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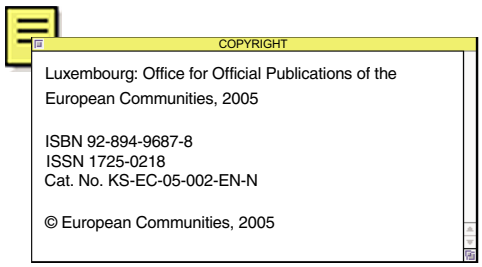
Environmental expenditure statistics:

Industry data collection handbook



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Preface

We are pleased to present this user-friendly handbook on how to collect, interpret and present data on expenditure by industry on environmental protection. This handbook is as a contribution to EU-wide and international activities in connection with national and environmental accounts.

In order to respond to the need for structural business statistics, extended under Council Regulation 58/97 to include environmental protection expenditure, Eurostat has produced this publication in collaboration with the Member States and the Accession and EFTA countries. It is designed as a practical aid to compiling statistics on environmental protection expenditure by industry and describes each step in the process, either by means of an explanatory text or on the basis of examples taken from the experience of various countries.

Eurostat regularly publishes statistics on environmental protection expenditure by industry in the series “Statistics in Focus” and it recently published “OECD/Eurostat Environmental Protection Expenditure and Revenue Joint Questionnaire/SERIEE Environmental Protection Expenditure Account – conversion guidelines”. Also to be found is the publication “SERIEE Environmental Protection Expenditure Accounts – Compilation Guide”, which can be downloaded from the Eurostat website at www.europa.eu.int.

Special thanks are due to the members of the Working Party on Expenditure and of the Task Force on "Environmental Protection Expenditure – Industry Data Collection", who have made this publication possible. Eurostat is particularly grateful for contributions by:

- Danica Bizjak (Statistical Office of the Republic of Slovenia)
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Eurostat is continuing its work on environmental protection expenditure with the help of the Working Party. Work is focusing on further developing the SERIEE methodology with a view to compiling structured accounts of environmental protection expenditure. Further work will also focus on the links with physical data and the relevant economic instruments.

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1. Introduction

1.1 Background and policy context

The public has become increasingly aware of the need to protect the environment against pollution and waste. Environmental protection is now being integrated into all policy fields with the general aim of ensuring sustainable development. All activities inevitably affect the environment to some degree, which means that all sectors of the economy have their specific role to play in the overall efforts to minimise the negative consequences: government agencies and local authorities, companies involved in industrial or other businesses activities, businesses providing environmental services (such as collection and treatment of waste, or environmental consultancy), and households as consumers.

Much of the impact on the environment is a direct result of the production of goods or services. To encourage businesses to protect the environment, governments can use regulatory measures, or they can levy taxes directly linked to pollution or provide other economic incentives. The "polluter pays" principle is another weapon in the fight against pollution. Measures to protect the environment are also increasingly being taken on a voluntary basis – to meet the expectations of consumers or stakeholders, to increase market shares, or to improve the corporate image, for example. Environmental protection also creates new markets for environmental goods and services, with benefits for exports and employment. Statistics on environmental protection describe the various economic implications of these efforts.

The information could be used for a variety of purposes:

- to follow up and monitor the efficiency of environmental policy, applications of the “polluter pays” principle and the costs of compliance with environmental regulations, and to provide a basis for cost/benefit analyses for new environmental policy proposals (DG ECFIN 2004);

- to analyse the economic impact of environmental policy – for example, possible effects on the competitiveness of businesses (DG ENTER 2002);

- to analyse the need for environmental financing and to follow up and monitor specific support and investment programmes (EEA 2003);

- in environmental performance reviews, to show, for example, what action countries have taken to reduce the pressure on the environment, to serve as an indicator of the response from society for reducing environmental pressure in general, and as a sustainable development indicator (OECD 2001);

- as an internal tool to help businesses identify and minimise their costs and report to external stakeholders on action taken, and as input for financial analysts in their business evaluations (Envirowise 2003);

- as a basis for descriptions of the market for environmental goods and services (ECOTEC 2002).

1.2 Purpose, scope and organisation

The purpose of this handbook is to facilitate the collection of high-quality, comparable data on environmental protection by businesses. The legal framework for the statistics is Council Regulation No 58/97 on Structural Business Statistics, which was first adopted in December 1996 and subsequently amended several times. The Regulation provides a tool for developing regular collection of data on the variables and economic activities of the highest relevance to policy over the coming years.

It mainly focuses on the variables and sectors that are subject to obligatory reporting under the Structural Business Statistics Regulation – i.e. investments and current expenditure on environmental protection by industry (NACE 10-41 – mining and quarrying, manufacturing, energy and water supply).

The content is also valid for other business activities, however, even if they are not specifically addressed. The handbook also includes an overview of other indicators that could be used for

describing other aspects of the economic implications of environmental protection (e.g. the scale of the environment industry, payment of environmental taxes etc.).

The handbook gives examples of the different tasks involved in the survey process and makes recommendations on the basis of experience with data collection at Eurostat and in the Member States. Practical examples from various countries have been incorporated into the different chapters of the handbook in order to illustrate specific key issues.

The handbook is intended to provide a benchmark for statistical services in countries launching new surveys or revising or expand existing ones, and for consultation on specific issues arising when the surveys are being conducted.

1.3 Structure

The structure of the handbook in many respects follows the sequence of tasks in the survey process. Statistics are most useful when they permit reliable comparisons over space and time. Chapter 2 presents the common frameworks forming the basis for international comparisons in this field. The frameworks themselves are also a reflection of data requirements at international level.

The first step in the survey process is to translate user needs into detailed definitions of the field of study.

- Chapter 3 gives detailed definitions of environmental protection expenditure variables subject to statutory reporting requirements under the amended SBS Regulation.

The next step in the survey process is to decide how best to achieve your goals – the survey methodology. Chapter 4 describes the different phases in the data collection and dissemination process – from deciding on the type of survey and setting up measures to ensure good quality, to the interpretation and dissemination of results.

- Chapter 5 gives a few examples of how to present and interpret the results from existing data.

- An overview of the definitions of other economic variables and previous experience is given in Chapter 6.

The annexes include the detailed Classification of Environmental Protection Activities (CEPA 2000), lists of examples of investments and current expenditure by CEPA domain, a description of typical environmental impacts of different industries, the links between the collection of EPE and business accounting, and the legal definitions of the SBS variables.

2. Expenditure frameworks and data reporting

Users of statistics often compare and analyse statistics from different sources, expecting to obtain harmonised statistics that will be comparable throughout the world. Within this global context, which, of course, is still a long way off, various 'levels' of harmonisation can be distinguished:

- According to the concepts of the EU statistical system, data supplied by EU Member States should add up to the EU aggregates. This is the vertical dimension of European harmonisation.

- The various subsystems within the EU system should be mutually consistent – e.g. environment protection expenditure should be consistent with foremost the SBS Regulation. This is the horizontal dimension of international harmonisation.

- National statistical offices should ideally use identical terminology, concepts and definitions in their publications, and these should be the same as those used in EU publications, so as not to confuse users but to enable them to compare and relate data from different countries and different sources.

- The EU system should be consistent with the other international systems, such as those of the UN or the OECD.

To make data comparable is to define what is to be included and excluded. Harmonisation is possible only if there is a consistent system in which each survey complies as closely as possible with internationally established standards and concepts. Statistics on environmental protection expenditure concern the economic aspects of environmental activities. It is important to relate the information as far as possible to general standardised classifications and breakdowns and common definitions, such as the activity classification (NACE) and (SNA/ESA 95) to name but a few.

There are, however, also existing frameworks that deal specifically with information on environmental protection expenditure. These systems are in themselves a reflection of user needs and incorporation of basic data into the systems could be seen as one use for the data. Here, we will briefly describe the main legal framework that is particularly important for environmental protection expenditure statistics and the frameworks used for international data reporting. Later in the handbook, we will make recommendations for information systems used by businesses (see Annex 4). A third framework that also covers environmental protection expenditure is the environmental accounts framework. For further information on this, see the publications by the London Group[1].

2.1 Council Regulation on structural business statistics

Council Regulation 58/97 of 20 December 1996 on structural business statistics (SBS) is the main legal framework for collecting business statistics in the EU. The Regulation has been amended several times to take account of information requirements in new areas. It is accompanied by a number of Commission Regulations on technical issues relating to the practical implementation of the data collection requirements and setting out definitions of the variables subject to statutory reporting requirements and the breakdowns required.

Variables relating to environmental protection expenditure are included in Annex 2 to the Council Regulation, which is the detailed module for structural statistics in industry. The Regulation specifies the minimum amount of data to be provided in this area to meet the users' minimum requirements. The data reported under the SBS Regulation will also in the future be supplemented by the data collected on a voluntary basis by means of the Joint OECD/Eurostat Questionnaire on Environmental Protection Expenditure and Revenues, which will be briefly described later in this chapter. Variables on environmental protection expenditure included in the Regulation are:

[1] SEEA 1993 and SEEA 2003

21 11 0 *Investment in equipment and plant for pollution control, and special anti-pollution accessories (mainly end-of-pipe equipment)*

21 12 0 *Investment in equipment and plant linked to cleaner technology ('integrated technology')*

21 14 0 *Total current expenditure on environmental protection*

Council Regulation 58/97 is accompanied by a package of Commission Regulations (ComR).

- ComR on the definition of the variables subject to statutory reporting (existing 1670/2003, see Annex 5).

- ComR on the breakdown of the series of data to be produced (existing 1669/2003, see Annex 5).

- ComR on the technical format for the transmission of SBS data (1668/2003). Data are sent as a set of records of which a large part describes the characteristics of the country, year and economic activity etc. to which they relate.

- ComR on derogations granted for data reporting by countries (existing 1667/2003)

The original Council Regulation stipulated obligatory reporting of variable 21 11 0 only. Now that Regulation (EC) No 2056/2002 of the European Parliament and of the Council of 5 November 2002 amending Council Regulation (EC, EURATOM) No 58/97 on structural business statistics[2] has been adopted the statutory reporting requirements are the following:

- Investments in environmental protection (variables 21 11 0 and 21 12 0) shall be compiled annually;

- Total current expenditure on environmental protection (variable 21 14 0) shall be compiled every three years.

The three variables shall be broken down by:

- a total of 29 industry groupings (NACE 2-digit level, division), covering mining and quarrying, manufacturing, energy and water supply (NACE 10-41, excluding 37);

- four environmental domains: protection of ambient air and climate, waste-water management, waste management, and other environmental protection activities. The environmental domains are based on the CEPA[3]. "Other" in the SBS Regulation is defined as the sum of CEPA 4–9;

- size classes on the basis of the number of employees: 1–49, 50–249, 250+. No cut-off is provided for in the Regulation. Data reported should refer to the entire population of businesses, regardless of size.

[2] OJ L 317/1 21.11.2002f

[3] Classification of Environmental Protection Activities and Expenditures

2.2 International data reporting

The reporting of data at international level is bringing vital information into the hands of decision-makers. There are currently several larger international organisations that collect and publish data on environmental protection expenditure. UN-ECE, for example, has done work on developing methods, classifications and definitions for environmental accounts. The London Group on environmental accounts, which comprises representatives of several leading countries working under the UN, has published a revised handbook on the SEEA system (SEEA 2003). This handbook deals with all areas of interest for environmental accounts and includes a chapter on environmental protection expenditure. The most comprehensive collection of environmental protection expenditure is the Joint OECD/Eurostat questionnaire, which will be discussed in the next section.

2.2.1 Joint OECD/Eurostat questionnaire

The Joint OECD/Eurostat Questionnaire on Environmental Protection Expenditure and Revenues is the main tool for the international collection of data on environmental protection expenditure from the statistical services in the Member States. It is comprehensive in its coverage and includes all sectors of the economy (public, business, households and specialised producers of environmental services). The questionnaire also includes separate, more detailed tables on the business sectors.

The questionnaire includes economic variables relating both to expenditure for own environmental protection activities and to financing of environmental protection in other sectors. The variables relating to the business sector are listed in the table below together with references to the relevant chapters of this handbook.

Table 2.1: Differences between EPEA and JQ

Joint questionnaire	SERIEE EPEA (Table B)	SBS	Handbook
A. investment expenditure (A1+A2)	+ Gross fixed capital formation + Other capital uses (land)	21 11 0 +21 12 0	3.3
A1. End-of-pipe investments	NA	21 11 0	3.3.2
A2. Investments in integrated technology	NA	21 12 0	3.3.3
B. Total current expenditure (B1+B2)	+ Intermediate consumption + Compensation of employees	21 14 0	3.4
B1. Internal current expenditure	+ Intermediate consumption - Intermediate consumption of (market) EP services + Compensation of employees	p.21 14 0	3.4.3
B2. Fees/Purchases	Intermediate consumption of (market) EP services	p.21 14 0	3.4.3
C. Receipts from by-products	Non-environmental output (related products)	NA	5.1.1
D. Subsidies/Transfers	+ Subsidies on production + Current transfers + Investment grants received + Other capital transfers received + Earmarked taxes (specific taxes) – Table C	NA	5.2
NA	Consumption of fixed capital	NA	5.3
NA	Environmental taxes – Table C	NA	5.6

(Source: Conversion guidelines 2005)

Each variable is broken down into a number of different environmental areas or environmental domains.

- Air
- Waste-water
- Waste
- Soil and groundwater
- Noise
- Biodiversity
- Other (sum of Radiation, R&D and general environmental management, and other)

For more information on the differences, see the Conversion guidelines 2005.

3. Definitions and guidelines for environmental protection expenditure

3.1 Introduction

You can never ask good concise questions unless you do know exactly what it is you want to measure!

The next step in the survey process is to define and delimit the field of study. The definitions should be a translation of the needs expressed by different users, taking into account what is feasible in terms of statistics. First, the definitions are intended mainly for internal use – i.e. to make sure we know exactly what it is we would like to measure. How to convert these conceptual definitions into clear and concise questions is another matter, and is dealt with in Chapter 4.6.

There can be different and sometimes conflicting user needs. It is important that the definitions are broad enough to include all relevant items for the field of study and for the results to be valid for the users (and indeed respondents). However, it is also important not to mix apples and pears, for the results to be relevant, and for the definitions to be clear and precise. Environmental protection expenditure as defined here is first and foremost intended as a measurement the costs a business incurs with specific activities aimed at protecting the environment. The aim is to answer policy questions such as:

- How much money is spent on environmental protection?

- What are the effects on the competitiveness of the business?

This inevitably leads to restrictions in the definitions and the introduction of selection criteria that could be used to single out the information needed. Environmental protection expenditure is therefore one indicator of the response by society with a view to combating environmental pressure. It is not, however, claimed that it provides a full description of all changes in levels of pollution – indeed that would not even be possible. Everything we do has some kind of effect on the environment – including activities that do not result in any expenditure (e.g. changes in behaviour) or where there is no basis for separating out an environmentally-relevant component from the normal everyday activities of a business.

- To include the total expenditure for all these activities would leave us with a result that was not relevant.

- To separate out an environmental component in all these activities is impossible, since there is no basis.

The conceptual basis for Eurostat's definitions of Environmental Protection Expenditure is the European System for Collection of Economic Information on the Environment (SERIEE) and its Environmental Protection Expenditure Account (EPEA).[4] The Joint OECD/Eurostat Questionnaire on Environmental Expenditure has been established as a framework and tool for harmonised international data reporting in this field. The specific definitions relevant to industry data collection have been reviewed during the past few years with a view to:

- defining the statutory reporting requirements of the SBS variables;

- ensuring that the definitions are as complete, up-to-date and policy-relevant as possible;

- ensuring that the data collected from different countries are harmonised, comparable and of good quality;

- providing guidelines for companies that would like to follow the Commission recommendations for measuring and disclosing this information.

[4] SERIEE (1994), SERIEE Compilation Guide (2002)

This information on environmental protection expenditure could in some cases be supplemented by other indicators to provide a more complete picture of the economic implications of environmental protection (e.g. the scale of the environment industry, payment of environmental taxes etc). Chapter 6 contains a description of other variables relating to environmental protection that might be of interest in this regard.

3.2 General definition of environmental protection expenditure

Businesses are involved in many different types of activities, the main one being the production of goods and services sold to third parties. Then there are a number of support (ancillary) activities, such as administration, staff training, repairs and renovation, warehousing, marketing etc. The results (output) of these activities are intended for the business's own internal use and are not sold.

Environmental protection is also a support activity needed to allow businesses to produce their goods and services (because of the business's own concerns, market strategy, demands from regulators or customers etc). The aim of environmental protection expenditure statistics is to record separately expenditure relating to this ancillary activity. This includes the use of capital goods and equipment, and staffing (internal current expenditure), and the purchase of services (e.g. waste-treatment).

The following 'general clause' summarises the general definition relevant for reporting environmental protection expenditure by businesses. It consists of a number of separate but interlinked parts, which will be discussed in further detail in the following chapters.

Environmental protection expenditure is the sum of capital and current expenditure on environmental protection activities.

Environmental protection is an activity (involving the use of equipment, labour, manufacturing techniques and practices, information networks or products) where the main purpose is to collect, treat, reduce, prevent or eliminate pollutants and pollution or any other degradation of the environment resulting from the activity of the business.

Environmental protection expenditure may relate to activities that generate marketable by-products or results in savings, or are financed by subsidies or capital allowances. In such cases, environmental protection expenditure should be reported gross of any such cost offsets.

(Source: SERIEE 1994 § 2007 *et seq.*)

3.2.1 Environmental protection activities – treatment or prevention

The general definition states in broad terms what constitutes an environmental protection activity: i.e. *collecting, treating, reducing, preventing or eliminating pollutants and pollution or any other degradation of the environment*. This is a recognition of the fact that environmental protection activities and the corresponding expenditure can be divided into two separate categories on the basis of the nature and function of the activity (apart from some general activities, such as administration) – i.e. "pollution treatment" and "pollution prevention".

This is an important division which makes it possible to relate the information more closely to important policy issues in the field, where in particular the move towards the prevention of pollution is high on the agenda (see, for example, Chapter 7).

This should also be a natural distinction for the respondent, particularly for classifying investments, but it may sometimes be less obvious for parts of the total current expenditure on environmental protection. This division is therefore used to divide investments into two separate variables, whereas in the SERIEE it is only recommended for showing how much of current expenditure is devoted to treatment as opposed to prevention, and is not laid down in the Regulation.

Pollution treatment

"Pollution treatment" is defined as *methods, practices, technologies, processes or equipment designed for collecting and removing pollution and pollutants (e.g. air emissions, effluents or solid waste) after their creation, treating and disposing of the pollutants, and monitoring and measuring the level of pollution*[5] Pollution treatment mainly involves the use of "end-of-pipe" methods, techniques or equipment (e.g. air emission filters, waste-water treatment plants, waste-collection and -treatment activities). A more detailed description follows in Chapter 3.3.2.

Pollution prevention

"Pollution prevention" is defined as *methods, practices, technologies, processes or equipment designed for preventing or reducing the pollution created at the source thereby reducing the environmental impacts associated with the release of pollutants and/or polluting activities*[6].

Prevention of pollution can be an integral part of the production process.

Prevention of pollution may involve various types of activity, e.g.:

- modifying equipment or technology;
- choosing new, improved technology;
- reformulating or redesigning products;
- substituting cleaner and/or renewable raw materials;
- changing practices, e.g. improving housekeeping, maintenance, training or stocktaking (environmental management).

This is dealt with in greater detail in Chapter 3.3.3.

3.2.2 The Classification of Environmental Protection Activities and Expenditure

The scope of environmental protection is also further defined in the Classification of Environmental Protection Activities and Expenditure (CEPA 2000). CEPA 2000 is a recognised international standard, adopted by the UN Statistical Commission, and included in the Family of International Economic and Social Classifications. CEPA is used world-wide as a tool both for defining environmental protection and for presenting results.

CEPA classifies environmental protection activities and expenditure in nine main areas known as "environmental domains" (see below). Each domain is then further divided into categories and subcategories, which are described in detail in the accompanying explanatory notes and definitions (the full CEPA is available in Annex 1).

[5] OJ L 244 2003 p.8
[6] OJ L 244 2003 p.9

CEPA 2000

1. Protection of ambient air and climate

2. Waste-water management

3. Waste management

4. Protection and remediation of soil, groundwater and surface water

5. Noise and vibration abatement (excluding workplace protection)

6. Protection of biodiversity and landscapes

7. Protection against radiation (excluding external safety)

8. Research and development

9. Other environmental protection activities
(Including general environmental administration and management, education, training and information, indivisible expenditure and expenditure not elsewhere classified)

Environmental protection expenditure is the sum of expenditure in the nine environmental domains, but a more aggregated grouping is often used in statistical surveys. The appropriate level of detail will depend both on the needs of the different users, and on the relative importance of the domains in terms of expenditure (so as to limit the size of the category "other"). At international level:

- The Joint OECD/Eurostat Questionnaire on Environmental Expenditure separates out CEPA 1-6 while CEPA 7-9 are aggregated into a category "other".

- The SBS Regulation stipulates that the minimum breakdown of the variables subject to obligatory reporting is four aggregate categories: Protection of ambient air and climate (CEPA 1), Waste-water management (CEPA 2), Waste management (CEPA 3) and Other environmental protection activities (CEPA 4-9).

CEPA specifies that environmental protection expenditure should be classified in environmental domains according to the purpose of the activity, taking account of both the technical nature and the purpose of the activity in terms of policy. Activities and expenditure that affect more than one environmental domain (including administration) should be allocated to the different domains involved, through the use of estimates, if necessary. Expenditure should be classified in CEPA 9 "indivisible expenditure and activities" (or "other") only as a last resort.

Experience suggests that an investment may affect different media, but is often driven by the need to reduce one specific environmental pressure. If allocation by domains is not possible, therefore, such expenditure items (e.g. a specific investment) could be classified according to the main domain (purpose). See example 3.1 below.

Example 3.1 Sweden: Sweden collects all information regarding investments and current expenditures by means of a questionnaire. The respondent has to state whether the investment is for preventing or treating pollution and what main environmental area the new asset concerns. As the respondents also enter a technical description of the investment, quality checks are easily made. Knowing whether the respondent has correctly understood the purpose of the questions is less of a problem therefore. This approach also provides the staff at Statistics Sweden with a very useful tool for identifying the correct domain for their data.

3.2.3 Selection criteria

Selection criteria are needed for distinguishing what belongs to the support activity of environmental protection from what belongs to the other activities of the business. The general definition contains an *environmental purpose criterion*. But how should this be interpreted? The starting point is the description of environmental protection activities (pollution treatment or pollution prevention) and the CEPA categories mentioned above.

Example 3.2 Eurostat: The environmental purpose criterion should be applied in connection with the function of the measure implemented. This means that all activities (and parts thereof in the case of "integrated" solutions) where the primary function is environmental protection are included, regardless of whether they are undertaken in response to environmental legislation, to meet demands of customers, to increase market shares or to improve the corporate image.

Comparing these descriptions with descriptions of measures by businesses will yield a list of measures that clearly belongs to the support activity of environmental protection. For our purposes, we assume (by default) that the main purpose for taking these measures is environmental protection.

Just describing environmental activities is not enough, however. There is a need for an additional criterion that could be used for treating multipurpose or multifunction activities.

The environmental purpose criterion should be applied by means of comparison with the normal operating activity of the business, whereby activities beneficial to the environment that would have been taken regardless of environmental protection considerations are not considered as environmental protection activities.

There are a large number of activities that may have a favourable effect on the environment but whose main purpose is not environmental protection. The expenditure associated with these activities should not be reported as environmental protection expenditure[7]*.*

The aim is not to try to identify an environmental component in everything the business does, but rather to single out a few specific activities that are clearly guided by environmental considerations. When the main direct function or effect is normal production and not environmental protection, only part, if any, of the expenditure should be included (extra cost, environmental share). This could also be used to check the expenditure reported by businesses. This means that you include only measures that are clearly driven or motivated by environmental considerations, but exclude all other measures regardless of their effect.

3.2.4 Criteria for estimating expenditure

However, it is not enough to separate out activities; you need to be able to separate out expenditure as well. There are three possibilities for doing this.

Specific measures

When the only direct function or effect of the equipment (measure) is environmental protection, the total amount of expenditure is considered as environmental protection expenditure.

- This would include all expenditure on end-of-pipe type of equipment such as filters, waste containers, sewage-treatment plants etc. (regardless of the purpose, as there can be no other purpose or possible profitability);
- This would also include biological cleaning systems, catalytic converters and enclosed cooling systems among other measures.

Specific parts

Some cases are harder to determine. The view taken of the investment is crucial for deciding what category it should come under. Sometimes an investment can be seen either as the total cost of a specific measure *or* as the cost of a specific part, i.e. a proportion of the total investment.

[7] SERIEE 1994, § 2007

Example 3.3 Eurostat: It is difficult to determine the proportion of a pollution prevention investment that can be considered to be environmental. For example; if a business that previously used filters for treating emissions decides to invest in brand-new equipment that, among other things, emits less without filters, how much of the investment would be regarded as expenditure on environmental protection? The business would first have to make an active environmental choice. It would then have to find a comparable investment that did not have any positive effects on the environment so that the proportion of the cost of the equipment that can be regarded as expenditure on environmental protection can be estimated. If there are no such investments to compare with, the newly purchased investment will not be considered as involving any environmental protection expenditure.

Specific choices

The only remaining possibility is to identify expenditure relating to a specific choice made by the business. This is applied mainly in the case of multipurpose or multifunction measures that are driven or motivated by environmental considerations.

If the measure would not have been taken at all, had it not been for the intended environmental effects, then the total expenditure should be reported as environmental protection expenditure.

Example 3.4 Sweden: A business in the timber industry was required by the surveying authorities to reduce the release of pollutants into water. Much of the pollution came from the storage of timber, since the timber is watered and this creates a run-off to the surface water. There is a correlation between the amount of water used and the amounts released into the water. The business decided that the best way to reduce the pollution was to invest in equipment that minimised the amount of water needed. It would not have made this investment had it not been for the instruction from the local authorities to reduce the amounts of pollutants released. The reduction in the amount of water used obviously also leads to some reduction in costs, but water is readily available in Sweden at low prices.

If another, less expensive, measure might have been chosen had it not been for the intended environmental effects, then the extra cost for the specific choice of measure should be reported as environmental protection expenditure.

When it is impossible to identify expenditure for a specific measure, a specific part or a specific choice, there is no basis for recording any environmental protection expenditure. In these cases, we have to assume that economic sense is the predominant factor, even if the measure has an environmental effect that may have affected the decision.

3.2.5 Decision tree for reporting environmental protection expenditure

The decision tree below illustrates schematically how a business could retrieve relevant information and how environmental protection expenditure could be estimated. The questionnaire has essentially been designed in such a way as to guide companies through such a decision tree. Usually it is both necessary and useful to make some simplifications in the guidelines for businesses, particularly if the expenditure is difficult to estimate or if it would not have much effect on the total expenditure reported by the business. In some cases there is a need to dedramatise the subject. In the interests of quality and coverage, a useful general guide is to try to make the businesses focus on the most important items, the largest investments and items of current expenditure. It is likely anyway that businesses responding to expenditure questionnaires will to some degree make the necessary simplifications even without specific instructions. It is also necessary to provide more details and illustrative examples to ensure that businesses understand the concepts in the same way as we do.

Surveying businesses, the first aim is to try to make them think of what they have done the past year to reduce their impact on the environment (waste management, reduced air emissions, improved overall eco-efficiency etc.). This will produce a rough list of measures to be considered when filling in the questionnaire (Question 1 in the tree). The purpose of the following questions is identifying different types of measure involving different types of cost estimation.

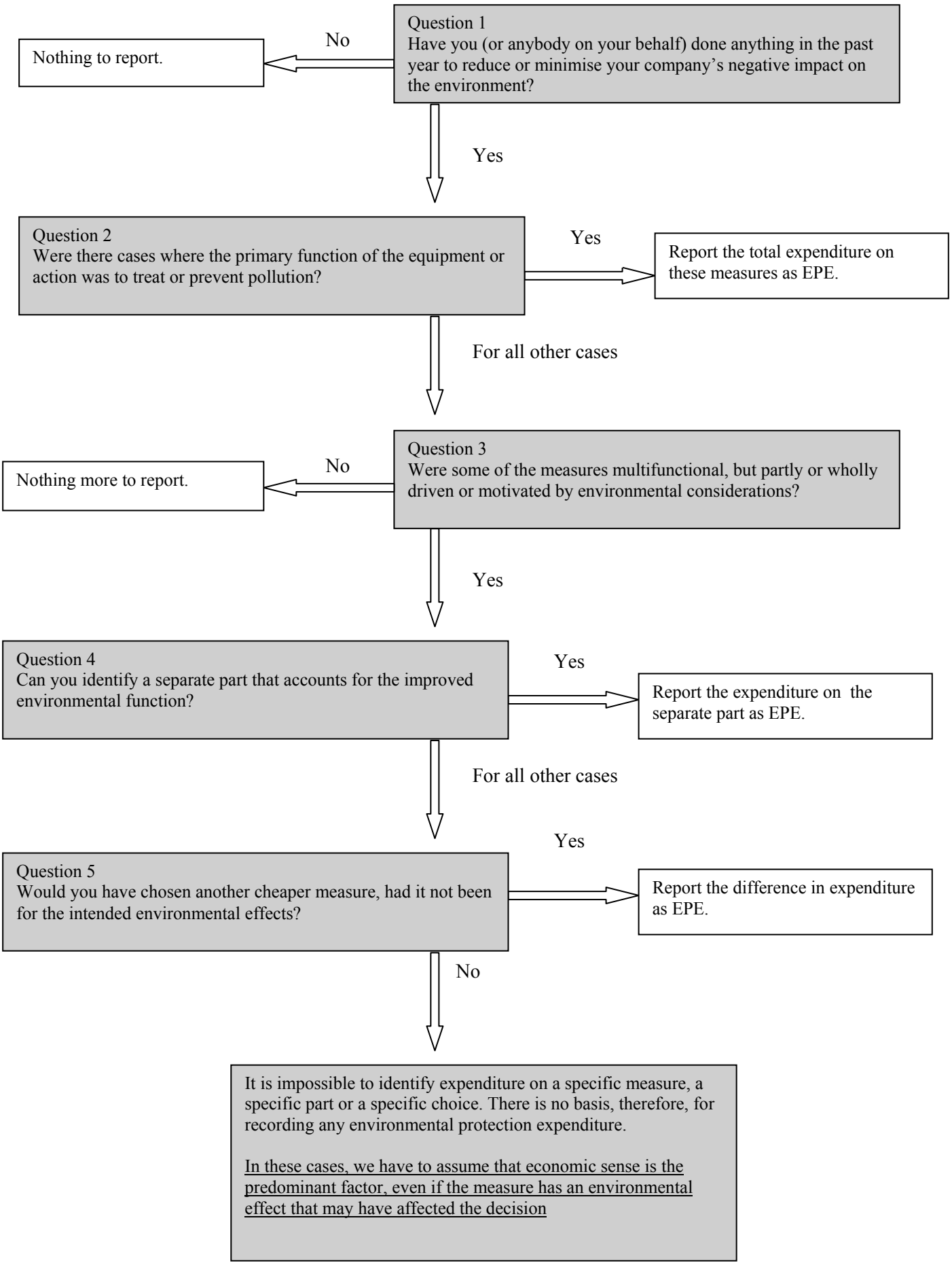
The second aim is to identify measures where the main function is environmental protection and the total cost would be reported regardless of the driving force.

The third aim is to ensure that the remaining measures on the list are multifunctional activities that are clearly driven by environmental considerations. As we have seen, there are three possibilities for estimating environmental expenditure on such measures.

- The first is to identify a separate part that accounts for the environmental effects and to estimate the expenditure for this separate part (Question 4).

- The second is to identify an extra cost relating to a specific choice. In this case the extra cost compared to the alternative without the intended environmental effects would be reported as environmental expenditure (Question 5).

There will inevitably be some measures that have improved the environmental performance of the business but no environmental protection expenditure can be reported. It is important to avoid giving the impression that we would like an environmental component for most of the respondent's investments. That would result either in too high figures, mostly based on a rule of thumb, or a refusal to answer because the response burden was thought to be unacceptable. It is also important to get the point over that the reason for not including these measures is not that they are unimportant, but rather that they are so fully integrated into the normal operating activity of the business that it is impossible to speak of and identify environmental protection expenditure.


Question 1
Have you (or anybody on your behalf) done anything in the past year to reduce or minimise your company's negative impact on the environment?
No
Nothing to report.
Yes
Question 2
Were there cases where the primary function of the equipment or action was to treat or prevent pollution?
Yes
Report the total expenditure on these measures as EPE.
For all other cases
Question 3
Were some of the measures multifunctional, but partly or wholly driven or motivated by environmental considerations?
No
Nothing more to report.
Yes
Question 4
Can you identify a separate part that accounts for the improved environmental function?
Yes
Report the expenditure on the separate part as EPE.
For all other cases
Question 5
Would you have chosen another cheaper measure, had it not been for the intended environmental effects?
Yes
Report the difference in expenditure as EPE.
No
It is impossible to identify expenditure on a specific measure, a specific part or a specific choice. There is no basis, therefore, for recording any environmental protection expenditure.
In these cases, we have to assume that economic sense is the predominant factor, even if the measure has an environmental effect that may have affected the decision

3.2.6 Treatment of specific examples

The general definition, the "general clause" in the SERIEE, also provides guidance on how to treat some specific examples.

Operating activity of the business

First of all, environmental protection expenditure is recorded at the unit (business) where the pollution is generated. This includes environmental protection activities in all parts of the operating activity of the business (purchasing, production, operation, maintenance, training, logistics, housekeeping, etc.). This coincides with the sphere of influence and responsibility of the business.

These activities can either be undertaken by the business itself or on its behalf by others (e.g. waste-management services, environmental consultants etc.). This means that environmental protection expenditure includes fees, charges and similar payments (whatever they are called) to external entities (outside the reporting unit) in exchange for environmental protection services relating to the environmental impact of the operating activity of the business.

However, these payments must be clearly linked to an activity which treats or prevents pollution generated by the business. Fees, charges and similar payments (whatever they are called), including environmental taxes that are not linked to purchasing such an environmental service are excluded, even if the government authorities have earmarked the revenue for financing other environmental protection activities (please see chapter 6.6 for more information about environmental taxes).

In addition to ancillary environmental protection activities, some units offer commercial "environmental protection services" (waste collection and treatment, waste-water treatment, environmental consultancy services etc.). These are mainly businesses whose main activity is energy production or water supply (NACE 40-41) and are often owned by local government. Expenditure on these activities should be excluded from the data on EPE by businesses, but if possible reported separately in the same way as for units that specialise in producing environmental services (usually classified as primary activity NACE 90).

Excluded from environmental protection expenditure as defined here are measures that aim to reduce pollution when products are used or scrapped (environmental modification of products). The exception is when environmental policy and regulation extend the liability of the producer to cover pollution generated by the products when used, or when they become waste. Environmental policies of this kind nowadays exist mainly in the field of waste, where producers may be responsible for the final treatment of the products as waste. In this case expenditure to be reported includes:

- Expenditure on the treatment of the products as waste (similar treatment to the waste generated by production), either by the business itself or in the form of payments for collection for treatment outside the business.

- Expenditure that facilitates the final treatment of the products as waste – e.g. simplifies dismantling.

The reasons for this delimitation are both conceptual and practical. There is a risk of double counting if you add expenditure relating to production and to products. Nor has a methodology yet been developed for recording expenditure on the environmental modification of products that could form a basis for comparable statistics on these aspects. Until this is the case, any collection of data on these aspects needs to be distinguished from what has been defined as environmental protection expenditure (see Chapter 6.4). Another possibility for recording these activities is to focus on the scale of production of these products rather than the expenditure on environmental modification (see Chapter 6.9 for further details).

Primary purpose

We have already seen how we use the environmental purpose criterion to distinguish what belongs to the support activity of environmental protection from what belongs to the other activities of the business. In addition to the examples given already, the application of this criterion means that measures primarily geared to health and safety at the workplace, including production safety, are excluded. Measures to protect a machine or fuel storage facility from explosion or fire, for example,

are part of normal production safety and do not lead to environmental expenditure, since most expenditure aimed at preventing technological disasters are a technical necessity unrelated to an environmental motive and should not be included under environmental protection[8].

However, specific measures to prevent environmental hazards are included – e.g. prevention of pollutant infiltration from storage of waste or waste-water, safety measures linked to the transport of toxic substances or hazardous waste (including high-level radioactive waste)

Environmental protection however includes measures directly or indirectly directed towards 'external' health issues (surrounding community) concerning, for example, air quality, spread of toxic substances or radiation.

Example 3.5 Sweden: An energy company specialises in building and operating energy networks. It claims that "magnetic fields" are their main 'environmental' concern and has received clear demands from the authorities and their customers to limit the magnetic fields to which the people living close to the networks will be exposed. This has led to specific measures and specific expenditure clearly linked to the reduction of magnetic fields. This constitutes environmental protection expenditure.

Resource-use and cost-saving activities are excluded (e.g. water supply or the saving of energy or raw materials), unless the primary purpose is environmental protection – for example, when these activities aim at implementing national or international environmental policy and are not undertaken in order to cut costs. Examples could include additional expenditure associated with switching to materials or processes that reduce pollution (e.g. solvent-free paints, low-sulphur fuels or renewable resources). In the case of renewable energy sources, examples could include:

- Modification of existing facilities (either when the energy generated is used by the business itself, or when it sells the energy).

- Possible additional expenditure associated with new facilities based on renewable energy sources.

- Possible additional expenditure associated with the use of renewable resources as production input.

Here too there are both conceptual and practical reasons for making these distinctions. First of all, many of these measures are indistinguishable parts of the normal operating activity of the business. The exception is specific appliances, but these are likely to be fairly insignificant compared with the total efforts to save energy. Secondly, these measures are in most cases by definition (often highly) profitable, which also makes it conceptually difficult to speak of "environmental protection expenditure". For more on the reporting of resource management issues, see 6.5.

EP activity (ancillary)

Expenditure needs to be related to an activity which either treats or prevents pollution. This means that loss of income, compensatory charges, fines, penalties and similar are excluded. Also excluded are donations to environmental causes, as these are not related to pollution from the operating activity of the business and are often made at least partly for tax purposes (i.e. would have been made regardless of any environmental protection considerations). Payments for insurance for environmental liabilities should similarly be excluded since these do not relate to an environmental protection activity. In cases where it would be useful to record these types of costs too, they need to be kept separate from what is recorded as environmental protection expenditure (see Chapter 6.8).

8 The reason for excluding "external safety" from class 7 is the assumption that this class mainly concerns nuclear power plants (and military installations in some countries). A large part of the costs of building a nuclear power plant is accounted for by the prevention of technological hazards (of the Chernobyl variety) – i.e. reinforced concrete containment, extra cooling systems etc. The same may be true of part of annual operating costs (safety checks, staff costs etc.). When CEPA 2000 was being drawn up it was thought that most expenditure aimed at preventing technological disasters at nuclear power plants were a technical necessity unrelated to an environmental motive and should not be included under environmental protection.

Only actual outlays on activities undertaken during the reference period are included. This means that calculated cost items such as depreciation of environmental equipment or capital losses due to forced replacement are excluded (i.e. the non-depreciated value of the existing equipment that can no longer be used because of environmental legislation).

There are various reasons for this exclusion. The investment is directly linked to the moment in time when payment has to be made and effects on the environmental impact could be expected. The annual capital costs could also be of interest, but these are more linked to financing aspects. This is usually not surveyed. The main reason is that what a business accounts for as depreciation is highly dependent on financial considerations (e.g. minimising tax payments). The tax rules allow quite a lot of freedom in accounting for this component. Consumption of fixed capital is included in the SERIEE expenditure accounts, but then calculated according to a method similar to the one used by the national accountants (see 6.3). This is difficult and requires quite a lot of information, however, (long time-series on investments are only the beginning), and has not been done in many countries. Depreciation of environmental equipment is excluded from the JQ, therefore, and depreciation is not included in the SBS Regulation.

3.3 Environmental protection investments

Environmental protection investments include all capital expenditure relating to environmental protection activities (involving methods, technologies, processes, equipment or parts thereof), where the main purpose is to collect, treat, monitor and control, reduce, prevent, or eliminate pollutants and pollution or any other degradation of the environment resulting from the operating activity of the business[9].

Total investment in environmental protection is the sum of investment in pollution treatment (3.3.2) and in pollution prevention (3.3.3), distinguished by the nature and function of the activity.

Investments can be in a number of things: machinery, equipment, buildings, land etc. There are specific and detailed definitions and guidelines for these economic variables in the national accounts, business statistics, business accounts etc. (although these are not always identical). The environmental expenditure variables should follow the same definitions. Businesses will most likely use the same definitions for the environmental protection as they use in their business accounting system (e.g. what to include as investments).

3.3.1 The “economic” definition of investments

The definition of investments is based on the accounting standards applied by the business in its bookkeeping, in compliance with EU accounting standards – in other words, these are items of expenditure that qualify for recognition as assets[10]*.* This means that investments are intended for use on a continuing basis for more than one year for the purpose of the business's activities. If they are to count as an investment with an environmental protection dimension, they must also meet one of the following criteria:

- The costs relate to economic benefits that are expected to accrue to the business and extend the life, increase the capacity, or improve the safety or efficiency of other assets owned by the business (beyond their originally assessed standard of performance).

- The costs reduce or prevent pollution that is likely to occur as a result of future operations of the business.

Recommended definitions of investments for statistical purposes can be found in *Commission Regulation (EC) No 1670/2003 - "Definition of characteristics for Structural Business Statistics*" in Annex 5. A summary of these definitions are given below as a guide. Investments in environmental protection consist mainly of gross investment in tangible goods, but could in principle also include other types of capital expenditure.

[9] (EC) No 1670/2003
[10] SNA 93, §10.7

Tangible goods

The existing SBS Regulation includes definitions of economic variables. Environmental protection investment is part of the variable “Gross investment in tangible goods” (15 11 0), which in turn is the sum of the variables

- Gross investment in land (15 12 0)
- Gross investment in existing buildings and structures (15 13 0)
- Gross investment in construction and alteration of buildings (15 14 0)
- Gross investment in machinery and equipment (15 15 0)

Gross investment in tangible goods includes investments during the reference period in all tangible goods, comprising new and existing tangible capital goods, whether bought from third parties or produced for own use (i.e. capitalised production of tangible capital goods) having a useful life of more than one year, and including non-produced tangible goods such as land. Also included are all additions, alterations, improvements and renovations that prolong the service life or increase the productive capacity of capital goods. As described above the two criteria are still valid for the investments in tangible goods to count as an environmental investment, also read more in 3.3.2 and 3.3.3.

Capital expenditure should be reported in the same period as it is recorded in the company's financial accounts (including measures where the invoicing, delivery, payment and first use of the item in question take place in different periods). The normal treatment of large investment projects covering several years would be for the company to capitalise the part that has been completed each year (the accrued payments during the year).

Gross investments in tangible goods should be valued as follows:

- purchased goods are valued at purchase price, i.e. transport and installation charges, fees, taxes and other costs of ownership transfer are included;
- own-produced tangible goods are valued at production cost;
- investments are valued prior to (i.e. gross of) value adjustments, and before the deduction of income from disposals[11].

Excluded are:

- goods acquired through restructuring (such as mergers, take-overs, break-ups, spin-offs);
- purchases of small tools which are not capitalised (these should be reported under current expenditure);
- current maintenance costs, and the value of and current expenditure on capital goods used under rental contracts.

