6th Annual Meeting of the London Group on Environmental Accounting
Canberra 15 – 19th November 1999

Session on Environmental Protection and Resource Management Accounts

Draft Chapter 4

Acknowledgements: Chapter co-ordinator and editor - Alan Brown; drafting contributions from Anton Steurer and from Gerard Gie, Alice Born, Anik Lacroix, Noritoshi Ariyoshi and other members of the Group

CHAPTER 4:

ENVIRONMENTAL PROTECTION AND RESOURCE MANAGEMENT ACCOUNTS

4.1 Scope of chapter 4, appraisal of uses and limits of expenditure accounts, links to National Accounts, "green" national income /welfare measures, links to physical data

4.1.1 Introduction and coverage
4.1.2 Uses
4.1.3 Limitations
4.1.4 Links to National Accounts
4.1.5 "Green" national income and welfare measures
4.1.6 Links to physical data

4.2 Definitions of environmental protection activities and expenditure, description of main data sources

4.2.1 Definition and classification
4.2.2 The "purpose" criterion
4.2.3 Description of main data sources

4.3 Basic concepts for the description of environmental protection activities (EPA) and environmental expenditure (EPE).

4.3.1 External environmental protection activities
4.3.2 Principal and secondary activities
4.3.3 Ancillary activities
4.3.4 Adapted and Connected products
4.3.5 Aggregate expenditure
4.3.6 Comparisons with other systems

4.4 Supply-use framework

4.4.1 A simplified supply and use framework
4.4.2 Basic data
4.4.3 Calculation methods
4.4.4 An illustrative supply-use framework for environmental protection expenditure
4.4.5 Data not used in the supply-use framework (transfers)

4.5 A full set of accounts

4.5.1 Analysis of the production of environmental protection services and financing
4.5.2 Analysis of financing of the uses of products for environmental protection (specific products)
4.5.3 Analysis of the financing of national expenditure for environmental protection
4.5.4 Net cost of environmental protection

4.6 Indicators

4.6.1 What is an indicator of environmental protection?
4.6.2 Use of environmental protection indicators
4.6.3 Set of indicators
4.6.4 Discussion of other issues

4.7 Extensions and applications

4.7.1 Analysis of the environment industry
4.7.2 Environmental input-output analysis
4.7.3 Environmental taxes
4.7.4 Links to physical data
4.7.5 Repercussion expenditure
4.7.6 The link to maintenance costing
4.7.7 Natural resource use and management account

4.1 Scope of chapter 4, appraisal of uses and limits of expenditure accounts, links to National Accounts, "green" national income /welfare measures, links to physical data

4.1.1 Introduction and coverage

Chapter 4 focuses on identifying and disaggregating within the SNA flow and asset accounts those stocks and flows which are of particular interest from an integrated environmental and economic perspective. In particular this includes the responses society make to the pressures that the economy exerts on the environment – the negative environmental effects of economic activity. This chapter describes how the activities, actions and expenditure undertaken should be recorded in SEEA, the link between responses and the changes in pressure, and how this presentation helps to estimate or model the effects of future responses. The conceptual basis for much of Chapter 4 is the 1993 SNA's Chapter XXI on satellite analysis and accounts.

Insert FIGURE illustrating how the various parts fit together

Environment-related transactions in the SNA may be categorised in different ways. From a perspective of environmental deterioration (and protection) one way is to distinguish:

- prevention (reducing and avoiding pressures on the environment)
- restoration (restoring the environment after it has been polluted or otherwise deteriorated)
- evasion and screening (actions or expenditure related to protecting the economy from a deteriorated environment)
- damage repair (actions or expenditure aimed at repairing and restoring property and human health that was damaged by a deteriorated environment)

From the point of view of activities (see BOX for more detailed description):

- environmental protection activities and expenditure by sectors and by environmental domain (air, waste, noise, nature protection, etc.),
- resource use and management activities and expenditure (water supply, forestry and fisheries management, recycling, energy saving, etc.),
- environment industry activities as those economic activities and markets that are generated due to environmental protection and resource management (turnover, employment, value added, exports of environmental technologies etc.),
- repercussion activities and expenditure aimed at the avoidance of damage from environmental deterioration and the treatment of damages that actually occur.

The way in which these activities or categories have been addressed in this chapter is by identifying "core" accounts which cover environmental protection and expenditure activities; then by identifying "supplementary" accounts which can be presented in the same or similar framework; and then finally "extensions" to the central framework ie:

- a core account for environmental protection activities and expenditure
- accounts which can be drawn up according to the same accounting principles for:
  - activities that are related to environmental protection (e.g. energy saving, recycling);
  - resource use and management activities (e.g. water supply, forestry, fishery – see also Ch. 2);
  - activities and expenditure related to consequential damages (repercussions) due to a deteriorated environment.
  - The environment industry
- extensions to the central framework: input-output analysis, links to physical data, environmental taxes etc.

- indicators that are either derived from the above accounts, or are the result of an integration with other frameworks and data sets, (as well as indicators which are directly obtained from basic data prior to making the accounts e.g. the size of ISIC 90 or total public spending).

BOX Types of activity

Environmental protection activities (and expenditure) are those activities (expenditure) whose purpose is the protection of the environment, that is the avoidance of the negative effects on the environment of economic activities.

Resource use and management activities (and expenditure) are those activities (expenditure) whose purpose is the management of natural assets or the management, mobilisation and use of the natural resources derived from these. These activities (expenditure) do not constitute environmental protection in a strict sense but are relevant from a perspective of sustainability and the careful use of the environment. Included are the management of water bodies, forests, fish stocks, sub-soil assets as well as activities (and expenditure) related to the use and management of water, timber, fish and other renewable and non-renewable natural resources.

Recycling and conservation activities i.e. activities aiming at the recovery and re-use of materials, energy and materials saving - are included under resource use and management when they are economic but usefully kept as a separate category given their close link to environmental protection activities.

The environmental goods and services industry (environment industry for short) '…consists 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. This includes cleaner technologies, products and services that reduce environmental risk and minimise pollution and resource use.' (OECD/Eurostat: The Environmental goods and services industry – manual for data collection and analysis, Paris 1999)

Repercussion activities and expenditure are defined as activities (expenditure) aiming at the avoidance of damage from environmental deterioration and the treatment of damages that actually occur. Such activities/expenditure would include damage avoidance through the adaptation of houses or change of permanent residence or workplace and damage treatment through increases in maintenance, repair and cleaning activities as well as the use of health services. While this concept is a useful complement to e.g. environmental protection activities, statistical identification is difficult and little experience is available so far. See also Ch. 5 for damage estimates.

BOX definitions of key terms

Environmental taxes are defined by OECD, the European Commission and IEA as unrequited payments to general government levied on a tax base deemed to be of particular environmental relevance. By convention, tax bases related to transport, energy and pollution are included. An overlapping but conceptually distinct concept are specific taxes. **Specific taxes** are defined as taxes whose revenues are earmarked (hypothecated) for specific purposes (e.g. environmental protection or resource management). This latter concept is useful in the analysis of the funding mechanisms of e.g. environmental protection activities and expenditure.

…and others

4.1.2 **Uses**

The main purpose of these accounts is to systematically identify those parts of the national accounts that are of particular interest from an environmental perspective so as to provide a comprehensive economic picture of the economy-environment interface. The data sets so provided are useful directly to derive indicators that are policy-relevant or of interest to the general public. They are also useful as a basis for ex-post analysis of policy measures and for ex ante scenario development. Many of the above mentioned accounts are closely linked to each other, but each has its particular uses.

The use of information about environmental protection activities and expenditure can be assessed from various view-points: first, it can be used to assess resources used (e.g. as measured by expenditure or labour hours) to protect the environment, or the effects of environmental protection on international competitiveness; it can also be used to identify opportunities such as investment, employment and trade.

There are other aspects such as measuring the net cost to society of environmental protection or the type of funding mechanism used (and hence the application of the polluter-pays-principle).

The market for environment industry products and services is of considerable policy interest in a very competitive international market.

Information on environment taxes is of interest from various perspectives. First, environment taxes are an instrument of environmental policy - for this purpose very detailed descriptions may be most appropriate with information on tax rates by product, tax exemptions, etc. Such detailed information can also be used to integrate environment taxes into emission accounts (see chapter 3) so as to analyse the effects of changes in tax rates or in the tax bases e.g. on the prices of energy or transport services or the effect on final demand and on emissions. Second, with a view to longer-term sustainability and the interest of many governments in supporting job creation, the fiscal perspective is important. Analyses are being made of the structure of taxation in several countries with a particular focus on taxation of labour versus taxation of natural resources and environment-related things.

As for many other fields of social life (education, health, housing, etc.), environmental protection expenditure is useful in itself. Expenditure contribute to well-being and welfare. When benefits can be valued, cost-benefit analysis may be done. Environmental protection contributes to economic activity, including exports and employment. Similarly, for resource use and management, interest may focus on the contribution to economic activity, the cost of management of natural assets, whether an appropriate resource rent is recovered by the government (or whether the resource rent foregone is well invested in achieving social policy objectives) and the like.

4.1.3 **Limitations**

The main limitations result from classification and definition issues. As with other satellite accounts there are problems with the “purpose” criteria which are the basis of the definition of the environmental protection domains, the resource use categories, the environment taxes and the environment industry. There are problems related to separating the scope of the different accounts e.g. separating environmental protection from resource management. There are also other conceptual and practical problems, which are particularly challenging when it comes to identifying adapted (“clean”) products or integrated (‘clean’) technologies and the corresponding expenditure.

A limitation is also that there is no direct link between the state of the environment and the level of environmental spending, environmental employment or environmental taxes.

4.1.4 **Links to National Accounts**

Actual environmental protection expenditure are included in the SNA, but are usually not identified separately. The environmental protection accounts are essentially a disaggregation and reformatting of standard national accounts. In order to be useful, the measurement of environmental protection or resource management must be defined as close as possible to SNA conventions and national accounts practice so that economic analysis, relating expenditure to economic aggregates, and modelling are possible. Satellite accounts to the SNA give additional flexibility, and presentations used in environmental protection and resource management accounts (valuation systems, classifications of units and transactions, etc) allow for comparisons to be made with other economic statistics as well as conventional national accounts aggregates.

4.1.5 **“Green” national income and welfare measures**

Some authors consider that environmental protection expenditure is “defensive expenditure” and is only the cost of “maintaining environmental well being” or keeping natural capital intact, and as a result should not be included in NDP. This concept does not form part of the SEEA.

Researchers may choose to deduct certain expenditure categories from national accounts aggregates in order to arrive at indices of welfare. However, it was shown that calculating the extent to which such 'defensive expenditure' is actually contained in NDP is not at all easy, in particular when it comes to NDP at constant prices and to the re-calculation of rates of economic growth (see for example A. Steurer, G. Gie, C. Leipert and D. Schafer: "Environmental protection expenditure and its representation in national accounts", in Uno, K. and P. Bartelmus (eds): Environmental Accounting in Theory and Practice, 1998).

One way of *using* environmental protection expenditure accounts is to model the effects of assumed changes in environmental protection measures, in order to estimate the way such changes will affect (directly and indirectly) environmental pressure, economic activity, growth and employment in the future. A particular use of such models may be to estimate the effect on GDP, employment and trade of a given level of environmental protection measures (see Chapter 5 for details).

