to special features of the environmental measures of the sector.

There have been great changes within the energy sector the last few years. The creation of public companies, and not the least the strong tendency for concentration in the sector to fewer and larger enterprises reduces the possibility of obtaining relevant data.

Another problem is linked to the fact that there exist a large number of public (municipal) enterprises in this SNI class. The links to municipalities have in some cases lead to anomalies in the business register as was mentioned in section 2.3. Some of the public enterprises have establishments with the main activity in the waste or wastewater domains: this includes wastewater treatment plants, waste collection services and landfills. It is worth mentioning that similar problems exist for enterprises in SNI 41. We decided that it would distort the results of the survey to include expenditure for these establishments that specialises in environmental activities. Through the use of information from the business register we were able to single out 10 enterprises with secondary activities in SNI 41 and 90. This referred to establishments within the enterprises with the main activity water supply, wastewater treatment and waste management. We printed out detailed information from the business register on their establishments and activities, and instructed the enterprises not to include expenditure associated with these establishments (activities).

Nuclear energy in Sweden makes up around half of the total gross supply of electricity. The production is limited to four enterprises. These were included in the original sample but after discussions with representatives of these enterprises, it was decided that nuclear energy production activities would not be part of this survey. This would lead to distortions of the results from the energy sector as a whole.

The total population for this survey consists of all enterprises with the main activity in SNI 40 with over 20 employees. There exists a subdivision of this SNI class into energy production (40.100), gas production (40.200) and heat production (40.300). This subdivision has not been used in the sample procedure for this survey.

Apart from these already existing sub-classifications, the enterprises can be divided into a further three categories.

1. Enterprises producing energy and heat.
2. Enterprises that are engaged in market activities (sell energy).
3. Enterprises that are responsible for the energy distribution system.

[2] Municipal incineration plants have been included in an earlier municipal survey for the reference year 1991.

Energy distribution activities are kept economically and judicially separate from energy production and market activities. But distribution activities can be a part of the activities of the heat producer.

At the moment there are no distinctions between producers, distributors, and sellers of energy in the business register. In surveys of environmental protection activities these three categories are likely to have widely different types of expenditure, and indeed pure sellers of energy are likely to have no expenditure of significance. In this survey it has not been possible to make any distinction between the three categories and they are therefore treated in a similar fashion in the statistical estimations etc. In the future it would be preferable to separate the three categories. The enterprises in the sample have been classified into different categories in order to make a first analysis of the different types of activities in the energy sector. This has been done through the use of information from energy statistics at Statistics Sweden, and information from branch associations. Although it is difficult to make a detailed analysis because of the few respondents in each category, a few characteristics for energy distributors, electricity and heat producers, and incineration plants are outlined below.

Distribution of energy
Investments include exchange of power and distribution transformers, which reduce the risk of oil leakage to soil and water. Here we also have examples of burial of electricity lines, which are linked to landscape and bio-diversity. In discussions with enterprises, instructions were only to include these in the questionnaire if the purpose is protection of landscape, which means mainly in rural areas. It became evident that the main reason for burials in urban areas is to reduce magnetic fields, which we considered to be outside the definition of environmental protection. Some enterprises also mentioned that another major reason for burial of electricity lines are pure economics, as burial of lines reduce maintenance and other current expenditure.

Electricity and heat production
Energy producers ought to have much larger environmental expenditure than the other categories, at least for maintenance and control. An analysis of the in-coming questionnaires as to types of costs included show that.

- Process-external investments include NO_x reduction equipment (both SNCR and SCR), desulphurize equipment, flue gas condensation and coolers, investments aiming to reduce dust formation including watering of flue dust.
- Process-integrated investments include conversion of furnaces for use of biofuel, different combustion technical measures linked with changes in fuels, installation of de-NO_x burners, and conversion and exchange of cooling agents (freon and halon).
- Current expenditure includes rough estimations of maintenance and control of existing equipment and extra costs associated with the choice of low-sulphur fuels. In addition to this there are expenditure associated with waste and general administration.

Incineration plants
A total of 17 incineration enterprises use waste for incineration. These are especially interesting as they burn waste and get a lot of ashes, which will have to be deposited outside the enterprise. There is also a possibility for misunderstandings as to what expenditure to include in the questionnaire, which is only expenditure associated with the waste they generate. Six of these enterprises were not part of the sample because of the sampling procedure. For two of these the enterprise is a municipality which have main activity codes in

Education(SNI80) or Child Care(SNI85). For two other the main activity code of the enterprise was in Waste collection and sorting(SNI 90002). Five out of the eleven remaining incineration enterprises did respond. These answers do not differ markedly from other plants which use oil etc., but the sample is too small to make a detailed analysis. It would however be interesting to try and separate these incineration plants in future surveys.

4.2 Analysis of Investments

As was mentioned above, only a preliminary analysis of the investment variables was made in the initial processing procedure. A more detailed analysis was made in a special project. The objective of this work was to analyse in detail the investment variable through the use of written comments in the questionnaire, contacts with respondents, and knowledge of cleaning techniques and environmental problems in different branches of industry. The split-up of investments between process-external and process-integrated was a major focus of the work. The scope of the work increased to include also analysis of the maintenance and control variable, and the enterprises that reported no expenditure at all.

The examination of all investment entries, and the following discussions, resulted in adjustments made in the in-coming answers. The most notable result was that for a total of 49 enterprises, investments were transferred from process-external to process-integrated. Several enterprises had difficulties in deciding the appropriate investment category. From an environmental technical point of view, the term process-integrated would indicate a broader concept than that described in the definitions given. This has been evident also in the contacts with enterprises. The adjustments made have had deep impact on the results presented in section 5, for both categories of investments, as can be seen in the table below.

Table 4. Investments transferred from process-external to process-integrated and the importance for the overall results for the two variables

SNI	Changes from external to integrated investments Million SEK (grossed up values)	Changes as percent of Total Process-integrated investment	Changes as percent of Total Process-external investments
15	177	71	369
20	17	40	33
21.12	12	5	2
22	10	21	64
26	25	64	18
27.4-5	5	68	18
31	3	29	12
36	1	18	2
40	53	10	16
Other SNI	10	1	1
Total	313	13	16

If we had made no changes between the two categories, the total process-integrated investments would have been 13 percent lower than what is shown in section 5, and total process-external investments would have increased by 16 percent. There are even more dramatic changes for individual branches. For SNI 15 the share of integrated investments presented in section 5 are over 80 percent of the total investments in this particular branch. Without the adjustments, this would have been around 25 percent.

This clearly shows the vulnerability of the results of the survey, and the importance of clear guidelines as to what should be included in each of the two categories. It is also clear that the treatment of a few individual investments can have great impact on overall results for specific SNI categories. This is especially true for process-integrated investments, which are relatively

few in number but large in terms of expenditure. It is also evident that without asking for individual investments and for written comments to each investment, these changes would not have been possible. The table below gives an indication of what kind of investments have been transferred in this way.

Table 5. Examples of investments that have been transferred from process-external to process-integrated by SNI.

SNI	Type of investment
15	Exchange of cooling agents (freon)
20	Changes in fuels (from fossil to biofuels) including adaptation of furnace, steering equipment
21.12	Recycle system for fibres
22	Closed system for washing of printing cylinder, new equipment for photo setting, exchange of freon, closed rinsing water system.
26	Changes in fuels
27.4-5	Process water evaporation, steering equipment
31	SF6 gas equipment: tubes, valves, and new steering equipment
36	Conversion of furnace
40	Changes of fuels to biofules, exchange of cooling agents

The work also resulted in other adjustments but these were not of the same magnitude. Additions for current expenditure were made for 29 enterprises after the contacts, mainly maintenance and control expenditure. For 13 enterprises investments were transferred from process-integrated to process-external.

An analysis of enterprises that reported no environmental protection expenditure in 1997 was also made. The impression was that a number of these ought to have some kind of current expenditure, at least for maintenance and control. This was in part confirmed when a few of these enterprises were contacted. In some cases the enterprises had some expenditure but considered them not significant, in one instant the enterprise did consider this as part of normal production costs.

5. Statistical results and evaluation

5.1 Statistical method and estimation

Estimation
For every economic variable a mean per employed has been calculated for each branch. The total amount of the variable for responding enterprises is divided by the total number of employed for the responding enterprises. The total for the branch was estimated by multiplying this mean by the number of employed in the branch. Technically the raising factors were calculated by branch, by the number of employed in the branch, divided by the number of employed in the responding enterprises.

The non-response has been regarded as random, i.e. the responding enterprises are considered representative for the non-responding. Thus for each variable the mean cost per employed for non-responding enterprises is estimated by the mean cost per employed for responding enterprises.

Enterprises with partial non-response of working places have got increased raising factors as the responding working places have been raised to the whole enterprise.

Enterprises with partial non-response of variables are omitted for these variables. Thus the total number of responding enterprises is varying around 750, but is at the most 752. However, all estimates are given for the whole population.

The process-integrated investment of one particular enterprise has not been used in estimating investments for the non-responding enterprises. This is an extremely large occasional investment made by a large enterprise. It is unlikely that there are similar investments in the non-responding enterprises, although there are a few of the latter which are of a similar size and engaged in similar activities. In addition, it is so large that it has considerable impact on the overall result when used for estimating the non-response.

Uncertainty

Non-response errors
The non-response of enterprises is discussed in section 3. The estimated number of employed in the population is about 650 000 , in the sample 517 000 and among the responding enterprises 233 000. An analysis of the reasons for non-response is also made in section 3. Although it is possible that there is a larger proportion of enterprises with no or insignificant expenditure in the non-responding enterprises than responding, this analysis has led to the assumption that the non-response can be treated as randomly selected from the sample.

