REVISION OF THE SYSTEM OF ENVIRONMENTAL - ECONOMIC ACCOUNTS (SEEA)

United Nations Committee of Experts on Environmental Economic Accounting (UNCEEA)

Statistics Division / Department of Economic and Social Affairs, United Nations

Draft Version for Second Round of Global Consultation, October 2011

Chapter 2: Accounting framework

Table of contents

2.1 Introduction

2.1 The SEEA framework describes the interaction between the economy and the environment and on the changing state of environmental assets. It expands the conventional economic measurement framework, the System of National Accounts (SNA), to incorporate flows between the economy and the environment, and highlight environmental activities and expenditures that are not shown explicitly in conventional national accounts presentations. The SEEA framework also incorporates environmental assets both inside and outside of the scope of conventional economic measurement, and records stocks of environmental assets and changes in these stocks over time.

2.2 The framework of the SEEA is based on the accounting framework of the SNA. Consequently, the description of the framework and the associated terminology and language has a strong national accounts basis. At the same time, the SEEA represents a melding of many disciplines (e.g. economics, statistics, energy, hydrology, forestry, fisheries, environmental science) each with its own concepts and structures. Thus while the underlying structure is from the national accounts, the SEEA aims to integrate perspectives from other disciplines, and where relevant, adjust the national accounts perspective to provide an improved set of information for environmental-economic analysis.

2.3 This chapter provides an overview of the SEEA accounting structure and its rules and principles of recording. This overview of the SEEA framework places the various aspects of the economy and the environment in a measurement context. Using the broad framework described in Section 2.2, Section 2.3 presents the accounting framework of the SEEA Central Framework, which is reflected in supply and use tables, asset accounts, the sequence of accounts, functional accounts, and demographic and employment information. Section 2.4 introduces one of the key outputs from the SEEA framework - combined presentations of physical and monetary data.

2.4 Section 2.5 describes stocks and flows in physical and monetary terms and Section 2.6 describes the economic units that are involved. Section 2.7 presents a range of specific accounting rules and principles that form the basis of the recording and compilation of the SEEA accounts.

2.2 Overview of the SEEA Framework

2.5 The SEEA framework describes the measurement of three main areas: (i) the physical flows of materials and energy within the economy and between the economy and the environment; (ii) the stock of environmental assets and changes in these stocks (including information on the condition of ecosystems); and (iii) economic activity and transactions related to the environment (including relevant fixed assets and inventories).

2.6 Central to measurement in these areas are definitions of the economy and the environment. Measurement boundaries are defined such that information can be organised in a consistent way over time, across countries and between different areas of analysis.

2.7 Broadly, the economy functions through the production and importation of goods and services that in turn must be consumed by enterprises, households or government; be exported to the rest of the world; or accumulate to be consumed in the future. Accumulation in this context includes the storage of materials for use in the future and the acquisition of machines and other types of produced assets that are used on an ongoing basis.

2.8 For measurement purposes the economy is represented by both stocks and flows. Stocks of economic assets provide capital inputs to production processes and are a source of wealth for economic units, including households. Many economic assets are produced from economic activity (e.g. buildings and machines) but many are non-produced (e.g. land, mineral resources, water resources).

2.9 The economic value of stocks of assets (e.g. buildings, natural resources, bank deposits) changes over time. These changes are reflected in flows. The flows relating to non-produced assets (for example, discoveries of mineral resources, and losses of timber resources due to fire) are considered to be flows outside the production boundary since the assets themselves are not the output from production processes undertaken by economic units (enterprises, households and government).

2.10 Thus, while the scope of the economy may be considered in terms of the total stock of economic assets (i.e. including both produced and non-produced assets) for the purposes of measuring the interaction between the economy and the environment, the scope of the economy is defined in terms of the production boundary. The production boundary defines the scope of those economic activities that are carried out under the control and responsibility of economic units and that use labour, assets and goods and services to produce outputs of goods and services (collectively known as products).

2.11 The production boundary is significant for the SEEA since all goods and services that are considered to be produced are effectively considered “inside the economy”, while materials that are considered non-produced are “outside the economy”. As an example, timber in natural forests is considered non-produced while timber in plantations forests is considered produced. In the SEEA, flows between the economy and the environment are determined by whether they cross the production boundary.

2.12 For measurement purposes, the environment may also be considered in terms of stocks and flows. In the SEEA, environmental stocks and flows are considered in a holistic way. From a stock perspective, the environment includes all living and non-living components that comprise the bio-physical environment, including all types of natural resources and the ecosystems within which they are located. From a perspective of environmental flows, the SEEA sees the environment as the source of all natural inputs to the economy including natural resource inputs and inputs absorbed by the economy, for example the air used in combustion processes and energy from solar and wind sources.

2.13 The remainder of this section provides additional description on the nature of the measurement of the economy and the environment in the SEEA.

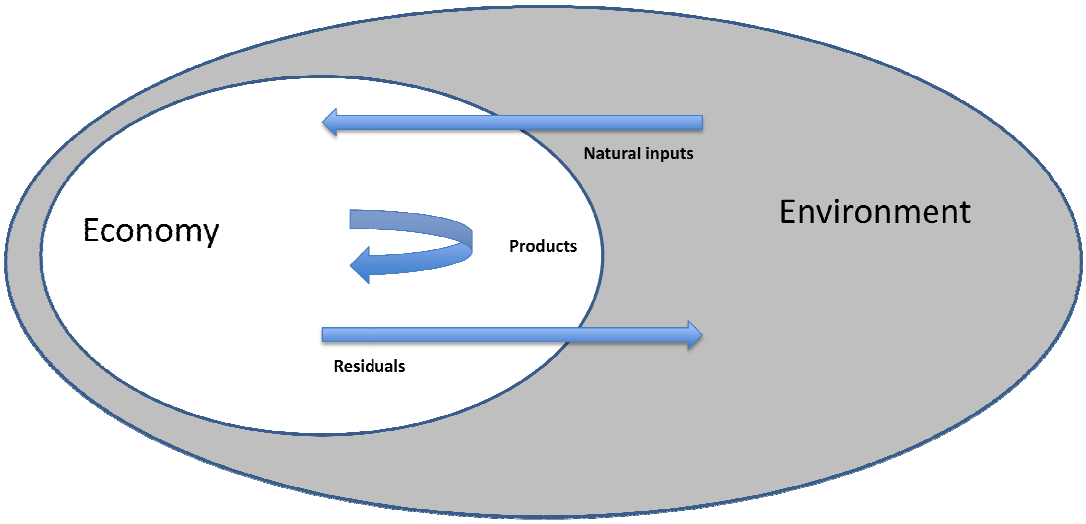
The measurement of physical flows

2.14 A key focus of measurement in the SEEA is the use of physical units to record flows of materials and energy that enter and leave the economy and flows of materials and energy within the economy itself. These measures are called physical flows. In broad terms, natural inputs flow from the environment into the economy (e.g. minerals, energy, timber, fish, water); products circulate within the economy (e.g. electricity, food, clothes); and residuals i.e. the materials and energy discarded, discharged or emitted as a result of production, consumption and accumulation activity – flow to the environment (e.g. solid waste, air emission, return flows of water)[2]. This broad characterisation is presented in Figure 2.2.1.

2.15 Physical flows are recorded in physical supply and use tables. These tables are extensions of the monetary supply and use tables used for the recording of flows of products in monetary terms in the SNA. Sections 2.5 and Chapter 3 provide detailed descriptions of the measurement of physical flows.

[2] It is noted that many residuals also remain within the economy for example solid waste collected in landfill sites.

Figure 2.2.1 Physical flows between the economy and the environment



The measurement of environmental assets

2.16 The use of natural inputs by the economy is linked to reductions in the stock of environmental assets that generate those inputs. Asset accounts for environmental assets in both physical and monetary terms are an important feature of the SEEA.