4.1.6 **Links to physical data**

As is the case for other satellite accounts, the usefulness of measuring environmental protection activities and expenditure, environment taxes or resource management expenditure will be greatly enhanced by making links with physical data, and in particular links with emissions and discharges (and ideally emissions and discharges avoided), waste collected and treated, the tax bases of environmental taxes (fuel use, vehicles in circulation etc) and the like. Some links are easy to establish, in particular links to treatment capacities, or waste or waste water treated. Links to individual pollutants and to emissions avoided are much more difficult to establish and will usually require modelling.

The main instruments for these linkages are NAMEAs (links to emissions and resource use) and the SEEA's integrated monetary and physical Input/Output frameworks. For linkages to the physical data, the environmental protection accounts must, as much as possible, apply the same classifications as are used in these physical accounts. Experience in countries has already shown that e.g. environmental expenditure and environmental taxes can be presented using the same industry classifications in the physical accounts thus providing information for each industry or branch of production on e.g. energy use, energy taxes paid, air emissions and environmental expenditure on the protection of air in a consistent way. Such data sets permit analysis, e.g. decomposition and attribution of the changes in emission (including emissions avoided) to the different factors that caused these changes.

4.2 Definitions of environmental protection activities, description of main data sources

4.2.1 **Definition and classification**

Definition: Environmental protection activities (and expenditure) are those activities (expenditure) whose purpose is the protection of the environment, that is the avoidance of the negative effects on the environment of economic activities. The SERIEE definition is '..actions and activities (whose prime objective is) the prevention, reduction and elimination of pollution as well as any other degradation of the environment' (SERIEE § 2006-2007). Environmental protection activities can be classified according to the CEPA (Classification of environmental protection activities – see UN-ECE 1994). The main headings of the CEPA are listed below, for the detailed classification see Annex 1.

Classification of Environmental Protection Activities (CEPA)

1 PROTECTION OF AMBIENT AIR AND CLIMATE
2 WASTE WATER MANAGEMENT
3 WASTE MANAGEMENT
4 PROTECTION OF SOIL AND GROUND WATER
5 NOISE AND VIBRATION ABATEMENT (excluding workplace protection)

6 PROTECTION OF BIODIVERSITY AND LANDSCAPE

7 PROTECTION AGAINST RADIATION (excluding nuclear power stations and military installations)

8 RESEARCH AND DEVELOPMENT

9 OTHER ENVIRONMENTAL PROTECTION ACTIVITIES

- 9.1 General administration of the environment
- 9.2 Education, training and information
- 9.3 Activities leading to indivisible expenditure
- 9.4 Activities not elsewhere specified

In the CEPA environmental activities are first classified by environmental domain (air, waste, nature protection etc.), and then by type of measure (prevention, reduction, etc). Practice has shown that basic data do not allow a full classification of activities and transactions by CEPA 2-digits due to identification and separation problems. Therefore, in practice, the accounts will often be presented for the CEPA 1-digits.

It is important to note that the CEPA can be used to classify not only activities, but also expenditure items as well as products.

Specific comments on the CEPA

The CEPA classifies activities and expenditure whose prime objective is environmental protection. Many activities and expenditure are beneficial for the environment but undertaken for different prime objectives. Therefore, activities and expenditure related to recycling, energy and materials saving, water supply, forest or fisheries management are excluded from the CEPA and included under the resource use and management account (see for details section 4.7).

Recycling activities. – In the ISIC Rev. 3 recycling (division 37) is defined as ‘processing of waste and scrap into a form which is readily transformed into new raw materials’. Recycling activities are not automatically included under environmental protection as their prime purpose is the production of secondary raw materials. However, recycling is a form of waste treatment so that any expenditure for the recycling of waste by waste generators are purchases of waste management services. Hence, statistical units classified under division 37 - recycling may have important secondary output of waste management services (their principal output consists of secondary raw materials by definition). Recycling activities may be presented as part of the resource use and management account.

Energy and materials saving. – energy saving measures (insulation, heat recovery etc.) and energy and materials saving by way of recovery or the use of advanced technologies do not automatically come under environmental protection as their prime objective is often purely economic (cost savings as main purpose). In practice, however, a clear separation of environmentally-motivated and cost-motivated measures is not always easy and much will depend on the primary data as collected by specific surveys.

Activities and expenditure related to the management and use of natural resources such as water supply or forest management come under the management and use of natural resources account (with the exception of activities and transactions specifically for environmental protection – for example management of protected forest).

Environmentally-related expenditure

Political priorities and public perception may differ across countries. In order to respond to policy demands specific to individual countries it may be necessary and useful to define, strictly for national purposes, the scope of ‘environmentally-related expenditure’.

This could be handled in a flexible way, e.g. by adding to environmental protection expenditure as defined above, those natural resource-related expenditure (e.g. water or forestry management, energy saving or

recycling) that are considered particularly important from an environmental perspective at the national level.

In order to remain consistent with international standards it is strongly recommended to compile the accounts for each of the different areas separately and to only add them together for presentational purposes later.

4.2.2 **The "purpose" criterion**

The purpose criterion guides the identification of relevant activities and expenditure. In practical statistical work, various variants of the purpose criterion have been developed.

- the pure purpose criterion: activities and expenditure undertaken with the objective of protecting the environment. Two forms have been developed: the 'primary purpose' criterion identifies all activities and expenditure whose principal purpose is environmental protection whereas the 'environmental share' criterion identifies, for each activity and transaction, the share that comes under environmental protection.
- the compliance criterion: activities and expenditure undertaken in order to comply with environmental protection legislation. Two variants can be used: the 'only compliance' principle identifies only those activities and transactions that are undertaken in order to comply with legislation. The 'also conventions' principle includes also those activities and transactions that are undertaken to respond to conventions and voluntary agreements.
- the cost criterion: only actions that are undertaken for environmental protection purposes **and** that lead to net cost are included (in a strict variant of this criterion: only the net cost).
- the technology criterion: used to identify the environmental share in the case of cleaner/integrated technologies and changes in process as well as cleaner (adapted) products. The investment and operating expenditure are compared to those of a 'standard' or 'dirty' alternative and only the expenditure over and above the standard technology or product are considered environmental expenditure.

In practical statistical work, the above variants may have to be used simultaneously, or different variants for different data sources. For example, when analysing public budgets it will often be impossible to identify the environmental share or the net cost when classifying transactions. Therefore, the primary purpose criterion may be used. When conducting surveys of environmental expenditure of corporations, the primary purpose criterion alone may be less useful and a combination with the compliance or cost criterion may be used.

A difficulty lies in attributing an explicit environmental protection purpose to activities and actions. For some activities (e.g. waste and waste water management) and some types of actions (adding "end-of-pipe" equipment in order to reduce emissions) there is no problem in applying the pure purpose criterion: waste and waste water management, when external activities, are grouped in specialised parts of ISIC; "end-of-pipe" equipment is easy to identify. For multipurpose activities and actions (e.g. technological improvements which generate environmental benefits, or integrated investment programmes by public bodies) the application of the purpose criterion is more difficult.

The cost criterion is most useful for multi-purpose actions. It cannot be used alone but only in combination with other variants. The cost criterion alone would exclude from environmental protection those measures undertaken for environmental protection reasons but which result in net savings. Examples are energy saving or increases in productivity which are higher than direct gross costs. A particular case are in-house (ancillary) activities that substitute the purchase of marketed environmental protection services. For example, net savings could occur because of reduced waste treatment bills resulting from taking up an own account waste treatment activity but this substitution should of course not lead to the exclusion of this ancillary activity.

The strict (net cost) variant would directly net out all 'side benefits' (e.g. sales of by-products of environmental protection activities) and would also exclude from environmental protection all producers (and their transactions) that are specialised in environmental protection. Valuable information could get lost in this way so that the net cost criterion should be used chiefly for identifying the expenditure associated with cleaner technologies, processes and products.

4.2.3 **Description of main data sources**

Environmental protection expenditure accounts describe expenditure: that is actual expenditure on goods and services for environmental protection uses. Production activities may be identified with reference to an activity classification (e.g. ISIC, NACE, NAICS) or may be derived from national accounts data etc. Uses may correspond to services or goods identified in product classifications as specifically for environmental protection purposes (e.g. waste management services or catalytic converters for motor vehicles) or to goods and services produced for own account environmental protection. Part of the expenditure may also consist of transfers only (e.g. international development aid, environmentally motivated income transfers to farmers e.g. for set-aside schemes, etc.).

In order to set up the accounts, several primary data sources will need to be analysed. A substantial amount of the primary data is available through the standard statistical system (e.g. ISIC, CPC or COFOG) but important parts need specific surveys (e.g. environmental expenditure by businesses) or specific analysis (specific analysis or reformatting of government finance data). An overview of possible primary data sources is provided below.

Overview of primary data sources

Government activities:
- Government finance statistics and national accounts (COFOG etc.)
- Analysis of budgets (in particular central and regional governments, large cities)
- Specific surveys (e.g. to municipalities or to associations of municipalities)
- Annual reports of e.g. government agencies or funds

Specialised corporations
- Service statistics
- National accounts
- Input-Output tables
- Turnover or tax statistics

Ancillary activities
- Specific surveys
- Data from business associations
- Engineering estimates

Households
- Data on final consumption expenditure (e.g. from household surveys)

Adapted and connected products
- Market data and expert assessment

Specific sources
- R and D statistics
- Data on sewage networks or waste disposal facilities (to estimate capital stocks)
- Environment industry market estimates

In order to ensure an efficient search for primary data, a first step is an analysis of the organisation of environmental protection in a country. The table below provides an illustration of how environmental protection could be organised in a country.

Table: Illustration of environmental protection competences/production activities

Domain Sub-sector/Entity	General administration	Waste	Waste water	Nature protection	Air	Etc..
Central government	X	-	-	x	x	
Regional governments	x	X	-	X	-	
Specific government agencies	X	-	x	-	-	
Associations of municipalities	-	X	-	-	-	
Municipalities	-	X	x	-	-	
Publicly owned disposal enterprises	-		X	-	-	
Private disposal enterprises	-	X	x	-	-	
Non-profit institutions	-	-	-	X	-	
In-house (ancillary) activities of mainstream industries	-	X	x	-	X	
Households	-	X	-	-	x	

When analysing basic data, a useful distinction for setting up the accounts is between supply and use or "demand side" and "supply side" data. This is important in the context of the supply-use framework (see section 4). However, this distinction is not always necessary or useful for primary data. For non-market activities (e.g. government or ancillary activities) the supply side is calculated based on expenditure. Some basic data sources (e.g. public budgets) provide data on both expenditure and revenue side.

Useful SNA classifications using purpose or function

Classifications by purpose and functional classifications are presented in Chapter XVIII of the 1993 SNA (COICOP, COPNI, COFOG and COPP) and have been revised recently (see OECD publication on functional classifications). The Annex 2 lists those categories of SNA functional classifications, which are most relevant for Chapter 4 purposes.

Functional classifications are used to classify individual transactions rather than activities or complete statistical units. However, in a satellite accounts context activities can be described based on this information.

The purpose or function as a guideline for classifications poses specific problems. For example there may be transactions that serve several purposes but cannot be divided by purpose. In such cases a predominance principle may have to be used and the transaction classified according to the principal purpose. Hence, the data according to the SNA functional classifications alone may not provide a complete picture and additional analyses of some items may be necessary.

A clear distinction must be made between purpose and effect. For example, in the case of environmental protection, actions undertaken for other than environmental purposes can have positive environmental effects (e.g. new technologies may lead to reductions in energy use, material consumption and discharges to the environment), whereas it is conceivable that actions undertaken with an environmental protection purpose may not actually have a beneficial environmental effect.