Coverage errors
Discussed in chapter 2.3.

Sampling errors - random errors
For sums in all branches relative standard errors of means have been calculated. The 95% confidence intervals are given by ± 2 x (standard error of mean). The principle chosen has been not to present figures in the statistical presentations in this report if the standard error of mean is 50% or more. In some cases figures with higher standard error of mean are shown in order to supply the complete picture for individual SNI classes. These figures are then shown in parenthesis.

Measurement errors
At least as important as sampling and non-response errors are errors linked with measurement problems. Some general comments on measurement problems are outlined here. These are discussed in more detail in connection with the statistical presentation later in the next section.

Measurement problems are linked with the difficulty of the subject and the absence of accounting systems. In order to give a complete picture of the environmental protection expenditure, the respondent not only need to remember all measures made the past year, and to consider them to be environmental protection, but he/she also must be able to estimate the expenditure without unreasonable input of time and resources.

An analysis of the questionnaires shows that the response varies considerably in terms of details, coverage, and effort made by the respondents. Some enterprises have spent as much as 50 hours supplying a detailed picture of measures taken, and expenditure incurred. Other respondents have spent a few hours in total and have included mainly the more easier parts, based to a larger degree on estimations. Therefore, the quality and coverage of the data given varies considerably. It is evident that the easier variables are better covered by the respondents than the more difficult. All in all, we believe that the results in most cases should be interpreted as a minimum. It is important to bear this in mind when analysing the data, and especially when comparing different items of expenditure.

- These types of problems are less common for process-external investments. The main problem here refers to border-line cases with process-integrated investments, and to the sometimes different notion by the enterprises (than the definition provided) of the concepts of external and integrated. But we saw in section 4.2 that this may have a major impact on the result nevertheless.
- For process-integrated investments there are problems to identify an environmental part of the investment. It is likely that some of the expenditure given include also non-environmental parts. On the other hand, these types of investments are difficult to capture by the respondents, and many enterprises do not consider them to be environmental investments. This means that it is likely that a number of process-integrated investments are not reported by the respondents.
- Current expenditure contains a multitude of different types of costs, some of which are easier to estimate than others. The coverage of easier parts such as payments of waste charges are probably quite good in this survey. The coverage of the more difficult parts such as maintenance and control of integrated equipment, and a full coverage of own labour input most likely various considerably.

5.2 Aggregate results and comments

This section gives an overview of the statistical results and some initial general comments. Detailed results and analysis are given for each variable in later sections. If we study the response rate per variable we see that

- 78 percent of all respondents reported that they had some kind of environmental protection expenditure in 1997,
- 2 percent only reported expenditure associated with economising with natural resources or environmental adaptation of products,
- and 20 percent reported that they did not have any environment expenditure in 1997.

The tables below shows the percentage response and the expenditure on the environmental protection variables distributed by domain. We see that almost half of the respondents reported some kind of environmental investment, and over ¾ reported current expenditure.

Table 6. Response rates per variable. Percentage of total response by variable and environmental domain

Survey item	Variable	Air	Water	Waste	Other	Total
1a	Process-external investments	21	20	20	11	42
1b	Process-integrated investments	15	10	5	6	25
1a+1b	Environmental protection investments	28	25	22	15	47
1c	Current expenditure	33	48	70	61	76
1a+1b+1c	Environmental protection expenditure	45	54	71	63	78

Table 7. Environmental protection expenditure in Industry 1997 per variable and environmental domain. Million SEK.

	Process-external investment	%	Process-integrated investment	%	Current expenditure	%
Air	1 112	56	1 836	74	511	13
Water	492	25	349	14	1 094	27
Waste	156	8	92	4	865	22
Other	225	11	195	8	1 513	38
of which						
General administration					*648*	*16*
R&D					*409*	*10*
Total	1 985	100	2 472	100	3 982	100

Process-external investments

From the tables above we see that process-external investments are the most common type of investments, 42 percent of the respondents reported this kind of investment in 1997. The percentage response is almost identical between air, water and waste, but there are large differences in terms of expenditure. Many enterprises reported one investment associated with waste but these are relatively small in terms of expenditure: e.g. containers. In the air domain there are approximately the same number of enterprises that had investments, but it is more common with more than one investment reported, and they are sometimes quite expensive. The domain other is dominated by measures to restrict pollution to soil and groundwater, and to some extent directed against outdoor noise. SNI 21.12 is the largest individual branch in terms of total process-external investments, 25 percent, with SNI 40 on 16 percent.

Process-integrated investments

Process-integrated investments account for as much as 55 percent of total investment expenditure, despite the fact that only ¼ of the enterprises reported this kind of investment. Integrated investments are few in number but expensive. The investments were mainly

directed against air or water pollution. Investments in the waste domain are mainly of an external type. Investments in the air domain dominate this category, and these investments can be quite expensive. The majority of the expenditure is linked with changes in fuels, and with related adaptations of furnaces. A lot of investments were also related to changes in cooling agents. Data on process-integrated investments should be interpreted with care as these are very sensitive to individual investment entries. The largest individual branch in terms of expenditure is SNI 34, but these figures are very uncertain and dominated by a few large investments. SNI 40 has 22 percent, and SNI groups 15 and 21.11 has 10 percent each.

Current expenditure

Current expenditure consists of a multitude of different items. This creates difficulties for the respondents. A full coverage of all items would for many enterprises require a substantial input of time and resources. In this survey we have tried to identify different categories of current expenditure and asked the enterprises to provide information on current expenditure for each relevant category. We believed this was vital in order to see what parts the enterprises have covered and what was left out. If the enterprises are asked only to provide aggregate figures, or even expenditure broken down on environmental domains, it is hard to interpret what the data stands for.

The analyses of the questionnaires show that there is a great variety in the response. Some enterprises have tried to cover most of the items of current expenditure, while others most likely have only reported the more easier parts. This makes it difficult to provide statistics of good quality. Data on overall current expenditure presented above should therefore be interpreted as a minimum. The average enterprise have reported payments of waste charges, expenditure for general administration (i.e. mainly for the people with environment protection as their main occupation), and some kind of maintenance and control expenditure. The largest individual branch in terms of expenditure is SNI 40, with 17 percent of total current expenditure. Much of this is in the domain other, where a substantial part is related to R&D. The table below summarises the response rates on the specific items of current expenditure.

Table 12. Response rates for current expenditure. Percentage of total response by type of cost and environmental domain

		Air	Water	Waste	Other	Own activities	Payments	Total
301+302	Maintenance and control	32	31	18	13	46	30	51
303	Cleaner inputs	2	1	1	2	5		5
304	Research and Development					12	6	15
305	General administration					48	25	52
306	Wastewater charges						30	30
307	Waste management and charges					23	64	68
308	Other					2	6	7
Total						64	71	76

From the table above it is clear that current expenditure for **air** is referred only to own maintenance and control. These are mainly linked to furnaces and burning of fuels.

Almost half of the responding enterprises reported expenditure associated with **water**. In the table above, we see that this includes both maintenance and control and payments of wastewater charges.

- Maintenance and control is most often linked to own wastewater treatment plants and the expenditure includes e.g. own personnel and chemicals needed for the operation of the plant.

- We asked specifically for wastewater charges, which is paid by enterprises that are connected to the municipal sewage system. A problem here is that the payments are linked to the amount of water used, where the cost per m^3 includes the use of wastewater facilities. Most enterprises cannot separate the two. This means that there is an overestimation element for this category.[3] At the same time a number of enterprises most likely refrained from entering this item: both because of the difficulties, but also because they did not associate this expenditure with environmental protection.
- A number of enterprises also included payments specifically related to wastewater in this category e.g. emptying of sewage dams etc.

Current expenditure for **waste** refers to maintenance and control, but also general waste management and waste charges.

- 64 percent of the enterprises reported payments associated with waste. This item mainly includes payments for transport and deposit of waste. Enterprises usually have good basis for the expenditure reported, and have often supplied us with a breakdown into transport and deposit for hazardous and non-hazardous waste respectively (and sometimes the amounts of waste as well). There are also enterprises that have included rent of containers in this category.
- 23 percent reported own expenditure for waste. This category is similar to maintenance and control for waste, and a few of the enterprises may have entered expenditure only in one category. Sorting of waste is included here. This expenditure is much harder to estimate, since more or less the whole staff could be involved in sorting of waste, and the activity is seen as a small part of their ordinary tasks.

In table 6, we saw that 61 percent of the respondents reported current expenditure in the domain **"other"**. Through the specification of current expenditure into types, it is possible to divide this further.

- In the table above we can see that it consists to a large part of general administration, information and the like. Over half of the respondents reported this kind of current expenditure.
- Included here are expenditure associated with setting up of environmental information systems and work on environmental certification. Many enterprises reported that they had this kind of expenditure in 1997, and many other reported that they had just started or planned to start work on environmental certification in the near future. This procedure also gives rise to large payments to external environmental consultants.
- Another related expenditure is education of the company's staff, which gives rise both to labour costs for the time the own staff is involved, and to payments to external educators.
- Many enterprises also included expenditure for the environmental manager or the like in this category, although a few put this into maintenance and control and tried to divide the expenditure on the domains.

It is also worth noting that as many as 15 percent of the respondents reported expenditure associated with Research and Development. This variable is greatly affected by how this activity is organised.

