Chapter 2: Accounting structure

Global consultation version

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2.1 Introduction

1. The purpose of the System of Environmental and Economic Accounts (SEEA) is to integrate information on the economy and the environment. The SEEA encompasses information on 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 that comprise the environment and changes in these stocks; and (iii) economic activity related to the environment.
2. A range of definitions, rules and principles need to be set out so that the recording of the information in these areas of the SEEA can be undertaken following clear and consistent treatments. This chapter provides an overview of the SEEA accounting structure and its rules and principles of recording.
3. Section 2.2 provides an overview of the SEEA framework placing the various aspects of the economy and the environment in context from a measurement perspective. Using the broad framework described in Section 2.2, Section 2.3 presents the accounting structure of the SEEA central framework which is reflected in supply and use tables, asset accounts, functional accounts and the sequence of accounts. The section highlights the relationship between different parts of the accounting structure.
4. Section 2.4 describes stocks and flows in physical and monetary terms and Section 2.5 describes the economic units that are involved. Section 2.6, 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

The measurement of economic activity related to the environment

5. The SEEA framework covers the interaction between the economy and the environment. It expands the conventional economic measurement framework, the System of National Accounts (SNA), to incorporate flows between the economy and the environment, and highlights 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.

6. The definition of the economy is founded on the three primary economic activities of production, consumption and accumulation. In broad terms, the economy functions through the production of goods and services which in turn must be either consumed by other industries, households, government or the rest of the world; or not consumed and hence must accumulate to be consumed in the future. Accumulation in this context includes the production of machines and other types of economic assets that are used on an ongoing basis.

7. The measurement of this basic economic model in monetary terms is defined in the SNA. In its measurement of the production of goods and services in monetary terms the SEEA adopts the same approach.

8. Beyond the measurement of flows in monetary terms associated with the economy and the environment, there is interest in the production, consumption and accumulation of goods and services to undertake environmental activity. Examples of such activity include expenditures on environmental protection and resource management, and the production of environmental goods 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.

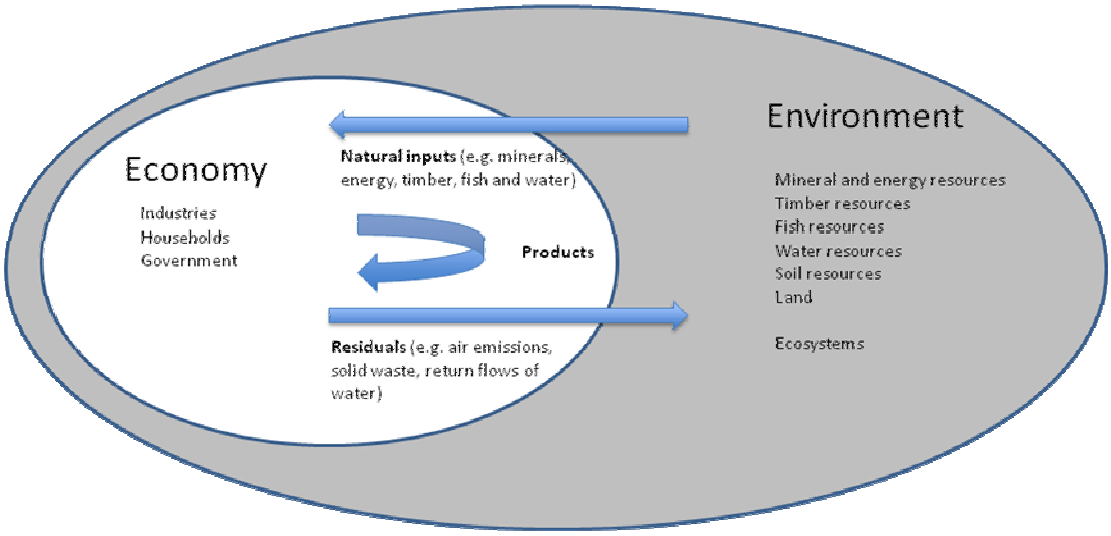
9. It is also possible to develop a more complete view of the environmental aspects of the economy by considering economic flows such as taxes, subsidies, grants, rent and flows to and from other countries. These flows, which are distinct from the flows of goods and services discussed above, are recorded in the national accounts framework in a sequence of accounts.