4.3 Basic concepts for the description of environmental protection activities (EPA) and environmental expenditure (EPE).

Basic concepts for the description of environmental protection are taken from the chapter XXI of the 1993 SNA (satellite analysis and accounts). For the analysis of a specific domain Chapter XXI first recommends

to identify the products and activities specific to this domain. Then it proposes to set up tables describing the supply, use and financing as well as the calculation of an aggregate - the national expenditure for this domain.

In this section, environmental protection activities are called characteristic activities. They may be undertaken either as external activities, i.e. activities that result in a market output or an 'other non-market output' explicitly identified and recorded in national accounts, or as ancillary activity, i.e. an activity the output of which is not explicitly recognised and recorded separately from the principal and secondary output of the unit that undertakes the ancillary activity. Ancillary activities are sometimes called 'internal' or 'in-house' activities. These different types of activities are examined below. The concept of expenditure for environmental protection is presented then.

It should be noted that the considerations below apply also to resource management and to environment industry accounts. Aspects specific to resource management or environment industry accounts are described in section 4.7.

4.3.1 **External environmental protection activities**

External environmental protection activities are rather easy to identify, as they result in an output which is separately identified in standard national accounts. Activities are determined by reference to a specific level of the ISIC classification (see Annex 3 for more detail). External activities that enter the environmental protection domain are mainly those of the ISIS 90 class: "sewage, and refuse disposal, sanitation and similar activities". Corresponding output, which consists in environmental protection services is used either as intermediate or final consumption for environmental protection, by other producing units, households or general government.

Environmental protection services may be market or non-market. This distinction is important for valuation: output of market services is valued at basic prices whereas non-market output is valued at the cost of production. Also, historically many environmental protection activities were either executed internally (ancillary activities) or executed by units of the general government sector and often no charges, or low charges, were levied on the users of these services. The situation is evolving quickly in many countries and these activities become market activities, either due to improved cost coverage via user fees charged by public units or due to e.g. privatisation (either completely or via creation of government-owned enterprises).

When produced as principal or secondary output, environmental protection services are recorded in national accounts. Supply-use tables may be drawn for these services, which relate supply and uses. Supply is mainly output by domestic units - imports of environmental protection services are often rather insignificant. Uses consist in intermediate consumption (e.g. producing units that buy waste treatment services) and final consumption by households (when the output is market) or general government (when the output is non-market). These supply-use tables, established at purchaser's prices, are in all aspects similar to national accounts supply-use tables (see also table 2 in section 4.4.4).

The objective being to determine the total actual expenditure for environmental protection, two other type of outlays related with external characteristic activities must be described: gross fixed capital formation for environmental protection and transfers whose purpose is environmental protection (in particular subsidies intended to lower the price paid by the users of environmental protection services).

Stocks of fixed capital for environmental protection (sewerage networks, waste water treatment plants, equipment for the collection of waste, incineration plants, landfills, etc.) and changes in these stocks (gross fixed capital formation and consumption of fixed capital) have to be identified. As indicated in Chapter 2, they are described as a specific category of produced assets in the SNA balance sheets. They are also recorded, by industries, in the use table (see SNA Table 15.1).

The transfers (and in particular subsidies) that lower the prices paid by the users of the environmental protection services are called *specific transfers*. As supply-use tables of environmental protection services

are drawn at purchaser's price, the effect of subsidies is to lower the expenditure in these services, giving rise to an underestimation of total expenditure. Therefore subsidies are to be added to expenditure in environmental protection services for arriving at the total expenditure of the national economy for environmental protection.

4.3.2 **Principal and secondary activities**

When an establishment (a local kind of activity unit) carries out more than one activity, the activity that accounts for the largest share of gross value added generated is called the principal activity. Secondary activities are activities carried out within the unit in addition to the principal activity. In principle, when an institutional unit producing goods and services undertakes a principal activity and one or several activities, it should be subdivided into the same number of units (establishments, kind of activity units) and the secondary activities should be classified under different headings from the principal activity. However, the precondition for this separation is that the information system of the institutional unit (e.g. enterprise) must be capable of indicating or calculated at least the value of production, intermediate consumption, compensation of employees, the operating surplus, employment and gross fixed capital formation. When this is not the case, the secondary activities cannot be separated and remain within the same unit, and the only information available is the value of the output in the respective (secondary) product.

In the environmental protection domain, many characteristic activities are carried out as secondary activities: public bodies that exert characteristic activities are often unable to identify the intermediate consumption, compensation of employees etc. corresponding to the provision of these services. This is the case not only for the waste water management and waste management domain, but more specifically for other domains (biodiversity and landscape protection, and other environmental protection activities). In general, the corresponding statistical units are classified under the position 75 of ISIC (provision of governmental services), and no separate output is recorded, for these activities, that corresponds to environmental protection.

In these cases, and in so far as a) the corresponding output is generally not identified in standard national accounts, b) these activities are non-market activities that should be valued by the costs, it is often difficult to identify the output. Use of the classification of the functions of the government is a way to separate expenditure and identify these activities and the corresponding output. If information is not readily available, either through the standard national accounts or through COFOG, specific analyses of public budgets can provide the primary data needed to describe such environmental activities and their output.

Environmental protection activities executed as secondary activities also exist in other specific positions of the classification of industries: ISIC 37 (recycling), 45 (construction), 73 (research and development) etc. In so far as the output is sufficiently detailed, output corresponding to products classified as environmental protection services may be separated; in most cases however this is not the case. In general, despite the recent developments that made many classifications more environmentally adapted, the identification of secondary activities and output is a difficult task. The structure of the accounts does allow, however, to derive estimates of secondary output in certain cases. For example, if purchases of environmental clean-up services (e.g. soil decontamination) by government or property developers can be identified, the corresponding output can be estimated.

4.3.3 **Ancillary environmental protection activities**

In general, an ancillary activity is undertaken within an enterprise to create the conditions within which the principal and secondary activities can be carried out (*e.g.* record-keeping, purchasing of material and equipment; hiring, training, managing and paying employees, cleaning and maintenance of buildings and other structures, etc.). An ancillary activity may grow to the point that it has the capacity to provide services outside the enterprise. For example, a waste managing unit may develop in-house capabilities for which there is outside demand. When an ancillary activity starts to provide services to outsiders, that part of the activity which produces output for sale has to be treated as secondary rather than ancillary.

For the purposes of this chapter, ancillary activities are those activities undertaken for own account by establishments (local kind-of-activity units) in order to reduce the environmental impact of their principal or secondary activity. Examples are in-house waste or waste water collection and treatment, air scrubbers in the case of power plants but also environmental management units within enterprises. Ancillary activities are not separated in SNA. They are separated (externalised) in the SEEA.

In order to calculate the total actual environmental protection expenditure of the national economy it is necessary to identify the outlays of the producers the purpose of which is to reduce the environmental impact of their principal or secondary activity.

Current and capital outlays of producers for environmental protection purposes have to be identified.

Current outlays must be converted into the same transactions as those recorded in the production and distribution of income accounts: intermediate consumption, compensation of employees, consumption of fixed capital, other taxes less subsidies. The value of the ancillary output is the total of these transactions and output is valued by the cost of production. By convention, for ancillary activities the net operating surplus is put to zero.

As indicated, in the SEEA, ancillary output is not only separately identified, but also externalised, which means that it is recorded as output. As a consequence, total output of the economy is higher than in standard national accounts. Ancillary output is also recorded as own (internal) intermediate consumption of the units undertaking the ancillary activities. Therefore total value added and gross domestic product is unchanged in relation with the standard national accounts. Recording in supply-use tables is done by adding supplementary columns and rows corresponding to the ancillary activities and output.

Alternative presentations are possible: to add columns showing the current outlays corresponding to the ancillary activities by industry, which would facilitate comparisons with standard supply-use tables. Or to create a specific column aggregating together the current outlays of all industries.

Capital outlays consist in the gross capital formation and changes in inventories necessary for carrying out the ancillary environmental production activities. It also includes acquisition less disposals of land. These capital outlays may be presented as supplementary data of the use table.

As for secondary activities, there are also difficulties in measuring ancillary output. First, standard statistical surveys generally do not separately identify current and capital expenditure of producers for environmental protection. Therefore, specific environmental expenditure surveys must be conducted in order to identify these expenditure. Second, consumption of fixed capital is not identified by surveys and must be calculated, ideally by using the perpetual inventory method (which requires long time series of capital formation – but see below ‘capital stock models’). Third, whereas capital expenditure (gross fixed capital formation) which consist in end of pipe equipment (filters for atmospheric emissions, specific installations for the own treatment of waste or waste water, etc), are relatively easy to identify through surveys, this is more difficult for integrated equipment.

Capital stock models

In order to calculate the consumption of fixed capital, capital stock models should be set up using the perpetual inventory method. Country experience (e.g. the experience in France, or in Germany with the statistical integration of the former German Democratic Republic) suggests that, if long time series of investment are not available, an initial estimate of the capital stock in place can be based on a variety of primary data. Such primary data include

- physical environmental data related to capital stock – e.g. population served by sewerage networks, number, capacity and category of treatment of waste water treatment plants, number and capacity of waste incineration plants, power plants equipped with flue gas scrubbers, etc.
- physical environmental data related to pollutant releases – e.g. waste arisings can be used as basis to estimate the cost of treatment and the capital stock needed for treatment and collection, time series of

air emissions may – together with data on energy use and output – allow to better understand environmental protection measures undertaken
- legal and administrative information – e.g. the coming into force of major environmental laws gives an indication of past patterns of investment, permit and supervision data may be helpful
- if environmental investment is supported by government via investment grants or low interest loans, such information – if long time series are available - can be a useful basis for estimates
- engineering estimates and expert assessment may be used to determine the past investment
- data on operating expenditure may be used to estimate the capital stock in place

The initial capital stock must be determined or estimated by categories of capital goods (vehicles, structures, and machinery) and by age class. The normal national accounts assumption of the lifetime for these categories may then be applied (unless more specific information is available) to calculate the consumption of fixed capital.

Capital stock models also allow estimating the operating expenditure related to the gross stock of capital in place. For this, case studies and expert assessment may be used to estimate average ratios of operating expenditure to the stock of environmental capital. For such estimates to be reliable, detailed breakdowns of the capital stock by environmental domain and by type of capital goods as well as detailed categories of operating expenditure (wages and salaries, energy, maintenance, etc.) are recommended. Detailed breakdowns also permit to apply detailed price indices to each category.

Integrated equipment ("cleaner" technologies)

Such equipment is typically integrated in the production cycle and may result from the modification of existing equipment for the explicit purpose of reducing the output of pollutants or from the purchase of new equipment whose purpose is dual, both industrial and for pollution control. In the first case, expenditure can be estimated from the cost of the modification of existing equipment. In the second, the extra cost due to pollution control has to be estimated, i.e. the cost of "non-pollutant or less pollutant" equipment is compared to that of a "pollutant or more pollutant" reference equipment.

These estimates are uncertain: reference equipment may no longer exist or new equipment may, in addition to its beneficial effects on the environment, present other advantages (savings or substitution of raw materials, higher productivity, etc.) which in terms of cost cannot be isolated. The difficulty arises with the gradual integration of environmental considerations and economic development: as this integration progresses, substantiated by the gradual replacement of "end of pipe" equipment by integrated equipment and the gradual vanishing of reference equipment, some part of environmental expenditure becomes gradually invisible.

