INTEGRATED ENVIRONMENTAL AND ECONOMIC ACCOUNTING (SEEA) Rev. 1

1 PREFACE

1.1 Purpose and process of SEEA revision

UNSD published an interim SEEA handbook in 1993

Since 1993 numerous national statistical offices have published environmental accounts

1.2 Objectives of this revision:

harmonisation and standardisation of different approaches and concepts and definitions where possible

clarification/elaboration of SEEA concepts, definitions, classifications and accounting procedures

discussion of policy uses

1.3 Process of revision:

UNSD invites London Group in the revision process

UNSD to ensure transparency (use of Internet) and participation of other countries, IGOs and NGOs not participating in the London Group

result: SEEA rev. 1 handbook to be issued as United Nations publication: still technical report, but possibly endorsed by the Statistical Commission

1.4 History of SEEA development

1.4.1 International mandates

Statistical Commission of the United Nations (1991) endorsed the development of environmental satellite (of SNA) accounts

Rio Earth Summit confirmed satellite approach and requested development and implementation of integrated environmental and economic accounting (1992)

Statistical Commission welcomed collaboration of UNSD with the London Group on the SEEA revision (1997)

1.4.2 International work on environmental accounting

IARIW Special Conferences laid the foundations for SEEA handbook (1991) and assessed the state of the art (1996)

World Bank organised two seminars (199? and 199?) on environmental accounting participants included leading academics and practitioners

In 1994 an annual meeting of environmental accountant practitioners “The London Group” was established to share experience. Membership consisted of countries and international organisations actively undertaking environmental accounts work

In 1995 the European Commission proposed that member states should develop environmental accounts along the lines of the Dutch NAMEA

In 1997 the London Group reviewed SEEA and further developed concepts and methods of environmental and natural resource accounting

Nairobi Group developed hands-on approach to SEEA implementation (including software) by means of an operational manual (draft on the Web, to be published in early 1999)

1.5 Work-in-progress character of SEEA handbook

CHAPTER 1

FRAMEWORK FOR ENVIRONMENTAL ACCOUNTS

1 Rationale for environmental accounting

1.1 Why calculate environmental accounts?

The impact of the economy upon the environment is an increasingly important policy issue. The emphasis has changed considerably since the 1940s when national accounts were first developed, as concern about the sustainability of economic growth has assumed an increasingly high political profile.

[Bring in here Rob's good stuff on the need for a more general model] The purpose of national accounts is to support policy making, especially at the level of the national economy. This is achieved by taking stock of past events in a systematic way, so that the accounts can be used as the basis for analysis and prediction. However, the conventional accounts do not take full account of the use of natural resources by the economy, either in terms of its use as inputs to the production process, or in terms of any unsustainable impact that the economy might have on the environment. [This issue is dealt with more fully in other parts of the introduction - it might be better to bring it together here.] Environmental accounts expand the compass of the national accounts, by integrating environmental information into the accounting framework. In this way they provide the link between national income accounting and measures of sustainable development. [The discussion of the link with sustainability might also be better here.]

1.2 The advantages of an accounting approach

The accounting approach brings a valuable discipline to environmental information since it:

- encourages the adoption of standard classifications in environmental statistics, which improve the value and relevance of existing environmental information;
- brings a new dimension to environmental statistics, both by viewing the state of media such as air and water in terms of a balance sheet, and by the application of concepts such as physical input-output tables to measure the flow of material goods through the economy;
- provides a link with the economic information contained within the traditional accounts, leading to improvements in the reliability and coherence of both sets of information;
- facilitates international comparisons.

Further the comprehensive nature of the accounts provides the opportunity for analysing the direct and indirect effects of economic and environmental policies.

1.3 Applications of environmental accounts [I've taken this bit to section 4.6 on policy uses (once Chapter 6 has been fleshed out more) but suggest we replace with a section on who this chapter is aimed at]

2 Linkages between the Environment and the Economy

2.1 Defining the economy and the environment

Implicit in the idea of an environmental-economic accounting system is the idea that the economy and the environment are separately identifiable. Yet it is not possible to define a distinct physical boundary between the two. In attempting to do so, one is confronted with many areas where the economy and environment overlap and interact in physical terms. Economic activities, logging and mining for instance, often take place in wilderness areas. Conversely, a variety of animals enjoy quite a good life within the walls of factories. That this is so is simply evidence of the fact that, in physical terms, the global economy is a sub-system of the global environment.

Although the environment and the economy are inextricably linked physically, it is useful to distinguish between them conceptually. Doing so allows one to conceive of and study the set of activities that can be considered purely economic and, in turn, to understand how these economic activities impact on the environment. This is one of the principal objectives of the SEEA.