- Some (groups of) enterprises choose to isolate this activity into separate enterprises. These

[3] Many enterprises did provide written information, which could be used in the future to estimate the wastewater part. As fees should cover the total cost in principle, and the cost for wastewater equals 60 percent of the total costs on average, 60 percent of the common fee should on average be associated with wastewater.

are then classified as R&D enterprises in SNI 73. The activities are however directed at supporting the normal production activities of the other entities in the group of enterprises. These enterprises will not be covered by the industry survey and this will of course affect the size of the R&D expenditure.

- Other enterprises choose to keep their R&D activity inside the production enterprise. Often this is placed at the company headquarters. The company headquarters are often a separate establishment within the enterprise, sometimes coded in SNI 70. These will not be covered if the survey only covers establishments within in SNI C-E, as was the case with the old Swedish surveys. There is also a risk of double counting. Enterprises belonging to a larger group of enterprises sometimes reports payments associated with R&D, financing R&D at the headquarters.

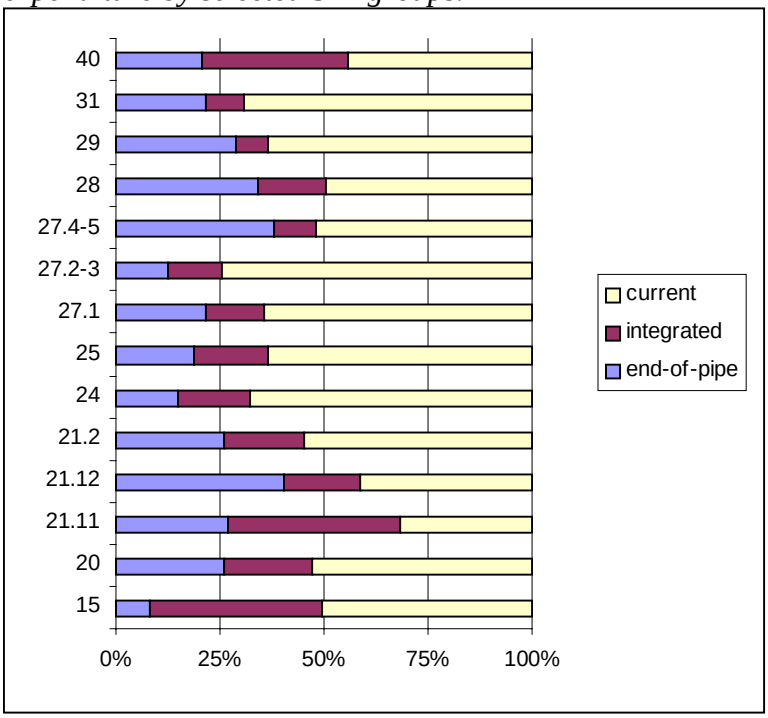
The remaining part of the domain ”other” is more or less payments for external services, which are not divided into domains at all. This is a drawback with the layout of the questionnaire. It is possible to reduce the size of this item considerably though. Many enterprises have provided written information, which have been used to code the payments as well into domains. This requires further analysis, though, which have not been possible in the line of this project.

Comparison between selected industries

A detailed activity breakdown of the variables are made in the sections to come. As will be seen, there are some SNI groups where the data are not of adequate quality to be published. Figure 2 below indicates the relative importance of the different variables in some selected SNI-groups.

- SNI 27.4-5 and 21.12 have the highest shares of end-of-pipe investments, around 40 percent. SNI 27.4-5 are insignificant in terms of expenditure, which means that the relative shares are influenced greatly by relatively small investments. SNI 21.12 on the other hand account for ¼ of all process-external investment expenditure.
- In SNI 15 and 21.11 the share of integrated investments are over 40 percent. SNI 40 has over 35 percent. These three branches are also important in terms of expenditure. They account for more than half of all process-integrated investment expenditure.
- In SNI 24, 27.2-3 and 31 current expenditure account for over ¾ of total expenditure. In some cases this may be because the easiest individual items for the enterprises to report are wastewater and waste charges, and these are part of current expenditure. SNI 24 is the only one of these branches which are important in terms of overall current expenditure. The enterprises in this group account for 10 percent of all current expenditure.

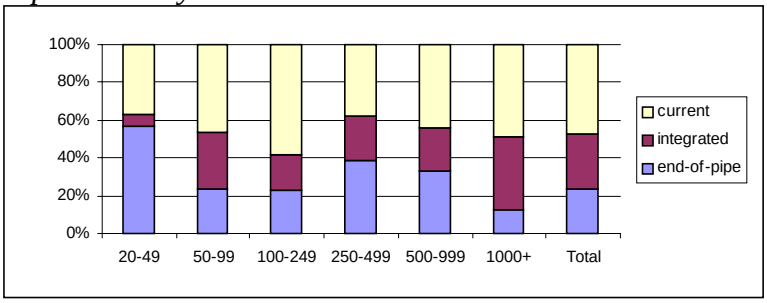
Figure 2. Proportion of end-of-pipe investments, integrated investments and current expenditure by selected SNI groups.



Size class breakdown

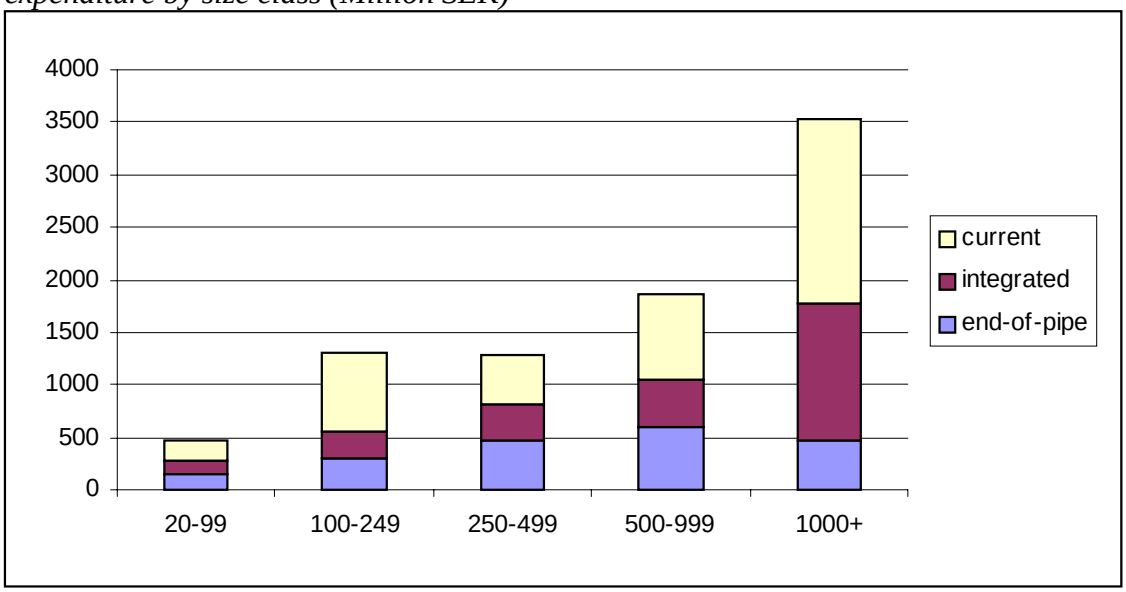
A division of the variables both on activities and size classes has not been deemed possible this year for data quality reasons. Starting from the reference year 1999 the requirements of the SBS regulation means that process-external investments must be broken down both on 13 groups of industries and six size classes. This kind of breakdown of the 1997 results would only give data with reasonable quality for between 2 and 5 size classes per group of branches. The issue of providing this kind of data with adequate quality will have to be addressed in future preparations of the implementation of the SBS regulation. It is possible however to study the importance of the different size classes in aggregate terms for each of the three variables. Figure 3 below shows the relation between the variables for each of the six size classes. It is hard to draw any decisive conclusion about the relative importance of the three variables, beside the fact that for the smallest enterprises integrated investments are of minor importance.

F*igure 3. Percentage of expenditure for end-of-pipe investments, integrated investments, and current expenditure by size class*



In figure 4 we can see the importance of each size class as to total expenditure, and the share of each variable for the different size classes. The importance of the larger size classes is quite evident. Enterprises with over 500 employees stand for 65 percent of total expenditure and nearly ¾ of all expenditure on process-integrated investments.