Other capital expenditure

Any investments in intangible assets or financial assets used for environmental protection should be included if these have been capitalised in the company’s accounts.

11 This comes from the definition of the SBS variable 15 11 0 – Gross investment in tangible goods. It is not specifically mentioned in the legal definition of environmental variables, but there is a reference to the variable «gross investment». It is in line with the general concept of recording gross outlays during the year, without any sort of reduction. However, this definition is different from the concept of GFCF used in national accounts and in environmental expenditure accounts (SERIEE) where deductions are made for income from disposals.

Any tangible goods used for environmental protection acquired through financial leasing should be included if these have been capitalised in the company's accounts. The value of tangible goods acquired through financial leasing has been defined in Commission Regulation (EC) No 2700/98 – Definition of characteristics for Structural Business Statistics (variable 15 31 0):

- the value to be recorded corresponds to the market value of the item if it had been purchased. This value is in principle known in the contract, or can be estimated by summing up the instalments that cover the capital reimbursement. The value should be recorded at the time when the item is delivered to the leaseholder.

- the instalments corresponding to the interest payments should be excluded;

- annual payments for assets under financial leasing should be excluded;

- the value of goods used under leases other than financial should also be excluded;

- if financial leasing of environmental equipment is not capitalised in the company's accounts, annual payments for assets under financial leasing should be reported as current expenditure.

3.3.2 Pollution treatment (end-of-pipe)

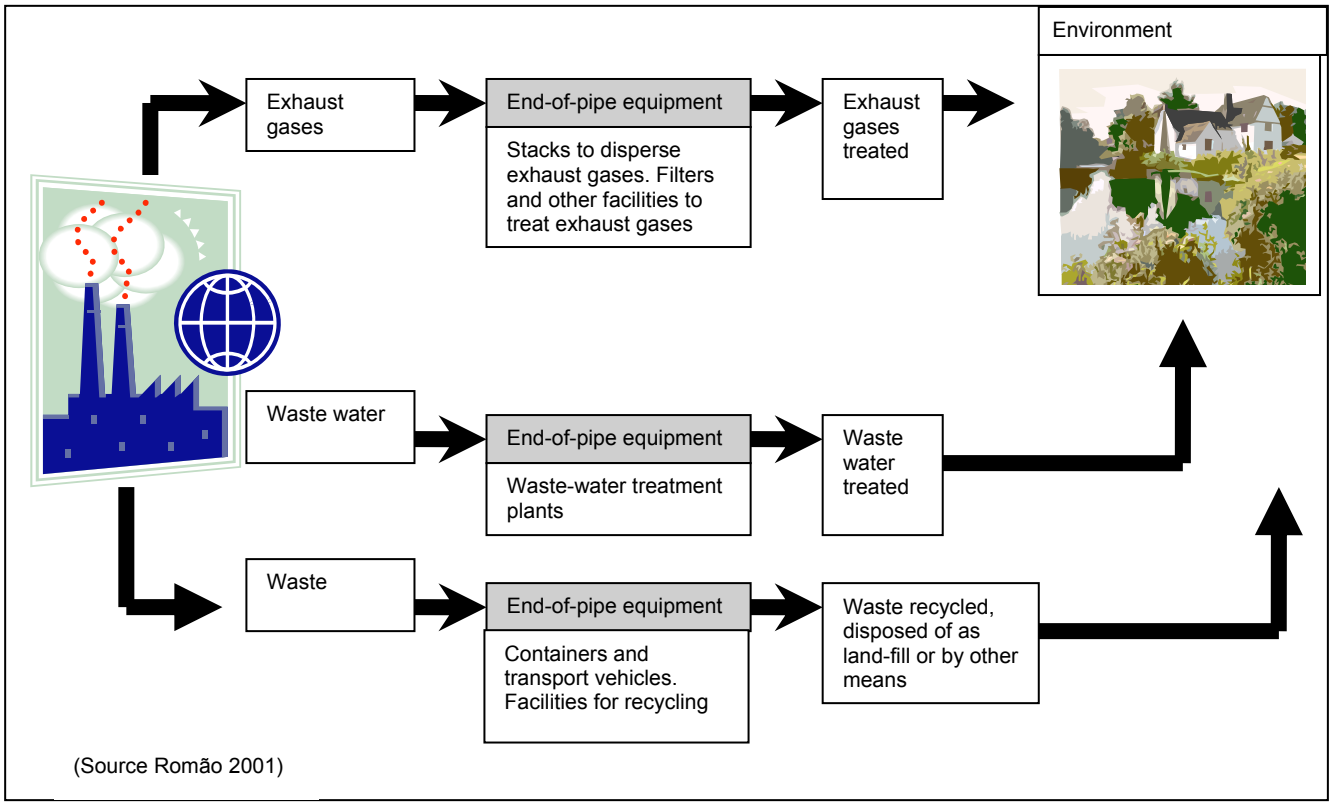
Pollution treatment investment is defined as capital expenditure on methods, technologies, processes or equipment designed for collecting and removing pollution and pollutants (e.g. air emissions, effluents or solid waste) after their creation, preventing the spread and measuring the level of the pollution, and treating and disposing of pollutants generated by the operating activity of the business[12].

I. Pollution treatment investments include distinct, identifiable components supplementing existing equipment, which are implemented at the end of, or completely outside, the production line ("end-of-pipe" equipment).

II. Pollution treatment also includes investment in equipment (e.g. filters or separate cleaning stages) that concentrate or extract pollutants in the production line, if the removal of these facilities would not generally affect the functioning of the production line.

The main purpose or function of the methods, technologies, processes or equipment is environmental protection by definition and the total expenditure for these should be reported as environmental protection expenditure.

[12] (EC) No 1670/2003



Other terms used for pollution treatment investments are end-of-pipe investments, add-on facilities or process-external investments. The table below gives a few illustrative examples of pollution treatment investments in different environmental domains. A more detailed list is given in Annex 2.

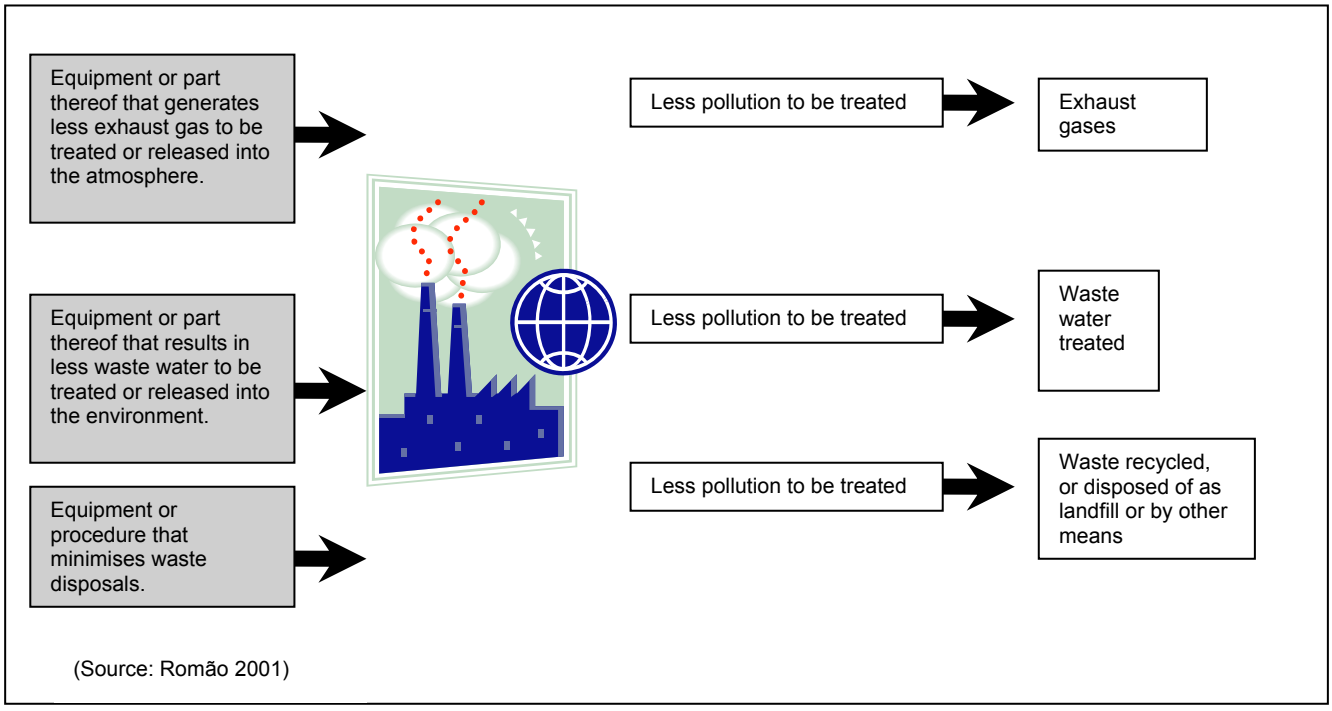
Examples of pollution treatment investments in different environmental domains

Protection of ambient air and climate	Various types of filters, scrubbers, cyclones, centrifuges, etc.
	Coolers and condensers to treat process gases
	Equipment for thermal and catalytic combustion of process gases and other measures involving combustion technology
	Measures to restrict dust problems including those in connection with transport and storage
	Measuring equipment
Waste-water management	All investments in own waste-water treatment plants
	Dams and tanks for storage of waste water
	Oil separators, sedimentation basins, neutralisation basins
	Equipment for handling and treating sludge
	Costs associated with connection to municipal waste-water treatment plants
	Measuring equipment
Waste management	Equipment for own storage and transport, e.g. special vehicles, containers, transfer stations, sorting equipment
	Equipment for own treatment, e.g. compressors and all investments in own landfill sites
Other	*Noise pollution*: various materials and measures to reduce noise pollution, e.g. enclosure of equipment, sound-proofing, noise barriers, etc.
	Landscape and biodiversity: examples include planting barriers of trees to hide a building
	Protection of soil, and groundwater: Equipment for cleaning up polluted soil

3.3.3 Pollution prevention (integrated technologies)

While pollution treatment investments treat pollution already generated, pollution prevention involves changes in production, operating processes, or the raw materials used in order prevent or reduce pollution at the source.

Pollution prevention investment is defined as capital expenditure on new, or modification of existing, methods, technologies, processes, equipment (or parts thereof) designed to prevent or reduce the amount of pollution created at the source, thereby reducing the environmental impacts associated with the release of pollutants and/or with polluting activities[13].



(Source: Romão 2001)

There are two types of preventive investment: separately identifiable and integrated.

[13] (EC) No 1670/2003

Separately identifiable

The first type includes investment in pollution prevention involving distinct, separately identifiable (environmental components of) methods, processes, technologies and equipment. The main purpose or function is by definition environmental protection and the total expenditure on the (environmental components of) methods, processes, technologies, equipment should be reported as environmental protection expenditure.

Modification of existing equipment

The first category is modification of existing equipment and processes so as to generate less pollution. Environmental protection could be the sole, main or subsidiary purpose of the activity. Examples could include investments needed when a business changes to a more environmentally-friendly input e.g. solvent-free paint or modifications to a furnace when the business changes over from oil to renewable energy sources. These investments could clearly be separately identifiable.

Specific function and purpose

The second category comprises investments where the main purpose is to reduce pollution.

Example 3.4 (cont.): In Sweden a business in the timber industry was required by the surveying authorities to reduce the release of pollutants into water. The total amount was classified as integrated investment in the water domain. Another example could be the obligatory replacement of an existing process or technology that would otherwise remain in use. A ban on cleaning solvents, for example, may mean that equipment has to be replaced sooner.

Integrated

Pollution prevention also includes capital expenditure on methods, processes, technologies and equipment that are integrated with the overall operating activity (production process/installation) in a way that may make it difficult to identify separately the pollution-prevention component[14]*.*

- *In these cases ("integrated measures"), only the environmental-protection component in the total investment should be reported as expenditure on environmental protection.*

- *This component corresponds to the additional cost of the selected investment over and above the capital expenditure that would have been incurred had it not been for the environmental protection considerations.*

- *The alternative for comparison therefore corresponds to the cheapest alternative available to the business that has similar functions and characteristics in all respects except for those relating to environmental protection.*

- *When the selected option is standard technology and there is no cheaper, less environmentally beneficial alternative available to the business, the measure is by definition not an environmental protection activity, and no environmental protection expenditure should be reported"*

This category comprises cases where the investments are partly driven or motivated by environmental considerations but the main purpose is usually production. When a specific measure or a specific component cannot be identified, the only remaining possibility for identifying a possible extra cost for environmental protection is to go back to the time when the decision to implement the measure was taken – that is to say, when a new item of equipment was bought that was needed for the normal operation of the business and the business chose a variant (or a specific modification) that was more beneficial to the environment than it would have chosen if it had disregarded environmental considerations.

[14] (EC) No 1670/2003

Some businesses argue that there is no easily defined alternative (reference) technology that could be used for estimating extra costs because the investments are largely company-specific, i.e. adapted to the particular situation of the individual company (e.g. chemical processes). The idea is, however, not to identify a precise piece of equipment but to obtain a reference providing an approximation.

A reference technology and an agreed price for such a technology would make it easier for a statistical office to estimate the extra cost when a business cannot. However, the alternative for comparison is what was available to the individual business when it made the investment decision. This means that the alternative for comparison will inevitably differ from one country to another. What could be seen as a large improvement in environmental performance in a developing country would be considered standard technology in more developed countries. It is important to bear this in mind when the data is being used, but it does not mean that data from different countries cannot be compared. Rather it is perfectly consistent with the specific purpose of the statistics, which is to record extra costs attributed to environmental protection.

It is also likely that the once "cleaner" technology will eventually become the standard or reference technology, and there will no longer be any identifiable environmental expenditure. The somewhat paradoxical result is that end-of-pipe equipment will always remain environmental expenditure, while various types of integrated investment will appear, count as environmental protection for a limited time and then disappear as they become standard. This is a mechanism that stabilises the relative proportions of the two types of investment, but it is consistent with the main purpose of the statistics – i.e. to compare extra costs or effects on competitiveness between countries.

The box below gives some examples of how an extra cost for environmental protection might be estimated by going back to the time of the investment decision.

TEXT BOX 3.1. Identification of environmental protection expenditure in the investment decision

A. Assumption that the options are equally efficient

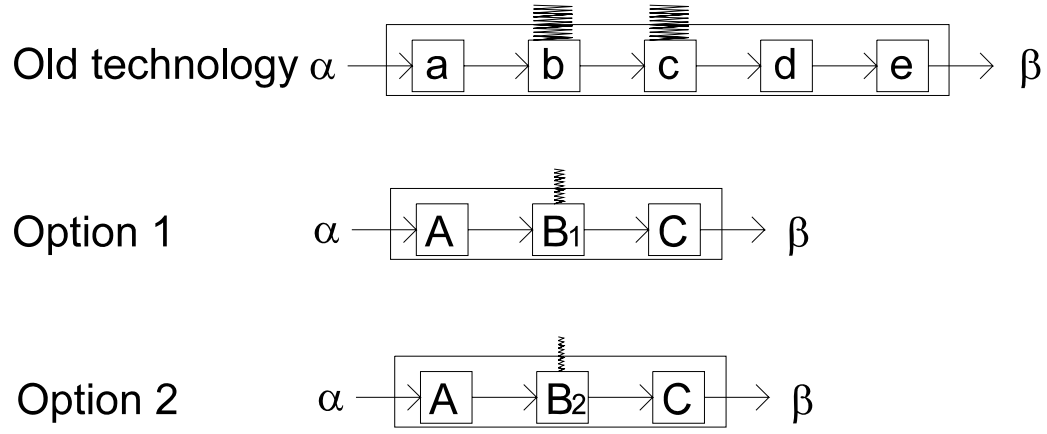
A business invests in a new production line to manufacture ß products. It has specified its requirements in terms of economic performance – i.e. how many products it can produce per hour. In this example we assume that there are two equally efficient machines in terms of production and use of inputs (running costs). We also assume that there are two machines available worldwide.

Option 1:

Machine B1 costs 1.0 monetary unit. This machine will cause emissions of 0.7 emission load units.

Option 2:

Machine B2 costs 1.2 monetary units. This machine will cause emissions of 0.35 emission load units.



Situation 1

In the market where business X operates, both alternatives are available and known to the business. The cheapest available technology is machine B1, which the business will choose if it does not consider the environmental effects.

- If machine B1 is purchased, no EPE investments will be reported.

- If machine B2 is chosen, the environmental expenditure (environmental component) is calculated as: EPE = B2 – B1 = 1.2 – 1.0 = 0.2 monetary units.

Situation 2:

The business considers that machine B1 is the only suitable alternative given its specific process. However, it asks the producers/suppliers to make some modifications in order to reduce pollution. They buy this modified machine, which is slightly more expensive than the original proposal. The EPE then consists of the extra costs for the modified version compared with the original B1 machine.

Situation 3:

Let us now assume that the business operates on a market where machine B2 is the standard technology. The business would then have to buy this machine in order to make the products, regardless of any environmental considerations, which means that there would be no EPE to be reported.

B. Assumption that the machines are not equally efficient

In many cases, when an business considers different investment options, the total investment, the running costs, the production capacity and the environmental effects will all be different. The question then is how to decide whether the investment is to be regarded as environmental protection and how to estimate the scale of the expenditure (the environmental component). Let us assume that only the following two options are available to the business and it decides to buy machine B2

Option 1:

Machine B1 costs 1.0 monetary units and the total cost for operating it 0.5 monetary units per year. The machine can produce 100 units per hour and will cause emissions of 0.7 emission load units.

Option 2:

Machine B2 costs 1.2 monetary units and the total cost for operating it is 0.3 monetary units per year. The machine can produce 110 units per hour and will cause emissions of 0.35 emission load units.

Here, the answer to the questions depends entirely on the main reasons why the business chose the more expensive machine.

- Let us assume that the main reason behind the investment is that the business needs to expand its production capacity. In this case, machine B2 would have been chosen regardless of environmental considerations. This means that there is no EPE to report.

- Let us assume that the main reason is that the pay-back period is so advantageous because of the low operating costs and the long lifetime of the machine. In this case, machine B2 would have been chosen regardless of environmental considerations. This means that there is no EPE to report.

- Let us assume that the business did not really need to increase production and that it could have undertaken other investment projects with a much higher return on the invested capital. In this case, the decision was mainly driven by the fact that they wanted to reduce pollution – because it expects new, stricter regulations in the near future, for example, or it has opted to use “green” products. In this case, the investment in pollution prevention is calculated as B2 – B1 = 1.2 – 1.0 = 0.2 monetary units. The investment would also result in reduced operating costs (i.e. cost savings), which could be separately reported (0.3 – 0.5 = -0.2 monetary units per year) (see 6.1). *Otherwise it is not to be included in the calculation of the environmental protection investment as it is always gross of any cost savings!*

In several countries, different names are used for this type of investment – i.e. “cleaner technology” or “process-integrated”. The table below gives a few illustrative examples of pollution prevention investments in different environmental domains. A more detailed list is given in Annex 2.

Examples of pollution prevention investments in different domains

Protection of ambient air and climate	Systems for the recirculation of process gases
	Measures involving combustion technology, control systems and optimisation of operations
	Measures involving switching to less polluting raw materials and fuels, e.g. cost of the modification of the production process to use water-based products or substitutes for fossil fuels, costs of the modification of the production process for the replacement of coolants
	Measures to reduce pollution by the flare system, e.g. steam- or water-injection systems for better combustion and flame monitoring equipment in order to prevent air pollution
	Measures to improve the dispersion of air pollutants into external ambient air, e.g. encapsulation of equipment, heightening of existing stacks, extra height of new stacks
	Special appendages (incl. taps and valves, welded joints instead of flanges, sealed pump-shafts)
	Reduced air emissions achieved by control equipment and programmes, for example
Water management and protection	Closed water systems, closed cooling systems, recirculation of process water
	Measures involving switching to less polluting production inputs
	Reduced discharges by control equipment and programmes for reduced and more efficient water use and reduced losses of solid substances, for example
	Equipment to maximise water circulation
	Counter current rinsing
	Multistage feeding of chemicals
	Modification of existing installations for extra pumping capacity to reduce discharge
	Control equipment to restrict thermal pollution
Waste management	Measures to increase recovery or to use recovered materials in production processes (if intended to reduce the production of waste)
	Measures to reduce the use of raw materials (only if intended to reduce the production of waste and not for cost savings)
	Measures to switch to less polluting production inputs to make waste less hazardous
Other	*Noise pollution:* extra cost for low-noise machinery
	Nature and landscape: extra costs for pylons that suit the landscape
	Protection of soil, groundwater and surface water: Extra costs of double-walled tanks (installed for protection of soil or groundwater)
	Reduced pollutant infiltration achieved by control equipment and programmes, for example

3.4 Current expenditure on environmental protection

Current expenditure on environmental protection includes labour costs, payments of rents, use of energy and other material goods and purchases of services, where the main purpose is to prevent, reduce, treat or eliminate pollutants and pollution or any other degradation of the environment resulting from the operating activity of the business"[15]

Excluded are:

- depreciation allowances for environmental equipment;

- transfers such as payments of taxes, fees or charges by the reporting unit. These transfers are not linked to purchasing an environmental service relating to the environmental impacts of the operating activity of the business, even if the government authorities have earmarked the revenue for financing other environmental protection activities.

Total current expenditure on environmental protection is in effect the sum of many different types of expenditure. This means that you could place these different items in different categories, depending on what your purpose or focus is – pollution treatment or prevention, or types of activity.

3.4.1 The economic definition of "current expenditure"

The definition of current expenditure is based on the standards applied by the business in its bookkeeping, in compliance with EU accounting standards – i.e. current expenditure, or current transfers, includes all expenditure that is not capitalised but charged to the profit and loss account[16]*.*

General current environmental expenditure consists of the costs of personnel, energy, materials, research and development services, payments for services etc. These correspond to the annual costs of carrying out and maintaining an activity, technology, process, or item of equipment (or parts thereof). There are existing specific and detailed definitions and guidelines for these economic variables in the national accounts, business statistics, and company accounts etc., although they are not always identical.

This means that current expenditure on environmental protection is the sum of purchases of raw materials and consumables, labour costs, public fees and charges, expenses for external services and rental and leasing charges for environmental protection activities (see Table 3.1 below).

- Labour costs includes expenditure on personnel (part- or full-time) involved in environmental protection activities. Labour costs should be reported including all employers' charges and social contributions, but excluding any general overheads.

- Only expenditure associated with leasing that is not capitalised in the company's accounts (operational leasing), if any, should be reported as current expenditure.

[15] (EC) No 1670/2003

[16] SNA 1993, § 8.32

Table 3.1 Current expenditure on environmental protection by accounting variables

Accounting variables		*Of which for environmental protection*
Purchases of goods and services		
	Raw materials and consumables	*(specifically needed for operating the environmental equipment only)*
External charges		
	Public fees and charges	*(fee for monitoring environmental protection facilities, municipal waste and waste-water fee etc.)*
	Expenses for external services	*(environmental consultancy, maintenance and repair, private waste collectors, staff training etc.)*
	Rental and leasing charges	*(of environmental equipment, if any)*
Labour costs		
	Wages and salaries	*(time spent on operation of equipment, environmental management, waste collection etc.)*
	Social security costs	

3.4.2 Types of activity – treatment or prevention

Current expenditure could also be classified in two different categories depending on the nature and function of the activity in the SERIEE – i.e. pollution treatment and pollution prevention. It is recommended that this distinction be maintained whenever possible, since this is a key link to important policy issues. There are also reasons to believe that preventive measures leading to current expenditure will increase in the future (e.g. in connection with changes in practices). However, in some cases this distinction is more difficult to make (administration) and would sometimes require a very detailed information system (labour costs).

Pollution treatment

This includes, for example, expenditure relating to the operation and monitoring of pollution treatment equipment such as sewage-treatment plants, expenditure on the collection, treatment and disposal of waste, and the measurement and monitoring of pollution levels etc.

Pollution prevention

This includes current expenditure linked to pollution-prevention equipment, but also includes changes in practices (environmental management) and switching to new production inputs that reduce the pollution or any other degradation of the environment resulting from the operating activity of the business.

Current expenditure on pollution prevention can be related to methods, technologies, processes or equipment integrated into the overall operating activity of the business in a way that may make it difficult to distinguish the pollution-prevention component. In these cases, the identification of the pollution-prevention component in current expenditure should follow the principles outlined above for capital expenditure on pollution prevention. In other words, the actual current expenditure could be compared with what would be needed to run, repair and maintain the alternative measure available to the business with similar functions and characteristics, except for the environmental protection aspects.

Experience in countries that have collected data separately on (extra) costs for the operation of integrated equipment shows that very few businesses have reported this type of current expenditure and the amounts have been very small compared with the total current expenditure. In addition, an unknown part of this amount was probably de facto related to preventive investments involving separately identifiable components. This is because experience would suggest that a substantial part of what we now call capital expenditure on pollution prevention (previously "integrated investments") would be for specific measures or separately identifiable components, while there would be only a few investments of the entirely integrated type (with an identifiable extra cost for environmental protection). Furthermore, new production equipment will almost always lead to reductions in the total operating costs, not increases (improved economic and environmental characteristics). The overwhelming majority of the costs for the operation of equipment will most likely be related to specific large cleaning facilities, which also might be identified as separate cost centres in the accounting system (e.g. waste-water treatment plants, landfills). In addition, there could be some operating costs related to other cleaning facilities or separate, physically identifiable environmental components (change of filters etc.). That is why "operation and maintenance of environmental equipment" is used as an example of current expenditure. However, we cannot rule out the possibility of some exceptional cases. Therefore, the general definition allows for the possibility of including additional items such as extra costs for the operation of entirely integrated equipment, but ONLY if it is possible to identify this extra cost separately in the same way as for integrated capital expenditure.

3.4.3 Recommended breakdowns – in-house or payments

It is strongly recommended that current expenditure be divided into "in-house spending" and "payments/purchases" according to the nature of the expenditure. This is a basic requirement, since otherwise it will not be able to aggregate expenditure from different sectors without double-counting. These are two separate variables in the Joint OECD/Eurostat questionnaire, while the aggregate amount is to be reported under the SBS Regulation.

In-house current expenditure

Current expenditure from own internal resources is called "in-house" or "internal" current expenditure. In-house spending includes all current expenditure on environmental protection except purchases of environmental protection services from external organisations.

In terms of accounting variables, it is the sum of labour costs, the proportion of total purchase of goods and services relating to raw materials and consumables used for environmental protection purposes, and leasing charges for environmental equipment, if any.

Examples by different activities:

- operation of environmental protection equipment: labour costs, rents payments, insurance cover for the environmental equipment, and consumption of goods and services necessary for running, monitoring, repairing and maintaining the environmental protection facilities and equipment. Included are expenditure on the collection, storage (including landfill) and treatment of waste, which may not always be directly linked to environmental protection equipment;

- measurement and monitoring of pollution levels conducted by in-house staff;

- purchase of goods used for environmental protection purposes that are not directly linked to environmental protection equipment. This includes identifiable and substantial additional costs resulting from a switch to new production inputs or practices: e.g. solvent-free paints, low-sulphur fuels or renewable resources.

  Experience suggests that substantial investments could be needed when a business changes to cleaner inputs, while the use of the cleaner input itself would generally not lead to any

significant additional current expenditure. Of course in the case when such input material is less expensive, there is no extra expenditure for environmental protection to be reported[17].

- General administration and other activities that are not directly linked to environmental protection equipment – e.g. setting up and maintaining environmental information systems; preparation for environmental licences, registration and certification; environmental education and information; external communications (e.g. with authorities); publishing and distributing environmental reports etc.

- Environmental protection research and development including tests of new equipment or practices aimed at reducing the environmental impacts of the operating activity of the business.

  Research and development (R&D) related to environmental protection must be included. Although normally done in-house, there might also be cases where R&D services are purchased externally, or where there is a combination of both. A special feature of R&D is that it is a separate environmental domain according to the CEPA. All R&D expenditure relating to environmental protection is therefore allocated to this domain. In the SBS regulation, R&D is allocated to the domain of other environmental protection expenditure.

Purchases of services

Current expenditure includes the full cost of purchasing environmental protection services (fees, charges) for an environmental protection activity relating to the environmental impact of the operating activity of the business.

Current expenditure includes all fees, charges and similar payments to external bodies (outside the reporting unit) in exchange for environmental protection services relating to the environmental impact of the operating activity of the business.

In terms of accounting variables, it is the sum of total (public) fees and charges and expenses for external services.

Examples by activities:

- payments for the collection and treatment of solid waste, including payments for the use of containers or wheelbarrows, pressed sludge etc.;

- payments for collection and treatment of waste water – to water-service companies for sewage treatment and general sewage services or to contractors for the removal of liquid waste;

- payments for the removal, treatment or containment of contaminated soil and/or groundwater. Also included are payments to the county administrative board or municipality for the purpose of covering future costs for soil decontamination in polluted industrial areas.;

- regulatory charges – e.g. payments to environmental agencies for discharge authorisations, consignment notes for special waste, IPC authorisation etc.;

[17] This item was asked for separately in the 1997 Swedish survey. Only 5% of the businesses reported that they had extra costs for cleaner inputs and the expenditure for this variable was very small compared to total expenditure. This 5% also included some businesses which mistakenly reported their material input for operation of environmental equipment. This variable has subsequently been included in an aggregate category “Other current expenditure”. There could be cases where either respondents or statistical services could calculate the additional costs compared with conventional production inputs. For example, in one year the unit price of conventional fuel oil was, on average, 2.0 monetary units per litre and that of low-sulphur fuel oil 2.5 monetary units per litre. One respondent used 10 000 litres of low-sulphur fuel. In that case, (2.5 - 2.0) × 10 000 = 5 000 monetary units are reported as the use of the cleaner production input in the protection of ambient air and climate.

- control and monitoring charges. Payments made to outside bodies for environmental control and monitoring are given here. Examples are supervision and research on the state of the environment, separate emission monitoring, analysis and research, and reports made for water and environmental permits;

- Payments to environmental consultants or cooperation with authorities in connection with, for example, investigations, staff training, information and certification activities, or for the operation and maintenance of environmental equipment and facilities.

Payments for insurance for environmental liabilities should be excluded from the definitions since they do not relate to an environmental protection activity. (OJ L 156/33)

4. Data collection methodology

4.1 Introduction

After settling WHAT information the users need and defining (for ourselves) more exactly what should be included or excluded, the next step is to decide HOW to compile the statistics. Statistical information is the final product of a more or less complex range of operations. This includes deciding on the type of survey (separate or not), selecting the population and sample, deciding on the exact content of the questionnaire and a suitable design, setting up the data collection and processing system, deciding on the rules for validation and setting up quality controls, deciding how to estimate missing values and gross-up for non-response, and preparing for analysis, interpretation and dissemination of the results.

Eurostat traditionally regulates what data are needed (variables, breakdowns, definitions, frequency, timeliness etc) while Member States have the freedom to choose what is the most appropriate method for them to compile the data. This is reiterated in Article 6 of the SBS Regulation. This article specifies that compilation of data may involve compulsory surveys, other equivalent sources, statistical estimation procedures, or a combination of the three. This means, for example, that when surveys are used they can be compulsory or voluntary, independent or linked to the general Structural Business Survey, depending on the preference of the Member State.

Council Regulation 58/97, Article 6

MEMBER STATES MAY ACQUIRE THE NECESSARY DATA USING A COMBINATION OF DIFFERENT SOURCES SPECIFIED BELOW, APPLYING THE PRINCIPLE OF ADMINISTRATIVE SIMPLIFICATION:

- COMPULSORY SURVEYS: THE LEGAL UNITS, TO WHICH THE STATISTICAL UNITS CALLED ON BY THE MEMBER STATES BELONG OR OF WHICH THEY ARE COMPOSED, SHALL BE OBLIGED TO GIVE ACCURATE AND COMPLETE INFORMATION WITHIN THE PRESCRIBED DEADLINES,

- OTHER SOURCES WHICH ARE AT LEAST EQUIVALENT AS REGARDS ACCURACY AND QUALITY,

- STATISTICAL ESTIMATION PROCEDURES WHERE SOME OF THE CHARACTERISTICS HAVE NOT BEEN OBSERVED FOR ALL OF THE UNITS.

However, how the data is compiled is certainly important for the quality of the result and for the comparability of the data between countries. There are also many common tasks and problems which are independent of the chosen methodology for example:

- How to convince the enterprises to send in their replies.
- How to convey to the enterprises in a simple way what they should report in the questionnaires.
- How to cope with demands from policy-makers and enterprises to reduce the response burden.
- How to make maximum use of a limited budget and/or availability of staff.

What is the most appropriate method will be dependent on the specific situation in the countries: national priorities, money and personnel available, survey traditions etc. What is important for the user is that the results reported are comparable and of acceptable quality. An introduction to the different aspects of quality is given in the next chapter, while more detailed examples linked to each phase in the data collection and dissemination process are given in the following chapters.

4.2 Quality aspects (general)

Quality is defined in the ISO 8402 - 1986 as: “the totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs”. Each survey process therefore needs to start with an explicit statement of the objectives formulated by different user groups, taking into account the expertise of the statistician when it comes to measurability and feasibility. The objectives include relevance of concepts, reliability of outcomes, processing time and survey cost. The ideal survey is one that satisfies all of these aims and makes optimum use of the available production means. In practice it is never possible to meet all the targets, for example, because of scarcity of resources and because the survey process is a human operation and errors are possible at each stage. The final survey results include all imperfections of the process. The overall quality of the survey can be seen as the difference between the ideal survey results and the results effectively achieved. Seven aspects of quality are described in more detail in chapter 4.2.1-4.2.7.

4.2.1 Relevance

A survey is relevant if it meets users’ needs, both in terms of content and quality. The identification of users and their different expectations is therefore necessary before the survey can be launched. The content of the expenditure survey would also need to take into account, for example:

- the legal reporting requirements of the SBS Regulation (see chapter 2.1)
- international data reporting according to the Joint OECD/Eurostat Questionnaire (see chapter 2.2)
- the user needs as input into environmental or expenditure accounts (see chapter 7)

The task of the survey manager is to convert these, sometimes conflicting, needs into questions in a questionnaire. The questionnaire must be flexible enough to allow for the production of final results with varying content, definitions and breakdowns depending on the user needs. This could for example be done if the main body of the questionnaire relates to items of common interests (e.g. environmental protection investments, current expenditure), while items where there are conflicting interests (definitions, breakdowns) would be asked about separately (e.g. fines, penalties and environmental taxes).

4.2.2 Accuracy

Accuracy is defined as the closeness between the estimated value and the (unknown) true population value. Assessing the accuracy of an estimate involves analysing the total error associated with the estimate. This aspect of quality has been extensively studied in many statistical agencies and by researchers. Accuracy focuses on an analysis of errors, divided into sampling and non-sampling errors:

1. **Sampling errors** because of the sampling procedure or because not all units are surveyed and their expenditure needs to be estimated.
2. **Non-sampling errors**
    - Frame errors because, for example, the business register is not complete or up-to-date or totally consistent with the target population.
    - Measurement errors because enterprises misunderstand the definitions or because it is difficult to easily provide expenditure estimates.
    - Processing errors because of the human factor.
    - Non-response errors because some companies cannot or refuse to answer which means that their expenditure needs to be estimated.

- Model assumption errors because calculated items might not meet the intended target.

Until now, statisticians have focused mainly on reducing sampling errors and non-response errors. Estimates of accuracy published by statistical agencies usually relate mainly to these two types of errors. However, research into non-sampling errors is developing rapidly, and some methods are now available for a first assessment of such errors. For environment expenditure surveys it may be as important, although more difficult, to try to measure, evaluate and prevent measurement errors. In the following chapters we will describe in more detail potential sources for errors and how these could be tackled.

4.2.3 Comparability

Statistics for a given characteristic have the greatest usefulness when they enable reliable comparisons of values for a specific variable through industries, across space and over time. It is also in everybody's interest (statistical offices, Eurostat, users and respondents) that data are comparable between countries, both European and other relevant countries (e.g. USA and Japan). The basis for international comparisons exists today in the form of:

- Common frameworks, definitions and set of variables, for example, as expressed in the SERIEE system, the Joint OECD Questionnaire, and not least the SBS Regulation.

- The use of standard statistical units, common classifications (such as CEPA), or classifications which are compatible (such as the economic activity classifications: NACE, NAICS, etc.),

However, it is clear that comparability of the statistics could still be improved both in terms of the number and types of breakdown and the definitions used in the questionnaires. Whenever there are differences between the national and international concepts, these should be clearly described in order to facilitate the correct interpretation and use of the data.

It is also important for the correct interpretation of the result to take into account underlying differences between the countries and possible structural changes which might have an impact on the size and structure of the environmental expenditure (for example industrial structure, environmental policy and, for example, new legislation, trends in privatisation and outsourcing, enterprise mergers, etc.).

Comparability should also exist over time. It is important to know about major revisions of concepts or other important changes which might have a significant effect on the results.

4.2.4 Coherence

The coherence between statistics concerns the comparison of different statistics which are generally produced in different ways and intended for different primary uses. When the data is coherent, the messages that statistics convey to users will clearly relate to each other, or at least will not contradict each other. It is particularly important that statistics estimating complex concepts (ratios, elasticity, or, for example, expenditure for environmental protection) are based on coherent elementary statistics (with compatible definitions of, for example, reference population(s), characteristics, reference period, statistical units etc). Misunderstanding by users should also be prevented by consistent use of different terminology for different concepts.

When originating from a single source, statistics are coherent in that elementary concepts can be combined reliably in more complex ways. Questions about environmental protection investments could, for example, be directly (even physically) related to questions and definitions of the total investments made by the enterprise. The survey will be answered by the same person, treated by the same team, grossed up using the same system etc. This means that there should be no problems of coherence related to the survey methodology. But as we will see in chapter 4.4, this method also has its disadvantages due mainly to the difference in the nature of the two sets of variables. Because of this, the coherence of the final results might even improve if the survey methodology is different.

When originating from different sources using different survey methodologies, statistics are coherent insofar as they are based on common definitions, classifications and methodological standards. Data on environmental protection expenditure produced via a separate survey would then be comparable to business statistics data, for example, through the use of:

- Standard statistical units, sample frame (SBR), activity classification (NACE), size class breakdown, etc.

- Standard "economic" definitions as a basis for the definitions of the environment expenditure variables, consistent with accounting definitions and the definitions used in SBS surveys, which in turn should be broadly consistent with the national accounts.

This means that relevant indicators such as environmental investments as a share of total investments could be calculated (on both micro and macro levels) and used in publications, or as a tool in the validation process. This means that the results of separate surveys on environmental protection expenditure by enterprises should in principle be consistent with other enterprise data, although there is a risk that differences occur because different persons reply to the two surveys.

This means also that the expenditure data could be related to national accounts totals, such as Gross Fixed Capital Formation (GFCF), Output or GDP, although there are some differences. The expenditure data (SBS and JQ) are not entirely comparable to GDP.

- The use of the enterprise as statistical unit instead of the activity unit (local KAU) in the national accounts means that there are differences in the distribution by NACE activities.

- Furthermore, consumption of fixed capital (CFC) is part of GDP, but CFC related to environmental protection is not included in the international data collection and not produced by most countries (although estimated in the complete SERIEE expenditure accounts).[18]

It is also important that expenditure statistics are coherent and could be related to environment statistics and specific environmental policy issues. This link is more difficult to establish on the micro level both for conceptual reasons (no clear link between, for example, expenditure and levels of air emissions) and practical reasons (in most cases it would require more detailed breakdowns than is feasible to include in a questionnaire to enterprises). The link between expenditure and physical data is easiest in the waste and wastewater area (e.g. expenditure related to amounts collected or treated). The basic link today is the breakdown of expenditure by environmental domains following the CEPA classification.

Where similar statistics from various sources (surveys or statistics calculated from administrative data at the national level by the Official Statistical System) exist, they should be identified and any differences should be analysed and, if possible, quantified. A discrepancy between two sets of statistics produced by different surveys may be due to differences in the data collection process or differences in reporting units resulting in different estimates. The situation may be improved by benchmarking (for instance monthly or quarterly statistics on annual results) or by combining different survey results. Statistics on environmental protection expenditure emanating from different sources could be analysed and compared and if possible balanced for example through the use of the accounting framework of the SERIEEs Environmental Protection Expenditure Accounts (EPEA) or the simplified framework in the Joint OECD/Eurostat Questionnaire. In this way, quality of the data could be analysed and improved by estimates of missing parts or identification of inconsistencies.

Example 4.1 Eurostat: The information on the total payment of subsidies by the government available from budget analyses could be compared with information about total subsidies received if that is available from the survey to businesses, otherwise it could be a basis for estimating this variable. Similarly, total costs for waste/wastewater collection and treatment could be compared with the payments made by households and businesses, or be the basis for an estimate of these payments, in which the burden on the respondents would be reduced, see 4.9 for an example.

4.2.5 Timeliness and punctuality

Most users want up-to-date figures which are published frequently and on time at pre-established dates. As regards international data reporting, the SBS Regulation requires the countries to submit data on environmental expenditure no later than 18 months after the end of the reference year: e.g.

[18] Theoretically, it would then be more accurate, for example, to relate expenditure totals to the net domestic product (NDP). However, these types of indicators are often used mainly to enable comparisons between countries or sectors, rather than to show exactly how much of GDP etc "was used" to protect the environment.

end of June 2002 for data relating to the reference year 2000. The Joint OECD/Eurostat Questionnaire has traditionally been sent out in the middle of March every two years with a deadline to respond set at the middle of June. This would mean that Eurostat could disseminate data to users with a delay of slightly less than two years: data for the reference year 2000 at the end of 2002, etc.

Three main aspects which affect the timeliness of publication are the date when the questionnaires are sent out, the time it takes to receive a sufficient number of replies and the internal production time.

- When the questionnaires are sent out they are affected by considerations regarding both when users need the data (taking into account predictions about total production time) and when it would be best for the enterprises to receive the questionnaire (when the accounts are ready, when it would not be in conflict with other main tasks etc).

- There are a number of things the statistician could do to reduce the time to collect the replies, both relating to form/process (see chapter 4.7), as well as relating to the survey content and the overall burden on respondents (see chapter 4.3).

- Keeping production times to a minimum implies efficient production techniques, often at great expense. The whole process of data collection, editing, imputation, estimation and dissemination has to be kept under control in order to minimise the processing period.

There is always a trade-off and often competition between statistical information being produced and disseminated very rapidly but with less reliability and less timely but more accurate statistics. What is adequate quality can only be seen in relation to user needs. Statistics which are accurate but produced with a long time delay, for example, could be useless for the users, which means that they would either have to do without the required information, or base their decisions on non-statistical sources (e.g. own estimates or estimates made by consultants). The same situation occurs when data needs are not fulfilled by the available statistics. The role of the statisticians is to give advice on the effects and implications of differences in quality. The challenge for both the statistical offices in the countries and for Eurostat is to provide statistics which are both adequate in terms of timeliness and quality given the specific needs of different users.

4.2.6 Accessibility and clarity

Dissemination is a vital step in the information chain. It is not sufficient to have “good statistics” stored somewhere inside the statistical office.

Statistical data have most value when they are easily accessible by users and the users should be in a position to know easily what information is available.

The information should be made available to all potential users in an appropriate form. Some users are only interested in getting an overview of the situation (e.g. in the form of indicators) while other users are more interested in using the most detailed information available (e.g. as a basis for their own calculations or for modelling).

The statistics should be accompanied by the necessary information on concepts and methods. Also this information could be targeted at different users, with a difference in the level of detail between those who are subject specialists and, for example, the general public.

