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**REVISION OF THE SYSTEM OF ENVIRONMENTAL - ECONOMIC ACCOUNTING
(SEEA)**

SEEA Central Framework

Chapter 2 Accounting structure

Prepared by the Committee of Experts on Environmental Economic Accounting

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(SEEA)**

**Committee of Experts on Environmental Economic Accounting
Statistics Division / Department of Economic and Social Affairs, United Nations**

**SEEA Central Framework
Draft subject to final editing**

Chapter 2: Accounting structure

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2.1 Introduction

- 2.1 The System of Environmental-Economic Accounting (SEEA) Central Framework is a multi-purpose conceptual framework that describes the interaction between the economy and the environment, and the stocks and changes in stocks of environmental assets. It uses a systems approach to the organisation of environmental and economic information and covers, as completely as possible, the stocks and flows that are relevant to the analysis of environmental and economic issues.
- 2.2 In applying a systems approach the SEEA Central Framework applies the accounting concepts, structures, rules and principles of the System of National Accounts (SNA). Because the SEEA Central Framework uses the same accounting conventions and structures as the SNA, it generally uses the same terminology and language as the national accounts.
- 2.3 At the same time, the SEEA Central Framework 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 the same as that used in the national accounts, the SEEA Central Framework aims to integrate perspectives from other disciplines, and where relevant, provide an improved set of information for environmental-economic analysis.
- 2.4 This chapter provides an overview of the accounting structure of the SEEA Central Framework and its rules and principles of recording. This overview places the various aspects of the economy and the environment in a measurement context. Using the broad description in Section 2.2, Section 2.3 presents the accounting structure which is reflected in supply and use tables, asset accounts, the sequence of economic accounts, and functional accounts. Section 2.4 introduces one of the key outputs - combined presentations of physical and monetary data.
- 2.5 Section 2.5 introduces the measurement of stocks and flows in physical and monetary terms and Section 2.6 describes the relevant economic units. Section 2.7 presents a range of specific accounting rules and principles that form the basis of recording and compilation.

2.2 Overview of the SEEA Central Framework

- 2.6 The Central Framework encompasses measurement in three main areas: (i) the physical flows of materials and energy within the economy and between the economy and the environment; (ii) the stocks of environmental assets and changes in these stocks; and (iii) economic activity and transactions related to the environment. Measurement in these areas is translated into a series of accounts and tables as described in Section 2.3.
- 2.7 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.
- 2.8 Broadly, the economy functions through the production and import of goods and services that in turn are consumed by enterprises, households or government; exported to the rest of the world; or accumulated to be consumed or used 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.
- 2.9 For measurement purposes the economy is represented by both stocks and flows. The measurement of flows centres on the economic activities of production, consumption and accumulation. Of these, it is the measurement boundary for production (the production boundary) which is the most significant since all goods and services (products) that are considered to be produced are effectively considered “inside the economy”. Flows between the economy and the environment are determined by whether they cross the production boundary.
- 2.10 Stocks of economic assets provide 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). Both produced and non-produced assets provide inputs to the production of goods and services.
- 2.11 The economic value and quantity of stocks of assets (e.g. buildings, natural resources, bank deposits) changes over time. These changes are reflected in flows, and are either recorded as transactions (such as the acquisition of buildings and land) or recorded as other flows. Many flows relating to non-produced assets (e.g. 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).
- 2.12 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 environment is seen as the source of all natural inputs to the economy including natural resource inputs (minerals, timber, fish, water, etc.) and other natural inputs absorbed by the economy, for example energy from solar and wind sources and the air used in combustion processes.