4.3.4 **Adapted and connected products**

Connected products are products whose use responds to an environmental protection purpose. Identification of these products is needed to provide a complete picture of environmental protection and ensure international comparability. For example, in densely populated countries virtually sewage networks may serve the whole population whereas in other countries the use of septic tanks may be important. Thus, a direct comparison of the level of expenditure on sewage collection and treatment would be misleading as long as the capital and operating expenditure related to the septic tanks are excluded.

Adapted products (environmentally friendly products) are products that are more environmentally friendly when used. As for integrated technologies the extra-cost criterion is used to identify associated expenditure. The methodological difficulties are thus similar – comparison must be made to a ‘dirty’ product. For example, unleaded gasoline or desulphurised fuels may be more expensive to produce. These extra costs of production are environmental protection expenditure. However, as the use of adapted products is rarely surveyed (but rather estimated), the practical difficulties are small.

A great number of adapted and connected products may exist. However, experience suggest that only very few merit detailed analysis because of their quantitative importance and because there are significant extra environmental costs related to these products. For many adapted products it was found that no extra costs exist. See list below for a proposal developed at EU level – this list may need to be adjusted to the specific conditions in a country.

List of adapted and connected products

Minimum requirements

- septic tanks
- maintenance services and other products for septic tanks
- catalytic converters for vehicles
- lead free gasoline
- desulphurised fuels

Highly recommended

- a more complete set of measures related to transport vehicles, based on the cost of compliance with environmental regulations. This includes measurement services of exhaust gases of vehicles, measures to adapt private cars (other than using catalytic converters) and measures to adapt trucks, buses and aeroplanes.
- trash bags, bins, rubbish containers, compost containers (this item is dependent on the organisation of waste collection in a country – e.g. whether wheeled rubbish containers are provided by the local authorities or not, whether rubbish containers are owned by local authorities or must be purchased by households, etc.)

The following products may be considered:

- measurement and supervision services of exhaust gases of heating systems
- exhaust pipes of vehicles

Method of measurement for adapted and connected products

The typical method to estimate the expenditure associated with the use of adapted and connected products will be based on physical information about market sizes (e.g. amount of desulphurised fuels used, number of newly registered cars equipped with a catalytic converter, number of newly constructed houses equipped with septic tanks, etc). These estimates will then have to be valued by either the market price (connected products) or by the extra cost due to environmental protection characteristics (adapted products). Extra costs will typically be difficult to survey so that expert assessment and technical knowledge may be used to estimate extra costs (e.g. technical expertise allows to estimate the extra costs of producing desulphurised fuels or of environmental adaptations of vehicles).

Together with environmental protection services, adapted and connected products form the category of *specific products*, i.e. those products the current use of which serves environmental protection purpose.

4.3.5 **Aggregate expenditure**

On the basis of the definition of the characteristic activities and the specific products corresponding to a particular domain, the Chapter XXI proposes the aggregate of national expenditure for this domain.

This expenditure is basically defined (see the exact definition in Chapter XXI § 21.61 sq.) as the sum of the final and intermediate consumption of specific products by resident units, gross capital formation for characteristics activities, specific transfers of residents units less the financing by the rest of the world.

This definition allows defining current expenditure and capital expenditure for environmental protection. Current expenditure corresponds to the final and intermediate consumption of environmental protection services and connected and adapted products plus current specific transfers (less financing by the rest of the world). Capital expenditure corresponds to gross capital formation for environmental purpose plus specific capital transfers (less financing by the rest of the world).

The various elements that enter the national expenditure can be compared with the corresponding aggregate of national accounts. Final consumption of specific products may be compared with total final consumption, gross fixed capital formation may be compared with the gross capital formation of the total economy. The ratio between national expenditure and the central aggregates of national accounts (GDP or GNI) may serve as an estimate of the relative national effort in favour of environmental protection.

However national expenditure cannot be strictly compared with GDP in a purely technical sense before a few hypotheses are tested. Hypotheses are:

- that the cost of environmental protection included in imports is equal to that included in exports (i.e. the intermediate consumption of environmental services by domestic producers translates into an equivalent domestic final use via increases in prices of ‘conventional’ products domestically used), and

- that the specific transfers do not include transfers which have the character of distribution of income (experience suggests that specific transfers are a very minor share of national expenditure in many counties).

Depending on the country, some deviations in one or the other directions from a strict comparability to central aggregates may exist which need to be analysed. Experience suggests that these deviations are negligible so that a strict comparability of national expenditure with GDP can be assumed (i.e. national expenditure in current prices are contained in – i.e. form part of – GDP in current prices). It should be noted however, that a calculation in constant prices poses much greater difficulties (see Steurer/Gie/Schäfer/Leipert in Uno/Bartelmus (1998)).

The national expenditure approach deviates from two other approaches.

In its interim 1993 version, SEEA only considers current actual expenditure connected with environment-related activities. They are called actual environmental costs. Actual environmental costs are defined as the sum of external environmental protection services used as intermediate or final consumption and the total value of internal protection activities. They therefore correspond to current national expenditure, the only differences being the current specific transfers and the financing by the rest of the world. However it should be noticed that for the SEEA actual environmental costs include not only environmental protection costs but also repercussion costs.

In some countries another "cost" concept is applied, which, for ancillary activities, takes into account not only the consumption of fixed capital but also the imputed interest on the stock of fixed assets for environmental protection but excludes capital formation. Objective is to measure the total (net) cost for the producing units of their environmental protection measures. This approach is also comparable with the Chapter XXI definition of current national expenditure, provided that a net operating surplus is imputed in the valuation of ancillary output (i.e. cost of production) that corresponds to the interest on tied-up environmental capital.

4.3.6 **Comparison with other systems**

Some other systems exist at international level for the recording of EPE (PAC by OECD, SERIEE by EU).

All these systems follow the same basic principles.

- only actual environmental protection expenditure (or costs) are recorded;
- deduction of environmental protection expenditure from e.g. GDP is not proposed;
- Environmental protection expenditure (or costs) are defined using some form of "purpose" criterion;
- Environmental protection activities and adapted and connected products are considered (only the terminology is different);
- valuation is made according to national accounts principles, except as concerns the "externalisation" of internal (ancillary) environmental protection activities, which are valued at cost of production;
- environmental activities are presented according to the supply-use framework of national accounts.

However, there are some differences:

- the focus is not always put on the same concepts: some frameworks favour costs and other expenditure;
- the purpose criterion is complemented with a "cost criterion" to a varying extent;
- the treatment of recycling differs;
- SEEA and NAMEA mainly limit themselves to the description of supply and uses, OECD's PAC and Eurostat's SERIEE also examine the issue of financing;
- generally only environmental protection expenditure are recorded; however the 1993 SEEA proposed to include also repercussion costs.

4.4 Supply-use framework

4.4.1 **A simplified supply and use framework**

This section is about using a simplified supply-use framework for presenting a comprehensive picture of environmental protection. This presentation is based on the system of supply-use tables in national accounts which is then simplified to show only the transaction related to environmental protection expenditure and activities. The basic data are then converted to fit into that simplified framework. The purpose of this conversion is to get a balanced and consistent view of the economics of environmental protection. In the same way, related issues such as resource use and management can be treated. Section 4.6 shows how some basic economic-environmental indicators can already be derived from the primary data of the standard statistical system.

In the SEEA chapter 4, this framework is set up in the same way as in the national accounts, except that the categories of products and activities identified, using the CEPA, are specific to environmental protection. In the field of environmental protection, existing information from environmental protection expenditure surveys, from national accounts and from standard statistical sources can be transformed to describe the production and use of environmental protection services. Also for other issues of interest, specific products and activities are identified (e.g. water supply done in-house by enterprises, or households) and accounts for their supply and use established. For some areas important parts of the information can be directly drawn from existing statistical sources (e.g. information on ISIC/NACE codes 37 – Recycling, 41 – Water supply or 90 – Sewage and refuse disposal can directly be used).

4.4.2 **Basic data**

Experience in various countries indicates that often the statistical systems provide good information on the supply side (production), whereas the uses side (consumption) is often less well described. Therefore it is recommended to start with a description of the supply side. For example in the field of environmental

protection expenditure the typical data sources and their relation to the supply and use framework are as follows:

Table - Typical data sources and their relation to the supply and use framework (not exhaustive)

Data source	Characterisation of the statistical unit	Supply	Use
Specific surveys of environmental protection expenditure by businesses	Non-specialised producer with ancillary environmental protection activity	Ancillary output can be calculated based on own account current and capital expenditure (transformed into cost of production)	Equals supply for the ancillary activities If surveys separately identify operating expenditure and the purchases of (external) environmental services within current expenditure: use of marketed services can be identified as well.
Government finance statistics, COFOG, budget data, annual reports of environmental agencies or funds, etc.	Often specialised producer	Market or non-market output can be calculated based on expenditure and revenues	Non-market part: collective consumption. Market part: unknown - often households and small businesses
Data on ISIC/NACE 90 and other data sources on private and public producers specialised in EP	Specialised producers	Market output	Unknown – often businesses, sometimes households, input-output tables may be useful to determine users
Household surveys, actual final consumption expenditure of households	households	No	Can help to identify the purchases of marketed environmental services by households

4.4.3 **Calculation methods**

The production account

Market output and non-market output must be distinguished. Non-market output (government non-market activities, ancillary activities) is calculated based on cost of production. The drawing up of the supply-use tables should be made by environmental domain to allow meaningful estimation procedures.

The uses

Often data on uses of market output are incomplete so that informed assumptions must be made. Input-output tables may be of help. Also, physical data and price information can be used (e.g. household waste versus industrial waste collected).

4.4.4 **An illustrative supply-use framework for environmental protection expenditure**

An illustrative example of a simplified supply-use framework for environmental services is given in Table 2 below. Table 2 also shows the details of the production account in its upper part and additional information on the factor inputs in its lower part. Table 2 allows fitting all data derived from the above listed primary data sources into the framework. Gaps may remain between supply and use that can be filled by specific estimates. Examples are: the distribution of the use of marketed waste services between households and businesses can be based on physical data on waste arising and price information if other information is not available. Specific information on the demand for soil clean-up services may be derived from public information – if information on the corresponding production is missing this may need to be imputed on the supply side.

Any difference in the price concepts used in each of the basic data sources need to be taken into account before the supply and uses sides can be balanced. According to the SNA, basic prices are used to value output and purchasers' prices are used to value uses but basic data sources (e.g. public budgets) may use specific valuation concepts which need transformation. Once the SNA concepts are applied, differences between the supply and use data can be due to taxes and subsidies on products, in particular non-deductible VAT, and trade and transport margins (do not apply to environmental services).

Supply and use should be set up for each environmental domain or other area of interest separately so as to make the balancing procedure meaningful.

Special attention is required on the uses side for the specialised producers. For example, waste services may be purchased in the context of waste water treatment activities – these should be identified to avoid double counting. In the waste domain, links among individual specialised producers can be important in volume. For example, government units may sub-contract private firms (1800 in the example below) or specialisation within the waste industry with a separation of collectors, treatment plants and landfill operators may lead to important deliveries among specialised producers. As these deliveries will normally end up in the output value of the downstream producers, they must be separately identified.