The statistics should as far as possible be supported by assistance in the use and interpretation of the data from the data providers, and could include offers of further statistical services (specific analysis performed according to user needs).

Example 4.2 Eurostat: The use of websites and fact sheets to disseminate data is growing more and more. A number of countries have specific comprehensive websites and distributes newsletters regularly to promote new statistics and new reports. For instance, Denmark and Sweden regularly publish newsletters on the subject of environmental accounts. Spain has an easily accessible database on environmental protection expenditure on its website.

4.2.7 Costs

Although not a measure of quality, the resources available for the production of statistics act as a constraint on quality. Two cost components can be considered: the cost to the statistical office and the cost to the reporting units (typically enterprises or parts of enterprises). Costs for a new survey are usually much higher than the costs for a regular survey, for both parties. The cost to respondents depends on how much information they have to report and therefore differs according to the size of the enterprise and the type of activity. Small enterprises usually have more limited resources to spend on non-production related tasks. In many countries there are therefore demands on statisticians to reduce the response burden specifically for the smallest enterprises. There are different ways of doing this. Estimates based on smaller samples or on modelling can be made or even questionnaires can be simplified. The use of administrative data and estimates produced by statisticians based on other available information will of course drastically reduce the burden on enterprises and often the total costs for society.

The task of the survey manager is to make optimum use of the, often limited, resources available, i.e.:

- Add questions in existing surveys and concentrate available resources on quality controls.
- Target the sample at enterprises and industries with a high probability of high expenditure on environmental protection.
- Focus the validation and quality controls on items which will have a significant effect on the final results (high expenditure items, important enterprises etc).

4.3 Minimising response burden in the survey process

National Statistical Offices throughout the world face the need to drastically reduce the response burden as one of their major strategic challenges. Minimising the response burden is not only in the interest of respondents. A successful reduction programme may very well reward the statistician too: data quality may be higher, the response will be quicker and response rates will rise, while collection costs fall.

Minimising the response burden should be an issue to take into account during all stages of the survey design process. A number of measures, norms and attention points apply, some of which require a corporate strategy towards data collection. It is true that in some respects the easing of reporting conditions requires extra effort for the statistician, but there are advantages as well, both with respect to efficiency and data quality. A smart sampling design and a respondent-friendly questionnaire are powerful tools in the struggle against overburden. However, prior to this all, the possibilities of making use of existing administrative registers must be specifically considered.

Example 4.3 Eurostat: To monitor the response burden, a question could be added about the total time it took for the responding organisation to complete the questionnaire. The respondent would have to take into account all activities: reading and understanding the accompanying letter and explanatory notes, gathering and processing data and gathering additional information if required.

There are several instruments for carrying out a corporate strategy, directed towards reducing the response burden:

- Co-ordination, concentration or integration of data collection.
- Respondents generally dislike receiving numbers of questionnaires from different departments within a national statistical office, since when surveying departments act more or less

independently there is a risk of overlaps and redundancy in questionnaires. There are cases when a respondent is confronted with different definitions for the same data item. It is then very important to clarify the purpose of the different definitions and in what context they apply.

- Individual surveys should be developed within the context of a coordinated survey strategy. Such a strategy aims at minimising the number of questionnaires and contact points. For a new survey this means that first one has to consider whether the information need can be met by incorporating the questions in an existing survey. Also, when this is not possible, the number of contact points can be further reduced by concentration of surveying activities in such a way that one particular respondent only communicates with one department within the statistical bureau. Of course, there may be good reasons to deviate from this ideal construction.

- Co-ordinated delimitation of sampling frames. Survey populations are often delineated according to field of economic activity: there are separate production statistics for separate SIC groupings. Care should be taken that a particular respondent is not classified in different groupings at a time. This risk can be reduced by drawing samples for all such surveys from one unequivocal source, i.e. a centrally maintained business register.

- Co-ordinated sampling. Control of response burden can be achieved by co-ordinated selection of samples. Without any internal co-ordination within the statistical agency it might happen that some businesses receive more forms than others, although these businesses are comparable in size, activity, etc. A powerful tool to spread the response burden is the combination of a centrally maintained business register and a comprehensive computer program for co-ordinated sampling.

- Information on response burden. Although quite a challenge, national statistical offices should aim at informing respondents in advance about the surveys they will be involved in. Ideally, the national statistical office should send a comprehensive listing of these surveys, including average completion time of the questionnaire, at the beginning of each year.

Policies applying at the level of individual surveys:

- Number of respondents. Take samples to suit the survey. Weigh costs and quality against each other.

- Concepts and definitions of variables. Whenever statistical concepts deviate from accounting concepts, this should be considered a problem for the statistician and not the respondent. This means that questionnaires should be designed in such a way that they can be completed directly from bookkeeping records as much as possible.

- Number and detail of variables. Only include what is absolutely essential. Try to resist the temptation to add variables and breakdowns. One should consider whether it is really necessary to apply full breakdown for every aspect in the questionnaire, for example, is it necessary to have a breakdown by financing bodies for all variables or only for the total investments.

- Accuracy of variables. For smaller units the burden may be relieved by collecting data in ranges rather than discrete values, without notable effect on the quality of statistical data.

- Tailor-made questionnaires. When a survey covers distinct NACE code, accounting practices, vocabulary or nature of activities may differ among branches. This may require different questionnaires for different groups of respondents or a flexibility of the questionnaire to allow enterprises some adjustments. One example is the UK. They describe in their cover letter the main purpose of the survey and give the enterprises the opportunity to choose the level of detailed response.

- Relevance of questions and explanatory notes. Response burden is not only determined by the time it takes to answer questions, but also by the time and effort needed to read and understand questions, introductory letters and explanatory notes. These should not only be brief and clear, but also applicable.

- Feedback of results. Providing respondents with the results of the survey is a measure which only affects the perception of burden. The information to supply should be carefully composed and one must make sure that it is of real interest to the businessman. Otherwise, the effect might as well be negative.

- Measure response burden. If properly introduced, respondents may consider such a question as an indication that the statistical office is aware of their problems and tries to do something about it.

4.4 Type of survey - Separate or integrated

There are two main ways for statistical offices to compile the data on environmental expenditure, both with their advantages and disadvantages.

4.4.1 Include questions in existing surveys

A few countries (Belgium, Norway, Italy, Denmark, Czech Republic, and Slovak Republic) use this method. Usually questions on environmental protection expenditure are added to existing surveys in the field of "economic" statistics, in particular the structural business statistics survey, or in some cases investment surveys. The part which relates to environmental expenditure could be sent to the all units or to a sub-sample of those that receive the total SBS survey (e.g. only industrial enterprises, or only enterprises with more than 20 employees). It could be totally integrated in the "mother survey" or be in the form of a separate leaflet, sometimes of a different colour to highlight the different subject.

It is often difficult to add a large new section on environmental expenditure in these existing surveys: in terms of number of variables, breakdowns, or detailed explanations in the questionnaire. Countries which have chosen this method generally collect only a limited amount of data, for example, data on pollution treatment investments which used to meet the former legal reporting obligations of the SBS Regulation (Italy, Denmark), or total investments in environmental protection (Czech Republic, Slovak Republic).

Advantage

The main advantage with this method is the use of an existing survey structure (process), which minimises the costs for the basic survey tasks, for the statistical office (printing, sending out, data entry, etc.). This makes it possible to provide information also with a limited budget, or free resources which, for example, could be used for quality controls.

Another advantage is the flexibility to introduce additional variables. It is often easier to add an extra variable to an existing survey, than to launch an entirely new survey. In some countries, entirely new surveys could only be done after changes to the statistical law, while small changes to existing surveys is approved in a simplified procedure.

Disadvantage

The main disadvantage is that the questionnaire is generally answered by people who are not specialists in the field and who might not have the necessary information, knowledge, or interest to answer the survey, or to report accurately the expenditure to protect the environment.

In addition, the total costs for the respondents could be higher compared to a separate survey with a targeted sample and more developed guidelines.

When executing a non-independent survey it is recommended to focus specific attention to some issues related to non-response and quality of response.

Response rates

There is a clear risk that less priority is given to the environmental part when it is a small part of a survey which mainly addresses other issues and which is answered by respondents who are not experts in the field. This could result in both low qualities of the data reported and by higher rates of

non-response. A specific problem is how to treat returned questionnaires where the environmental part is not filled in, as non-response or as a reply indicating zero environmental expenditure.

Example 4.4 Belgium: Statistics Belgium made a first pilot study on current expenditure for the reference year 1999. A separate section (voluntary) was inserted in the SBS survey. 97.8% of the enterprises sent in the SBS questionnaires together, but only 15% had answered the separate section on environment. Statistics Belgium treated companies which sent in an empty section as non-response.

Example 4.5 Slovenia: Data on gross fixed capital formation and current expenditure for environmental protection and other environment related expenditures are the result of the annual survey on Gross Fixed Capital Formation. The reporting units are enterprises and organisations with more than 10 persons in paid employment. In 2002 the response rate in data collection was almost 90%, of which 23.4% units reported on gross fixed capital formation for environmental protection, 54.5% on current expenditure for environmental protection.

Counter the risk of underestimation and overestimation

For the respondent to report a specific environment protection measure in the questionnaire, he has to remember the measure, consider it to be for environmental protection as we define it, and be able to provide a cost estimate (see 4.6.1). There is a clear risk that people who are not used to the subject and who receive only limited instructions, in the end report either too little or too much compared to our definitions. Probably there is particularly a risk of underestimation, but experience also shows that enterprises are often eager to show what they have done to protect the environment. There is an inclination to report the information they have (or consider relevant) although this does not correspond to the definitions and delimitation in the questionnaires. This is a general problem, but the risk could be higher for non-independent surveys since these often include only a very limited number of variables.

Example 4.6 Belgium (cont): Initially, only 40% of the enterprises (201 out of 504) which answered the question on current expenditure reported an amount larger than 0. Statistics Belgium then analysed the replies and contacted enterprises which they believed were likely to have current expenditure. The final result was that 81% of the responding enterprises reported current expenditure greater than 0 (1217 out of 1507). This is comparable to the share experienced by, for example, Statistics Sweden which has a separate survey on environmental protection expenditure, In the 1999 survey, 89% of the enterprises responding reported a current expenditure > 0. You would expect a higher share enterprises reporting expenditure in separate surveys, since the sample is usually targeted to enterprises which are expected to have high environmental expenditure (large sample in specific industries and for large enterprises, small sample for other strata).

Statistics Belgium also made a statistical analysis of the effects of their efforts to select and contact enterprises with “dubious” entries (saving and comparing two versions of the database). Many enterprises changed the value they initially reported (normally adding expenditure), but these contacts (somewhat surprisingly) only marginally affected the total results, disregarding the increase in response rates. The effect was a decrease in total current expenditure by about 3 per cent.

Example 4.7 Norway: Statistics Norway has previously made pilot studies on environmental protection expenditure by industry. They have now started to collect data on pollution treatment investments. They choose to include a question in the structural business survey, directly after the variable total gross investments (as an of-which-variable). The first year, many enterprises reported that they had higher pollution treatment investments than the total gross investments. One possible explanation is that the enterprises wanted to report what they had done to protect the environment and included, for example, investments in previous years when no survey was sent out, and/or integrated investments and current expenditure although this was not asked for.

4.4.2 Separate survey on environmental protection expenditure

Most countries have decided to make a separate survey on environmental protection expenditure, usually under the responsibility of the environment statistics unit. In the EU at least Germany, France, Netherlands, Austria, Portugal, Finland, Sweden and the UK have chosen this method. In the remaining chapters of this handbook, most examples will relate to separate surveys, although many of the issues will be relevant regardless of the choice of survey methodology.

Advantage

The most obvious advantage with a separate survey is the freedom to include more variables and more detailed definitions, instructions and illustrative examples.

Another advantage is that the questionnaire could be sent directly to the person likely to be most suited to answer these questions, which often is the environmental manager.

In a separate survey, the sample could also be targeted to those believed to have the largest expenditures: census of large enterprises and/or enterprises in certain “polluting” activities, but considerably fewer small enterprises. This could limit the total response burden for the enterprises.

Disadvantage

The main disadvantage is that a separate survey can be more costly. The increase of costs can be found in the requirement of more human resources but also in the form of increased correspondence with respondents. Also to be considered is the increased response burden for the respondents. It can be perceived as an extra workload to reply to a separate survey than just an added variable.

4.5 Population and sample

The next step in the survey process is to define in more detail the population of units relevant for the survey. Four different types of populations can be identified, see figure below:

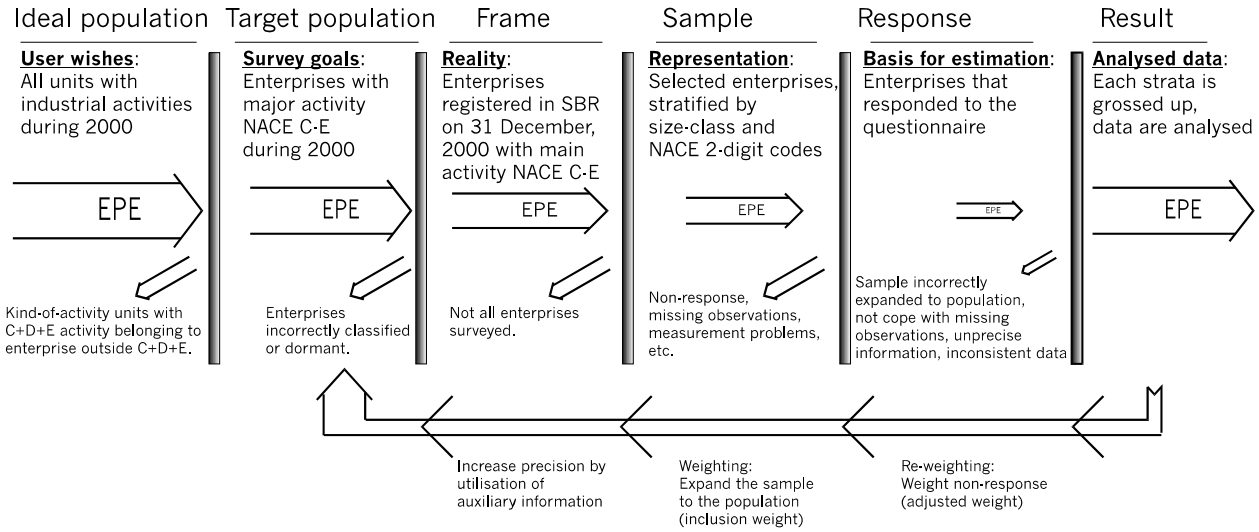
- There is an **ideal target population** (all industrial activities) which is a perfect representation of the user wishes, and the **intended target population** (enterprises with the main activity industrial production), specifying what information users can expect to receive. The target population represents the actual objectives of the survey (the intended statistical output). When we speak of the target population in this handbook, we mean the intended one. When the statistics are presented, no attempt is usually made to bridge the gap to the ideal target population.

- There is a **frame population** consisting of a set of units, which represents the best possible materialisation of the target population (e.g. all enterprises in the business register at a certain date, with an industrial activity as their main activity). The gap between the frame and the target population is bridged by alternative sources and calculations.

- Then there is the **sample** which consists of all units from which data are actually collected. In the case of a census, the sample and the frame are identical. When only parts of the frame population are surveyed, the gap between the frame and the sample is bridged by weighting (grossing up).

- Finally, there is the population of **responding** units. Usually there is some non-response (both for a census and sample survey). The gap between the responding units and the sample also needs to be bridged by weighting (grossing up).

Graph 4.1. Population – from ideal to results



The Statistical Business Register (SBR) is commonly used as the main source for the identification and selection of the frame population and for selecting the sample. However, sometimes other specific sources could be used: to target the sample to units known to have a high probability of having high environmental expenditure (e.g. lists of enterprises with highly polluting activities).

The SBR contains a number of different units, and a lot of detailed information for each unit. The next step in the sampling process is to decide what units the population should consist of (the statistical unit.)

4.5.1 Statistical unit

Council Regulation (EEC) 696/93 of 15 March 1993 on the statistical units for the observation and analysis of the production system in the Community describes the different statistical units of the production system. The statistical units are defined on the basis of three criteria.

- Legal, accounting or organisational criteria

  In order to define units that are recognisable and identifiable in the economy, legal or institutional criteria must be applied. In some cases, legally separate units must be grouped together as they are not sufficiently autonomous in their organisation. Legal units include:

  - Legal persons whose existence is recognised by law independently of the individuals or institutions which may own them or are members of them.

  - Natural persons who are engaged in an economic activity in their own right

- Geographical criteria

  A unit can be geographically identified. A distinction is made between local, regional, national, Community and worldwide areas.

- Activity criteria

  An economic activity (production) can be said to take place when resources such as equipment, labour, manufacturing techniques, information networks or products are combined, leading to the creation of specific goods or services. An activity is characterised by an input (goods or services), a production process and an output supplied to third parties (products or services).

  Economic activities are determined and classified into specific groups according to the NACE Rev. 1.1. If a unit carries out more than one activity, all the activities are ranked according to the gross value added (GVA) at factor cost which they generate. If GVA is not available, other

criteria must be used, such as employment or turnover. The activity with the highest share of GVA is called the **principal activity** and all other are called **secondary activities**.

Principal and secondary activities are backed up by **ancillary (support) activities**, such as administration, accounting, data processing, purchasing, process monitoring, repairs and renovation, warehousing, transport, marketing and sales. The unit carries out these ancillary activities in order to support the main activity, the production of goods and services sold to third parties. The results of ancillary activities are not supplied to third parties.

Environmental protection could be seen as an ancillary activity, which is needed (and sometimes required) to allow the unit to produce its goods and services, see, for example, SERIEE compilation guide 2002. The objective of environmental expenditure statistics is to separate out all the expenditures related to this ancillary activity. This includes the use of capital goods, the use of material and the enterprise staff (internal current expenditure) and the purchase of equipment (e.g. for waste treatment).

Example 4.8 Eurostat: In addition to ancillary environmental protection activities, some units provide an "environmental protection service" for the market. An enterprise with its own landfill could, for example, decide to accept the receipt of waste from other enterprises. Payments for the sale of such services should be classified as a secondary activity (NACE 90). Expenditure for these activities should be excluded from the data on EPE by businesses, but if possible reported separately. The same holds for units whose main activity is to provide these kinds of services (e.g. primary activity NACE 90).

The economy could be divided into a number of different types of units, some of which would be possible to identify in the business register. The choice of unit to use for statistical surveys is often a compromise between the type of analysis needed by different users and practical considerations such as the content of the business register, or the unit most appropriate to answer the specific questions on environmental expenditure

- The institutional unit

  The institutional unit is an elementary economic decision-making centre, which is characterised by uniformity of behaviour and autonomy of decision (e.g. be entitled to own assets, take economic decisions, engage in economic activities, incur liabilities).

  Institutional units include corporations (public and private), co-operatives, public producers, non-profit institutions, agencies of general government, and households[19].

- The enterprise group

- The enterprise

  The enterprise is the smallest combination of legal units (a separate organisational unit) which wholly or partially execute an economic activity (producing goods or services). The enterprise must also have a certain degree of autonomy of decision-making, especially the allocation of its current resources. An enterprise carries out one or more activities at one or several locations. An enterprise may be a sole legal unit.

- The local unit

  The local unit is an enterprise or a part thereof (e.g. a factory, main office or a warehouse) situated in a geographically identified place. At or from this place, an economic activity is carried out for which one or several persons work employed by one and the same enterprise.

- The Kind of activity unit (KAU) and the Local Kind of activity unit (Local KAU)

[19] ESA 95 § 2.12-16

The kind-of-activity unit (KAU) groups all the parts of an enterprise contributing to the performance of an activity at class level (four digits) of NACE Rev. 1 and corresponds to one or several operational subdivisions of the enterprise. The enterprise's information system must be capable of indicating or calculation for each KAU at least the value of production, intermediate consumption, manpower costs, the operating surplus and employment and gross fixed capital formation.

The Local KAU, similarly groups together all the parts of a local unit which performs an activity at class level (four digits) of NACE Rev 1.1.

- Units of homogenous production (UHP)

  A unit of homogenous production is a unique activity which is identified by its inputs, a particular process of production and its outputs. This makes UHP the ideal division of units for production process analysis (input-output). However, a division into UHP is rarely available in practice in, for example, business registers.

The business register and the surveys on expenditure should include all units with an activity in the country. This includes units owned and controlled by foreigners, but excludes local units own by the citizens situated abroad.

We will in this handbook in most cases assume that the enterprise is chosen as statistical unit, following the requirements of the SBS Regulation (part of section on enterprise statistics). It is important to remember that this includes enterprises which are both privately and publicly owned.

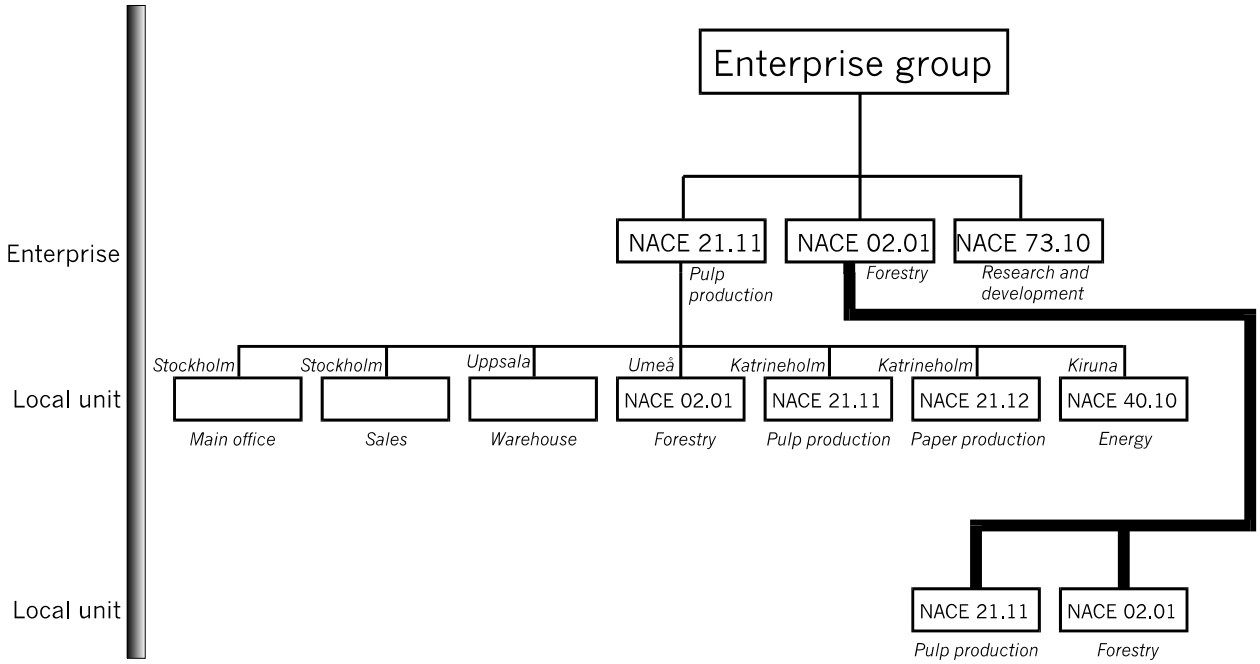
When executing a survey, it is important to remember that the vocabulary and definitions used in the business registers may not be the same as those used in the "business community". The respondent may, for example, associate the word enterprise only with the local unit where he works and the sum of all local units as a group of enterprises, or he would perhaps be inclined to include also units in the same group of enterprises situated abroad. Therefore, it is important to make it clear to the respondents for which units he shall report data, for example, by a clear definition maybe accompanied by a list of units with names and addresses. It is also a good idea to include checks that the response corresponds to the intended statistical unit (e.g. through questions about number of employees in the questionnaire, or comparison of expenditure data with totals reported by the same unit).

In some countries most enterprises have only one local unit and many are involved in only one activity. However, there are also enterprises which consist of many local units spread over the country, involved in many different activities.

The choice of statistical units will lead to differences in the final results, in particular the distribution of expenditure by activities (NACE). An enterprise in NACE 21 "Pulp and Paper Industry" might, for example, also be involved in forestry and energy production, sometimes but not necessarily in separate local units. At the same time enterprises mainly involved in forestry, might have a secondary activity pulp and paper. When the enterprise unit is chosen as a statistical unit (for the target population), expenditure in NACE 21 "Pulp and Paper Industry", for instance, is the total expenditure in all enterprises (and all their local units) with principal activity pulp and paper. This includes, for example, expenditure for any secondary activities in forestry and energy production. Excluded is expenditure for secondary pulp and paper industry activities in enterprises with another primary activity.

There may also be a systematic underestimation of some general environmental protection activities when only the local units classified in an industrial activity are surveyed. This is because the organisation of some enterprises is such that, for example, the head office and/or the department responsible for Research and Development are separate local units (classified in NACE 73 or 74). There may also be underestimation of these activities when the enterprise is the statistical unit, since in some groups of enterprises these have been organised into separate enterprises.

Graph 4.2. The structure of economic units – from the enterprise group to local units



4.5.2 Choosing the population

After the decision on the statistical unit, the business register (SBR) is used to select the units in the frame population. Council Regulation (EEC) 2186/93 of 22 July 1993 on Community co-ordination in drawing up business registers for statistical purposes, specifies that Member States shall set up for statistical purposes one or several harmonised registers. The registers shall be compiled of

- All enterprises carrying on economic activities contributing to the gross domestic product at market prices (GDP).
- The legal units responsible for those enterprises.
- The local units dependent on those enterprises.

In principle, this requirement shall not apply to households. The inclusion of enterprises, their legal and local units for which the main activity falls within Section A (Agriculture, hunting and forestry), B (Fishing) or L (Public administration and defence; compulsory social security) of NACE Rev. 1.1 shall be optional.

Ideally, the frame population corresponds to the target population. In practice, it will often differ, simply because no SBR is perfect. The ideal situation is the existence of a perfect sampling frame, i.e. an up-to-date register containing all elements in the target population. In that case the frame population would correspond fully to the target population. The formation and updating of a business register is, however, a complex and difficult matter. Indeed, characteristics as well as composition of the population are constantly changing over time, while the information sources used for updating are far from perfect, both with respect to accuracy and timeliness. This means that there will always be a certain degree of both over-coverage and under-coverage, both in the population and the sample. For the survey manager it is important to be aware of these imperfections and take compensation measures whenever possible.

It is often advisable to base the population and the sample on the most recent update of the SBR as possible, since the SBR is updated continuously whenever new information is available or when mistakes have been discovered. In principle, populations refer to either a moment or a period. Moment bound populations are good for the compilation of moment bound data, like employment and stocks. However, many variables including environmental protection expenditure have the character of a flow and consequently refer to a period. This raises the question how to deal with changes in the

population during the course of such a period and compared to the situation on the date when the sample was drawn. It is recommended to include all units that had activity during the reporting period, even though the period of activity may be shorter than the whole reference period.

This *includes* for example:

- An enterprise that started the activity in August which may already have made considerable investments before the end of the year.

- An enterprise which ceased the activities in November, which may have had considerable expenditure up till that point. However, in practice it might be difficult to get a reply from these enterprises which means that they would normally be treated as non-response. Some of these might be sorted out through use of information in the SBR (e.g. non active enterprises, code data of cessation).

- An enterprise which has changed ownership (bought by another enterprise or merged with another unit), although also here it might be difficult to get a reply.

This *excludes* for example:

- An enterprise which was wrongly classified in the business register, that has an activity which is not covered by the survey (e.g. not an industrial activity). However, if the activity is different to the classification in the register, but one that is covered by the survey, then the enterprise would be moved to another stratum in the population and sample.

- An enterprise which was included in the sample but which started the activity after the end of the reference period. These enterprises could normally be sorted out already at the time the sample was drawn, on the basis of some of the variables in the business register (such as start-date).

As we will show, the information in the business register could be very useful both when choosing which units to survey (sampling), but also in different steps of the data collection and validation process.

- Detailed addresses where to send the questionnaires and phone numbers to use for reminders and for follow-up.

- Information about principal activity and size (employees and/or turnover) are often the basis for stratification and used for grossing up the results for non-response.

- Enterprises which have a secondary activity in the field of environmental protection (e.g. waste collection, waste treatment and sewage treatment) could be identified and instructed not to include expenditure related to these activities in their business expenditure.

- A question about the number of employees could be added to the questionnaire. The reported figure could then be compared with the information in the business register, to check whether the response relates to the whole enterprise or only to an individual local unit.

- The information about ancillary activities (support functions) could be used to select local units where it is likely there is no environmental protection expenditure (e.g. sales office).

4.5.3 Drawing the sample

In the majority of business surveys, only part of the frame population is represented in the actual data collection. The last step in the sampling procedure is therefore to decide how to select those units which should receive a questionnaire. A sample is drawn in such a way that information about the whole population data can be estimated by weighting the sample results. This will be done based on the detailed information available in the SBR.

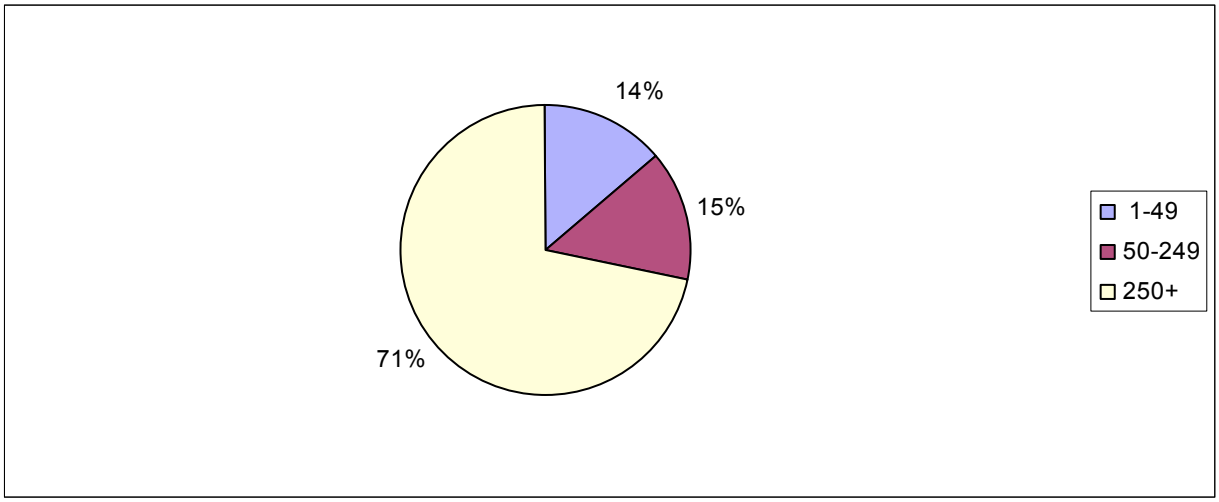
There may be situations where certain groups of units are excluded from sampling.

- Producers of nuclear energy have, for example, traditionally been excluded following the recommendations in an older version of the CEPA classification. These should now be included following the revised CEPA 2000, see the explanatory notes to the domain Radiation in Annex 1.

- The smallest enterprises are sometimes excluded altogether from the target population, mostly because of cost reasons or concerns about the reporting burden. If this is the case, users should be carefully informed about the existence of this gap. However, an omission caused, for example, by size-class cut-off does not fulfil the legal reporting requirements of the SBS Regulation. The expenditure for the total population needs to be estimated, if not surveyed. The smallest enterprises usually account for only a limited part of total environmental protection expenditure, although the importance varies between industries and between countries. It is recommended to adjust the size of the sample and/or to use estimation techniques to keep the response burden to a minimum.

Example 4.9 Italy:

Graph 4.3 Total EPE by size class. 2001



In 2001, enterprises with less than 50 employees accounted for 14% of total EPE according to Istat's estimations. Out of the industries C, D, E, F, I, O and "other activities" industry E accounted for the largest share of total EPE among this size group. However, as can be seen from the pie chart the larger sized enterprises accounts for the largest share of total EPE.

(Source: Istat, 2005)

After defining the target population and the frame population, the next step is the choice of the sampling design and the estimation procedure. Sampling theory provides a variety of methods according to which samples can be drawn and estimates can be produced. We will here only give some general advice relevant for expenditure surveys.

The first question is whether to take a sample or to carry out a census. Usually a sample has to be sufficient because of cost reasons and concerns about response burden.

The next step is to decide on the sampling design. The sampling design is a set of specifications that define the target population, the sampling units and the probabilities attached to the possible samples. In the design stage it is useful to study the performance of different strategies in order to find the best strategy for the survey in question. To study the performance of a strategy, we have to consider all possible estimates that might be generated by the combination of the sampling design and the estimator. Important aspects are the bias, the variance and the mean square error of the estimator.

In business surveys the method of stratified sampling is widely used. Prior to sampling, the population is divided into non-overlapping sub-populations, called strata. The strata can be treated as separate populations for which suitable strategies can be chosen. The selection of the samples in each of the strata is carried out independently. The first step in stratified sampling concerns the choice of the characteristics by which the strata are to be formed. This choice depends on the purpose for which stratified sampling is applied. Some reasons for stratification are:

- Enlarge precision (at a given sample size) and minimise response burden.
- Produce estimates with a specified precision for separate strata or for sub-populations consisting of more than one stratum.
- Control fieldwork efficiently.
- Use different frames for different parts of the population.

If more precision is the reason for stratification, it is beneficial to form strata which are more or less homogeneous groups in the sense of the target variables. Environmental protection expenditure generally varies according to the nature of the activity and size of the enterprise, although there is often no straightforward connection since individual characteristics are important. Most countries also use NACE and size-class based on the number of employees to divide the population into strata, often coinciding with desired level of detail of the breakdown of the results. Some countries make adjustments for specific cases, for example, enterprises with a high turnover but few employees (e.g. energy producers).

Once the combination of sampling design and estimator has been decided, the sample size can be determined. Two aspects play a role in the determination of the sample size: cost and precision. Usually the precision will increase if the sample size increases. However, the larger the sample the more expensive and time consuming the survey will be. A related issue is the way in which the total sample size is allocated to each of the strata. For environmental protection expenditure surveys, it is recommended to target the sample as much as possible to units with a high probability of large expenditures. The sample would then be higher in certain activities (chemicals, pulp and paper etc and in the largest size classes.

Example 4.10 Lithuania: The statistical office in Lithuania uses the Neyman allocation to draw the sample from strata where the sample of *n* is allocated into H strata:

$$n_h = n \frac{N_h s_h}{\sum_{h=1}^{H} N_h s_h},$$

$h=1,2,\ldots,H$ with the population variances s_h^2 of the survey variable estimated from th previous survey.

(Source: Krapavickait, 2003)

4.6 Questionnaire design

For reasons of cost, collection of information about environmental protection expenditure by industry would normally be done through postal surveys. Enterprises with non-response or large enterprises with potentially relatively large expenditure may be contacted by the telephone at a later stage of the survey. Interviews, whether face-to-face or telephone, are generally too expensive. Postal surveys do, however, have a potential drawback. The response rates are generally lower than interview surveys. We will here assume that postal surveys are used, although there are countries which are able to utilise regional authorities for example Portugal and Cyprus.

4.6.1 The filter process

For the respondent to report a specific environment protection measure, the following conditions should be met:

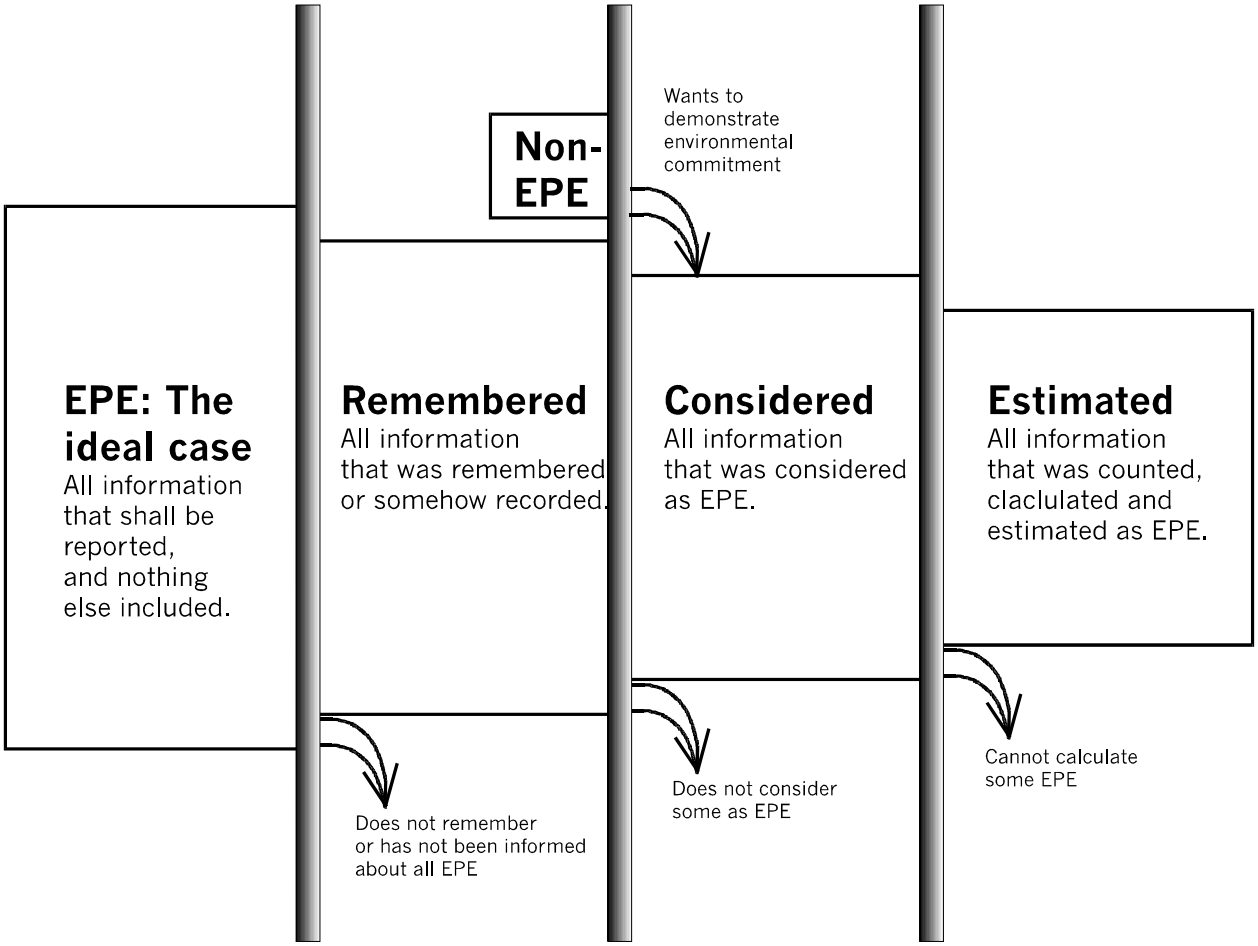
1) The respondent has to at some stage have had information about the measure and (s)he also has to remember it. The respondent must remember everything that was done the last year. The investments are generally few, but current expenditure could be a sum of many different things.

2) The respondent has to consider the measure as an environment protection measure (definition problem). The respondent needs to know what to include and exclude, but often has not time or interest to read detailed definitions. He may also have a different intuitive interpretation of what environment protection is, compared to our definitions (e.g. include total energy and water saving, total cost for a new machine which generates pollution, think that everything they do is to produce not to protect the environment etc.)

3) The respondent has to be able to calculate the expenditures on the measure with a reasonable amount of effort. This could sometimes be difficult and time-consuming (finding invoices, identifying number of hours worked, estimate the extra cost for integrated investments etc).

These three criteria can be regarded as a filter through which a measure has to pass, if the respondent is to include it in his answer. A great number of measures that ought to be reported could get stuck in the filter by not meeting one or more of the conditions. The opposite occurs as well. Some measures are erroneously reported, maybe because the respondent wants to demonstrate the enterprise's environmental commitment. For example, an investment may be included even though it refers to a time before or after the period covered by the survey.

Graph 4.4. The filtering process or how the data ends up in a questionnaire



(Source: Björsell 1995)

Problems with errors like the once above are likely to decrease over time.

- Part of the problem can be attributed to the fact that today the majority of enterprises have not implemented an accounting or information system from where information on environmental protection expenditure could easily be extracted. This means that there is a risk that the answers might be subjective and depending on who answers the questionnaire. The problem would also significantly decrease when more enterprises include this information in their accounting or information systems. There are signs that the accounting of these are on the increase, see Annex A4.

- This problem should be specifically important for new surveys and decrease when the survey is regular, but as experienced by the NL "In a lot of cases (even after so many years we have done this survey) we notice that environmental costs is a difficult subject. We often make phone-calls to these contact persons to ask them for clarification/explanation and discuss with them. Therefore it is important to use clear and practicable definitions/instructions."[20]

- Another way of minimising time and effort is to convey the importance and the benefits to the respondents of them using this information for themselves. It could either be for annual follow-ups, for benchmarking or for customer demands.

4.6.2 Principles of questionnaire design

The objective of the statistician is to do everything possible to create the conditions needed so that the right information (in adequate amounts) passes through these filters so that he/she can produce statistics with adequate quality. The main tool for this is the questionnaire and the accompanying definitions, instructions, examples, quality checks etc. There are a number of things which could be done to facilitate for the respondent and secure quality data.

- **Questions for supplementary information**
    - Number of employees/turnover etc.
    - Contact persons.
    - Description of the activity.
- **Definitions, instructions and questionnaire layout**
    - Make the definitions, instructions and questionnaire layout as clear and simple as possible.
    - Important to have these close to where the data is filled in!
    - Better to be clear on the important parts than to cover every theoretical possibility.
    - Allow or even encourage the respondent to use estimation procedures when information is not readily available, not the least for items which are less important (expensive) or where no other source of information is available (e.g. give examples how to estimate staff costs or integrated investments).
- **Examples**
    - Important and/or illustrative examples close to the questions for guidance, focus attention on important parts.
    - Examples should be relevant, could consider specific list or even specific questionnaires which are targeted to different enterprises (small or large, different NACE).

[20] Van Riessen, CBS Netherlands

- **Breakdown of variables**

    - Both depending on the requirements of the users, but also a powerful tool to show the users what sub-component should be included. Try to get the respondent to focus his efforts on the most important (largest) expenditure items by giving examples, or asking not only for totals but also sub-components.

- **Physical information**

    - Short description for quality control of the investments. Also one way of reducing the response burden. Let the enterprise describe what he has done and the Statistical Office will make sure that the treatment is consistent throughout all companies.

- **Other**

    - Purpose and method of the survey.

    - Statutory obligations of respondents. The relevant laws are referred to.

    - Confidentiality. The statistical Office will treat as confidential information all the details provided by the respondents in the questionnaire. The Statistical Office shall use all the details provided for the purpose of statistics only and shall not disclose them to any third party.