The measurement of physical flows

10. The environment is the location within which economic activities of production, consumption and accumulation take place. Thus, the flows of goods and services within the economy directly interact with the broader system of natural processes that occur in the environment.

11. 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, natural inputs flow from the environment into the economy, products flow within the economy, and residuals – the undesired materials resulting from production and consumption activity – flow to the environment[1]. This broad characterisation is presented in Figure 2.2.1.

Figure 2.2.1 Physical flows between the economy and the environment



The measurement of environmental assets

12. The use of natural inputs by the economy is linked to changes in the stock of environmental assets that generate these inputs – for example, changes in the stock of mineral and energy resources, timber resources, fish resources and water resources. Accounting for environmental assets in both physical and monetary terms is an important role of the SEEA.

13. In the central framework the focus is on accounts for individual resources. This focus reflects the most commonly understood use of environmental assets as natural inputs for the economy. In undertaking the accounting for natural resources, a particular focus is on the extent of depletion in physical and monetary terms. Depletion reflects the using up of the natural resources through extraction, abstraction and harvest thus reducing the potential for the resources to be available in the future.

14. At the same time, these individual resources co-exist within the environment and together, as a system, provide a broader range of benefits to the economy and society than is commonly appreciated. The functioning of the various components of the

[1] It is noted that many residuals also remain within the economy for example in the case of solid waste collected in landfill sites. Details on the definition of physical flows are presented in Section 2.4 and in Chapter 3.

environment as a system is reflected in the concept of an ecosystem. An ecosystem can be defined as a "dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit".[23]

15. The importance of ecosystems can be considered in terms of the range of benefits (often referred to as ecosystem services) that they deliver. Beyond the provision of natural inputs such as coal, timber, fish, etc (generally referred to as provisioning services), the environment provides other ecosystem services

    i. when acting as a sink for residuals, such as emissions to air and water, and when providing services such as pollination and flood protection,

    ii. in the form of amenity and cultural services provided when the environment is used by people as a place for recreation and reflection; and

    iii. to itself, in the form of services internal to the operation of the environment such as the formation of soil.

16. Economic activity may degrade environmental assets such that they are not able to deliver the range and quantity of ecosystem services on an ongoing basis. Thus, a focus on ecosystems encompassing all environmental assets provides a more holistic view of the environment and allows analysis of the extent to which economic activity may reduce ecosystem capacity – that is an assessment of degradation.

17. From a measurement perspective, accounting for ecosystems and ecosystem services is partly addressed through accounting for changes in land use and land cover. Also relevant is the measurement of flows with a potential negative influence on the provision of ecosystem services, for example, releases of air emissions.

18. However, ecosystem accounting itself is a statistical activity that is still maturing. For that reason, the SEEA central framework focuses on the measurement of individual environmental assets within the environment – mineral and energy resources, timber resources, fish resources, water resources, soil resources and land. The broader question of overall changes in the quality of the environment and its capacity to deliver ecosystem services will be addressed in SEEA Part II: Experimental Ecosystem Accounts.

[2] Article 2, Convention on Biodiversity

[3]It is noted that the SEEA includes sub-soil mineral and energy resources as part of the set of environmental assets. However, they do not interact within ecosystems in the same way as other environmental assets.

2.3 Main accounts and tables of the SEEA central framework

2.3.1 Introduction

19. The aim of the SEEA is to organise and integrate the information on the various stocks and flows of the economy and the environment described in Section 2.2. The process of organisation is undertaken by building tables. These tables indicate whether the flows are from the environment to the economy or between different groups within the economy, such as industries and households (collectively these groups are referred to as "economic units"). As an example, the tables record flows of water from the environment to water distributers, from water distributers to households and other industries and finally return flows to the environment.

20. The strength of the organisational framework of the SEEA comes from (i) using consistent definitions for different types of stocks and flows; (ii) defining the different economic units and locations in the same way; and (iii) using consistent classifications for physical and monetary accounts.

21. The SEEA central framework is comprised of the following types of tables: (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 showing all economic flows between economic units; (iv) functional accounts which highlight economic activities undertaken for environmental purposes; and (v) population, demographic and employment information relevant for the analysis of environmental issues.