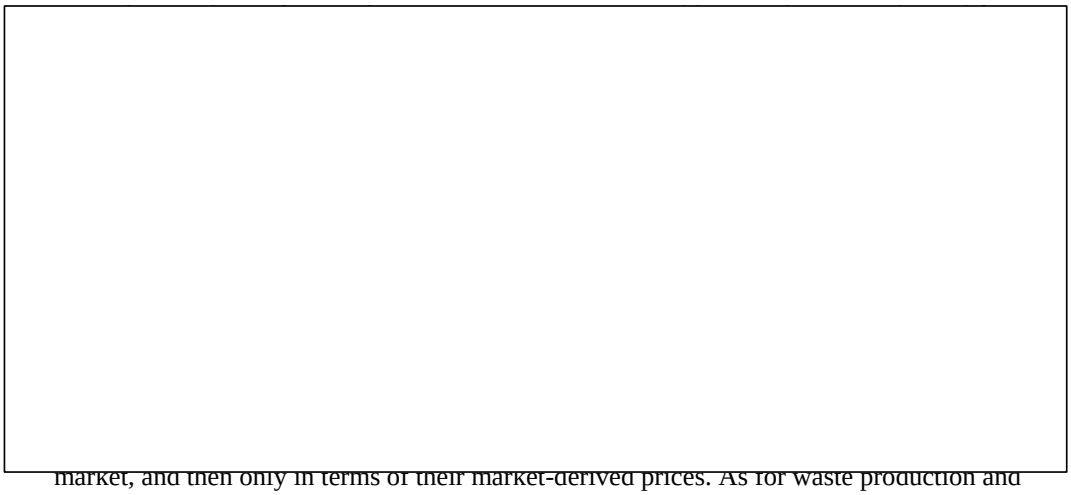
One way to establish a conceptual distinction between the economy and the environment is to define the **economy** as the collection of activities that use materials, energy or human skills to produce goods and services that can be exchanged for money (or for other commodities) *including* the use of these commodities by their final purchaser. By this definition, an economy may be described at practically any scale, from a town to a region, to a nation, to the globe as a whole. The **environment**, for its part, can be defined as the physical surroundings in which the economy operates and to which it is physically linked. Like the economy, the environment may be described at several levels: local, regional, national, continental or global. When one is considering the physical links between the economy and the environment, it is important to remember that a local economy can have physical impacts well beyond its local environment, just as a national economy will undoubtedly have an impact on the environment at the continental level and, if it is a large economy, at the global level.

Of course, the complexity of economic systems in terms of the varieties of materials and energy forms used, the commodities produced, and the human skills employed increases as their size and sophistication increases. Even in a small, local economy this complexity can be quite high. Dozens of commodities may be produced, using a variety of different materials, several energy sources and many individual human skills. Needless to say, when the economy of a nation or the globe is considered, the complexity becomes overwhelming.

This complexity has always presented a challenge to those who manage economic affairs. Such people would like, among other things, to precisely predict the effect on future prosperity of decisions and actions in the current period. To do this, they are forced to resort to simplified conceptions of the economy to make their problem tractable. Until very recently, the conceptual model of the economy that informed most of the field of economics, including national accounting, looked something like that portrayed in Figure 1. There are three elements of this “circular-flow framework” that are important to note.

First is the use of market-based activity as the boundary for the framework. This boundary is chosen for a number of reasons, but mainly because market-place activity encompasses the majority of activity in modern economies. Any activity that occurs outside the market is considered to be of marginal importance in overall production in this model. Of course, this

choice excludes from consideration any activity or process that could be defined as economic but in which no money changes hands; housework is a good example of such an activity that is of significance within the economy.



market, and then only in terms of their market-derived prices. As for waste production and disposal, these are not explicitly included in the circular-flow framework. However, to the extent that waste disposal is an activity for which money is exchanged in the market, the value of this exchange is implicitly included in Figure 1. Waste disposal for which no market exchange occurs, when the free waste assimilation capacity of the environment is used for example, is not included in the circular conception. The services of the environment in this regard are taken for granted.

2.2 The Need for a More General Model

Figure 1 shows a circular flow of money through the economy. People buy goods and services from firms; firms pay out dividends and wages to their shareholders and employees, this income is used to finance further consumption. Because of technological developments and the accumulation of capital there is a tendency for the economy to grow over time.

This model does not analyse the extent to which the economy relies upon the environment as a source of raw materials and energy and as a sink in which to emit wastes .

Shadowing the economic flows shown in Figure 1 is a linear flow of energy and materials through the economy. Matter and energy resources are drawn from the environment. They are converted into useful goods and services, a proportion of which are recycled and used once again within the economy. Eventually they will be returned to the environment as material waste and low temperature heat. The first law of thermodynamics requires that matter and energy cannot be destroyed by the economic process. As much matter and energy is left after the economic activity as before.

The economy requires this steady flow of materials and energy from the environment. Likewise, if the environment were somehow not available for use as a waste sink, we would be forced to fully treat all our wastes ourselves.

