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# SEEA/Environmental accounting's user needs with regards to energy statistics

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# 1 Introduction

A brief review of where energy statistics are needed in the compilation of SEEA-2003 environmental-economic accounts is provided in this paper to help the London Group in the evaluation of the SEEA systems before these systems can be considered to be ready to be a part of a standard. In some cases the environmental-economic accounts need additional development and harmonisation before the SEEA-user needs can be adequately understood while in other cases some specific user needs can be identified which can then be communicated to appropriate working groups that are addressing these different issues.

The SEEA-2003 contains four categories of environmental-economic accounts:

- Category 1: Physical and hybrid flow accounts
- Category 2: Economic accounts and environmental transactions
- Category 3: Asset accounts in physical and monetary terms
- Category 4: Extending SNA aggregates to account for depletion, defensive expenditure and degradation

Various types of energy related data are required in all of these four categories. Energy data are used in material flow accounts and in physical input-output systems as well as in hybrid/NAMEA accounts. Economic data related to energy products/commodities are needed in category 2 with respect to the national accounts. Physical stocks/reserves data for energy-rich subsoil assets, such as petroleum, natural gas, oil sands and oil shale, and coal, are needed for asset accounting in category 3. And both physical and economic data are needed for category 4 type of extensions to SNA aggregates but this information is typically based on data developed for categories 2 and 3 and will not be evaluated specifically in this paper.

This paper has two main parts. The first part, chapters 2-4, is an evaluation of the SEEA-systems with regards to how they include energy in appropriate and adequate ways. Included in this evaluation are also considerations where these environmental accounting systems need to be improved, further developed or changed to better deal with the special features of energy flows.

The second part, chapter 5, is a description of the SEEA's user needs with regards to energy statistics. These user needs should be communicated to the appropriate groups working on improving energy statistics, such as the Oslo Group, the UNECE Ad Hoc Group of Experts on Harmonization of Fossil Energy and Mineral Resources Terminology and various national accountants fora for example the Canberra Group.

# 2 Energy flow data in SEEA physical and hybrid flow accounts

## 2.1 Physical supply and use accounts (SEEA-2003 Chapter 3)

Physical supply and use tables are accounts in physical units in the form of matrices that record the flows of natural resources, residuals, products and eco-systems inputs according to origins (supply) and destinations (uses). (OECD http://stats.oecd.org/glossary/detail.asp?ID=6541)

In the SEEA-2003 the physical supply and use tables are presented in tables 3.11-3.14. In these tables energy appears as a product, P3 Energy, and as assets, N1 Oil, N2 Gas and possibly also in N3 Other.

The P3 category “energy” is not very clear since category P6 Wood, paper etc. and some other categories could also be considered as energy relevant.

As these tables are presented only at very highly aggregated levels some assumptions need to be made regarding the types of detailed data that must be included in these aggregations. In general the supply and use tables are based on standard industrial classifications (ISIC/NACE) and standard product classifications (HS/CPA/SITC) so these SEEA aggregated categories should most likely be interpreted in this fashion. If this is true, that the SEEA-2003 physical SUTs are based on these standard classification systems, this should be made more clearly in the text.

It must be noted, however, that the aggregation of mass units, such as tonnes, for energy commodities will not be particularly meaningful. For energy it is possible to calculate the energy content of an energy commodity and it is these units (for example, GWh or Joules) that can be added together in a meaningful way.

Although many who work with material flow accounts assume that there is a direct correlation between environmental effects and total material flow amounts (in mass units) this is not necessarily agreed upon by all experts since a mg of dioxins have much greater environmental effects than a tonne of sand or gravel. And with regards to energy commodities, aggregating them to mass units are not normally done in energy statistics since this requires detailed conversion factors and knowledge regarding the content of the different types of energy commodities being extracted.

**<u>Conclusion</u>**
The classification systems to be used in developing the physical SUTs needs to be more clearly identified in the SEEA. And if they are based on the standard industrial and product classification systems then it is important that the energy statistics classification categories correspond as closely as possible to the standard product classification systems (HS/CPA/SITC).