22. Although accounting for ecosystems in not part of the SEEA central framework a similar set of tables is relevant for the development of ecosystem accounts in particular supply and use tables and asset accounts. The development of relevant tables for ecosystem accounts is discussed in SEEA Part II: Experimental Ecosystem Accounts.

23. This section introduces the different tables that are part of the SEEA 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 SEEA.

2.3.2 Primary components of the central framework

24. The main economic actors recorded in the SEEA are industries (groups of businesses undertaking similar types of activity), households, government and economic units in the rest of the world. The main locations recognised in the SEEA are the national economy and the environment. The stocks and flows that exist entirely outside of the environment are not recorded.

25. The main stocks that are recorded are environmental assets (primarily natural resources and land), and produced or man-made assets (such as buildings, dams and wind turbines). The three broad types of flows that are recorded are natural inputs from the environment, products (goods and services) produced in the economy, and residuals which are undesired materials generated by economic activity flowing from the economy to the environment or flowing within the economy.

26. A more detailed introduction to the various stocks and flows in physical and monetary terms is presented in Section 2.4.

2.3.3 Supply and use tables

Monetary supply and use tables

27. Monetary supply and use tables fully articulate the monetary flows of products in an economy between different economic units. They are compiled to provide information on 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 or to activities and expenditures associated with the environment, for example environmental protection expenditure. Highlighting the relevant flows in monetary terms is therefore an important part of the SEEA.

28. The recording of the products that flow within the economy is aligned with the recording of these flows in the SNA. Products are "supplied" to 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).

29. 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); or

    v. the products can be held as inventories for later use[4] or used as assets (e.g. machines) to produce other products over a longer period of time (these

[4] 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.

longer term uses are flows known as gross fixed capital formation, and together with inventories are referred to as gross capital formation).

30. As shown in Table 2.3.1, these flows are classified by type of product in the rows and by type of economic unit in the columns.

31. The table is divided into two parts – the supply table and the use table. For each product the summation of the various sources of supply (output or imports) is equal to the summation of the various uses of that product (intermediate consumption by industry, household or government final consumption, gross capital formation or exports). This equality between the total supply and total use of each product is known as the supply and use identity and is a fundamental identity in both the monetary supply and use tables and in the physical supply and use tables that together form the basis of much of the data compilation and analysis in the SEEA.

Table 2.3.1 Basic form of a Monetary Supply and Use Table

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

32. A feature of monetary supply and use tables is that key economic aggregates can be derived using the components of the supply and use tables. In particular, the aggregate Gross Value Added can be calculated as the difference between output and intermediate consumption. This aggregate forms the starting point for the sequence of accounts described in Section 2.3.6.

33. 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)

34. Physical flows are represented in the SEEA using physical supply and use tables (PSUTs). The focus of PSUTs is on flows of energy, water or materials and they are used to assess how an economy supplies and uses energy, water and materials, and 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.

35. The structure of PSUTs is based on the monetary supply and use tables above but they are not limited to products. They are structured to bring together flows of products with flows of natural inputs and residuals. Table 2.3.2 shows this extension of the monetary supply and use table structure to incorporate flows of natural inputs and residuals between the economy and the environment.

Table 2.3.2 Basic form of a Physical Supply and Use Table

SUPPLY TABLE							
	Industries	**Households**			**Rest of the World**	**Environment**	**Totals**
Natural inputs						Flows from environment	Total supply of natural inputs
Products	Domestic production				Imports		Total supply of products
Residuals	Residuals generated by industry	Residuals generated by households			Residuals received from the rest of the world		Total supply of residuals
USE TABLE							
	Industries	**Households**	**Government**	**Accumulation**	**Rest of the World**	**Environment**	**Totals**
Natural inputs	Use of natural inputs						Total use of natural inputs
Products	Intermediate consumption	Household Consumption	Govt. Consumption	Gross Capital Formation	Exports		Total use of products
Residuals	Collection & treatment of waste and other residuals			Accumulation of waste in controlled landfill sites	Residuals sent to the rest of the world	Residual flows direct to environment	Total use of residuals

36. Within the PSUT the supply and use balance that applies in monetary terms also applies in physical terms. Thus, for each product measured in physical terms (for example cubic metres of water) 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.

37. In addition to the supply and use balances, the PSUT incorporates an additional identity concerning flows between the environment and the economy. This second identity requires that the total flows into the economy (for example in the form of water abstracted from natural lakes) are, over an accounting period, either accumulated in the economy or returned to the environment.