The second law of thermodynamics (the entropy law) reminds us that we need an external source of energy. Simply put, this second law tells us that in a closed system there is a tendency for high potential energy to become converted into low potential, less versatile energy which is less economically useful. For instance a cup of boiling hot water left in a cold room will slightly raise the temperature of the room as it cools. The energy in the hot water is highly versatile and can be used to dissolve sugar and coffee, generate steam and heat small objects. The dissipated heat has few practical uses. The second law requires that the economy needs an external source of low entropy energy. This external source is, of course, the environment.[1]

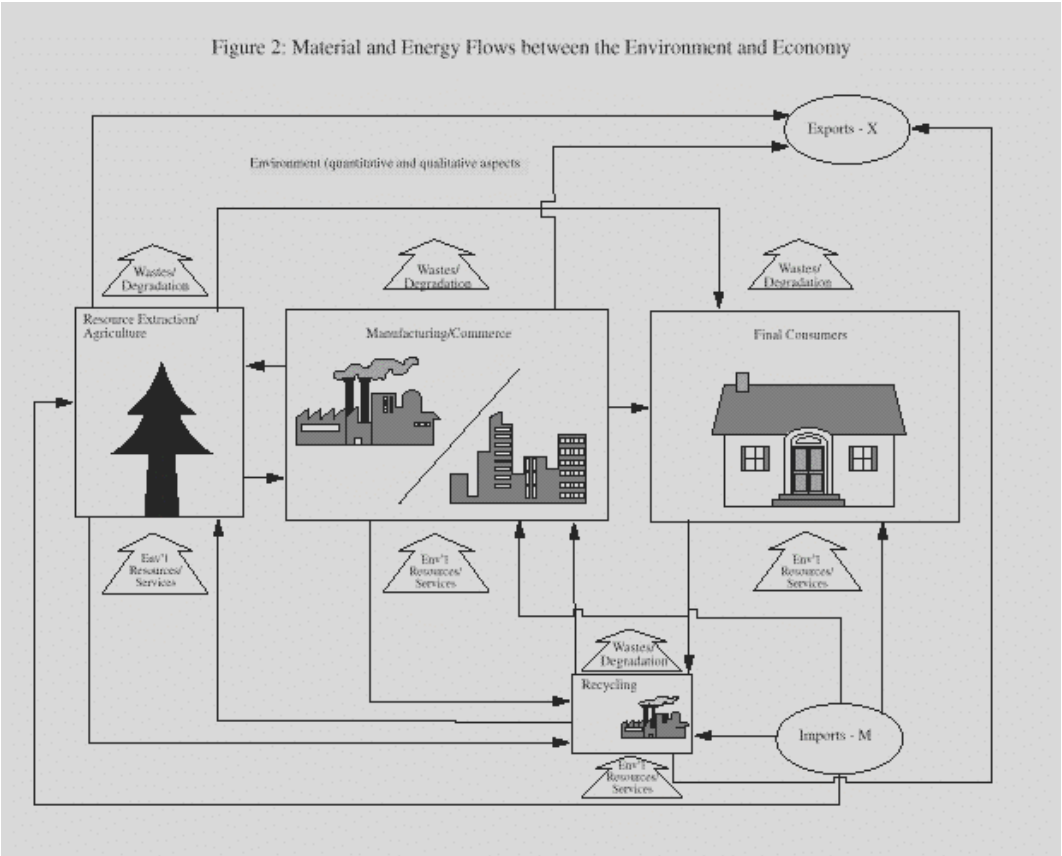
As well as needing a waste sink and an external source of low entropy energy,the economy cannot get by for long without an injection of raw materials. [It was not immediately clear what the other two points were] Material commodities are not of infinite durability and, therefore, require periodic replacement. Moreover, many material goods are not produced with durability in mind, but with the purpose of delivering some short-term service followed by more or less immediate disposal as wastes. Of course, recycling can offset some of the need for virgin material inputs into the production process. Current rates of recycling do not approach those that might be maximally achieved however, in part because of a lack the of necessary social attitudes and technological knowledge, and in part because the cost of virgin materials is often lower than that of recycled materials. In any case, complete material recycling is not practically possible. Even if it were, the economy would still be forced to rely on an external source of raw materials to the extent that the physical quantity of material goods production increased from one year to the next.

The above arguments make it plain that the flows of material and energy between the economy and the environment are of fundamental importance to the operation of the economy. They are also of fundamental importance to the environment, since it is the scale of these flows that largely determines the impact of economic activity on the environment. A more complete conceptual model would therefore represent the economy as a set of transformations of raw materials and energy extracted from the environment into intermediate and finished commodities and finally into wastes that are returned to the environment (Ayres, 1977; 5, Victor, 1972; 18). Figure 2 portrays such a model, which might be called the environment-economy linkage model (EELM).

[As far as I can see, we do not refer anywhere to the final chart (labelled figure 1) at the end of this document. I think it would be better to use/adapt it to replace figure 2. The detail on the sectors is not absolutely necessary (the point of the chart being to demonstrate the physical flows, the physical linkages and the qualitative aspects) and tends to clutter the chart, while the nature of the flows and the relationship with the rest of the world environment are not well covered. I think an adaptation of the final "figure 1", with pictures and wider arrows as desired, would serve the context better.]

1 Note that the second law does not imply that the economy must be connected to the earthly environment to ensure a steady supply of energy for conversion into work (or high quality energy). Solar energy is of high quality and can be directly converted into electrical work by photovoltaic cells. However, current technology and market conditions are such that only an extremely small portion of the total energy consumption of the global economy is supplied by direct solar energy. It seems unlikely that this situation will change in the near future, so the earthly environment will remain the primary source of high quality energy for the time being.

