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Issue #3a: Bridging energy accounts and energy balances[1]

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[1] This outcome paper has been prepared by the SEEA Editor. It is based on papers presented to the London Group of Experts on Environmental Accounting and discussions among those experts. Investigation and research for this outcome paper was led by Ole Gravgard of Statistics Denmark.

A. Introduction

1. In the revision of the System of Environmental and Economic Accounts (SEEA) it has been recognised that there are a range of related data that either provide source information for the compilation of the accounts or reflect alternative presentations on similar topics. A particularly important case is the compilation of SEEA based energy accounts and energy balances compiled by many countries and by international agencies. This case is important because of the high and increasing focus on energy supply and use in all of its aspects.

2. Since both energy accounts and energy balances are based on well established but different concepts it is important that the relationships between each of these approaches are well understood by compilers and users of energy data. Often it will be the case that similar source data – energy statistics – are used to compile both energy accounts and energy balances and with a good understanding of the differences in approach a stronger alignment might be gained in statistical terms.

3. The relationship between the approaches can be articulated in a number of ways. A common method is the development of bridge tables. These tables usually start from a key aggregate from one approach and show the relationship with a similar key aggregate from another approach by adding and subtracting amounts equal to the extent of the conceptual and scope differences. The quantification of the various differences is a key benefit of the use of bridge tables.

4. This outcome paper presents the differences between energy accounts and energy balances in two parts. First, the main differences between the approaches are described. Second, illustrative bridge tables between aggregate measures of energy supply and use are presented. Some conclusions are presented in a final section.

5. While the description and presentation of the differences between energy accounts and energy balances does not directly impact on the SEEA standards for energy accounts the ability to understand the relationships between these two key measures of energy supply and use is considered an important part of the SEEA revision process. The paper therefore seeks feedback on whether the description of the relationship in the paper captures the key differences and whether bridge tables should be defined within the SEEA to help explain the relationship.

B. Areas of difference between energy accounts and energy balances

Definitions of energy accounts and energy balances

6. An energy balance is an accounting framework for the compilation and reconciliation of data on all energy products entering, exiting and used within the national territory of a given country during a reference period.

7. An energy account is also an accounting framework which seeks to organise information relating to energy in a coherent manner consistent with the concepts, definitions and classifications of the System of National Accounts (SNA). A full energy account has a number of components including asset accounts which consider available energy resources, flow accounts in physical and monetary terms, energy-related air emission accounts and hybrid accounts which link physical and monetary data. By using a consistent basis for all of these accounts many analytical opportunities are opened up – especially in the ability to link physical flows of energy with associated monetary transactions and values.

8. The common scope of energy balances and energy accounts is the measurement of physical flows of energy. It is the differing definitions and scope in this area that is of interest in this paper.

The distinction between residence and territory

9. The main conceptual difference between energy balances and energy accounts concerns geographical coverage. The reference territory for the energy balances is the national territory and statistics are compiled for all of the institutional units – businesses, households and governments – physically located on the territory. Institutional units physically located outside of the territory are considered as part of the rest of the world and out of scope. This geographical coverage is referred to as the *territory principle.*

10. The energy accounts use a geographic coverage based on all institutional units that are resident of a particular national economy – independent of where they are located. Those units which are not defined to be resident units are considered to be part of the rest of the world and out of scope. An institutional unit is said to be a resident unit of a country when its centre of predominate economic interest is within the economic territory of the country. Generally, the economic territory will align with the physical boundary of a country but there is special treatment given to free trade zones, offshore financial centres, embassies and international organisations and the like. This geographical coverage is referred to as the *residence principle*.

11. The use of the territory or residence principle leads to differences in the way certain statistics are recorded – for example the definition of imports and exports and the treatment of international bunkers.

12. The use of the territory principle in the energy balances implies that imports and exports cover all transactions between institutional units physically present in the territory and institutional units physically located outside the territory. Further, transactions between institutional units physically located inside the territory are never recorded as imports or exports. On the other hand use of the residence principle in the energy accounts means that imports and exports are recorded when transactions occur between resident units and non-resident units wherever the location of the transaction.