Table 2: Supply and use of environmental services including production account

Supply	Waste			Etc….	Total supply
	Government	Corporations (non-specialised)	Corporations (specialised).		
Intermediate consumption	2000	1000	3000		
Compensation of employees	600	2000	2000		
Consumption of fixed capital	400	1000	1000		
Taxes less subsidies on production (if any)	0	0	0		
NOS/mixed income	0	0	500		
Output (at basic prices/cost of production)	3000	4000	6500		
Of which:					
Market (m)	1200	0	6500		
Own final use	0	4000	0		
Other non-market (nm)	1800	0	0		
Imports (cif)	0	0	0		
Total supply (at basic prices)	3000	4000	6500		

Revaluation items (from basic prices to purchasers' prices)					
Non-deductible VAT/sales tax	120	0	150		
Other taxes less subsidies on products (if any)	0	0	0		
Trade and transport margins (only for goods)	0	0	0		
C.i.f./f.o.b. adjustments on imports (if any)	0	0	0		
Total supply (at purchasers' prices)	3120	4000	6650		

Use	Waste			Etc…	Total uses
Government collective consumption (nm)	1800	0	0		
Intermediate consumption - non-specialised producers (m)	0	0	3500		
Intermediate consumption - specialised producers (m)	0	0	1500		
Intermediate consumption - ancillary output (own final use)	0	4000	0		
Final consumption – households (m)	1320	0	1650		
Gross fixed capital formation in waste services	0	0	0		
Exports (fob)	0	0	0		
Total use (at purchasers' prices)	3120	4000	6650		

Gross fixed capital formation	1100	2500	1000	…	
Stock of fixed capital	7000	12000	15000		
Labour inputs (in 1000 hours worked)	4000	8500	10000		

4.4.5 D**ata not used in the supply-use framework (transfers)**

Government-related data sources may include information that are not used directly in the supply-use framework, in particular information on current transfers, investment grants, preferential loans given for funding environmental investment, or government receipts from pollution charges.

Transfers will often be related to expenditure recorded already and would hence lead to double counting. However, this is not necessarily the case. First, the concept of specific transfers captures those transfer payments without a counterpart in the uses (for example subsidies or international co-operation). Second, in practice it may occur that the primary data sources are incomplete. For example, while data of government transfers (current or capital) to specific entities are available, there are no data on these entities. Examples may be: government transfers to associations of municipalities or to NPISHs. In this case these transfers should not be netted out but rather used to estimate a production account for the

entities not covered in primary data. Therefore, whether a transfer has a counterpart in uses or not (and should hence be netted out or not) is also depending on the completeness of the primary data.

Information on transfers should be presented and treated as follows:

A table of intra-governmental transfers should be set up – many transfer payments are between different levels of government, e.g. from the central state to an environmental fund or to local authorities. Such transfers should be separately identified, presented in a table of intra-governmental transfers (basically a supply-use-of-transfers table). Transfers, where both the source and the beneficiary are described in the basic data should be netted out (e.g. basic data include investment grants from the central state to local authorities but also includes the investment undertaken at local level). However, there may also exist 'open-ended' transfers without a counterpart in the basic data available, e.g. transfers to a government agency whose annual report is not available. In such a case, the transfers can constitute a basis to estimate the expenditure of that agency (see also above).

A table of transfers among sectors. Normally, transfers will only go from the government sector to the other sectors (households, corporations, and non-profit institutions) but the reverse can be true e.g. for large donations or for pollution charges. The same principles above apply: if the expenditure which correspond to the transfers (i.e. are financed by the transfer) are included in the primary data, the transfers should be netted out. Some kinds of transfer will have no counterpart in basic data by definition (for example international co-operation).

Information on transfers can be used to describe the financing flows related to environmental protection and hence the application of the polluter-pays-principle.

4.5 A full set of accounts

This chapter, based on SNA Chapter XXI deals with the compilation of a full set of accounts for environmental protection. The supply-use presentation combines two approaches: the production of environmental protection services (either external or internal) and the use of these services, as well as the use of connected and adapted products. Extension to the analysis of financing is then examined.

4.5.1 **Analysis of the production of environmental protection services, and financing by producers**

Starting with the list, definition and classification of environmental protection activities, the first step is to identify the units, which execute these activities as principal, secondary or ancillary activities. Some of the problems related with this step have been analysed above. The focus is put here on the categorisation of producers and the way the different categories of producers finance their outlays.

Two types of producers of environmental protection services are distinguished: specialised producers (those producers that execute the environmental protection activities as principal activity) and non-specialised producers (those that execute the environmental protection activities as secondary or ancillary activity). All other producer unit of the economy are only users of environmental protection services, they are not considered here but in the analysis of uses (see below 4.5.2).

Within the specialised producer units those producers pertaining to the general government sector, i.e. that mainly produce non-market services are distinguished.

The grouping of units being made on the basis of industries, i.e. establishments (local kind of activity units), analysis of the financing is simplified and needs some conventions. Market specialised producers finance their capital outlays for that part which is not financed by capital transfers (investment grants) from other units. As concerns non-market specialised producers, non-market output and capital outlays are deemed to be financed by the institutional unit the producer belongs to, for that part which is not financed by current and capital transfers by other units. As will be seen, the financing flows may be further analysed. E.g., when capital transfers originate in earmarked receipts from e.g. pollution taxes, the units

that contribute to these earmarked funds are to be considered the financing units of the expenditure supported by that fund.

For non-specialised producers a distinction has to be made between secondary and ancillary producers. Generally for producers which execute a characteristic activity (environmental protection activity) as secondary, the capital outlays (gross fixed capital formation) is not known and therefore is not recorded. As concerns ancillary producers they are by definition the financing units of their output (classified as own intermediate consumption) and of their capital outlays (with the exception of transfers received).

The analysis of production results thus in the identification of the financing by the producers or the institutional units they belong to.

4.5.2 **Analysis of financing of the uses of products for environmental protection (specific products)**

The various components of the national expenditure are presented by user categories. These users are grouped together according to the following classification: producers, general government as collective consumer and households as actual consumers. Financing of the uses of producers (gross fixed capital formation, own intermediate consumption of ancillary environmental protection services) has been examined above.

Uses of environmental protection services are already presented in the supply-use tables. In general final and intermediate consumption of market environmental protection services are financed by the users: either producing units grouped by industries (intermediate consumption) or households (final consumption). As has been seen final consumption of non-market environmental protection services are financed by general government (or NPISH?) as collective consumer for the value of the non market output less current transfers. Own intermediate consumption of ancillary environmental protection services is financed by the user, i.e. the producer itself.

Uses of adapted and connected products follow the same rules; they are financed by their users.

Specific transfers (subsidies on environmental protection services and adapted and connected products which result in reduced prices paid by users) are part of the national expenditure (see 4.3.1 & 4.3.5). As any other transfers, when the funds used for the transfers are earmarked receipts, financing units are those at the origin of the earmarked receipts.

4.5.3 **Analysis of the financing of the national expenditure for environmental protection**

Environmental protection is characterised by complex financing circuits, due to the existence of subsidies, investment grants, and other transfers specifically intended for the financing of environmental protection activities and expenditure.

Previous analysis of the production of environmental protection services and of uses of specific products allow to describe the financing of the national expenditure. This financing is presented by cross-classifying the users and the financing units grouped by institutional sectors. The elaboration of the financing table requires a careful analysis of all transfers related with environmental protection, in particular of those transfers that originate in earmarked funds.

Table - Financing of national expenditure for environmental protection

FINANCING UNITS	USERS/BENEFICIARIES									
	Producers				General government as collective consumer		House-holds as actual consu-mers	Rest of the World	Total	of which: cur-rent expen-diture
	Specialised producers		Other producers (by industry)							
	GG & NPISHs	Other	non-special-ised	Non-cha-racte-ristic	CG	LG				
General Government (GG)										
Central Government (CG)	x	x	x	x	x	x	x	x	x	x
Local Government (LG)	x	x	x	x	x	x	x	x	x	x
NPISHs	x	-	-	-	-	-	x	-	x	x
Corporations										
Specialised producers	t,x	t,x	t	t	t	t	t	t	x	x
Other producers	t	t	t, x	T, x	t	t	t	t	x	x
Households	t	t	t, x	T, x	t	t	t, x	t	x	x
National Expenditure	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**
Rest of the world	t, x	t, x	t, x	T, x	t, x	t, x	t, x	x	x	x
Uses of resident units	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**

Notes: an ‘x’ indicates a (possible) financing flow, a ‘t’ indicates (possible) financing via e.g. pollution taxes that are earmarked for environmental protection.

4.5.4 **Net cost of environmental protection**

Financing of the national expenditure may be extended in order to determine the current burden that weights on the different categories of resident units due to environmental protection.

Some complementary items are first introduced. For producers, the imputed or actual interests on fixed capital less (in the case of specialised market producers) any net operating surplus is added to the financing of current national expenditure. For all units, environment-related taxes which are not earmarked for financing current national expenditure (and which are not already included in taxes on production) paid by the resident units are added.

Reclassification of some transactions is then made. Receipts of the taxes, as well as the non-deductible VAT on specific products are deducted from financing of the general government.

For the corporation sector, objective of this complementary analysis is to obtain the supplementary costs linked to the environment. Of course, these costs are not on the whole finally supported by producers (they are part of the price the producers cover from the purchasers of their products).

For households, the objective is to know how much they actually pay related to environmental protection whether through their financing of environmental protection expenditure or through environment-related taxes they pay which are not used for the financing of national expenditure.

Finally for the government deducting the receipts from environment-related taxes (not used for the financing of the national expenditure) allows to calculate the net (own) financing of national expenditure.

4.6 Indicators

4.6.1 **What is an indicator of environmental protection?**

An indicator of environmental protection identifies the *effort* of society to prevent or to reduce pressures on the environment. Derived from the satellite environmental protection account, it tracks the progress toward minimising environmental degradation by measuring the use of environmental products and technologies, clean products and environmentally-friendly and resource conservation practices. A set of indicators of environmental protection includes the following measures:

- demand and supply of environmental products
- net cost of environmental protection
- contribution of environmental activity to economic growth, export potential and innovation
- role of the different economic sectors and regions with respect to environmental protection
- impact of environmental protection on achieving eco-efficiency (waste minimisation and resource conservation)

Environmental protection can be measured in a variety of ways and at various levels of detail, depending on policy interests and data availability. Indeed, alternative sets of indicators can be developed for different policy aims and different data collection constraints.

Indicators of environmental protection can be developed as mentioned above with special emphasis given to one or several of the following frameworks:

- environmental domain breakdown: air, water or soil; greenhouse gases; wildlife protection, etc.
- breakdown by environmental product or technology
- sector approach: government, business, households, non-government organisations
- regional approach

A set of indicators may, in a first step be drawn from the core account for environmental protection activities. This means that the indicators would relate to pollution prevention and abatement activities. Another set of indicators could be derived from supplementary accounts such as an account of activities related to resource management such as energy saving and recycling and a resource use and management account (e.g., water supply).

4.6.2 **Use of environmental protection indicators**

Environmental protection indicators provide useful information for policy decisions, research and market analysis on demand and supply of environmental products and impacts of environmental protection activity on economy and environment. Such indicators help policy makers to assess the net benefits of environmental policies (economic growth, environmental efficiency…), to determine needs for subsidies toward environmental protection and R&D, etc. These indicators allow industry associations to identify markets for environmental products and technologies and areas for growth potential in the environmental field. Indicators of environmental protection may be assessed vis-à-vis the policy goals previously established (greenhouse gas reductions, waste minimisation, etc.). Economic impacts of environmental protection may be compared to the results in terms of waste reduction, resource conservation, etc.

The Table 4.1 includes some examples of policy issues and related indicators of environmental protection.