Figure 2: Material and Energy Flows between the Environment and Economy



not only in terms of depleting natural resources but also by degrading the quality of natural systems. For another, because the economy relies upon high quality natural systems for the provision of services such as clean air and water [and natural landscapes.] [Not sure whether this refers to natural landscapes which have recreational value, or does it refer to eco-tourism? It's clearer without it.] [Peter has commented that it is often possible to quantify qualitative changes, but the issue of quality is clearly still a point worth drawing out from the chart.]

3 National accounts and Environmental accounts

3.1 SEEA and SNA: links and extensions

[Environmental accounts draw on SNA concepts and principles

The satellite approach: modifying, elaborating and extending the central framework of SNA while maintaining consistency.]

2 [Strictly speaking, the recycling sector is a sub-sector of the manufacturing/commerce sector. It is shown in Figure 2 as a unique sector because of its importance as a node in the material flow network.]

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National accounts establishes two boundaries that set limits on the definition of goods and productive activities. These are:

- the asset boundary, and;
- the production boundary.

The **asset boundary** defines the types of goods that can be classed as economic assets. To be so defined a good must be of economic value and be under the ownership or control of an economic agent. Under this definition sub-soil assets are included as economic goods since they are of value and ownership can be established. However environmental goods and services such as fresh air and the detoxifying properties of the soil microbial organisms are not included since no ownership rights are enforced even though economic activity would be inconceivable without either.

The **production boundary** defines transactions between economic agents that count as productive activities. Put bluntly transactions are counted as productive when one economic agent pays another economic agent for the good or service that is exchanged. There are a few exceptions to this rule. The most significant is owner occupation of a house. Owner-occupiers of homes are treated as they were paying a notional rent to themselves.

Loss of environmental assets, for instance the reduction of oil and gas from a deposit or the loss of climate stability through the release of carbon dioxide into the atmosphere, are not counted as negative production. However the income earned from these activities (the market value of the oil, the money earned from the combustion process) is counted as productive activity. A frequent complaint against national accounts is therefore that they 'credit' environmentally harmful activities without 'debiting' the value of the loss to the environment.

Conceptually the inclusion of natural assets in the asset account and the recording of monetary losses to the environment in the production accounts can be thought of as extending the definition of the asset boundary and the production boundary. [Peter has argued that the production boundary requires no extension, by which he means (I think) that the physical impacts of economic activity upon the environment all take place within the production boundary. Is this a debate which has been had before and already been resolved? I think if we introduced a system of accounting which scored the environment (Mother Nature plc) as an economic player then we would be extending the production boundary, and this is perhaps what Chapter 5 does implicitly. But the creation of physical accounts is conceptually different and much of it takes place as part of production activity - we are extending the accounts to record different types of transactions in different units.

Hence I propose changes to this para and also to section 4.1 para 4, figure 3, section 4.4 para 1 etc. Note also that as the asset and physical flows accounts have not so far been defined in this chapter I have not used those terms.] This means that instead of restricting the definition of assets to things that can be owned and that have a market value the environmental asset accounts include environmental services that are none the less essential to economic (and environmental) viability. Rather than restricting the production boundary to transactions where money is exchanged, the environmental accounts make it possible to record non-market transactions between the environment and the economy. The satellite account approach allows us to make these changes without altering the content of the standard national accounts.

3.2 Alternative units of measurement in environmental accounts

The national accounts are measured in monetary units. In the case of the environment, physical quantities are frequently more relevant than monetary quantities, since environmental policy is often expressed in terms of physical data on concentrations and emissions. For most purposes, quantities of scarce material resources, especially biological resources such as fish, topsoil and timber, can be more meaningfully measured in physical units.

Systematic physical information remains an essential component of both economic accounts and environmental policy making. This revision of the handbook for a System of Economic and Environmental Accounting therefore places greater emphasis on and elaborates in greater detail physical accounting measures.

The revision also recognises that there is a strong demand for a single index of well-being that integrates economic performance, environmental quality, income inequality and social conditions. Such an index would have to be expressed in monetary terms. In order to calculate a single environmentally (and possibly socially) adjusted GDP, explicit values would need to be placed on goods and services provided by the environment which do not have a directly observable market price. The information that would be required to calculate such an adjustment to GDP would need to include much of the data outlined in the description of the physical accounts.

3.3 Accounting in physical units

A detailed understanding of the relevance of the physical data to particular applications is necessary when developing environmental accounts. However the choice of unit is not always obvious. Forestry, for example, might be described in terms of area, volume of timber or biodiversity. Each measure is useful from a particular policy viewpoint, but adds to the potential complexity of the accounts.