2.17 ***Environmental assets are the naturally occurring living and non-living components of the Earth, together comprising the bio-physical environment, that may provide benefits to humanity.*** In the SEEA, environmental assets are considered from two perspectives. In the Central Framework the focus is on individual components of the environment that provide materials and space to all economic activities. Examples include mineral and energy resources, timber resources and water resources.

2.18 This focus reflects the material benefits from the use of environmental assets as natural inputs for the economy but does not consider the non-material benefits from the use of environmental assets (for example, benefits from environmental services such as water purification, storage of carbon, and flood mitigation).

2.19 The coverage of individual assets in the Central Framework does not extend to the individual elements that are embodied in the various natural and biological resources listed above. For example, carbon and various soil nutrients are not explicitly considered as individual environmental assets in the Central Framework.

2.20 A complete description of the measurement of environmental assets in terms of the various individual environmental assets is presented in Chapter 5.

2.21 The second perspective on environmental assets is described in SEEA Experimental Ecosystem Accounts. These accounts consider the non-material benefits of the environment, in addition to the material benefits. The measurement focus is on ecosystems. ***Ecosystems are areas containing a dynamic complex of biotic communities (for example, plants, animals***

and micro-organisms) and their non-living environment interacting as a functional unit to provide environmental structures, processes and functions. Examples are terrestrial (e.g. forests) and marine ecosystems that interact with the atmosphere. Often there are interactions between different ecosystems at local and global level.

2.22 Within a given ecosystem, ecosystem accounts consider the capacity of living components within their non-living environment to work together to deliver ecosystem services. ***Ecosystem services are the benefits supplied by the functions of ecosystems and received by humanity.*** The benefits are supplied in many ways and vary from ecosystem to ecosystem. Ecosystem services may be grouped into four types (i) provisioning services (such as the provision of timber from forests); (ii) regulatory services (such as when forests act as a sink for carbon); (iii) supporting services (such as in the formation of soils); and (iv) cultural services (such as the enjoyment provided to visitors to a national park). Generally, provisioning services are related to the material benefits of environmental assets, whereas the other types of ecosystem services are related to the non-material benefits of environmental assets.

2.23 Economic activity may degrade environmental assets such that they are not able to deliver the same range, quantity or quality of ecosystem services on an ongoing basis. A focus on ecosystems that includes both material and non-material benefits of environmental assets provides a basis for analysis of the extent to which economic activity may reduce ecosystem capacity to produce ecosystem services.

The measurement of economic activity related to the environment

2.24 In addition to the measurement of stocks of environmental assets and flows between the environment and the economy, the SEEA framework records flows associated with economic activities related to the environment. Examples of economic activity related to the environment include expenditures on environmental protection and resource management, and the production of environmental goods and services such as devices to reduce air pollution. Using the measurement framework of the SNA, economic activity undertaken for environmental purposes can be separately identified and presented in what are known as functional accounts.

2.25 The SEEA provides a more complete view of the environmental aspects of the economy by considering environmentally related transactions such as taxes, subsidies, grants, and rent. These transactions of the SEEA framework are recorded in the sequence of economic accounts and in functional accounts (such as environmental protection expenditure accounts).

2.3 Main accounts and tables of the SEEA Central Framework

2.3.1 Introduction

2.26 The SEEA organises and integrates the information on the various stocks and flows of the economy and the environment in a series of tables and accounts. The SEEA Central Framework is comprised of the following types of tables and accounts: (i) supply and use tables in physical and monetary terms showing flows of natural inputs, products and residuals; (ii) asset accounts for environmental assets in physical and monetary terms showing the stock of environmental assets at the beginning and end of each accounting period and the changes in the stock; (iii) a sequence of economic accounts showing all economic flows between economic units; (iv) functional accounts which highlight economic activities undertaken for environmental purposes; and (v) demographic and employment information relevant for the analysis of environmental issues.

2.27 The strength of the organisational framework of the SEEA comes from consistently applying definitions and classifications for stocks, flows and economic units across different types of environmental assets and different environmental themes (e.g. across water and energy). Further strength comes from these various definitions and classifications being consistently applied in physical and monetary terms and in being consistent with the same definitions and classifications used in the SNA and economic statistics.

2.28 Implementation of the SEEA does not require compilation of every table and account for all types of environmental asset or environmental theme. The SEEA can be implemented in a modular way taking into account those aspects of the environment of a country that are most important. At the same time, the ambition should be to fully account for the environment-economic structure within a country and to provide information on issues of global concern using a common measurement framework.

2.29 This section introduces the different tables that are part of the SEEA framework and shows the nature of the integration between them. The explanation is stylised, as the reality is more complex, but the basic logic and intent of the approach explained in this section applies throughout the SEEA.

2.3.2 Supply and use tables

Monetary supply and use tables

2.30 Monetary supply and use tables fully articulate the flows of products in an economy between different economic units in monetary terms. They are compiled to describe the structure of an economy and the level of economic activity. Many of the flows of products recorded in monetary terms relate to the use of natural inputs from the environment, for example the manufacture of wood products, or to activities and expenditures associated with the environment, for example environmental protection expenditure. Highlighting the relevant flows in monetary terms and developing finer breakdowns as required for analysis of specific topics is therefore an important part of the SEEA.

2.31 In the SEEA, the recording of the products that flow within the economy is the same as the recording of these flows in the SNA. Products are "supplied" within the economy when they are

i. produced by industries in the national economy (a flow known as output)

ii. brought in from the rest of the world (a flow known as imports).

2.32 All products that are supplied must be recorded as being "used". Use can occur in a number of ways:

i. the products can be used by other industries to make different products (a flow known as intermediate consumption);

ii. the products can be consumed by households (a flow known as household final consumption);

iii. the products can be consumed by governments (a flow known as government final consumption);

iv. the products can be sold to the rest of the world (a flow known as exports);

v. the products can be held as inventories for later use;[3] or

vi. the products can be used as assets (e.g. machines) over a longer period of time to produce other products (these longer term uses are flows known as gross fixed capital formation)

2.33 As shown in Table 2.3.1, these flows are classified by type of product in the rows and by type of economic unit (enterprises, households, government) and the rest of the world in the columns. Enterprises are classified to Industries on the basis of their principal activity. The exception in the naming of the columns is "Accumulation". Accumulation flows are recorded separately since while they concern supply in the current accounting period, they are not used in the current period and instead accumulate for future use or sale by economic units and the rest of the world – either in the form of inventories or in the form of fixed assets.

2.34 The table is divided into two parts – the supply table and the use table. Overall, the total supply of each product must equal the total use of each product. This equality between the total supply and total use of each product is known as the supply and use identity and is a fundamental equation in both the monetary supply and use tables and in the physical supply and use tables that together form the basis of much data compilation and analysis in the SEEA.

2.35 The row of the supply table shows that for each product Total supply is equal to Output plus Imports. The row of the use table shows that Total use is equal to Intermediate consumption plus Household final consumption expenditure plus Government final consumption expenditure plus Gross capital formation plus Exports.

[3] When products are withdrawn from inventories in subsequent accounting periods they are effectively re-supplied to the economy at that time. By accounting convention, the net change in inventories (additions to inventories less withdrawals) during an accounting period is recorded as a "use" of products.

Table 2.3.1 Basic form of a Monetary Supply and Use Table

SUPPLY TABLE						
	Industries				**Rest of the world**	**Total**
Products	Output				Imports	Total supply
USE TABLE						
	Industries	**Households**	**Government**	**Accumulation**	**Rest of the world**	**Total**
Products	Intermediate consumption	Household final consumption expenditure	Government final consumption expenditure	Gross capital formation	Exports	Total use
	Value added					

2.36 A feature of monetary supply and use tables is that key economic aggregates can be derived using the various components. In particular, the aggregate gross value added by industry can be calculated as the difference between that industry's output and its intermediate consumption. This aggregate forms the starting point for the sequence of accounts described in Section 2.3.4.