38. Both of these identities 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.

39. Further details on the compilation of PSUTs are presented in Chapter 3 including the presentation of specific PSUTs focused on individual types of materials. 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 (e.g. tonnes) this is not commonly done.

Classifications for supply and use tables

40. 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 boundary around the national economy is defined using the residence principle. The use of these classifications is discussed at various points throughout the SEEA.

2.3.4 Asset accounts

41. The intent of asset accounts is to record the opening and closing stock of environmental assets[5] 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 more quickly than they can regenerate. More broadly, information from asset accounts can be used to assist in the management of environmental assets.

42. An asset account is structured as shown in Table 2.3.3. Asset accounts can be compiled in physical or monetary terms, noting that the revaluation of the stock of resources concerns changes due to movements in the price of resources and is only applicable to asset accounts compiled in monetary terms.

[5] Environmental assets are defined in Section 2.4 and in Chapter 5.

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

43. 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.

44. Other changes in environmental assets may be 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). Finally, when measured in monetary terms, there may be changes between the opening and closing stock of resources that are due to changes in the price of the asset. These are recorded as revaluations.

45. 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.

46. 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

47. 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.

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 & use**	Inputs of natural resources					Extracted natural resources
	Product - supply	Output			Imports		
	Product - use	Intermediate consumption	Final consumption	Final consumption	Exports	Gross Capital Formation	
	Residuals - supply	Generation of solid waste, wastewater and emissions			Residuals received from the rest of the world		
	Residuals - use	Collection & treatment of waste and other residuals			Residuals sent to the rest of the world		Residuals flowing to the environment*
						Other changes in assets (e.g. discoveries, catastrophic losses, revaluations)	
						Closing stock	

* Strictly, the flow of residuals to the environment is not reflected in the asset accounts for individual natural resources although they are likely to impact on the capacity of environmental assets to deliver ecosystem services.

48. 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. 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.

49. The two right hand columns of Table 2.3.4 show stocks and flows related to produced and environmental assets. 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.

50. Significantly, measures of the extraction of environmental assets in physical terms recorded in the asset accounts align precisely to the measures of natural inputs recorded in the PSUTs. The valuation of this extraction is also consistent between the asset accounts and the monetary supply and use tables.

2.3.5 The sequence of economic accounts

51. Supply and use tables and asset accounts record the bulk 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 and transfers and grants from government units to other economic units to support environmental protection activity.

52. The definition and recording of these flows from an environmental perspective is important to highlight flows of environmental taxes and subsidies, present measures of the income earned from the extraction of resources after deduction for the cost of the depletion of natural resources and to provide the information required for an assessment of the full economic costs and benefits of environmental activity.

53. These transactions and flows are of particular interest when considered from the perspective of different institutional sectors of the economy, such as households, governments and corporations.

54. The SNA shows all of these flows in a presentation referred to as the full sequence of accounts. 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.

55. In the SNA the balancing items can be shown after the deduction of the cost of using fixed assets, consumption of fixed capital, to form “net” measures, i.e. net value added, net operating surplus and net saving. In the SEEA, these “net” balancing items are further adjusted to account for the cost of using up natural resources, depletion. The SEEA balancing items are therefore referred to as “depletion adjusted”.

56. The basic sequence of economic accounts in the SEEA is presented in Table 2.3.5. It is compiled only in monetary terms because these accounts record transactions other than

transactions in products. The sequence 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).

Table 2.3.5 Basic SEEA sequence of economic accounts

Production account		
	Main entries	Output, Intermediate consumption
	Balancing item	**Depletion adjusted Value added**
Income accounts		
	Main entries	Compensation of employees, taxes, subsidies, interest, rent, final consumption
	Balancing items	**Depletion adjusted Operating surplus, Depletion adjusted Saving**
Capital account		
	Main entries	Acquisitions and disposals of assets
	Balancing item	**Net lending/borrowing**
Financial account		
	Main entries	Transactions in financial assets and liabilities
	Balancing item	**Net lending/borrowing**

57. The sequence continues in the income accounts. These accounts contain information on the way 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).

58. The third account is the capital account. This account records how saving is used to purchase assets including produced assets and environmental assets. 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.

