Integrated Environmental and Economic Accounting

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1. Introduction

The purpose of this paper is to inform the Oslo Group of existing methodologies on energy accounts, as developed in the handbook *Integrated Environmental and Economic Accounting 2003* (United Nations *et al.*, 2003), commonly referred to as SEEA-2003. It describes the uses, basic structure and concepts of energy accounts and compares them to energy statistics. It also outlines the current activities of the London Group on Environmental Accounting, and in particular its subgroup on Mineral and Energy Accounts, chaired by Statistics Denmark.

The United Nations Statistical Commission, upon the advice of the United Nations Committee of Experts on Environmental-Economic Accounting (UNCEEA), recommended at its thirty-sixth session in March 2005, to mainstream environmental-economic accounting and related statistics and to elevate the SEEA-2003 to the level of an international statistical standard.

This paper consists of 5 Sections. Section 2 provides a general overview of the uses and structure of the SEEA-2003 and highlights the advantages of organizing environment and energy statistics in an accounting framework. Section 3 describes the process for the revision of the SEEA-2003 under the coordination of the UNCEEA and Section 4 presents the work programme of the London Group on Environmental Accounting in the field of mineral and energy accounts and in particular the structure of the Handbook on Mineral and Energy Accounts. Section 5 describes the methodology to compile energy accounts, outlining the similarities and differences between energy statistics and energy accounts, using Denmark as an example. The Danish bridge tables illustrating how energy statistics can be transformed into energy accounts are also presented. Section 6 summarises the key points of the paper.

2. The System of Environmental-Economic Accounting 2003 (SEEA-2003)

The SEEA-2003 is a satellite system of the System of National Accounts (SNA), which is the standard system for organizing economic information. As such, it has a similar structure to the 1993 SNA and shares common definitions and classifications. It provides an integrated set of aggregate environmental and economic information from which indicators of performance can be derived. These can be at the sectoral and macroeconomic level, as well as at more detailed levels, and may guide resource managers and policy makers alike.

The SEEA-2003 provides a set of definitions, classifications, statistical accounts and tables to analyse the interactions between the economy and the environment. It provides a framework for organizing environment and energy statistics together with economic information using common concepts, definitions and classifications. It also enables to analyze links between different environmental domains (e.g. between energy, pollution, land, water, etc).

By bringing the concepts, definitions and classifications of environment and energy statistics closer to those of environmental-economic accounting, the potential use of the data available in both the environment and economic spheres is increased. The SEEA-2003 allows for the incorporation of the environment and energy statistics directly into the national accounting framework, an important tool for economic planning and policy determination. It significantly improves the likelihood that environmental information is considered more fully in economic decision-making

process. In short, the SEEA-2003 provides an integrated framework allowing trade-offs to be examined.

The integration of information on the economy and energy allows decisions and policies to be designed, analysed and reviewed for effectiveness. In the case of energy and associated air emissions, policy makers need to be aware of the likely consequences for the economy of implementing or increasing targets for reducing air emissions. Similarly, those industries making extensive use of energy resources in production processes need to be aware of the long-term consequences of their use on the environment (e.g. increased temperatures, reduced water availability).

Linking the environment and energy statistics to the accounting framework also increases the checks and balances in the data. It can improve data quality and produce consistent data system from individual sets of environment and energy statistics. The system improves consistency over time and enables comparisons between countries.

The accounting system has substantial analytical value. By integrating economic and environmental and energy accounts it becomes possible to develop a coherent and consistent set of indicators to examine the implications for different patterns of production and consumption of the environment and energy resources, or conversely, to examine the economic consequences of maintaining given environmental standards. Because economic activities and their environmental impacts, in terms of resource use and emissions, can be compared directly, the system makes it possible to calculate intensities and to derive various kinds of indicators. Moreover, since it uses an input-output structure it can be used for modelling; for example the impact of introducing specific energy taxes on resource consumption and emissions.