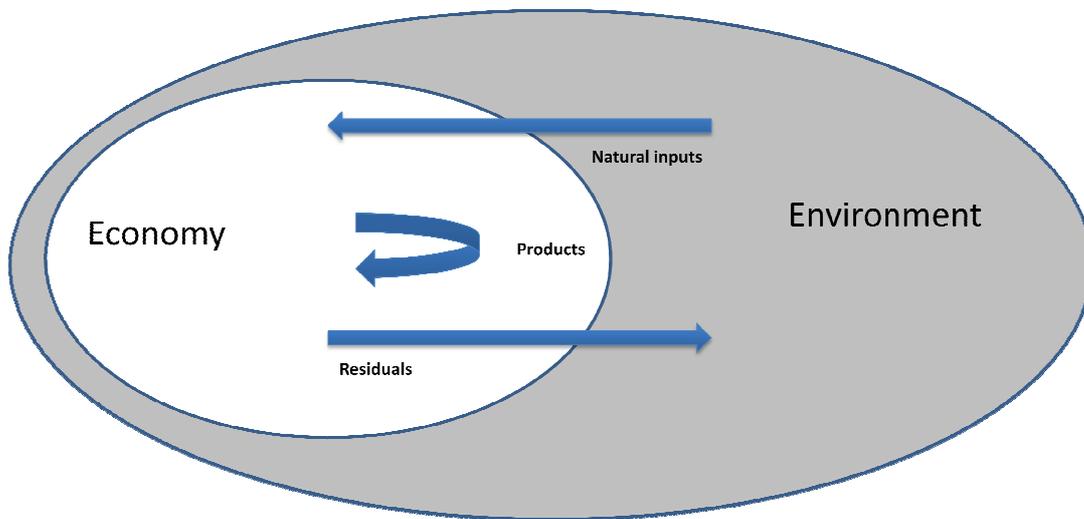
- 2.13 The remainder of this section provides additional description on the nature of the measurement of the economy and the environment in the Central Framework.

The measurement of physical flows

- 2.14 A key focus of measurement 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, the flows from the environment to the economy are recorded as natural inputs (e.g. flows of minerals, timber, fish, water). Flows within the economy are recorded as product flows (including additions to the stock of fixed assets) and flows from the economy to the environment are recorded as residuals (e.g. solid waste, air emissions, return flows of water)¹. 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. Section 2.5 and Chapter 3 provide detailed descriptions of the measurement of physical flows.

¹ It is noted that many residuals also remain within the economy for example solid waste collected in controlled landfill sites.

Figure 2.2.1 Physical flows of natural inputs, products and residuals



The measurement of environmental assets

- 2.16 The use of natural inputs by the economy is linked to changes 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.*** Although they are naturally occurring, many environmental assets are transformed to varying degrees by economic activities. 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, water resources and land.
- 2.18 This focus reflects the material benefits from the direct use of environmental assets as natural inputs for the economy by enterprises and households. However, this focus does not consider the non-material benefits from the indirect 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 does not extend to the individual elements that are embodied in the various natural and biological resources listed above. For example, the various soil nutrients are not explicitly considered as individual assets.
- 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. This perspective covers the same environmental assets but instead considers the benefits obtained from environmental assets, including both material and non-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 ecosystems (e.g. forests) and marine ecosystems that interact with the atmosphere. Often there are interactions between different ecosystems at local and global levels.
- 2.22 For a given ecosystem or group of ecosystems, ecosystem accounting considers the capacity of living components within their non-living environment to work together to deliver benefits known as ecosystem services. ***Ecosystem services are the benefits supplied by the functions of ecosystems and received by humanity.*** Ecosystem services 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).² 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 analysing 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 Central 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 (such as environmental protection expenditure accounts).

² See for example Millenium Ecosystem Assessment (2005)

2.25 The Central Framework provides a more complete view of the environmental aspects of the economy by considering environmental transactions such as taxes, subsidies, grants, and rent. These transactions 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 Central Framework 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 Central Framework comprises 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 individual 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 that highlights depletion adjusted economic aggregates; and (iv) functional accounts which record transactions and other information about economic activities undertaken for environmental purposes. The analysis of these data can also be extended by linking the tables and accounts to relevant employment, demographic and social information.
- 2.27 The strength of the Central Framework 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 being consistent with the same definitions and classifications used in the SNA and economic statistics.
- 2.28 Implementation does not require compilation of every table and account for all environmental assets or environmental themes. Rather it 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 environmental-economic structure of 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 Central 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 Central Framework.