Table 4.1

Policy issues	**Variables/indicators**	**Users**

Net cost of environmental goods and services (net of any savings from environmental activity); cost/benefit analysis of environmental regulations and voluntary initiatives	Investment spending and current expenditures on environmental protection; cost savings, energy savings from environmental technologies or products	Industry, industry associations, environment departments and other government body, universities
Contribution of environment industry to economic growth, production and employment; potential for aid to industry	Relative yearly growth in turnover (revenues), value added, employment, type of jobs, etc.	Governments (environment, industry and finance departments in particular); industry associations (including environment industry associations); universities; marketing consultants
Contribution of environmental goods and services industry to international trade	Exports, imports (amounts and as a percentage of total exports/imports), international direct investment, licensing agreements	Governments and industry associations, exporters and importers
Regional and structural differences in characteristics and importance of environment industry	Turnover, value added, employment, etc. by region, by industry structure, etc.	Regional governments, industry associations, national and regional
Environmental protection and R&D and innovation potential	Environmental R&D as a share of total R&D; new patents for environmental technology	Governments, industry, universities
Economic efficiency	Price per unit of environmental services (e.g., $ per ton of treated waste)	Governments, industry
Adequacy of environmental products and technologies to environmental protection goals (environmental efficiency)	Linkages of environment industry activities and characteristics to environmental quality indicators	Governments, industry, universities
Contribution of environment industry to sustainable development	Preventive activities (ex cleaner technologies and products) as a share of total environment industry output	Governments, industry, universities
Transfer of environmental technologies	Share of imports and exports of environmental capital expenditures	Governments, industry, intergovernmental organizations

Source:
Modified after Drouet, D. (RDI, 1997), *The Environment Industry in France*, Armand Colin/Masson Editeur, Paris, 1997.

4.6.3 **Set of indicators**

This is an initial list of indicators; it is by no means exhaustive. As environmental protection accounts get developed, more indicators will added to the list. Different policy agendas may put emphasis on different sets of environment protection indicators.

Box 4.1

Indicators of financial burden and demand for environmental products and technologies

- Capital investment in environmental protection as a share of total gross fixed capital formation
  - government investment: by level of government and overall
  - business investment: by industry and overall
- Government current expenditures on environmental protection as a proportion of total government current expenditures
  - this indicator can be estimated for each level of government.
- Government expenditures on environmental protection as a proportion of GDP
  - this indicator can be estimated for each level of government.
- Environmental protection expenditures of households and non-government organisations as a proportion of their total expenditures
- Imports of environmental products as a proportion of total imports or as a share of GDP
- Environmental exports as a proportion of total exports
- Cost savings, energy savings associated with recycling and reuse
- Revenues from sale of by-product (e.g., recycled waste, energy from incineration, etc.)
-

Th tors of th

Time series of capital and current expenditures show the trends and changes overtime in the cost of environmental protection and the allocation of budgets toward environmental protection. Estimation of expenditures on environmental protection in constant dollars is a challenge because of the lack of specific price indices to deflate environmental expenditure data.

It is possible to disaggregate indicators in Box 4.1 to reflect more detailed information.
A set of indicators of demand for environmental protection also has to reflect the characteristics of spending according to the type of activity, the region, the sector, the industry, etc. (Box 4.2)

Box 4.2

Indicators of environmental protection expenditures by activity, sector, industry and region

- Government gross fixed capital formation and current expenditures by type of environmental activity (e.g., waste management services, site reclamation): comparisons can be made between various levels of government to identify the role of the various types of governments with respect to environmental protection.
- Business capital and operating expenditures on environmental protection by activity: comparisons can be made between industries and between firms of different sizes to identify any concentration of activity.
- Business and government expenditures by media (air, water, soil, etc.) or by group of pollutant (ex green house gas)
- R&D spending on environmental protection as a share of total R&D
- Investment and current expenditures by type of environmental technology (ex end-of-pipe versus integrated processes): would reveal trends in pollution prevention (sustainable development) versus traditional pollution abatement processes

Investment and government current expenditures in environmental protection are also indicators of environmental production. Government is at the same time the producer and the user of its environmental products. Business investment in environmental protection represents the final demand of business for own account production of environmental products.

Box 4.3

Indicators of production of environmental products

- Value added associated with environmental goods and services, expressed as a share of GDP
  - It is a challenge to estimate environmental value added as opposed to environmental gross output because it is often difficult to distinguish primary input (salaries especially) related to environmental production from primary input related to non-environmental production. The best method to estimate that value added would be through the use of an input-output structure. Environmental value added could be broken down by sector, by industry, by activity or media.
- Gross output (environmental and non-environmental) associated with environmental production: could be broken down according to the media, the environmental domain, the type of product, etc.
- Current expenditures and gross fixed capital formation (GFCF) of government for environmental protection: represent government share of environmental value added.
- Total investment of environmental firms (e.g., environmental and non-environmental investment of waste management industry) and environmental investment of other firms (e.g., pulp and paper firms): part of business environmental value-added.
- Revenues of business from production of environmental goods and services: this may be done by type of activity or product, e.g., revenue from environmental services vs revenue from environmental goods.
- "Environmental" employment, that is employment associated with environmental production. Again, estimating environmental employment is a challenge; it is very difficult to separate environmental employment from non-environmental employment unless it is clear that all the production is purely environmental (ex. Waste management services provided by a waste management firm). If such a distinction is not possible, it is better to look at total employment provided by main, secondary and ancillary producers of environmental goods and services. An analysis of the "greening of jobs" includes a look at the types of jobs required for environmental projects.
- Concentration of environmental producers and ownership of firms that are part of the environment industry: number and size of producers, mergers and acquisitions; share of the market served by local suppliers

Box 4.4

Linkages between environmental protection indicators and environmental quality indicators

The framework of an environmental protection account may be extended to take into account the adequacy of environmental production to environmental protection goals regarding waste minimisation, resource conservation and pollution prevention. This requires the development of links between environmental protection indicators and waste output indicators and indicators of resource intensity. Governments and businesses are interested in comparing and finding out the cost-benefits of various environmental technologies. An example of such linkages would be the dollars per ton of treated waste indicator.

Ideally one would assess the effectiveness of environmental protection on a project by project; for instance, what are the impacts of a particular biotechnology on decreasing release of toxics in surface waters? What are the impacts of a particular energy efficient technology in reducing green house gas emissions? This would require a great deal of resources to do the work and the use of experts in several fields.

An input/output framework for environmental protection accounts and waste output accounts may provide some of the links between environmental production and waste minimisation. However one has to take into account the time differential between the investment in an environmental technology and the waste reduction resulting from that investment.

Box 4.5

Indicators by Domain

Protection of the atmosphere: expenditures on air pollution abatement
Protection of water: expenditures on wastewater treatment (and water supply purification)
Protection of groundwater and soil: expenditures on site remediation and decommissioning
Environmental management of solid waste: expenditures on waste management, waste recycling and municipal disposal
Environmental management of hazardous waste: expenditures on hazardous waste treatment

[Note: text will need to be written around Text Boxes 4.3 to 4.5].

4.6.4 **Other issues**

Transfers including environmental taxes

It is also possible to develop environmental protection indicators that would reflect the distinction between who pays and who undertakes the environmental activity. To that end, a set of indicators

showing the transfer payments between sectors could be developed. That set would include subsidies paid by government to business and households for environmental protection, tipping fees, fees and fines paid by business to government for polluting, cost of pollution trading permits, payment of environmental taxes, etc.

Timing issue

As mentioned above, it is not easy to assess the impacts of an investment in environmental protection in terms of environmental efficiency because of the time lag between the expenditure and the result. Timing is also critical in other aspects of environmental protection indicators:

- How long does it take before an investment in environmental protection becomes profitable?
- When does an environmental expenditure cease to be environmental to be considered instead as the cost of doing business?

4.7 Extensions and applications

This section deals with the application of the framework presented in earlier section to other fields of interest, such as resource use and management expenditure or the environment industry. Extensions include environmental input-output analysis, the link to physical data (see also Chapter 3), the treatment of repercussion expenditure (e.g. health or material damage related expenditure) and the link to maintenance costing (see also Chapter 5).

4.7.1 **Analysis of the environment industry**

The focus so far has been on the expenditure (uses) side – expenditure related to environmental protection in a strict sense as well as other issues of interest (recycling, water supply, forest management…). The environment industry perspective is one of markets and exports, employment and job opportunities. The principles of satellite accounting are also fully applicable here when it comes to employment or value added.

Main policy interest is in the creation of economic activity, trade and employment due to environmental protection measures and the management of natural resources. That is, the focus is on the production side.

OECD/Eurostat: definition and classification of the environment industry

The environmental goods and services industry (environment industry for short) '…consists 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. This includes cleaner technologies, products and services that reduce environmental risk and minimise pollution and resource use.' (OECD/Eurostat: The Environmental goods and services industry – manual for data collection and analysis, Paris 1999), variables of interest, data sources and methods for assessment. (summary of manual to be added about here)

The links between the environment industry on the one hand and environmental protection and resource use and management accounts on the other hand are illustrated by the main headings of the classification below (for the full classification please see Annex 4). The groups A (Pollution management) and B (cleaner technologies) have a direct correspondence to environmental protection, whereas group C (resource management) corresponds to the resource use and management accounts. However, there are some minor conceptual differences in the detail which result from the different main purposes. For example, activities related to nature protection are classified under group C.

Classification of the environment industry

A - POLLUTION MANAGEMENT Group
B - CLEANER TECHNOLOGIES AND PRODUCTS Group
C - RESOURCES MANAGEMENT Group

The environment industry account includes the description of the production of connected and adapted products as well as investment goods and construction activity. Also, due to this extended scope, trade is an important issue (but difficult to assess). As with environmental protection expenditure, specific surveys of environment businesses are an essential tool for providing data on the environment industry.

The main data sources are very similar to those for environmental expenditure and include standard statistics (e.g. some ISIC categories) and specific surveys. The main approaches to measuring the environment industry are

- Supply side approach (specific surveys of environment industry producers, etc.)
- Demand side approach (environmental protection and resource management expenditure)
- Integrated supply-demand approach (not an independent method in itself but a combination of the supply and demand side data within an accounting framework)

The integrated supply-use approach and environmental input-output tables as a specific approach that aims at full consistency of supply side and demand side data and that allows to estimate the environment industry (or, alternatively, expenditure categories) with the help of input-output techniques. It also allows estimating the value added in the environment industry (via estimates based on industry averages, with the help of input-output analysis. Further, input-output techniques allow to calculate the total (direct plus indirect) effects of environmental protection in terms of value added and employment (see Nestor/Pasurka 1995)

4.7.2 **Environmental input-output analysis**

The main purpose of an environmental protection input-output table (EIOT) is to investigate the structural and other effects on the total economy of producing environmental protection services[1]. The SEEA attaches high priority to the linkage of monetary and physical data on the basis of IOTs (NAMEA). This linkage is the only way in which the effectiveness of environmental protection measures can be examined, and to this end the EIOT is designed to match the physical input-output tables (PIOT)[2], thus building a bridge between environmental protection measures and materials and energy flow accounts. This bridge is made by the use of identical classifications and the parallelism of the data in physical and monetary units.