13. The following table (Table 1) gives an example of the types of adjustment that are required to bridge between imports and exports as defined according to the SEEA and the same aggregates defined according to the energy balances. It is note that not all of the possible conceptual adjustments are made in this table and this is not a proposed bridge table for the SEEA.

14. The residence and territory principles also impact on the recording of uses of products. In the energy balances the use of energy refers to use by all units physically located in the territory. In the energy accounts the use of energy refers to use by all residents units wherever they are located. Thus residents who travel abroad and consume fuel in a hire car would be recorded in the energy accounts as use in the country of their residence while in the energy balance this would be recorded as use in the country being visited.

Table 1. Examples of adjustments to imports and exports in energy accounts and energy balances

Imports (SEEA)	Exports (SEEA)
= Imports (energy balances)	= Exports (energy balances)
+ Energy products purchased by residents abroad	+ Energy products sold to non-residents on domestic territory
Of which:	*Of which*:
Bunkering of oil abroad for sea transport and fishing vessels	Foreign ships' and fishing vessels' bunkering of oil on domestic territory
Bunkering of jet fuel and kerosene abroad for air transport	Foreign planes bunkering of fuel and kerosene on territory
Refuelling of gasoline and diesel for land transport	Foreign vehicles' refuelling of gasoline and diesel on domestic territory
Tourists' and businessmen's purchase of energy abroad including fuel for private cars	Foreign tourists' and businessmen's purchase of energy on domestic territory including fuel for private cars
Energy purchased by military bases on foreign territories	Energy sold to foreign military bases on national territory
Energy purchased by national embassies abroad	Energy sold to foreign embassies on national territory
Energy products in transit	Energy products in transit

The distinction between industries and activities

15. In the standard tables of energy accounts the presentation of statistics for economic activities and households strictly follows the principles of classification and the structure of the International Standard Industrial Classification (ISIC). Thus information on any specific enterprise or establishment is presented under the ISIC division/class of the principal activity of the unit involved.

16. In the energy balances the same principle is not followed and information on a specific enterprise or establishment is not explicitly linked to the relevant ISIC division/class. Rather, it is presented in different sections of the energy balances depending on the nature of the activity, the type of use and the ISIC division or class of the unit involved.

17. A typical example is "transport". In the energy balances, the final consumption of energy in transportation refers to the use of energy for transportation independent of the economic activity in which the transport takes place. In the energy accounts however, under the heading of Transportation (ISIC 49, 50 and 51) statistics are reported on all of the uses of energy (including for example electricity for heating) by those units whose principal activity is transportation and the statistics for Transportation will exclude energy used for transportation by units in other ISIC classes (for example, wholesalers).

18. Another area of difference between energy balances and energy accounts concerns energy transformation. The energy balances include a part describing the energy transformation which includes processes that convert energy products into other energy products. The transformation is usually performed by energy industries defined as economic units whose principal activity is the primary energy production, transformation of energy and distribution of energy. The transformation processes are identified by the plants in which they occur and not by economic activity classified by ISIC. The table below (based on IRES Table 5.1.) provides the correspondence between the energy industry groups to ISIC. The ISIC correspondence indicates in which category(ies) the plant (or activity) in the left column is found. The energy accounts on the other hand are based entirely on ISIC.