2.3.2 Supply and use tables

Monetary supply and use tables

- 2.30 Monetary supply and use tables record all 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 Central Framework.

2.31 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 expenditure);
- iii. the products can be consumed by governments (a flow known as government final consumption expenditure);
- 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 monetary supply and use 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. It is a fundamental identity in both the monetary supply and use tables and in the physical supply and use tables.

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 change in inventories (additions to inventories less withdrawals) during an accounting period is recorded as a use of products.

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 formation⁴ plus Exports.

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 (incl. changes in inventories)	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 Value added by industry can be calculated as the difference between an 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 (PSUT)

2.38 Physical flows are recorded by compiling supply and use tables in physical units of measurement. These tables are commonly known as physical supply and use tables, or PSUT. 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 a column for the environment, and rows for natural inputs and residuals. Table 2.3.2 shows these extensions.

⁴ Gross capital formation is equal to Gross fixed capital formation plus Changes in inventories.

- 2.40 The column for Government is removed to form the PSUT because, in physical terms, government activity is completely recorded within the first column, Industries. That is, the intermediate consumption associated with activities undertaken by government units are incorporated in the estimates of these flows for the relevant industry, for example, as part of public administration, or water collection and supply. In the monetary supply and use table the column for government final consumption expenditure reflects the acquisition by government of its own output which is a acquisition of services rather than a purchase of physical goods.
- 2.41 The column for Households in the PSUT relates purely to the consumption activity of households. Many households also undertake a range of activity for own-consumption, including the collection of water and fuelwood, the generation of hot water through the use of solar energy. While this activity is often regarded as direct household consumption from the environment, in the SEEA all products that are consumed must first be recorded as being produced. Hence, all of this production activity and the associated flows of natural inputs and products should be recorded in the first column, Industries. The consumption activity of households recorded in the PSUT extends to the generation of solid waste and other residuals as a consequence of consumption.
- 2.42 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.
- 2.43 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	Output			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 explained in detail in Chapter 3.

2.44 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 output and imports (total supply of products) must equal the quantity of intermediate consumption, household final consumption, gross 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.

2.45 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).

2.46 Both the supply and use identity and the input-output identity are an integral part of the Central 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.

2.47 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 (including flows of emissions and solid waste). Of note is that, unlike monetary flows which are measured in currency units, 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 material flows in an economy using a single measurement unit (e.g. tonnes), it is not usual practice.

Classifications for supply and use tables

2.48 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. Industries are consistently classified using the *International Standard Industry Classification of All Economic Activities* (ISIC), products are 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). The ISIC and the CPC are not only used in supply and use tables. They are also used in the other accounts and tables to classify industries and products. Other classifications, such as the *Standard International Energy product Classification* (SIEC), may also be used in specific situations.

2.3.3 Asset accounts

2.49 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.

2.50 An asset account is structured as shown in Table 2.3.3. It starts with the opening stock of environmental assets and ends with the closing stock of environmental assets. 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

environmental assets. This entry accounts for changes in the value of assets over an accounting period that are due to movements in the price of the assets.

Table 2.3.3 Basic form of an asset account

Opening stock of environmental assets		
Additions to stock		
	Growth in stock	
	Discoveries of new stock	
	Upwards reappraisals	
	Reclassifications	
	<i>Total additions to stock</i>	
Reductions in stock		
	Extractions	
	Normal loss of stock	
	Catastrophic losses	
	Downwards reappraisals	
	Reclassifications	
	<i>Total reductions in stock</i>	
Revaluation of the stock *		
Closing stock of environmental assets		

* Only applicable for asset accounts in monetary terms

2.51 There are many and varied reasons for changes in the quantity and value of a stock of environmental assets 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 planting of timber resources. Other changes in environmental assets are caused by natural phenomena, for example, losses of water from reservoirs due to evaporation or catastrophic losses of timber resources due to forest fires.