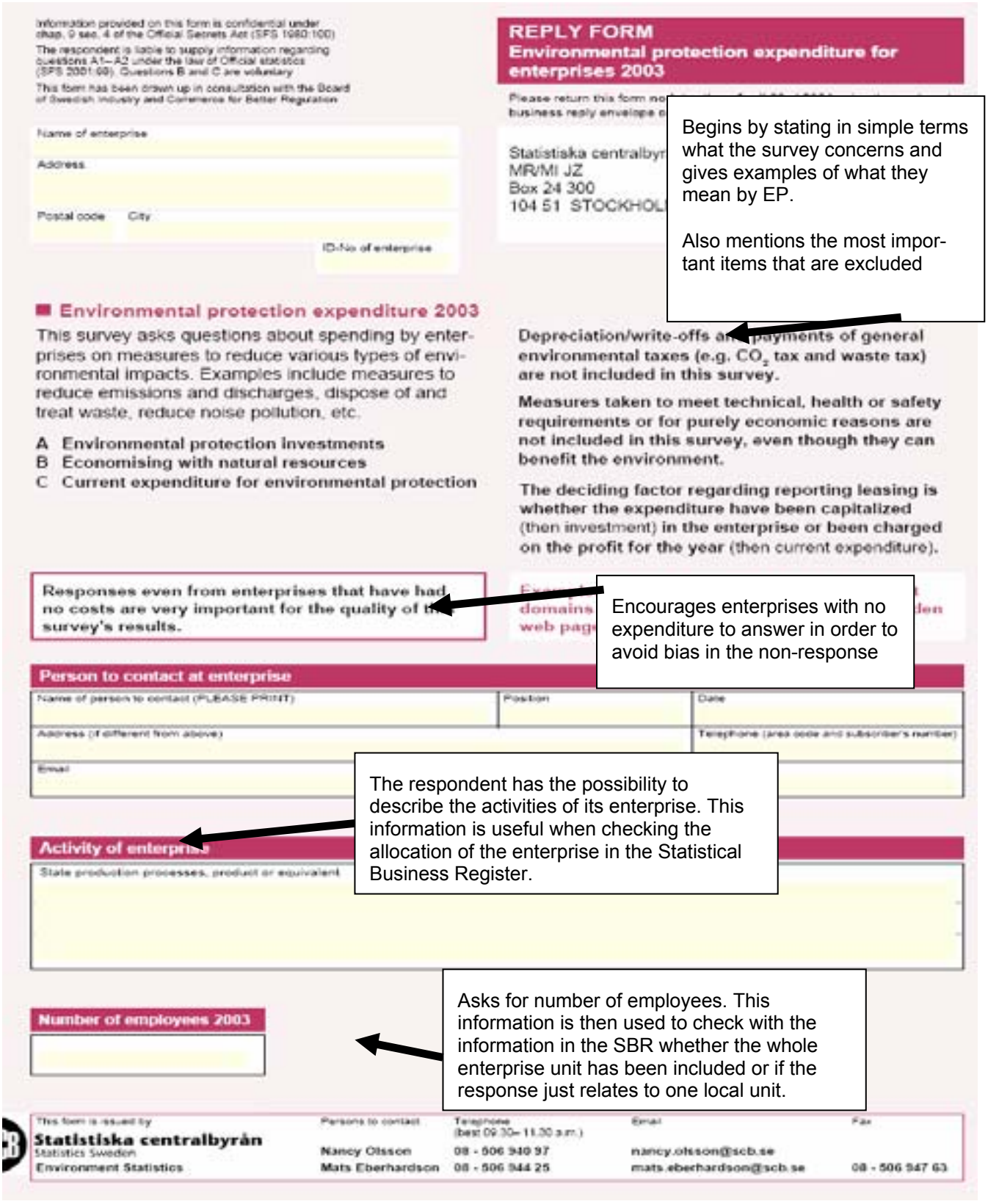
Example 4.11 Sweden: At Statistics Sweden there is a position specially for creating questionnaires and here is how this person thinks when creating the questionnaires: First of all it is important to be a part of the production process and to be informed in time for making the design. It is also important to have access to a good working tool. I use a special questionnaire design software that is in accordance with ISO and SIS standards called “Fill-in-design”. After that, you start on the first page with name of the survey, address fields and, something which should not be forgotten, who is the responsible for the survey. It has happened that it was forgotten to put names and contact information on the questionnaire, which would have been disastrous if a reply envelope had not been included.

It is important to decide in advance how many pages the questionnaire should have. This makes it easier for the designer to use all space available on the decided format paper. To fool the eye colours can be used. For example can two colours with white fill-in areas could be a good idea. It could also be an advantage to do a questionnaire in a PDF format on the internet. Then it is possible to “hide” information texts and make the design even better than for a paper version[1]. See chapter 4.6.3 for the design created by Mrs Jonsson.

(Source: Jonsson, SCB 2004)

4.6.3 Example 1 of questionnaire: Sweden

The following example is the 2003 questionnaire on environmental protection expenditure by Statistics Sweden. It consists of a four-page folded A3, including tables, definitions and instructions. Some comments are given in text boxes below.



Information provided on this form is confidential under chap. 9 sec. 4 of the Official Secrets Act (SFS 1980:100)
The respondent is liable to supply information regarding questions A1–A2 under the law of Official statistics (SFS 2001:99). Questions B and C are voluntary
This form has been drawn up in consultation with the Board of Swedish Industry and Commerce for Better Regulation

REPLY FORM
Environmental protection expenditure for enterprises 2003

Please return this form no... business reply envelope o...

Statistiska centralbyr...
MR/MI JZ
Box 24 300
104 51 STOCKHOL...

Name of enterprise
Address
Postal code City
ID-No of enterprise

Environmental protection expenditure 2003

This survey asks questions about spending by enterprises on measures to reduce various types of environmental impacts. Examples include measures to reduce emissions and discharges, dispose of and treat waste, reduce noise pollution, etc.

A Environmental protection investments
B Economising with natural resources
C Current expenditure for environmental protection

Depreciation/write-offs a... payments of general environmental taxes (e.g. CO_2 tax and waste tax) are not included in this survey.

Measures taken to meet technical, health or safety requirements or for purely economic reasons are not included in this survey, even though they can benefit the environment.

The deciding factor regarding reporting leasing is whether the expenditure have been capitalized (then investment) in the enterprise or been charged on the profit for the year (then current expenditure).

Responses even from enterprises that have had no costs are very important for the quality of t... survey's results.

Ex... domains ... web pag... ...den

Person to contact at enterprise

Name of person to contact (PLEASE PRINT) | Position | Date
Address (if different from above) | Telephone (area code and subscriber's number)
Email

Activity of enterprise

State production processes, product or equivalent

Number of employees 2003

This form is issued by
Statistiska centralbyrån
Statistics Sweden
Environment Statistics

Persons to contact	Telephone (best 09.30–11.30 a.m.)	Email	Fax
Nancy Olsson	08 - 506 940 97	nancy.olsson@scb.se	
Mats Eberhardson	08 - 506 944 25	mats.eberhardson@scb.se	08 - 506 947 63

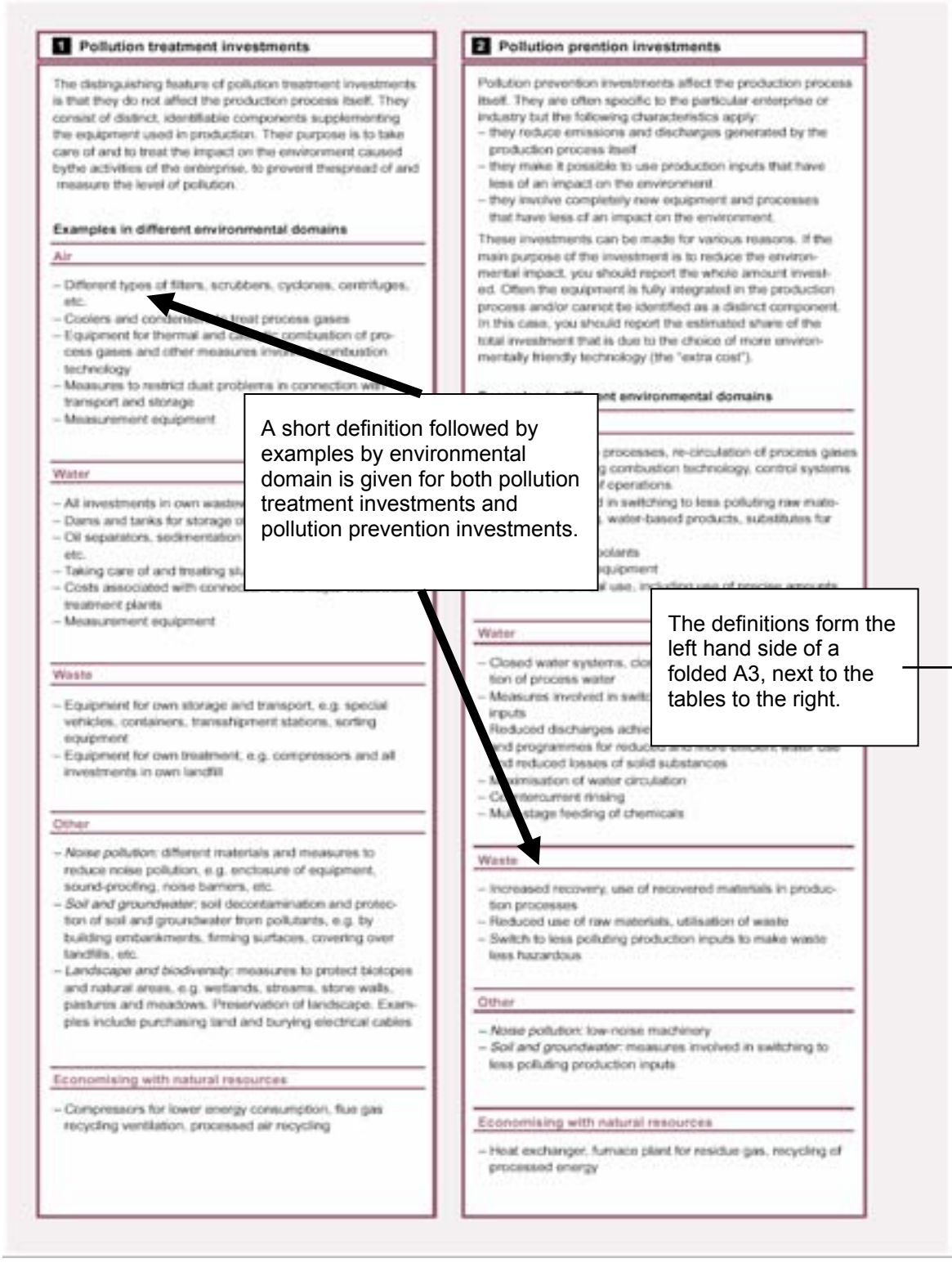
Begins by stating in simple terms what the survey concerns and gives examples of what they mean by EP.

Also mentions the most important items that are excluded

Encourages enterprises with no expenditure to answer in order to avoid bias in the non-response

The respondent has the possibility to describe the activities of its enterprise. This information is useful when checking the allocation of the enterprise in the Statistical Business Register.

Asks for number of employees. This information is then used to check with the information in the SBR whether the whole enterprise unit has been included or if the response just relates to one local unit.



1 Pollution treatment investments

The distinguishing feature of pollution treatment investments is that they do not affect the production process itself. They consist of distinct, identifiable components supplementing the equipment used in production. Their purpose is to take care of and to treat the impact on the environment caused bythe activities of the enterprise, to prevent thespread of and measure the level of pollution.

Examples in different environmental domains

Air

- Different types of filters, scrubbers, cyclones, centrifuges, etc.
- Coolers and condensers to treat process gases
- Equipment for thermal and catalytic combustion of process gases and other measures involving combustion technology
- Measures to restrict dust problems in connection with transport and storage
- Measurement equipment

Water

- All investments in own waste
- Dams and tanks for storage o
- Oil separators, sedimentation etc.
- Taking care of and treating sl
- Costs associated with connec treatment plants
- Measurement equipment

Waste

- Equipment for own storage and transport, e.g. special vehicles, containers, transshipment stations, sorting equipment
- Equipment for own treatment, e.g. compressors and all investments in own landfill

Other

- *Noise pollution*: different materials and measures to reduce noise pollution, e.g. enclosure of equipment, sound-proofing, noise barriers, etc.
- *Soil and groundwater*: soil decontamination and protection of soil and groundwater from pollutants, e.g. by building embankments, firming surfaces, covering over landfills, etc.
- *Landscape and biodiversity*: measures to protect biotopes and natural areas, e.g. wetlands, streams, stone walls, pastures and meadows. Preservation of landscape. Examples include purchasing land and burying electrical cables.

Economising with natural resources

- Compressors for lower energy consumption, flue gas recycling ventilation, processed air recycling

2 Pollution prention investments

Pollution prevention investments affect the production process itself. They are often specific to the particular enterprise or industry but the following characteristics apply:
- they reduce emissions and discharges generated by the production process itself
- they make it possible to use production inputs that have less of an impact on the environment
- they involve completely new equipment and processes that have less of an impact on the environment.

These investments can be made for various reasons. If the main purpose of the investment is to reduce the environmental impact, you should report the whole amount invested. Often the equipment is fully integrated in the production process and/or cannot be identified as a distinct component. In this case, you should report the estimated share of the total investment that is due to the choice of more environmentally friendly technology (the "extra cost").

nt environmental domains

processes, re-circulation of process gases
g combustion technology, control systems
f operations
l in switching to less polluting raw mate-
, water-based products, substitutes for

olants
quipment
l use, including use of precious amounts

Water

- Closed water systems, clo tion of process water
- Measures involved in switc inputs
- Reduced discharges achie and programmes for reduced and more efficient water use and reduced losses of solid substances
- Maximisation of water circulation
- Countercurrent rinsing
- Multi-stage feeding of chemicals

Waste

- Increased recovery, use of recovered materials in production processes
- Reduced use of raw materials, utilisation of waste
- Switch to less polluting production inputs to make waste less hazardous

Other

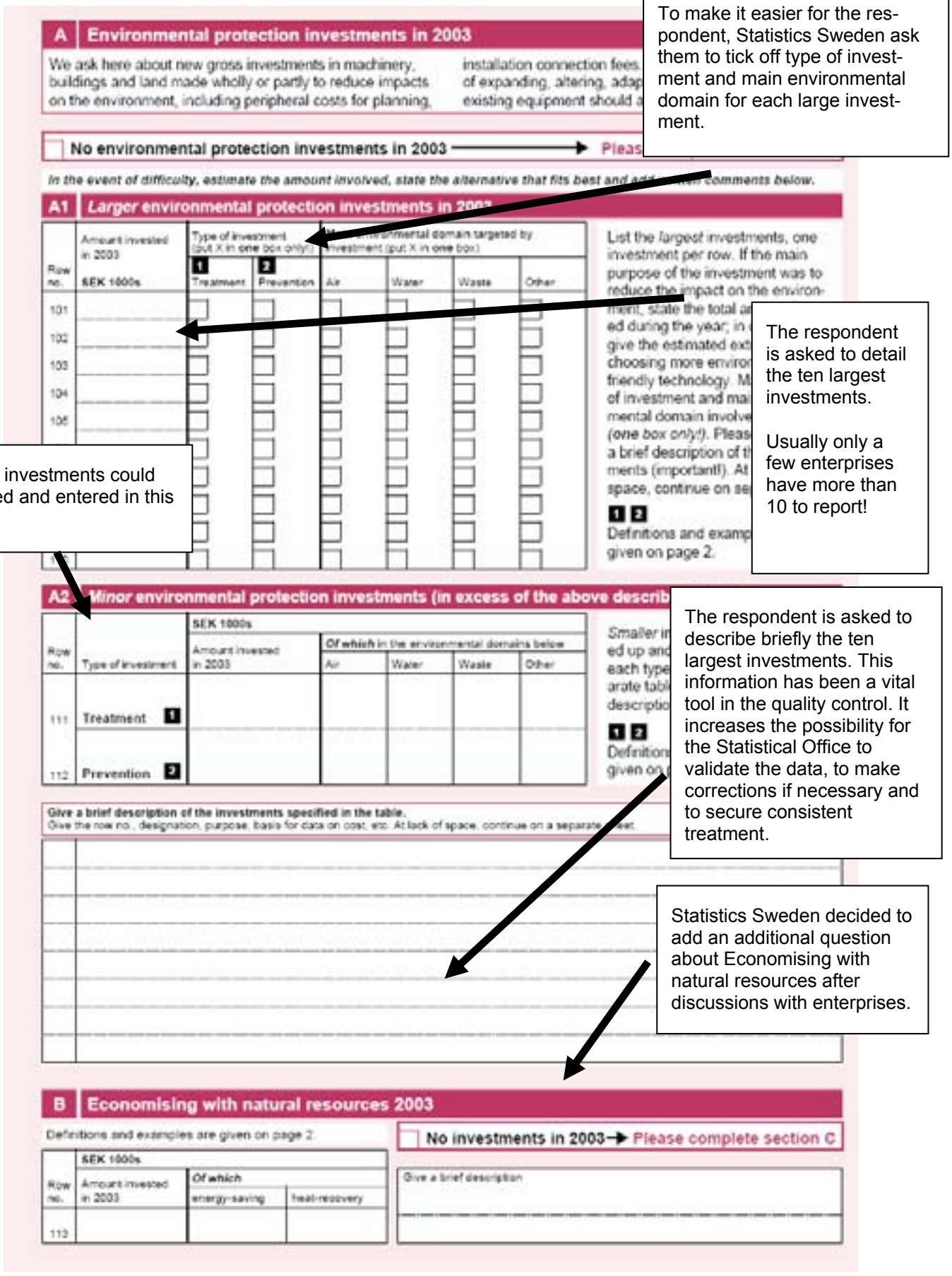
- *Noise pollution*: low-noise machinery
- *Soil and groundwater*: measures involved in switching to less polluting production inputs

Economising with natural resources

- Heat exchanger, furnace plant for residue gas, recycling of processed energy

A short definition followed by examples by environmental domain is given for both pollution treatment investments and pollution prevention investments.

The definitions form the left hand side of a folded A3, next to the tables to the right.



A Environmental protection investments in 2003

We ask here about new gross investments in machinery, buildings and land made wholly or partly to reduce impacts on the environment, including peripheral costs for planning, installation connection fees, of expanding, altering, adap existing equipment should a

No environmental protection investments in 2003 → Pleas

In the event of difficulty, estimate the amount involved, state the alternative that fits best and add ... comments below.

A1 *Larger* environmental protection investments in 2003

Row no.	Amount invested in 2003 SEK 1000s	Type of investment (put X in one box only): 1 Treatment	2 Prevention	Main environmental domain targeted by investment (put X in one box): Air	Water	Waste	Other
101							
102							
103							
104							
105							

List the *largest* investments, one investment per row. If the main purpose of the investment was to reduce the impact on the environ- ment, state the total a ed during the year; in give the estimated ext choosing more enviro friendly technology. M of investment and mai mental domain involve *(one box only!)*. Pleas a brief description of t ments (important!). At space, continue on se

1 2

Definitions and examp given on page 2.

A2 *Minor* environmental protection investments (in excess of the above describ

Row no.	Type of investment	SEK 1000s: Amount invested in 2003	Of which in the environmental domains below: Air	Water	Waste	Other
111	Treatment 1					
112	Prevention 2					

Smaller i ed up and each type arate tabl descriptio

1 2

Definition given on

Give a brief description of the investments specified in the table.
Give the row no., designation, purpose, basis for data on cost, etc. At lack of space, continue on a separate sheet.

B Economising with natural resources 2003

Definitions and examples are given on page 2.

No investments in 2003 → Please complete section C

Row no.	SEK 1000s: Amount invested in 2003	Of which: energy-saving	heat-recovery
113			

Give a brief description

To make it easier for the respondent, Statistics Sweden ask them to tick off type of investment and main environmental domain for each large investment.

The respondent is asked to detail the ten largest investments.

Usually only a few enterprises have more than 10 to report!

Smaller investments could be added and entered in this table

The respondent is asked to describe briefly the ten largest investments. This information has been a vital tool in the quality control. It increases the possibility for the Statistical Office to validate the data, to make corrections if necessary and to secure consistent treatment.

Statistics Sweden decided to add an additional question about Economising with natural resources after discussions with enterprises.

eurostat

C Current expenditure for environmental protection in 2003

Here you should report all costs for environmental protection that are not investments. These may be related to existing equipment but they can also be more general. Examples include payments for operation of purification plants, fees regarding water purification and waste water treatment, payments for transport of waste and landfill, inspection fees paid to public authorities, costs for environmental management and certification, costs for personnel with environmental responsibilities etc.

For each type of expenditure you should [illegible] costs for work by your own enterprise (ro[illegible] for purchased services (row 31). Please [illegible] costs (row 30) should be reported separa[illegible]

Interest payments and capital costs (depreciation), and payments of general environmental taxes and fees for NO_x should not be reported.

☐ **No current expenditure for environmental protection in 2003** → Please complete section D

In the event of difficulty, estimate the amount involved, state the alternative that fits best and add written comments below.

Current expenditure environmental protection 2003

SEK 1000s

		a Operations, maintenance, inspection and control	Of which in the environmental domains below: Air	Water	Waste	Other	b General environmental administration, education and training, information, etc.	c Research and development	d Other
		1	2				3	4	5
Internal expenditures	30								
Thereof staff expenditures	e SEK 1000s								
Bought services and fees	31								

Give a brief description of the investments specified in the table above. Give the row, designation, purpose, basis for data on cost, etc.

a Operations, maintenance
Internal expenditures: Costs for personnel, materials, energy used in operations and maintenance of existing plants and general envi[illegible]
Bought services and fees: Fe[illegible] water treatment should be repor[illegible] tal domain "Water" [illegible] state in[illegible] public authorities und[illegible]

b General environmental ad[illegible]
Internal expenditures: Costs fo[illegible] investigation, education and trai[illegible] environmental management and[illegible] includes costs for environmental[illegible] mental coordinators, etc., that ar[illegible] ted to operations and maintenan[illegible]
Bought services and fees: Ref[illegible] education and training, environm[illegible] environmental studies conducte[illegible]

c Research
Total costs for R&D, tests, etc., [illegible] impact of the enterprises operati[illegible] ment. Bought services here can [illegible] activities at other enterprises in the group.

d Other
Internal expenditures: Costs fo[illegible] aimed at reducing the impact of [illegible] operations on the environment.
Bought services and fees: Ref[illegible] activities at other enterprises in t[illegible] group.

e Staff expenditure for Envi[illegible]
The costs for the [illegible] protection reported above[illegible] costs. This question asks for a [illegible] these personnel costs, incl. social insurance payments and other peripheral costs.

D Follow-up and evaluation

How long did it take to fill in this form (incl. data collection)?	hours

☐ We would like an electronic summary of the statistics "Environmental protection expenditure for enterprises 2003"

The respondent is instructed to exclude some payments that do not belong to the definition

Current expenditure is divided into 'internal expenditure" and 'bought services'. The expenditures are broken down by environmental domains.

The current expenditures are divided into the most important types of activities, which are explained in more detail just below the table. This division is mainly to make it clear that these items should be covered, and to allow for checks if certain items are missing.

If the respondent wishes, it can receive an electronic copy of the first dissemination of the survey.

4.6.4 Example 2 of questionnaire: Germany

Germany has a slightly different survey structure. They have separate questionnaires for investments and for current expenditure. The latter can be found below. The division of current expenditure follows quite closely the accounting variables in the profit and loss account. Definitions and examples are also given as footnotes at the end of the questionnaire.

Statistisches Bundesamt

DESTATIS
wissen.nutzen.

Survey of current expenditure on environmental protection in the production industries 2003

15 A

Legal bases and guidance: please see the explanatory notes which are part of of the survey form.
Statistisches Bundesamt
Group VII B 52

53117 Bonn

Bei Rückfragen erreichen Sie uns unter:
(+49) 01888 644

Mrs. Widike
Mrs. Wegner

Fax: (+49) 01888 644 8976

email:
umweltaufwendungen@destat

Vielen Dank
für Ihre Mitarbeit!

Deadline for return of form:

30 June 2004

Statistisches Bundesamt, Zweigstelle Bonn, 53117 Bonn, Deutschland

please give the name of the be contacted in case of (voluntary) : name, fon, fax or e-mail:

VII B 4 52 / Arbeitsunterlagen / Erhebungsvordrucke / 2003 /

- translation of German survey form -

Ort, Datum, Unterschrift:

Please correct on page 4 if the address is incorrect!

Identitfication no: (please quote in all

Sst 2 - 10

SA Sst 1

Guidance on completing the form:
these returns relate to the **complete enterprise** as a legally independent unit, including all production areas but excluding any branches abroad. Legally independent subsidiaries **should not be included.**

The reporting year is the calendar year. If the accounting year does not coincide r to the accounting year which ended during 2003.

A maximum of 12 months are to be included in the accounting year.

Please see the explanatory notes on pages 6-7.

Reporting deadline: please send one copy of the survey forms to the Statistisches Bundesamt by the above deadline. If the final end-of-year figures are not available by that date, provisional values or carefully estimated figures will suffice. The second copy of the forms is for your files.

If any unusual results have influenced the data, please comment briefly, to avoid our having to contact you later :

Any unusual expenditure can already be mentioned on the first page.

Is the accounting year the same as the calendar year?

Yes ... ☐ No ... ☐

it runs

from TT MM JJJJ

to TT MM JJJJ

15 A - Laufende Aufwendungen für den Umweltschutz im Produzierenden ewerbe für das Jahr 2003

page 1

Current expenditure on measures intended solely for environmental protection including emission charges in 2003, by environmental area

Data on waste management, water protection, noise abatemer

Expenditure on own plant should be reported under **1**
If you have no such plant, please begin at **2**

The first more detailed part concerns the most important environmental domains. The other domains are included on a separate page.

Definitions and examples are given at the end of the question-naire.

The breakdowns here follow more closely the different accounting variables in the profit and loss account. Some items are included which are not defined as current expenditure (depreciation, interests).

A separate section for emission charges is added at the end.

		Waste	Water	Noise
		in complete units of Euro		
		1	2	3
1	**Cu…ant for environmental protection**			
1.1	Depriciation	01		
1.2	Inputet interest	02		
	*If you have set up **cost centres** for plant, please fill in 1.3 - 1.6*			
1.3	Payroll costs (Gross wages and salaries, social security contributions)	03		
1.4	Expenditure on raw materials and supplies excluding energy	04		
1.5	Expenditure on energy	05		
1.6	Expenditure on external services and other expenditure, in particular on measures carried out by the enterprise itself (plant-related expenditure only)	06		
	*for plant **with no** own **cost centre***			
1.7	Expenditure on staff, raw materials and supplies, including energy, and on external services and other expenditure	07		
2	**Charges and contributions** in particular charges for municipal waste disposal services and sewerage charges	08		
3	**Other current expenditure not on the running of plant** Expenditure on external services, including for the disposal of waste by private enter-prises and other expenditure, in particular on measures implemented by the enterprise itself, if not already included with plant (number 1 above).	09		
	Total current expenditure (Sum of 1.1 – 1.7, 2 and 3 above)	10		
B	***Emission charges***			
1	resulting from the Taxes on the Discharge of Effluent into Receiving Waters Act (Abwasserabgabengesetz-AbwAG)	11		

4.7 Data collection

The main task in the next phase of the survey process is to get replies from as many enterprises as possible: i.e. to minimise the non-response. For obvious reasons, the issue of non-response is closely related to that of response burden. One might even reason that the degree of non-response is, to a certain extent, an indicator of the burden as perceived by the respondents. It is therefore both in the interest of the statisticians and the respondents to reduce the response burden as much as possible.

As with response burden, there is a variety of interpretations of the concept of response. The deviations stem from different treatment of some borderline cases.

1. Returned questionnaires which are only partly filled in.

2. Questionnaires, completed partly or entirely by a field service.

3. Questionnaires, returned after the deadline for processing.

Whether or not to incorporate these borderline cases in an indicator of the response rate is primarily a matter of how the indicator will be used.

- If it is intended as an indication of the willingness of respondents to co-operate, the second category should not be included. For such a purpose it might be interesting to make a further breakdown of the rates in spontaneous response and response induced by follow-up actions.

- In the case the response rate is used as a quality indicator, the second category should be included, while the third should be left out. This is the figure that should appear in publications as part of the explanatory notes for the user.

- The first category poses a borderline problem for which no concrete rules can be given. In fact, it points to a weakness in the whole concept of response suffers from: ideally, the response rate should be based on counts of questionnaires after weighting all of them with the quality of the answers. This is not feasible in practice. Still it is important to be aware of this weakness when interpreting the response rates.

In sample surveys it is usually necessary to do everything possible to maximise the response rates. , The general rule, therefore, would be to include as many of the partly completed questionnaires as possible and complement by estimating the missing parts. Furthermore, late replies are usually accepted up till the point when enough replies are available to enable good quality results. Anyway, it is recommended to document response behaviour in such a way that different categories can be recognised. This would allow an evaluation of the different measures taken to reduce the non-response (e.g. response before initial deadline, after first written reminder, after phone reminder, etc.).

Below follow some specific suggestions of ways to reduce non-response.

- Send the questionnaires around the date when data are expected to be available.

- The final date of return should give the enterprises enough time to answer but not be too far away, so as to prevent respondents forgetting the questionnaire.

- Send first reminders within a week after the deadline for final return.

- Telephone reminders are more effective than written reminders, but are more expensive. , Start, therefore, with one or two written reminders (with or without a new questionnaire) and end with a telephone reminder.

- Give priority to larger businesses, especially with respect to expensive actions, like personal visits. In some countries, a limited number of very large enterprises could account for the majority of the expenditure. Their response and its quality are crucial for the end results and maximum efforts should be devoted to getting their reply (build up a good personal contact, visit the enterprise, help them in anyway possible to fill in the questionnaire).

- Permit ‘guesstimates’, not as a ‘general pardon’ (that might be dangerous and gives the impression we do not care about the quality) but on an individual basis, i.e. for those respondents who are willing but not able to deliver the data in time. This is especially relevant for items which are less important (expensive), time-consuming and/or difficult to find basic sources for.

- Always contact respondents - and do it quickly after return - who only partly complete questionnaires or report implausible data (e.g. always the same numbers) so as to avoid the impression that their behaviour does not matter. However, the resources should be devoted to enterprises and expenditure items which would have the highest effect on the quality of the end result. (All items higher than X Euro, enterprises in the largest size classes or in specific activities where you would expect high expenditure).

- Invite respondents to contact the statistical office in case of questions and make sure that there is always a qualified staff member to answer the telephone. An example of this is the UK, which has a survey help-desk with advertised office hours. The use of e-mail could also make these contacts more efficient for both the respondent and the statisticians, at least when the questions are clear and concise.

- Build up and up-date a mailing list with contact persons from previous surveys or, for example, from directories of environmental managers, etc. In this way you can minimise the time it takes for the questionnaire to reach the right person to answer your questions, and you can prevent the questionnaire being sent back and forth to different people because no-one takes responsibility (would like to respond or has the time).

- State clearly why this information is needed, how it would be used and by whom. Offer the respondent the possibility to get a summary of the results or (extracts of) publications. If they are not interested - which is the likely case with accounting staff - let them indicate other staff within the organisation.

- Make sure the respondents understand that the information they send in will be treated as confidential and used for statistical purposes only.

- State clearly that response from enterprises which have little or no effect on the environment and who have low or zero expenditure is very important for the quality of the final results. This is to prevent these companies thinking the survey is not relevant for them, which would lead to bias in non-response.

- Stimulate survey staff by providing them with response score (and comparisons) on a continuing basis and train staff in handling difficult respondents.

- If an adequate quality of results cannot be guaranteed by using a voluntary survey, consider making it obligatory for the enterprises to respond. Some enterprises have as a general rule that they only answer obligatory surveys.

Finally, the importance of good co-operation with respondents (and industry/trade organisations) can never be stressed enough, both for the response rates and for the quality of the results. This is of course particularly important before a new survey is set up or before major revisions, but there is also much to be gained from a continuous dialogue with representatives of enterprises and industry associations about, for example,

- the survey objectives (to get acceptance, make the results useful also for the industry),

- the content of the survey (make it relevant for the respondents),

- the questionnaire itself (to test that the definitions are clear, to get examples that are relevant),

- the survey process (when is the best time to send out the questionnaire),

- what could be done to limit the response burden (perhaps print previous replies on the questionnaire),

- dissemination (interpretation of the result, usefulness for the respondents themselves).

4.8 Processing and validation

After data has been collected, it has to be processed and validated. The starting point for the processing stage is the information as reported by the respondents. Processing and analysis can be said to comprise all operations, applying for 'promotion' of these data to the level of the intended statistical output as specified at an earlier stage. For various reasons, the act of processing comprises more than just aggregating questionnaire items:

- Some respondents will make errors while filling in the questionnaire; the same holds for people entering the data.
- Both at micro and aggregated level there may be inconsistencies compared to related items obtained from other surveys.
- Some respondents will only partly complete the questionnaire.
- To comfort respondents, not the entire questionnaire items are a perfect representation of the output concepts envisaged.
- Only a sample of the frame population has been surveyed.
- There will be non-response.
- The sampling frame, from which the sample was taken, is not a perfect representation of the survey population.
- Certain output data require further analysis.

Processing comprises a range of operations and subsequently settling all these deficiencies. The following steps apply:

- After data entry, errors and inconsistencies are detected and corrected during editing.
- Subsequently, item non-response as well as gaps between questionnaire concepts and output concepts are dealt with, some by persuading respondents to reply, some by imputation.
- Next, the resulting set of clean and complete micro data serves as a basis for weighting and re-weighting. During this stage, frame errors are also accounted for.
- The aggregated data are then compared with related data from other sources and integrated.
- Finally, where appropriate, statistical compilations and analysis are carried out, resulting in final tabulations.

Validation is the examination of data for the purpose of error detection. Like any respondent, the person reporting environmental protection expenditure is prone to different types of errors while completing the questionnaire. Only part of these errors can be traced by the statistical agency collecting the data; many errors can and will not be traced. Therefore even exhaustive data editing will never result in a totally error-free data file. The important thing is to identify and correct the important, influential errors. Fortunately, there are methods available to do so. In general it is easier to describe what is allowed ('checking rules') than to state what cannot be allowed ('rejection rules'). We will distinguish checks and edits by the moment they occur in data processing and by type.

4.8.1 Check the responding unit

The first check is to control that the answer actually refers to the selected statistical unit (e.g. all local units in an enterprise). As we have seen above (chapter 4.5.2), the respondent may have different interpretation of units than is formally registered in the business register. There is in particular a risk

that the reply does not relate to the whole enterprises, but only the specific local unit where the person filling in the questionnaire is working.

The relevant unit should be clearly defined early on in the questionnaire. If necessary, a list of the different local units could be attached when the questionnaire is sent out.

Checks of the responding unit could be built into the questionnaire, for example, as questions on the number of employees or turnover, which are then compared to the information in the business register.

Wrong unit might also be detected when other logical checks are performed, such as comparisons between environmental investments and total investments.

Example 4.12 Sweden: 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 local units, and number of employees and NACE code for each individual local unit. Through this procedure we were able to identify a number of answers that referred only to a single local unit and not to the whole enterprise. We then contacted the respondent to confirm this, to get contact persons for the other local units, and to ask if there were any of the other units that had no (or insignificant) environmental expenditure. Many enterprises have a few production units and some units 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 units of relevance. A total of 55 enterprises were discovered to have answered only for one local unit. This is equal to 10 percent of all responding enterprises that reported environmental expenditure. For 35 of these, we were able to collect information from all other units of relevance. For the remaining 20 enterprises we usually got information from additional units, but did not capture the whole enterprise. The information gathered for these was used for statistical estimations of the rest of the enterprise.

(Source: Johansson 2000)

4.8.2 Check response to questions

The second check is to see whether all questions which should have been answered have in fact been answered. This involves deciding how to treat empty cells in the questionnaire, if they should be seen as a statement that the expenditure is zero or if they could indicate an item non-response. As has already been stated, this is particularly important when the survey is non-independent (see 4.7).

4.8.3 Arithmetic checks

Arithmetic or logical checks are done in order to discover basic mistakes made by respondents when filling in the questionnaire. This would include checking that the sum of sub-components should equal the total reported for each variable. It would also be of interest to include yearly checks for enterprises that are recurrently included in the surveys. It would quickly be revealed if any major change has occurred or even if the enterprise is trying to take an easy route by reporting the same amounts as the previous year.

4.8.4 Check coverage of variables

It is also important to know whether there are items included in the definitions of variables which are not covered by the figures reported. When only aggregated totals are asked for (e.g. total current expenditure) there is a clear risk that the respondent forgets or omits some of the underlying items. If this is the case, it is recommended to analyse the possible under- or over-estimation (e.g. by selecting and contacting a number of respondents).

Checking coverage is easier when sub-categories are asked for separately in the questionnaire. These checks could then be based on a normal case scenario. For example, it might be assumed that most enterprises should have either internal expenditure on waste or have payments for waste collection, etc.

4.8.5 Relational checks

Relational checks are done either to check that the figures reported are permissible, or that they are plausible. However, in business surveys the valid value range must often be very wide, for instance because of varying firm size and the often inherent variability of the data. This means that it is difficult to set up fixed rules. Instead relational checks are a more powerful validation tool. These checks take the form of a ratio between two variables, which should be within specific bounds. Through this, a number of outliers would be identified and could be investigated further (e.g. by contacting the respondent).

Help variables for checking environmental protection expenditure data could be business statistics for the same enterprises if available (total investments, total labour costs, etc.). If this is not available, the average for the specific industry or size class could be used as a substitute. Comparisons could also be done with historic data for the same enterprise.

The problem with these checks is that the size of environmental protection expenditure for an individual enterprise in a particular year could be to a large extent non-correlated with these variables and more dependent on individual characteristics. There is clearly a considerable variation in the size of expenditure between enterprises of the same size and involved in the same activity, and between the years for the same enterprise. This means that these checks could only produce a list of candidates for further investigation.

4.8.6 Check for measurement errors

The most important check for environmental expenditure is that for possible measurement errors, particularly for the investment variables. Experience has shown that it is very useful to ask for written descriptions in the questionnaire. The Netherlands, Finland and Sweden, for example, all ask the respondents to report a list of individual investments with a short description of the measures.

- These text descriptions are then used to identify possible mistakes (wrong investment category, wrong environmental domain, not environmentally motivated, etc.).

- In many cases, the text description itself may be enough to decide to change categories. In this way the statistician could make sure that similar examples are recorded in a consistent way.

- The text descriptions also provide a basis for the interpretation of results.

Example 4.13 Netherlands: We use different kinds of validation procedures, data editing and correction-procedures:

- **On the micro level.** All cost items are automatically compared, cost item by cost item, for every responding enterprise in the sample (if available) to data of earlier years for this enterprise. We distinguish soft and hard errors: hard errors have to be solved by the editor, soft errors are left to the judgement/responsibility of the editor (these are for instance errors because margins are exceeded compared to last year data of the enterprise). The editor will contact the enterprise if necessary. Special attention is given to investments (e.g. for process-integrated investments; to determine the environmental part of the total amount of a process-integrated investment).

- **On the meso-level.** We connect the results to other indicators. For example, environment investments are compared to the general investment level in a branch (but we also compare at enterprise-level if available)

- **On the macro level.** We connect the results (net environmental costs) to general macro-economic information like turnover, added value and number of employees.

We keep the raw data separate:

We store and keep the rough data (as filled in by the enterprise, even if we know it's wrong!) after data-entry and do the data editing on a copy-database. This is important because it shows the influence of the (manual) data-editing process; CBS is working on an automatic editing program (Cherry Pi and Slice). Input for this program is the existing data we have for a range of years, together with the rough and the (manually) edited data. We already know (after research) that this program can edit part of our data. Investments cannot be automatically edited!

Good contact with enterprises etc.

It is important to have good contact with the contact persons in the enterprises, and also in the branch-organisations, to show the results to respondents (feed-back). We pay visits to enterprises. In some cases this is done by the statisticians themselves. From time to time they go to some of the largest enterprises. Apart from these occasional visits by statisticians, each year our field workers visit about 150 enterprises, particularly those enterprises that need help filling in questionnaires, or for other reasons.

Some important (because of high annual environment costs) enterprises, which are usually large, simply refuse or do not want to fill in our questionnaires. In such cases we agree for them to send us the information in the form in which it is available in their administration. Obviously we don't get all the information we want this way, but it is preferable to get something rather than nothing. For some of these cases we have a separate way of accounting. Data from these enterprises is not put at micro-level in our system (this is not possible because the data is unsuitable), but the data goes in at a higher level (NACE 2- digit, domain).

(Source: Van Riessen, CBS Netherlands)

4.9 Estimation of variables

In some cases it is an advantage to estimate certain variables instead of collecting them directly from the respondents. This could be due to difficulties in retrieving a particular piece of information and therefore creating inconsistencies in incoming replies.

Example 4.14 UK: Respondents to the self completed questionnaire did not always answer every question and in some cases provided answers that were inconsistent. It was, therefore, necessary to develop a process for imputing these missing answers in order that the expenditure totals were always internally consistent. This meant, for example, that the total expenditure for a given category was equal to the sum of the expenditures by media for that category.

For wastewater expenditure a large number of companies (particularly in the earlier surveys) entered a value of £0. From the 2002 survey respondents were requested to specify why if a zero entry was recorded. For the surveys in 1999, 2000 and 2001 zero responses and "not applicable" or "not known" answers had a value imputed based upon the fact that a very high proportion were left blank or had a zero entry, and that most, if not all, companies should have some expenditure on waste water.

The value imputed was calculated as the number of employees within the given company multiplied by the rounded median wastewater per employee spends for each standard industry classification (SIC).

The median wastewater spend per employee was used as this was not as influenced by any outliers within the data that the mean value could have been. In addition only companies that had recorded some wastewater expenditure were used within the calculation. The median values were rounded to the nearest £5.

(Source: DEFRA, 2004)

Example 4.15 Netherlands: In the Netherlands current expenditures are divided into expenses that are directly related to an investment for environmental protection and the rest. The directly linked expenditures include: Staff costs for operation, maintenance and supervision, energy costs, costs of raw and auxiliary materials, minus revenues and savings. Below shows the method used to calculate these directly linked expenditures taking into consideration the environmental domains.

$$CE^{NACE,comp}(t) = \sum_{t-10/t-25}^{t} Dep_{\tau}^{NACE,comp} \times \left([CE / Dep.]^{comp}(response) \times AF^{\,t-(\tau+1)} \right)$$

t = year for which the current expenditure is calculated

τ = year when the investment was installed

comp = environmental domain

= Total depreciation of all investments for a certain NACE and environmental domain, corrected with price-index figures

= Ratio between current expenditure (CE) and depreciation (Dep) for environmental equipment installed in year τ for a certain environmental domain, as obtained from the questionnaires on current expenditure for the year τ+1, corrected with price index figures

= Ageing factor (AF) = 1.035: current costs increase with 3.5% for every year the equipment is in operation.

Total depreciation ($Dep.^{NACE,\ comp}$) is calculated based on the information on the environmental investments, which are still surveyed annually.

(Source: Schenau and Van Riessen, 2004)

4.10 Imputation and grossing up

In most surveys one has to face the problem of missing data. Two types of missing data are usually distinguished: unit non-response and item non-response. Imputation applies for the latter, while unit non-response is dealt with by re-weighting or grossing up.

There might also be a third type of missing data, because of a gap between the desired output variables and questionnaire items actually surveyed. Unlike non-response, this is due to a deliberate choice during the survey design stage, for example, to estimate part of the parameters. Therefore we will speak of intentionally missing data.

4.10.1 Item non-response

Item non-response or partial non-response occurs when the sampled units have not answered all relevant questions, but did respond to part of them. (If a respondent reported on all questions, inconsistencies between some of the answers may occur or an answer may be logically incorrect). One can distinguish three different types of item non-response. In the first type the missing values are completely at random. The second type does not depend on the value of the variable, but on the values of some other variable(s). The third type depends on the value of the variable on which it is missing. For example, high scores are often more likely to be missing than low ones.