Table2. Transformation processes

Transformation processes	**ISIC Rev. 4**
Electricity and heat plants	Division: 35 - Electricity, gas, steam and air conditioning supply
Coke ovens	Group: 191 - Manufacture of coke oven products
Coal liquefaction plants	Class: 1920 - Manufacture of refined petroleum products
Patent fuel plants	Class: 1920 - Manufacture of refined petroleum products
Brown coal briquette plants	Class: 1920 - Manufacture of refined petroleum products
Gas works (and other conversion to gases)	Class 3520: Manufacture of gas: distribution of gaseous fuels through mains
Gas to liquid (GTL) plants	Class: 1920 – Manufacture of refined petroleum products
Blast furnaces	Class: 2410 - Manufacture of basic iron and steel
Peat briquette plants	
Charcoal plants	Class: 2011 - Manufacture of basic chemicals
Petrochemical plants	
Natural gas blending plants	
Other transformation processes not elsewhere specified [e]	

19. Another difference has to do with the presentation and scope of production. In the energy balances production of energy products is presented as a total and not disaggregated by ISIC. Furthermore, production includes production as principal, secondary and ancillary activities. In the energy accounts, ancillary production is separately identified as it is not included as part of the output in the monetary accounts.

Terminology

20. Since both energy accounts and energy balances are accounting frameworks concepts of supply and use of products and resources are central. However, there are differences between the aggregates of energy supply and energy use as defined by these two approaches.

21. In the energy balances supply represents energy entering the national territory for the first time, energy removed from the national territory and stock changes. Thus

Total energy supply =

Primary energy production

plus Imports of primary and secondary energy

less Exports of primary and secondary energy

less International (aviation and marine) bunkers

less Stock changes

22. In the energy accounts supply is defined consistently with the definition of supply in the SNA. Hence,

Total energy supply =

Energy output of resident producers

plus Imports of energy

23. Since in both approaches supply and use are equivalent the definitions of energy use are also different between the approaches. In the energy balances we have

Total energy use = Final consumption of energy

plus Consumption of energy by energy producers

24. In the energy accounts use is equal to

Total energy use =

Final consumption of energy

plus Intermediate consumption of energy

plus Exports of energy

plus Changes in inventories of energy

25. In both definitions of energy use the term “final consumption” is used. However, here there is also a different definition. In energy balances final consumption refers to the use of fuel, electricity and heat delivered to final consumers (both households and businesses) of energy for both their energy and non-energy uses. It essentially excludes the use of energy products in the energy industries and by other energy producers as input to transformation and energy industry own-use.

26. In the energy accounts the term final consumption is used to denote the use of energy by individual households or the community generally (usually through government expenditure). When energy is used as an input to production processes it is considered intermediate consumption which is also considered a part of total energy use.

27. Another difference in terminology has to do with stock changes and changes in inventories used respectively in energy balances and energy accounts. Although two different terms are used, they denote the same thing.

28. A final consideration in the reconciliation of the definitions of supply and use is the treatment of international bunkering of aviation and marine fuel. In the energy balances the fuel placed in international bunkers is considered a deduction from supply since it is for the refuelling of ships and planes on international voyages.

29. On the other hand in energy accounts international bunkering is considered as a use. It is considered either intermediate consumption if the bunkering is undertaken by a ship or plane operated by a resident unit, or as exports if the ship or plane is operated by a non-resident.

30. Overall, these different definitions of supply and use can lead to quite large differences in the associated aggregate statistics and hence care is needed when comparing data from the two approaches.

Classifications of products

31. Aside from the different approaches to defining industries and activities noted above there are also different definitions and classifications of products. In the energy balances the intention is to use the Standard International Energy Classification (SIEC) for the classification of energy products which is being developed as part of the forthcoming International Recommendations for Energy Statistics (IRES).

32. As part of the SEEA revision, work is under way to finalise relevant classifications of products, natural resources and residuals (see SEEA Revision Issue #2: Classification of physical flows). The classification of products is likely to be based around the Central Product Classification (CPC). One reason for the use of the CPC is that product data in monetary terms is generally classified this way and hence using CPC to classify products in physical terms as well will aid broader and hybrid use of the SEEA framework.

33. However, given that the SIEC has been develop especially for the purposes of classifying energy products strong consideration is being given to use of SIEC for energy products in the SEEA. This will be raised for global consultation under the broader topic of the classification of physical flows as noted above.