2.52 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 changes in the categorisation of the asset (reclassifications). The reassessment of the size and quality of mineral resources is an example of a reappraisal and the entries required to record changes in land use between agriculture and built-up areas are examples of reclassifications.

2.53 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 the net wealth of an economy can be obtained.

- 2.54 The capacity to account for and analyse the state of environmental assets and changes in them is a fundamental component of the Central Framework. 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

- 2.55 The different tables 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.
- 2.56 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 natural inputs, products, 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.
- 2.57 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 account 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 a flow of natural inputs.
- 2.58 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 the asset accounts and the supply and use tables. Some changes in stocks are not recorded in the supply and use tables and these are grouped together in the cell 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 (revaluations). It is noted that some environmental assets may be restored through human activities (e.g. restoration of water bodies as aquatic habitats).

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	Household final consumption expenditure	Government final consumption expenditure	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	Household 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 controlled landfills	
	Residuals - use	Collection & treatment of waste and other residuals				Accumulation of waste in controlled landfills	Residuals flowing to the environment **
						Other changes in volume of 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 (for example, air emissions) are not flows of environmental assets they may affect the capacity of environmental assets to deliver benefits. The changing capacity of environmental assets may also be reflected in other changes in the volume of assets.

2.59 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 may well affect the capacity of environmental assets to deliver benefits.

2.3.4 The sequence of economic accounts

- 2.60 In monetary terms, 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 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.
- 2.61 These flows are recorded in the sequence of economic accounts. It is compiled only in monetary terms because these accounts include transactions that do not have a direct underlying physical base, for example interest payments. The sequence of economic accounts in the SEEA follows the broad structure of the sequence of accounts in the SNA.
- 2.62 A particular feature of the sequence of accounts is the presentation of balancing items. Typically, there is not a balance between relevant inflows and outflows. Thus, a balancing item is introduced. The balancing items are measures of economic performance in their own right but also link the sequence of accounts together. Key balancing items include value added, operating surplus, saving and net lending/borrowing. Economy wide aggregates, such as Gross Domestic Product (GDP) and Gross National Income (GNI), can also be constructed from balancing items.
- 2.63 Of particular importance is the derivation of depletion adjusted balancing items and aggregates within the sequence of economic accounts. Depletion adjusted measures go beyond the balancing items and aggregates measured in “net” terms in the SNA (i.e. after the deduction of consumption of fixed capital) and further deduct the cost of using up natural resources, i.e. depletion. The main balancing items and aggregates within the sequence of economic accounts are shown in broad terms in Table 2.3.5.

Table 2.3.5 Basic SESA sequence of economic accounts

Production account (elaborated in supply and use tables)		
	<i>Main entries</i>	Output, Intermediate consumption, Consumption of fixed capital, Depletion
	<i>Balancing items/Aggregates</i>	Gross Value Added, Gross Domestic Product, Depletion adjusted Net Value Added, Depletion adjusted Net Domestic Product
Distribution and use of income accounts		
	<i>Main entries</i>	Compensation of employees, Taxes, Subsidies, Interest, Rent, Final consumption expenditure, Consumption of fixed capital, Depletion
	<i>Balancing items/Aggregates</i>	Depletion adjusted Net Operating Surplus, Depletion adjusted Net National Income, Depletion adjusted Net Saving
Capital account		
	<i>Main entries</i>	Acquisitions and disposals of produced and non-produced assets
	<i>Balancing item/ Aggregate</i>	Net lending/borrowing
Financial account		
	<i>Main entries</i>	Transactions in financial assets and liabilities
	<i>Balancing item/ Aggregate</i>	Net lending/borrowing

2.64 The sequence of economic 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 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 GDP. Consumption of fixed capital and depletion are deducted from gross value added and GDP to form measures of depletion adjusted net value added and depletion adjusted NDP.