Items in an environmental assets account and in accounts which record the physical flows of resources and energy can either be expressed in units such as mass, volume or some measure of environmental pressure. Often resources will be measured in terms of their physical mass or their energy equivalent. For instance the stock of oil can either be described in terms of its mass or its energy content (giga-joules). Waste emissions will be measured either in terms of their mass or in terms of their equivalence with regards some environmental problem, for instance their Global Warming Potentials. Often it is convenient to express resources or contaminants that contribute to a common environmental problem in the same unit, by applying a weighting factor pertaining to the environmental theme to the amount of individual contaminant.

Comment [RBS1]: Volume (metres cubed) is more likely for oil.

This handbook seeks to give guidance on the most appropriate units to use for articulating the physical accounts. Physical accounts measured in mass lend themselves to accounting since matter can neither be created nor destroyed within an economic transaction[3]. The Conservation of Mass principle is similar to the accounting identity equating the income earned from employment and capital, to the total expenditure by final demand and the difference between industrial output and intermediate consumption. The total material inputs into the economy = total output + total waste, adjusted for changes in capital stock and work-in-progress. The same is

[3] Except for nuclear reactions

true of any sector, industry and even industrial process. Chapter 3 (section 1.B.2) describes this in more detail.

3.4 Valuation of environmental goods and services

If measures of resources and contaminants within the environmental accounts use different units they cannot be readily compared with one another or with the economic accounts. To allow such comparisons it is necessary to monetise the physical accounts. Chapter 5 of the handbook describes techniques for converting environmental assets and flows into monetary terms. The national accounts are of course measured in market prices. These prices reflect a balance between the demand and supply for goods and services. Such a balance between supply and demand incorporates the cost of producing the goods and services and also the willingness of consumers to pay for the goods and services. It also embodies an assessment of quality within the price, which might be difficult to convey in a purely physical description.

Natural resources are extracted rather than produced by the economic process. The price at which they are traded reflects the balance between the cost of extraction and the demand for the good. The price does not include the cost of creating the oil this is a geological process (for renewable assets this would be a natural process) nor the cost of replacing non-renewable assets with those from sustainable sources. The techniques for valuing these resources are relatively straightforward and are discussed more fully in Chapter 5.

Similarly the waste emissions are not usually transacted on the market at all. Techniques used to value wastes and environmental degradation can broadly be split into two sorts: costs of emissions abatement and costs generated from hypothetical markets (such as contingent valuation). With some environmental goods and services prices exist in surrogate markets (damage cost estimates, hedonic prices) which can act as a proxy market for valuation purposes. Using different techniques often produces significantly different valuations for the same environmental features.

Comment [RBS2]: What about the more straightforward techniques used to value stocks of sub-soil resources? Are these not “environmental goods?” If not, we must define clearly what they are and how they are differentiated from other resources.

[classifications of industries, domestic economy / rest of the world, distinction between flows and stocks

Basic approach: extension of the SNA asset and production boundaries:

modification of classifications: environmental expenditures, asset and asset change

asset accounts: treatment of other volume changes, introduction of environmental assets

stocks and flows of materials in physical units

environmental costing in production and income accounts]

4 Modules of the environmental accounts

4.1 The modular framework

Section 2 of this chapter described the interactions between the economy and the environment which environmental accounting seeks to capture. Section 3 described some of the links between the SNA and the SEEA and some of the issues involved in producing environmental accounts. This section shows how these interactions can be placed into the framework of the national accounts and thus integrated with economic statistics. It draws upon the existing conventions and definitions of national accounts and describes how these can be systematically extended or adapted to include environmental concerns within the framework.

In order to operationalise the development of environmental accounts this handbook proposes the development of a series of accounts. These modules do not have to have to be calculated sequentially. Indeed there is no requirement for every one to be calculated. The modules are as follows:

- Asset accounts (Chapter 2)
- Physical flows accounts (Chapter 3)
- Environmental protection expenditure accounts (Chapter 4)

The physical flows account and the environmental protection expenditure accounts are linked to the supply and use tables in the economic accounts through the use of consistent industrial and product classifications.

The **asset accounts** contain data on the stock of environmental assets at the start and the end of the accounting period and categorise the changes that arise during the accounting period. The physical **flows accounts** are concerned with sectorally disaggregating the changes arising during the accounting period. Typically they contain details of how the environmental assets are used by economic sectors, the flow of matter between the economy and the environment and the use of energy by the economy. [The energy account typically only covers the flows within the economy, not the full account between the economy and the environment] The **environmental protection expenditure accounts** contain data on actual expenditures in the economy arising for example from environmental regulation and data on the revenue from environmental taxation [There is an issue here about the coverage of environmental taxation in Chapter 4 which I will contact Anton about separately].

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Figure 3 shows how the elements shown in Figure 2 can be incorporated into the national accounting framework. [This figure does not seem to relate well to figure 2. The latter specifically covers recycling, degradation, imports and exports, which do not explicitly feature in figure 3. The coverage of physical flows is not obvious - one has to deduce that emissions equates to the output waste and degradation - and it does not seem to cover physical flows within the economy very clearly. As I commented on section 3.1 above, we need to make a clearer distinction here between the physical accounts and the extension of the production boundary to cover Mother Nature plc. I suspect the physical flows account needs to be shown more like the monetary supply and use tables. I'm not sure we have to hand the Canadian 1997 accounts - perhaps Rob could circulate a version of the chart he's referring to.