2.1. The structure of SEEA-2003

The SEEA-2003 comprises four types of accounts. The first category of account comprises physical flow and hybrid flow accounts. Physical flow accounts describe the flows of natural resources from the environment to the economy, within the economy and back to the environment. Hybrid flow accounts link the physical flow accounts with the standard SNA accounts in monetary terms. They are called “hybrid” because they entail accounts expressed in different units – i.e. monetary and physical quantity (SEEA-2003, Chapters 3 and 4). Energy accounts are presented in chapter 3.

The second category of account comprises accounts for economic activities and products related to the environment and environmental transactions. Accounts in this category explicitly identify those economic transactions related to the environment such as environmental protection activities (SEEA-2003, Chapter 5), accounts for environmental taxes and subsidies and other economic instruments e.g. permits and licences (SEEA-2003, Chapter 6). In the case of energy, the latter category of accounts is particularly relevant and includes, for example, the cost of extraction, production and distribution of energy products, fees paid by the users for the energy products and permits paid by companies to extract mineral and energy resources.

The third category comprises asset accounts in physical and monetary terms (SEEA-2003, Chapter 7). Chapter 8 shows how the considerations in chapter 7 can be applied for specific resources, e.g. mineral and energy resources. These accounts describe, in physical and monetary terms, stocks at the beginning and end of the accounting period and changes therein due to natural causes and human intervention (e.g. extraction, discoveries, changes in prices, etc.).

The fourth category covers the valuation techniques for measuring environmental depletion of natural resources, as well as degradation of natural assets (SEEA-2003, Chapter 9). Further, it addresses ways to adjust standard national accounts aggregates (GDP, savings), for depletion and degradation (SEEA-2003, Chapter 10).

The last chapter of the SEEA-2003 illustrates examples of policy applications of environmental-economic accounts through country case studies (SEEA-2003, Chapter 11).

3. The revision process of the SEEA-2003

After the finalization of the SEEA-2003, countries felt that it was timely to focus efforts on elevating environmental-economic accounting to an international statistical standard, mainstreaming it in national statistical offices and promoting its uses in the users' community. In 2005, the UN Statistical Commission approved the creation of the UN Committee of Experts on Environmental-Economic Accounting (UNCEEA), a strategic body responsible for bringing forward the above objectives.

The following five main elements of work identified for the UNCEEA include:

(a) *Coordination*: It was felt that a stronger coordination, in particular among the international agencies active in the environmental field, would be necessary in order to raise the profile of environmental-economic accounting;

(b) *Promotion of the accounts:* Since environmental-economic accounting is a new area of statistics, the United Nations Statistical Commission underscored the need for raising awareness of the uses of the accounts through the promotion of environmental-economic analysis and formulating international priorities based on canvassing users' needs;

(c) *Methodological research:* SEEA 2003 is a handbook of best practices. When a consensus could not be reached, a list of options, rather than a single recommendation, was presented. The UNCEEA has been entrusted by the Statistical Commission to organize and steer the process of the revision of the SEEA-2003 to elevate it to an international statistical standard;

(d) *Technical Cooperation:* With the publication of SEEA, it was considered timely to develop an implementation strategy in countries. The Committee would play a role in coordinating development of training material and foster exchanges of best practices as well as maintaining a list of on-going country projects so as to avoid duplication of efforts;

(e) *Harmonization of data collection activities with environmental accounting concepts and definitions*. It was considered important that environment and related statistics becomes firmly aligned with environmental-economic accounting.

At its last meeting in June 2006, the UNCEEA identified energy accounts as an important topic to be included prominently in the revision of the SEEA-2003. The UNCEEA considered that the methodology is well advanced and there exists considerable practical experience in countries to warrant the elevation of energy accounts to international statistical standard.