Example 4.16 Eurostat: Imagine a form containing an item about pollution tax. If enterprises do not respond to this item because they erroneously assumed the question was not meant for them, the non-response is called completely at random. Indeed, whether or not the question was answered has no relation with the level of the tax or with any other item. Now suppose some of the businesses are used to paying pollution tax for a particular kind of chemical they expose to the air. Recently this chemical has proved to be rather dangerous for the environment. Such respondents may be more likely to "forget" the pollution tax question than other respondents. In this case the non-response depends on another variable, i.e. type of pollution. Now we might say that, given the type of pollution a business is taxed for, the non-response is completely at random. The non-response is not at random when businesses with high tax levels are more likely not to respond than firms with low levels of tax.

Two general strategies apply with respect to the way to deal with item non-response.

- The first strategy ignores the missing values while their treatment is deferred to the analysis stage. The simplest way is to ignore all forms with missing values and confine to analysis of the fully completed forms. This method is called the complete case analysis. An alternative is the available case method, which uses all available information for uni-variate and bi-variate statistics. More elaborate methods directly analyse the incomplete data by specifying a model. Methods that directly analyse the incomplete data are based on distribution assumptions regarding the variables.

- In the second strategy estimates for the missing data are sought and with these new values the data matrix is made complete. This is called imputation. On the imputed data matrix standard analysis techniques can be applied.

There are a variety of imputation methods, ranging from very simple and intuitive to rather complicated statistical procedures. The objective is to find the best possible substitute for the missing values. Some more simple possibilities to consider are to:

- Impute on the basis of values which appear reasonable. For example, one might deduce the labour costs if the number of employees is known.

- Impute the mean of a variable, or the median in order to eliminate the effect of outliers (also by strata).

- Find reasonable estimates for the missing values in another data set, for instance a previous measurement (historic data) or another source close to the non-responding one (proxy data).

- Select a donor (nearest neighbour) which is close to the non-respondent according to some distance criterion. Or select one from the nearest group.

Example 4.17 Belgium: Deterministic imputation is used where only one correct value exists, as in the missing sum at the bottom of a column of numbers. A value is thus determined from other values on the same questionnaire (UN-ECE, 2000).

A deterministic imputation on the level of the databank following logical principles described below was performed:

1-a company declaring zero for the total should have zero for the details;

2-a value in "other" is supposed to cover all remaining, not detailed, expenditure: a zero is attributed to all missing domains and the total is calculated accordingly;

3-a company that answered for all domains, but not for "others" is supposed to have classified all of its expenditures: other is then estimated to be zero, and the total is calculated accordingly.

Deterministic imputation is illustrated below:

	Total	Air	Water	Waste	Soil	Other
Case 1	**0**	*0*	*0*	*0*	*0*	*0*
Case 2	1000	*0*	*0*	*0*	*0*	**1000**
Case 3	3000	**0**	**1000**	**2000**	**0**	*0*

In bold : response, *In itallic* : imputation

A remaining case is more problematic:

	Total	Air	Water	Waste	Soil	Other
Case 4	**3000**	?	**1000**	**2000**	?	?

In this frequent situation, a company answered something for several domains, and gave as total, the total of its detailed answers. This could be interpreted in 2 ways:

1-either the answer is fully correct and we should add zero to the remaining fields;

2-either the company declared the total of what it could identify, and we can not affirm that there is no expenditure for other or undifferentiated domains.

In this latest situation, we did NOT impute the missing values. This implies that the total answered could be considered "doubtful" (possibly underestimated) and is subject to post-editing.

(Source: Kestemont 2004)

The natural variance in the variables measuring environmental protection expenditure, both on the macro and the micro level are commonly large. This is particularly true for investments. This means that it could be perfectly natural that two enterprises of the same size, involved in the same activity, report completely different amounts in the questionnaire. There could also be substantial variance over time, both for the single enterprise and for an entire industry (e.g. following new environmental regulations or the availability of new technology). This makes it difficult to estimate accurately non-response both based on substitutes, averages or historic data.

An enterprise may report their environmental protection investments, but could be unable or refuse to report current expenditure on environmental protection. This could be accepted as a valid (partial) response from the enterprise, which has to be complemented by an estimate of the missing variable. If

no better information is available, the missing variable could be estimated using the same procedure as for grossing up for complete non-response or for non-sampled enterprises.

It is also possible to receive information which relates only to a part of the enterprise: e.g. one local unit of many. This could also be accepted as a valid (partial) result, but then the environmental expenditure in the remaining local units needs to be estimated. This could be done by using normal grossing up procedures (e.g. number of employees in the missing units) or using enterprise specific information (directly from the respondent or from the business register), or a combination of the two.

- Use data for the local unit to gross up to the enterprise. Assume for example the same expenditure by employee in the whole enterprise, as in the responding local unit.

- Use standard grossing up procedures. Assume, for example, the same expenditure per employee in the missing units as the average in the strata.

4.10.2 Intentional missing data (including use of other sources)

The survey manager might decide to deliberately refrain from explicitly surveying certain variables, for example, to make it easier to fit in with respondents' accounting systems

Example 4.18 Eurostat: For the compilation of pollution treatment investments, a surveyor wishes to measure the purchase value of new fixed assets put to use for environmental purposes. However, enterprises that lease the asset acquired will not be able to supply the purchase value. Therefore, the questionnaire mentions "lease amount paid", and the statistical office imputes the purchase value by means of certain keys.

The survey manager might also decide to completely estimate certain sub-components as was shown in chapter 4.9.

4.10.3 Calculating national data

It is common practice for statistical offices to attach weights to the elements in a sample. The objectives of weights are to:

- expand the sample to the population;

- cope with missing observations;

- achieve consistency with data from other sources.

We distinguish between weighting and re-weighting. Weighting, i.e. the attribution of weights to sampled units, can in principle take place before data collection, provided the sampling design is not too complex. Re-weighting always applies after data collection.

Expansion of the sample to the population is a process in which first order inclusion probabilities play a key role. The first order inclusion probability of a population element is the chance that this element is included in the sample.

---

i) Simple by average in strata

In the survey of environmental investments by industry, the population (of a NACE activity) is divided into three strata: small, medium and large enterprises, according to the number of employees. The inclusion weights do not depend on observed values. However, in case of non-response, it is necessary to adjust the inclusion weights. The adjusted weights are the inverse of the product of the inclusion probability and the response probability. The adjusted weights are applied to the observed totals in the respective strata to calculate the total investments for the population.

Stratum	Small	Medium	Large
Population	1000	300	50
Sample	250	150	50
Inclusion probability	¼	½	1
Inclusion weight	4	2	1
Response	200	120	40
Response probability	200/250	120/150	40/50
Adjusted weight	4 x 250/200	2 x 150/120	1 x 50/40
Observed total investments	3.3	46	810
Estimated total for the population	16.5	115	1012.5

ii) Number of employees

Assume that the population in the largest size class consists of two enterprises – one with 5000 employees and one with 10000 employees. Both receive a questionnaire but only the smallest replies and states 500 in environmental expenditure. The method above assumes that these two are similar in that they have the same **absolute** level of expenditure. By using the number of employees, you assume instead that the enterprises in the same strata are similar in that they have the same **relative** levels of expenditure per employee.

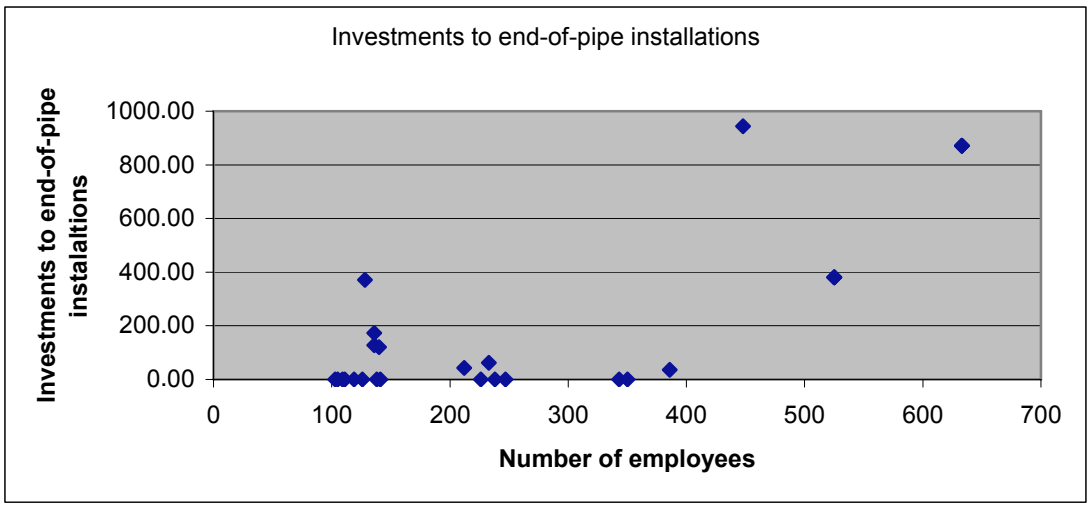
The two methods would only achieve the same results if the average size of the non-respondents in a stratum were the same as the average size of the respondents!

Stratum	Large
Population (units)	2
Sample (units)	2
Response (units)	1
Population (employees)	15000
Sample (employees)	15000
Response (employees)	5000
Observed total pollution treatment investments	500
Weight (average in strata)	2
Estimated total for the population	1000
Weight (employees)	3
Estimated total for the population	1500

There have been several studies on the connection between number of employees and environmental expenditure in order to find out if this is a good variable for re-weighting.

Example 4.19 Lithuania and Sweden:

Graph 4.5 Distribution of investments into end-of-pipe installations by number of employees



A correlation analysis was carried out in 2002 in Lithuania which showed low correlation between number of employees and EPE variables. Picture 2 reveals three outliers would have a large impact on the correlation analysis. The same exercise in Sweden showed that the scenario is somewhat better for a correlation between investments and number of employees (Table 3). Outliers occurred in the Swedish set as well that disturb the overall correlation, but looking at individual sectors there are grounds for basing grossing up on number of employees.

Table 4.1: Correlation table of EPE, turnover and number of employees

	Turnover vs. investments	Employees vs. investments	Turnover vs. total EPE	Employees vs. total EPE
2001	0.42	0.21	0.54	0.36
2000	0.29	0.11	-	-
1999	0.36	0.16	0.42	0.29

(Source: Krapavickait 2003, Olsson, Eberhardson 2003)

5. Presentation and interpretation of results

The objective of this chapter is to use the results to show on an aggregate level how important different variables, different industries, different environmental domains, different size classes, different components of variables (e.g. parts of current expenditure) could be.

5.1. Statistical quality

The tables in the final publications contain figures which we can call estimates. The underlying unknown quantities in the target population for which the estimates are given are called parameters. Some examples of parameters are population totals, population means, etc. In most surveys, estimates are not made for the entire population, but rather for a number of sub-populations into which the population is divided. Such divisions can be made according to economic activity (NACE codes at 2-digit level) and size class breakdown based on employee numbers (1-49, 50-249, 250+).

The bias is the difference between the expectation of the estimator (the average of all estimates generated) and the value of the population parameter. A good estimator should be unbiased because this guarantees that, with repeated sampling, the results are not systematically too high or too low. Bias might occur, e.g. when the survey population and the frame population do not entirely overlap. Non-response might also cause bias. It is for example important to convey to the enterprises that they should send in a reply even if they have no environmental expenditure (or a relatively minor effect on the environment). Otherwise, there would be a bias in the non-response (overrepresentation of enterprises with zero costs), which would lead to an overestimation in the final result. (Grossing up for non-response would be done using the average expenditure of the enterprises in the stratum that responded).

Variance and the mean square error of the estimator are measures describing quality that are often published together with the results.. The variance can be considered as the ‘long run’ average of all squared differences between the estimates and the expectation of the estimator. Likewise, the mean square error averages the squared differences between the estimates and the parameter. It can be easily shown that the mean square error is equal to the sum of the variance and the squared bias.

The variance expresses how close the estimates are to the expectation of the estimator, whereas the mean square error measures their closeness to the parameter. The term accuracy usually refers to the variance and precision to the mean square error. An estimator is called accurate if the variance is small, and precise if the mean square error is small. In most surveys one cannot draw on all possible samples to calculate the variance, but in many circumstances the value can be estimated on the basis of one single sample.

For unbiased (or nearly unbiased) estimators, accuracy is often expressed in terms of the variation coefficient, which is defined as the square root of the estimated variance divided by the estimate of the parameter. An advantage is that the variation coefficient is a dimensionless quantity.

The large natural variance and the relevant infrequent nature of some of the expenditure variables (such as investments) mean that standard measures of statistical quality such as variance and mean square error could be high, even when the sample is large and non-response low.

5.2 Presentation and interpretation

Example 5.1 United Kingdom: In the UK, the Department for Environment, Food and Rural Affairs, DEFRA publish a bulletin that reports on the key results, focusing on one sector.

Graph 5.1 Operating and Capital expenditure for the Mining and quarrying sector

		Operating Expenditure (£M)			
		In-house	External	R&D	Total
2002	<250 employees	12	12	1	25
	250+ employees	30	25	1	56
	Total	**42**	**37**	**2**	**81**
2001	*Total*	*43*	*55*	*2*	*101*
2000	*Total*	*78*	*165*	*37*	*280*

		Capital Expenditure (£M)		
		End of Pipe	Integrated	Total
2002	<250 employees	1	15	16
	250+ employees	3	39	42
	Total	**5**	**53**	**58**
2001	*Total*	*32*	*99*	*130*
2000	*Total*	*94*	*121*	*214*

N.B. Totals may not add due to the rounding effects.
Comparisons between years should be treated with caution because of the low response rate.
(Source: ONS 2004)

Operating Expenditure (OPEX) on Environmental Protection
Operating expenditure covers in-house expenditure associated with the operation of pollution control abatement equipment and payments to external organisations for environmental services, including, labour costs, leasing payments, maintenance costs for equipment and the treatment and disposal of waste.

For all sectors in the 2002 survey, the total operating expenditure was about £2.1 billion, representing 0.4 per cent of total turnover for these industries and an average of £600 per industry employee. For the *mining and quarrying* sector the total operating expenditure was approximately £80 million (4 per cent of the OPEX total), equivalent to 0.4 per cent of the sector's total turnover and about £1200 per sector employee.

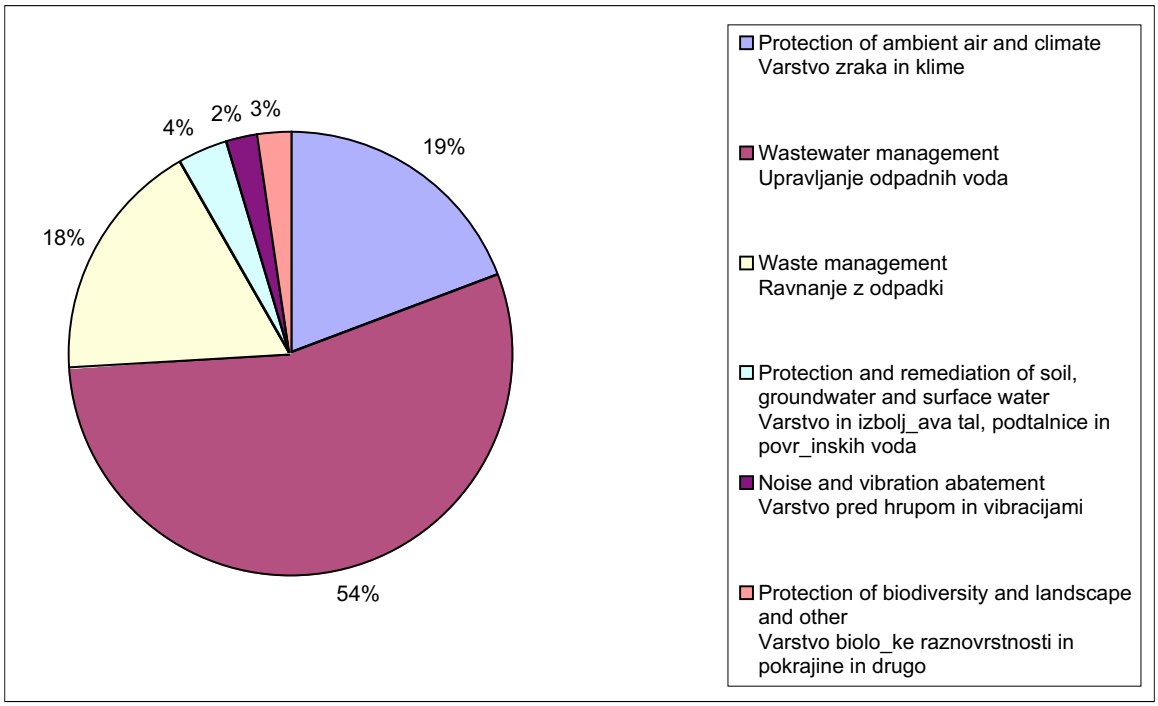
Capital Expenditure (CAPEX) on Environmental Protection
Capital expenditure covers expenditure on end-of-pipe pollution control equipment and on integrated processes - new or modified production facilities that have been designed so that environmental protection is an integrated part of the process.

For all sectors in the 2002 survey, the total capital expenditure was approximately £500 million, representing 0.1 per cent of the total turnover for these industries and an average of £140 per industry employee. For the *mining and quarrying* sector total capital expenditure was about £60 million (12 per cent of the CAPEX total), equivalent to 0.3 per cent of this sector's total turnover and about £870 per sector employee.

(Source: DEFRA, 2004)

Example 5.2 Slovenia: Slovenia has another way of making the public aware of newly collected data. It issues a smaller publication of *rapid reports* using recent statistics and highlighting certain aspects of newly collected data.

Graph 5.2 Structure of gross fixed capital formation for environmental protection, 2002
Slika 5.2 Struktura investicij za varstvo okolja, Slovenija, 2002



The response rate in data collection was almost 90%, of which 23.4% units reported on gross fixed capital formation for environmental protection, 54.5% on current expenditure for environmental protection and 12.3% on revenues from environmental protection related activities.
For non-response we performed recalculation to the total population with the ratio estimator, using depreciation of fixed assets from financial accounts or the number of people employed in the field of activity L – Public administration. For the recalculation of the payments for the environmental protection services was used another weight, calculated according to the estimation that all active units have such expenses. Recalculation was made under the same procedure as for the first weight.

(Source: Rapid reports, 6 September 2004, No 250. Slovenia)

Example 5.3 Sweden: Sweden has a third way of informing the public about newly collected data. Statistics Sweden has a standard publication called *statistical message* and there is one for each area of statistics.

Below is a graph showing an environmental and economic profile for the pulp, paper and graphical industry (NACE 21-22) in 1999-2002. It expresses the percentage contribution of each specific industry in relation to total contribution of industry. The profile shows each specific industry's contribution to the total for the different variables. For example, NACE 21-22 accounts for a bit less than 25 percent of total environmental protection investments in 2002. The value added for these industries stands for less than 15 percent of the total value added for industry.

The same publication also describes the quality of the estimated data by showing the response rate both by industry and by size group. In the 2004 survey, 91 percent of sampled enterprises answered and, looking at employee numbers, 94 percent replied, which indicates that the major enterprises handed in their questionnaires.

Graph 5.3 Environmental and economic profile for Pulp, Paper and Graphical industry

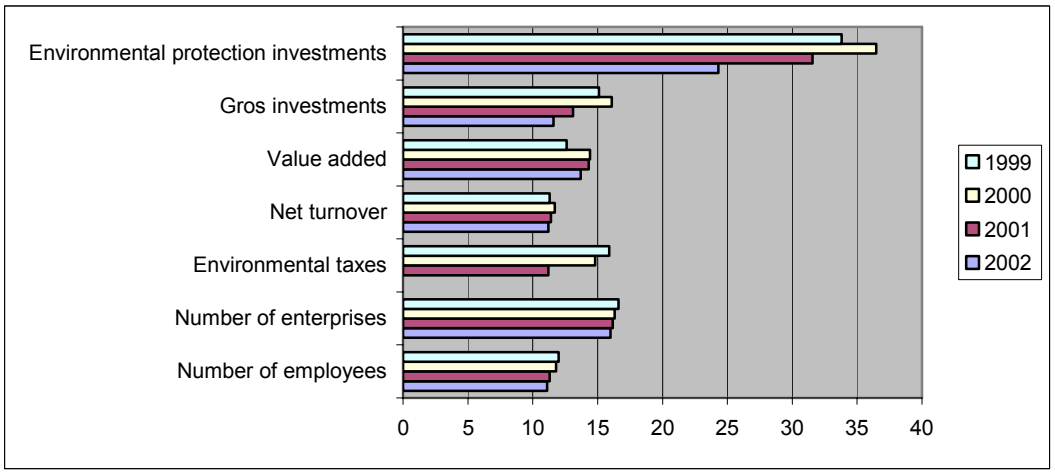


Table 5.1 Number of enterprises and employees in sample and non-response, divided by industry and size class.

		Number of enterprises			Number of employees		
NACE	**Industry**	**Sample**	**Non-response**	**%**	**Sample**	**Non-response**	**%**
10-14	Extraction of minerals	22	2	9%	6992	136	2%
15-16	Food products; beverages and tobacco	80	7	9%	41203	1028	2%
17-19	Textiles and textile products	34	1	3%	4544	56	1%
20	Wood products	64	10	16%	14176	1389	10%
21	Pulp and paper	61	3	5%	35485	520	1%
22	Publishing and printing	54	7	13%	14259	2217	16%
23	Coke, refined petroleum products and nuclear fuel	8	0	0%	2116	0	0%
24	Chemicals	52	3	6%	31857	151	0%
25	Rubber and plastic goods	49	6	12%	8650	692	8%
26	Other mineral products	33	4	12%	12617	663	5%
27	Steel and metal	46	6	13%	31549	3227	10%
28	Other metal goods	81	10	12%	14306	1080	8%
29	Machinery	126	10	8%	57589	6341	11%
30-31	Office supplies, computers, electrical appliance	42	6	14%	20196	501	2%
32	Telecommunication	24	2	8%	31890	2944	9%
33	Instrument	34	3	9%	12040	707	6%
34	Vehicles	64	4	6%	65630	423	1%
35	Other transportation means	22	2	9%	16509	1944	12%
36	Furniture	37	0	0%	9575	0	0%
40-41	Energy- and water supply	55	2	4%	13695	1121	8%

Size class						
20-49	116	18	16%	3546	476	13%
50-99	166	21	13%	11441	1418	12%
100-249	287	23	8%	44043	3474	8%
250-499	217	18	8%	75419	6224	8%
500-999	120	3	3%	81110	1893	2%
1000-	82	5	6%	229319	11655	5%
Total	**988**	**88**	**9%**	**444878**	**25140**	**6%**

Sveriges officiella statistik

(Source: Statistics Sweden 2004)

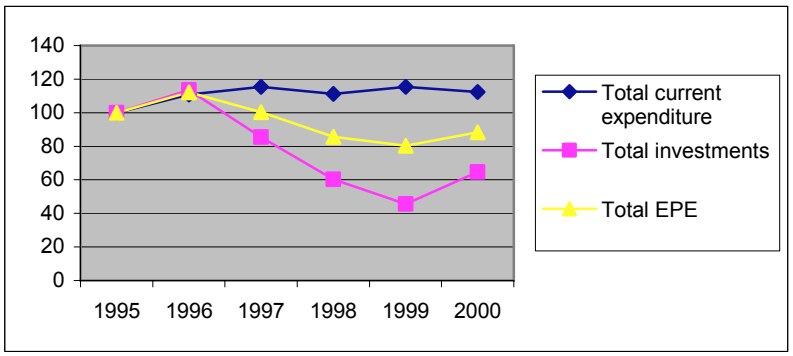
Example 5.4 Eurostat: For an EU level interpretation, it is possible to focus on three aspects of environmental protection costs: the scale of environmental protection expenditure; the other likely costs of environmental protection for industry; and the range of taxes on industrial energy inputs.

The costs of environmental policies

Environmental improvement has come at an important financial cost to private industry. In 2002, environmental expenditure by EU industry amounted to EUR 28 billion or about 0.3% of GDP. It accounted for 1.5% of industrial value-added. Substantial increases in environmental protection expenditure have occurred since the early 1980s. The tax component of industrial fuel prices has also more than doubled since the mid-1980s to stand at between 20-40 % of final fuel prices, depending on fuel type. It is clear that the additional resources made available by increased growth and productivity have been essential for the successful financing of environmental progress.

The extensive range of domestic and EU environmental legislation has increasingly led to a rise in spending by the manufacturing industry on environmental protection expenditure. Chart 5.1 shows the development in environmental protection expenditure in Finland since 1995. Investment expenditure, as a percentage of value added, has declined steadily during the latter half of the 1990s. Current expenditure on environmental protection has on the other hand fluctuated between 10 and 15 percent over this time period.

Chart 5.4 Environmental Protection Expenditure as % of GVA in total industry, Finland



The following table shows the estimates for EU environmental protection expenditure for the manufacturing industry and the energy sector[21]. Overall environmental protection expenditure is equal to 1.5 percentage points of total industrial value added. The overall total shows that some industries spend considerably more than this, with particularly high expenditures in refineries and the chemicals, paper and pulp industries.

Not all the measures to reduce environmental pressure result in environmental protection expenditure. There is probably some under-estimation due to measurement problems. However, many improvements are also made as part of the normal operating activity of the enterprise, in which case no additional expenditure to protect the environment can be distinguished. This includes special investments in new production equipment that is often more efficient than the old equipment in terms of environmental performance. Estimates of such expenditure do not exist for the EU, although these have been found to be substantial in United States industry[22].

Table 5.2 Environmental protection expenditure in the EU in 2002
Total industry (including mining, quarrying and electricity, gas and water)

	Air	Waste	waste water	Other	% GVA	% GDP
EU-25	20%	27%	30%	17%	1.5%	0.3%
of which						
EU-15	18%	28%	29%	17%	1.4%	0.3%
NMS10	30%	20%	36%	13%	3.4%	0.8%
of which						
capital expenditure	37%	13%	28%	21%	0.4%	0.1%
current expenditure	14%	32%	31%	15%	1.1%	0.2%

[21] The estimates for the EU total cover the manufacturing, mining, electricity, gas, and water industries.

[22] See Gray and Shadbegian (1995), who suggest that environmental protection expenditure may underestimate actual impacts on industrial costs by some 35%.

6. Other variables related to environmental protection

This chapter describes other economic variables related to environmental protection apart from those defined as environmental protection expenditure. For some of these, internationally agreed definitions already exist and they are included in regular data compilations in many countries, while for others there is currently no agreed methodology and very little data collection experience.

The first three parts deal with economic variables which are included at least partly in the Joint OECD/Eurostat Questionnaire or in the Expenditure Accounts, as defined by SERIEE.

- Chapters 6.1 and 6.2 deal with information related to the financing of environmental protection, either directly in the form of revenues or cost-savings, or through other external units in the form of subsidies received by enterprises.

- Chapter 6.3 relates to the annual capital costs incurred for environmental protection equipment, which usually are not surveyed but estimated by a few countries when drawing up the environmental expenditure accounts.

- Chapter 6.5 concerns issues related to the management of natural resources, including energy and material efficiency. Here, there are some recommendations from the field of environmental accounting, but so far not much experience in terms of regular data collection.

- Chapters 6.4 and 6.9 deal with issues related to the production of environmental products and services. Chapter 6.4 focuses on the specific expenditure by the producer to make the products more “environmentally friendly” when used or scrapped. This is an issue said by many to be gaining importance, and also when compared to expenditure related to the production process. However, an agreed methodology for the compilation of statistics on this issue does not yet exist and the individual countries have very little practical experience.

- Chapter 6.9 focuses on the total production of environmental products and services, including the services produced and used internally by businesses. OECD and Eurostat have developed a set of agreed definitions and guidelines for this. Several countries have conducted pilot studies in this area, but using quite different methodologies, which makes the statistics difficult to compare. Moreover, estimates have been produced based on information from the supply side, mainly the data on environmental protection expenditure.

Finally, chapters 6.6 to 6.8 relate to the different types of costs linked to environmental protection activities, as there may be a trade-off between these costs and environmental protection expenditure. Environmental protection activities to reduce the pollution generated lead to lower pollution taxes, a lower risk of being fined and a reduced need to buy emission permits (increased possibility to sell emission permits) etc.

- Chapter 6.6 concerns environmental taxes for which there is both an agreed international definition and regular data collection. However, this data is generally not based on direct surveys of enterprises, but rather estimates based on existing information (tax revenue statistics etc).

- Chapter 6.7 deals with the issue of emission permits. Two generally agreed guidelines currently exist on how to incorporate them into statistics

- Chapter 6.8 concerns expenditure incurred by the enterprise when it fails to observe agreed environmental standards. There are a few cases when these are included in surveys of enterprises.

Data related to environmental protection expenditures such as revenues and receipts from by-products are collected through the Joint OECD/Eurostat Questionnaire, as already mentioned in chapter 2.2. However, there are other related economic variables that are not collected via international organisations but are included in international frameworks. This chapter will examine the nine different variables shown in table 6.1 and their status in terms of international interest.

Table 6.1: Variables related to environmental protection and status as collected data

Variables	JQ	Other	Comments
6.1 Revenues and cost-offsets	X		
6.1.1 Receipts from by-products	X	SERIEE	
6.1.2 Other cost-savings and productivity gains	-	EPEA	
6.1.3 Increase in sales, e.g. due to improved image	-	-	
6.2 Subsidies/Transfers	X	SERIEE	
6.3 Depreciation allowance	-	EPEA	Calculated and not collected
6.4 Environmental adaptation of products	-	-	
6.5 Resource management (energy, material saving)	-	SEEA/SERIEE	
6.6 Environmental taxes	(x)	EPEA, Tax statistics	JQ: only ear-marked taxes.
6.7 Emission permits	-	-	
6.8 Loss of income, compensatory charges, etc	-	-	
6.9 Environment industry	-	-	

6.1 Environmental protection revenues and cost offsets

It is clear that expenditure for some measures might be (at least) partly offset by cost reductions or increased productivity (preventive measures, changes in practices etc), or subsidies received. Governments and other bodies are also actively involved in promoting the dissemination of information on these so-called win-win situations which increase economic efficiency and environmental performance.

Sometimes, the statistics on environmental protection expenditure are criticised as being too limited in scope and too focused on the costs. There is also less experience in collecting information about the revenue side. However, existing experience suggests that it is considerably more difficult for the respondents to report revenues than to report expenditure.

There are also different types of revenues and cost-savings. For all types, however, there must be environmental protection expenditure against which the saving could be counted. However, as was stated earlier, environmental protection expenditures should be reported gross of these revenues and cost offsets and irrespective of any subsidies received. But the net cost for the enterprise of the environmental protection activity could be calculated as the difference between environmental protection expenditure and revenues, other cost offsets and subsidies received, whereas a specific environmental protection activity may very well be profitable for the unit undertaking the activity.

- The most easily identified type of revenue or cost-offsets are those associated directly with a physical by-product. These so-called “Receipts from by-products” are asked for in the Joint OECD/Eurostat questionnaire, but the information is currently unavailable in many countries and they seem to be of relatively minor importance compared to the expenditure involved.

- A more difficult type of cost-offsets are the savings made. For example, a new machine costs less to run than the old alternative due to increased production capacity. Information on the magnitude of this cost-offset should be part of the decision material on what machine to buy if it is deemed important, and probably monitored during the first year of operation. However, it becomes more and more difficult (and less and less relevant) for the enterprise to identify such offsets as the years go by.

- The most difficult economic benefit to estimate is the possible increase in product sales, e.g. due to improved environmental image. If deemed important, such predictions should be taken into account in the investment decision, but this information would be highly unreliable.

6.1.1 Receipts from by-products

Sometimes Environmental Protection activities produce by-products that have an economic value. These could either be sold and generate revenues, or be used internally and lead to reductions in costs. These receipts should always stem from a specific Environmental Protection activity (and expenditure). Receipts from by-products are the sum of the sales value and the value of the cost saving (if used internally) related to these by-products[23]. Energy or material savings due to more efficient processes and other productivity gains resulting from Environmental Protection activities are not to be included as Receipts from by-products[24].

Examples include

- Energy generated from waste incineration (only from the waste generated by the operating activity of the enterprise).

- Recovered material generated from the enterprise's waste management activities e.g. sale of metal scrap.

6.1.2 Other cost-savings and productivity gains

Other cost-savings and productivity gains could include savings on labour expenditure, energy and other production inputs as a result of environmental protection activities. For example, fees, charges and environmental taxes could be avoided (e.g. as a result of reduction in the amounts of waste generated, or of internal treatment and recycling instead of payments to external enterprises)[25]. However, the production gains and measures would not be offset by the main components in chapters 2 and 3. These measures are also extremely difficult to measure in a direct way. Cost-saving measures could be identified by looking into the decision-making process when deciding on new investments or ways to handle cost reductions. Any potential cost-saving could be found in the sensitivity analyses conducted by the enterprises.

6.1.3 Increase in sales

Increased sales may be due to environmentally improved product quality, enhanced public image, consumer trust in green products or other effects. If the enterprise has marketed its environmental protection efforts, thus improving its image, and this is clearly related to an increase in sales, then these increased revenues are included in this item. Practically, it can be hard to measure less tangible benefits such as the relationship between market efforts and increased sales. However, if the enterprise perceives a strong link between marketing and revenues, a distinction can be made between types of marketing efforts. If these different kinds of marketing efforts can be distinguished from environmental protection efforts and other marking efforts, the share of revenue increase can be estimated.

[23] Definition in the Joint OECD/Eurostat Questionnaire
[24] SERIEE §2101 et seq
[25] SERIEE §2103

6.2 Subsidies/Transfers

Subsidies/Transfers include all types of transfers financing environmental protection activities, such as transfers to or from other countries. These constitute part of the financing expenditure for the paying sector, and reduce the financing expenditures in the receiving sector. When a sector both receives and pays out subsidies/transfers, the net amount should be recorded.

The net amount between the following two categories is included for the business sector:

- The subsidies/transfer received from other units. This includes subsidies from the government or other bodies that finance part or all of the environmental protection activity. These subsidies could take the form of direct transfers, capital grants or soft loans.

- Payments of so called "ear-marked" environmental taxes (e.g. pollution taxes), which are not payments for a bought service but where the revenues thus generated are ear-marked for financing environmental protection measures. Payments of general environmental or green taxes (such as energy taxes) where the generated revenues are not ear-marked for financing environmental protection measures are excluded (see 6.6).

- The issue of who finances environmental protection is important in some countries, in particular when an important part of the activities are financed either by transfers from international organisations or through bilateral contacts with other countries. The questionnaires could then include either a specific question or a specific breakdown related to the financing body.

6.3 Depreciation allowance for environmental protection equipment

Environmental protection expenditure as defined here includes total expenditure on new capital goods but excludes the annual capital cost linked to the depreciation (use) of environmental protection equipment and facilities.

These annual capital costs could be reported separately. A calculation of the annual costs for environmental protection could then be made by adding these and total current expenditure for environmental protection.

Companies should apply the calculation standards used in enterprise bookkeeping to record depreciation. Depreciation in commercial accounting is generally valued at historic costs (i.e. the value of fixed assets at the date of acquisition) and could be greatly influenced by fiscal considerations.

Therefore, statistical services do not usually collect this information in surveys of enterprises but rather calculate the consumption of fixed capital according to the standards used in the national accounts. For an exception, see the questionnaire from Germany in chapter 4.6.4.

In national accounts, the consumption of fixed capital is imputed as a measure of the decrease in value of the fixed assets due to their use in production. This is based on estimates of the value of the fixed capital stock at replacement cost and assumptions as regards the service life of the assets.

Example 6.1 The Netherlands: Enterprises are allowed to depreciate on the environmental investment at a pace chosen by themselves. Faster depreciation on investments give enterprises the opportunity to pay less taxes (in the) short term.

Depending on how large the positive effects of the investment are on the environment, 15 or 30% of the investment sum can be directly deducted from the profits before taxation in the year the investment is made.

In the case of energy saving investments or investments in machinery making use of sustainable energy, there is the so called EIA arrangement. It works rather like the MIA arrangement. The subsidy, if granted, is 30% of 87% of the investment sum. Not all fiscal benefits are looked upon as environmental subsidies in case we do not consider the investments to be environmental investments. The correction factor of 50% is rather arbitrary. Energy saving investments can often be too profitable to be considered an environmental investment.

(Source: Wentink, CBS Netherlands)

6.4 Environmental adaptation of products

This includes expenditure associated with measures by the enterprise to adapt the enterprise's products so that they generate less pollution or impact on the environment when they are used by consumers, as material input in other companies, or when scrapped or as waste.

> However, these measures should be reported as environmental protection expenditure if environmental policy and regulations expand the legal responsibility of the producer to cover the pollution generated by the products when used or the care of the products once they become waste.

Environmental adaptation begins in the product design phase. This is the real essence of the new legislation on producer responsibility. In the design phase, decisions are made that determine the extent of a product's future environmental impact. These concern choice of materials, production methods, and functions to be included in the product, as well as energy consumption both during production as well as throughout the product life cycle. The choices all made to enhance or sustain the functionality of the product, will lessen the environmental burden of producing and using the product and affect the ease with which the materials can be recovered (in different components). The choices made in the design phase also allow the enterprise to meet environmental requirements imposed by the business community. To fulfil these requirements, the enterprise in turn imposes requirements on its suppliers. Product manufacturers must also ensure the proper disposal of obsolete products. To meet the requirements, the enterprise must have full knowledge of the content of its various products in the form of lists of the material components in a product and their environmental impact. Consequently, the enterprise can create a materials database, to be used as a tool in the preparation of materials declarations.

Many different tools are used when environmentally adapting products: Life Cycle Analysis (LCA), Environmental Impact Assessment (EIA), Ecological Risk Assessment (ERA), Design For Environment, Material Flow Analysis (MFA), Substance Flow Analysis and different types of indicators (e.g. environmental performance indicators, sustainability indicators).

Types of activities

- Adaptation of machinery: making machinery, including cars, less damaging for the environment when used. This includes adaptations to allow the use of fuels that generate less pollution.

- Components and material: exchanging environmentally hazardous components such as lead or phosphates in detergents for materials that generate less pollution in later stages of the life cycle, such as PET-plastic.

- Packaging and waste:. A measure to facilitate the care of the products as waste, e.g. the phasing out of mixed material. Reductions of packaging.

Types of expenditure

Expenditure for the environmental adaptation of products consists of the same expenditure categories and could follow the same valuation methods as those already described for environmental protection expenditure. In practice, the separate identification and recording of these expenditures may be difficult, except perhaps in the case of product development expenditure and/or investments in the adaptation of machinery and equipment.

- Product development expenditure i.e. expenditure for research and development and tests with the main purpose of reducing the environmental impacts when the products of the enterprise are used, scrapped or become waste. Product development expenditure could be related both to the adaptation of existing products and to the environmental impacts of new products.

- Capital expenditure for the adaptation of existing processes and equipment, or identifiable components of new processes and equipment, resulting from the environmental adaptation of the products.

- Any additional current expenditure linked to the production of the adapted product, except those recorded as product development expenditure.

Example 6.2 Spain: Spain has implemented several EU and national legislations on the quality of products. As a result, refineries are investing in producing low-sulphur gasoline. Companies are obliged to produce cleaner gasoline according to these legislations, and due to this, they are spending great amounts of time and money to adapt their production processes so as to meet the requirements covered in EU legislation on the quality of products. These types of activities should count as an environmental protection activity.

The European road towards Integrated Product Policy

In 2000, a preparatory publication on Integrated Product Policy entitled "Developing the foundation for integrated product policy in the EU[1]" was published as a background document to the final Green Paper. This document used eight countries as a basis for its analyses. Table 6.2 shows the lessons that these countries experienced when working with IPP issues[1].

Table 6.2 Lessons from national experience

Nordic Group Countries	The Netherlands	Germany	The UK	Italy
Find areas in common to begin with to avoid paralysing early conflicts (Nordic group) Detailed priorities cannot be set for individual product groups. Priorities need to be determined in the light of existing political goals, which already set a broadly accepted agenda for action (Denmark). Decentralised administrative structures make monitoring and co-ordination more difficult (Sweden).	International dimension of IPP, which Dutch policy has always emphasised. Avoid overemphasis on information instruments. Link consumption policy agenda to products. Work with industry.	Much useful experience exists to build on in areas such as labelling, approaches to consultation, standards development, and product-related innovation in firms. Experience of eco-taxes has highlighted some difficulties related to the implementation of these measures in the market.	Life cycle approach must inform policy, but not through slavish adoption of LCA tools. Key priorities need to be agreed which channels down into focus on the most relevant products. Consensus is key, as is business engage-ment, including a focus on innovation. Consumer engagement, supported by clear and verifiable information, is a key long-term requirement.	Not applicable yet.

The Green Paper, published in 2001[1], proposed a strategy to "strengthen and refocus product-related environmental policies". The responses from the stakeholders showed a very positive opinion of the proposed strategy. In 2003, a Communication[1] was released to the Council and the European Parliament on the importance of a product dimension to environmental policies and the expected achievements of an integrated product policy. Work on the implementation of the goals set out in the Communication is ongoing.

6.5 Resource management (including energy and material saving)

The efficient use of resources and, for example, the management of non-renewable resources are clearly important issues both in terms of overall economic development and the move towards more sustainable development.

However, expenditure on resource use and saving activities (for example the water supply or the saving of energy or raw materials) is not included as environmental protection expenditure as defined here unless the primary purpose is environmental protection: e.g. when these activities aim at implementing national or international environmental protection policy and are not undertaken for cost-saving reasons.

The accounting for economic issues related to these and other resource-related activities should be developed separately according to the main international accounting frameworks. The SERIEE system includes a specific satellite account for the expenditures related to the use and management of natural resources; this account is kept separated from the one concerning the environmental protection expenditures, i.e. the EPEA[26]. Also the SEEA 2003 manual includes a chapter on resource management and exploitation activities[27].This section classifies the natural resources as an asset but follows the CEPA classification that links environmental protection expenditure closely to natural resource management.

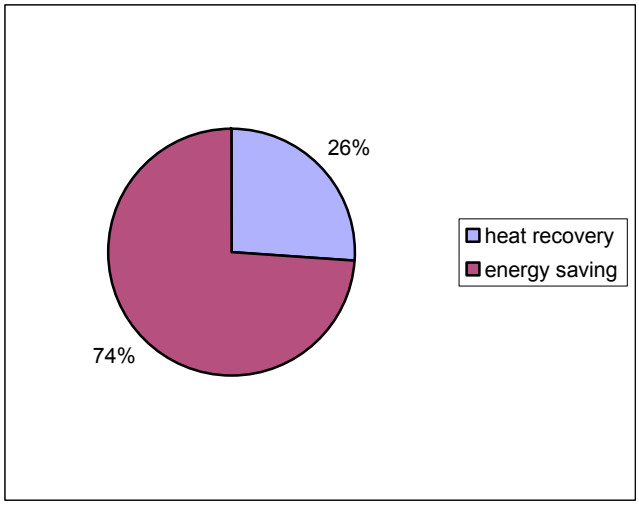
The CEPA classification also applies to resource management. The most common domains are: inland waters, sub-soil assets, forest resources and wild flora and fauna. The normal activities are included, such as research into the management of natural resources, monitoring, control and surveillance. However, activities and transactions specifically for environmental protection, such as the management of protected forests, are not included. (They are included under environmental protection expenditure activities, where the primary purpose is the protection of the environment).

As already discussed, qualitative protection activities concerning natural resources, for example activities for biodiversity and landscape protection or activities aimed at preserving certain functions or the quality of the natural environment (air, water, soil and groundwater), are also included under environmental protection[28].