59. The transactions involved in lending and borrowing are recorded in the financial account, the final account in the sequence. 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.

60. 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.

61. 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.

2.3.6 Functional accounts

62. 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 require additional disaggregation because the conventional industry and product classifications do not necessarily highlight environmental activities or products.

63. By highlighting environmental activities and products, information can be presented on the economic response to environmental issues, for example, information on the relative significance of environmental activity (in terms of value-added or employment), or information on the source and nature of environmental protection expenditure.

64. The approach taken in the SEEA is to define the activities, goods and services that have an environmental purpose and then to reorganise the information in scope of the monetary supply and use table to clearly identify the environmentally related transactions associated with the environmental activities and environmental goods and services.

65. In addition to information in monetary supply and use tables, there is a range of other flows measured in monetary terms that are considered environmental in nature and can be presented in functional accounts following the logic of the sequence of accounts described above. Particular flows of interest are the output of environmental goods and services, expenditures on environmental protection and resource management as well as environmentally related taxes and subsidies.

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

2.3.7 Population, demographic and employment information

67. 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 income levels and household types. This information may be useful in assessing issues such as resource availability, changes in energy use and sources of emissions. The adjustment of data to account for differences in population size and structure is also important for international comparisons of environmental and economic data.

68. 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.

69. 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.

2.3.8 Combining physical and monetary data

70. By structuring the physical supply and use tables in the same way as monetary supply and use tables, relationships between monetary and physical data can be analysed in much greater depth. Indeed, the use of similar structures and classifications for both monetary and physical data is at the core of the SEEA philosophy.

71. Physical and monetary information can be combined in many different ways. In the first instance, the nature of its presentation depends on the question of interest. Ways to combine physical and monetary data are described in Chapter 6.

2.4 Accounting for stocks and flows

2.4.1 Introduction

72. The compilation of supply and use tables, asset accounts, the sequence of accounts and functional accounts 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.

2.4.2 Flows

Flows in monetary terms

73. 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. Transactions involve an interaction between economic units by mutual agreement. The majority of economic flows are a form of transaction. Other flows relate to changes in the value of assets and liabilities that do not result from transactions. Examples are losses of assets due to natural disasters and the effect of price changes on the value of assets and liabilities.

74. The majority of transactions relate to exchanges of products between economic units. Products may be sold on markets, 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-marketed products.

75. There are two main types of non-marketed products. First, there are “collective” services such as national defence that are provided to a community as a whole and are not considered to be consumed by individuals. Second, there are “individual” services that are consumed by individuals, for example water supply and education, but that may be provided by governments at zero or economically insignificant prices as a matter of social or economic policy. Where the production of the same types of services is sold on markets at economically significant prices, these products are considered to be marketed products.

76. All of these 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 2.5.

Physical flows

77. The same accounting approaches can be used in physical terms; flows are reflected in the movement and use of materials, water and energy. As introduced earlier in this chapter physical flows are considered as natural inputs, products or residuals.

78. Natural inputs are all physical inputs from the environment that are directly incorporated into economic production and consumption processes or that are moved from their location in the environment as a part of economic production processes. They may be (i) natural resource inputs such as mineral and energy resources or timber resources, (ii) non-fuel energy inputs such as solar energy captured by economic units, or (iii) ecosystem inputs such as oxygen for combustion processes.

79. Products are goods and services that result from a process of economic production. 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 car retailer. For accounting purposes, the SNA only records flows of products between economic units and flows internal to the operation of a producing unit are ignored. However, in physical terms, depending on the purpose and field of analysis, it may be relevant to record these internal flows.

80. Residuals are the undesired flows of materials, water and energy that are discarded, discharged or emitted by businesses and households as a result of processes of production, consumption or accumulation. Residuals may be emitted to the environment (for example emissions to air) but may also flow within the economy – such as when waste is collected as part of a waste collection scheme. When residuals flow between units in the economy, they do not have a value to the generator and often the generator pays for services for the removal and treatment of the residuals.

81. At the same time, residuals may become products when they are recycled or otherwise reused in the economy, possibly following a degree of reprocessing or treatment – for example, broken glass may become a bottle following recycling.

82. 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 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.

83. 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 flows solely within the environment and hence are not recorded in the supply and use tables as natural inputs, products or residuals because they are not used in the economy as intermediate inputs.