2.65 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 expenditure. 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 final consumption expenditure).

2.66 As in the production account, depletion can be deducted from the balancing items of net operating surplus and net saving. The key aggregates from these accounts in gross terms are Gross National Income (GNI) and gross national saving. Both of these can be adjusted for depletion and consumption of fixed capital to form depletion adjusted measures.

- 2.67 The next account is the capital account. This account records how saving is used to acquire assets including produced assets and environmental assets. Thus it includes 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, 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.
- 2.68 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.
- 2.69 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.
- 2.70 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

- 2.71 While monetary supply and use tables can be used to organise and present certain types of transactions of particular relevance to the environment, identifying these transactions within supply and use tables usually requires additional disaggregation because the conventional industry and product classifications do not necessarily highlight environmental activities or products.
- 2.72 The approach taken 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). Second, relevant information in scope of the monetary supply and use table and the sequence of economic accounts is reorganised to identify clearly the transactions associated with the environmental activities and environmental goods and services.
- 2.73 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.

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

2.3.6 Employment, demographic and social information

2.75 The usefulness of the information in the various tables and accounts can be enhanced by relating different environmental and economic data to estimates of employment, estimates of population, various demographic breakdowns (such as age, household income levels and household characteristics related to material well-being), and measures of societal interest such as health and education.

2.76 Examples of the application of such data include the incorporation of employment data on the production of environmental goods and services, the use of socio-economic groupings of households to assess water and energy use and access to resources, and the linking of information on health status to data on air emissions in particular regions.

2.77 Section 6.2 discusses further the use of these types of data in the context of the Central Framework, and the SEEA Extensions and Applications presents techniques and analytical approaches for linking SEEA based data with various types of employment, demographic and social data.

2.4 Combining physical and monetary data

- 2.78 The presentation of information in a consistent format that combines integrated physical and monetary data is one of the strongest features of the Central Framework. This feature enables the provision of 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 use both physical and monetary data.
- 2.79 Given the integrated accounting structures for physical and monetary accounts, it is logical to use these structures and the common underlying accounting rules and principles to present physical and monetary information at the same time. Such integrated formats have sometimes been referred to as “hybrid” presentations or accounts because they contain data in different measurement 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.
- 2.80 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 ensures a consistent comparison of environmental burdens with economic benefits, or environmental benefits with economic costs. This linkage can 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.
- 2.81 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.
- 2.82 In combined presentations, it is 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.
- 2.83 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.
- 2.84 At finer levels of disaggregation, combined presentations can provide the research community with access to a structured database for further research regarding 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.

- 2.85 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 are 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 questions under investigation.
- 2.86 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 publications (such as on water and energy).

2.5 Accounting for flows and stocks

2.5.1 Introduction

2.87 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

2.88 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, and residuals. All of these flows are defined in greater detail in Section 3.2.

2.89 ***Natural inputs are all physical inputs that are moved from their location in the environment as a part of economic production processes or are directly used in production.*** 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).

2.90 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 return immediately to the environment. These flows are termed natural resource residuals.

2.91 ***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 a 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 establishment are ignored. However, depending on the purpose and field of analysis, it may be relevant to record these intra-establishment flows. For example, in the analysis of energy flows it may be relevant to record the generation of energy by an establishment from burning its own solid waste.

2.92 ***Residuals are 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.

2.93 Physical flows are often separated into three categories - 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 form 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.

2.94 Physical flows are also recorded in asset accounts where they represent changes in the stocks of assets between one period and another. These flows include flows 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 are 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.

2.95 An important flow in physical terms that concerns environmental assets is depletion. Depletion relates to the physical using up of natural resources 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 aquatic 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. The measurement of depletion is discussed in detail in Chapter 5.

Flows in monetary terms

2.96 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.

2.97 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.