2.37 Full details on the definitions of the different variables that comprise the monetary supply and use tables are described in the 2008 SNA, Chapter 14.

Physical supply and use tables (PSUTs)

2.38 Physical flows are recorded in the SEEA by compiling supply and use tables in physical units of measurement. These tables are commonly known as physical supply and use tables, or PSUT. The focus of PSUT is on flows of energy, water or materials. PSUT are used to assess how an economy supplies and uses energy, water and materials, and are also used to examine changes in production and consumption patterns over time. In combination with data from monetary supply and use tables, changes in productivity and intensity in the use of natural inputs and the release of residuals can be examined.

2.39 The PSUT structure is based on the monetary supply and use tables described above with extensions to incorporate rows for natural inputs and residuals and a column for the environment. Table 2.3.2 shows these extensions. The column for Government is removed from the PSUT because, in physical terms, government activity is completely recorded within the first column, Industries. In the monetary supply and use table the column for government consumption reflects the purchase by government of its own output which is a purchase of services rather than a purchase of physical goods.

2.40 The column for Households relates purely to the consumption activity of households. Many households also undertake a range of production activity including the collection of water and fuelwood, the generation of energy through the installation of solar panels, etc. All of this production activity and the associated natural inputs and residuals should be recorded in the first column, Industries.

2.41 The broad structure and underlying principles of PSUT are the same regardless of whether the PSUT is measuring flows of energy, water or materials but for each of these sub-systems of physical flows different rows and columns may be used.

2.42 Table 2.3.2 only provides an introduction to PSUT. There are a range of additions and refinements that are required to this basic PSUT to cover all relevant flows of natural inputs, products and residuals. These are explained in detail in Chapter 3.

Table 2.3.2 Basic form of a Physical Supply and Use Table*

SUPPLY TABLE						
	Industries	**Households**	**Accumulation**	**Rest of the World**	**Environment**	**Totals**
Natural inputs					Flows from the environment	Total supply of natural inputs
Products	Domestic production			Imports		Total supply of products
Residuals	Residuals generated by industry	Residuals generated by household final consumption	Residuals from scrapping and demolition of produced assets			Total supply of residuals
USE TABLE						
	Industries	**Households**	**Accumulation**	**Rest of the World**	**Environment**	**Totals**
Natural inputs	Extraction of natural inputs					Total use of natural inputs
Products	Intermediate consumption	Household final consumption	Gross Capital Formation	Exports		Total use of products
Residuals	Collection & treatment of waste and other residuals		Accumulation of waste in controlled landfill sites		Residual flows direct to environment	Total use of residuals

* Note: Grey cells are null by definition. Blank cells may contain relevant flows. These flows are articulated in detail in Chapter 3.

2.43 Within the PSUT, the supply and use identity that applies in monetary terms also applies in physical terms. Thus, for each product measured in physical terms (for example cubic metres of timber) the quantity of domestic production and imports (total supply of products) must equal the consumption, capital formation and exports (total use of products). The equality between supply and use also applies to the total supply and use of natural inputs and the total supply and use of residuals.

2.44 In addition to the supply and use identity, the PSUT incorporates an additional identity concerning flows between the environment and the economy. This second identity, known as the input-output identity, requires that the total flows into the economy, or an enterprise or household are, over an accounting period, either returned to the environment or accumulate in the economy. For example, flows of energy into an enterprise in the form of electricity and petroleum products must be released to the environment after using the energy (as losses of residual heat); stored (as inventories for future use); or incorporated into non-energy products (e.g. petroleum products used to manufacture plastics).

2.45 Both the supply and use identity and the input-output identity are an integral part of the SEEA framework. They are premised on the law of the conservation of mass and energy which states that the mass and energy of a closed system will remain constant. The implication for accounting is that, in theory, mass and energy flows must balance across natural inputs, products and residuals.

2.46 Further details on the compilation of PSUT are presented in Chapter 3 including the presentation of specific PSUT for energy, water and various material flows. Of note is that, unlike monetary flows, physical flows are generally measured in different units depending on the material. Thus, while it is conceptually possible to compile a complete PSUT for all materials using a single measurement unit (e.g. tonnes), it is a complex task.

Classifications for supply and use tables

2.47 In the compilation of supply and use tables in both physical and monetary terms, an important factor is the use of consistent classifications for the main economic units and products. In the SEEA, industries are consistently classified using the *International Standard Industry Classification of All Economic Activities* (ISIC), products are consistently classified using the *Central Product Classification* (CPC), and the determination of whether particular economic units are within a particular national economy is based on the concept of residence (explained further in Section 2.6).

2.3.3 Asset accounts

2.48 The intent of asset accounts is to record the opening and closing stock of environmental assets and the different types of changes in the stock over an accounting period. One motivation for accounting for environmental assets is to assess whether current patterns of economic activity are depleting and degrading the available environmental assets. Information from asset accounts can be used to assist in the management of environmental assets and valuations of natural resources and land can be combined with valuations of produced and financial assets to provide broader estimates of national wealth.

2.49 An asset account is structured as shown in Table 2.3.3. It starts with the opening stock of resources and ends with the closing stock of resources. In physical terms, the changes between the beginning and end of the accounting period are recorded as either additions to the stock or reductions in the stock and wherever possible the nature of the addition or reduction is recorded. In monetary terms, the same entries are made but an additional term is included to record the revaluation of the stock of resources. This entry accounts for changes in the value of assets over an accounting period that are due to movements in the price of resources.

Table 2.3.3 Basic form of an asset account

Opening stock of resources		
Additions to stock of resources		
	Growth in stock	
	Discoveries of new stock	
	Upwards reappraisals	
	Reclassifications	
	Total additions to stock	
Reductions in stock of resources		
	Extractions	
	Normal loss of stock	
	Catastrophic loss	
	Downwards reappraisals	
	Reclassifications	
	Total reductions in stock	
Revaluation of the stock of resources *		
Closing stock of resources		

* Only applicable for asset accounts in monetary terms

2.50 There are many and varied reasons for changes in the quantity and value of a stock of resources over an accounting period. Many of these changes are due to interactions between the economy and the environment – for example due to the extraction of minerals or the replanting of timber resources.

2.51 Other changes in environmental assets are caused by natural phenomena, for example, natural losses of water from reservoirs due to evaporation or catastrophic losses of timber resources due to forest fires. Some changes between the opening and closing stock are more purely accounting in nature and reflect changes due to improved measurement (reappraisals) or due to differences in the definition or composition of the asset (reclassifications). The reassessment of the size and quality of mineral resources is an example of a reappraisal and reclassifications are recorded when there are changes in land use for example between agriculture and urban areas.

2.52 Generally, asset accounts are compiled for individual types of environmental assets. In monetary terms, there may be interest in aggregating the values of all environmental assets at the beginning and end of the accounting period. Such aggregations can be presented in balance sheets, and when combined with the value of other assets (e.g. produced assets and financial assets) and liabilities an overall measure of net worth of an economy can be obtained.

2.53 The capacity to account for and analyse the state of environmental assets and changes in them is a fundamental component of the SEEA. There are however many conceptual and practical measurement challenges, often unique to particular environmental assets. These measurement issues are discussed in detail in SEEA Chapter 5.

The connections between supply and use tables and asset accounts

2.54 The different tables of the central framework are compiled for different purposes and highlight different aspects of the relationship between the economy and the environment. At the same time, there are close links between the supply and use tables and the asset accounts as shown in Table 2.3.4. These connections highlight that the central framework is an integrated system.

2.55 The upper left hand part of Table 2.3.4 shows the supply and use of products measured in monetary terms. The bottom left hand part shows the supply and use of products, natural inputs and residuals in physical terms. In both cases the set of economic units are the same (i.e. enterprises represented in industries, households, government and the rest of the world). It can be seen that the supply and use of products is recorded in the framework in both monetary and physical terms.