The UN Committee is now working on the preparation of a project management framework for the revision process of the SEEA-2003. The framework will delineate the role and responsibilities of the various groups involved in the revision process; including the governance structure, finalize an agreed research agenda including a list of issues to be addressed with timelines and deliverables. The London Group on

Environmental Accounting, given its expertise and role in the advancement of methodologies in environmental-economic accounting, has been asked and has agreed to assist the UN Committee of Experts in addressing a large number of issues which will be included in the agreed research agenda for the revision of the SEEA-2003.

Given the leading role of the Oslo Group in advancing methodologies in energy statistics, the Committee considered important to develop cooperation with the Oslo Group. To this end, the Chair of the UNCEEA requested the Chair of the Oslo Group to consider accepting to develop and solve a list of issues on energy accounts to be included in the research agenda for the revision of the SEEA-2003.

4. The Handbook on Mineral and Energy Accounts

In 2003, the London Group on Environmental Accounting has created a subgroup on Mineral and Energy Accounts chaired by Statistics Denmark. The Group is working on a manual on mineral and energy accounts, in addition to addressing the related issues on the research agenda for the revision of the SEEA-2003. The sub-group is focusing its efforts on the part of the manual dealing with mineral and energy asset accounts, with the expectation that the Oslo Group will develop the part on the energy flow accounts. The London Group at its last meeting recommended that the subgroup on Mineral and Energy Accounts reach an agreement with the Oslo Group on its collaboration to the manual. The Oslo Group is invited to provide its views on the cooperation with the subgroup on the London Group on the preparation of the manual of Mineral and Energy Accounts.

The manual will supplement the SEEA-2003 by developing a set of standard tables for the compilation of mineral and energy accounts, addressing and solving issues in the methodology and implementation of mineral and energy accounts, including examples on policy applications of the mineral and energy accounts.

Work on the manual is still in a preliminary stage. A first outline for the asset accounts has been prepared by Statistics Denmark[1], Chair of the Sub-group and will be presented at the 11th meeting in the London Group on Environmental Accounting in Pretoria, South Africa in March 2007.

The part of the manual on mineral and energy asset accounts comprises three parts. Part I provides an introduction to the basic concepts of mineral and energy asset accounting and the definitions and classifications used for both physical and monetary asset accounts. Part I will also describe in detail how the manual relates to the SEEA-2003 and its revision and the 1993 SNA Rev.1.

The manual will focus on the opening and closing stocks, with changes in stocks only addressed marginally. A more comprehensive description of the flows will benefit from the contributions of the Oslo Group. However, consistency between the stock and the flow accounts is a very important objective of the manual.

The manual will also introduce various classifications of resources, e.g. the McKelvey box and the United Nations Framework Classification (UNFC) system for energy and mineral reserves resources as the classification systems.

Part II of the manual is on implementation issues and will provide a practical guideline on developing the physical and monetary accounts.

[1] This work has benefited from funding by the European Commission, Eurostat.

Part III will show examples of mineral and energy accounts as well as examples of the policy applications of these accounts.

5. Similarities and differences between energy accounts and energy statistics in the Danish situation

Many countries compile energy accounts on a regular basis. This Section describes the experience of Denmark.

Energy statistics or energy balances[2] serve as one of the main sources of information for energy accounts. For the most part, energy statistics can be used directly for the derivation of energy accounts. There exists, however, two differences which require data manipulation to go from one to the other. These are mainly related to the issues of boundary and classifications.

Both the energy statistics and the energy accounts can be presented as gross energy consumption or as net energy consumption. See Schenau and Delahaye (2006).

Since energy accounts are satellite of the 1993 SNA, they follow the principles of the 1993 SNA and therefore the residence principle is adopted. This implies that all economic activities of a resident unit are within the energy accounts boundaries. Energy statistics, on the other hand, follow the territory principle according to which all activities that take place in the national territory are considered within the boundary. This difference in approach has implications mainly on the treatment of energy consumption, especially for transportation.

In energy statistics all energy consumption for transportation is reported as a total. In energy accounts, it is broken down according to intermediate consumption of industries (transport industries and other industries) and final consumption of households. Further, consumption of energy products for international sea transport is not included in energy statistics, but it is in the energy accounts. In this case, energy statistics have to be complemented with additional information to meet the requirements of the energy accounts.