84. 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 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 and this factor makes the measurement of depletion challenging. Depletion is discussed in detail in Chapter 5.

2.4.3 Stocks

Physical stocks

85. In physical terms, stocks refer to the total quantity of assets at a given point in time. In the SEEA, the focus is on the physical stock of environmental assets. Environmental assets are the naturally occurring living and non-living components of the Earth, together comprising the bio-physical environment, that are used in production and that deliver ecosystem services to the benefits of current and future generations.

86. Environmental assets encompass mineral and energy resources, land, soil resources, timber resources, fish resources, other biological resources and water resources. Conceptually, all of these individual environmental assets are contained within ecosystems and work jointly to deliver ecosystem services. Thus, environmental assets can be considered either from the perspective of the individual assets or from the perspective of the ecosystems themselves.

87. In the central framework, the measurement scope is based on recording the stocks and flows for individual environmental assets. The approaches to measurement of environmental assets in physical terms are discussed in detail in Chapter 5. The techniques required for the measurement of environmental assets from an ecosystems perspective are still maturing and are discussed in SEEA Part II: Experimental Ecosystems Accounts.

88. The central framework excludes oceans and the atmosphere from the scope of environmental assets as they are so vast that they cannot be clearly attributed to individual countries. Thus they are not a key focus for the purposes of national level environmental and economic accounting even though information relating to these environmental assets may be of interest in other situations, for example the concentration of carbon dioxide in the atmosphere.

Stocks in monetary terms

89. 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 economic benefits that accrue to owners of environmental assets and does not aim to value all of the benefits that may accrue to current and future generations. In this regard, the approach to defining stocks in monetary terms in the SEEA aligns with the definition of economic assets in the SNA.

90. One exception concerns the valuation scope for mineral and energy resources. The SNA recommends only the inclusion of the value of proven resources whereas in the SEEA the scope is broadened to include the value of proven, probable and possible mineral and energy resources. The relevant measurement issues are discussed in Chapter 5.5.

91. One consequence of the approach to valuing assets is that assets may enter or leave the scope depending on changes in the expected economic benefits. This is most likely to occur in relation to environmental assets when new environmental assets are discovered, or when technologies or prices change such that the extraction of environmental assets becomes or ceases to be of economic value to the owner.

92. For many environmental assets there are few markets that buy and sell the assets in their natural state and hence determining whether it has value and what that value is can be difficult. A number of approaches to valuation are possible but 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 future economic benefits that can be attributed to an environmental asset, for example profits from the sale of mineral resources, and then discounts the future economic benefits to give them a value in the current period. The NPV approach is described in detail in Chapter 5. It is noted that the application of the NPV approach requires information on the stock of assets in physical terms.

2.5 Economic units

2.5.1 Introduction

93. 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 units involved.

94. 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.

95. The environment itself is not considered to be a unit. 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. An alternative perspective 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 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 Part II: Experimental Ecosystem Accounts.

2.5.2 Enterprises, establishments and industries

96. An enterprise is an economic unit that produces one or more goods and services and may be located across multiple locations within a single economy. These units undertake production in a range of different ways including as identifiable profit making businesses, as a part of household activity or as part of the function of government. Importantly, an enterprise can own assets and liabilities and generally operates in a "stand alone" sense.

97. An enterprise may be comprised of one or more establishments. 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.

98. 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.

99. 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.

100. For some purposes of environmental and economic accounting in physical terms, it may be relevant to identify the secondary activities of an establishment and also activities undertaken within the establishment but where output is not sold to other units. This is particularly the case in accounting for 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.

101. In the compilation of functional accounts, it may be relevant to identify the secondary and other activities of businesses 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 compilation of functional accounts on environmental activities and environmental goods and services, the SEEA aims to separately identify these 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.

102. In both physical and monetary terms the activities undertaken within establishments are referred to in the SEEA as "own-account" activities. The use of the term "own account" differs from its use in the SNA. In the SNA, own-account activity only covers activity undertaken for either the final consumption or investment of the economic unit (own account final use). As defined here, own-account activity also includes activity undertaken for own account intermediate use for the production of other goods and services. The SNA does allow the possibility of incorporating some own account intermediate use activity, described as ancillary activity, but this is limited to a specific set of activities.[6]

103. 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 insulation in houses) are of interest in the SEEA. As in the SNA, where the activity is of significance, a separate production establishment should be recognised and its activity recorded consistently with other units undertaking the same activity.