2.56 The major change in Table 2.3.4 from a supply and use perspective, is that the flows recorded in the Accumulation and Environment columns of the supply and use tables have been reworked into an asset accounts framework. This is shown in the two right hand columns. The distinction between produced assets and environmental assets highlights the different recording of these flows in the supply and use tables – in particular that the extraction of natural resources is not recorded in the monetary supply and use tables but is recorded in the PSUT as natural inputs.

2.57 The opening and closing stocks for a given period are at the top and bottom of the table respectively. Some of the changes in the stocks are also recorded in the supply and use tables. For example, gross capital formation and natural inputs are included in both tables. Some changes in stocks are not recorded in the supply and use tables and these are grouped together in the cells labelled “other changes in assets”. Examples of these changes include discoveries of mineral resources, losses of assets following catastrophic natural events and changes in the values of assets due to price changes.

Table 2.3.4 Connections between supply and use tables and asset accounts

						ASSET ACCOUNTS (Physical & Monetary terms)	
		Industries	**Household**	**Government**	**Rest of the world**	**Produced assets**	**Environmental assets**
						Opening stock	
MONETARY SUPPLY AND USE TABLE	**Product - supply**	Output			Imports		
	Product - use	Intermediate consumption	Final consumption	Final consumption	Exports	Gross Capital Formation	
PHYSICAL SUPPLY AND USE TABLE	**Natural inputs – supply**						Extracted natural resources
	Natural inputs – use	Inputs of natural resources					
	Product - supply	Output			Imports		
	Product - use	Intermediate consumption	Final consumption		Exports	Gross Capital Formation	
	Residuals - supply	Residuals generated by industry	Residuals generated by household final consumption			Residuals from scrapping and demolition of produced assets Emissions from landfills	
	Residuals - use	Collection & treatment of waste and other residuals				Accumulation of waste in controlled landfills	Residuals flowing to the environment **
						Other changes in assets (e.g. natural growth, discoveries, catastrophic losses, revaluations)	
						Closing stock	

* Note: Grey cells are null by definition. Blank cells may contain relevant flows. These flows are articulated in detail in Chapter 3.

** While these residual flows are not flows of environmental assets they may impact on the capacity of environmental assets to deliver benefits.

2.58 Special mention is required of the final row concerning the use of residuals. Strictly, neither the accumulation of waste in controlled landfills nor the flows of residuals to the environment are recorded in asset accounts for individual environmental assets. However, more broadly, the accumulation of waste in the economy does represent an increase in a stock and flows of residuals to the environment which may well impact on the capacity of environmental assets to deliver ecosystem services. Thus with a different focus for asset accounting, for example with a focus on ecosystems, these flows are relevant.

2.3.4 The sequence of economic accounts

2.59 In monetary terms, monetary supply and use tables and asset accounts record much of the information of interest in the assessment of the interactions between the economy and the

environment. However, there are a range of other monetary transactions and flows that are of interest such as payments of rent for the extraction of natural resources, payments of environmental taxes, and payments of environmental subsidies and grants from government units to other economic units to support environmental protection activity.

2.60 These flows are shown in the sequence of economic accounts, shown in a stylised form in Table 2.3.5. It is compiled only in monetary terms because these accounts record transactions that do not have an underlying physical base, for example interest payments. The sequence of accounts follows the structure of the sequence of accounts in the SNA. Of particular importance is the derivation of measures of depletion adjusted income within the sequence of accounts. The sequence of accounts also provides the information required for an assessment of the full economic costs and benefits of environmental activity.

2.61 A particular feature of the sequence of accounts is the presentation of balancing items. Balancing items are calculated as the total value of all inflows to a group of economic units less the total value of all outflows from the same group of economic units. The balancing items provide information in their own right but also link the sequence of accounts together. Key balancing items include value added, operating surplus and saving. Economy wide aggregates can also be constructed such as gross domestic product and gross national income.

2.62 In the SNA, the balancing items and aggregates can be shown after the deduction of the cost of using fixed assets, consumption of fixed capital, to form "net" measures, e.g. net value added, net operating surplus and net domestic product. In the SEEA, the "net" balancing items and aggregates are further adjusted to show a deduction for the using up of natural resources, i.e. depletion. The resulting SEEA balancing items and aggregates are referred to as "depletion adjusted".

Table 2.3.5 Basic SEEA sequence of economic accounts

Production account		
	Main entries	Output, Intermediate consumption, Depletion
	Balancing items	**Gross Value Added, Gross Domestic Product, Depletion adjusted Value added, Depletion adjusted GDP**
Distribution and use of income accounts		
	Main entries	Compensation of employees, Taxes, Subsidies, Interest, Rent, Final consumption, Depletion
	Balancing items	**Depletion adjusted Operating surplus, Depletion adjusted Saving**
Capital account		
	Main entries	Acquisitions and disposals of produced and non-produced assets
	Balancing item	**Net lending/borrowing**
Financial account		
	Main entries	Transactions in financial assets and liabilities
	Balancing item	**Net lending/borrowing**

2.63 The sequence of accounts starts in the production account that is formed using the entries of output and intermediate consumption from the monetary supply and use table. In the case of the production account, the balancing item is value added (output less intermediate consumption). At an economy wide level the main related aggregate from the production account is Gross Domestic Product (GDP). Depletion is deducted from the balancing item of value added and the aggregate GDP to form measures of depletion adjusted value added and depletion adjusted GDP.

2.64 The sequence continues in the distribution and use of income accounts. These accounts contain information on the manner in which value added, i.e. the income directly obtained from production, is allocated to economic units as either compensation of employees or gross operating surplus and on flows of other income and related payments such as flows of taxes, subsidies, interest and rent for the use of land or other environmental assets. A total amount of disposable income (all income received less all income paid) is available for final consumption. The balancing items for the income accounts are operating surplus (value added less compensation of employees and taxes less subsidies) and saving (disposable income less consumption).

2.65 As in the production account, depletion is deducted from the balancing items of operating surplus and saving. The key aggregates from these accounts are national income and national saving and these can both be adjusted for depletion within the sequence of accounts framework.

2.66 The third account is the capital account. This account records how saving is used to purchase assets including produced assets and environmental assets. Thus it records the acquisition and disposal of environmental assets – in particular transactions in land and cultivated biological resources such as plantations and livestock. If the expenditure on assets is less than the amount of saving (assuming saving is positive) then an economy will have resources available to lend to the rest of the world. If the expenditure on assets is more than the amount of saving, then an economy will need to borrow from the rest of the world. The balancing item for the capital account is therefore known as net lending/borrowing.

2.67 The sequence of accounts is completed in the financial account which records the transactions involved in lending and borrowing. The financial account shows all transactions in financial assets and liabilities (e.g. deposits, loans, shares and equities). The balance of these transactions is net lending/borrowing, the same as the capital account balancing item.

2.68 The sequence of accounts can be complemented by balance sheets that record the values of all assets and liabilities at the beginning and end of an accounting period. The balancing item for a balance sheet is net worth representing the total value of all assets less the value of all liabilities.

2.69 A more detailed description of the sequence of accounts and the derivation of depletion adjusted measures is presented in Chapter 6. The definition and measurement of depletion is discussed in Chapter 5.

2.3.5 Functional accounts

2.70 While monetary supply and use tables can be used to organise and present certain types of transactions of particular relevance to the environment, environmentally related transactions within supply and use tables usually require additional disaggregation because the conventional industry and product classifications do not necessarily highlight environmental activities or products.

2.71 The approach taken in the SEEA is first to define the activities, goods and services that have an environmental purpose (i.e. their primary purpose is to reduce or eliminate pressures on the environment or to make more efficient use of natural resources). And second, to reorganise relevant information in scope of the monetary supply and use table and the sequence of accounts to clearly identify the environmentally related transactions associated with the environmental activities and environmental goods and services.