The difference in classification entails to a different definition of production. In energy accounts, production is defined according to the 1993 SNA and economic activities are classified according to the International Standard Classification of All Economic Activities (ISIC) of the primary product of the establishment. In energy statistics activities are classified mainly by sector.

The energy products in the energy accounts are those as classified by the Harmonized System (HS), for trade data, and the Central Product Classification (CPC), for production and consumption data. In most situations, it is not difficult to link the classification of energy products in energy statistics with that used in the accounts.

However, it should be noted that the standard product classifications, HS and CPC, do not provide very detailed breakdown of energy products. For instance, biomass based products like wood pellets etc. is classified in HS together with sawdust and wood waste whereas classification of energy products used in energy statistics would identify wood pellets separately.

[2] In this paper energy statistics and energy balances is used synonymously. See also Boeng, 2006.

5.1. Bridge table linking the Danish energy accounts with the Danish energy statistics

The bridge table links the Danish energy accounts with the Danish energy statistics in 2004 and explains the difference between the two approaches.

The bridge table shows the gross energy use. Even though the gross energy consumption involves double counting it is suitable for the analysis of individual energy products. The bridge table is an aggregation of the individual energy products.

The differences are calculated as the energy accounts minus the energy statistics i.e. the difference on production is calculated as the production as recorded in the energy accounts minus the production as recorded in the energy statistics.

The general idea in the bridge table is that the vertical dimension shows what comprises the supply and use in the energy accounts, column (1) and in the energy statistics, column (5).

Whereas the horizontal dimension, column (2), (3) and (4), explains the differences between the energy accounts and the energy statistics.

Column (2) shows the difference between the energy products accounted for in both the energy accounts and the energy statistics. These differences are due to differences in the boundaries. However, in the Danish situation the differences are also due to differences in the data sources. For example, differences in the data on foreign trade with energy products.

Column (3) shows the differences caused by the non-energy related use of energy products (white spirit, lubricants and bitumen). This use is not accounted for in the Danish energy accounts.

Column (4) shows the differences caused by the other energy products not accounted for in the energy accounts. This group is composed of renewable types of energy (solar energy, geothermal power, liquid bio fuels, fish oil, heat pumps), which are all still of lesser economic relevance, which is why they are not part of the SNA framework and therefore not accounted for in the Danish energy accounts.

The table should be interpreted in the following way.

Row I shows the production. The total production accounted for in the Danish energy accounts is 1,909,692 TJ. The production accounted for in the Danish energy statistics is 1,920,158 TJ. Thus, the difference is 10,466 TJ. This difference is broken down by the differences in column (2), (3) and (4).

In the same way each of the other rows explains the differences between the energy accounts and the energy statistics.

Row II shows the imports. Row I and II add up to the total supply in row III. The difference in the supply of energy between the Danish energy accounts and the Danish energy statistics is primarily made up of the Danish ships bunkering of fuel oil abroad and the Danish planes bunkering of JP1 abroad.

Row IV shows the exports. The difference on the exports is caused by the foreigners bunkering in Denmark. In the national accounts framework this bunkering is export,

whereas in the energy statistics based on the territorial principle, this bunkering is consumption on the territory.

In order to show the total consumption of energy in the Danish energy accounts and the Danish energy statistics respectively, the energy statistics should first be adjusted for the international sea transport. The energy used for international sea transport is included on the supply side however it is not part of the total energy consumption[3]. This adjustment is carried out in row V.

Having adjusted the total supply for the exports and for the international sea transport row VI shows the disposable amount of energy within the economy and within the territory.

Row VII shows the amount of energy used by the industries and the households whereas row VIII shows the changes in stocks, the losses and the discrepancy.

Row VII and column (2) show that the major part of the difference between the energy accounts and the energy statistics is caused by the fact that, the ships and planes bunkering abroad is accounted for in the energy accounts.