The classification of the "environment industry" included in the joint OECD/Eurostat manual identifies the "Resource management" group as a separated category of activities[29]. The criteria used there can be adopted with those used for defining the CEPA, i.e. the environmental domain.

Example 6.3 Sweden: The survey of environmental protection expenditures in industry includes one separate section of resource management. This was included after discussions with the industry at a seminar to which the majority of industrial representatives were invited. Resource management in Sweden is growing and is looked upon as an important measure.

Graph 6.1: Resource management in Swedish industry, 2003



(Source: statistics Sweden 2004)

6.6 Environmental taxes

Payments of environmental taxes are not part of environmental protection expenditure as defined here, but could be reported separately. The distinction between taxes and sales of services is

[26] SERIEE – 1994 Version, Ch. X.
[27] SEEA 2003, § 5.37
[28] SEEA 2003, § 5.39 et seq
[29] OECD/Eurostat (1999), Environmental good & services industry – Manual for data collection and analysis, Ch II and Annex 1.

sometimes difficult. Irrespective of the name of the payment (rate, charge, fee, etc.), when there is a service provided in return, the payment would typically be classified as a purchase of services and would therefore be included under current expenditure on environmental protection (see chapter 3.4).

Some of the environmental taxes defined here could be ear-marked to finance environmental protection activities and these would then also be included under subsidies/transfers (see chapter 6.2).

OECD, Eurostat, the IEA and the European Commission's Directorates General for Environment and for Taxation have developed a statistical framework as concerns environmental taxes.[30]

The development of this statistical framework started from the following definition of environmental taxes: "a tax whose base is a physical unit (or a proxy for it) that has a proven specific negative impact on the environment". It was felt that the tax base provides the only objective basis for identifying environmental taxes for the purpose of international comparisons. This definition lays emphasis on the potential effect of a given tax in terms of its impact on the costs of certain activities or the prices of certain products. The key issue for ensuring international comparability is the list of environmental tax bases (see table 6.3 below) as agreed by the institutions involved.

Table 6.3 List of environmental tax bases

Measured or estimated emissions to air
Measured or estimated emissions to water
Energy products
- Energy products used for transport purposes
- Energy products used for stationary purposes
Transport
- Per kilometre driven
- Import or sales of vehicles
- Annual taxes
- Other
Waste water discharges (not measured)
Agricultural inputs (fertiliser, pesticides)
Waste
- General waste collection and treatment (waste collection, landfill)
- Individual products (packaging materials, batteries, tyres, lubricant oils, etc.)
Ozone depletion (CFCs, halons)
Noise.

When the number of environmental taxes is limited, the following aggregated groupings of environmental taxes could be used. This is also used for publication purposes.

1) Energy taxes (including CO2-taxes)
2) Transport taxes
3) Pollution taxes (on emissions, waste, packaging, pesticides, CFC, noise, etc.)
4) Resource taxes (water abstraction, sand and gravel, etc.).

It should be noted that resource taxes (as part of environmental taxes) do not include taxes on oil and gas extraction. These taxes generate important revenues in a very limited number of countries. The inclusion of taxes on oil and gas extraction would distort the analysis of the role that environmental taxes play within the overall structure of taxation. Furthermore, such taxes are set to capture (only) the extra profit or resource rent. This extra profit is determined by the difference between the cost of extraction and the world market prices for crude oil and natural gas. Energy prices are not influenced by these taxes. Hence such taxes do not fit the definition of environmental taxes.

6.7 Emission permits

"The key policy issues in relation to emissions of pollutants concern the threshold to set for the emissions and the way in which to achieve this threshold in the most cost-effective manner. In setting an acceptable threshold for emissions, the costs and benefits to society from reducing emissions need to be balanced. In the absence of any emissions controls, the benefits to society from starting to make

[30] See OECD document DAFFE/CFA/WP2(97)5 "Statistical Framework on Environmental Taxes in OECD Member Countries": see Eurostat 2001 "Environmental Taxes – A statistical guide"

emissions reductions would be very considerable and likely outweigh the additional costs involved. However, as further reductions in emissions are required, the costs of these reductions are likely to rise, whilst the additional benefits to society are likely to fall. The optimal emissions reduction policy would therefore balance the marginal cost to firms of making additional emissions reductions with the additional benefits to society of such reductions. Using similar reasoning, the most cost-effective means of achieving such an emission threshold would be to equalise the marginal costs of emissions between different firms. The most efficient means of achieving this would be through market-based instruments such as emissions trading."[31]

Tradable emission permits allow the government to give companies licenses to pollute at a certain level. Companies can buy, sell and trade these permits on the market. It is in the interests of companies to pollute as little as possible. If they pollute at a level higher than their permit allows, they have to buy permits from another enterprise. If they pollute less than they are allowed to, they can sell their permit, which would generate an additional cost-offset or increase the revenue linked to their environmental protection activities.

The amounts involved in transactions of tradable emission permits could be reported separately (purchases on the one hand and sales on the other). If trade were regulated through established stock exchanges, these would represent a basic source of information.

6.8 Loss of income, compensatory charges, fines, penalties and the like

These include other payments that are related to the pollution generated by the enterprise, including:

- Loss of income e.g. due to emergency shut-downs.
- Payments of compensation to damaged parties.
- Payments of fines and penalties for non-compliance with environmental rules and regulations.

Some countries include questions about these payments in their surveys of enterprises and others analyse these payments on the basis of administrative registers.

Example 6.4 Norway: Norway is investigating the legislative role and its importance in a publication about natural resources and the environment published in 2003.
Few companies are reported to the police
The Norwegian Pollution Control Authority rarely reports companies to the police for breaches of environmental legislation. The Authority's response depends on how serious the breach is and how likely it is that the company will be convicted. The Authority only considers reporting companies to the police after 3 per cent of the inspections. It is up to the prosecuting authority and in the final instance the courts to determine any penal measures. Even though few cases result in penal measures, some form of sanction appears to be imposed in most cases where non-compliance with the rules is revealed. Sanctions may include more frequent inspections (for which the company has to pay) or coercive fines. In addition, there are less formal types of sanctions such as publication of the results of an inspection, which can result in extensive media coverage. Negative exposure in the media is something that management and owners prefer to avoid, and it can be perceived as an additional penal measure. For example, it may reduce the demand for a company's products and thus have a direct financial effect. Even though the costs of sanctions make breaking the law less attractive, sanctions may nevertheless cost less than complying with the law, so that it is "worthwhile" to break the rules.
(source: Statistics Norway 2003)

6.9 Environment industry

There is substantial policy interest in the environmental goods and services industry (environment industry for short) and in its growth, employment and export potential. In 1999, OECD and Eurostat published *"The Environment Goods and Services Industry Manual" for data collection and analysis.* This manual offers a definition and classifications for the environmental goods and services industry and provides a set of guidelines on best practices and methods for data collection and analysis.

[31] DG Enterprise Competiveness Report 2002, final draft

OECD and Eurostat have defined and classified the environment industry as consisting of "activities which produce goods and services to measure, prevent, limit, minimise or correct environmental damage to water, air and soil, as well as problems related to waste, noise and eco-systems". These include cleaner technologies, products and services that reduce environmental risk and minimise pollution and resource use.

At the first level, activities are classified according to three main groups:

1) The pollution management group comprises goods and services that are clearly supplied for an environmental purpose, have a significant impact in reducing polluting emissions and are easily statistically identifiable.
2) The cleaner technologies and products group comprises goods and services which reduce or eliminate negative environmental impact, but which are often supplied for other than environmental purposes and for which statistical assessment remains disputed, difficult or expensive.
3) The resource management group comprises goods and services which may be associated with environmental protection, although their primary purpose is not environmental protection (e.g. energy saving and management, renewable energy, etc.).

These three main groups cover the description and production of equipment and materials, services, construction and installations for various environmental protection activities

Several countries have made pilot studies in this area, but using quite different methodologies, which makes the statistics difficult to compare. In addition, estimates have been produced based on information from the supply side, mainly the data on environmental protection expenditure.

Example 6.5 Germany: In Germany a specific questionnaire is sent out surveying the environmental industry. They ask for such information as sales revenues, kind of products produced and imports and exports figures. It gives them several indicators to evaluate the development of environmental industry and the status of environmental goods and services in Germany.

Box 6.1 Methodology for estimating the European Eco-industries

1.0 STUDY METHODOLOGY

1.1 Demand and Supply of Eco-Industry Products

An analysis of EU and Candidate Country eco-industries was conducted, focusing on the economic significance at a macro and micro level. However, the available statistical data generally relates to the expenditure incurred by purchasers of eco-industry goods and services rather than to the sales, investment, value added, etc. of the producers. Environmental expenditure data (the demand side) therefore has to act as a proxy for the value added of the eco-industries. The emphasis on data collection has therefore been on environmental expenditure, with additional data (e.g. private sector waste management industry turnover) used to build up a more complete picture of particular eco-industry sub-sectors.

1.2 Method of Approach: Using Environmental Expenditure to Assess Eco-Industries

In order to define the economic significance of the eco-industries using expenditure data, it is important to understand the transactions between producers of environmental goods and services, intermediate goods producers, and the consumers of environmental goods and services. Environmental protection services can either be traded; provided by in-house processes and staff (e.g. within industry); or provided free of charge by government on behalf of households and enterprises, i.e. collective consumption. Environmental protection goods in themselves cannot "execute" environmental protection activity. Only when these goods are used is the characteristic activity executed and an environmental protection service provided. It is at this point that the environmental expenditure occurs. The approach used in this study is to focus on the **final expenditure incurred by consumers** when using environmental protection services. This is used as a proxy in determining the size (turnover) of the eco-industries.

7. Environmental Policy issues

DG Environment is the main policy holder for environmental issues. It is also the main user at European level for environmental protection expenditure data. Environmental protection expenditure data can be used in different areas of the work in DG Environment. The Sixth Environmental Action Programme 2001-2010, the development of the Environmental Technology Action Plan, sustainable development, and the integration of environmental concerns into other policy areas such as enlargement, implementation and enforcement are examples of such areas. In 1999, Mr Madeira of DG Environment prepared a text which reflected the main needs of his DG concerning EPE data. The conclusions of Mr Madeira's paper are still completely valid today.

> "To conclude, there should be no doubts whatsoever about the relevance of having comprehensive, harmonised and up-to-date EPE data for the EU. The availability of this data is a requisite for meeting the expanding legal requirements for the economic assessment of environmental regulatory policy and initiatives. The design and implementation of environmental regulation would greatly benefit from more extensive and in-depth collection of these data".

7.1 Sixth Community Environmental Action Programme

In 2002, the European Parliament and the Council adopted the Sixth Community Environmental Action Programme[32]. The main purpose of the programme is to identify and prevent pollution and the degradation of the environment. The major priorities and objectives for environmental policy are being handled in this programme along with the way in which measures can be implemented. The actions and commitments are mainly directed at the Community level but also at national and regional levels. The proceedings from the EAP will generally lead to an increase in expenditure for the environmental area, either for governments or enterprises. On the other hand, this programme will also increase support for environmental innovation and research, creating opportunities for creative enterprises.

Four main priority areas are targeted in the EAP

i. Tackling climate change;
ii. Nature and bio-diversity – protecting a unique resource
iii. Environment and health;
iv. Ensuring the sustainable management of natural resources and wastes

And five priority avenues of strategic action were developed to help meet the environmental objectives.

1. Improve the implementation of existing legislation.
2. Integrating environmental concerns into the decisions taken under other policies.
3. Find new ways of working closer with the market via businesses and consumers.
4. Empower people as private citizens and help them to change their behaviour.
5. Encourage better land-use planning and management decisions.

Under the four main priority areas, links can be traced to environmental protection expenditures under ii. Nature and bio-diversity – protecting a unique resource and iii. Environment and health.

Nature and bio-diversity – protecting a unique resource

The EAP aims at protecting nature and bio-diversity in, for example, the soil, forest and marine environment.

Among other things, the Community intends to extend the scope of directives such as the Seveso II Directive[33]. The danger of an accident in an industrial plant is always present, even if measures and policies to substantially decrease the risk exist. This Directive clarifies that the industry must have proper installations and equipment to handle the risk of an accident. This entails educating the staff in risk management and notifying the authorities. The extensions of the Seveso II Directive are also intended to cover pipelines and mining. *An upgrade of preventive measures would be reported as an*

[32] Decision No 1600/2002 of 22 July 2002
[33] Council Directive 96/82/EC on the control of major accident hazards, OJ No L 10 of 14 January 1997

investment in environmental protection along with administrative expenditures from education and contacts with authorities.
Another measure that the EAP aims to encourage is forest certification on wood and wood products. *This certification would also be seen under current expenditure for environmental protection. The wood industries have already started to certify some of their forests, but the price is quite high and the process is slow. The expenditure for certified forests could also be seen in the pulp and paper industry. If certified timber was purchased despite the higher price, the increase in price could be taken up as environmental protection expenditure.*

Regarding the protection of the marine environment, the Community intends to identify and quantify various types of environmental pressure caused by different economic activities. Some examples: the reduction of dumping at sea of harbour's sludge and sediments, problems caused by cabling and pipelines and the reduction of eutrophication. *The manufacturing industry located along coastlines and river beds will be under pressure to continue to reduce their emissions to sea and rivers. The establishment of new installations and cleaning plants is expected to continue.*

Environment and health

This topic deals with areas such as chemicals, water quality, noise pollution and air quality issues among other areas. Human health and the well-being of the environment go hand in hand and the distinction between what is done for human health and for the environment is not always clear.

The aim as far as chemicals are concerned is to have a non-toxic environment and the road to achieving this is long. Among other things, the Community aims to phase out especially dangerous chemicals, to clean up old stockpiles and contaminated zones and to identify new compounds to be included within the UN Convention on Persistent Organic Pollutants (POPs). Other conventions have also been ratified and are now in the process of implementation, e.g. OSPAR[34] and HELCOM[35]. *The pressure on manufacturing industries to reduce and change production processes will continue to increase, initially leading to increases in investments and expenditures related to changing material inputs and, in some cases, changing the production process itself.*

Noise pollution is steadily on the increase from sources like transport and construction. The work done so far by the Community has been restricted to setting noise limits for certain types of equipments. The policy approach is to reduce noise levels at a local level by identifying appropriate actions and measures. This includes the adoption and implementation of the proposed Community Directive on Noise[36]. When located close to suburbs and towns, the *manufacturing industries are a source of high noise, and preventive measures will create investments in environmental protection.*

Ensuring the sustainable management of natural resources and wastes

The EAP is devoting an entire priority area to the management of natural resources and waste. The objectives are to ensure improved resource efficiency and to establish decoupling from economic growth. The Community intends to create a policy focused on the overall decoupling of resource use from economic growth, especially as far as non-renewable resources are concerned. With regard to the sustainable management of natural resources, the EAP states that the policy will identify and implement measures that promote the research and technological development of less resource-intensive products and production processes. IPP promotion and eco-labelling, green procurement policies and environmental reporting will be endorsed with a view to integrating resource efficiency considerations. With regard to waste management, improvements in existing waste management systems, investment in waste prevention and recycling initiatives and infrastructure will be prioritised. *Here are several interesting points for environmental protection expenditure to pick up on. If research in the production process intensifies, the expenditures should be visible in the data collection. Investments in waste prevention and management will be clearly visible in the collection of EPE data.*

The EAP also includes a chapter on "**policymaking based on participation and sound knowledge**". In this chapter, the focus is on enterprises and their obligation to reduce the pressure they exert on the environment. The aim is to stimulate innovation on environmental equipment and modernisation through regulation. The regulation would set the standards at a high but not unachievable level. It would regulate the results rather than provide a description of how to achieve the goals. *This could improve the situation for the environmental industry by increasing demand for their products.*

[34] Convention for the Protection of the Marine Environment of the North-East Atlantic
[35] Convention for the Protection of the Marine Environment of the Baltic Sea Area, 1992
[36] Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 relating to the assessment and management of environmental noise

This chapter also states the importance of sound up-to-date statistics that can describe current environmental problems, their geographical distribution and socio-economic trends.

7.2 Environmental Technology Action Plan

On 28 January 2004, the Commission adopted the Environmental Technologies Action Plan and this was supported by a range of groups, for example the Environment Council in March 2004 and the European Economic and Social Committee in May 2004[37]. The main aim of this action plan is to stimulate environmental technology and identify barriers and how to deal with them[38].

Many new environmental technologies have great potential to improve the environment and, at the same time, boost the competitiveness of companies. Examples of environmental technologies range from recycling systems for waste water in industrial processes, to energy-saving car engines that allow cars to use less fuel, to soil remediation techniques. However, there are still many barriers, including the complexity of switching from traditional to new technologies, and insufficient access to capital. The Action Plan aims to overcome these barriers through a concerted European effort to help maximise the potential of environmental technologies. It will also help the EU achieve its sustainable development goals in a cost effective way. The Plan should enable the EU to become a recognised leader in environmental technologies. Key actions include the launch of technology platforms with stakeholders in areas such as hydrogen and fuel cells, photovoltaics, and water supply and sanitation; establishing environmental performance targets for products and services; and making the most of funding schemes and public and private procurement policies[39].

In order to follow the progress of ETAP, DG Environment is promoting the development of appropriate indicators. Indicators should show market developments and the performance of EU industry in the market. DG Environment also states that the indicators should build on the work done by the Commission in the field of environmental accounting and of eco-efficiency indicators.

7.3 Country Environmental Performance Reviews

Environmental commitments both at a domestic and international level are becoming increasingly common. But what is actually being done in practice? The OECD has an environmental performance review programme that should help member countries"…to improve their individual and collective performances in environmental management". The goal of the programme is threefold: to help governments assess progress, to promote a continuous policy dialogue among member countries and to stimulate greater accountability from member countries' governments[40]. Three performance reviews for France, Spain and Sweden respectively are given below.

[37] COM (2004)38 final. OJ 241 of 28/09/2004
[38] COM(2003)131 final, OJ C 32 of 5.2.2004
[39] Press release IO/04/117
[40] OECD 2002

Example 7.1 France:
Over the review period (1996-2004), environmental management in France benefited from institutional strengthening, increased public and private expenditure and consideration of sustainable development in policy choices. Attention to environmental issues has reinforced economic development through the conservation of resources such as water and energy, the creation of environmental jobs, lower spending on public health and protection of the urban and natural heritage and landscape. Major concerns remain as regards pollution from agriculture and transport, the development of energy policy, improvement of environmental health and management of natural and technological risk. Other key concerns include pressures from urbanisation and the need to protect natural spaces, coastal areas and mountains, which are assets for tourism. International environmental issues, such as implementation of multilateral environmental agreements, marine conservation and the environment-development interface are also at the top of the environmental agenda. To meet these challenges, France will have to: i) strengthen environmental policy implementation, ii) integrate environmental concerns into sectoral and fiscal policies and iii) pursue international co-operation. This review examines progress made by France since the previous OECD Environmental Performance Review, and the extent to which the country's national objectives and international commitments are being met. It also reviews progress in the context of the OECD Environmental Strategy** Forty-nine recommendations are put forward that could help strengthen France's environmental performance in a context of sustainable development.

(Source: OECD 2005)

Example 7.2 Spain: The OECD's report on Spain's environmental performance praises a number of achievements but also insists that Spain steps up the efficiency of its environmental policies, the integration of environmental concerns in sectors such as tourism, construction, transport, energy and agriculture, and the implementation of its international commitments.

Noting that priority environmental issues in Spain include water management, biodiversity conservation, climate change and air pollution, sustainable tourism and waste management, the report recommends that Spain improves its environmental management by:

- further controlling air emissions of SOx, NOx, VOC, NH_3 and improving air quality by reducing ground level ozone and particulates from stationary and transport sources,
- shifting to water demand management and efficient water pricing,
- phasing out environmental subsidies and making better use of economic instruments to encourage the efficient management of resources and reduce pollutants,
- anticipating the EU reduction of environmental support in areas such as water infrastructure,
- more tightly enforcing pollution and land use regulations, such as coastal zone protection, at national and regional levels.

The OECD suggests that Spain could progress towards sustainable development by:

- integrating environmental concerns into tourism, construction, transport, energy and agriculture policies by reviewing the environmentally harmful impact of the taxes and subsidies in these sectors and developing strategic environmental assessments for them,
- reforming the eco-tax,
- decoupling waste generation and energy consumption from economic growth in relevant sectors,
- following the international environmental agenda by curbing GHG growth, further increasing ODA, ratifying the Aarhus convention, preventing marine pollution caused by land based pollution and oil spills, and better managing fisheries.

Over the past decade, Spain has significantly improved its environmental polices, and the report praises a number of achievements:

- strengthened institutional and legislative environmental framework at national and regional levels, based on EU directives, a network of environmental authorities, and new laws,
- greater emphasis on nature and biodiversity such as management of protected areas, Natura 2000 proposals, more international co-operation, and a national biodiversity strategy,
- improved municipal water infrastructure and quality of coastal bathing waters, recent revision of water management policies, in line with the EU water framework directive,
- renewed commitments to climate change policies, in line with EU and Kyoto commitments.

(Source: OECD website 23/02/05)

Example 7.3 Sweden: The OECD report praises the innovative and effective environmental policies of Sweden. For instance, Sweden makes good use of economic incentives to protect the environment, including environmental taxes, and is on track to meet its Kyoto Protocol commitment to limit greenhouse gas emissions. The OECD notes, however, that Sweden needs to further progress towards its environmental objectives and to better integrate environmental concerns into the industry, energy, transport, forestry, and agriculture sectors.

The report recommends that Sweden could better manage its environment by:

- strengthening the inspection, compliance, and enforcement of environmental regulations at regional and local levels,
- improving water management to reduce nitrates and pesticides, and comply with the EU water framework directive,
- better protecting nature and biodiversity, including through increasing the number and quality of protected areas for marine, forest, and wetland areas,
- reviewing trade controls on the export of ozone depleting substances and the illegal trade in endangered species,
- providing more economic information on the environment (e.g. on environmental expenditures and energy prices) and economic analysis of climate change policies.

Sweden gives high priority to sustainable development, and the report offers a number of recommendations to further integrate environmental concerns with economic and social policies including:

- addressing the management of marine resources (e.g. problems of nutrients, dioxins, environmental inspection of foreign ships, over-fishing),
- increasing energy efficiency through flexible mechanisms and energy pricing practices,
- decoupling municipal waste generation and road traffic expansion from economic growth,
- promoting access to green spaces to promote physical exercise, health and well being,

The report notes considerable environmental achievements by Sweden over the past 10 years, including:

- the adoption of 15 ambitious, long-term, strategic environmental quality objectives (EQOs),
- decoupling of some environmental pressures from economic growth (e.g. improved energy, material, and pollution intensities) and lowest level of CO2 emissions per unit of GDP among OECD countries,
- a strategic national environmental planning approach, including the setting and monitoring of environmental objectives and targets,
- development of a national sustainable development strategy, with a secretariat to oversee its implementation in the Prime Ministers' office,
- an active role in global and European environmental co-operation, including international leadership on chemicals management,
- implementation of the Polluter Pays Principle, extensive use of market-based instruments (e.g. in agriculture, transport, energy), and green tax reform,
- progress with environmental democracy and environmental education,
- integration of health and environment policies, with a national environment and health action plan, and reductions in pesticide, heavy metals, and persistent organic pollutants.

(Source: OECD web-site 23/02/05)

Annex 1. The Classification of Environmental Protection Activities and Expenditure (CEPA 2000)

Introductory notes

CEPA 2000 is a generic, multi-purpose, functional classification for environmental protection. It is used for classifying activities and also products, actual outlays (expenditure) and other transactions. The classification unit is often determined by the units of the primary data sources that are being classified and by the presentation formats used for results. For example, the analysis of government budgets and accounts requires the coding of items of government environmental protection expenditure into the CEPA. Some of these expenditure items will be transfers such as subsidies or investment grants whereas others will be inputs into an environmental protection activity (e.g. wages and salaries). The compilation of environmental expenditure accounts entails identifying environmental protection activities and their output of environmental protection services by CEPA category.

The CEPA is designed to classify transactions and activities whose primary purpose is environmental protection. The management of natural resources (e.g. water supply) and the prevention of natural hazards (landslides, floods, etc.) are not included in the CEPA. Resource management and the prevention of natural hazards are covered in broader frameworks (e.g. SERIEE, SEEA 2000 or the OECD/Eurostat Environment Industry Manual). Separate classifications for e.g. resource management should be set up which, together with the CEPA, would be part of a family of environment-related classifications.

Environmental protection activities are production activities in the sense of national accounts (see e.g. SNA § 6.15 or ESA § 2.103), i.e. they combine resources such as equipment, labour, manufacturing techniques, information networks and products to create an output of goods or services. An activity may be a principal, secondary or ancillary activity.

Environmental protection products are

- the environmental protection services produced by environmental protection activities,
- adapted (cleaner) and connected products.

The expenditure recorded refers to the purchasers' prices for environmental protection services and connected products and the extra costs over and above a viable but less clean alternative for cleaner products.

Expenditure for environmental protection refers to outlays and other transactions related to

a) inputs into environmental protection activities (energy, raw materials and other intermediate inputs, wages and salaries, taxes linked to production, the consumption of fixed capital),

b) capital formation and the purchase of land (investment) for environmental protection activities,

c) outlays of users for the purchase of environmental protection products,

d) transfers for environmental protection (subsidies, investment grants, international aid, donations, taxes earmarked for environmental protection, etc.)

For the presentation of aggregate results and expenditure indicators, care must be taken when adding up expenditure of different types. Available frameworks such as the SERIEE or the OECD/Eurostat PAC framework offer ways to avoid double counting items of expenditure. In particular, they offer guidance on how to avoid mixing transfer payments with the expenditure financed by the transfers, and purchases of environmental products with the expenditure on their production.

Classification structure

The level 1 structure of CEPA (the 1-digits) covers the *CEPA classes*. CEPA classes 1 to 7 are also called *(environmental) domains*. The main function of most 2-digits and 3-digits in CEPA is to guide classification. Selected 2-digits and 3-digits may also be used for data collection and coding as well as for publication purposes. In statistical practice, countries will have to adapt the CEPA structure to some extent to reflect national policy priorities, data availability and other circumstances. Examples include separate 1-digit headings for traffic, international aid, energy savings programmes, general

environmental administration or soil erosion. For international comparison purposes, the level 1 structure of CEPA should be fully respected.

General classification principles

Classification should be made according to the main purpose, taking into account the technical nature as well as the policy purpose of an action or activity. Multi-purpose actions, activities and expenditure that address several CEPA classes should be divided according to these classes. Classification under the heading “indivisible expenditure and activities” should only be made as a last resort.

Classification of individual items cannot be based solely on the technical nature of the items. For example, the purchase of double-glazed windows in warm countries will typically relate to issues of noise protection, whereas in colder countries they will be a standard energy saving device. Measures to reduce fertiliser use may primarily fall under CEPA 4 (protection of groundwater), CEPA 2 (prevention of runoff to protect surface waters) or CEPA 6 (prevention of nutrient enrichment to protect biotopes) depending on the main purpose of measures and policies. Measures against forest fires will be unimportant or purely serve economic purposes (and thus fall outside the CEPA) in some countries whereas in others the main aspect of forest fires will be an environmental one related to landscape and habitat preservation rather than the protection of a natural resource.

Classification of transversal activities and expenditure

Transversal activities cover R&D, administration and management as well as education, training and information. All R&D should be allocated to CEPA 8. Administration and management as well as education, training and information should, to the extent possible, be allocated to the ‘Other’ positions in CEPA 1-7. Ideally, transversal activities would be identified separately as well as by CEPA class, but primary data sources related to CEPA 1-7 often do not allow this. R&D, education and training or administration and management are often either inseparable from other actions relating to another class (administration or training as part of waste management, for example) or cannot be split by class (R&D data collected by industry expenditure surveys, for example). If such identification problems are considered substantial, data on R&D, administration and management and on education, training and information should not be published at the 2-digit level.

The classification of R&D in CEPA 8 follows the NABS 1993 (the Nomenclature for the Analysis and Comparison of Scientific Programmes and Budgets). CEPA 8 should be used when primary data following the NABS are available from R&D statistics. When this is not the case, other data sources employed (e.g. budget analysis) may not allow a systematic separation of R&D from other actions and activities. R&D may then be included under several CEPA classes.

The above considerations will apply differently from one country to another, depending on the availability and level of detail of primary data sources. Often, differences in the main data sources will result in different practices for coding transversal activities and expenditure, and international comparability for these may be limited.

Explanatory notes and definitions

1 PROTECTION OF AMBIENT AIR AND CLIMATE

Protection of ambient air and climate covers measures and activities aimed at the reduction of emissions into the ambient air or ambient concentrations of air pollutants as well as measures and activities aimed at the control of emissions of greenhouse gases and gases that adversely affect the stratospheric ozone layer.

Excluded are measures undertaken for cost-saving reasons (e.g. energy saving).

1.1 Prevention of pollution through in-process modifications

Activities and measures aimed at the elimination or reduction of the generation of air pollutants through in-process modifications related to:

- cleaner and more efficient production processes and other technologies (cleaner technologies),
- the consumption or use of 'cleaner' (adapted) products.

Cleaner technologies

Prevention activities consist of replacing an existing production process by a new process designed to reduce the generation of air pollutants during production, storage or transportation, e.g. fuel combustion improvement, recovery of solvents, prevention of spills and leaks through improving air-tightness of equipment, reservoirs and vehicles, etc.

Use of cleaner products

Prevention activities consist of modifying facilities so as to provide for the substitution of raw materials, energy, catalysts and other inputs by non- (or less) polluting products, or in treating raw materials prior to their use in order to make them less polluting, e.g. the desulphuration of fuel. Expenditure under this position also includes the extra cost incurred due to the use of cleaner products (low sulphur fuels, unleaded gasoline, clean vehicles, etc.).

1.2 Treatment of exhaust gases and ventilation air

Activities involving the installation, maintenance and operation of end-of-pipe equipment for the removal and reduction of emissions of particulate matter or other air-polluting substances either from the combustion of fuels or from processes: filters, dedusting equipment, catalytic converters, post-combustion and other techniques. Also included are activities aimed at increasing the dispersion of gases so as to reduce concentrations of air pollutants.

Exhaust gases are emissions into the air, usually through exhaust pipes, stacks or chimneys, due to the combustion of fossil fuels. Ventilation air refers to the exhaust from air conditioning systems in industrial establishments.

1.3 Measurement, control, laboratories and the like

Activities aimed at monitoring the concentrations of pollutants in exhaust gases, the quality of air, etc. Included are measurement services covering exhaust gases from vehicles and heating systems and monitoring of the ozone layer, greenhouse gases and climate change. Weather stations are excluded.

1.4 Other activities

All other activities and measures aimed at the protection of ambient air and climate. Includes regulation, administration, management, training, information and education activities specific to CEPA 1. These can be separated from other activities related to the same class and from similar activities related to other environmental protection classes.

2 WASTEWATER MANAGEMENT

Wastewater management comprises activities and measures aimed at the prevention of pollution of surface water through the reduction of the release of wastewater into inland surface water and seawater. It covers the collection and treatment of wastewater, including monitoring and regulation activities. Septic tanks are also included.

Excluded are actions and activities aimed at the protection of groundwater from pollutant infiltration and the cleaning up of water bodies after pollution (see CEPA 4).

Wastewater is defined as water that is of no further immediate value for the purpose for which it was used or in the pursuit of which it was produced because of quality, quantity, or the time of its occurrence.

2.1 Prevention of pollution through in-process modifications

Activities and measures aimed at reducing the generation of surface water pollutants and wastewater through in-process modifications related to:

- cleaner and more efficient production processes and other technologies (cleaner technologies),
- the consumption or use of 'cleaner' (adapted) products.

Cleaner technologies

Prevention activities consist of replacing an existing production process by a new process designed to bring about a reduction of water pollutants or wastewater generated during production. They include the separation of networks, the treatment and re-use of water used in the production process, etc.

Use of cleaner products

Prevention activities consist of modifying an existing production process so as to provide for the substitution of raw materials, catalysts and other inputs by non- (or less) water-polluting products.

2.2 Sewerage networks

Activities aimed at the operation of sewerage networks, i.e. the collection and transport of wastewater from one or several users, as well as rainwater, by means of sewerage networks, collectors, tanks and other means of transport (sewage vehicles, etc.), including maintenance and repair.

Sewerage networks are the systems of collectors, pipelines, conduits and pumps to evacuate any wastewater (rainwater, domestic and other wastewater) from the points of generation to either a sewage treatment plant or to a point where wastewater is discharged into surface water.

2.3 Wastewater treatment

Wastewater treatment designates any process to render wastewater fit to meet applicable environmental standards or other quality norms. Three broad types of treatment (mechanical, biological, and advanced treatment) are specified below. Alternative definitions of types of treatment may be used, e.g. based on removal rates for BOD.

The mechanical treatment of wastewater refers to processes of a physical and mechanical nature that result in decanted effluent and separate sludge. Mechanical processes are also used in combination and/or in conjunction with biological and advanced unit operations. Mechanical treatment is understood to include at least such processes as sedimentation, flotation, etc. The activity is aimed at separating materials in suspension by the use of screens (large solids) or through sedimentation, possibly assisted by chemicals or flotation (elimination of sand, oil, part of the sludge, etc.).

Equipment includes screens for large solids, biological plants, equipment for filtration, flocculation, sedimentation; separation of oils and hydrocarbons; separation using inertia or gravity, including hydraulic and centrifugal cyclones, diaphragm floats, etc.

Biological treatment of wastewater designates processes which employ aerobic or anaerobic micro-organisms and result in decanted effluent and separate sludge containing microbial mass together with pollutants. Biological treatment processes are also used in combination and/or in conjunction with mechanical and advanced unit operations. This activity is designed to eliminate pollution from oxidisable materials through the use of bacteria: activated sludge technique or anaerobic treatment for specific concentrated wastewater. Biodegradable materials are treated with the addition of bacteria-enriched sludge in open or closed tanks.

Treatment of wastewater by advanced technologies designates processes capable of reducing specific constituents in wastewater not normally achieved by other treatment options. They cover all unit operations which are not considered to be mechanical or biological. This includes, for example, chemical coagulation, flocculation and precipitation; break-point chlorinating; stripping; mixed media filtration; micro-screening; selective ion exchange; activated carbon absorption; reverse osmosis; ultra-filtration; elector flotation. Advanced treatment processes may be used in combination and/or in conjunction with mechanical and biological unit operations. This activity is aimed at eliminating oxidisable non-biodegradable matter at a higher level, as well as metals, nitrate, phosphorous, etc. by using powerful biological or physical and chemical action. Special equipment is required for each depollution.

Septic tanks are settling tanks through which wastewater flows and the suspended matter is decanted as sludge. Organic matters (in the water and in the sludge) are partly decomposed by anaerobic bacteria and other micro-organisms. Maintenance services of septic tanks (emptying etc.) and other products for septic tanks (biological activators, etc.) are included.

2.4 Treatment of cooling water

Treatment of cooling water designates "processes which are used to treat cooling water to meet applicable environmental standards before releasing it into the environment. Cooling water is used to remove heat." Means, methods, facilities used may be: air cooling (extra cost compared with water cooling), cooling towers (to the extent they are required to reduce pollution, as distinct from technical needs), cooling circuits for processing water from work sites and for condensing released vapour, equipment for enhancing the dispersion of cooling water on release, closed cooling circuits (extra cost), circuits for use of cooling water for heating purposes (extra cost).

2.5 Measurement, control, laboratories and the like

Activities aimed at monitoring and controlling the concentration of pollutants in wastewater and the quality of inland surface water and marine water at the place wastewater is discharged (analysis and measurement of pollutants, etc.).

2.6 Other activities

All other activities and measures aimed at wastewater management. These include regulation, administration, management, training, information and education activities specific to CEPA 2, where they can be separated from other activities related to the same class and similar activities related to other environmental protection classes.

3 WASTE MANAGEMENT

Waste management refers to activities and measures aimed at the prevention of the generation of waste and the reduction of its harmful effect on the environment. This includes the collection and treatment of waste, including monitoring and regulation activities. It also includes recycling and composting, the collection and treatment of low level radioactive waste, street cleaning and the collection of public litter.

Waste are materials that are not prime products (that is, products made for the market) for which the generator has no further use for own purposes of production, transformation, or consumption, and which he wants to dispose of. Wastes may be generated during the extraction of raw materials, during the processing of raw materials to intermediate and final products, during the consumption of final products, and during any other human activity. Residuals recycled or reused at the place of generation are excluded. Also excluded are waste materials that are directly discharged into ambient water or air.

Hazardous waste is waste that due to its toxic, infectious, radioactive or flammable nature or due to any other character defined by the legislator as posing a substantial actual or potential hazard to human health or living organisms. For the purposes of this definition, "hazardous waste" comprises for each country all those materials and products considered to be hazardous in accordance with that country's practices. Low level radioactive waste is included, whereas other radioactive waste is excluded (see CEPA 7).

Low level radioactive waste is waste that, because of its low radionuclide content, does not require shielding during normal handling and transportation.

Treatment and disposal of waste

Treatment of waste refers to any process designed to change the physical, chemical, or biological character or composition of any waste to neutralise it, render it non-hazardous, safer for transport, amenable for recovery or storage, or to reduce it in volume. A particular waste may undergo more than one treatment process.

Composting and recycling activities for the purpose of environmental protection are included. Composting is often used as a waste treatment method, and the resulting compost is provided free of charge or at a very low price. The manufacture of compost classified in division 24 of ISIC/NACE (Manufacture of fertilisers and nitrogen compounds) is excluded.

Division 37 of ISIC/NACE defines recycling as "the processing of waste, scraps whether or not used, into a form feasible to be transformed in new raw materials. Typical is that, in terms of commodities, both input and output consist of waste and scrap, the input being sorted or unsorted but always unfit for further direct use in an industrial process whereas the output is made fit for further processing and is to be considered then as an intermediate good. A process is required, either mechanical or chemical". The main purpose of activities classified in division 37 of ISIC/NACE is the manufacture of secondary raw materials but there may be important secondary waste management activities.

Compost and secondary raw materials (as well as products made of secondary raw materials) are not considered environmental protection products. Their use is excluded.

Disposal of waste is the final deposition of waste on or underground in controlled or uncontrolled fashion, in accordance with the sanitary, environmental or security requirements.

3.1 Prevention of pollution through in-process modifications

Activities and measures aimed at eliminating or reducing the generation of solid waste through in-process modifications related to:

- cleaner and more efficient production processes and other technologies (cleaner technologies),
- the consumption or use of 'cleaner' (adapted) products.

Cleaner technologies

Prevention activities consist of replacing an existing production process by a new process designed to reduce the toxicity or volume of waste produced during the production process, including by separation and re-processing.

Use of cleaner products

Protection activities consist of modifying or adapting the production process or facilities so as to provide for the substitution of raw materials, catalysts and other intermediate inputs by new, "adapted" inputs the use of which produces less waste or less hazardous waste.

3.2 Collection and transport

Collection and transport of waste is defined as the collection of waste, either by municipal services or similar institutions or by public or private corporations, and their transport to the place of treatment or disposal. It includes the separate collection and transport of waste fractions so as to facilitate recycling

and the collection and transport of hazardous waste. Street cleaning is included for the part referring to public litter and collection of garbage from the streets. Excluded are winter services.

3.3 Treatment and disposal of hazardous waste

Treatment of hazardous waste comprises the processes of physical/chemical treatment, thermal treatment, biological treatment, conditioning of wastes, and any other relevant treatment method. Disposal of hazardous waste comprises landfill, containment, underground disposal, dumping at sea, and any other relevant disposal method.

Thermal treatment of hazardous waste refers to any process for the high temperature oxidation of gaseous, liquid, or solid hazardous wastes, converting them into gases and incombustible solid residues. The flue gases are released into the atmosphere (with or without recovery of heat and with or without cleaning) and any slag or ash produced is deposited in the landfill. The main technologies used in the incineration of hazardous waste are the rotary kiln, liquid injection, incinerator grates, multiple chamber incinerators, and fluidised bed incinerators. Residues from hazardous waste incineration may themselves be regarded as hazardous waste. The resulting thermal energy may or may not be used for the production of steam, hot water, or electric energy.

Landfill is an activity concerning final disposal of hazardous waste in or on land in a controlled way, which meets specific geological and technical criteria.

Other treatment and disposal of hazardous waste may consist of chemical and physical treatment, containment and underground disposal.

Chemical treatment methods are used both to effect the complete breakdown of hazardous waste into non-toxic gases and, more usually, to modify the chemical properties of the waste, e.g. to reduce water solubility or to neutralise acidity or alkalinity.

Physical treatment of hazardous waste: includes various methods of phase separation and solidification whereby the hazardous waste is fixed in an inert, impervious matrix. Phase separation encompasses the widely used techniques of lagooning, sludge drying in beds, and prolonged storage in tanks, air flotation and various filtration and centrifugation techniques, adsorption/desorption, vacuum, extractive and azeotropic distillation. Solidification or fixation processes, which convert the waste into an insoluble, rock-hard material, are generally used as pre-treatment prior to landfill disposal. These techniques employ blending the waste with various reactants or organic polymerisation reactions or the mixing of the waste with organic binders.

Containment is the retention of hazardous material in such a way that it is effectively prevented from dispersing into the environment, or is released only at an acceptable level. Containment may occur in specially built containment spaces.

Underground disposal includes temporary storage or final disposal of hazardous wastes underground that meet specific geological and technical criteria.

3.4 Treatment and disposal of non-hazardous waste

Treatment of non-hazardous waste comprises the processes of physical/chemical treatment, incineration of waste, biological treatment, and any other treatment method (composting, recycling, etc.).

Incineration is the thermal treatment of waste during which chemically fixed energy of combusted matters is transformed into thermal energy. Combustible compounds are transformed into combustion gases leaving the system as flue gases. Incombustible inorganic matters remain in the form of slag and fly ash.

Disposal of non-hazardous waste comprises landfill, dumping at sea, and any other disposal method.

3.5 Measurement, control, laboratories and the like

Activities and measures aimed at controlling and measuring the generation and storage of waste, their toxicity, etc.

3.6 Other activities

All other activities and measures aimed at waste management. It includes administration, management, training, information and education activities specific to the class, when they can be separated from other activities related to the same class and from similar activities related to other environmental protection classes.

4 PROTECTION AND REMEDIATION OF SOIL, GROUNDWATER AND SURFACE WATER

Protection and remediation of soil, groundwater and surface water refers to measures and activities aimed at the prevention of pollutant infiltration, cleaning up of soils and water bodies and the protection of soil from erosion and other physical degradation as well as from salinisation. monitoring, control of soil and groundwater pollution is included.

Excluded are wastewater management activities (see CEPA 2), as well as activities aimed at the protection of biodiversity and landscape (see CEPA 6).

4.1 Prevention of pollutant infiltration

Activities and measures aimed at the reduction or elimination of polluting substances that may be applied to soil, percolate into groundwater or run-off to surface water. Included are activities related to sealing of soils of industrial plants, installation of catchments for pollutant run-offs and leaks, strengthening of storage facilities and transportation of pollutant products.

4.2 Cleaning up of soil and water bodies

This means processes to reduce the quantity of polluting materials in soil and water bodies either in situ or in appropriate installations. It includes soil decontamination at former industrial sites, landfills and other blackspots, dredging of pollutants from water bodies (rivers, lakes, estuaries, etc.), the decontamination and cleaning up of surface water following accidental pollution e.g. through collection of pollutants or through application of chemicals, as well as the cleaning up of oil spills on land, inland surface waters and seas - including coastal areas. Excluded are the liming of lakes and artificial oxygenation of water bodies (see CEPA 6). Civil protection services are also excluded.