2.72 By highlighting environmental activities and products, information can be presented on the economic response to environmental issues. Particular flows of interest are the output of environmental goods and services, expenditures on environmental protection and resource management as well as environmental taxes and subsidies.

2.73 The construction of functional accounts and associated information is discussed in detail in Chapter 4.

2.3.6 Demographic and employment information

2.74 The usefulness of information within the SEEA can be enhanced by relating different environmental and economic data to estimates of population and various demographic breakdowns such as by household income levels and other detailed information by household characteristics related to material well-being. This information may be useful in assessing issues such as resource availability, changes in energy use and sources of emissions. Accounting for differences in population size and structure is also important for international comparisons of environmental and economic data.

2.75 Employment information such as the number of people employed, the number of jobs and the number of hours worked may be of particular interest in the assessment of environmental activity from an industry perspective. In particular, there is likely to be interest in employment indicators related to the production of environmental goods and services.

2.76 Data on population and labour inputs may need to be adjusted in order to be consistent with the concepts, definitions and classifications of the SEEA, in particular to align with the concept of residence. Relevant information can be found in the 2008 SNA, Chapter 19.

2.4 Combining physical and monetary data

2.4.1 Introduction

2.77 The presentation of information in a consistent format that combines integrated physical and monetary data is one of the strongest features of the SEEA. This feature enables the SEEA to provide a wide range of information on specific themes (e.g. water, energy, air emissions) to compare related information across different themes and to derive indicators that require the use of both physical and monetary data.

2.78 Given the integrated accounting structures for physical and monetary accounts and statistics, it is logical to use these structures and the common underlying accounting rules and principles to present both physical and monetary information. Such integrated formats have sometimes been referred to as "hybrid" presentations or accounts because they contain data in different units. However, even though the measurement units are different, the data sets are presented following common classifications and definitions, and hence these presentations are referred to as combined physical and monetary presentations in the SEEA.

2.79 Different forms of combined physical and monetary presentations are possible and, indeed, there is no standard form for these presentations or accounts. Commonly, physical flow data is presented alongside information from monetary supply and use tables but even for this basic structure different combinations are possible. Ultimately, the structures of combined presentations of monetary and physical data are dependent on the availability of data and the question under investigation.

2.80 While no standard structure can be defined, compiling and contrasting monetary and physical data in meaningful ways is at the heart of the SEEA philosophy. This section provides a general introduction to combined physical and monetary presentations. Chapter 6 discusses the compilation of these presentations and provide examples of potential presentations on particular themes, such as energy and water. More detailed presentations involving structures such as input-output tables, the full sequence of economic accounts or presentations that cover a particular theme or topic, for example fisheries, are considered in SEEA Extensions and Applications and in targeted thematic SEEA publications (such as on water and energy).

2.4.2 The concept of combining physical and monetary data

2.81 At the core of combining physical and monetary data is the logic of recording physical flows in a manner compatible with economic transactions as presented in the SNA. This linkage guarantees a consistent comparison of environmental burdens with economic benefits, or environmental benefits with economic costs. This linkage could, in principle, be examined not only at the national level but also at disaggregated levels, for example, in relation to regions of the economy, or specific industries, or for the purpose of examining the flows

associated with the extraction of a particular natural resource or the emissions of a particular material.

2.82 Because these presentations combine physical data that may be of more immediate use to scientists, with monetary data familiar to economists, they also have the potential to form a bridge between these two schools of concern about the environment.

2.83 It is reinforced that it is quite legitimate to include only a limited set of variables, depending on the most urgent environmental concerns to be taken into consideration and it is not necessary to complete an exhaustive physical supply and use table to be able to present combinations of physical and monetary data.

2.84 A combined physical and monetary presentation thus represents an analytical framework showing which parts of the economy are most relevant to specific indicators and how changes in the economic structure influences the evolution of indicators over time. Further, because the accounts provide consistent environmental and economic indicators, the possible trade-offs in environmental terms between alternative environmental and economic strategies can be analysed.

2.85 At finer levels of disaggregation, combined presentations can provide the research community with access to a structured database for further research into the role of these indicators in monitoring the overall environmental performance of national economies. In particular datasets with combinations of physical and monetary data may be of direct use in the development of environmental-economic models.

2.5 Accounting for flows and stocks

2.5.1 Introduction

2.86 The compilation of supply and use tables, asset accounts, the sequence of economic accounts, functional accounts, and the incorporation of demographic and employment information, requires an understanding of the concepts of stocks and flows in both physical and monetary terms. This section presents the general framework for the recording of stocks and flows in both physical and monetary terms.

2.5.2 Flows

Flows in physical terms

2.87 Physical flows are reflected in the movement and use of materials, water and energy. As introduced earlier in this chapter, the three types of physical flows are natural inputs, products or residuals.

2.88 Natural inputs are all physical inputs from the environment that are moved from their location in the environment as a part of economic production processes or are directly incorporated into economic production processes. They may be (i) natural resource inputs, such as mineral and energy resources or timber resources, (ii) inputs from renewable energy sources, such as solar energy captured by economic units, or (iii) other natural inputs such as inputs from soil (e.g. soil nutrients) and inputs from air (e.g. oxygen absorbed in combustion processes).

2.89 During the extraction of some natural resource inputs not all extraction is retained in the economy. For example in fishing operations there is an amount of discarded catch and in timber harvesting there is an amount of felling residues. The extraction that is not retained in the economy is considered to immediately return to the environment and is considered a natural resource residual.

2.90 Products are goods and services that result from a process of production in the economy. They are defined consistently with the definition of products in the SNA. Generally, products are evidenced by a transaction of positive monetary value between two economic units – for example the production and sale of a car from manufacturer to a purchaser. For accounting purposes, generally only flows of products between economic units are recorded and flows internal to the operation of an enterprise are ignored. However, depending on the purpose and field of analysis, it may be relevant to record these internal flows. For example, in the analysis of energy flows it may be relevant to record the generation of energy by an enterprise by burning its own solid waste.

2.91 Residuals are physical flows of solid, liquid and gaseous materials and energy that are discarded, discharged or emitted by establishments and households through processes of production, consumption or accumulation. Residuals may be discarded, discharged or emitted to the environment (for example emissions to air) but may also flow within the economy – such as when solid waste is collected as part of a waste collection scheme.

2.92 Physical flows are often separated into three categories for the purpose of constructing physical supply and use tables. These three categories are energy, water and materials. Materials themselves are often analysed by type of material or specific groups of materials for example flows of solid waste or carbon emissions. The three categories of physical flows from three distinct but related accounting sub-systems which each take a different perspective on physical flows. For example, analysis of coal and oil may focus on the energy content or on the mass and volume of the materials. Thus, there are connections between each sub-system. The three sub-systems are described in more detail in Chapter 3.

2.93 Physical flows are also recorded in asset accounts where they represent changes in the stocks of assets between one period and another. These flows may consist of natural inputs, products and residuals as defined but other physical flows may also be recorded in asset accounts. For example, flows of evaporation from natural lakes and precipitation into natural lakes will alter the stock of water resources in the lakes and hence must be recorded in the asset account. However, these natural processes are considered environment to environment flows and hence are not within the scope of the supply and use tables as natural inputs, products or residuals.

2.94 An important flow in physical terms that is recorded in the asset accounts is depletion. Depletion relates to the physical using up of environmental assets through extraction, abstraction and harvest by economic units such that there is a reduced availability of the resource in the future at current extraction rates. Estimates of the flow of depletion must consider whether the natural resource is non-renewable (such as mineral and energy resources) or renewable (for example, timber and fish resources). For non-renewable resources, the physical flow of depletion relates directly to the quantity of resource extracted. However, in the case of renewable resources, the capacity for the natural resource to regenerate over time must be taken into account. Depletion is discussed in detail in Chapter 5.