## 2.2 Economy-wide Material Flow Accounts (SEEA-2003 Chapter 3.D.5)

The physical flows of materials are based on the concept that:

Economy-wide material flows = domestic extraction + imports - exports

There appears to be differences between the way the MFA is described in the SEEA-2003 (§3.191-3.209) and how it is being practically implemented in countries. In the SEEA-2003 there is no specific description regarding how to handle water and in the SEEAland data set for economy-wide MFA water is included (Table 3.24). In practice EW-MFA excludes water on the reasoning that there are such huge amounts of water in an economy that these overwhelm the dataset. This of course means that the system is not aligned with the national accounts. For example the economic side of hydroelectric power generation is included in the national accounts however the mass flows providing this economic activity are excluded. For a country like Norway where nearly all electricity production comes from hydro this is a serious mismatch in these accounts.

The problem of EW-MFA and SEEA-2003 boundaries is being addressed separately in the London Group. In this paper, the focus is on how energy appears in EW-MFA.

In statistics for material flow accounts a number of different types of statistics need to be combined. When it comes to energy commodities these are found in the domestic extraction statistics for the mining and extraction industries and the import and export figures are obtained from the external trade statistics.

For MFA calculations the categories used in these different statistics (for example, CPA, SITC, HS[2]) become very important since the materials need to be grouped appropriately into the different MFA categories. This is particularly important in order to see changes over time. A Eurostat Task Force, with consultancy help with IFF and the Wuppertal Institute, has developed MFA reporting tables and associated correspondence tables to the various external trade statistics categories (CPA, SITC and HS). The section of the Eurostat MFA reporting tables that has to do with energy is section 4 and uses the following categories.

**4. Fossil energy carriers**

- 4.1 Brown coal
- 4.2 Hard coal
- 4.3 Crude petroleum
- 4.4 Natural gas
- 4.5 Peat
- 4.6 Other, including bituminous or oil shale and tar sands

Correspondence tables between these MFA categories and the CPA and SITC classification systems have been developed (see annex) and are available from Eurostat in the 2007 version of the MFA reporting tables. However there are no descriptions regarding the energy extraction/supply statistics and the MFA categories or the CPA/SITC classifications and the energy extraction/supply statistics. This is particularly problematic when it comes to the classification of natural gas liquids and condensate.

The extraction figures published by the Norwegian Petroleum Directorate use the following definition for natural gas liquids (NGL):

NGL = butane + ethane + isobutane + propane + LPG + gasoline + NGL mix.

NGL is included in figures for crude petroleum together with condensate; whereas the SITC/CPA to MFA correspondence tables appear to treat these energy commodities differently. Since total material flow is supposed to be obtained by taking domestic extraction plus imports minus exports, it is necessary that the categories are coordinated in such a way that the calculation is done correctly. If the categories do not have a one-to-one correspondence then the calculations will not be able to be made except at very high aggregation levels.

Definitions of MFA categories “petroleum” and “natural gas” need to be defined with regards to the actual energy commodities that are extracted which include natural gas liquids and condensate.

This case illustrates the importance of having the energy extraction statistics and the import-export statistics coordinated in terms of categories and there does appear to be a need for better coordination.

Another issue specifically with regards to the trade statistics is the conversion factors used when these amounts are reported. There is no available information regarding the conversion factors used for converting especially natural gas from cubic meters to kg. This conversion factor is very dependent on the components in the natural gas. The same is true for other liquid petroleum products.

The energy commodity classifications included in the different SITC product categories are a combination of different types of hydrocarbon-based products and converting from a volume unit to a mass unit requires using the density of these products. With such a range of energy/hydrocarbon

[2] HS = Harmonised System; CPA = Statistical classification of products by activity ; SITC = Standard International Trade Classification

commodities choosing the correct density factor to convert to mass units is very important. For countries like Norway that extract and export huge amounts of these types of products these types of conversion factors in the import and export statistics can have a very large influence on the material flow figures.

Another issue with respect to MFA's system boundary is the treatment of water. Water, by definition, is excluded from the MFA system boundary. With respect to the energy used for the extraction of crude oil when seen from an MFA perspective, the energy use appears to increase as the field ages. Typically the same volume of crude oil and water is being extracted from the ground no matter what the age of the field but what changes over time is the ratio of crude oil to water. This ratio decreases over time. For example in a unit of extracted liquid in the early stages of a field there might be a crude oil to water ratio of 80 per cent whereas in a more mature field the ratio may be 25 per cent crude oil and 75 per cent water. Since only the crude oil is being included in the MFA calculations then it appears that there is less extraction occurring with a greater energy requirement. But this is not the case when the water is included in the picture.