*Figure 4. Total expenditure for end-of-pipe investments, integrated investments, and current expenditure by size class (Million SEK)**



* Please note that size classes 20-49 and 50-99 have been aggregated

5.3 Activity breakdown

5.3.1 Process-external investments

Table 8. Process-external investments (variable 1a) in Million SEK by SBS regulation group, SNI and environmental domain[1]

SBS	SNI	Air	%	MF	Water	%	MF	Waste	%	MF	Other	%	MF	Total	%	MF
	10-12	..			..			..			..			..		
	13	..			..			..			..			..		
	14	..			..			..			..			..		
1	10-14	..			..			..			..			..		
	15	14	*1*	*49*	20	*4*	*35*	12	*8*	*33*	(1)	*0*	*68*	48	*2*	*28*
	16	*n*			*n*			*n*			*n*			*n*		
2	15-16	14	*1*	*49*	20	*4*	*35*	12	*8*	*33*	1	*0*	*67*	48	*2*	*28*
	17	..			..			..			..			2	*0*	*40*
	18	..			..			..			..			..		
	19	..			..			..			..			..		
3	17-19	..			..			..			..			..		
4	20	34	*3*	*34*	4	*1*	*40*	3	*2*	*27*	10	*4*	*27*	51	*3*	*26*
	21.11	107	*10*	*34*	52	*11*	*37*	1	*1*	*46*	1	*0*	*47*	161	*8*	*25*
	21.12	190	*17*	*40*	231	*47*	*38*	51	*33*	*22*	29	*13*	*36*	502	*25*	*29*
	21.2	..			..			..			..			28	*1*	*35*
	22	..			..			..			..			.		
5	21-22	320	*29*	*41*	297	*60*	*45*	60	*38*	*32*	(30)	*13*	*52*	706	*36*	*33*
6	23	..			..			..			..			..		
	24	38	*3*	*33*	37	*8*	*27*	22	*14*	*31*	4	*2*	*32*	100	*5*	*18*
	25	..			..			..			..			18	*1*	*39*
7	24-25	51	*5*	*35*	38	*8*	*37*	24	*15*	*37*	5	*2*	*34*	118	*6*	*23*
8	26	..			..			..			..			..		
	27.1	58	*5*	*39*	18	*4*	*26*	3	*2*	*36*	2	*1*	*48*	81	*4*	*31*
	27.2-3	12	*1*	*28*	2	*0*	*33*	2	*1*	*24*	(2)	*1*	*51*	17	*1*	*22*
	27.4-5	23	*2*	*46*	2	*0*	*28*	1	*1*	*48*	(2)	*1*	*69*	27	*1*	*40*
9	27	92	*8*	*38*	22	*4*	*35*	6	*4*	*29*	6	*3*	*36*	126	*6*	*32*
10	28	65	*6*	*38*	(31)	*6*	*53*	6	*4*	*35*	8	*4*	*48*	110	*6*	*29*
	29	30	*3*	*50*	23	*5*	*31*	18	*12*	*31*	9	*4*	*44*	81	*4*	*23*
	30	..			..			..			..			..		
	31	(2)	*0*	*62*	15	*3*	*42*	4	*3*	*35*	(0)	*0*	*66*	22	*1*	*33*
	32	..			..			..			..			2	*0*	*37*
	33	..			..			..			..			..		
	34	..			..			..			..			..		
	35	..			..			..			..			..		
	36	..			..			..			..			..		
11	29-36	173	*16*	*31*	51	*10*	*23*	42	*27*	*23*	15	*7*	*30*	281	*14*	*21*
12	40	166	*15*	*31*	11	*2*	*50*	1	*1*	*41*	(148)	*66*	*63*	325	*16*	*32*
	Total	1 112	*100*	*23*	492	*100*	*35*	156	*100*	*19*	(225)	*100*	*67*	1 985	*100*	*19*
	%	56			25			8			11			100		

1 Figures between parenthesis are given for information but are uncertain, .. indicates that figures are not given for quality reasons, n indicates that there are to few observations for publication.

5.3.2 Process-integrated investments

Table 9. Process-integrated investments (variable 1b) in Million SEK by SBS regulation group, SNI and environmental domain[1]

SBS	SNI	Air	%	MF	Water	%	MF	Waste	%	MF	Other	%	MF	Total	%	MF
	10-12	..			..			..			..			..		
	13	..			..			..			..			..		
	14	..			..			..			..			..		
1	10-14	..			..			..			..			..		
	15	(203)	*11*	*51*	28	*8*	*34*	15	*16*	*43*	(3)	*2*	*59*	249	*10*	*42*
	16	*n*			*n*			*n*			*n*			*n*		
2	15-16	(203)	*11*	*51*	28	*8*	*34*	15	*16*	*43*	(3)	*2*	*59*	249	*10*	*42*
	17	..			..			..			..			..		
	18	..			..			..			..			..		
	19	..			..			..			..			..		
3	17-19	..			..			..			..			..		
4	20	20	*1*	*33*	6	*2*	*49*	(1)	*1*	*57*	(14)	*8*	*58*	42	*2*	*28*
	21.11	(175)	*10*	*51*	72	*21*	*49*	(1)	*1*	*70*	(0)	*0*	*57*	248	*10*	*50*
	21.12	(14)	*1*	*57*	171	*49*	*41*	2	*2*	*50*	(41)	*24*	*58*	227	*9*	*34*
	21.2	..			..			..			..			21	*1*	*44*
	22	..			..			..			..			..		
5	21-22	(228)	*8*	*69*	251	*72*	*45*	23	*25*	*41*	(44)	*26*	*77*	545	*16*	*45*
6	23	..			..			..			..			..		
	24	93	*5*	*34*	11	*3*	*45*	4	*4*	*44*	5	*3*	*48*	113	*5*	*29*
	25	..			..			..			..			17	*1*	*43*
7	24-25	98	*4*	*43*	12	*3*	*37*	14	*15*	*44*	(5)	*3*	*63*	130	*4*	*35*
8	26	..			..			..			..			..		
	27.1	22	*1*	*31*	0	*0*	*29*	27	*29*	*47*	3	*2*	*47*	52	*2*	*28*
	27.2-3	17	*1*	*30*	0	*0*	*35*	(0)	*0*	*62*	(0)	*0*	*62*	18	*1*	*28*
	27.4-5	(5)	*0*	*51*	1	*0*	*48*	0	*0*	*.*	(1)	*1*	*73*	7	*0*	*37*
9	27	44	*2*	*28*	1	*0*	*35*	(27)	*29*	*70*	4	*2*	*47*	76	*2*	*31*
10	28	22	*1*	*36*	(25)	*7*	*75*	(4)	*4*	*67*	(1)	*1*	*83*	52	*2*	*41*
	29	14	*1*	*37*	6	*2*	*44*	(2)	*2*	*65*	1	*1*	*50*	22	*1*	*26*
	30	..			..			..			..			..		
	31	5	*0*	*48*	(0)	*0*	*65*	0	*0*	*.*	3	*2*	*46*	9	*0*	*35*
	32	..			..			..			..			..		
	33	..			..			..			..			..		
	34	*(666)*	*36*	*80*	..			..			..			*(722)*	*29*	*149*
	35	..			..			..			..			..		
	36	..			..			..			..			..		
11	29-36	*(1 625)*	*59*	*73*	8	*2*	*36*	(2)	*2*	*65*	(42)	*25*	*53*	*(775)*	*50*	*92*
12	40	492	*27*	*39*	(4)	*1*	*68*	(2)	*2*	*72*	(46)	*27*	*55*	544	*22*	*36*
	Total	(1 836)	*100*	*52*	348	*100*	*44*	92	*100*	*46*	170	*100*	*39*	2 472	*100*	*37*
	%	74			14			4			8			100		

1 Figures between parenthesis are given for information but are uncertain, .. indicates that figures are not given for quality reasons, n indicates that there are to few observations for publication.

5.3.3 Current expenditure

Table 10. Current expenditure for environmental protection (variable 1c) in Million SEK by SBS regulation group, SNI, environmental domain, and percentage own activities(O%) and payments for bought services(P%)[1]

SBS	SNI	Air	%	MF	Water	%	MF	Waste	%	MF	Other	%	MF	Total	%	MF	O%	P%
	10-12	..			..			..			..			2	0	26		
	13	..			..			..			..			..				
	14	..			..			..			..			..				
1	10-14	..			..			..			..			..				
	15	12	2	42	164	15	31	74	9	23	50	3	23	300	8	25	49	51
	16	n			n			n			n			n				
2	15-16	12	2	41	164	15	31	75	9	22	51	3	22	302	8	24	49	51
	17	0	0	39	14	1	27	8	1	20	5	0	24	27	1	19	37	63
	18	..			..			..			..			..				
	19	..			..			..			..			..				
3	17-19	0	0	45	34	3	47	10	1	22	(16)	1	51	61	2	42	42	58
4	20	9	2	29	8	1	43	34	4	22	52	3	23	104	3	21	58	42
	21.11	(5)	1	55	(78)	7	58	(21)	2	51	85	6	27	190	5	41	76	24
	21.12	32	6	23	300	27	21	62	7	15	118	8	15	510	13	17	82	18
	21.2	(5)	1	52	(9)	1	57	24	3	32	21	1	30	59	1	25	75	25
	22	(6)	1	60	2	0	36	15	2	26	14	1	23	37	1	21	51	49
5	21-22	49	10	28	389	36	33	122	14	21	238	16	24	796	20	26	79	21
6	23	..			..			..			..			..				
	24	32	6	35	148	14	28	98	11	17	170	11	26	448	11	19	77	23
	25	6	1	32	3	0	27	33	4	20	20	1	23	61	2	17	57	43
7	24-25	38	7	40	151	14	38	130	15	19	190	13	32	509	13	24	74	26
8	26	13	3	37	9	1	22	25	3	21	33	2	18	81	2	18	69	31
	27.1	111	22	43	69	6	26	17	2	19	45	3	27	242	6	30	85	15
	27.2-3	28	5	35	35	3	48	30	3	23	10	1	20	103	3	30	80	20
	27.4-5	5	1	46	(8)	1	56	16	2	32	8	1	29	37	1	33	51	49
9	27	(144)	28	51	112	10	31	63	7	15	63	4	31	382	10	31	80	20
10	28	21	4	29	43	4	31	55	6	14	39	3	14	158	4	15	61	39
	29	6	1	22	15	1	19	69	8	15	89	6	29	179	4	19	59	41
	30	0	0	.	1	0	42	2	0	38	9	1	46	12	0	40	75	25
	31	5	1	26	12	1	33	20	2	33	33	2	25	70	2	22	64	36
	32	..			..			..			..			..				
	33	0	0	47	4	0	50	13	2	46	10	1	37	27	1	40	56	44
	34	(23)	5	62	49	4	39	68	8	49	47	3	25	187	5	35	64	36
	35	..			..			..			..			..				
	36	..			..			..			..			..				
11	29-36	41	8	33	157	14	22	235	27	16	303	20	14	739	19	14	66	34
12	40	91	18	27	11	1	24	103	12	42	486	32	48	690	17	35	87	13
	Total	511	100	34	1 094	100	19	865	100	11	1 510	100	26	3 982	100	14	73	27
	%	13			27			22			28			100				

1 Figures between parenthesis are given for information but are uncertain, .. indicates that figures are not given for quality reasons, n indicates that there are to few observations for publication.