Flows in monetary terms

2.95 Flows in monetary terms are recorded in a manner completely analogous to the SNA definition of economic flows. Two broad types of economic flows are defined in the SNA – transactions and other flows. A transaction is an economic flow that is an interaction between economic units by mutual agreement such as sales of timber products or purchases of environmental protection services. Other flows relate to changes in the value of assets and liabilities that do not result from transactions. Examples are new discoveries of assets or losses of assets due to natural disasters and the effect of price changes on the value of assets and liabilities.

2.96 Many transactions relate to exchanges of products between economic units. Products may be sold on markets for intermediate or final use, they may be produced for own final use by economic units (either for consumption or investment purposes) or they may be services produced by governments that are not sold on markets. The products not sold on markets are called non-market products.

2.97 Product flows are recorded in monetary terms in the monetary supply and use table. Flows in monetary terms are also recorded in the asset accounts and the other accounts that comprise the full

sequence of accounts following the application of certain valuation and other accounting rules. These rules are discussed in more detail in Section 2.6.

2.5.3 Stocks

Stocks in physical terms

2.98 In physical terms, stocks refer to the total quantity of assets at a given point in time. In the Central Framework, the measurement is focused on recording the physical stocks of individual environmental assets, such as tonnes of coal, cubic metres of timber and hectares of land.

2.99 Individual environmental assets comprise mineral and energy resources, land, soil resources, timber resources, aquatic resources, other biological resources and water resources. These individual assets are generally defined by their material content such as soil volume without specific reference to their individual elements such as the nutrients in soil resources.

2.100 The volume of water in the ocean is not considered in scope of water resources in the Central Framework because the stock of water is too large to be meaningful for analytical purposes. The exclusion of the ocean in terms of a volume of water resources does not in any way limit the measurement of ocean-related individual components such as aquatic resources (including fish stocks on the high seas over which a country has harvesting rights) and mineral and energy resources on the ocean floor.

2.101 In principle, for each environmental asset, the measurement scope includes all stocks that may provide benefits to humanity. In practice, a specific measurement boundary is defined for each environmental asset in the Central Framework and the relevant approaches to measurement of environmental assets in physical terms are discussed in detail in Chapter 5.

2.102 Environmental assets also encompass ecosystems and ecosystem services. The measurement of ecosystems in terms of both material and non-material benefits from the environment, and in terms of the capacity of ecosystems to provide ecosystem services, is a maturing area and relevant techniques are discussed in SEEA Experimental Ecosystem Accounts.

Stocks in monetary terms

2.103 The measurement of stocks in monetary terms focuses on the value of individual environmental assets and changes in those values over time. In the Central Framework, the valuation of these assets focuses on the benefits that accrue to economic owners of environmental assets. In this regard, the approach to measuring stocks of environmental assets in monetary terms aligns with the definition and treatment of economic assets in the SNA.

2.104 In the Central Framework, there is no aim to place a monetary value on all of the benefits that may accrue to current and future generations and hence provide what might be regarded as social valuations of environmental assets. The consideration of the value in monetary terms of a broader range of benefits from the environment is discussed in SEEA Experimental Ecosystem Accounts.

2.105 Since in physical terms, the conceptual scope for each individual component is broad extending to include all of the resources that may provide benefits to humanity, there may be some stocks recorded in the SEEA in physical terms that have a zero economic value. For example, all land within a country is within scope of the SEEA to allow for a full analysis of changes in land use and land cover, but in monetary terms some land may be considered to have zero value.

2.106 Table 2.5.1 shows the scope of the different measures of environmental assets in the SEEA.

Table 2.5.1 The scope of environmental assets in SEEA

	Central framework	**Experimental Ecosystem Accounts**
Physical terms	Individual environmental assets	All (from ecosystem perspective)
Monetary terms	Individual environmental assets with economic value consistent with SNA	All (from ecosystem perspective)

2.107 Ideally, following SNA, the preferred approach to the valuation of assets is the use of market values. However, for many environmental assets there are few markets that buy and sell the assets in their natural state and hence determining whether an asset has an economic value can be difficult. A number of approaches to estimating market prices are possible if observable market prices for assets do not exist. Most commonly in these cases, the SEEA recommends that valuation be undertaken using the Net Present Value (NPV) approach. This approach uses estimates of the expected economic benefits that can be attributed to an environmental asset, for example profits from the sale of mineral resources, and then discounts the expected economic benefits to give them a value in the current period. The NPV approach is described in Chapter 5.

2.6 Economic units

2.6.1 Introduction

2.108 In addition to defining various stocks and flows, the key component in accounting for the interaction between the economy and the environment is the definition of the economic units involved.

2.109 For the central framework, the units involved are economic units who interact with each other and that are able to make decisions about the production, consumption and accumulation of goods and services. They are classified in different ways depending on the type of analysis being undertaken. The description of these economic units is the focus of this section. The section concludes with a discussion on reporting units for statistical purposes. In this context, both economic units and "units" within the environment – for example river basins and mineral deposits, are relevant considerations.

2.6.2 Institutional sectors

2.110 The starting point for considering economic units is a focus on the purposes, objectives and behaviours of individual economic units. Institutional units are those individual economic units that are capable of owning assets, incurring liabilities, and engaging in transactions and other economic activities with other economic units. These institutional units may be either households, or legal or social entities (such as corporations) that are recognised independently of the people that own or control them. Groupings of units that are similar in their purposes, objectives and behaviours are defined as institutional sectors.

2.111 The SEEA, following the SNA, recognises five types of institutional sector. Households, Non-financial corporations, Financial corporations, General government and Non-Profit Institutions Serving Households (NPISH). Although important in the context of the SNA, the distinction between non-financial and financial corporations is not significant in the SEEA and hence, generally, these are presented as one sector, Corporations. The 2008 SNA Chapter 4 defines and describes the different institutional sectors in detail.

2.112 Institutional sectors are of particular interest in the SEEA in considering the ownership of environmental assets (an issue discussed in Chapter 5 with particular emphasis on the ownership of mineral and energy resources) and in the development of a full sequence of accounts. The full sequence of accounts records a range of transactions between economic units, for example payments of rent on environmental assets, that are usefully analysed from the perspective of institutional sectors rather than by industry or activity.

2.113 A full accounting of transactions and flows requires consideration of flows to and from the rest of the world including flows to and from international organisations. In theory, as for a national economy, the rest of the world is also composed of institutional sectors of the types listed above. Generally, however, the accounting framework defines the rest of the world as a single institutional sector for ease of compilation and presentation.

2.6.3 Enterprises, establishments and industries

2.114 An enterprise is the view of an institutional unit as a producer of goods and services. It can own assets and acquire liabilities and has the capacity to engage in transactions and other economic activities with other economic units.

2.115 An enterprise may be comprised of one or more establishments and hence may be located across multiple locations within a single economy. An establishment is a unit situated in a single location and within which only a single type of productive activity is carried out or within which a single productive activity (the primary activity) accounts for most of the value added.

2.116 The ability to define and observe establishments and enterprises and determine the types of goods and services they produce is at the heart of supply and use accounting. Meaningful analysis can be undertaken at an aggregate level by grouping units that undertake similar types of productive activity and by grouping goods and services that display similar characteristics.

2.117 In the SEEA, as in the SNA, the groupings of establishments that undertake similar types of productive activity are referred to as industries. Industries cover, broadly speaking, agriculture, mining, manufacturing, construction and services. Ideally, an industry is composed of establishments that undertake the same activity and only that activity – i.e. the grouping would be homogenous. In practice, many establishments undertake a variety of activities but must have a primary activity that can be used to classify them to a specific industry class.