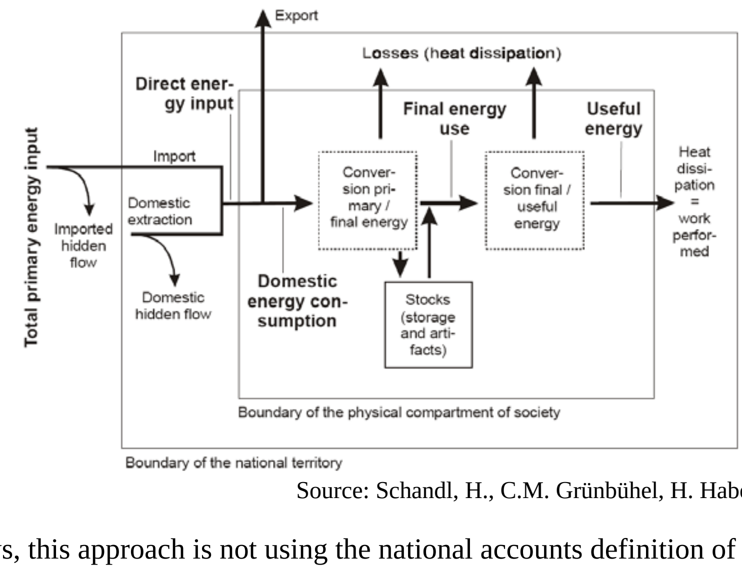
**Conclusion**

As this example shows, there are still a number of consistency issues remaining for the MFA system as a whole with respect to the system of national accounts. These issues are also relevant with respect to how energy is included in the MFA as the next section also highlights. These boundary issues need to be addressed in general as well as with respect to energy issues before economy-wide MFA as it has been developed by countries can be included in the SEEA. There are important differences between EW-MFA and the system of national accounts that need to be resolved.

## 2.3 MFA-EFA (SEEA-2003 Chapter 3.D.5)

Within the MFA and industrial ecology fields, there is also work being done with regards to energy flow accounts. The following figure shows the conceptual approach used and systems boundaries used in these types of energy flow accounts:

**Figure 2. Energy flow accounts schematic from an MFA/industrial ecology perspective**




Source: Schandl, H., C.M. Grünbühel, H. Haberl, H. Weisz (July 2002)

As this figure shows, this approach is not using the national accounts definition of the economy nor is it using an energy statistics definition of energy flows but adheres to the material flow concepts and ways of looking at the area of energy inputs and uses. "Energy flow accounting (EFA) aims at the establishment of a *complete balance of energy inputs, internal transformations, and energy outputs of a society* or of a defined socioeconomic component in a way that is compatible with MFA." (Schandl et al., 2002, italics in the original text)

Schandl et al. (2002) go on to describe two critical issues for EFA: that the system boundaries are the same as for MFA, i.e. the physical components of society which are defined as humans, domesticated animals and artefacts, and that the defined system boundary inputs are equal to outputs plus stock changes.

According to Schandl et al. (2002) there are four major differences between the MFA-energy flow accounts and the typical statistical energy balances:

1. The statistical energy balances only include the energy used to build, maintain and operate the "artefacts" portion of the MFA system whereas the MFA-EFA aims to also include energy inputs of humans and domesticated animals and inputs of energy-rich materials that are used for other purposes than energy generation (for example, wood for construction, paper, furniture, etc.).
2. The statistical energy balances include only the non-energetic uses fossil fuels, such as oil products used for production of chemicals, plastics, asphalt, etc., but do not include these same types of non-energetic uses of biomass. MFA-EFA includes all inputs of energy-rich materials when calculating the energy input of a society.
3. The statistical energy balances often only include energy flows through market activities and are not very good at capturing non-market flows. In developing countries the use of non-market biomass can be substantial. MFA-EFA should correct for these short comings.
4. The statistical energy balances convert material (mass) flows into energy flows using net calorific values of the respective, whereas the MFA-EFA uses gross calorific values.

These are the four major differences and areas that need to be adjusted when developing MFA-EFAs. It should be noted that these types of energy accounts are not consistent with the national accounts and are not specifically covered in SEEA-2003 although MFA is part of SEEA and so these MFA-EFA can be seen as a special case that only focuses on energy flows.