Table 11. Current expenditure for environmental protection (variable 1c) in Million SEK by SBS regulation group, SNI and expenditure type[1]

		Maintenance and control			General administration etc			Wastewater Charges			Waste Management and Charges			*Other*		
SBS	SNI	301/2	*%*	*MF*	305	*%*	*MF*	306	*%*	*MF*	307	*%*	*MF*	303/4/8	*%*	*MF*
	10-12	..			..			..			...			..		
	13	..			..			..			...			..		
	14	..			..			..			...			..		
1	10-14	..			..			..			...			..		
	15	130	*7*	*38*	25	*4*	*29*	71	*41*	*41*	70	*10*	*24*	5	*1*	*32*
	16	*n*			*n*			*n*			*n*			*n*		
2	15-16	131	*7*	*37*	26	*4*	*28*	71	*41*	*41*	70	*10*	*24*	5	*1*	*31*
	17	5	*0*	*39*	3	*0*	*26*	10	*6*	*33*	8	*1*	*20*	*2*	*0*	*47*
	18	..			..			..			...			..		
	19	..			..			..			...			..		
3	17-19	10	*1*	*43*	4	*1*	*32*	26	*15*	*48*	10	*1*	*22*	(11)	*2*	*66*
4	20	24	*1*	*24*	29	*4*	*21*	3	*2*	*33*	33	*5*	*22*	(15)	*3*	*58*
	21.11	155	*8*	*48*	12	*2*	*15*	(0)	*0*	*70*	(4)	*1*	*57*	19	*3*	*31*
	21.12	398	*21*	*19*	53	*8*	*23*	2	*1*	*37*	45	*7*	*16*	11	*2*	*30*
	21.2	29	*2*	*32*	10	*2*	*33*	2	*1*	*37*	11	*2*	*31*	(7)	*1*	*66*
	22	5	*0*	*37*	12	*2*	*25*	1	*1*	*49*	14	*2*	*27*	(5)	*1*	*77*
5	21-22	587	*30*	*31*	86	*13*	*23*	6	*3*	*28*	75	*11*	*19*	42	*7*	*33*
6	23	..			..			..			...			..		
	24	263	*14*	*27*	102	*16*	*40*	11	*6*	*43*	62	*9*	*15*	8	*1*	*26*
	25	22	*1*	*31*	11	*2*	*31*	2	*1*	*35*	24	*4*	*19*	(2)	*0*	*58*
7	24-25	285	*15*	*35*	114	*18*	*48*	13	*7*	*48*	86	*13*	*16*	10	*2*	*30*
8	26	29	*2*	*23*	20	*3*	*19*	4	*2*	*26*	21	*3*	*24*	6	*1*	*42*
	27.1	147	*8*	*28*	17	*3*	*25*	8	*5*	*35*	12	*2*	*21*	57	*10*	*43*
	27.2-3	74	*4*	*40*	8	*1*	*24*	1	*1*	*31*	20	*3*	*24*	1	*0*	*29*
	27.4-5	16	*1*	*31*	5	*1*	*36*	(1)	*1*	*56*	15	*2*	*35*	(0)	*0*	*73*
9	27	237	*12*	*31*	30	*5*	*25*	10	*6*	*45*	46	*7*	*16*	(59)	*10*	*63*
10	28	72	*4*	*26*	27	*4*	*17*	7	*4*	*30*	50	*7*	*14*	2	*0*	*37*
	29	40	*2*	*27*	67	*10*	*37*	6	*3*	*19*	61	*9*	*14*	4	*1*	*35*
	30	1	*0*	*47*	9	*1*	*48*	(0)	*0*	*65*	1	*0*	*37*	0	*0*	*40*
	31	15	*1*	*26*	21	*3*	*29*	(5)	*3*	*51*	20	*3*	*34*	10	*2*	*43*
	32	..			..			..			...			..		
	33	2	*0*	*45*	9	*1*	*36*	3	*2*	*50*	13	*2*	*46*	1	*0*	*42*
	34	82	*4*	*43*	33	*5*	*23*	4	*2*	*37*	65	*10*	*50*	(2)	*0*	*51*
	35	..			..			..			...			..		
	36	..			..			..			...			..		
11	29-36	240	*12*	*20*	224	*35*	*17*	29	*17*	*20*	205	*31*	*17*	41	*7*	*21*
12	40	194	*10*	*30*	75	*12*	*23*	5	*3*	*26*	62	*9*	*27*	355	*63*	*48*
	Total	1 925	*100*	*17*	648	*100*	*14*	175	*100*	*22*	669	*100*	*9*	(566)	*100*	*51*
	% of CE	48			16			4			17			14		

1 Figures between parenthesis are given for information but are uncertain, .. indicates that figures are not given for quality reasons, n indicates that there are to few observations for publication.

6. Response analysis of extra variables

As has been mentioned in section 2.1 the objective of this survey was also to test possibilities of measuring other environmental expenditure than those included under the strict definition of environmental protection. In this survey we therefore introduced two new areas: economising with natural resources and environmental adaptation of products. It was believed that these areas are viewed as a natural part of a survey of environmental expenditure. This is also to some extent qualified by the (surprising) fact that as many as 85 percent considered these areas to be a natural part of environmental expenditure surveys, although only around 30 percent reported that they had these kinds of expenditures in 1997.

It is possible that there would exist an inclination for the enterprises with these kinds of costs, which they view as ”environmental costs”, to include them in the questionnaires on environmental expenditure, although they do not qualify under the strict definition of environmental protection expenditure.

We also included specific questions on labour input and revenues and cost savings that are outside the legal requirements of the SBS regulation but which are of specific interest in these connections.

We have not made attempts so far to produce any statistics for these areas which means that in this section we report on the results of summaries of incoming answers. It might be of interest to analyse the possibility of producing statistics for some of these areas after a more thorough analysis, especially for labour input.

6.1 Labour input

The costs associated with the companies’ own labour input into environmental protection activities is included in variable 1c Current expenditure. It is part of Own environmental protection activities: mainly Maintenance and control (rows 301+302), Research and Development (row 304), and Education and administration (row 305). In order to get a full picture of this variable we have included a separate question asking for the total cost for own labour input, and the equivalent number of person years.

Many enterprises clearly listed labour costs under current expenditure, without filling in this variable. There were also some enterprises that by mistake only registered labour cost here, and not under current expenditure. The latter were discovered through comparisons with the categories of current expenditure, which most commonly include labour costs.

A total of 353 enterprises registered labour input costs, compared to the 570 enterprises that reported current expenditure under question 1c. In some cases the enterprise only registered costs or person years:

- 298 enterprises reported number of person years
- 344 enterprises reported costs for own personnel
- 289 reported on both the variables.

The number of person years reported by enterprises in different size classes can be seen in the table below.

Table 12. Number of enterprises by size class and person years

Person year / Size classes	20-49	50-99	100-249	250-499	500+	Total
-1	13	35	37	11	9	105
1	4	11	37	15	9	76
2	1	6	15	11	15	48
3	0	1	6	7	12	26
4-10	0	0	10	3	18	31
11-20	0	0	0	1	10	11
20+	0	0	0	0	1	1
Total	18	53	105	48	74	298

In order to analyse labour costs and person years jointly, we have made imputations for the missing variables for those enterprises that have not answered both variables. It was assumed that the cost for an average person year was equal to a cost of 300.000 SEK, based on the average used by enterprises.

Table 13. Person years and labour costs by size classes

	20-49	50-99	100-249	250-499	500+	Total
Total number of person years	9	47	168	143	440	807
Average number of person years	0,4	0,7	1,3	2,5	5,6	2,3
Average labour cost (SEK 1000)	141	201	456	932	2 075	827
Number of enterprises	24	65	128	57	79	353

Number of person years and number of employees are two different concepts. Despite this, we have made a calculation of the share of person years for environmental protection of the total number of employees in the enterprise, in order to relate the reported figures to the company size. The average was about one percent of the total number of employees, with slightly higher shares for the smaller size classes, and slightly lower for the largest size classes.

6.2 Revenues and cost savings

We had two versions of the questionnaire. They were the same for all environmental protection expenditure variables (1a-1c). For the remaining variables half of the enterprises were asked for actual figures (version 1), and the other half were asked related questions (version 2).

Both versions included the general question whether the enterprises had any revenues or cost savings. 685 enterprises of the total responding enterprises answered this question. About ¼ of the enterprises reported that they had this type of revenues or cost savings in 1997

91 of the 103 enterprises that had revenues reported actual figures in table 1d. Of these, 62 enterprises had revenues, and 42 cost savings. The total sum of these ”operational benefits” equalled 280 Million SEK. The dominant domain both by total revenues and by number of enterprises is not surprisingly the waste domain: ¾ of the enterprises and 40 percent of the reported revenues. The air domain was also quite large in terms of expenditure but less so by enterprises, while the were very little revenues related to water.

63 of the 75 version 2 enterprises that had revenues answered the additional question on how large this was as compared to the total current expenditure they had reported in table 1c. 10 estimated the revenues to less than one percent of the current expenditure, 24 between 1 and 10 percent, and 29 estimated the revenues to be more than 10 percent of the total current expenditure.