2.118 In both physical and monetary terms the activities undertaken within establishments are referred to as "own-account" activities. In the SNA, own-account activity covers activity undertaken for either the final consumption or investment of the economic unit (own account final use). The SNA does allow the possibility of recording separately some own account intermediate use activity, described as ancillary activity, but this is limited to a specific set of activities.[4]

2.119 For some purposes of environmental and economic accounting, it may be relevant to identify the secondary activities of an establishment and also activities undertaken within an establishment but where output is not sold to other units. This is particularly the case in accounting for physical flows of energy where measuring all transformations of energy products is likely to be of interest. Generally however, the recording of physical flows internal to establishments is only undertaken in specific circumstances.

2.120 In the compilation of functional accounts, it may be relevant to identify the secondary and other activities of establishments that are being undertaken for environmental purposes such that a complete description of relevant activity can be made. An example of such activity is the incineration of solid waste or biogas to produce electricity for use by the firm. For the

[4] See 2008 SNA paragraphs 5.35 - 5.45.

compilation of functional accounts on environmental activities and environmental goods and services, the SEEA aims to separately identify these types of activities. They are valued in monetary terms using information on the associated input costs such as intermediate consumption of goods and services and compensation of employees.

2.121 A particular case of own-account activity in both physical and monetary terms concerns households. The activities of households, in both the use of natural resources (e.g. the collection of fuel wood and water) for own consumption and in the undertaking of environmental protection and resource management activity (e.g. the installation of solar panels on houses) are of interest in the SEEA. As in the SNA, where the activity is of significance its activity is recorded together with that of other units undertaking the same activity.

2.6.4 Geographic boundaries for economic units

2.122 A key feature of the SEEA is that it aims to account for the interaction between the economy and the environment at a national level. The geographical boundary that defines the scope of an economy is based on the concept of economic territory. Economic territory is the area under effective control of a single government. It includes the land area of a country including islands, airspace, territorial waters and territorial enclaves[5] in the rest of the world. Economic territory excludes territorial enclaves of other countries located in the reference country.

2.123 A national economy comprises the set of all institutional units that are resident in an economic territory, i.e. the unit has its centre of predominant economic interest in a particular economic territory. In general, there will be a large overlap between those units that are resident and those units located within the geographically defined boundaries of a country. There are three primary exceptions

i. Units intending to operate in a country for less than a year, for example, specialised construction firms or aid and relief agencies. These are considered residents of their home country.

ii. Resident producing units may operate outside of the national territory, for example ships and aircraft, and fishing operations in international and other nation's waters. In these cases they are considered to remain residents of their national economy regardless of their location of operation.

iii. Residents of a national territory may stay temporarily in other countries for work or leisure. The consumption undertaken by such residents in other countries is considered to be resident consumption abroad. The consumption is recorded as an import of the country in which the person is resident and an export of the country visited.

[5] Territorial enclaves include embassies, consulates and military bases and the operations of international organizations.

2.124 The use of this geographic scope of the economy aligns with the scope of the economy as defined in the SNA thus allowing a strong alignment between flows in physical and monetary terms. However, this geographic boundary is different from that commonly used for some important environmental statistics such as air emissions and energy statistics. Where these statistics are an information source for the compilation of SEEA accounts, adjustments to the statistics data are likely to be needed to account for differences in geographic coverage.

2.125 Accounting in both physical and monetary terms at sub-national levels may be appropriate for specific environmental and economic accounting issues, for example the management of water resources using information at the level of river basins. It is noted however, that while physical data may be available for such geographic areas, corresponding economic data may not be readily available.

2.6.5 Measurement units for statistical purposes

2.126 The discussion of economic units in this section has focused on the ability of these units to operate within an economy as active participants. In statistical terms, these units are often also the focus of measurement as units of observation or reporting units. Depending on the structure of information within a country, economic data are likely to be available for most types of economic unit, particularly for enterprises and, in some cases for individual establishments. However, since the ownership structures of enterprises can vary significantly and since some enterprises may produce a range of different products matching the conceptual model to the information available may not be straightforward.

2.127 In the physical supply and use table the environment is added as an additional column alongside enterprises represented as industries, households and the rest of the world. However, in the Central Framework the environment is not considered an additional type of unit akin to economic units. Rather the environment is seen as passive with decisions regarding the supply of natural inputs to the economy and the receipt of residuals from the economy being made by economic units.

2.128 At the same time, the collection of information about the environment, particularly as it concerns environmental assets, requires consideration of appropriate environmental measurement units for statistical purposes. These measurement units reflect the parts of the environment about which statistics may be collected and presented. Examples include inland water bodies (lakes, rivers, etc), mineral deposits, forests and fish stocks. In some cases, it will be possible to align the environmental measurement unit and an associated economic unit but this should not be expected.

2.129 An alternative perspective on the environment is to consider that the environment plays a more active role. From this perspective the environment can be conceived as a set of ecosystem “units” that supply ecosystem services to the economy and whose capacity to deliver those services may change over time. The development of approaches to defining and categorising ecosystem units is introduced in Chapter 5.6 and discussed in detail in SEEA Experimental Ecosystem Accounts.

2.7 Accounting rules and principles

2.7.1 Introduction

2.130 The recording of accounting entries requires the use of a consistent set of accounting rules and principles. Without these, related transactions and flows may be recorded on different bases, at different times and with different values thus making accounting and reconciliation difficult and far less useful.

2.131 The SEEA follows the same accounting rules and principles as the SNA. This section introduces the rules and principles of most relevance to the SEEA. Readers are encouraged to refer to the 2008 SNA Chapter 3 for more detail.

2.7.2 Recording rules and principles

Double and quadruple entry accounting

2.132 A key feature of accounting in the SEEA is the consistency that is applied in the recording of transactions between different economic units.

2.133 From the perspective of a single economic unit the principle of vertical double entry accounting is applied. This requires that for each transaction there are two entries. There is an entry of output, consumption, investment, property income or transfer and there is a corresponding entry showing the increase or decrease in financial assets or liabilities.

2.134 For example, the purchase of fish by a household will be reflected as both an increase in consumption and a decrease in cash (presuming the purchase was paid for in this way).

2.135 Since the focus of the SEEA is not on accounting for individual units but on accounting for all units in the economy, the double entry accounting principle must be extended to ensure that a single transaction is recorded in the same way by both parties. This is known as quadruple entry accounting.

2.136 Thus, the purchase of fish by a household is an increase in consumption and decrease in cash for the household and, at the same time, decrease in inventory and an increase in cash for the fisherman. All four entries must be recorded to ensure that the accounting is complete.

2.137 While all of these entries are required for accounts in monetary terms, in physical terms the associated transactions in financial assets (cash in this example) are not recorded.

Time of recording

2.138 One requirement of the quadruple and horizontal double entry accounting principles is that transactions and other flows must be recorded as occurring at the same point in time in the various accounts for both units involved.

2.139 In monetary accounts, the general principle is that transactions are recorded when ownership changes and the corresponding claims and obligations arise, are transformed or are cancelled. Transactions internal to one unit are recorded when economic value is created, transformed or extinguished. This time of recording is called an accrual basis.

2.140 The key distinction to be monitored with respect to timing is that the time of the transactions under an accrual basis of recording may not align to the time the cash flow associated with the transaction occurs. For example, if a good is purchased and the purchaser is invoiced for payment within 30 days, the time of recording under an accrual approach is the date of the purchase not the date when the invoice is paid.

2.141 Ideally, the time of the recording of physical flows should align with the time of recording of the flows in monetary terms on an accrual basis. However, in practice environmental processes may operate on quite different cycles and timeframes compared to the standard calendar and financial years used in monetary accounting. For example, in the case of water resources, the hydrological year does not correspond to a calendar year.[6] Adjustments to account for different underlying cycles of data in physical and monetary terms should be made as required.