**Conclusion**

This specific energy example shows clearly that the EW-MFA system needs further development with respect to its integration with the national accounts and the need to align the MFA definitions more fully with the SNA. The way that MFA is commonly being implemented is not compatible with the national accounts and this should be addressed before EW-MFA can be included in the SEEA as part of a satellite accounts standard.

## 2.4 PIOT (SEEA-2003 Chapter 3.D.6)

Monetary supply and use tables are converted into input-output tables which can then be used for analysis. The same assumptions and techniques have been applied to physical supply and use tables to produce physical input-output tables, called PIOTs. These require a great deal of data and effort to compile and only a few countries such as Denmark and Germany produce full sets of PIOTs on a regular basis.

Supply and use tables are asymmetric in the sense that they show industries and other economic entities in one dimension and products or materials in the other. They are industry by products tables. In contrast, input-output tables are symmetric; they are either industry by industry or product by product tables.

Although compiling a PIOT does not involve any tasks which have not already been covered in principle, in practice many more data entries need to be considered. Generally, it will only be possible to construct a physical table when detailed monetary supply and use tables already exist because for some entries the physical quantities will have to be determined by dividing the monetary figures by appropriate prices (SEEA-2003, §3.217).

**Conclusion**

Since the PIOT is constructed using the same product and industry classifications and groupings as the national accounts the correspondence between the energy product/commodity classification and the energy product/commodity classifications used in various economic statistics (national accounts, trade statistics, customs data, etc.) again need to be as close to a one-to-one correspondence as possible.

## 2.5 Energy flow data in hybrid flow accounts (SEEA-2003 Chapter 4)

Reporting energy use to Eurostat as part of the biannual NAMEA reporting cycle began in the reporting made in 2006. For this reporting total energy use and energy use resulting in air emissions were to be reported at the two digit NACE[3] level.

The NAMEA basically takes existing statistics and re-organizes the information so that it is consistent with the national accounts' breakdown by industry groupings. To make sure that the NAMEA statistics are consistent with the original statistics, it is often good to be able to check that especially the totals are the same in both the NAMEA and the original official statistics. If this is not the case, then it is often helpful to have bridge tables which can inform the user how it is possible to convert from one set of statistics to the other.

In our opinion however the NAMEA energy tables do not contain enough detail to be particularly useful for analytical work. We would like to be able to develop these types of tables in much more detail and not just total energy consumption and emissions relevant energy use. It would be a helpful guide for the development of aggregated figures to have tables which include the energy consumption of industries (for example, at the 2-digit ISIC/NACE level) according to detailed types of energy commodities, more in line with the first attempts of developing NAMEA-energy tables. Analogous to the NAMEA-air emissions tables, a proposal for a NAMEA-energy table was developed and tested by members of the Eurostat NAMEA Task Force in 2003.

Although reporting to a detailed energy table was approved in the Working Group for Environmental Accounts this has not been implemented. On the other hand, to be able to report total energy use, it is necessary that the detailed data are available for aggregation to these totals. Therefore, developing a more detailed and harmonized accounting system which would need to be developed from the energy statistics is important to help to make this type of supply and use system for energy flows to be more consistent between countries and to communicate these user needs to the Oslo Group for incorporation into the revision of the energy flows statistical system.

The following table was proposed for reporting. Although this is only a draft it does illustrate the type of industry-by-energy commodity use table needed for environmental-economic accounts (European Commission, Eurostat 2003).

| | Primary energy forms combusted | | | | | | | Secondary energy forms combusted | | | | | | | | | Air emission free energy forms and net balance | | | | | | Total by industry |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Biofuels | | | | | | Petroleum products | | | | | | | | | (-) | (+) | (-) | (+) | |
| | Lignite | Coal | Natural Gas | Wood | Other Biofuels | Peat and other | Waste | Coal Coke | Coke gas and other gases | Total | Fuel Oil | Diesel Oil | Motor gasoline | LPG | Jet fuel and kerosene | Other petroleum products | Primary electricity produced | Other | Electricity sold | Electricity purchased | Heat +hot water sold | Heat +hot water purchased | |
| Total (industries+ households) | | | | | | | | | | | | | | | | | | | | | | | |
| Total industries | | | | | | | | | | | | | | | | | | | | | | | |
| Industries by 2-digit NACE | | | | | | | | | | | | | | | | | | | | | | | |
| Households | | | | | | | | | | | | | | | | | | | | | | | |

3 ISIC stands for International Standard Industrial Classification of All Economic Activities. NACE refers to the Statistical Classification of Economic Activities in the European Community and is an abbreviation of the French title, Nomenclature statistique des activités économiques dans la Communauté européenne.