Comment [RBS3]: I find Figure 3 difficult to follow. You might want to consult the figure we published in our 1997 guide to the Canadian accounts as an example of what I think is a cleaner presentation.

The emissions abatement matrix seems to me to be inappropriate, as it refers to events (transactions between the environment and the economy) which did not take place but which otherwise would have taken place. I cannot see how such a matrix can be consistent with national accounts principles. It seems much more like a piece of analysis, such as indicators, which need not be dealt with here.

The title to the asset account should read "OUTSIDE THE ASSET BOUNDARY"; the units are presumably in monetary terms.]

The environmental expenditure and flow accounts can be thought of as:

- re-categorisations of existing items in the supply and use tables to highlight environmentally significant flows (Environmental protection expenditures);
- supply and use tables expressed in physical terms (Physical flows).

Figure 3: Links between the environmental accounts and the national accounts

Flow accounts

Monetary units — **THE PRODUCTION BOUNDARY**

	Industries	Purchases by industry	
Product groups	Supply matrix	Combined use matrix **Environmental costs** **Environmental protection expenditures**	Final demand
		Value added Imports, product taxes	
		Gross output	

Monetary or physical units — **OUTSIDE THE PRODUCTION BOUNDARY**

Natural resource usage

Non-renewable resources
Renewable resources

Emissions abatement	**Emissions**
Emissions reductions	**Emissions**

Asset accounts

OUTSIDE THE PRODUCTION BOUNDARY

	Economic assets	Renewable resources	Non-renewable assets	Environmental services
Opening stock				
Depletion / harvesting				
Regrowth				
New discoveries				
Reclassifications				
Other volume changes				
Closing stocks				
Revaluations				
Closing stocks				

4.2 Supply and Use tables [I think a section like this is needed, if we are to target more general readership in this chapter.]

The Supply and Use tables [within the production boundary rectangle] are the main link between the core national accounts and the physical flows accounts. The supply table describes the production of goods and services by industries within the economy. Columns of the supply table represent the sectors manufacturing the goods and the rows of the tables the goods being made. Most of the entries lie on the main diagonal (top left to bottom right) of the table.

The (combined) use table describes the sales of goods and services from one sector to another sector or to final demand. The columns of the use table show the purchasing industries and the rows show the products being bought. The rectangle below the Use table gives the value added by each industry. This is the difference between the value of the sales from the industry and the purchases from other industries. Expenditures that count towards value added include wages, pre-tax profits and direct production taxes. Industries utilise a proportion of their profits (and borrow) to finance investment in new capital items. Both these tables, like the rest of the core accounts, are measured in financial units.

Comment [RBS4]: Why are we on to Supply and Use Tables now? Are we still talking about the modular framework, or is this a new sub-section? Section numbering would really help the reader keep track of where he's at.

Comment [RBS5]: I find this paragraph and the next far too detailed for an introductory chapter. Presumably, the definition of supply and use tables will be spelled out in detail in chapter 3 and need not be here.

4.3 Asset accounts (Chapter 2)

The environmental asset accounts can be thought of as extending the conventional stock accounts to include categories of assets excluded from the core accounts. Broadly environmental assets can be split into two sorts, environmental resources and environmental services. Environmental resources are withdrawn from the environment and converted into economic goods. They can be further split into three sorts:

- Fully renewable assets: water;
- Conditionally renewable assets: fish, endangered species, forests;
- Non-renewable assets: fossil fuels, high grade metal ores.

Renewable assets are capable of natural regeneration and not presently in danger of being used up or made extinct. They can however become scarce at particular times or in particular regions due to over exploitation or failure of natural renewal processes. Conditionally renewable assets, such as fish and many endangered species, are under great pressure and there is a real risk that populations might respectively collapse, become extinct through human pressure. Non-renewable assets are being run down over time.

The second category of environmental asset is environmental services. Examples of environmental services include fertility of soil, detoxification properties of rivers and seas, opaqueness of the ozone layer to UV radiation. Economic activities use these 'in situ' properties of the environment. Ideas such as ownership cannot meaningfully be applied to environmental services. Often there is no convenient means of even quantifying these services, although it may be possible to classify them in terms of absorption capacity, for detoxification services.

The services provided by land such as biodiversity and visual amenity fall into the latter category. Because the quality and quantity of environmental services provided

by land is itself a function of the stock of land in a particular use it is convenient to associate the land accounts to data on land use rather than the stock of land *per se*.

This categorisation of assets is useful because different techniques will be needed in order to value different types of asset.

This is easiest to do for as yet undeveloped "pre-market" assets such as sub-soil assets and available supplies of water. Once these are developed and enter into economic control well-defined prices often exist. It is more difficult to quantify and value environmental services such as decomposition of sewage by rivers, or the screening of UV radiation by the ozone layer in these terms (see Chapter 5). [presumably]

Comment [RBS6]: Again, the reader is left wondering "So what?"