Activities may consist of: measures for separating, containing and recovering deposits, extraction of buried casks and containers, decanting and re-storage, installation of off-gas and liquid effluent drainage networks, soil washing by means of degasification, pumping of pollutants, removal and treatment of polluted soil, biotechnological methods capable of intervening without affecting the site (use of enzymes, bacteria, etc.), physical chemistry techniques such as pervaporation and extraction using supercritical fluids, injection of neutral gases or bases to stifle internal fermentation, etc.

4.3 Protection of soil from erosion and other physical degradation

Activities and measures aimed at the protection of soil from erosion and other physical degradation (compacting, encrusting, etc.). They may consist of programs intended to restore the protective vegetal cover of soils, construction of anti-erosion walls, etc. Measures may also consist in subsidising agricultural and grazing practices less harmful for soils and water bodies.

Excluded are activities carried out for economic reasons (e.g. agricultural production or protection of settlements against natural hazards such as landslides).

4.4 Prevention and remediation of soil salinity

Activities and measures aimed at the prevention and remediation of soil salinity. Concrete actions will depend on climatic, geological and other country-specific factors. Included are actions to increase groundwater tables, e.g. through increased freshwater infiltration to avoid infiltration of seawater into groundwater bodies, lowering of groundwater tables (when groundwater contains high levels of salts) through long-term re-vegetation programmes, changes in irrigation practices, etc.

Excluded are measures that respond to economic purposes (agricultural production, reclamation of land from the sea, etc.).

4.5 Measurement, control, laboratories and the like

All activities and measures aimed at controlling and measuring the quality and pollution of soils, groundwater and surface water, measuring the extent of soil erosion and salinisation etc. These include the operation of monitoring systems, inventories of "black spots", maps and databases of groundwater and surface water quality, of soil pollution, erosion and salinity, etc.

4.6 Other activities

All other activities and measures aimed at the protection and remediation of soil, groundwater and surface water. They include administration, management, training, information and education activities specific to the class, where they can be separated from other activities related to the same class and from similar activities related to other environmental protection classes.

5 NOISE AND VIBRATION ABATEMENT (EXCLUDING WORKPLACE PROTECTION)

Noise and vibration abatement refers to measures and activities aimed at the control, reduction and abatement of industrial and transport noise and vibration. Activities for the abatement of neighbourhood noise (soundproofing of dance halls, etc.) as well as activities for the abatement of noise in places frequented by the public (swimming pools, etc.), in schools, etc., are included.

Excluded is the abatement of noise and vibration for purposes of protection at the workplace.

5.1 Preventive in-process modifications at source

Activities and measures aimed at the reduction of noise and vibration from industrial equipment, vehicle motors, aircraft and ships engines, exhaust systems and brakes, or noise level due to tyre/road or wheel/rail surface contact. They include the adaptation of equipment, vehicles (buses, trucks, or train and power units in the case of rail transport, aircraft and ships) in order to make them less noisy: soundproofing of hoods, brakes, exhaust systems, etc. Also included are plant modifications, specially conceived foundations to absorb vibrations, extra cost for regrouping of buildings and/or of facilities in the interest of noise abatement, special facilities in building construction or reconstruction, equipment and machines designed or constructed for low noise or vibrations, low noise level flares and burners, etc.

Other preventive activities consist of noise abatement through the modification of surfaces. As noise emissions from motors, engines, exhaust systems and brakes are lowered, those from other sources become more important, in particular noise that originates from the contact between tyres and road surfaces. Activities include replacing concrete by silent asphalt, multi-layered surfaces, etc.

5.2 Construction of anti noise/vibration facilities

Activities and measures aimed at the installation and management of anti-noise facilities. These may be screens, embankments or hedges. They may consist of covering sections of urban motorways or railways. As regards industrial and vicinity noise they also consist of add-on facilities, covering and soundproofing of machines and piping, fuel regulation systems and sound absorption, noise screens, barriers, soundproofing of buildings, noise protective windows, etc., in order to limit noise perception.

5.3 Measurement, control, laboratories and the like

Activities and measures aimed at controlling the level of noise and vibration: installation and operation of stationary measurement and monitoring sites or mobile equipment in urban areas, observation networks, etc.

5.4 Other activities

All other activities and measures aimed at noise and vibration abatement. They include administration, management, training, information and education activities specific to the class, where they can be separated from other activities related to the same class and from similar activities related to other classes. They also include, where separable, traffic management with noise abatement purposes (for example, lowering of speed limits, improvement of traffic flows), introduction of time and geographical restrictions for noisy vehicles, traffic diversions at a distance from residential areas, creation of pedestrian areas, creation of construction-free buffer zones, restructuring of modal split (improvement

of public transportation, use of bicycles). This covers a potentially large set of administrative measures, which raise serious identification problems given their incorporation in integrated programmes of traffic control and urban planning and the difficulty of separating that part of measures and expenditure which, in these programmes, concerns noise and vibration abatement from expenditure related to air pollution control, improvement of the living environment or traffic security.

In addition to regulation, other measures may consist of: financial incentives for the production and use of low-noise vehicles, labelling or information programmes for consumers so as to encourage the use of low-noise vehicles and the adoption of quiet driving behaviour.

6 PROTECTION OF BIODIVERSITY AND LANDSCAPES

Protection of biodiversity and landscape refers to measures and activities aimed at the protection and rehabilitation of fauna and flora species, ecosystems and habitats as well as the protection and rehabilitation of natural and semi-natural landscapes. The separation between 'biodiversity' and 'landscape' protection may not always be practical. For example, maintaining or establishing certain landscape types, biotopes, eco-zones and related issues (hedgerows, lines of trees to re-establish 'natural corridors') have a clear link to biodiversity preservation.

Excluded from this category are the protection and rehabilitation of historic monuments or predominantly built-up landscapes, the control of weed for agricultural purposes as well as the protection of forests against forest fires where the underlying reasons are predominantly economic. The establishment and maintenance of green spaces along roads and recreational structures (e.g. gulf courses, other sports facilities) are also excluded.

Actions and expenditure related to urban parks and gardens would not normally be included but may be related in some cases to biodiversity - in such cases the activities and expenditure should be included.

6.1 Protection and rehabilitation of species and habitats

Activities and measures aimed at the conservation, reintroduction or recovery of fauna and flora species, as well as the restoring, rehabilitation and reshaping of damaged habitats for the purpose of strengthening their natural functions. Included are conserving the genetic heritage, re-colonising destroyed ecosystems, placing bans on exploitation, trade, etc. of specific animal and plant species, for protection purposes. Also included are censuses, inventories, databases, creation of gene reserves or banks, improvement of linear infrastructures (e.g., underground passages or bridges for animals at points along roadways or railways, etc.), feeding of the young, management of special natural reserves (botany conservation areas, etc.). Activities may also include the control of fauna and flora to maintain natural balances, including re-introduction of predator species and control of exotic fauna and flora that pose a threat to native fauna, flora and habitats.

Main activities are the management and development of protected areas, however designated, i.e. areas protected from any economic exploitation or in which the latter is subject to restrictive regulations whose explicit goal is the conservation and protection of habitats. Also included are activities for the restoration of water bodies as aquatic habitats: artificial oxygenation and lime-neutralisation actions. Where they have a clear protection of biodiversity purpose, measures and activities related to urban parks and gardens are to be included. Purchase of land for protection of species and habitats purpose is included.

6.2 Protection of natural and semi-natural landscapes

Activities and measures aimed at the protection of natural and semi-natural landscapes to maintain and increase their aesthetic value and their role in biodiversity preservation. They include the preservation of legally protected natural objects, expenditures incurred for the rehabilitation of abandoned mining and quarrying sites, renaturalisation of river banks, burying of electric lines, maintenance of landscapes that are the result of traditional agricultural practices threatened by prevailing economic conditions, etc. For biodiversity and landscape protection related to agriculture, the identification of specific state aid programmes to farmers may be the only data source available. Protection of forests against forest fires for landscape protection purpose is included.

Excluded are measures taken in order to protect historic monuments, measures to increase aesthetic values for economic purposes (e.g., re-landscaping to increase the value of real estate) as well as protection of predominantly built-up landscapes.

6.3 Measurement, control, laboratories and the like

Measurement, monitoring, analysis activities which are not classified under the preceding items are included under this heading. In principle, inventories of fauna and flora are not covered since they are classified under protection of species.

6.4 Other activities

All other activities and measures aimed at the protection of biodiversity and landscape. They include administration, training, information and education activities specific to the domain, where they can be separated from other activities related to the same domain and similar activities related to other classes.

7 PROTECTION AGAINST RADIATION (EXCLUDING EXTERNAL SAFETY)

Protection against radiation refers to activities and measures aimed at the reduction or elimination of the negative consequences of radiation emitted from any source. Included is the handling, transportation and treatment of high level radioactive waste, i.e. waste that, because of its high radionuclide content, requires shielding during normal handling and transportation.

Excluded are activities and measures related to the prevention of technological hazards (e.g. external safety of nuclear power plants), as well as protection measures taken at workplaces. Also excluded are activities related to collection and treatment of low-level radioactive waste (see CEPA 3).

Definition of radioactive waste

Any material that contains or is contaminated with radionuclide at concentrations or radioactivity levels greater than the "exempt quantities" established by the competent authorities, and for which no use is foreseen are included in the heading “radioactive waste”. Radioactive waste is produced at nuclear power plants and at associated nuclear fuel cycle facilities as well as through other uses of radioactive material: for example, the use of radionuclide in hospitals and research establishments. Other important wastes are those from the mining and milling of uranium and from the reprocessing of spent fuel.

7.1 Protection of ambient media

Protection of ambient media groups together activities and measures undertaken in order to protect ambient media from radiation. It may consist of protecting measures such as screening, creation of buffer zones, etc.

7.2 Transport and treatment of high level radioactive waste

Any process designed for the transport, conditioning, containment or underground disposal of high level radioactive waste.

Collection and transport of high level radioactive waste consists of the collection of high level radioactive waste, generally by specialised firms and their transport to the place of treatment, conditioning, storage and disposal.

Conditioning of high level radioactive waste consists of activities that transform high level radioactive waste into a proper and fit condition for transport and/or storage and/or disposal. Conditioning may occur as part of ISIC/NACE 23 (processing of nuclear fuels) activities.

Containment of high level radioactive waste designates the retention of radioactive waste in such a way that it is effectively prevented from dispersing into the environment, or is released only at an acceptable level. Containment may occur in specially built containment spaces.

Underground disposal of high level radioactive waste is the temporary storage or final disposal of high level radioactive waste in underground sites that meet specific geological and technical criteria.

7.3 Measurement, control, laboratories and the like

Activities aimed at measuring, controlling and monitoring ambient radioactivity and radioactivity due to high level radioactive waste by means of specific equipment, instruments and installations.

7.4 Other activities

All other activities and measures aimed at the protection of ambient media against radiation and transport and treatment of high level radioactive waste. They include administration, training, information and education activities specific to the domain, where they can be separated from other activities related to the same class and similar activities related to other environmental protection classes.

8 RESEARCH AND DEVELOPMENT

Research and development (R&D) comprises creative work undertaken on a systematic basis in order to increase the stock of knowledge and the use of this knowledge to devise new applications (see Frascati manual, OECD 1994) in the field of environmental protection.

The class includes all R&D activities and expenditure oriented towards environmental protection: identification and analysis of sources of pollution, mechanisms of dispersion of pollutants in the environment as well as their effects on human beings, the species and the biosphere. This heading covers R&D for the prevention and elimination of all forms of pollution, as well as R&D oriented towards equipment and instruments of pollution measurement and analysis. Where separable, all R&D activities, even when referring to a specific class, have to be classified under this heading.

Environmental R&D is further classified in accordance with the 1993 NABS (Nomenclature for the Analysis and Comparison of Scientific Programmes and Budgets, Eurostat 1994).

Excluded are R&D activities related to the management of natural resources.

9 OTHER ENVIRONMENTAL PROTECTION ACTIVITIES

Other environmental protection activities refer to all environmental protection activities which take the form of general environmental administration and management activities or training or teaching activities specifically oriented towards environmental protection or which consist of public information, where they are not classified elsewhere in CEPA. They also include activities leading to indivisible expenditure, as well as activities not elsewhere classified.

9.1 General environmental administration and management

General administration of the environment designates any identifiable activity that is directed at the general support of decisions taken in the context of environmental protection activities, whether by governmental or by non-governmental units.

General administration of the environment, regulation and the like

Included here are identifiable activities within general government and NPISH units that are directed towards the regulation, administration of the environment and the support of decisions taken in the context of environmental protection activities. Where possible, such activities should be allocated to other classes. If this is impossible, they should be included under this heading of the classification.

Environmental management

Any identifiable activity of corporations that is directed at the general support of decisions taken in the context of environmental protection activities. It includes the preparation of declarations or requests for permission, internal environmental management, environmental certification processes (ISO 14000, EMAS), as well as the recourse to environmental consultancy services. Activities of units specialised in environmental consultancy, supervision and analysis are included. Where possible, such activities should be allocated to other CEPA classes.

9.2 Education, training and information

Activities that aim at providing general environmental education or training and disseminating environmental information. Included are high school programs, university degrees or special courses specifically aimed at training for environmental protection. Activities such as the production of environmental reports, environmental communication, etc. are also included.

9.3 Activities leading to indivisible expenditure

Environmental protection activities that lead to indivisible expenditure, i.e. which cannot be allocated to any other CEPA class. International financial aid may be a case in point as it may be difficult for the donor countries to attribute international aid to individual classes. If international aid is considerable in volume and/or of specific political interest, a separate 2-digit heading under CEPA 9 could be adequate for national purposes.

9.4 Activities not elsewhere classified

This heading groups together all those environmental protection activities that cannot be classified under other headings of the classification.

Annex 2. Examples of EPE by environmental domain

Requests have been coming in for several years now to create a list of examples, by environmental domain and by industry, of pollution treatment and pollution treatment investments. There is no such thing as a perfect and complete list of investments or of current expenditure for environmental protection purposes, the main reason being that new technologies are constantly being invented and the characteristics in each country are different. The advent of new ways to use existing techniques is another reason. However, that should not stop us from drawing up the list of best available agreed techniques or facilities that can be allocated by type of investment and by environmental domain. The list presented here is an amalgam of lists available in the Netherlands, Portugal, Sweden and Belgium.

Pollution treatment investments (end-of-pipe)

Air and climate

Emission, odour and concentration measurements outside buildings

- Emission, odour and concentration measurements outside buildings

Equipment and installations for treating gaseous emissions

- Equipment for thermal or catalytic combustion of gaseous emissions
- Equipment for separation of gases by gravity or inertia, including centrifuges
- Electro filters
- Bag filters, absorption filters and equipment and installations for absorption by quicklime
- Bio filters and bio purifiers
- Special filters for emissions of radioactive gases
- Equipment for recovery of sulphur after processing gases
- Gas coolers and condensers for preventing and reducing air pollution
- Equipment for purifying and cleaning gaseous emissions
- Equipment for cleaning and/or purifying combustion gases
- Investments to increase the height of existing stacks
- Equipment for additional heating of gaseous emissions with a view to dispersing gases at greater heights in the atmosphere
- Equipment to monitor combustion in order to prevent air pollution
- Equipment installed on the perimeter of industrial installations to monitor and check gaseous emissions, concentration levels and odours
- Equipment for steam collection and recovery
- Measures and equipment to reduce and prevent dust and ash formation during storage, loading and transport operations

Flare systems

- Steam or water injection systems for better combustion
- Flame monitoring equipment in order to prevent air pollution

Improvement in the dispersion of air pollutants into ambient air:

- Heightening of existing stacks
- Extra heating of cold flue gas to ensure plume rises higher

Restriction of waste gas production:

- Extra tank insulation or cooling (not for safety purposes)
- Cover of outflow and treatment systems (e.g. oil/water separators)
- Measures to restrict dust formation in air during storage, transhipment and transport
- Systems to collect and recover vapour
- Pressure-balancing systems
- Floating blankets in storage tanks

Treatment of waste gases:

- Separation by gravity or inertia (incl. cyclones and centrifuges)
- Electro filters
- Cloth filters, candle filters, adsorption filters etc.
- Bio filters and bio cleansers
- Special filters for radioactive waste gases
- Wet dust filters and gas cleansers
- Sulphur recovery from process gases
- Venturi product separation
- Coolers and condensers for waste and ventilation gases to avoid air pollution
- Thermal and catalytic combustion of waste gases
- Extra facilities to combust purging or ventilation gases

Other

- Air compressor
- Air moisture for reducing dust
- Air purification equipment
- Airlock
- Assembling purification plant for discharge of dissolvent
- Barrier filters for oil aerosol
- Barrier filters that clean the air of powder coming from lacquering plant
- Briquette facility for less transportation and dust reduction
- Cartridge filter for dust separators
- Catalytic burning of dissolvent
- Change of handling chemicals for reduced emissions
- Changes in ventilation system and purchase of smoke suction apparatus
- Chip and dust filters
- Cleaning equipment for processing dust in air
- CO meter for furnace
- Cold goods transportation

- Compressor, filters in lacquering unit
- Computer program for collecting and compiling environmental data
- Connection to distant heating
- Converter ventilation
- Cooling machines
- Cyclone against dust
- Cyclone for chip outlet
- Different types of oil absorbers/filters
- Distant cooling
- Distant heating connection
- Dust extractor facility
- Dust filter for slicing plant
- Dust filters for laser cutting
- Dust filters for purification of extractor
- Dust material
- Dust reduction sprinkler system
- Electric water heater
- Electronic testing of burner
- Emission meter for air emissions
- Enclosure of printer equipment
- Equipment for purifying the air from dissolvent
- Equipment that lessen dust problems when handling powder
- Evaporator for painting
- Exchange of distribution systems
- Exchange of flue gas fan for acid-proof material for destruction furnace
- Exchange of incinerator including filters
- Exchange of screen sheet metal to enable replacement of VOC with water based washing detergent
- Exchange of chip cyclone for chip filter cassette
- Exchange of cleaning type of gases from varnishing/bio filters
- Extension of Hg filters
- Extractor of oil fog from cutting machines (oil separator)
- Filter cases for filter cassettes
- Filter cassettes for air when fog spraying
- Filter facility for ventilation
- Filter/extractor for solder smoke
- Filters and cleaning parts
- Flue gas filters
- Flue gas purifying equipment
- Flue gas purifying with bicarbonate as added ingredient
- Furnace central filter for external discharge
- Grease filter
- Improved air filtration
- Improved solder extractor
- Installation of air filter for hydrocarbon
- Installation of cartridge filter for dust caused by grinding

- Installation of NOx meter
- Insulation of air filters
- Investment in dust separator
- Measuring equipment for dust
- Meter equipment
- Meter equipment for dust and particle measurement
- Mineral air filters
- Modification of electricity filters
- Neutralising vessel (condensation water)
- New house and barrier filter for cleaning equipment to reduce the spread of dust
- Oil separator
- Operation control systems for three compressors including air filters
- Purchase of meter
- Purification filter for heat exchanger
- Purifying facility for air
- Rebuilding and extension of air purifier
- Recycling of trichlorethylene
- Renovation and rebuilding of bio filters
- Sand purifier filter
- Selection centre for air compressor facility
- Slag handling
- Supervision equipment for NOx meter
- Taking care of smoke and dust
- Thermal combustion of processing air, VOC
- Time controlled compressors
- Tunnel kiln
- Ventilation and recycling welding
- Ventilation system

Wastewater

Equipment and installations for biological and chemical treatment of wastewater

- Aerobic treatment
- Anaerobic treatment
- Separation of metals, phosphates and fluorides by ionisation
- Ultra filtration and hyper filtration
- Neutralisation equipment
- Heat treatment
- Absorption or ionisation installations
- Mechanical equipment for dispersal and sorting
- Other equipment for biological and chemical treatment of wastewaters

Equipment and installations for conveying and storing wastewater

- Tanks and other storage facilities to prevent discharge peaks
- Tanks for discharges of radioactive wastewaters

- Sewage network and pipelines to carry wastewaters to the municipal sewage networks or sewage treatment plants

Equipment and installations for mechanical treatment of wastewaters

- Screens for separating solids, sand traps, other filtering installations and filters
- Septic tanks and sedimentation, flocculation and/or flotation tanks
- Equipment for separation of oils and fats
- Installations and equipment for centrifugal separation
- Grids for bulky waste, sand riddles, screening installations, filters etc. (excl. intake)
- Flotation, flocculation, sedimentation and septic tanks
- Separation of oils and fats
- Inertia separation incl. hydrocyclones, centrifuges

Equipment and installations for treatment of sludges and wastewaters

- Equipment for aerobic stabilisation of sludges
- Equipment for anaerobic stabilisation of sludges (fermentation)
- Heat treatment of sludges
- Incineration of sludges
- Equipment and installations for the processing and recovery of metals from sludges
- Equipment for storing and conveying sludges
- Sludge dewatering and drying

Equipment and installations to reduce thermal pollution

- Cooling columns and installations to reduce spray
- Equipment and installations for condensing steam and cooling discharges from boilers
- Cooling towers, if necessary to reduce thermal pollution, incl. any supplementary facilities to restrict spray (do not include if these are cost-effective for saving water/drinking water)
- Cooling facilities for discharged boiler-tap water and steam condensation
- Dispersal of discharged cooling water

Equipment for restricting and preventing accidental discharges into surface waters

- Equipment for cleaning and detecting discharges and leaks
- Floating screens

Measurement of discharges and concentrations

- Measurement of discharges and concentrations

Physical-chemical wastewater treatment:

- Ion separation, e.g. metals, phosphates, fluorides
- Hyper filtration and ultra filtration (reverse osmosis)
- Neutralisation
- Heat treatment
- Adsorption and ion exchange
- Strippers
- Dispersants

Restriction and clearance of discharges on surface waters

- Clearance of spills and leakages
- Floating screens

Storage and transport

- Separation of existing sewage systems or water/cooling-water systems to treat wastewater more efficiently
- Construction of separate sewage systems or water/cooling-water systems to treat wastewater more efficiently (extra costs only)
- Buffer tanks and other storage facilities for wastewater to avoid peak discharges or peak loads
- Tanks to collect radioactive discharges
- Main sewage connections and pressure pipelines to transport collected wastewater to municipal sewage networks or treatment plants

Other equipment

- Equipment for measuring and monitoring discharges and concentration levels in surface waters.
- Equipment to reduce consumption or reuse water.
- Sewage treatment plants.
- Cleaning of degreasing basin
- Adaptation of waste pipe systems for adapting cleaning facility
- Addition of existing sewage-treatment plant
- Asphalting of driving area
- Biological purification system
- Biological treatment of wastewater
- Chamber filter press for cooling water
- Changes within washing building (filters and the like)
- Chemical dosage, purifying plant
- Chemical storage
- Cleaning, circulation of processing water
- Collection basin for oils
- Dosage basin for a more even flow of wastewater
- Environmental supervision system
- Equipment for PH steering of precipitate chemicals
- Evaporator for concentration of dirty water, condensate being led to sewage system and treated as hazardous disposal
- Evaporator for cutting emulsions
- Evaporator for water purification
- Exchange of chemical container to a model without bottom ventilator and new washing system
- Exchange of draining gutter
- Exchange of ultra filter piping
- Exchange well for irrigation surfaces
- Extension of ultra filters for end purification of water
- Filter for purifying water
- Filters for well water
- Filtration facility for damp water drain

- Flow meter for outgoing water
- Grease separator plus levelling base
- Improved handling of grease separators
- Improvement of cleaning process for wastewater discharge
- Installation of filters for outgoing water after sedimentation
- Installation of green sludge formation filter
- Installation of heat exchanger
- Installation of oil separator in the company carwash
- Installation of recycling system, feeding-pocket design modification
- Investigation of water handling plan
- Investments in wagons containing sanitation equipment
- Ion exchange
- “Liquidate transformer”
- Management system for central purification plant
- Measuring equipment for flows
- Neutralising facility, purification in wastewater processing
- New flow indicator for wastewater
- Oil separator facility
- Oil separators for compressor cooling water
- Own line for processing wastewater
- PH meter/equipment
- Processing system above ground
- Programming of controlling system and dosage equipment for additives
- Pump station for wastewater by vat station
- Purification equipment for processing water
- Purification of cutting liquid
- Purification of wastewater with ultra filters
- Purification plant for wastewater
- Purifying plant for lift truck
- Purifying plant for water
- Rebuilding of drainpipe system. Oil separator, coil well for sampling and for use as tuning indicators
- Rebuilding of sewage treatment plant
- Recycling from irrigation surfaces
- Recycling tank for cooling water
- Reduced nitrogen discharge in wastewater
- Sand filter
- SAR plant (handling leftover products)
- Sealed draining gutter to prevent discharges
- Separation of process water with slam well
- Sludge drier for reducing amount of hydroxide sludge from purifying plant
- Sludge weight for water purification
- Steam evaporator plant for process water
- Taking care of sludge formation from grease separators
- Tanks for storing processed water
- Tanks, wires and pumps for treating environmental damaging processing water

- Tightening of draining gutter
- Transition to filters
- Vacuum distillation of washing water
- Waste and day water equipment
- Water dams for improved ventilation system
- Water purification equipment
- Well tightening

Waste

Equipment and installations for storage and carriage on own account

- Vehicles used strictly for carrying wastes
- Containers and tanks strictly for storage and carriage of wastes
- Waste transfer points
- Tanks and other installations for waste collection
- (special) vehicles
- Own containers
- Transhipment stations
- Storage of waste oils and/or chemical waste
- Collection of cleansing liquids for tanks (also when originating from wagons, lorries and ships)
- Collection of bilge and ballast water

Equipment and installations for treatment on own account

- Equipment for sorting and separating wastes
- Installations and equipment for physical, chemical, biological and thermal treatment (e.g. dry distillation, pyrolysis) of wastes
- Equipment and installations for condensation and compression of wastes
- Equipment and installations for detoxification, neutralisation and drying of wastes
- Treatment of radioactive wastes (e.g. concrete or glass encasement)
- Equipment for separation of heavy metals
- Equipment and installations for waste disposal (landfills)
- Equipment for incineration of waste
- Equipment and/or materials for impermeabilisation of soils in premises for treating wastes, including construction of dykes, tubes and pump lifts to drain water
- Equipment for biological treatment (composting and fermentation), except for sewage sludges
- Treatment of bilge and ballast water
- Treatment of sludge (excl. sewage treatment sludge)
- Dumping on own premises (incl. installation, operation, ground water protection and final treatment)

Other

- Acid piping for more secure transportation
- Barrel draining
- Circulation plant. Transhipment area
- Cleaning up in old storage space
- Closed-in compressor to be filled up from inside the plant
- Collection of waste from electronics

- Collection vessel for oil waste
- Collection vessel for recycling
- Collection vessel, filing cabinet for chemicals
- Compressor for corrugated cardboard
- Compressor for flammable waste
- Compressor for plastic waste
- Compressor for waste disposals
- Compressor for plastic packaging
- Compressors, waste disposal containers
- Container for controlling sorting
- Container for sorting waste disposals
- Containers and posters for collecting waste disposals
- Containers for recycling
- Corrugated cardboard compressor
- Culvert for condensation water piping
- Dust addition, sand storage
- Environmental education
- Environmental station for recycling
- Environmental station for recycling of hazardouis waste disposals
- Environmental station for recycling of disposals
- Equipment for collecting and storing rinsing water from electrolyte plant
- Equipment for handling hazardous disposals
- Equipment for recycling
- Equipment for sorting waste disposals
- Equipment for taking care of own waste disposals
- Equipment reducing wind dispersal of chips
- Expansion of sorting equipment, containers and stations
- Facilities for equipment that treats waste disposals and material recycling
- Facility for ashes
- Facility for runoff of empty basins
- Granulation mill
- Handling glass waste
- Improved collection of paint waste and reduced amount of paint
- Improved mud treatment
- Improved residue product handling
- Improved waste disposal handling. Optimising of transportation volumes
- Improvements with handling waste disposals
- Installation of waste and environmental stations
- Internal transportation vessels for waste and leftover products
- Investigation of deposit area
- Investments in new waste disposal equipment
- Mill for recycling PVC
- New construction of plant for sorting waste disposals and leftover products
- Oil cleaning of rolling mill
- Paper compressor

- Piping for disposal sand
- Press for waste disposal
- Purchase of containers for waste handling
- Purification equipment for processed oil that goes to recycling
- Purifying plant for solvent
- Rebuilding a biogas pump for more efficient "transportation"
- Recycling container
- Recycling equipment
- Recycling of cutting emulsion
- Recycling of food
- Recycling system
- Return packing
- Road equipment for sorting waste disposals
- Scales for waste disposals
- Sludge handling
- Sludge irrigation equipment for bio sludge
- Sludge press installed
- Sorting equipment
- Sorting equipment for waste disposals
- Sorting of waste disposals
- Sorting station for waste disposals
- Space for composting spice disposals
- Supplementing the recycling system
- Taking care of organic waste
- Tank and pump system for deliveries to biogas establishment
- Transition to PVC-free cable inside light fittings
- Turnable vessel for waste handling
- Waste compressor
- Waste disposal container
- Waste disposal system for adjusted environmental treatment of leftover products
- Waste oil meter
- Washer bending machine
- Solvent cleaner

Soil and groundwater

Equipment and installations for treatment on own account

- Equipment and measures for impermeabilisation of soil
- Measures and equipment to reduce consumption of groundwater
- Measures and equipment for biological treatment of soil
- Measures and equipment for analysis, measurement and monitoring of pollutant levels in the soil and groundwater
- Solvent or vacuum extraction of pollutants

Other

- Impermeable lining of the soil with upright edges or dykes, incl. corresponding drainage systems, pumps, pipes and basins
- Catchments of spills and leakages
- Facilities to underground storage tanks and pipes, e.g. electrostatic (e.g. cathodic) protection for protection of soil or ground water, not to lengthen lifespan
- Removal of underground storage tanks and pipes for protection of soil or ground water
- Cleaning of polluted soil
- Asphalting of timber area
- Cabling
- Chemical handling
- Collection vessel underneath basin and inside chemical storage
- Digging electrical cables down into the ground
- Electrically driven vehicles
- Exhaust silencer for exhaust hood
- Filtering rainwater from transformer base
- Fish stairs
- Frequency control of ventilation
- Ground and subsoil water investigation in industrial area
- Ground sanitation
- Improvements around chemical storage
- Investment in environmental boxes to put emulsion containers in for the prevention of leakage
- Oil storage space
- Outer sanitation and improvement of oil container
- Pole storage for creosote poles
- Protective sheet metal underneath diesel tank
- Purchase of sanitation equipment and "catastrophe boxes" to be used in the event of any environmental accidents
- Rebuilding of storage space,
- Renovation of oil tank
- Sanitation aid for oil discharge
- Sanitation of environmentally dangerous goods and collection area for older building material
- Storage space for creosoted timber
- Storage space put in order
- Testing for PCBs

Noise and vibration

- Covering and acoustic installation of machinery and other equipment (except on health and safety at work grounds)
- Covering and acoustic insulation to reduce noise propagation (except on health and safety at work grounds)
- Constructions to dampen vibrations and absorb noise
- Screens and other barriers to reduce noise
- Soundproof windows
- Equipment or suspension systems to absorb vibrations

- Silencers for decompression and discharge equipment
- Silencers for compressed gas inlets or outlets
- Other silencers
- Other equipment for measuring, controlling and monitoring noise and vibrations
- Encasement and acoustic insulation of machines and pipes
- Dampers
- Screens and barriers
- Noise measurements
- Equipment for measuring outdoor noise and rebuilding sources of noise
- Noise level protection
- Noise reduced cooling tower
- Noise reducing measurements
- Noise reducing plank in front of outer chip and ventilator facility
- Noise reduction of cooling tower for process water
- Noise reduction of fan against outer environment
- Noise reduction of pumps
- Noise sanitation
- Noise wall
- Reduced noise level of sulphate mill
- Reduced noise level on truck
- Silencer of fans, external
- Sound insulation of outlet

Biodiversity and landscape

- Land purchases for nature conservation purposes
- Reforestation schemes for conservation of species
- Rehabilitation of landscapes following quarrying of rock, sand and other minerals
- Planting of tree and shrub corridors around the perimeter of factories or business premises
- Adaptation of structures to prevent collisions between birds in flight
- Green belts and earth barriers, obligatory around factory sites and industry parks
- Landscape reconstruction (e.g. on quarry sites)
- Clear marking of power lines to prevent bird collision

Pollution prevention investments (integrated technologies)

Air and climate

- Additional cost borne for accessories which are more beneficial for the environment (vacuum pumps instead of steam ejectors, valves, tubing, etc.)
- Adoption of more costly but cleaner production processes, understanding as an environmental protection cost the additional cost representing the difference between the total cost of the process in question and the average cost which would have had to be borne had an equivalent but more polluting production process been used
- Application of more expensive, less polluting processes/production processes
- Biological cleaning system

- Cars with environmental friendly cooling
- Catalyst exchange/purifier
- Catalytic NOx purifier
- Central refrigerating plant using ammonia replaced by smaller refrigerating plant
- Changing cooling system to indirect refrigerator
- Cleaner fuel oil
- CO and NOx optimisation
- Cold storage, flooring, and heating recycling
- Compressor exchange for more environmental friendly cooling material
- Compressor switchover. Change of cooling material for dryer
- Computer steering of furnace facility in factory
- Conversion of CFC/R-12 units
- Conversion of furnace from oil to electricity
- Conversion of refrigerator compressor
- Cooling compressor
- Cooling facility
- Cooling investment, liquidation of freon
- Distant cooling system
- Distant cooling system that replaces cooling unit with R22
- Distant heating culvert
- Enclosed processes by BTG manufacturing
- Exchange of cooling agent
- Exchange of cooling material
- Exchange of cooling material in air conditionining and test chamber
- Exchange of cooling material in cooling system
- Exchange of cooling system to NH3
- Exchange of fire extinguisher
- Exchange of material in refrigerator
- Exchange of R22 inside air conditioning unit
- Exchange of refrigerating machine and material in the machine
- Exchange of solvent based cleaning equipment to water based
- Exchange of waterborne paint
- Exchanging air conditioner unit with R22
- Exchanging material in cooling system
- Extra costs of special appendages (incl. taps and valves, welded joints instead of flanges, sealed pump shafts)
- Floating covers and coverings for tanks and other storage areas.
- Flue gas operation control of furnace, central
- Fog separator for turning lathe
- Frequency control of ventilation in evaporation facility
- Furnace rebuilt for better burning
- Grounding with UV varnish
- Heat exchanger
- Hot water accumulator for improved low cargo management
- Improved density testing equipment for SF6 gases

- Installation of equipment for NOx reduction
- Installation of low NOx burner for oil-heated furnace
- Insulation of ovens
- Liquidation of cooling machines containing R22
- Liquidation of ethylene oxide sterilization
- Liquidation of Freon
- Liquidation of trichloroethylene
- Machine for recycling air
- New condenser (ammonia cooler)
- New evaporation line
- New heat pump
- New pump equipment to use more environmental friendly under sealing
- New washing technique based on alcohol
- NOx burning chamber. Gas turbine
- Office supplies, reduced use of paper and plastic
- Operating management of furnace
- Painting tanks white (only costs above normal maintenance)
- Pellet furnace
- Purchase of electrostatic equipment for reducing paint usage when lacquering
- Rebuilding of bark furnace to improve efficiency level and to reduce NOx emissions
- Rebuilding of furnace
- Rebuilding of primary air regulator on bio furnace
- Rebuilding of ventilation and air purifier plant at the department for lacquering
- Reduced amount of Freon
- Reduced dust discharge of furnace, central
- Refrigerating compressor
- Refrigerator with ammonia as cooling agent. Replacing old refrigerators containing HCFC
- Repealed CFC cooling unit
- Replacement of cooling material with a cyclic equipment
- Replacement of Freon based refrigerating machine
- Restriction of emission and odour caused by fossil fuel combustion, e.g. facilities at and casing of combustion equipment
- Restriction of gaseous emissions and odours due to fuel combustion, for example coverings for premises and parts of equipment consuming oil based fuels.
- Re-use of exhaust gases as a means of preventing and reducing emissions to the atmosphere.
- Reuse of waste gas to prevent air pollution
- Robot in process reducing air pollution within foundry
- Screen sheet metal wash, water based
- Silencer of extractor
- SO2 meter from bark furnace
- Special device for taking away bottom ashes
- Stain machines for water stain
- Supplementing the refrigerating plant from freon to ammonia as cooling means
- Tanks with floating roofs
- Transition to enamel with water based colours

- Trimming of airflows
- Use of equipment which is cleaner but more costly than equivalent conventional equipment
- Use of green products (see definition below) to reduce the pollutant load during the production process
- Use of more expensive, less polluting equipment
- Use of relatively environment-friendly raw and auxiliary materials (to restrict pollution during your production process)
- Vacuum conveyor, enclosure of process with handling chemicals
- vacuum pumps instead of steam ejectors
- Ventilation, switchover from Freon to water
- Ventilator, isolator
- Water cutting robot
- Water lacquering with drier
- Water stain cylinder

Wastewater

- Adoption of closed circuit cooling water systems to prevent and reduce thermal pollution
- Adoption of cooling air systems instead of cooling water systems to prevent and reduce thermal pollution
- Application of more expensive, less polluting processes/production processes
- Assemblage of magnate ventilator for shutting down water flows when machinery stops
- Cabin washer for reducing emissions to air and water
- Circulating cooling system
- Cleaning of process-cleaning water through vacuum evaporation equipment
- Climate controlled watering of lumber with recycling
- Compressed air dryer
- Deionisation of processing water to reduce the concentration of chemicals
- Enclosed cooling system
- Enclosed system of rinsing water for developing films
- Enclosed water cooling system
- Enclosed water system regarding processed water
- Enclosure of cooling system
- Equipment for taking care of slam in enclosed system
- Exchange of dishwasher
- Extra costs for special appendages (incl. cut-offs and valves, welded joints instead of flanges, sealed pump shafts)
- Extra costs of air cooling over water cooling (if intended to restrict thermal pollution)
- Extra costs of closed cooling-water systems (if intended to restrict thermal pollution)
- Extra maintenance (e.g. cleaning) of cooling water systems if chlorination of cooling water is not permitted for environmental reasons
- Extra oxygen supply facility
- Extra pumping capacity in existing installations to reduce discharge temperature (if intended to restrict thermal pollution)
- Installation of circulation tank for cold water when spot welding
- Installation of coal filters before outgoing water; main use is to recycle the water
- Installation of heating cables
- Meter equipment
- More efficient washing equipment for storage packing

- More modern printing press
- New moisturizing method that saves water usage and uses no chemicals
- Oil separator
- Polymeric facility
- Purifying processing water from alkaline washing
- Rebuilding and changed pipelines
- Rebuilding of the department of surface treatment; new process bathtub and new purifying plant (enclosed process)
- Reduced chromium discharge in wastewater
- Reduction of consumption of water or reuse of water
- Reductions in water use, reuse of water
- Regulation arrangement for water transferring
- Resistance rinsing equipment in Ni/Cr line
- Supplementing purifying plant to clean water so it can be recycled
- Supplementing surface treatment unit with additional economical rinsing steps; this is done to reduce discharge of fluoride
- Ultraviolet light for reduction of the growth of bacteria in rinsing water
- Use of green products (see definition below) to reduce the pollutant load during the production process
- Use of more expensive, less polluting equipment
- Use of relatively environment-friendly raw and auxiliary materials (to restrict pollution during your production process)
- Vacuum pump in process manufacturing
- Ventilator shutters
- Washing machine with enclosed system and machinery details
- Washing robot, re-circulation of H2O and Ism
- Washing system improvement for dosage

Waste

- Adoption of more costly but cleaner processes reducing the volume of waste, understanding as an environmental protection cost the additional cost representing the difference between the total cost of the process in question and the average cost which would have had to be borne had an equivalent but more polluting production process been used
- Application of more expensive processes/production processes to reduce the generation of waste
- Reduction in the use of raw and auxiliary materials to reduce amount of waste
- Reduction of use of raw materials to reduce the quantity of waste generated
- Reuse of waste in the production process
- Reuse of waste materials in the production process
- Use of equipment which is cleaner but more costly than equivalent conventional equipment.
- Use of green products (see definition below) to reduce the pollutant load during the production process
- Use of relatively environment-friendly raw and auxiliary materials

Soil and groundwater

- Burning exchanger for solvent
- Distant heating connection
- Double covering or double walls for tanks and reservoirs to prevent leaks and protect soil and groundwater.

- Exchange for low energy using fittings
- Exchange of electrical cables containing PCB oil
- Exchange of high tension in oil cables
- Exchange of MPS
- Extra costs of double-walled tanks (installed for protection of soil or ground water
- Repletion protection for container
- Repletion protection for oil
- Steering system for filters, ventilations

Noise and vibration

- Equipment and machines designed or constructed for a low noise or vibration level
- Flexible appendages etc.
- Foundations designed to damp vibrations
- Furnaces or components with low noise emission levels
- Ground flares
- Low-noise burners on flares
- Noise reducing measurement
- Parts of equipment and machinery designed to reduce noise and vibrations
- Parts of foundations and/or structures of installations designed specially to dampen and absorb vibrations
- Regrouping of buildings and/or installations to reduce noise pollution (include extra costs only)
- Special facilities in the construction or reconstruction of buildings (including insulation material in buildings)

Biodiversity and landscape

- Extra costs for pylons which blend in with the landscape
- Facilities to restrict the use of groundwater
- Prevention of damage to nature and landscape (e.g. detouring site-access roads, drilling at an angle)

Other

- Steps in reducing magnetic fields

Total current expenditure on environmental protection

In-house (internal) current expenditure

Air and climate

- Air analysis
- Control of air, own control of cooling facility
- Control of emissions to air through periodical inspections and own control
- Control of ventilation
- Exchange of coal filters for the reduction of solvent discharge from painting
- Maintenance of ventilation system
- Management and the maintenance of air purifying facilities

Wastewater

- Control of emissions to water through periodical inspections and own control
- Current expenditure for purification of oil mixed with water in a ultrafiltration plant
- Lye for PH adjustments
- Maintenance of cooling water system (enclosed)
- Maintenance of water-purifying plant
- Purifying processed water (energy and labour expenditure)
- Renovation of sediment basins
- Wastewater sampling
- Water analysis of oil separator, ground water
- Water purification, tinning

Waste

- Additional cost for recycling
- Expenditures for handling leftover products
- Internal handling of waste disposal
- Internal transportation and taking care of waste disposals
- Internal waste disposal handling
- Maintenance and control measurements of filter plant for Hg and xylene
- Management and the maintenance of waste disposal facilities
- Staff expenditures for grease separator facility

Other

- Building up an environmental management system
- Certifying according to ISO14001
- Collection of environmental information
- Developing environmental control system and providing information to own staff
- Development and implementation of lead and halogen free production
- Education for property and environmental management
- Education in environmental work
- Environmental certification
- Environmental coordinator and education of staff
- Environmental department and revision of ISO 14001
- Environmental education
- Environmental engineer and environmental work
- Environmental management system
- Expenditure for environmental coordinator
- Expenditure for staff and management to handle environmental issues
- Expenditures for producing environmental report
- Half-day training in environmental issues for all employees
- Information on and training for waste handling system
- Internal expenditure of ISO 14001
- Laboratory work for chemical technical development of processing water purification
- Participation in different research and control projects
- Pilot study with biogas purification
- Quality and environmental manager
- Research and development expenditure on how to destruct ethyleneoxide

- Research and development for project that eliminates impregnating agent for painting
- Research and development; developing methods for analyses and analysing
- Salary for environmental department

Purchases of services (external current expenditure)

Air and climate

- Filter
- Measuring of discharges

Wastewater

- Sampling and transporting slam away
- To water service enterprise for sewage treatment and general sewage charges
- To contractors for the removal of liquid wastes

Waste

- Controlled tipping and transportation
- Destruction expenditures for chemical processing equipment and setting-up of a chemical storage facility
- Destruction of chemicals
- Emptying and deposit fees
- Environmental station for recycling of disposals
- Environmental waste disposals
- Expenditures associated with external waste management handling
- Expenditures for unsorted waste products
- External supervision of dangerous and non dangerous waste
- Fees for waste disposals
- Normal refuse collection
- Payments to REPA
- Rent for compressor for waste disposals
- Rent for containers for sheet metal waste
- Sludge suction
- Solid Wastes (including pressed sludge)
- Transportation and depositing of waste disposals
- Vessels and more for recycling paper, cardboard and other waste disposals
- Waste disposal treatment for biogas establishment

Soil and groundwater

- Removal, treatment or containment of contaminated soil and/or groundwater

Other

- Additional cost for wind power electricity
- Auditing expenditure for environmental management system and certification

- Chemical agreement with the chemical inspection department
- Consultant for environmental education
- Course on the environmental code
- Environmental certification
- Expenditures for keeping environmental certification
- Expenditures to county administrative board regarding environment
- Flux means switched over to VOC-free
- Increased expenditures for switching chemicals
- Inspection of control program
- Payments to environment agencies for discharge permits, consignment notes for special waste, IPC authorisation etc
- Payments to SEMKO and local government fees
- Refilling catalysts on trucks
- Supervision fee
- Supervision fee for the chemical inspection department
- Supervision fee, expenditures for analyses, noise measurements and dust measurements
- Washing method replaced by VOC-free method

Annex 3 Typical environmental impacts of industries

The remainder of this chapter is taken from a report entitled "*Manual for the statistical operation on industries' expenditure on environmental protection", Nuno Romão, Instituto Nacional de Statística, Portugal, Eurostat EXP-01-3.4.1, except for the text on NACE 24 which is written by Jaap Van Riessen, CBS Netherlands.*

……..