The non-energy related use of energy products not accounted for in the energy accounts and the use of other types of renewable energy not accounted for in energy accounts are of minor importance.

Thus, the differences are caused by the difference in the boundaries as regards the residence or the territory principle and the demarcation of the energy products accounted for.

Finally, it should be emphasised that the bridge table is not only a tool that can be used to explain the differences between the energy accounts and the energy statistics. The bridge table is also a tool which can be used for quality control and checks of the energy accounts and the energy statistics.

[3] The consumption of energy as reported to the International Energy Agency (IEA).

Bridge table **The differences between the Danish Energy Accounts and the Danish Energy Statistics 2004**

		Danish Energy Accounts	Differences between the energy accounts and the energy statistics	Non-energy related use of energy not accounted for in the energy accounts	Other renewable energy not accounted for in the Energy Accounts	Danish Energy Statistics
		(1)	(2)	(3)	(4)	(5)=(1)-(2)-(3)-(4)
		TJ				
I	**Production**	**1 909 692**	**-3 033**	**- 76**	**-7 357**	**1 920 158**
II = II.1,.. + ..,II.3	**Imports**	**952 765**	**378 923**	**-12 049**	**-**	**585 892**
II.1	Of which Danish ships bunkering of fuel oil abroad	332 146	332 146	-	-	-
II.2	Of which Danish planes bunkering of JP1 abroad	7 128	7 128	-	-	-
II.3	Of which imports of other energy products	613 491	39 649	-12 049	-	585 892
III = I + II	**Total supply**	**2 862 457**	**375 890**	**-12 126**	**-7 357**	**2 506 050**
IV = IV.1 + IV.2	**Exports**	**1 068 789**	**50 282**	**- 229**	**-2 444**	**1 021 180**
IV.1	Of which foreigners bunkering in Denmark	49 739	49 739	-	-	-
IV.2	Of which other exports	1 019 051	543	- 229	-2 444	1 021 180
V	**Adjustment for international sea transport**	**-**	**33 450**	**83**	**-**	**-33 534**
VI = III - IV + V (= VII + VIII)	**Disposable within the economy / the territory**	**1 793 668**	**359 058**	**-11 814**	**-4 913**	**1 451 337**
VII	**Used by the industries and by the households**	**1 734 251**	**334 209**	**-12 172**	**-4 913**	**1 417 127**
VIII	**Changes in stocks, loses and discrepancy**	**59 417**	**24 849**	**359**	**-**	**34 209**
IX = IV - V + VII + VIII (= III)	**Total use**	**2 862 457**	**375 890**	**-12 126**	**-7 357**	**2 506 050**

Source: Danish Energy Accounts and Danish Environmental Accounts published by Statistics Denmark (2006). Danish Energy Statistics published by the Danish Energy Authority (2006).

6. Summary

Integrated Environmental-Economic accounting provides a way of structuring information that allows decision makers and others to gain new insights into public policy issues. It enables to systematically analyse the impact of the environment on the economy, and *vice versa*.

The information obtained from energy statistics can be manipulated to produce energy accounts. The similarities between energy accounts and energy statistics far outnumber the differences. For example, many of the categories in the SEEA-2003 and the IEA manuals are substantially similar. However, the allocation of energy use by transport is a particular area of difference arising from the territory rather than residence principle.

The SEEA-2003 has been developed by a group of countries and its continued development and elevation to an international statistical standard is being supported by the United Nations Statistical Commission. The UNCEEA, London Group on Environmental Accounting and Oslo Group on Energy Statistics should continue to work together in order to align methodologies so as to ensure continued improvements in the collection, production, dissemination and use of data.

A mechanism for cooperation between the London Group on Environmental Accounting and the Oslo Group on Energy Statistics under the coordination of the UN Committee of Experts on Environmental-Economic Accounting should be developed in order to ensure a common, integrated approach to energy statistics avoiding overlap and duplication of work.

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