Units of measurement

2.142 For accounts compiled in monetary terms, all entries in the accounts must be measured in terms of money and therefore the components from which the entries are built up must be measured in terms of money. In most cases, the amounts entered are the actual transactions that form part of flows that involve money. In other cases the amounts entered are estimated by reference to other equivalent monetary values (for own-account consumption) or valued at the cost of production (for non-market output).

2.143 For accounts compiled in physical terms, the unit of measurement will vary depending on the type of asset concerned. Thus flows of energy are generally measured in energy content, such as joules, stocks and flows of water are generally measured in volume, such as cubic metres, and stocks and flows of other materials are generally measured in mass units such as tonnes. The details regarding the choice of measurement unit are outlined in the description of specific accounts.

2.144 A common principle is that within a single account in physical terms only one unit of measurement should be used such that aggregation and reconciliation is possible across all accounting entries. It is noted however, that in combined presentations of physical and monetary data a range of measurement units might be involved.

[6] A hydrological year is a 12 month period such that the overall changes in storage are minimal and carryover is reduced to a minimum (International Glossary of Hydrology, 2nd ed., UNESCO/WMO 1992)

2.7.3 Valuation rules and principles

Valuation at market prices

2.145 For accounts in monetary terms the question of valuation is central. In the SEEA, as in SNA, the values reflected in the accounts are, in principle, the current transaction values or market prices for the associated goods, services, labour or assets that are exchanged.

2.146 Strictly, market prices are defined as amounts of money that willing buyers pay to acquire something from willing sellers. The exchanges should be made between independent parties on the basis of commercial considerations only, sometimes called "at arm's length".

2.147 Defined in this way, a market price should be distinguished from a general market price that gives an indication of the "average" price for exchanges in a type of good, service or asset. In most cases, market prices based on the totality of transactions that actually occur will be equal to the general "average" market prices just described. However, there are some transactions where this is not the case, for example in the case of transfer pricing between affiliated enterprises and concessional pricing by government units. Corrections should be considered in such situations in order to get closer to normal market price equivalents.

2.148 When market prices are not observable, valuation according to market-price-equivalents should be used to provide an approximation to market prices. A particular example of the need to apply market price principles is the recording of goods and services produced and used on own-account and more generally the valuation of non-market production. Following the SNA, such production should be valued as the sum of the costs of production namely: intermediate consumption, compensation of employees, consumption of fixed capital, a net return to fixed capital and other taxes less subsidies on production.

2.149 Special considerations are required in the application of the market price principle to the valuation of assets, particularly non-produced assets such as mineral and energy resources, natural aquatic resources and natural timber resources. A number of techniques are suggested in the SNA[7] for the estimation of market prices of assets in situations where there are no developed asset markets. A full description of the different techniques and approaches relevant to environmental and economic accounting, including discussion on the use of Net Present Value (NPV) approaches, is in SEEA Chapter 5.

2.150 The use of market prices in the SEEA must be distinguished from the potential to adopt social valuations in the pricing and valuation of environmental assets. Social valuations take into account a broader range of benefits and costs than are considered in the individual, exchange level, market prices used in the SEEA. The measurement of this broader set of social benefits and costs is not standardised and is not discussed directly in the context of the central framework of the SEEA although the issue does arise in the consideration of the choice of discount rate to be used in the application of the NPV approach. This is discussed in detail in Annex A5.2.

[7] See 2008 SNA Chapters 10 and 13.

Basic, producer and purchaser's prices

2.151 Transactions in products involve two economic units. For a number of reasons, the amount ultimately received by the producer or supplier of the product is likely to differ from the amount paid by the purchaser. These reasons include the addition of taxes to the price of a product, the addition of transport costs to deliver the product from producer to final purchaser, the inclusion of wholesale and retail margins and the receipt of subsidies by the producer. To take these different factors into account three different kinds of prices are defined reflecting the prices from supply and use perspectives. The relationship between these three prices is shown in Figure 2.6.1.

Figure 2.6.1: Basic, producers' and purchasers' prices

Basic prices
plus
Taxes on products excluding invoiced VAT
less
Subsidies on products
equals
Producers' prices
plus
VAT not deductible by the purchaser
plus
Separately invoiced transport charges
plus
Wholesalers' and retailers' margins
equals
Purchasers' prices

2.152 Two kinds of prices are used from a supply perspective, basic prices and producers' prices. The basic price is the amount receivable by the producer from the purchasers for a unit of a good or service produced as output, minus any taxes payable on the product plus any subsidy receivable by the producer as a consequence of its production or sale. The basic price excludes any transport charges invoiced separately by the producer and any wholesale and retail margins that may be applicable.

2.153 The basic price measures the amount retained by the producer and is, therefore, the price most relevant for the producer's decision making.

2.154 The producers' price is the amount receivable by the producer from the purchaser for a unit of a good or service produced as output minus any VAT, or similar deductible tax invoiced to the purchaser. The producers' price excludes any transport charges invoiced separately by the producer.

2.155 The purchasers' price is the amount paid by the purchaser, excluding any VAT or similar tax deductible by the purchaser, in order to take delivery of a unit of a good or service at the time and place required by the purchaser. The purchasers' price of a good includes any

transport charges paid separately by the purchaser to take delivery at the required time and place. This is the price most relevant for the purchaser.

2.156 The differences between the three sets of prices are most important in the compilation of monetary supply and use tables. When compiling monetary supply and use tables in basic prices the transport charges and wholesale and retail margins are allocated to the relevant services (transport, wholesale and retail services) rather than being deducted from the table as a whole. Full details on the appropriate valuation approaches in the compilation of monetary supply and use tables are contained in the 2008 SNA Chapter 14.

2.7.4 Volume measures

2.157 For estimates compiled in monetary terms, the changes over time in the values of goods and services can be decomposed into two components: changes in prices and changes in volumes. These volumes are not equivalent to measures of the physical volume of solids, liquids or gases but instead relate to an economic notion of volume which encompasses both the changes in quantity and quality of goods, services and assets. Thus for example, the economic notion of volume would include increases in the number of cars produced (or their mass) as well as improvements in the quality of the cars. Thus even if the number of cars produced remained the same over time there may be an increase in volume if the quality of cars improved.

2.158 The measurement of economic activity in terms of volumes rather than values is commonly referred to as measurement in “constant prices”. Volume measures are particularly important for the measurement of economic growth which is generally understood as the volume increase in key aggregates, such as gross domestic product.

2.159 The compilation of volume measures is undertaken by removing the effect of price change from a time series of transactions in products, income flows or asset values. Ideally, detailed information on the price changes of individual products or assets is weighted together to provide price indices that reflect changes in the prices of the specific products or assets of interest. Where such detail is not available, it is necessary to use general measures of price change, i.e. measures of inflation, rather than specific price indices. Volume measures derived using general price indices are commonly referred to as “real” measures. Real measures are often derived in cases where it is necessary to remove the effects of changes in purchasing power from measures of income.

2.160 Volume measures, particularly those for production and consumption, are essential in the assessment of environmental-economic trends. They may help illustrate the extent to which the economy becomes more or less efficient in terms of resource inputs or residual outputs. More generally, such assessments may indicate to what extent economic growth is coupled to, or can be decoupled from, environmental pressures such as the use of natural resources as inputs to economic production or emissions from production.

2.161 An important application of volume measures is in the derivation of volume measures of the value of stocks of environmental and other assets. The analysis of changes in total

economic wealth is enhanced when the impact of price changes on the changing values of assets is removed.

2.162 A general description of methods for deriving measures of assets in volume terms is provided in Chapters 5 and 6. Details regarding their theoretical basis and their compilation are presented in the 2008 SNA Chapter 15 and in international manuals on the compilation of consumer and producer price indices.[8]

[8] See *Consumer Price Index Manual: Theory and Practice* (2004), ILO/IMF/OECD/UNECE/ Eurostat/World Bank and *Producer Price Index Manual: Theory and Practice* (2004), ILO/IMF/OECD/UNECE/World Bank