As in the environmental protection expenditure account, the EIOT separates internal and external environmental protection services and fixed capital formation for environmental protection:

- **Internal services** are for own account. They are not sold, but serve to remove, avoid or reduce environmental damage arising from own production processes (ancillary activities) and include, for example, the purification of sewage in a plant belonging to the firm which produced the sewage or the operation of flue gas desulphurisation and denitrification plants in power stations. These services are shown not as independent branches but as part of the branches in which they are carried out as ancillary activities.
- **External services** are disposal services supplied on behalf of others. They include the disposal of waste and sewage provided that it is a service produced for third persons. The vast majority of such services are produced by general government and public or private waste disposal enterprises. For external environmental protection services, a separate branch has to be formed, which consists of the environmentally relevant sections of the branches "other market services" and "non-market services". In the column, the new branch shows intermediate consumption by commodity group and the components of gross value added, i.e. the inputs needed for the production of external environmental protection services. The corresponding row for these services describes which branches purchase and use them.
- **Fixed capital formation for environmental protection** refers to the investments needed for the above protection activities. They are disaggregated by commodity group and shown in the EIOT as part of the fixed capital formation of the total economy.

4.7.3 Environmental taxes

The focus is on revenue data for environmental taxes, thereby providing information on the structure and importance of environmental taxes within the taxation system. Such information is useful in a policy context of 'green' fiscal reform. A basic idea of 'green' fiscal reform is to change the structure of taxation systems so as to reduce the tax burden on labour and to increase the tax burden on the use of the environment (double dividend).

OECD, Eurostat, the IEA and the European Commission's Directorate Generals for Environment and for taxation have developed a statistical framework (see OECD document DAFFE/CFA/WP2(97)5 'Statistical Framework on Environmental Taxes in OECD Member Countries').

The development of this statistical framework started from the following **definition of environmental taxes**: 'a tax whose tax base is a physical unit (or a proxy of 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 puts **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. Other criteria such as the name given to a tax or the purpose of a tax as expressed by the legislator or the fact that the revenues from a tax are earmarked for environmental purposes were therefore not used. Of course these latter criteria can still be useful when identifying environmental taxes in a national context.

---

[1] See Schäfer, D., Stahmer, C. (1989): Input-Output Modelle zur gesamtwirtschaftlichen Analyse von Umweltschutzaktivitäten, Zeitschrift für Umweltpolitik & Umweltrecht, 2/89, pp. 127 - 158, Frankfurt 1989

[2] See Stahmer, C., Kuhn, M., Braun, N.: Physical Input-Output Tables, a report to Eurostat and DG Environment.

The definition gives an idea of the key concept that should be measured. It also provides a guideline for the assessment of newly introduced taxes. However, the definition still leaves room for debates on borderline cases (e.g. VAT on energy products, taxes on the purchase of land, on tourism, etc.). The key issue for ensuring international comparability is therefore the list of environmental tax bases (see below) as agreed by the institutions involved.

Categories 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

As, for each country, there may be rather few environmental taxes, the following aggregated groupings of environmental taxes may be used:

- Energy taxes (including CO2-taxes)
- Transport taxes
- Pollution taxes (on emissions, waste, packaging, pesticides, CFC, noise, etc.)
- Resource taxes

It should be noted that resource taxes do not include taxes on oil and gas extraction. These taxes generate important revenues in a very limited number of countries. 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 would not fit the definition of environmental taxes.

The basis for the identification of environmental taxes will often be the tax revenue statistics. A list of environmental taxes must be set up which allows to separate the environmental taxes from all other taxes and to assign them to the detailed or aggregated classification above.

4.7.4 **Links to physical data**

As for other satellite accounts, the usefulness of measuring EP activities and expenditure can be enhanced by making links with physical data, in particular with emissions either collected, treated or even avoided as well as with protection equipment and facilities. Main instruments for this linking are NAMEA (links to

emissions) and the SEEA's integrated monetary and physical IO frameworks. In general, it must be stressed that physical data or indicators about EP equipment and facilities are necessary for the compilation of emissions (and emission accounts). In these cases the links between physical data on equipment and expenditure are normally direct.

However some difficulties arise: expenditure data on pollution abatement measures are normally not available at a detailed level (e.g. by air pollutant), abatement measures often reduce emissions for several pollutants. Furthermore emissions are the result of many factors, including the level of activity and savings in the use of raw materials or energy, as well as other measures not described in EP accounts. Therefore linking physical data on emissions with a description of EP activities (expenditure) requires, for some domains (mainly air emissions), a careful and detailed analysis.

4.7.5 **Repercussion expenditure**

This section is linked to Chapter 5 (valuation). Repercussion expenditure (as opposed to environmental damage) are only the actual expenditure done due to adverse changes in the state of the environment.

Identification of repercussion expenditure (e.g. a share of health expenditure, maintenance expenditure….) is difficult as data sources do not exist.

The SEEA does not recommend for the moment to elaborate on this area.

4.7.6 **The link to maintenance costing**

Maintenance costs (or avoidance costs)– see Chapter 5 for details - are the hypothetical imputed environmental costs required to prevent or to mitigate deterioration of the natural environment. While chapter 4 is concerned with actual expenditure and activities, the maintenance cost approach describes hypothetical expenditure and activities.

The main issues are:

- the definitions of cost, expenditure in the two approaches–do they differ?
- does chapter 4 shed light on how maintenance costing should be done to be consistent with national accounts?

Maintenance costing has been proposed as a valuation method for the deterioration of the environment, but there are difficulties. For example, in order to apply the method to the discharge of residuals, an environmental standard which is to be maintained must be previously set, and then measures or activities for maintaining such a level have to be chosen.

In estimating maintenance costs in practice, one method that may be used is to calculate the unit cost per amount of residuals removed, by using the cost data actually required for treatment of residuals (consumption of fixed capital and operating cost) and to multiply the volume of emissions by the unit cost. Such estimates are not exactly maintenance costs since they are approximate. However, using this method, maintenance costs are estimated on the basis of actual environmental cost or actual environmental protection expenditure. If maintenance costs and environmental protection expenditure are estimated for the same environmental items, then they can be regarded as complementary values.

4.7.7 **Natural resource use and management account**

Note: This section needs to be improved and made consistent with chapter 2

Activities for the management of natural resources as well as energy and material saving activities and recycling (to the extent that recovered products are not considered as environmental output) are excluded from the environmental protection field. These activities can be analysed as natural resource management activities.

Natural resource use and management accounts describe activities for the management of certain natural resources, linking monetary data with physical data. Some major aspects are preliminarily summarised in this section.

Natural assets are non-produced assets: water (marine and inland), air, land (soil, ecosystems, etc.), wild flora and fauna, sub-soil assets. Natural assets give rise to natural resources, the use of which can translate into a quantitative depletion of the assets concerned, if the corresponding resource consists of a good, and/or the deterioration of their quality, if the corresponding resource constitutes a service (environmental services relevant to certain natural assets: air, water, etc.).

Management activities

For the purpose of the account, management activities designate:

- research for new resources
- withdrawals from existing resources
- activities aimed at reducing withdrawals (recovery, recycling, policies for saving or substitutes resources)
- development and regulatory activities for certain resources (e.g. inland waters).

Activities of transformation of natural resources, i.e. their use as input for the production of other products are not described in the accounts; however activities aimed at lowering their consumption, whether directly or indirectly, are considered.

Qualitative protection activities of natural resources, e.g. activities for biodiversity and landscape protection or activities aimed at preserving certain functions or the quality of the natural environment (air, water, soil and ground water) are included in the environmental protection expenditure account (see previous sections).

It may be useful to distinguish, within the natural resource use and management account, activities related to:

- management
- mobilisation and exploitation and
- reduction of use.

The following table attempts to describe the field covered by the natural resource use and management account.

Table of activities and resources (preliminary)

Activities Resources	Management	Mobilisation	savings/recycling/recovery
inland waters	Administration, supervision, research, regulation	Exploration, extraction, treatment, distribution	savings, recycling
natural forest resources	Administration, supervision, research, regulation	Exploitation	

wild flora and fauna	Administration, supervision, research, regulation	Harvesting, fishing, hunting	
raw materials	Administration, supervision, research, regulation	Exploration and extraction	recycling, savings, etc.

Accounting framework

As concerns units, transactions, tables and national expenditure the accounting framework for the natural resource use and management account is identical to the one described for environmental protection (see previous sections). In practice, some categories will need adjustment and specific classifications must be developed, e.g. of activities or adapted or connected products related to management and use of a particular resource).

An inland water mobilisation account

Inland water management includes research, mobilisation and regulation of inland water resources. Research covers activities aimed at identifying new sources of inland water. Mobilisation covers all activities aimed at abstraction, treatment and distribution of water resources for their various uses. The following may be usefully distinguished:

- Drinking water supply: Capital outlays for water abstraction (protection of abstraction perimeters, pumping stations, etc.), processing of drinking water, pressure build-up, storage and distribution, expenditure for major maintenance. Operating expenses: operating cost of production facilities, energy, purchase of treatment and distribution products, metering, billing, etc,

- Irrigation: all mobilisation activities corresponding to agricultural and animal breeding uses: ground water abstraction, construction of dams, catchments for surface flows, etc., including the operation of irrigation systems,

- Industrial water mobilisation: all mobilisation activities corresponding to industrial uses of water; uses for cooling of power plants and industrial installations are included.

For the above, collective systems should be distinguished from those designed for own use (ancillary activities).

- Water regulation: all other activities involved in the transit of water from its "natural" status to that of "controlled" water status: fitting out of rivers, especially for flood defence, construction and maintenance of waterways, water engineering and dams. Dams for the production of electricity are not considered.

- Recharging activities: may consist of land improvement, development of vegetal cover in order to increase water infiltration and recharge phreatic water bodies. In so far as they are not accounted for in protection of soil against erosion, corresponding transactions have to be recorded in the inland water management account.

- Savings policies: all measures aimed at saving water, whether for household, industrial, service or agricultural uses. They may take the form of investments (irrigation systems, industrial or household facilities to reduce water consumption, recycle water, etc.) or the use of products adapted for lower water consumption (specially adapted washing machines, etc.). These activities are described in a specific recycling and saving account.

Adapted and connected products

Adapted products are those products, which allow for the saving of water. Thus their uses are not recorded in the inland water mobilisation account but in the water saving and recovery account. Connected products may be exemplified by water meters.

A recycling and saving account

Recovery, recycling activities, as well as savings policies of water, energy, raw materials do, in principle, reduce the net uses of natural resources. Impacts on natural resources and expenditure related to these activities and policies have to be described in order to get a comprehensive view of the interactions between economic activity and the environment. Activities include:

A draft classification for a fisheries management account
(based on the conclusions of the FAO/UNSD Workshop June 1999, New York)

Expenditures which are made for the management of the fish stocks would comprise

- expenditures for research for fisheries management purposes,
- monitoring, control and surveillance (MCS),
- data collection and statistics,
- expenditure of the fisheries management authorities (local, national and regional such as a regional fisheries management bodies)
- temporary costs for facilitating structural adjustments of the fishery or fisheries sector (e.g. vessel buy-back programmes; re-training; etc.).

An account for the 'Prevention of natural disasters'

It should be considered to include a brief description of an account for the prevention of natural disasters (floods, avalanches, landslides etc.) as this would appear to become more policy relevant in future. Also, it would well link to other sections of this chapter (water, forest, repercussion expenditure) as well as to chapter 2 and chapter 5 on valuation.