34. Nonetheless it is recognised that the hierarchies of CPC and SIEC are not compatible. There are known cases of split links between CPC and SIEC whereby the classes in the CPC and in SIEC cannot be matched easily. In this situation comparing datasets compiled using SIEC and monetary data based on the CPC becomes more challenging. For example, CPC Division 17[2] is partially covered by three different SIEC sections[3], and with one of its Groups not covered by SIEC at all[4].

The treatment of statistical discrepancies

35. In concept, following the SNA, the SEEA energy accounts do not include an item for statistical discrepancies. However in practice statistical discrepancies will arise between supply and use. It is a matter of compilation practice as to how best to deal with these discrepancies. In some cases the accountant will resolve the discrepancy through careful data confrontation but it may be that after investigation discrepancies remain. In these cases the accountant might choose to distribute the discrepancy across the supply and use categories or introduce a balancing item called statistical discrepancies to ensure that estimates of supply and use are balanced.

36. The same challenges face compilers of energy balances. Energy balances show explicitly the statistical discrepancy. No attempt is made to reconcile it unless the discrepancy is big and thus indicates inaccuracies of the underlying data rather than differences inherent with the use of different measurement units and conversion factors. It is suggested that compilers and users should understand the various ways in which statistical discrepancies are dealt with in individual datasets so as to best understand the various aggregates and components.

C. Bridge tables linking energy balances and energy accounts

37. Bridge tables can be used in order to show the link between the main concepts and aggregates of different measurement approaches. Based on the description of the main differences between energy accounts and energy balances in the previous section, this section presents illustrative bridge tables showing the reconciliation between aggregate energy supply and use for energy accounts and energy balances. It may be that a reconciliation at an industry level is of more interest and it is simply noted here that the general concept of bridge tables can be applied at many levels.

38. It is to be noted that in these examples the bridge tables do not include any bridging items for statistical discrepancies, which are normally included in the energy balances in order to

[2] CPC Division 17 – "Electricity, town gas, steam and hot water"

[3] SIEC Section 1 – "Solid fossil fuels and derived products", SIEC Section 5 – "Electricity" and SIEC Section 6 – "Heat".

[4] Group 173 – "Ice and Snow".

reconcile differences between the supply and use side of the balances. These statistical differences should be added to either the bridge tables for supply or the bridge tables for the use of energy depending on how the differences are dealt with when the energy accounts are constructed.

39. In addition to the statistical discrepancies between supply and use, statistical differences may occur because sometimes different data sources are used for the energy balances on one hand and the energy accounts on the other. Such differences need also to be accounted for in actual bridge tables.

40. Table 3 starts with the domestic supply of the IEA energy balances. By adding international marine bunkers, exports, inventory changes and purchases by residents abroad the total supply as presented in the SEEA energy accounts is obtained. For natural gas an additional bridging item for the extraction of natural gas is added. This is due to the fact that the energy accounts records both natural gas extracted (by the extraction industry) and the natural gas distributed by the manufacturing and distribution industry. In contrast, the energy balances includes only natural gas when it is marketed or used by the gas industry.

41. Table 4 starts with the final consumption of energy as presented by the IEA energy balances. Again, international marine bunkers, exports, inventory changes and purchases by residents abroad are added in order to reach the end use as recorded in the SEEA energy accounts.