[6] See 2008 SNA Chapter 5.

2.5.3 Institutional sectors

104. An alternative perspective on economic units does not focus on the units as producers but rather considers their purpose, objectives and behaviours. These institutional units are defined as 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.

105. 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.

106. Institutional sectors are of most interest from the perspective of 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.

107. 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 presentation.

2.6 Accounting rules and principles

2.6.1 Introduction

108. 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.

109. 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.

2.6.2 Recording rules and principles

Double and quadruple entry accounting

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

111. For example, the purchase of a bed 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). The sale of a car by a manufacturer will represent an increase in the manufacturer's output and cash.

112. 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 by both parties in the same way. This is known as quadruple entry accounting.

113. Thus, the purchase of a bed 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 bed retailer. All four entries must be recorded to ensure that the accounting is complete.

114. While all of these entries are required for accounts in monetary terms, in physical terms the associated financial transactions are not recorded. Only the relevant entry for each unit involved in the transaction is recorded. Since only two entries are recorded, but they refer to entries across two units, this is referred to as horizontal double entry accounting.

Time of recording

115. 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.

116. 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. This time of recording is called an accrual basis. Transactions internal to one unit are recorded when economic value is created, transformed or extinguished.

117. 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.

118. 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. Adjustments to account for different underlying cycles of data in physical and monetary terms should be made as required.

Units of measurement

119. 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 similar monetary values (for own-account consumption) or components of the value (for non-marketed output).

120. 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 joules, stocks and flows of water are generally measured in 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.

121. 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.

2.6.3 Geographic boundaries

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 the environment is based on the political boundaries of a country.

123. The SEEA also incorporates those mineral and energy resources and fish resources that are offshore and are generally able to be attributed to a country on the basis of international agreements. The oceans themselves and the land under the oceans are excluded from the scope of environmental assets in the central framework.

124. The geographic scope of an economy is based on the concept of economic territory. Economic territory is the area under effective economic control of a single government. It includes the land area of a country including islands, airspace, territorial waters and territorial enclaves[7] in the rest of the world. Economic territory excludes territorial enclaves located in the reference country. For the purposes of land accounts, the area is defined as the surface enclosed by all inland borders and, for countries bordering the sea, the normal base-line (low-water mark) is used (see Chapter 5.6).

125. Using this definition of economic territory a national economy is defined using the concept of residence. 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.

126. In general, there will be a large overlap between those units that are resident and those units located within the politically defined geographical 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 national waters. In these cases they are considered to remain residents of the national economy irrespective of their location of operation although their activity will have impacts on both other economies and other environments.

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.

127. 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

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

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. Adjustments to these data are likely to be needed for use in SEEA accounts and tables.

128. 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.

2.6.4 Valuation rules and principles

Valuation at market prices

129. 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.

130. 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".

131. 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.

132. When market prices are not observable, valuation according to market-price-equivalents should be used to provide an approximation to market prices. In such cases, market prices of the same or similar items should provide a good basis for applying the principle of market prices. A particular example of the need to apply such principles is the recording of goods and services produced and used on own-account.

133. 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, wild fish and natural timber resources. A number of techniques are suggested in the 2008 SNA (Chapters 10 and 13) 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 approaches, is in SEEA Chapter 5.

134. 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 further in the context of the central framework of the SEEA.

Basic, producer and purchaser's prices

135. 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 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.

136. Two kinds of prices are used to 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.

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

138. 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.

139. 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.

140. 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

141. 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.

2.6.5 Volume measures[8]

142. 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. 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 gross domestic product over time.

143. Volume measures, particularly those for production and consumption, are very useful to assess environmental-economic trends. They may help showing 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, economic growth.

[8] In this context volume measures refer to economic notions of the quantity and quality rather than measures of the physical volume of solids, liquids and gases.

144. 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 is weighted together to provide price indexes 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 indexes. Volume measures derived using general price indexes are commonly referred to as "real" measures. Real measures are often derived in cases where it is necessary to remove the effects of inflation from measures of income.

145. 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 net worth is enhanced when the impact of price changes on the changing values of assets is removed.

146. Chapter 6 provides some additional description of volume measures. 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.[9]

[9] 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