6.3 Economising with natural resources

659 of the total 753 enterprises answered the general question whether they had any expenditure associated with natural resource management. 20 percent of all enterprises reported that they had these kinds of expenditures in 1997. For this variable there was a marked difference between the two versions. 15 percent of the enterprises that were asked for actual expenditure reported that they had this kind of expenditure, while 30 percent of the version 2 enterprises claimed they had expenditure associated with economising.

51 of the 59 version 1 enterprises who reported that they had this kind of expenditure actually reported figure. The total expenditure for these equalled 460 million SEK, and as much as 95 percent of the expenditure referred to investments related to energy. 80 percent of the expenditure was in enterprises with more than 500 employees, and SNI 40 accounted for as much as 85 percent of total expenditure. This indicates the importance of providing clear directives and examples for the energy sector.

The 351 version 2 enterprises were asked additional questions on relations to environmental protection expenditure. The majority of the respondents reported that both R&D and investments with this purpose are lower than the environmental protection equivalents. But about 30 percent of the respondents claimed that economising R&D and investments were larger.

6.4 Environmental adaptation of products

645 enterprises answered the general question whether they had expenditure associated with environmental adaptation of the company's products. Also for this variable there was a marked difference between the two versions with the same proportions as for economising: 15 percent of the enterprises that were asked for actual expenditure reported that they had this kind of expenditure, while 30 percent of the version 2 enterprises claimed they had expenditure associated with economising.

60 of the version 1 enterprises who reported that they had expenditure for environmental adaptation of products filled in actual figures. The total expenditure for these equalled 260 Million SEK, with equal shares for product development and investments. As much as 93 percent of this expenditure was in enterprises with more than 500 employees. Three specific SNI groups dominated. SNI 24 accounted for about 35 percent of total expenditure, SNI 27.1 has 28 percent of total expenditure and SNI 29 has 29 percent of total expenditure. For these three SNI groups total expenditure on environmental adaptation of products are of the same order of magnitude as total process-external investments.

7. Conclusions and future work

The work with the 1997 survey has provided new and more detailed insights, and new statistics in the area of environmental protection. We have also identified a number of key factors for obtaining good quality data in possible future surveys.

The response rates will need to be improved considerably. Environmental protection expenditure is a difficult area for statistics, and much would be won if the non-response errors could be minimised. We have shown that there are good opportunities of increasing the response rates in surveys to come.

There are practical difficulties for the respondents to provide adequate information. The burden on the respondents is such that it must be possible to provide the relevant information with a minimum of input of time and resources. Own interest in the subject, or own use of the information gathered, or realisation of the importance of the data produced are other key factors affecting the survey results. Many of these practical difficulties could be reduced over the years if the survey becomes regular. Some are likely to remain as they are intrinsically linked with the definition of the subject.

Problems with definitions include the grey border lines between different variables, and between environmental protection and normal production expenditure. There are also problems linked with the scope of the variables, where a full coverage would require very detailed information. These issues will have to be addressed and the measures should be focused on facilitating for the respondents. This is possible through more precise and practically based definitions, with lists of concrete examples. It is also possible to limit the field of coverage for certain variables.

The experience differ between the three variables mentioned in the SBS regulation.

- End-of-pipe investments does not seem to pose too much problems, although it is vital to try and define the border-line to integrated investments more closely, including providing lists of examples.
- Many parts of current expenditure do not pose any serious problem. Here we propose an analysis if not the scope of the variable could be limited, in order to reduce the burden of the respondents.
- As for process-integrated investments we believe it is important that work continue on giving a more concrete form to the concept, including lists of examples and practical guides for estimating the environmental part.

The experience in Sweden is that there are two opposing camps and trends in regards to environmental protection expenditure. There is a slight trend for growing demand for this kind of information from some actors, and the development of environmental information systems seems promising in this respect. On the other hand, there is a counter trend with emphasis on positive effects of environmental measures, where the view is that environmental concerns are integrated into all aspects of production, and the whole life-cycle of the product. This makes accounting environmental protection expenditure extremely difficult and of less interest.

Work in this area will continue. A Swedish report will be made which summarises the statistical results and the evaluation. A short summary of this will be sent to respondents. The experience gained in this project will be the basis for discussions of possible future actions in

this field in the Steering committee of the Environmental Accounts, with Department of the Environment and Department of Finance, Agencies, Branch associations and enterprises.

There is a choice between a more comprehensive survey made by the department for environment statistics, or a more limited one focused on the demands of the SBS regulation made in co-operation with the department for business statistics. This decision ultimately depends on the demands of the users and the resources needed for providing the information.

Annex 1. Classification of activities

SBS		SNI	Activitiy
		10-12 13 14	Mining and quarrying of energy producing material Mining of metal ores Other mining and quarrying
1	C	10-14	
		15 16	Manufacture of food products and beverages Manufacture of tobacco products
2	DA	15-16	
		17 18 19	Manufacture of textiles Manufacture of wearing apparel; dressing and dyeing of fur Manufacture of leather and leather products
3	DB+DC	17-19	
4	DD	20	Manufacture of wood and wood products
		21.11 21.12 21.2 22	Manufacture of pulp Manufacture of paper and paperboard Manufacture of articles of paper and paperboard Publishing, printing and reproduction of recorded media
5	DE	21-22	
6	DF	23	Manufacture of coke, refined petroleum products and nuclear fuel
		24 25	Manufacture of chemicals and chemical products Manufacture of rubber and plastic products
7	DG+DH	24-25	
8	DI	26	Manufacture of other non-metallic mineral products
		27.1 27.2-3 27.4-5	Manufacture of basic iron and steel and of ferro-alloys (ECSC) Manufacture of tubes + Other first processing of iron and steel and production of non-ECSC Manufacture of basic precious and non-ferrous metals + Casting of metals
9	27	27	Manufacture of basic metals
10	28	28	Manufacture of fabricated metal products, except machinery and equipment
		29 30 31 32 33 34 35 36	Manufacture of machinery and equipment n.e.c. Manufacture of office machinery and computers Manufacture of electrical machinery and apparatus n.e.c. Manufacture of radio, television and communication equipment and apparatus Manufacture of medical, precision and optical instruments, watches and clocks Manufacture of motor vehicles, trailers and semi-trailers Manufacture of other transport equipment Manufacture of furniture; manufacturing n.e.c.
11	DK+DL+DM+36	29-36	
12		40	Electricity, gas, steam and hot water supply

Annex 2. Questionnaire

Any information given here is treated as classified and guided by the Official Secrets Act (SFS 1980:100)

Survey of Environment Expenditure in Industry 1997

Please return the questionnaire by the **15th of May 1998** in enclosed envelope or to

Statistiska centralbyrån
MR/MI LE
Box 24 300
104 51 STOCKHOLM

Describe briefly what the company produces (products, product groups) **and the production process** (or enclose such a description)	

Number of employees 1997-12-31	

Company contact person in these matters	Signature		Date
	Name		Position
	Address (if different from above)		
	Telephone	Telefax	E-mail

SCB M/MI 180.e SCB-Tryck, Örebro 1998-08

Form issued by	Contact persons	Telephone (09.00–11.00)	E-mail	Telefax
Statistiska centralbyrån Statistics Sweden	**Ulf Johansson**	**08 - 783 48 40**	**ulf.johansson@scb.se**	
Environment Statistics	**Jan Grünberger**	**08 - 783 47 69**	**jan.grunberger@scb.se**	**08 - 783 47 63**

Definitions and examples

Investments in environmental protection (1a and 1b)	By this we mean investments in machinery, equipment, construction and purchase of land with the main or part of the purpose to protect the environment. Included are associated costs such as planning, installation, surveillance of the actual realisation, and connection fees.	Also included are all additions, alterations, renovations and improvements that prolong the service life or increase the capacity of the equipment. Investments in environmental protection are divided into process-external investments (**1a**) and process-integrated investments (**1b**).

1a Process-external investment (end-of-pipe)

General

Process-external investments are investments in extra capital equipment used for environmental protection. These include:

– Equipment that work independently of and are identifiable parts of the production process equipment.

– The equipment **takes care of** and **treats** the pollution generated by the activities of the enterprise, prohibits the spread of and measures the level of pollution.

This is in contrast to **process-integrated investment** that aims for reducing the actual generation of polluting substances.

Examples within different environmental domains

Air

Equipment for treatment of air pollution
– different types of filters and scrubbers
– separation by gravity (cyclones and centrifuges)
– sulphur recovery from process gases
– coolers and condensers for process and ventilation gases
– thermal and catalytic combustion of waste gases

Equipment for restriction of waste gas production
– measures to restrict the problems with dust formation in connection to storage and transport
– system to collect and recover vapour
– pressure-balancing systems

Equipment for improvement of the dispersion of air pollutants into ambient air
– heightening of existing stacks
– extra height of new stacks
– extra heating of flue gas for higher plume rising

Flare systems
– steam or water injection for better combustion
– flame monitoring equipment

Measurement equipment

Water

Equipment for storage and transport
– dams and tanks for storage of wastewater
– connection to municipal sewage network

Equipment for treatment and purification of wastewater
– all investment in own wastewater treatment plant
– oil separators

Equipment for treatment of sewage sludge
– aerobic, anaerobic and heat treatment
– incineration, de-watering and drying of sludge
– floating screens

Equipment for reduced thermal pollution
– cooling facilities
– disperal of discharged cooling water

Measurement equipment

Waste

Equipment for own storage and transport
– special vehicles
– own containers
– transhipment stations
– storage of waste in special premises
– tanks for collection of cleansing liquids

Equipment for own treatment
– all investment in own landfill
– sorting and separation
– thermal treatment
– condensation and compression
– waste incineration
– detoxification, neutralisation and de- watering

Other

Outdoor noise and vibration
– build in equipment and fans
– sound prove buildings to reduce outdoor noise
– different materials and measures to reduce outdoor noise

Soil and groundwater
– equipment directed at underground tanks and pipes in order to reduce pollution and protect groundwater
– embankment and other measures to stop pollutants reaching the groundwater
– stop fluids released via floors and wells
– reduce the use of groundwater
– measurement equipment

Landscape and biodiversity
– land bought and set aside for protection of biotopes
– green belts around plants
– landscape protecting measures
– burying of electrical lines

1 Environmental Protection Expenditure 1997

With environmental protection we mean measures and associated expenditure wholly or partially directed towards reducing the impact on the environment from the company's production. Also included are associated expenditure such as investigations, surveillance, education and general administration.