4.4 Physical flows accounts (Chapter 3)

The physical flows accounts show the flows of resources and wastes into and out of an industry respectively. They are measured in physical terms [or monetary costs (including environmental valuations) - chapter 5 deals with valuations].

Comment [RBS7]: Not in all instances. Marketed natural resources are already within the production boundary of the SNA. The only difference in the environmental accounts is that the flows of these are measured in physical as well as monetary units.

[We have already noted that the environmental costs of exploiting natural resources and releasing contaminants do not directly appear in an industry's expenditures since these 'non-financial' costs are not seen in the market. The value added figure for an industry does not reflect these 'non-financial' costs except to the extent they have a financial counterpart in the economy (such as a fine paid to a regulator for breaching an official limit, or a claim paid to a victim as compensation for the effect of pollution). - this para deals with monetary, not chapter 3 issues.]

Comment [PV8]: The same ("non-linearity" between production and emissions can be said for emissions account. I don't see much point in carrying out environmental expenditure surveys unless we are interested in how effective they are in reducing emissions

[In the environmental accounts extra accounts are added beneath the economic accounts 'use' table to symbolise non-market resources used by sectors, additional to the intermediate purchases and factors of production that are already 'used' by sectors. Two extra modules can be added below the use table. These are the **Natural resource use** module which contains data on biological, water, mineral and energy resources extracted from the environment. The **Emissions** module contains information on the wastes released into the environment. Data for the latter can be aggregated into environmental themes condensing the large number of separate contaminants into a shorter list of environmental concerns. Redraft when we agree on the presentation in figure 3.]

Comment [RBS9]: I'm quite sceptical of the possibility of estimating emissions abated and even if were possible to do so, I'm not sure what value there would be to the numbers. Pollution abatement is not a linear process wherein every marginal dollar of expenditure yields the same marginal reduction in emissions. Because it is more costly to eliminate the last unit of emissions than the first, the "efficiency" of abatement will decline over time in a given process. Thus, the aggregate "efficiency" of pollution abatement will depend greatly on where an economy is positioned in terms of technology. An older, dirty economy will be able to reduce its emissions quite cheaply, while a more modern one must spend a lot to become cleaner.

[Conceptually it is possible to think of an **Emissions abatement** module below the supply table. This module contains data on emissions successfully abated as a result of environmental expenditures. It therefore presents the physical "non-market" production arising from environmental regulations. See comments on figure 3 above]

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The physical flows accounts are described in detail in Chapter 3 of this handbook.

4.4.1 Physical flows accounts and national borders

One country's economic activity can impact upon another country's environment in three ways.

- Emissions of global contaminants such as greenhouse gases
- Transboundary flows of emissions such as acid rain gases or river-borne pollutants

Comment [RBS10]: I find the distinction between "emissions of global contaminants" and "transboundary flows" confusing, as greenhouse gases are no less transboundary than acid rain gases. Perhaps it would be clearer to say that a given country can affect the environment outside of its borders through the airborne, waterborne or vehicle-borne transport of its wastes across its borders. These effects can occur at the regional, continental or global scale depending upon the type of pollutant and means of transport.

- Resource use and emissions arising from the production of traded goods ("ecological footprint" of exports)

The first of these is essentially global and has no analogue in the core national accounts. Transboundary flows of emissions are non-market transactions that correspond to imports and exports and can be shown as transfers between the Rest of the World and the domestic environmental theme. The resource use and emissions arising from trade are included in the exporting country's environmental accounts but are usually not separately identified.

4.4.2 Physical flows accounts and accounting periods

Comment [RBS11]: The reader is left thinking "So what?" after reading this paragraph. Beyond just identifying this timing problem, shouldn't we propose some way of handling it? A means of doing so is suggested in the Canadian material and energy flow accounts, although we've never tried to implement it.

There can sometimes be a long time lag between an economic activity and the emissions reported in the flow accounts by an economic sector. For instance metal mines can give rise to contamination of fresh water long after the mine is closed. This discontinuity between the time of the economic output and the emission of the contaminant is also found in landfill sites and most notoriously in nuclear waste production. [Rob - yes, but chapter 3 is intending to cover timing issues]

4.5 Environmental protection expenditure and environmental costs

4.5.1 Environmental protection expenditure (Chapter 4)

Environmental protection expenditure is defined as "capital and operating spending which has been incurred, and can be attributed directly to, the pursuit of an environmental objective". These items are expressed in financial terms and already appear in the core national accounts either as intermediate spending or as investments by industry in compliance with regulatory standards. These expenditures yield *emissions abatement* rather than *marketable output*. As such they represent "polluter pays charges". Environmental expenditure also includes environmental taxation. These are product or emissions charges that raise the price of resources or emissions thereby creating an incentive to reduce throughput of materials or reduce emissions.

The environmental expenditure accounts recategorise existing national accounts flows to highlight environmentally significant items. For instance the conventional use tables (and conventional sources of industrial statistics) make no distinction between purchases to manufacture marketed goods and purchases to abate emissions. These would be separated out in an environmental protection expenditure account. Environmental protection expenditures are described in Chapter 4 of this manual. [Key elements and main uses are....]