From this draft, it becomes clear that the energy commodities in the column headings need to correspond to the categories in the energy supply and use statistical system in as close to a 1-to-1 correspondence as possible. The system boundaries for this data are the same as the national accounts, i.e. an economic definition based on the residence principle.

One problem encountered when testing this table by countries in the Task Force was particularly related to the table's third section dealing with air emissions free energy forms and net balance. Here there is a blending of use and supply data that is not consistent with the 2 left hand sections which focus on energy use.

Since the NAMEA-energy system has not yet been fully developed it is possible to adapt the column headings to include categories that may have been left out or to clarify the column contents so that there is a better correspondence with existing energy commodity categories.

Another example of a NAMEA-energy system is found in the SEEA-2003. Here an example of the Danish energy accounts is given, see §4.45-4.77, figure 4.2 and table 4.4. In the supply and use tables presented, total energy supply and total energy use are provided in physical units, petajoules, and the production, export, import and intermediate consumption values  in monetary units, billion DKK.

These monetary units are different from the value added figures often used with NAMEA tables and reported to Eurostat. In the Danish Energy-SUT the monetary units in the supply table are production values and the value of the export, while the monetary units in the use table are intermediate consumption and the value of imports. Since NAMEA accounts combine environmental and economic data, it is important that the information included about the quantity of energy produced or consumed in physical units is comparable to the similar information about energy produced or consumed in monetary value.

The first challenge is to define what energy products in the national accounts are equivalent to the energy products included in the NAMEA energy flow accounts. A correspondence table between the energy products of these two accounts needs to be developed.

The next challenge is to check the comparability between the NAMEA energy flow accounts and the national accounts. Although the energy accounts follow national accounts definitions, it is not a given that the information included in these two sets of data is comparable. For example electricity use in GWh may not match with the economic consumption data from the national accounts. To have a fully integrated physical and monetary supply and use system all of these different portions must be balanced and adjusted at highly detailed levels.

The supply of energy products/commodities must be equal to the use/consumption of these energy products/commodities. In a supply and use system there can be no statistical discrepancies. If there are discrepancies between supply and use within the physical and monetary portions of the integrated system, these need to be reconciled. Guidelines for how to reconcile the differences need to be clearer and need to be considered in association with the standards used in energy statistics as well as those used in the national accounts.

**<u>Conclusion</u>**

Exactly how the integrated physical and monetary supply and use hybrid/NAMEAsystem for energy flows is to be set up needs to be further developed, tested and harmonised before this can be described further in the SEEA. Practical testing of proposed tables has proved to be very valuable in the past and needs to be continued so that a theoretically robust, internationally harmonised and practical system can be the result.

# 3 Energy data in SEEA economic accounts (SEEA-2003 Chapters 5 and 6)

## 3.1 National Accounts

There are a variety of energy related information in monetary terms are found in the national accounts. Production and intermediate consumption of energy products by industries and import and export of energy products, both in current and fixed prices are all found within the national accounts systems. The energy products are classified according to CPA product codes.

It is desirable that there is full consistency between the information found in the physical energy data and the monetary use data in the national accounts and that the connection between these two are prices equal to the official prices used

- when the physical energy data form the basis for the national accounts data in current prices, and
- as deflator when transforming the national account in current prices into national accounts in fixed prices.

Having fully integrated supply and use physical and monetary data sets would bring better consistency to the national accounts and the energy statistics.

Some energy products/commodities are physically similar and could be considered to be almost the same product. And to a certain degree the use quantities for these products can be determined after they have been imported into the country and before these are distributed for consumption. But this can cause some challenges when balancing the supply and use for each of these different commodities if they are counted as one product on the supply side and as two products on the use side. At the same time it can be important to have them as different products in the economic accounts because of differences in the prices and tax levels.