Table 3. Bridge table for domestic supply and total supply

	Supply						
	S.1	+S.2	+S.3	+S.4	+S.5	+S.7	= S.8
	Domestic Supply (energy balances)	+ International marine bunkers	+ Exports	+ Inventory change	+ Purchases by residents abroad	+ Extraction of gas including gas reinjected, flared and vented	**Total supply (SEEA)**
	TeraJoule						
1. Coal, coke, gas work gas and peat							
a) Coal, coke and peat	**246**		2	- 21			**227**
Products							225
Losses and own use							2
b) Gas work gas	**0.5**						**0.5**
Products							0.5
Losses and own use							0
2. Oil							
Crude oil	**344**		493	- 3			**834**
Products							831
Losses and own use							2
Oil, others	**265**	44	308		560		**1 177**
Products							1 158
Losses and own use							19
3. Natural Gas [1)]	**194**						**806**
Extraction for own use	28						28
Re-injection (energy ressource)						32	32
Flaring and venting (energy ressource)						7	
							7
Extraction for distribution (energy ressource)						369	369
Natural gas distributed	166		201	2			369
4. Electricity							
Primary (wind, solar, hydro, nuclear, etc.)	**22**						**22**
Products							22
Losses and own use							
Secondary electricity	**140**		49				**189**
Products							173
Losses and own use							17
5. Heat							
Primary (solar, geothermal, etc.)							
Products							
Losses and own use							
Secondary heat	**130**						**130**
Products							102
Losses and own use							27
6. Renewable fuels and waste							
a) Solid biomass and wastes	**109**		1	0.3			**110**
Products							73
Waste, losses and own use							38
b) Liquid biofuels and biogas	**2**						**2**
Products							
Losses and own use							
Total supply	**1 452**	44	1 055	- 22	560	408	**3 498**

Table 4. Bridge table for final consumption and end use of energy

	Use							
	U.1	+ U.2	+ U.3	+ U.4	+ U.5	= U.6		
	= Final consump-tion (energy balances)	+ inter-national marine bunkers	+ Exports	+ Inventory change	+ purchases by residents abroad	**End use (SEEA) excluding losses in distribution**	Losses in distri-bution	**Total end use incl. losses in distribution**
	TeraJoule							
1. Coal, coke, gas work gas and peat								
a) Coal, coke and peat	**21**		2	- 21		**2**	2	4
Products						2		2
Losses and own use							2	2
b) Gas work gas	**0.5**					**0.5**	0	0.5
Supply of products						0.5		0.5
Losses and own use							0	0
2. Oil								
Crude oil	**0.5**		493	- 3		**490**	2	493
Products						490		490
Losses and own use								
Oil, others	**229**	44	308		560	**1 142**	4	1 146
Supply of products						1 142		1 142
Losses and own use							4	4
3. Natural Gas	**84**		201	2		**287**		**287**
4. Electricity								
Primary (wind, solar, hydro, nuclear,								
Products								
Losses and own use								
Secondary electricity	**123**		49			**173**	8	180
Products						173		173
Losses and own use							8	8
5. Heat								
Primary (solar, geothermal, etc.)								
Products								
Losses and own use								
Secondary heat	**104**					**104**	26	130
Products						102		102
Losses and own use						2	26	27
6. Renewable fuels and waste								
a) Solid biomass and wastes	**41**		1	0.3		**42**	1	43
Products						42		42
Waste, losses and own use							1	1
b) Liquid biofuels and biogas	**0.5**					**0.5**		0.5
Products								
Losses and own use						0.5		0.5
Total use	**603**	44	1 055	- 22	560	**2 240**	43	2 283

D. Conclusions

42. Energy data are of high and increasing interest and it is important to be able to both construct and relate relevant sets of energy information. Both energy balances and energy accounts present structured data on energy within accounting frameworks. However, both frameworks have differences in scope and definition that mean that similarly labelled aggregates mean quite different things under the different approaches.

43. As part of the SEEA revision better understanding and presenting the relationship between energy balances and energy accounts is seen as an important task. Based on investigation of the differences and discussion in the Oslo Group and the London Group, this outcome paper describes the main differences between the two approaches and illustrates how the data from each approach can be reconciled through the construction of a bridge table.

44. As part of the global consultation on SEEA Revision issues your feedback is sought on whether the range of differences between energy accounts and energy balances as described in the outcome paper reflects the complete set of differences and whether the description is accurate. Also, thoughts would be appreciated on whether the technique of constructing bridge tables should be explained and used in the revised SEEA, in particular to explain the differences between energy accounts and energy balances.