4.5.2 Environmental costs [Not sure where these are dealt with - Chapter 5 maybe? - hence I think it OK that they should be dealt with separately here]

Comment [RBS12]: I don't see how "costs" are substantially different from "expenditures." To my understanding, there are two basic categories of environmental protection expenditures that are measured in the account: costs of pollution abatement, and costs of mitigation of previous damage. I see no benefit in treating these two as though they are different from one another.

A second type of financial item related to the environment is actual costs incurred by firms and final demand sectors to mitigate or repair the effects of pollution. These **environmental costs** are from the perspective of victims of emissions. They are "victim pays" estimates of remediating damage rather than "polluter pays" costs of avoiding emissions described in the section above. Examples might be the costs of

cleaning the exteriors of buildings in a smoky area, or the costs of illness brought about by pollution. Such environmental costs are often used as the basis for valuing the environment.

Deleted: ¶

4.6 Policy uses of environmental accounts

The handbook concludes with a discussion of the practical uses to which the accounts can be put to in some detail. These are covered in Chapter 6. For instance the flows shown in the waste accounts can be used to calculate key environmental 'pressure' indicators. {TO BE COMPLETED LATER}[Taking in section 1.3, as below]

Given that environmental accounts are seen as an extension to the conventional national accounts, it is hardly surprising that they can be used to inform policies which have hitherto been based primarily upon an analysis of national accounts data. The link with environmental information means that they can also be used to inform environmental policy decisions. The main areas where environmental accounts might be applied, and the actors that might use them, include the following:

Fiscal policy. Government and pressure groups can use the accounts to develop and analyse the effect of environmental tax policy on the economy and the impact of other tax policies on the environment. The input-output framework allows the impact to be traced through the economy to those indirectly affected by the policy.

Environmental regulations. Government and Statutory Agencies responsible for environmental regulations can apply the accounts to make an assessment of the environmental costs of changes to the regime. The information on environmental protection expenditure can be used to assess the costs of the regulations and their effectiveness.

[Tradeable pollution options?]

Resource Use Management. Some form of basic economic accounting is essential as a foundation for making rational resource allocation decisions. This applies to natural resources as much as to produced capital. It follows that Government and businesses need to account for the consumption of natural capital in much the same way as produced wealth. In practical terms it is not easy - without a large number of qualifying assumptions - to place consistent monetary values on the use of all environmental assets, particularly those natural resources like air and fresh water that are not accounted for directly as inputs to the production process.

The accounts can also be used to inform trade negotiations, by revealing the impact of particular types of trade upon the environment.

Once consistent accounts are available internationally, it will be possible for supranational bodies to use them to facilitate international environmental management.

[Policies to improve the efficiency of capital (?)]

Environmental policy. The information provided by the accounts can be used by non-Government organisations to increase environmental awareness, assess environmental policy options and bring pressure on Government, businesses and consumers to reduce the impact of economic activities upon the environment.

Environmental Damage Control. Businesses and business organisations can use the accounts to benchmark the effect of their own economic activities on the environment compared with the impact of the industrial sector as a whole. The accounts can also be used to improve project appraisal and environmental impact assessments through the production of sectoral pollution coefficients.

Environmental protection sector. Government and businesses can use the accounts to assess the level of environmental protection expenditure and the scope for expansion of the sector. The accounts also provide information on the extent to which revenues from earmarked environmental taxes, fees and charges are fed back to the environmental protection sector.

4.7 Future work and limitations of the present work

To be inserted after finalisation of the manual; might include:

future research agenda (unresolved questions)

case studies

training, technical cooperation programmes

workshops/seminars/special IARIW conference

role of international organizations

special studies of natural resources and environmental concerns

limitations of accounting (Robert I think you suggested this heading, any ideas?) [I guess spatial limitations can be covered here]

limitations of the accounts

based on present best scientific knowledge of harmful substances. This list is always open to review in light of better knowledge

not all emissions are pollution. The damage caused, hence the loss of welfare, is not just a function of the volume of emissions but of the susceptibility of the area of release

non-linear and complex of environmental pressures

valuation based on human preferences, these might be different to rankings based on sustainability

accounting period are a year but some environmental effects are highly ephemeral; for instance an emission of biological oxygen demand, and others very long lived such as the generation of certain radio-nucleotides. The result is a year based account will tend to give the wrong emphasis to the former and ignore the latter except in the year of generation.

["Figure 1" at the end. I discussed this with Alessandra. Our conclusions were

1. Natural resources can be directly consumed by households (ie the arrow should stop at the domestic economy boundary)

2. Internal satellites include environmental costs; eco-industries (great interest now in this amongst EU states)

3. Consumption box to include indents "including household spending on i) environmental protection ii) self-protection (environmental costs)

4. Possibly move use of land to the left (with arrow to stopping at the domestic economy boundary)

5. Move cross boundary flows to the right to correspond with emissions to domestic environment

6. Delete "Rest of the world" in the bottom box

7. Somehow make it clearer that imports includes imports of natural resources

Again, I haven't tried redrawing as I don't trust my graphic skills]

Figure 1 : Interactions between the economy and the environment