The energy related information in the national accounts is constructed according to standard industry classifications (ISIC/NACE) and according to standard product classifications (HS/CPA/SITC). For this reason it is important that these classifications systems correspond as closely as possible to classifications used regarding energy.

**Conclusion**
The price statistics as a link between national accounts and energy statistics is, as well as same industry and product classification, an important factor when establishing fully integrated supply and use physical and monetary data sets.

## 3.2 Other SEEA-economic accounts

The national accounts include data for output, intermediate consumption, gross fixed capital formation, taxes paid and subsidies received, employment etc., and in order to make environmental protection expenditure accounts, the task is to isolate the environmental protection component included in these totals into satellite accounts. Unfortunately these environmentally related expenditures are not often defined or reported separately and therefore special ways of identifying and reporting them have been developed.

Although there are environmental protection expenditures throughout the energy products/commodities supply-chain the unit of analysis in this section of the SEEA-2003 is on the enterprises/establishments and not on the physical flows of energy or on energy assets. For this reason no specific energy-related needs were identified.

**Conclusion**
Again, as was concluded in the physical flows, here the important factor is that the same product and industry classifications and groupings used in the national accounts needs to correspond as best as possible to the energy product/commodity classification.

# 4 Energy reserves/stocks in SEEA asset accounts (SEEA-2003 Chapters 7 and 8)

There is a sub-group of the London Group that is specifically looking at the further development of subsoil assets, including energy-rich commodities such as petroleum, natural gas, coal, tar sands, oil shale, oil sands, etc. An important issue is the classification of these sub-soil assets and the UNFC system has been proposed as the one to use when determining the reserves (also referred to as stocks in the national accounts) to be included in the valuation calculations.

It is important to understand the terminology regarding assets/inventories/use/consumption from a national accounting perspective and the way that energy statistics use the terms reserves/stocks/consumption. The following table provides a correspondence table between some of these different terms. Because the same words are used to mean two different things there are often misunderstandings. Since environmental-economic accounting is so closely connected with the national accounts these misunderstandings are typical in this field as well.

| National Accounts perspective | Energy perspective |
|---|---|
| Tangible non-produced assets | Reserves |
| Inventories / stocks | Stocks |

Since there is a sub-group working in more detail with the asset related issues for energy there is only one important issue to consider in this case and that is the boundary definition between reserves in the ground/tangible non-produced assets and when it goes into the production system and is considered part of the energy flows.

**Conclusion**
The UN Framework Classification for assets is not that clear with regards to this and neither is the energy flow statistics. This boundary is important in the SEEA context. This boundary needs to be defined in cooperation with the energy statistics experts in the Oslo Group and also clarified with the UNECE Ad Hoc Group of Experts on Harmonization of Fossil Energy and Mineral Resources Terminology.

# 5 What are SEEA user needs with respect to energy?

## 5.1 System boundaries – residence principle and “assets” vs. “flows”

At the current time there are two main ways of defining national system boundaries. One approach uses a geographic definition and the other an economic definition. Both of these ways of defining a country or an economy have inherent advantages and disadvantages – but it must be pointed out that these are very different definitions.

The definition of the system boundaries and which institutional units should be included and excluded in environmental-economic accounts is based on the national accounts definition of resident institutional units. From the System of National Accounts handbook (SNA 1993) resident units are defined as follows:

> The accounts of the System are compiled for resident institutional units grouped into institutional sectors and sub-sectors… An institutional unit is said to be resident within the economic territory of a country when it maintains the centre of economic interest in that territory – that is, when it engages, or intends to engage, in economic activities or transactions on a significant scale either indefinitely or over a long period of time, usually interpreted as one year… Some of the production of a resident institutional unit may take place abroad… Conversely, some of the production taking place within the country may be attributable to foreign institutional units.
>
> (Part E. Concepts and Classifications, Section 4. National boundaries, SNA 1993, §1.28)

In practical terms this definition means that corrections from a geographic definition need to be made for the activity of resident units in the rest of the world and the activity of non-resident units on the domestic territory. For an energy supply and use data set, the following types of corrections from a data set using a territorial boundary definition would need to be made.