There is a set of equipment and procedures for correct pollution management which can be used across the full spectrum of industrial activities. It comprises:

(a) equipment for collecting and transporting unused packaging (or that used in packing products produced by the enterprise or raw materials used);

(b) equipment for collecting and packaging various oils used in machinery – hydraulic systems oil, engine oil, cutting oils, etc.;

(c) equipment for filtering gaseous emissions;

(d) equipment for treating liquid effluents;

(e) equipment for collecting and transporting sludge from wastewater treatment stations.

The various industrial processes have different effects on the environment, in that the pollution they generate typically affects a particular domain more as a result of the production process. This Annex presents the kinds of equipment and environmental protection activities for branches of activity according to the pollution released and the domains on which they have the greatest impact.

NACE 10-14 Extractive industries

Air quality and climate protection

As far as atmospheric pollution is concerned, open-cast operations can be expected to invest in, and incur costs on, measures to contain the dust raised. This applies in particular to operations near to centres of population. The equipment involved sprays vehicles transporting the materials extracted as they leave the site in order to prevent dust spreading. There may also be measures relating to heat recovery and/or to the treatment of gaseous emissions from combustion engines used as generators.

Wastewater management

Wastewater is produced in the course of extractive activities by washing rock and the recovery of the water applied in containing dust. It is to be expected that there will be proper equipment for treating this water and rainwater accumulating in the craters on open cast sites.

Waste management

Pollution in the form of solid waste is the component with the greatest environmental risk in extractive activities. The waste produced in most extractive activities is significant by virtue of its typical volume and weight. Spoil banks are commonly found on site. Many enterprises prepare suitable sites for depositing this waste. Thus, it is to be expected that there will be investment and costs in connection with keeping such dumps duly prepared. In some situations, however, these spoil banks constitute a by-product - aggregate - most of which is used in road building and maintenance. In this case, this is not waste, and investment or operating costs in relation to these materials should not be considered in the present context.

Noise and vibration

Noise and vibration is an environmental domain in which the extractive industries generally have a sometimes significant impact, partly due to the use of explosives, heavy machinery and drilling. Enterprises can be expected to invest in perimeter barriers to prevent the propagation of noise and vibration. This domain requires careful attention because many of the measures concerned may be taken for reasons of health and safety at work, although there may well be environmental benefits.

Protection of biodiversity and landscape

Another environmental component in relation to which environmental protection measures may be recorded is the cost and investment involved in restoring the original landscape when a site is abandoned or closed down. Here, the cost of measures to restore landscape should be considered when operations are closed down.

NACE 15-16 Food, drink and tobacco industries

Air quality and climate protection

Emissions of gases are essentially the result of burning fuels in boilers to produce steam. Investment is thus to be expected in equipment for filtering and treating such emissions before they are released into the atmosphere, or in altering chimneys, plus other current expenditure on facilities for the treatment of gaseous emissions of this kind.

Wastewater management

Pollution caused in the form of wastewater is the biggest component. Essentially, it stems from losses in the process which carry waste raw material and finished products, and from washing water from the equipment and plant itself. Effluents from the food and drinks industry typically have a very high organic burden. Before returnable bottles are filled in the drinks industry, huge quantities of washing water are used which then go on for subsequent treatment. Adopting technologies to recover this must be considered from the first time enterprises record a similar technological switch and when this is adopted as an integrated measure to reduce pollution.

Waste management

Pollution in the form of solid waste generated by this sector is not usually environmentally significant. The main waste is: waste from unused packaging; organic sludge from wastewater treatment stations; products unfit for consumption or processing and waste oil and ash from burning fuel oil. Firms naturally incur costs in this area either from contracting services for correct treatment and disposal of this waste, on equipment such as compactors of waste packaging or on the right containers for temporary storage and/or transport of sludge from wastewater treatment stations.

NACE 17-19 Textile and fur industries

Air quality and climate protection

The fur industry generates emissions in the form of particles from some of the materials produced. By law, chimneys releasing emissions in this sector must be at least 10 metres high, and there is a need to fit filters on these to prevent particle emissions. Emissions from burning fuels used in producing steam for dyeing and bleaching sections should also be considered, as should emissions from applying chemicals during these stages, which of course create the need for equipment and other goods to treat similar emissions.

Wastewater management

This domain is highly significant in the textile and fur and dyeing industries. Wastewater arising at the various stages of the production process contains high levels of organic matter, and toxic substances in some cases. Frequent investment in equipment and parts for wastewater treatment stations is to be expected, as is current expenditure on operating this equipment. Dyeing operations for thread and skins give rise to significant quantities of wastewater containing chemical substances which may be reused, along with the water. Only with the technological switch to equipment which permits water to be recovered can the dilute chemicals be reused. However, this investment should solely be considered when enterprises adopt such technologies for the first time.

Waste management

The main waste comes from damaged packaging and remains of processed materials. In these industries, a substantial part of the waste is material not fit for processing. The one waste component which causes a great deal of expenditure for processing and correct disposal is sludge from wastewater from treatment stations. In the hides industries, much of the waste generated is reusable in the textile industries (hair and wool) or in the footwear industry (leather offcuts).

NACE 20 Wood and cork industries

Air quality and climate protection

Investment is to be considered in equipment for treating gaseous emissions from furnaces and incinerators used in eliminating waste and recovering energy.

Wastewater management

This activity has little impact in this domain. Equipment purchased for treating wastewater from processes in which wood is treated with chemicals is to be considered.

Waste management

Purchases are made of equipment for burning waste raw material in the sector. However, this equipment should solely be considered for the first time when there is a change of technology and when it is integrated as a measure to reduce waste management or to make use of this waste.

NACE 21-22 Industries manufacturing pulp, paper and paper products; publishing and printing

Air quality and climate protection

This sector uses energy intensively; it may account for as much as one-quarter of production costs. Waste raw materials are increasingly burnt as an energy source. In this respect, the use of equipment for filtering and treating emissions from burning this waste is to be expected. The production of pulp and paper uses thermal energy to a great extent, which gives rise to the adoption of integrated technologies for energy efficiency as in the case of co-generation (combined production of electrical energy and heat in the form of steam or hot water).

Wastewater management

This domain is widely affected by this particular sector, which uses wastewater treatment stations. Integrated equipment may be used to recover organic matter (fibres) diluted in wastewater for reintegration into the production process instead of losing them as sludge in wastewater.

Waste management

The main waste is raw material rejected at the beginning of the production process and sludge in wastewater. Thus, the adoption of equipment for correct disposal of this kind of waste should be considered. In the case of energy-recovery incineration equipment adopted for waste management, this should be considered when the technology is changed for the first time. This of course includes equipment for collecting and packing this kind of waste.

NACE 23 Petroleum industry

Air quality and climate protection

This industrial sector has a heavy impact in this domain. There is substantial investment and expenditure on equipment for filtering and treating gaseous effluents of sulphur dioxide (SO_2) and nitrogen oxides (NO_x).

Wastewater management

Like other sectors, the petroleum industry requires the installation of equipment for wastewater treatment. Expenditure on purchasing and managing equipment for wastewater treatment is considered as such. When equipment permits treated water to be reused, only the investment made for the first time when there is a change of technologies is to be considered, and only when this course is taken to reduce pollution levels.

Waste management

There is a need for proper equipment for treating and eliminating waste raw material rejected in the initial stages of the production process or from uncontrolled run-off. Technologies are being adopted which permit waste to be reintegrated into the production process, along similar lines to equipment for reusing water.

Protection against contamination of the soil, groundwater and surface water

This activity demands the adoption of equipment, such as the installation of cloth and the sealing of soil to prevention contamination, particularly in facilities where raw materials are transported from unloading points to manufacturing facilities. In the event of spillage during operations to discharge raw materials, expenditure on measures to clean up soil and areas affected should be considered, as should expenditure on the correct treatment of waste arising from this activity.

Protecting biodiversity and landscape

This industry uses large-scale equipment and facilities which have a clear impact on landscape. Expenditure on planting tree corridors around facilities and other measures to blend facilities into the landscape should not therefore be ruled out.

NACE 24 Chemical Industry (source: Van Riessen, CBS Netherlands)

Air quality and climate protection

As in NACE 23 this industrial sector has a heavy impact in the domain of Air. Most of the investment and expenditure is done on equipment for filtering and treatment of waste gases and restriction of waste gas production (or reuse of waste gas to prevent air pollution). Extra costs are made for special appendages (incl. taps and valves, welded joints instead of flanges, sealed pump shafts).

Wastewater management

The chemical industry makes a lot of effort to prevent water pollution by different types of (e.g. physical-chemical) wastewater treatment installations, reuse of water and spends money on special appendages (cutoffs and valves, etc.). To restrict thermal pollution this industrial sector invests in cooling towers and makes extra costs for air cooling instead of water cooling and closed cooling-water systems.

Waste management

Chemical enterprises invest in equipment to store (tanks and containers), transport and treat their own chemical waste and waste oils. Examples of different techniques are thermal treatment (e.g. dry distillation, pyrolisis), detoxification, neutralisation, dewatering and separation of heavy metals. Companies in this sector also invest in the application of more expensive (production) processes to reduce the generation of waste and they try to reuse waste in the production process.

Protection against contamination of the soil, ground water and surface water

Catchments of spills and leakages are important in this activity. Expenditure is done in impermeable lining of the soil with coatings and upright edges or dykes, incl. corresponding drainage systems, pumps, pipes and basins.

NACE 26 Cement and building materials industry

Air quality and climate protection

Gaseous emissions are the main source of pollution generated by the cement industry - pollution from emissions from gases from burning fuel and dust in the kilns used in producing cement. This kind of pollution creates the need for equipment for proper treatment and filtering of emissions.

Wastewater management

The cement industry does not have a major impact in this domain, with the exception of the treatment of cooling water used in the process. On the other hand, the building materials industry and the production of bathroom goods and tiles, in particular, generate various kinds of wastewater from baths used in production.

Waste management

Waste from cement production largely comprises stones rejected in the process of preparing raw material. The building materials industry also generates waste in the form of rejects from the preparation of raw materials or unused products. Current costs are therefore incurred in eliminating or assessing this waste.

Noise and vibration abatement

The production processes associated with this kind of activity use heavy machinery which may generate noise and vibrations in excess of the limits for industrial plant, whereupon measures should be taken and equipment adopted to reduce and control sources of noise.

Protecting biodiversity and landscape

The cement industry, like the petroleum industry, uses large-scale equipment and facilities which have a heavy impact on landscape, which may lead to expenditure on planting tree corridors around facilities and other measures to disguise facilities within the landscape.

NACE 40-41 Electricity, gas and water

Air quality and climate protection

In the electricity sector, investment in and expenditure on equipment to treat and filter gaseous effluents should be considered when the production uses fossil fuels, and coal and fuel oil in particular. In the water sector, there are cases of the use of emergency generators to guarantee the operation of lift pumps and other facilities as measures to prevent power cuts in the general network.

Possible costs associated with filters and other measures to control emissions from such generators run on liquid fuels should not be excluded.

Wastewater management

In thermal power stations, equipment used to treat cooling water and other water from the treatment of gaseous emissions should be considered.

Waste management

Industrial units producing electricity from coal create significant quantities of waste ash. The equipment used in collecting and packing this ash, which is generally used in manufacturing cement, should be considered. In collecting and distributing water, investment in and expenditure on equipment used to collect and treat sludge from water treatment stations should be considered. The costs of eliminating waste oil from liquid-fuel-operated generators already cited in the air domain are to be considered.

Annex 4. Environmental protection expenditure at a micro-level

A4.1 Industry associations and enterprises

In conventional corporate cost accounting, environmental and non-environmental costs are often aggregated in overhead accounts, which mean that they are in effect "hidden" from management. The exception is large environmental facilities which sometimes could be identified as separate cost centres. Today only a limited number of enterprises have set up an activity-based information system in which they can separately identify expenditure for environmental protection. Those that have adapted their accounting systems to identifying environmental expenditures usually cite the following three reasons:

- To increase overall cost-efficiency and identify opportunities for cost savings. The costs for industry of environmental protection, including pollution reduction, waste management, monitoring, regulatory reporting, legal fees and insurance, have increased rapidly in the past 20 years with increasingly stringent environmental regulations. If these costs are not separately identifiable, there is a risk that management could underestimate the extent and growth of such costs, and product and production managers have no incentive to reduce environmental costs.

Case studies of enterprises that gained economic benefits from the managerial decision that resulted from disclosing environmental costs are described in Ditz, D. Ranganathan, J. and Banks, D. editors, (1995) *Green ledgers: case studies in corporate environmental accounting*, World Resources Institute 1995. One of them is the case of Du Pont[41], that reversed its decision to dispose of the wastewater by deep well injection as the correct calculation of costs revealed that it was more convenient to treat it at the on-site biological treatment facility.

- To provide information about what the enterprise has done to reduce pressure on the environment, which could be communicated to stakeholders and the general public e.g. in notes to the annual accounts or in separate environmental reports.

- To provide information that could be used in discussions with policy makers when discussing possible future actions and their effects on corporate competitiveness.

Example A4.1 Italy:

[41] See footnote 43 in Tudini (1999)*:*

Environmental cost[42] categories recorded by selected companies

ENTERPRISE [REFERENCE]	ENVIRONMENTAL COST CATEGORIES
US companies participating in API (Association of Petroleum Industries) survey [API (1997)]	i) Capital ii) Operating, Maintenance (O&M), direct administrative expenditures iii) All costs are recorded for: five activities: 1. Exploration & production, 2. Transportation, 3. Refining, 4. Marketing, 5. Other, and for environmental domains air, water, wastes, spills, remediation, other
Ontario Hydro [US EPA (1996)]	Material and waste management, water management, air management, land use management, environmental approvals, energy efficiency and renewable energy technology. For each of the above categories, costs are distinguished in terms of: operations, maintenance, and administration (OM&A), capital, and fuel & related.
Grupo Primex [US EPA (1997)]	Regulatory: environmental audits, risk assessment, penalties, remediation or R&D; Maintenance: all expenses incurred as a result of preventive and corrective maintenance for ecological assets, e.g. the wastewater treatment plant; Fixed expenses: salaries, wages paid to ecology department personnel
"International Refiners" (fictitious name) [US EPA (1997)]	Air: compliance fines, emissions testing, stack sampling Water Solid waste: compliance fines, hazardous waste, non-hazardous waste, waste testing and analysis Remediation: soil remediation, compliance fines, testing and analysis and site assessment waste transportation Spill cleanup Medical services Other: miscellaneous environmental expenses Costs are also tracked by media, location and line of business
AGIP [Bartolomeo (1997)]	Protection of air, protection of water, protection of landscape, waste management, protection of soil, noise abatement, R&D; accident remediation
IP (Italiana Petroli) [Bartolomeo (1997)]	Protection of air and climate; protection of surface water; protection of soil and groundwater; soil remediation; environmental monitoring; waste; health; noise abatement; safety and fire prevention; training and information
Paper-Mill "Favini" [Bartolomeo (1997)]	Environmentally friendly raw materials: for example totally chlorine-free cellulose, recycled paper, natural colours Labour (direct and indirect)

[42] The word "cost" is used here with reference to environmental accounting at the enterprise level, instead of "expenditure" which is used in a macro context. From a conceptual standpoint, "expenditure" refers to an actual outlay of money whereas "cost" is not necessarily related to an actual outlay.

	Industrial expenditures: monitoring and control, R&D, external environmental services, waste disposal, wastewater treatment, maintenance Marketing General expenditures: training, etc. Depreciation Capital expenditures Expenditures are also grouped by activity (monitoring, prevention, treatment, conservation) and by environmental domain (air, water, waste, noise, natural resources)
Baxter International [Bennet and James (1997)]	Proactive: corporate environmental affairs, auditors' and attorneys fees, corporate environmental engineering/facilities engineering, division/facility environmental professionals and programmes, packaging professionals and programs for packaging reductions, pollution controls, O&M, pollution control, depreciation. Remediation and waste disposal: attorneys' fees for clean-up claims, waste disposal, remediation/clean-up on-site and off-site. Income, savings and cost avoidance: ozone depleting substances cost reductions (c.r.), hazardous waste, disposal c.r., hazardous waste material c.r., non-hazardous waste disposal c.r., non-hazardous waste material c.r., recycling income, green lights energy conservation, packaging c.r.
Sulzer Technology corporation [Schroeder and Winter (1997)]	Direct: environmental costs (e.c.) from waste, e.c. from pollution treatment of waste and wastewater, e.c. from recycling, e.c. from waste reduction. Indirect (occurring in overheads): e.c. occurring in e.c. centres, e.c. occurring in mixed cost centres.

Costs included in the table can be grouped according to the following categories:

- by type of environmental activity: monitoring, prevention, treatment, etc.;
- by environmental domain: air, water, waste, noise, etc.;
- by economic nature: capital or operating;
- by whether they are expected to generate future benefits for the enterprise ("proactive"), or not ("remediation");
- by cost centres: direct (occurring in production), indirect (occurring in overheads).

Hence, there is no unique classification of costs adopted by companies as they tend to choose the classification that suits their individual needs.

This need for flexibility also applies to the definition of environmental costs that is adapted to the internal decision-making requirements: "How an enterprise defines an environmental cost generally depends on how it intends to use the information (e.g. cost allocation, capital budgeting, process/product design, other management decisions) and the scale and scope of the exercise"[43].

[43] See US EPA (1995), An introduction to environmental accounting as a business management tool: key concepts and terms EPA 742-R-95-001, page 7.

Definitions can differ with respect to the scope of the environmental costs concept adopted, the accounting criteria chosen and the production activities considered as sources of environmental costs.

Moreover, the range of activities considered as sources of environmental expenditure can vary considerably. Environmental costs can be calculated for environmental protection activities, following a definition similar to the SERIEE one, or can also encompass natural resource management, particularly that of energy and water.

A4.2 Business accounting

There are some indications that accounting in relation to these matters is on the increase:

- The European Commission Recommendation on accounting includes some guidance on environmental protection expenditure, see A4.4.1 below.

- EMAS - the Eco-Management and Audit Scheme. The EMAS Regulation (EEC No 1836/93) allows voluntary participation of the industrial sector in a Community eco-management and audit scheme. The objectives of EMAS is to promote continuous improvements in the environmental performance of industrial activities by the establishment and implementation of environmental policies, programmes and management systems, systematic, objective and periodic evaluation of the environmental performance and provision of information on environmental performance to the public. In short, EMAS is an environmental management system with a verified environmental report to gain credibility and market advantages in safeguarding the environment. Voluntary environmental reports by enterprises are a tool for policy and thus marketing, but it also gives an incentive for enterprises to identify environmental protection expenditure.

- THE ISO 14001 standard for environmental management systems requires implementation of an Environmental Management System (EMS) in accordance with defined internationally recognized standards (as set forth in the ISO14001 specification).

- The Environmental Management Accounting Initiative (EMA) of the United Nations Division for Sustainable Development examines the design and implementation of incentives to promote the adoption of environmental managerial accounting, based on work undertaken in a number of countries, see A4.3 below.

Enterprises also often adapt their information or accounting system in response to statistical surveys. A particular enterprise would choose the system that is most efficient given its specific situation.

- For a large enterprise with a major impact on the environment, it is difficult to gain an overview of everything that has been done to protect the environment. Here it may be most efficient (and perhaps necessary if a good quality level is to be achieved) to set up a coherent information or accounting system.

- For a small enterprise, where it is easier to have an overview of activities, or an enterprise which has little or no impact on the environment, the situation is different. Here it could be enough to estimate the few items of expenditure they have, based on expert knowledge.

A4.2.1 EC Recommendation on accounting of environmental issues

The European Commission has adopted a *Recommendation on recognition, measurement and disclosure of environmental issues in the annual accounts and annual reports of EU companies*.[44] The Recommendation clarifies existing EU accounting rules and provides guidance to improve the quality, transparency and comparability of environmental data available in companies' annual accounts and annual reports. The current lack of a common set of rules and definitions means that environmental information disclosed by companies is often incomplete and incomparable. This makes it difficult for investors and other users of financial statements to form a clear and accurate picture of the impact of environmental factors on a enterprise's performance or to make comparisons between companies.

The tightening of corporate financial environmental accounting rules comes as part of the European Union Financial Reporting Strategy to harmonise the European accounting field and require the application of International Accounting Standards by listed EU companies as from 2005.

The International Accounting Standards Board is an independent, privately funded accounting standards body based in London. The board is committed to developing a single set of global accounting standards that require transparent and comparable information in general-purpose financial statements. There is currently little guidance for corporate filing of environmental issues under International Accounting Standards Board standards. The absence of a common set of rules and definitions has resulted in companies disclosing sets of environmental performance information that are incomparable. This makes it difficult for investors and other users of financial statements to form a clear and accurate picture of the impact of environmental factors on an enterprise's performance or to make comparisons between companies.

The Recommendation

- provides guidance on how to apply the provisions of the existing Accounting Directives (see below) as regards environmental information;

- suggests closer coordination of separate environmental reports, statutory annual accounts and annual reports so as to reduce inconsistencies;

- indicates that relevant, transparent disclosures should be incorporated into companies' annual accounts and annual reports in a way that complements the more detailed separate environmental reports;

[44] http://europa.eu.int/comm/internal_market/en/enterprise/account/news/01-814.htm

- recommends companies to use the detailed definitions developed by Eurostat as part of the implementation documents of Council Regulation 58/97 of 20 December 1996 concerning Structural Business Statistics

Investors and users of financial statements need information about the impact of environmental risks and liabilities on the financial position of the enterprise, as well as the enterprise's attitude towards the environment and its environmental performance, to the extent that these factors may have consequences for the financial health and performance of the enterprise. Regulatory authorities have an interest in monitoring the application of environmental regulations by companies and the costs incurred as a result. But companies' voluntary disclosure of environmental expenditure data in annual accounts and annual reports is low.

Users of annual reports have an interest in ascertaining to what extent environmental protection is an integral part of the enterprise's policies and activities and what costs and benefits are associated. For example, the financial position of an enterprise could be affected by policies and programmes that have been adopted by the enterprise in respect of environmental protection measures, such as pollution prevention. Also, costs may be incurred as a result of fines and penalties for non-compliance with environmental regulations and compensations paid to third parties. On the other hand, benefits can also be realised, for example, from government financial incentives related to environmental protection that the enterprise receives or to which is entitled.

Even when companies do report environmental information, the value of that information is diminished by the absence of a common and recognised set of definitions and concepts with regard to environmental issues and their associated costs. The lack of a common set of guidelines on the disclosure of environmental factors in financial reporting means it is very difficult to make meaningful comparisons between companies in this respect.

This Recommendation applies to all companies covered by EU Accounting Directives (namely the 4th Enterprise Law Directive on annual accounts (78/660/EEC) and the 7th Enterprise Law Directive on consolidated accounts (83/349/EEC)), allowing for exemptions that Member States are permitted to introduce for small and medium-sized companies in accordance with these Directives. Because environmental issues also have financial implications for banks, other financial institutions and insurance companies, the Recommendation also applies to them, even though they are subject to specific accounting requirements laid down in Directive 86/635/EEC for banks and other financial institutions and Directive 91/674/EEC for insurance companies.

As part of its 1995 Accounting Strategy, the Commission is seeking to integrate European harmonisation in the accounting field within the broader context of international accounting harmonisation. The Recommendation has been prepared taking into account relevant requirements in International Accounting Standards (IAS) that deal with environment-related information. Therefore, it is consistent with and supports both the EU Financial Reporting Strategy (see IP/00/606), which requires the application of International Accounting Standards (IAS) by listed EU companies from 2005 onwards, and the recent Commission proposal for a Regulation on the application of

International Accounting Standards (see IP/01/200). However, there exists little guidance directly related to environmental issues in IAS and no specific IAS is solely focused on these issues.

The Recommendation reinforces Community initiatives in the area of environmental protection. It was foreseen in the Commission's 1999 Communication on the 'Single Market and the Environment' (see IP/99/382).

A4.3 Environmental management accounting (EMA)

The UN has launched an initiative to promote the implementation of Environmental Management Accounting (EMA). Management accounting is a broad term referring to the process of identification, measurement, accumulation, analysis, preparation, interpretation, and communication of financial information used by management for planning, evaluation, and control within an organisation, and for ensuring accountability for its resources.

Environmental management accounting serves as a mechanism to identify and measure the full spectrum of environmental costs of current production processes and the economic benefits of pollution prevention or cleaner processes, and to integrate these costs and benefits into day-to-day business decision-making.

The box below contains extracts from *Environmental Management Accounting - Procedures and Principles*, United Nations Division for Sustainable Development In cooperation with the Austrian Federal Ministry of Transport, Innovation and Technology, UNITED NATIONS, New York, 2001

The objective of this report is to define principles and procedures for Environmental Management Accounting (EMA) with a focus on techniques for quantifying environmental expenditures or costs as a basis for the development of national EMA guidelines and frameworks. The intended users of these EMA procedures are national governments interested in establishing national EMA guidelines appropriate to their own countries' context and organizations seeking to install EMA systems for better controlling and benchmarking purposes.

The limits of traditional financial and cost-accounting methods to reflect organizations' efforts towards sustainability and to provide management with information needed to make sustainable business decisions have been broadly recognized. Information on environmental performance of organizations might be available to some extent, but, internal enterprise decision-makers, as well as those in public authorities, are seldom able to link environmental information to economic variables and are crucially lacking environmental cost information. As a consequence, decision makers fail to recognize the economic value of natural resources as assets, and the business and financial value of good environmental performance. Beyond "good-will" initiatives, few market-based incentives exist to integrate environmental concerns in decision-making. Therefore, there is a need to upgrade the business decision-making process by including information on material flows and related costs to account for efforts towards sustainable development.

Although differing definitions and applications exist, the general use of EMA information is for internal organizational calculations and decision-making. EMA procedures for internal decision-making include both: physical procedures for material and energy consumption, flows and final disposal, and monitored procedures for costs, savings and revenues related to activities with a potential environmental impact. The procedures most useful for decision-making depend on the type of organization (e.g., manufacturing versus service sector) and the types of decisions to be made (e.g., purchasing decisions about raw materials, investment decisions for energy efficiency, altered product design).

EMA data and their application structured into past and future oriented tools.

Environmental Management Accounting (EMA)			
Monetary EMA (MEMA)		**Physical EMA (PEMA)**	
Past oriented tools	**Future oriented tools**	**Past oriented tools**	**Future oriented tools**
Annual environmental expenditure or costs, transition from bookkeeping and cost accounting	Monetary environmental budgeting and investment appraisal	Material, energy and water flow balances	Physical environmental budgeting and investment appraisal
	Calculating costs, savings and benefits of projects	Environmental performance evaluation and indicators, benchmarking	Setting quantified performance targets
External disclosure of environmental expenditures, investments and liabilities		External environmental reporting and other reporting to agencies and authorities	Design and implementation of environmental management systems, cleaner production, pollution prevention, design for environment, supply chain management, etc.

EMA data support environmental management systems and decision-making with regard to improvement targets and investment options. Linked financial and environmental performance indicators are important for controlling and benchmarking purposes. The material flow balance as well as the derived indicators is vital information for environmental reporting. Ranking agencies are interested to see combined monetary and physical approaches towards sustainability.

The costs for industry of environmental protection, including pollution reduction, waste management, monitoring, regulatory reporting, legal fees and insurance, have increased rapidly in the past 20 years with increasingly stringent environmental regulations. Conventional management accounting systems attribute many of those environmental costs to general overhead accounts, with the consequence that product and production managers have no incentive to reduce environmental costs, and executives are often unaware of the extent of environmental costs.

In conventional cost accounting, the aggregation of environmental and non-environmental costs in overhead accounts results in their being “hidden” from management. There is substantial evidence that management tends to underestimate the extent and growth of such costs. By identifying, assessing and allocating environmental costs, EMA allows management to identify opportunities for cost savings. Prime examples from the EMA literature are the savings that can result from replacement of toxic organic solvents by non-toxic substitutes, thus eliminating the high and growing costs of regulatory reporting, hazardous waste handling and other costs associated with the use of toxic materials. Many other examples deal with more efficient material use, highlighting the fact that waste is expensive not because of disposal fees but because of the wasted material purchase value. Waste and emissions are therefore a sign of inefficient production.

A rule of thumb of environmental management is that 20 per cent of production activities are responsible for 80 per cent of environmental costs. When environmental costs are allocated to overhead accounts shared by all product lines, products with low environmental costs subsidize those with high costs. This results in incorrect product pricing which reduces profitability.

Financial accounts include most of these costs but aggregated in a way that does not identify the specifically environmental costs. There is evidence, however, that some environmental liabilities and risks that are in principle covered by reporting requirements are often not reported, for example liabilities for cleaning up contaminated land. A comprehensive EMA system would promote more complete financial accounts in such cases.

Still, future costs and less tangible costs are hardly found in the existing accounting records. The expected future costs for a necessary wastewater treatment plant upgrade should be part of the current budgeting cycle. Less tangible costs like potential future liability claims and enterprise image costs from poor environmental performance should be considered when comparing investment options.

The most important task is to make sure that all relevant, significant costs are considered when making business decisions. In other words, “environmental” costs are just a subset of the bigger cost universe that is necessary for good decision making. “Environmental” costs are part of an integrated system of material and money flows throughout a corporation and not a separate type of cost altogether. Doing environmental management accounting is simply doing better, more comprehensive management accounting, while wearing an “environmental” hat that opens the eyes for hidden costs.

Costs for environmental protection are usually not traced systematically and attributed to the responsible processes and products but simply summed up in general overhead. The fact that

environmental costs are not fully recorded often leads to distorted calculations for improvement options. Environment protection projects aiming to prevent emissions and waste at the source (avoidance option) by better utilizing raw and auxiliary materials and requiring less (harmful) operating materials are not recognized and implemented. The economic and ecological advantages to be derived from such measures are not used. The people in charge are often not aware that producing waste and emissions is usually more expensive than disposing of them.

What is environmental management accounting (EMA)?

<table>
<tr><th colspan="2">Accounting in monetary units</th><th colspan="2">Accounting in physical units</th></tr>
<tr><td rowspan="2">Conventional accounting</td><td colspan="2">Environmental management accounting</td><td rowspan="2">Other assessment tools</td></tr>
<tr><td>Monetary EMA</td><td>Physical EMA</td></tr>
<tr><td colspan="4">DATA ON THE CORPORATE LEVEL</td></tr>
<tr><td>Conventional bookkeeping</td><td>Transition of environmental part from bookkeeping and cost accounting</td><td>Material flow balances on the corporate level for mass, energy and water flows</td><td>Production planning systems, stock accounting systems</td></tr>
<tr><td colspan="4">DATA ON THE PROCESS/COST CENTRE AND PRODUCT/COST CARRIER LEVELS</td></tr>
<tr><td>Cost accounting</td><td>Activity based material flow cost accounting</td><td>Material flow balances on the process and product levels</td><td>Other environmental assessments, measures and evaluation tools</td></tr>
<tr><td colspan="4">BUSINESS APPLICATION</td></tr>
<tr><td>Internal use for statistics, indicators, calculating savings, budgeting and investment appraisal</td><td>Internal use for statistics, indicators, calculating savings, budgeting and investment appraisal of environmental costs</td><td>Internal use for environmental management systems and performance evaluation, benchmarking</td><td>Other internal use for cleaner production projects and eco-design</td></tr>
<tr><td>External financial reporting</td><td>External disclosure of environmental expenditures, investments and liabilities</td><td>External reporting (EMA-statement, corporate environmental report, sustainability report)</td><td>Other external reporting to statistical agencies, local governments etc</td></tr>
<tr><td colspan="4">NATIONAL APPLICATION</td></tr>
<tr><td>National income accounting by statistical agencies</td><td>National accounting on investments and annual environmental costs of industry, externalities costing</td><td>National resource accounting (material flow balances for countries, regions and sectors)</td><td></td></tr>
</table>

Annex 5 Definitions and breakdowns in the SBS Regulation

Commission Regulation (EC) No 1670/2003 of 1 September 2003 concerning the definitions of characteristics for structural business statistics

Code: **21 11 0**

Title: **Investment in equipment and plant for pollution control and special anti-pollution accessories (mainly" end-of-pipe" equipment)**

Definition

Capital expenditures for methods, technologies, processes or equipment designed to collect and remove pollution and pollutants (e.g. air emissions, effluents or solid waste) after their creation, prevent the spread of and measure the level of the pollution, and treat and dispose of pollutants generated by the operating activity of the enterprise.

The expenditures are aimed at the protection of ambient air and climate, wastewater management, waste management, protection and remediation of soil, groundwater and surface water, noise and vibration abatement, protection of biodiversity and landscape, protection against radiation, environmental research and development and other environmental protection activities such as environmental management (see CEPA classification).

Included are:

- Investments in distinct, identifiable components supplementing existing equipment, which are implemented at the end of or completely outside the production line ("end-of-pipe" equipment).
- Investments in equipment (e.g. filters or separate cleaning steps) which compose or extract pollutants within the production line, when the removal of these added facilities would not affect in the main the functioning of the production line.

The main purpose or function of these capital expenditures is environmental protection and the total expenditure for these should be reported.

The expenditure should be reported gross of any cost-offsets resulting from the generation and sale of marketable by-products, savings made, or subsidies received.

Excluded are:

- Actions and activities beneficial to the environment that would have been taken regardless of environmental protection considerations, including measures that primarily aim at health and safety of the workplace and production security.

- Measures to reduce pollution when the products are used or scrapped (environmental adaptation of products), unless environmental policy and regulation expands the legal responsibility of the producer to cover also the pollution generated by the products when used, or for taking care of the products when they become waste.

- Resource use and saving activities (e.g. water supply or the saving of energy or raw materials), unless the primary purpose is environmental protection: e.g. when these activities aim at implementing national or international environmental policy and are not undertaken for cost saving reasons.

Link to enterprise accounts

The definition is based on the accounting standards applied by the enterprise in its bookkeeping, in compliance with EU accounting standards: i.e. these are expenditures that qualify for recognition as an asset.

Link to other variables

Total environmental protection investment is the sum of the variables 21 11 0 and 21 12 0. Total environmental protection expenditure is the sum of the variables 21 11 0, 21 12 0 and 21 14 0.

Part of:

15 11 0 Gross investment in tangible goods

15 31 0 Value of tangible goods acquired through financial leasing

Code: **21 12 0**

Title: **Investment in equipment and plant linked to cleaner technologies (”integrated technology”)**

Definition

Capital expenditures for new or adaptation of existing methods, technologies, processes, equipment (or parts thereof) designed to prevent or reduce the amount of pollution created at source (e.g. air emissions, effluents or solid waste), thereby reducing the environmental impacts associated with the release of pollutants and/or with polluting activities.

The expenditures occur in activities such as protection of ambient air and climate, wastewater management, waste management, protection and remediation of soil, groundwater and surface water, noise and vibration abatement, protection of biodiversity and landscape, protection against radiation, research and development and other environmental protection activities (see CEPA classification).

Included are:

- Capital expenditures that involve distinct, separately identifiable (environmental parts of) methods, processes, technologies and equipment. Their main purpose or function is environmental protection by definition and the total expenditure of the (environmental parts of) methods, processes, technologies, equipment should be reported.

- Capital expenditures for methods, processes, technologies and equipment that are integrated with the overall operating activity (production process/installation) in a way that makes it difficult to separately identify the pollution prevention component. In these cases (“integrated measures”), only the environmental protection fraction of the total investment should be reported.

  This fraction corresponds to the additional investment vis-à-vis the capital expenditure that would have been incurred were it not for the environmental protection considerations. Therefore, the alternative for comparison corresponds to the cheapest alternative available to the enterprise with similar functions and characteristics, except for those related to environmental protection.

  When the selected option is standard technology and there is no cheaper less environmentally beneficial alternative available to the enterprise, the measure is by definition not an environmental protection activity, and no expenditure should be reported.

The expenditure should be reported gross of any cost-offsets resulting from the generation and sale of marketable by-products, savings made, or subsidies received.

Excluded are:

- Actions and activities beneficial to the environment that would have been taken regardless of environmental protection considerations, including measures that primarily aim at health and safety of the workplace and production security.

- Measures to reduce pollution when the products are used or scrapped (environmental adaptation of products), unless environmental policy and regulation expands the legal responsibility of the producer to cover also the pollution generated by the products when used, or for taking care of the products when they become waste.

- Resource use and saving activities (e.g. water supply or the saving of energy or raw materials), unless the primary purpose is environmental protection: e.g. when these activities aim at implementing national or international environmental policy and are not undertaken for cost saving reasons.

Link to enterprise accounts

The definition is based on the accounting standards applied by the enterprise in its bookkeeping, in compliance with EU accounting standards: i.e. these are expenditures that qualify for recognition as an asset.

Link to other variables

Total environmental protection investment is the sum of the variables 21 11 0 and 21 12 0. Total environmental protection expenditure is the sum of the variables 21 11 0, 21 12 0 and 21 14 0.

Part of:

15 11 0 Gross investment in tangible goods

15 31 0 Value of tangible goods acquired through financial leasing

Code: **21 14 0**

Title: **Total current expenditure on environmental protection**

Definition

Total current expenditure on environmental protection comprises the expenditure for operating and maintaining an activity, technology, process, equipment (or parts thereof) designed to prevent, reduce, treat or eliminate pollutants and pollution (e.g. air emissions, effluents or solid waste) or any other degradation of the environment resulting from the operating activity of the enterprise.

The expenditure occurs in activities such as protection of ambient air and climate, wastewater management, waste management, protection and remediation of soil, groundwater and surface water, noise and vibration abatement, protection of biodiversity and landscape, protection against radiation, research and development and other environmental protection activities (see CEPA classification).

Current expenditure is the sum of “in-house expenditure” and “payments for/purchases of environmental protection services”

- In-house expenditure includes all current expenditure on environmental protection except purchases of environmental protection services from other organisations. In-house expenditure includes the expenditure for energy, materials and other products, payments of rents, maintenance, minor repair and insurance of environmental protection equipment and the use of the enterprise’s employees (part or full-time) for environmental protection purposes. Labour expenditure includes the gross wages and salaries as well as all employers’ charges and social contributions, but excludes general overhead.

- Payments for/purchases of environmental protection services include all fees, charges and similar payments to other organisations (outside the reporting unit), public or private, in exchange for environmental protection services related to the environmental impacts of the operating activity of the enterprise. For example, payments for waste collection or fees for the removal of wastewater.

Total current expenditure on environmental protection should be reported gross of any cost-offsets resulting from the sale of marketable by-products, savings or subsidies received.

Excluded are:

- Actions and activities beneficial to the environment that would have been taken regardless of environmental protection considerations, including measures that primarily aim at health and safety of the workplace and production security.

- Measures to reduce pollution when the products are used or scrapped (environmental adaptation of products), unless environmental policy and regulation expands the legal responsibility of the

producer to cover also the pollution generated by the products when used, or for taking care of the products when they become waste.

- Resource use and saving activities (e.g. water supply or the saving of energy or raw materials), unless the primary purpose is environmental protection: e.g. when these activities aim at implementing national or international environmental policy and are not undertaken for cost saving reasons.

- Payments of taxes, fees or charges by the reporting unit that are not linked to purchasing an environmental service related to the environmental impacts of the operating activity of the enterprise, even if the government authorities have earmarked the revenue for financing environmental protection activities (e.g. taxes on pollution).

- Calculated cost items such as depreciation of environmental equipment, capital loss due to forced replacement or general overhead.

- Loss of income, compensatory charges, fines, penalties and similar which do not relate to an environmental protection activity.

Link to enterprise accounts

The definition of current expenditure is based on the accounting standards applied by the enterprise in its bookkeeping, in compliance with EU accounting standards: i.e. current expenditure includes all expenditure that is not capitalised but charged to the profit and loss account.

It is the sum of purchase of raw materials and consumables, labour costs, public fees and charges, expenses for external services and rental and leasing charges for environmental protection activities.

Link to other variables

Total environmental protection investment is the sum of the variables 21 11 0 and 21 12 0. Total environmental protection expenditure is the sum of the variables 21 11 0, 21 12 0 and 21 14 0.

Part of:

13 11 0 Total purchase of goods and services

13 31 0 Personnel costs

Commission Regulation (EC) No COMMISSION REGULATION (EC) No 1669/2003 of 1 of September 2003 concerning the series of data to be produced for structural business statistics

Series 2B

The Annex to Commission Regulation (EC) No 2701/98 is amended as follows:

L 244/60 EN 29.9.2003 Official Journal of the European Union

Series name	Environmental Protection expenditure
First reference year	2001 for characteristics 21 11 0, 2001 for characteristics 21 12 0 and 21 14 0
Frequency	Annual for characteristics 21 11 0 and 21 12 0, every three years for characteristics 21 14 0
Activity coverage	NACE Rev.1, sections C-E (except for division 37)
Characteristics (in Annex 2, section 4, paragraph 3)	21 11 0 Investment in equipment and plant for pollution control, and special anti-pollution accessories (mainly end-of-pipe equipment) 21 12 0 Investment in equipment and plant linked to cleaner technology (“integrated technology”) 21 14 0 Total current expenditure on environmental protection
Level of activity breakdown	NACE Rev.1: two digit level (classes)
Level of size class breakdown	Number of persons employed: 1-49, 50-249, 250+’
Level of breakdown by environmental domains (according to the CEPA classification)	Protection of ambient air and climate, Wastewater management, Waste management and Other environmental protection activities.

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