Annexes (to be checked and updated)

Annex 1: Classifications of environmental protection activities and facilities

CLASSIFICATION OF ENVIRONMENTAL PROTECTION ACTIVITIES (CEPA)

1 PROTECTION OF AMBIENT AIR AND CLIMATE

- 1.1 Prevention of pollution through in-process modifications
  - 1.1.1 for the protection of ambient air
  - 1.1.2 for the protection of climate and ozone layer
- 1.2 Treatment of exhaust gases and ventilation air
  - 1.2.1 for the protection of ambient air
  - 1.2.2 for the protection of climate and ozone layer
- 1.3 Measurement, control, laboratories and the like
- 1.4 Other activities

2 WASTE WATER MANAGEMENT

- 2.1 Prevention of pollution through in-process modifications
- 2.2 Sewerage networks
- 2.3 Waste water treatment
- 2.4 Treatment of cooling water
- 2.5 Measurement, control, laboratories and the like
- 2.6 Other activities

3 WASTE MANAGEMENT

- 3.1 Prevention of pollution through in-process modifications
- 3.2 Collection and transport
- 3.3 Treatment and disposal of hazardous waste
  - 3.3.1 Thermal treatment
  - 3.3.2 Landfill
  - 3.3.3 Other treatment and disposal
- 3.4 Treatment and disposal of non-hazardous waste
  - 3.4.1 Incineration
  - 3.4.2 Landfill
  - 3.4.3 Other treatment and disposal
- 3.5 Measurement, control, laboratories and the like
- 3.6 Other activities

4 PROTECTION OF SOIL AND GROUND WATER

- 4.1 Prevention of pollutant infiltration
- 4.2 Decontamination of soils
- 4.3 Measurement, control, laboratories and the like
- 4.4 Other activities

5 NOISE AND VIBRATION ABATEMENT
(excluding workplace protection)

- 5.1 Noise and vibration from road and rail traffic
  - 5.1.1 Preventive in-process modifications at the source
  - 5.1.2 Construction of anti noise/vibration facilities
- 5.2 Air traffic noise
  - 5.2.1 Preventive in-process modifications at the source
  - 5.2.2 Construction of anti noise/vibration facilities
- 5.3 Industrial process noise and vibration
- 5.4 Measurement, control, laboratories and the like
- 5.5 Other activities

6 PROTECTION OF BIODIVERSITY AND LANDSCAPE

- 6.1 Protection of species
- 6.2 Protection of landscapes and habitats
  of which:
  - 6.2.1 protection of forests
- 6.3 Rehabilitation of species populations and landscapes
- 6.4 Restoration and cleaning of water bodies
- 6.5 Measurement, control, laboratories and the like
- 6.6 Other activities

7 PROTECTION AGAINST RADIATION
(excluding nuclear power stations and military installations)

- 7.1 Protection of ambient media
- 7.2 Measurement, control, laboratories and the like
- 7.3 Other activities

8 RESEARCH AND DEVELOPMENT

- 8.1 Protection of ambient air and climate
  - 8.1.1 protection of ambient air
  - 8.1.2 protection of atmosphere and climate
- 8.2 Protection of ambient water
- 8.3 Waste
- 8.4 Protection of soil and ground water
- 8.5 Abatement of noise and vibration
- 8.6 Protection of species and habitats
- 8.7 Protection against radiation
- 8.8 Other research on the environment

9 OTHER ENVIRONMENTAL PROTECTION ACTIVITIES

- 9.1 General administration of the environment
- 9.2 Education, training and information
- 9.3 Activities leading to indivisible expenditure
- 9.4 Activities not elsewhere specified

Classification of Environmental Protection Facilities

1 PROTECTION OF AMBIENT AIR AND CLIMATE

1.1 Dedusting equipment, filters
Industrial establishments equipped for the treatment of exhaust gases [percentage for NACE two digit categories; percentage of thermal electricity generation plants]

1.2 Air monitoring installations [number of measurement sites by type of compound monitored; number of measurements per year; number of mobile equipments]

- 1.2.1 Stationary sites in built up areas
- 1.2.2 Stationary sites in open areas
- 1.2.3 Mobile sites

2 WATER MANAGEMENT AND PROTECTION

2.1 Sewerage networks (in kilometres)

2.2 Waste water treatment installations [number; capacity in terms of population equivalents or COD]

- 2.2.1 Mechanical treatment technology
- 2.2.2 Biological treatment technology (excluding septic tanks)
- 2.2.3 Advanced treatment technology
- 2.2.4 Septic tanks

2.3 Monitoring installations [number of measurement sites; number of mobile equip- ments; number of measurements per year and by type of water body monitored]

3 WASTE MANAGEMENT

3.1 Facilities for the treatment of hazardous waste [number; capacity in terms of weight that can be treated by year, by type of waste as applicable]

- 3.1.1 Physical/chemical treatment technology
- 3.1.2 Thermal treatment technology
- 3.1.3 Biological treatment technology
- 3.1.4 Conditioning of radioactive wastes
- 3.1.5 Other treatment technologies

3.2 Facilities for the treatment of other than-hazardous waste [number; capacity in terms of weight that can be treated by year, by type of waste as applicable]

- 3.2.1 Physical/chemical treatment technology
- 3.2.2 Incineration of municipal or similar wastes
- 3.2.3 Incineration of industrial wastes
- 3.2.4 Biological treatment technology
- 3.2.5 Other treatment technologies

3.3 Facilities for the disposal of waste [number of sites]

- 3.3.1 Landfill for all types of waste
- 3.3.2 Landfill exclusively for hazardous waste
- 3.3.3 Containment/underground disposal
- 3.3.4 Other disposal installations

4 PROTECTION OF SOIL AND GROUND WATER

4.1 "End-of-pipe" facilities [number]

- 4.1.1 Soil surface sealing including ditches and walls, drainage systems
- 4.1.2 Catchments for run-offs, losses, leaks
- 4.1.3 Improvement of underground storage and transport facilities in the interest of ground water and soil protection
- 4.1.4 Removal of underground storage and transport facilities in the interest of ground water and soil protection

4.2 Reservoir liners, reinforcement of transport systems for hazardous products and other integrated facilities [number]

5 NOISE ABATEMENT

5.1 Noise barriers: roads, railroads, airports [in kilometres]
5.2 Equipment for follow-up and control of noise [number of sites and measurement equipments]

Annex 2 – functional classification

Relevant COICOP categories

Division 4 – housing, water, electricity, gas and other fuels

- 04.4 Water supply and miscellaneous services related to dwelling
  - 04.4.1 Water supply
  - 04.4.2 Refuse collection
  - 04.4.3 Sewerage collection
  - 04.4.4 Other

Division 13 - individual consumption expenditure by NPISH

- 13.8 Environmental protection

Relevant COPNI categories

Division 08. Environmental protection

- 08.1.1 Environmental protection services
- 08.1.1 R and D

Relevant COFOG categories (selection)

04. Economic affairs

- 04.2 Agriculture, forestry, fishing and hunting
  - 0.4.2.2 Forestry
  - 0.4.2.3 Fishing and hunting
- 04.3 Fuel and energy
- 04.4 Mining, manufacturing and construction
  - 0.4.4.1 Mining of mineral resources other than mineral fuels

05. Environmental protection

- **05.1 Waste management**
- **05.2 Waste water management**
- **05.3 Pollution abatement**
- **05.4 Protection of biodiversity and landscape**
- **05.5 R and D**
- **05.6 Other**

06. Housing and community amenities

- 06.3 Water supply

Annex 3 – Relevant categories in activity classifications

Annex 3.1 - ISIC categories which identify environmental protection activities a)

ISIC Rev. 3 Code	Category
37	*Recycling*
41 b)	*Collection, purification and distribution of water*
51	*Wholesale trade and commission trade, except of motor vehicles and motorcycles*
5149 (part of)	Wholesale of other intermediate products, waste and scrap
73 (part of)	*Research and development*
74	*Other business activities*
7421 (part of)	Architectural and engineering activities and related technical consultancy
75	*Public administration and defence; compulsory social security*
7512 (part of)	Regulation of the activities of agencies that provide health care, education, cultural services and other social services, excluding social security
90	*Sewage and refuse disposal, sanitation and similar activities*

a) This list is not exhaustive. Environmental protection activities may also be part of other ISIC Divisions and Classes. Please also note that not all output of these activities is environmental protection output.
b) Part of Resource Management

Annex 3.2-Environmental activities in the North American Industry Classification System (NAICS)

The North American Industry Classification System (NAICS) provides common industry definitions for Canada, Mexico and the United States.

22 Utilities
- 22.13 Water, sewage and other systems
  - 22.13.1 Water supply and irrigation systems*
  - 22.13.2 Sewage treatment facilities
  - 22.13.3 Steam and air-conditioning supply*

23 Construction
- 23.49 Other heavy construction
  - 23.49.1 Water, sewer, and pipeline construction**

54 Professional, scientific, and technical services
- 54.16 Management, scientific, and technical consulting services
  - 54.16.2 Environmental consulting services

56 Administrative and support and waste management and remediation services
- 56.2 Waste management and remediation services
  - 56.21 Waste collection
  - 56.22 Waste treatment and disposal
  - 56.29 Remediation and other waste management services

71 Arts, entertainment, and recreation
- 71.2 Museums, historical sites, and similar institutions
  - 71.21.9 Nature parks and other similar institutions

81 Other services (except public administration)
- 81.33 Social advocacy organisations
  - 81.33.12 Environment, conservation and wildlife organizations

92 Public administration
- 92.4 Administration of environmental quality programs

Notes: *…part of Resource Management, **…some part of this activity relates to Resource Management

Annex 4 - Classification of the environment industry

A POLLUTION MANAGEMENT group

Production of equipment and specific materials for:

1. Air pollution control.
2. Wastewater management.
3. Solid waste management:
   - 3.1 Hazardous waste collection, treatment and disposal;
   - 3.2 Waste collection, treatment and disposal;
   - 3.3 Waste recovery and recycling (excludes manufacture of new materials or products from waste and scrap).
4. Remediation and clean-up of soil, surface water and groundwater.
5. Noise and vibration abatement.
6. Environmental monitoring, analysis and assessment.
7. Other.

Provision of services for:

8. Air pollution control.
9. Wastewater management.
10. Solid waste management:
    - 10.1 Hazardous waste collection, treatment and disposal;
    - 10.2 Waste collection, treatment and disposal;
    - 10.3 Waste recovery and recycling (excludes manufacture of new materials or products from waste and scrap).
11. Remediation and clean-up of soil, surface water and groundwater.
12. Noise and vibration abatement.
13. Environmental R&D.
14. Environmental contracting and engineering.
15. Analytical services, data collection, analysis and assessment.
16. Education, training, information.
17. Other.

Construction and installation for:

18. Air pollution control.
19. Wastewater management.
20. Solid waste management:
    - 20.1 Hazardous waste collection, treatment and disposal;
    - 20.2 Waste collection, treatment and disposal;
    - 20.3 Waste recovery and recycling (excludes manufacture of new materials or products from waste and scrap).
21. Remediation and clean-up of soil, surface water and groundwater.
22. Noise and vibration abatement.
23. Environmental monitoring, analysis and assessment.
24. Other.

B CLEANER TECHNOLOGIES AND PRODUCTS group

Production of equipment, technology, specific materials or services for:

1. Cleaner/resource-efficient technologies and processes.
2. Cleaner/resource-efficient products.

C RESOURCE MANAGEMENT group

Note: For this group, activities aimed at the production of environmental goods and services and related construction are grouped together for convenience. However, it is suggested that, wherever possible, information on these items be separately collected and presented.

Production of equipment, technology and specific materials, provision of services, and construction and installation for:

1. Indoor air pollution control.
2. Water supply.
3. Recycled materials (manufacture of new materials or products from waste or scrap, separately identified as recycled).
4. Renewable energy plant.
5. Heat/energy saving and management.
6. Sustainable agriculture and fisheries.
7. Sustainable forestry.
8. Natural risk management.
9. Eco-tourism.
10. Other (*e.g.* nature conservation, habitats and biodiversity).