Measures and expenditure directed towards natural resource management or adapting the company's producs so that the impact on the environment is reduced when they are used or become waste should not be included here but in sections 2 and 3.

Measures that are positive for the environment but mainly fulfil technical needs or demands on workplace environment is not at all including in this survey.

Did your company make any investments in 1997 that were wholly or partially directed towards protecting the environment?

☐ Yes → **Answer sections 1a and 1b below**
Investments are divided between 1a and 1b depending if they operate independently of the company production process or not.

☐ No → **Go to section 1c on page 7**

- ***If it is difficult to get exact figures try to make the best possible estimation.***

1a Process-external Investments (end-of-pipe)

Here you report investments in
– cleaning devices
– filters
– waste treatment
– own landfill etc.

The main purpose of these investments are environment protection and the total expenditure during the year is reported.

Fill in one investment on each row for the largest investments and indicate the main environmental domain by a cross.

The smaller investments can be added and put into one row. Please divide the total expenditure on the domains if possible. →

	External Investments 1 000 SEK	Main domain Air	Water	Waste	Other
101		☐	☐	☐	☐
102		☐	☐	☐	☐
103		☐	☐	☐	☐
104		☐	☐	☐	☐
105		☐	☐	☐	☐
106		☐	☐	☐	☐
107		☐	☐	☐	☐
108		☐	☐	☐	☐
109		☐	☐	☐	☐
199		Main doman (1 000 SEK) Air	Water	Waste	Other

Make a short description of the investments above.

Indicate which investment by the row number above, name, purpose, basis for expenditure data etc.

If there is a lack of space continue on the back of this questionaire.

Definitions and exemples

1b Process-integrated investments

General

By process-integrated investments we mean installations that have been adapted in order to generate less influence on the environment. The environmental investment refers here only to the adaptation and integration part.

As opposed to a process-external investment this quipment is integrated into the production process (and cannot be identified as a separate part). The expenditure therefore has to be estimated. **The environmental investment consists only of an estimated share of the total investment** that can be attributed to the choice of this more environmentally friendly technique.

This extra cost must be estimated for example by comparison with alternative less expensive and more polluting solutions, or identification and estimation of the expenditure for **those parts that are aimed at environmental protection.**

In case of changes of equipment which laws and regulations make necessary, the capital loss on the old equipment is included. This caipital loss is defined as:

$$\frac{\textit{Estimated remaining life time x purchase price}}{\textit{Estimated total life time}}$$

Process-integrated solutions are often company or branch specific but have usually one of these characteristics:

– Investments involving changes in production process etc that reduces the generated amount of polluting substances and waste so that emissions etc per product or production unit is reduced.
– Investment that enables use of less polluting production inputs.
– Investments in new equipment and processes with improved environmental performance.

Examples within different environmental domains

Air

Equipment or parts therof
– reduce the generation of pollution such as closing of processes
– limit pollution and odour generated by fuel combustion
– re-circulation of waste gases
– enable use of less polluting raw materials
– new less polluting equipment and processes
– vapour exchange systems

Water

Equipment or parts thereof
– reduce the amount of wastewater through reduction in use of water, or re-circulation of used water
– closing of processes and cooling systems
– use of less polluting raw materials
– new less polluting equipment and processes

Extra cost for installations or parts thereof
– air cooling instead of water cooling if the purpose is reduction of thermal pollution
– closed water cooling systems if the purpose is reduction of thermal pollution
– special devices such as joints and valves

Installations or parts thereof necessary for
– extra maintenance e.g. cleaning of water cooling systems if chlorinating of cooling water is not allowed

Waste

Equipment or parts thereof
– reuse of materials in the production process if the purpose is reduction of the amount of waste generated
– reduce the use of raw materials e.g. by the use of monitoring and controlling equipment if the purpose is reduction of the amount of waste generated
– use of less polluting raw materials
– new and less polluting equipment and processes

Other

Outdoor noise and vibration
– machinery and equipment constructed for low noise and vibration
– foundations designed to damp vibration

Soil and groundwater
– new and less polluting equipment and processes
– extra cost for double walled tanks with the purpose of protecting soil and groundwater

1b Process-integrated investments

With process-integrated investment we mean changes in the production process or other measures that prevent pollution from occurring etc. so that e.g. emissions per production unit decrease.

In general only a part of these changes are made with an environmental protection purpose. In these cases only report an **estimated environmental share** of the total investment.

- ***If it is difficult to get exact figures try to make the best possible estimation.***

Here you report an estimated environmental share of the total investment expenditure, and how large this share is of the total expenditure.

Fill in one investment on each row for the largest investments and indicate the main environmental domain by a cross.

The smaller investments can be added and put into one row. Please divide the total expenditure on the domains if possible. →

	Process-integrated investment (= extra cost)	Environmental investment as a share of total investment	Main domain			
	1 000 SEK	Percent	Air	Water	Waste	Other
201		%	☐	☐	☐	☐
202		%	☐	☐	☐	☐
203		%	☐	☐	☐	☐
204		%	☐	☐	☐	☐
205		%	☐	☐	☐	☐
206		%	☐	☐	☐	☐
207		%	☐	☐	☐	☐
208		%	☐	☐	☐	☐
209		%	☐	☐	☐	☐
			Main domain (1 000 SEK)			
			Air	Water	Waste	Other
299		%				

Make a short description of the investments above.

Indicate wich investment by the row number above, name, purpose, basis for expenditure data etc.

If there is a lack of space continue on the back of this questionnaire.

Definitions and examples

1c Current expenditure for environmental protection

General	Here you list all other costs for environmental protection that is not considered to be investments. These can be related to existing environmental protection plant and equipment (rows 301 and 302), but can also be of a more general character.	For each type of expenditure you list expenditure for own environmental protection activities and payments for bought services. ***Please observe*** – rent and capital costs (depreciation) is **not** asked for in this survey.
Own environmental protection activities	Here you list all current expenditure that is not bought services. These consist of costs for own personnel, material, and energy used in the company's own environmental protection activities.	Costs for own personnel include social security charges and other general labour costs.
Fees and charges and other payments for bought services	Instead of executing own environmental protection activities, the same services could be bought from another company or from a government unit. These consist of e.g. waste and wastewater charges, surveillance fees, chemical analysis, and payments to environmental consultants.	***Please observe*** – the cost must be related to measures made outside the own enterprise – payments of general environment taxes and the like should **not** be included.
Maintenance and control (rows 301, 302)	Here you fill in cost for maintenance and control during the year which are directly linked to previous environmental investments such as wastewater treatment plants, landfills, filters and the like, but also an estimated share of the cost for maintenance of integrated equipment (the environmetal part).	The cost can consist of **energy, material, costs for own personnel** etc. Please split up the costs on type of plant and equipment: process-external or process-integrated.
Extra costs for less polluting raw material (row 303)	This is an extra cost associated with purchase of a less polluting and more expensive raw material, such as low-sulphur fuels. Other examples are extra material cost when shifting from solvent based to water	based paint, use of non-aromatic solvents which are more expensive but better for the environment, or shift in fuels from oil to LPG. Only include an estimated **extra material cost**.
Research and development (row 304)	Total cost for research and development in order to reduce influence on the environment from the company production.	***Please observe*** – R&D directed at economising/natural resource management or making the products more environmentally friendly when they are used or in the waste phase should **not** be included here, but in sections 2 and 3.
Education, administration (row 305)	General environmental protection activities such as education of own personnel, information activities, general administration, investigations and the like. Also included here are work with environmental certification and environmental information systems.	Fill in costs for the company environment division, environmental co-ordinator and the like, but also the total time for other employees, e.g. for educational activities.
Sewage charges (row 306)	Here the total cost for connection to the sewage system is included. **please observe that costs for water supply is not included**. If a division is not possi-	ble, include the total cost and write down a comment. Maintenance and control for own wastewater treatment plant should be included in row 301.
Waste management and charges (row 307)	Current costs for waste management that cannot be referred to own plants and landfills e.g. sorting of waste.	Also included are total costs during the year for getting rid of e.g. environmentally hazardous waste and other waste.
Soil sanitation and other expenditure (row 308)	Here you fill in costs for soil sanitation and other restorative measures, and possible other types of current costs for environmental protection not included elsewhere.	

1c Current expenditure for environmental protection

Did yor company have any other expenditure for environmental protection that were not recorded under environmental investments (1a and 1b)?

☐ Yes → **Answer section 1c below**
Divide the current expenditure on rows 301 to 308 depending on what type of measure the expenditure is related to.