- 2.98 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 economic 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

- 2.99 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.
- 2.100 Individual environmental assets comprise mineral and energy resources, land, soil resources, timber resources, aquatic resources, other biological resources and water resources. These assets are defined by their material content (i.e. the volume of timber or soil resources) without specific reference to their constituent elements (such as carbon in timber and nutrients in soil resources).
- 2.101 Some biological resources (i.e. timber resources, aquatic resources, other biological resources) may be cultivated within a production process (e.g. plantation timber, fish in aquaculture facilities). A distinction is made between environmental assets that are cultivated and those that are natural resources. ***Natural resources include all natural biological resources (including timber and aquatic resources), mineral and energy resources, soil resources and water resources. All cultivated biological resources and land are excluded from scope.*** The difference between cultivated and natural biological resources is discussed in Section 5.2.
- 2.102 The volume of water in the ocean is not considered in scope of water resources 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 assets 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.
- 2.103 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 and the relevant approaches to measurement of environmental assets in physical terms are discussed in detail in Chapter 5.

Stocks in monetary terms

- 2.104 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 measurement of economic assets in the SNA.
- 2.105 In the Central Framework, a monetary value is not placed 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.
- 2.106 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 physical terms that have a zero economic value. For example, all land within a country is within scope 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.
- 2.107 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 an asset's 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, it is recommended 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 relevant economic units.
- 2.109 For the Central Framework, the relevant economic units are those that 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 the definition of 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 institutional units that are similar in their purposes, objectives and behaviours are defined as institutional sectors.
- 2.111 Following the SNA, five types of institutional sector are recognised, 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 Central Framework and hence, generally, these are presented as one sector, Corporations. The 2008 SNA Chapter 4 describes the different institutional sectors in detail.
- 2.112 Institutional sectors are of particular interest in the context of 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 economic accounts. The full sequence of economic 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. 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.

2.115 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.

2.116 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.

2.117 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). 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 fuelwood 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 Central Framework. As in the SNA, where the production activity is of significance it is recorded together with that of other units undertaking the same activity.

2.118 The SNA allows the possibility of recording separately some own account, intra-enterprise activity, described as ancillary activity, but this is limited to a specific set of

activities.⁵ For some purposes of environmental-economic accounting, it may be relevant to identify the secondary activities of an enterprise and also activities undertaken within an enterprise where output is not sold to other units. A particular example is in accounting for physical flows of energy where measuring all transformations of energy products is likely to be of interest.

2.119 Also, in the compilation of functional accounts, it may be relevant to identify the secondary and other activities of enterprises 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 an enterprise. For the compilation of functional accounts on environmental activities and environmental goods and services, the Central Framework 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.

2.120 Thus, in some circumstances a wider coverage than the SNA is permitted for the recording of intra-enterprise activities (explained further below) but the same scope as the SNA is retained in relation to own-account activity of households undertaken for own-account final use.

2.6.4 Geographic boundaries for economic units

2.121 A key feature of the Central Framework is that it aims to account for the interaction between the economy and the environment at a national level. The geographic 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 enclaves⁶ in the rest of the world. Economic territory excludes territorial enclaves of other countries located in the reference country.

2.122 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

⁵ See 2008 SNA paragraphs 5.35 - 5.45.

⁶ Territorial enclaves include embassies, consulates and military bases and the operations of international organizations. For more details see 2008 SNA 26.24 – 26.45.

- 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 nations' 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.⁷

2.123 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 measured in physical and monetary terms. However, this geographic boundary is different from the one commonly used for certain important environmental statistics, such as air emissions and energy statistics. Where these statistics are an information source for the compilation of accounts, adjustments to the statistics are likely to be needed to account for differences in geographic coverage.

2.124 Accounting at sub-national levels in both physical and monetary terms 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 Statistical units

2.125 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 and in this context are referred to as statistical units. Depending on the structure of information within a country, economic data are likely to be available for different types of economic unit, particularly for enterprises and, in some cases for individual establishments. Consequently, the economic unit and the statistical unit will align in scope. However, since the ownership structures of enterprises can vary significantly and since some enterprises may produce a range of different products matching the information available to the ideal conceptual model of economic units may not be straightforward, and statistical units will need to be defined for measurement purposes.

⁷ For details regarding the specific treatment of households and individuals see the 2008 SNA 26.37-26.39.

- 2.126 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.
- 2.127 At the same time, the collection of information about the environment, particularly as it concerns environmental assets, requires consideration of appropriate statistical units for the environment. These statistical units reflect the parts of the environment about which statistics may be collected and presented. Examples include inland water bodies (lakes, rivers, etc), specific deposits of mineral resources, forests and fish stocks. In some cases, it will be possible to align the environmental statistical unit and an associated economic unit but this should not be expected.

2.7 Accounting rules and principles

2.7.1 Introduction

- 2.128 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 the information far less useful.
- 2.129 The Central Framework follows the same accounting rules and principles as the SNA. This section introduces the rules and principles of most relevance. 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

- 2.130 A key feature of accounting is the consistency that is applied in the recording of transactions between different economic units.
- 2.131 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.
- 2.132 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).
- 2.133 Since the focus 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 consistently by both parties. This is known as quadruple entry accounting.
- 2.134 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, a decrease in inventory and an increase in cash for the fishing business. All four entries must be recorded to ensure that the accounting is complete and balanced.
- 2.135 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

- 2.136 One requirement of the double and quadruple 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.
- 2.137 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 approach to the time of recording is called an accrual approach.
- 2.138 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.
- 2.139 Ideally, the time of the recording of physical flows should align with the time of recording of the flows in monetary terms using an accrual approach. 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.⁸ Adjustments to account for different underlying cycles in physical and monetary terms should be made as required.

Units of measurement

- 2.140 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 entries are the monetary values of the actual transactions. In other cases the entries are estimated by reference to other equivalent monetary values (for own-account consumption) or valued at the cost of production (for non-market output).
- 2.141 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.

⁸ 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)

2.142 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 are likely to be used.

2.7.3 Valuation rules and principles

Valuation at market prices

2.143 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.

2.144 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”.

2.145 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 approximate the general “average” market prices just described. However, there are some prices for individual 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 general market price equivalents.

2.146 When market prices are not observable, valuation according to market price equivalents should be used to provide an approximation to market prices. Particular examples of the need to apply market price principles concern the valuation of goods and services produced and used on own-account, and the valuation of non-market production. Following the SNA, the own-account production of market producers (including own-account capital formation) 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 assets used in production, and other taxes less subsidies on production. The valuation of all non-market production follows the same approach except, by convention, a net return to fixed assets used in production is excluded.

2.147 In the SEEA these valuation principles are applied slightly more broadly than in the SNA as the SEEA includes a wider range of intra-enterprise flows, in particular own-account production used for intermediate consumption by market producers (see Section 2.6). Since, intra-enterprise flows are not sold on the market, no net return to fixed assets used in production is included in the derivation of the value of this output.

2.148 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 SNA⁹ 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 discussed in Section 5.4.

2.149 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 Central Framework 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.

Basic, producer and purchaser's prices

2.150 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 2.7.1.

⁹ See 2008 SNA Chapters 10 and 13.

Figure 2.7.1: Basic, producers' and purchasers' prices

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

- 2.151 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 purchaser 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.
- 2.152 The basic price measures the amount retained by the producer and is, therefore, the price most relevant for the producer's decision making.
- 2.153 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. Unlike the basic price, the producers' price includes any taxes on products other than a deductible VAT, and excludes any product subsidies.
- 2.154 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.
- 2.155 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, functional accounts, and the sequence of economic accounts are contained in the 2008 SNA Chapter 14.

2.7.4 Volume measures

- 2.156 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.
- 2.157 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.
- 2.158 The compilation of volume measures is generally 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.
- 2.159 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.
- 2.160 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.

2.161 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.¹⁰

¹⁰ 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