☐ No → **Go to section 1d on page 9**

- ***If it is difficult to get exact figures try to make the best possible estimation.***

For every measure record expenditure for bought services separated from other expenditure (= own environmental protection activities).

Expenditure for each measure of your own activities is divided into the main environmental domain.

	Maintenance, control, surveillance etc. for	**Own environmental protection activities**					**Fees and charges and other payments for bought services**
		Environmental domains (1 000 SEK)				**Total**	**Total**
		Air	Water	Waste	Other	1 000 SEK	1 000 SEK
301	– end-of-pipe facilities . . .						
302	– integrated facilities						
303	Extra cost raw materials . .						
304	Research & Development						
305	Education, information, administration and the like						
306	Sewage charges						
307	Waste treatment and charges						
308	Soil sanitation and other current expenditure						

Make a short description of the current expenditure above.
Indicate row number above, name, purpose, basis for expenditure data etc.

If there is a lack of space continue on the back of this questionnaire.

Definitions and examples

Own labour input	In the costs for own environmental protection activities given on rows 301–308, costs for own personnel are included. Here you account separately an estimate of the total costs for own personnel for environmental measures during the year.	**Person year**. Fill in the estimated number of person years the labour input equals. One person year is the same as one year's fulltime work. **Labour cost**. Fill in the estimated total labour cost that the total labour input equals, including social security charges and other general labour costs.

1d Revenues and cost savings

General	Environmental protection measures may lead to a number of different types of revenues and cost savings. All in all, the measures may be economically profitable. Here we ask only for revenues from different types of by-products from the environmental protection measures e.g. – Energy generated from waste incineration that either can be sold and generate revenues, or be used within the company and lead to cost savings.	– Recovered material generated from the company's waste management that either can be sold or used within the company e.g. collection and sale of metal scrap. ***Please observe*** – Increase in revenues due to increase in sale of the company's products should **not** be included. – Reduced environmental taxes should **not** be included as cost savings.
Revenues from selling of by-products (row 401)	Here you fill in revenues during the year from selling by-products directly linked with the company's environmental protection measures.	
Cost savings (row 402)	The enterprise use the by-products for its own activity, which leads to cost savings. The cost saving is valued by how much a purchase of an equivalent product would have cost the company.	

Own labour input	**Approximately how much of the current expenditure for environmental protection above can be referred to own labour input?**	Person year	Labour cost (1 000 SEK)
	Comments:		

1d Revenues and cost savings

Under section 1a – 1c we asked for the total cost for environmental protection. The measures included there could lead to different types of revenues. Here we ask only for a certain type of revenue that can be referred to something with a value (a by-product) that **result directly from the company's environmental protection measures**. This by-product could either be sold and generate revenues, or be used within the company and lead to cost savings.

Did your company have any revenues or cost savings in 1997 that occurred as a direct side effect from the different environmental protection measures listed under section 1a – 1c above?

☐ Yes → **Answer section 1d below**

☐ No → **Go to section 2 on page 11**

- ***If it is difficult to get exact figures try to make the best possible estimation.***

Split the amount on environmental domains after the main domains of the measures (expenditure)			Environmental domains (1 000 SEK)				**Total** 1 000 SEK
			Air	Water	Waste	Other	
	401	Revenue from selling of by-products					
	402	Cost savings					
Short description: Indicate the row number above, which environmental measure the revenue can be referred to, the source of the revenue, basis for estimation of the amount etc.							

Definitions and examples

2 Economising with natural resources

General	Under sections 1a – 1c above costs for environmental protection was asked for. According to international definitions of environmental protection measures where **the main purpose is economising with natural resources** such as water, energy and raw material is not included.	Exemples here can be efficient use of material, data supervising for reduced material consumption, supervision for process-ventilation, heat-recovery and all types of energy-saving measures.
R&D directed at economising (row 501)	Research and development during the year directed at economising with natural resources and other efficiency measures.	
Economising investments (row 502)	Investments where the main or part of the purpose is economising with natural resources. These can be of both an external and integrated nature (compare with 1a and 1b).	Report the total investments in capital goods with the sole aim of economising with natural resources, and an estimated economising-part for investments with another main purpose.

3 Environmental adaptation of products 1997

General	Under section 1a – 1c above cost associated with less environmentally damaging production was asked for. Here we ask for costs associated with measures for environmental adaptation of the company's products. With environmental adaptation we mean that the products will be **less damaging for the environment when used by consumers, as material input in other companies, or when scrapped or as waste.**	**Three typical examples** – *Adaptation of machinery.* To make machinery or e.g. cars less damaging for the environment when used, including make possible the use of fuels that generate less pollution. – *Components and material.* Exchange environmentally hazardous components such as lead. Switch to production in a material that generates less pollution in later stages of the life cycle, such as PET-plastic. – *Package.* Measures on the packaging side that makes it easier to take care of the product as waste, such as phase out mixed materials.
Product development (R&D) (row 601)	Included here are adaptation and improvement of existing products as well as development costs directed at environmental characteristics of new products.	***Please observe*** – Development costs associated with production are **not** included here but under the section on environmental protection (1c).
Investments (row 602)	Investments can be of the same two types as in section 1a and 1b.	– *External.* Included here are adjustment-investments for production of the environmentally adapted products, or identifiable parts of new production equipment following the environmental adaptation. – *Integrated.* A share of investments with totally new production that can be referred to the environmental adaptation.

2 Economising with natural resources 1997

Under section 1a – 1c above measures with the main purpose of economising with natural resources like water, energy and raw material was not included.

Did your company have costs for R&D or make any investments with this purpose in 1997?

☐ Yes → **Answer section 2 below**

☐ No → **Go to section 3**

- ***If it is difficult to get exact figures try to make the best possible estimation.***

			Domains (1 000 SEK)			
			Water	Energy	Raw material	**Total** 1 000 SEK
	501	R&D directed at economising.				
	502	Investments in economising				

Short description:
Indicate row number above, name of the measure, purpose, basis for estimated costs etc.

If there is a lack of space please continue description on the last page.

3 Environmental adaptation of products 1997

Under section 1a – 1c above measures directed at reducing the influence on the environment from the company's products when used or as waste was not included.

Did your company have any costs for R&D or make any investments with this purpose in 1997?

☐ Yes → **Answer section 3 below**

☐ No → **Go to page 12**

- ***If it is difficult to get exact figures try to make the best possible estimation.***

		Cost (1 000 SEK)
601	Product development (R&D)	
602	Investments	

Short description:
Indicate row number above, name of the measure, purpose, basis for estimated cost etc.

F Comments and suggestions for improvement

	Hours
How long time did it take you to fill in the questionnaire (including the time used for gathering information)?	

This survey is a pilot survey, which will be evaluated closely. It is therefore extra important with comments and suggestions for improvement.

The result of the survey will be published as official statistics in Statistical Messages (SM) etc.
A thorough evaluation will be made during the autumn of 1998 and published in a special report.
These publications can be ordered from Environment Statistics, Statistics Sweden

In addition, enterprises that take part in this survey are offered a summary free of charge.

☐ **Yes, we would like a summary of the statistics Environmental expenditure in industry 1997**

Alternative Page 9

Own labour input	**Approximately how much of the current expenditure for environmental protection above can be referred to own labour input?**	Person year	Labour cost (1 000 SEK)
	Comments:		

1d Revenues and cost savings

Under section 1a – 1c we asked for the total cost for environmental protection. The measures included there could lead to different types of revenues. Here we ask only for a certain type of revenue that can be referred to something with a value (a by-product) that **result directly from the company's environmental protection measures**. This by-product could either be sold and generate revenues, or be used within the company and lead to cost savings.

Did your company have any revenues or cost savings in 1997 that occurred as a direct side effect from the different environmental protection measures listed under section 1a – 1c above? . . ☐ Yes ☐ No → **Go to section 2 on page 11**

How large was this revenue in relation to the total current expenditure listed under section 1c above? . . . . . ☐ Less than 1 % ☐ Between 1–10 % ☐ More than 10 %

2 Economising with natural resources 1997

In sections 1a – 1c above measures with the main purpose of economising with natural resources like water, energy and raw material was not included.

2.1 Did your company have costs for R&D or make any investments with this purpose in 1997? . . . . . ☐ Yes ☐ No → **Go to question 2.4**

2.2 Approximately how large are the costs for R&D directed at economising compared to R&D for environmental protection given in section 1c (row 304)? . . . . . ☐ Less ☐ Equal ☐ Larger

2.3 Approximately how large are the economising investments compared to the total investments in environmental protection given in sections 1a – 1b?. . . . . ☐ Less ☐ Equal ☐ Larger

2.4 Do you think these kinds of costs are a natural part when accounting environment expenditure? . . . . . ☐ Yes ☐ No

3 Environmental adaptation of products 1997

In sections 1a – 1c above measures directed at reducing the influence on the environment from the company's products when used or as waste was not included.

3.1 Did your company have any costs for R&D or make any investments with this purpose in 1997? . . . . . ☐ Yes ☐ No → **Go to question 3.4**

3.2 Approximately how large are the costs for R&D directed at the environmental influence of the company's products compared to R&D for environmental protection given in section 1c (row 304)? . . . . . ☐ Less ☐ Equal ☐ Larger

3.3 Approximately how large are the investments for environmental adaptation of the company's products compared to the total investments in environmental protection given in sections 1a – 1b?. . . . . ☐ Less ☐ Equal ☐ Larger

3.4 Do you think these kinds of costs are a natural part when accounting environment expenditure? . . . . . ☐ Yes ☐ No