Energy use on national territory
- (+) Residents in the rest of the world including especially
  - Road transport
  - Air transport
  - Water transport
- (-) Non-residents on domestic territory including especially
  - Road transport
  - Air transport
  - Water transport

= Energy use by resident units (i.e., the national accounts definition)

Ocean transport with bunkering abroad can include large amounts of fuel purchases that are not included in the national statistical systems where the ships are resident. These types of purchases are not recorded in the trade statistics since these units purchase and use the fuel while abroad. Special data collection and estimations may need to be developed to include these activities of resident units abroad. Fishing vessels operating abroad and foreign vessels in national waters may pose a similar problem as ocean transport. International air transport poses similar problems.

Specific to extraction of oil and natural gas is the problem of accounting for the energy commodities in pipelines and in ships. Ownership of these commodities and how these are accounted for in the production, inventory/stocks and trade statistics is not always easy to determine but since the amounts of energy commodities in pipelines and ships can be large this can be a significant problem.

Another boundary issue has to do with the definition of when energy-rich commodities are classified as "assets" and when are they classified as "flows."

## 5.2 Supply = Use therefore any statistical discrepancies are not acceptable!

In a supply and use accounting system, supply must equal use. If it does not, then adjustments need to be made within the system to make this system balance. All supply and use of services and products (including energy commodities) must be accounted for and broken down according to industries, import, export, changes in inventories and trade and transport margins. When supply of a product does not equal the use of these products, there are in the Norwegian national accounts an option to adjust for this discrepancy as "changes in inventories" if both the supply and use side data are checked and no further balancing changes are found in the basic statistics.

When balancing the supply and use of goods and services in the national accounts, typically the inventories (referred to as "stocks" in energy statistics) of products are adjusted. However in cases where it is not possible to adjust stocks, such as in the services industries or for electricity, then either the basic statistics used in populating the supply or the use table are adjusted. In general this leads to inconsistencies between the figures presented in the national accounts and the basic statistics produced to populate the supply and use tables. In some cases this can be problematic and confusing to have two different figures for the same thing but it can often lead to improvements in the basic statistics in the long run when checks in the system can be implemented before the basic statistics reach the national accounts. In other cases, these checks are not possible to do before basic statistics are included in the fully integrated SUT of the National Accounts.

Energy statistics typically contain a row showing "statistical discrepancies."  Since these are extremely problematic in the integrated physical-monetary supply and use tables these need to be eliminated. It may not be a good idea to apply the national accounts method of balancing these differences, i.e. adjusting inventories ("stocks" in energy statistics), to the field of energy statistics. The inventory/stock figures in the energy statistics are important to keep consistent with the physical amounts available in a country. These energy stock figures contain both market sensitive information and implications for national security. Therefore it is unacceptable to simply use these figures as a balancing item in an accounting system. It then becomes necessary to adjust either the supply or use ("consumption" in energy statistics) data. Ideally this should be the concern of the energy statistics and this balancing problem should not exist. If this is not possible, then some guidelines for how to balance the supply and use ("consumption") need to be proposed.

## 5.3 Institutional units: Industry classification, consistency over time and attributing energy use

***Industry classification***

It is very important that the same groupings are used in the different statistical systems that are going to be combined. If the groupings are not the same, it then becomes necessary to aggregate the groupings until there can be an exact match between all of the different sets of data.

Ideally the definitions used by the system of national accounts should be used for defining the groupings of the institutional units in the energy supply and use statistics. More specifically this means the use of the ISIC (or NACE) standard classifications of economic activities.

***Consistency over time***

Another important factor is the consistency of these groupings of institutional units over time. Institutional units can change their industrial classification due to a number of different circumstances. Mergers, spin offs, and changes in main activity can all result in the reclassification of institutional units into different groups of economic activities.

When there are two or more linked statistical data sets, such as energy and national accounts maintaining a consistent time series becomes even more challenging. When there is a major revision of a classification system, such as ISIC Rev. 4 and the corresponding NACE Rev. 2, the coordination tasks are not non-trivial since the revision of all the data sets that contribute to both sets of statistics also need to be updated to the new classification system and consistent time series developed – internally and to the corresponding data set.

***Attributing energy use***

Attributing energy use to the institutional units that use ("consume") the energy commodities is an important part of developing the supply and use tables.

The main principle used in this assignment process is that the institutional units that have the economic activity that is directly responsible for the energy use are assigned the energy use. In the air emissions NAMEA the pollution generated from electricity production should be attributed to electricity suppliers and not to the electricity use/consumers. The same would be the case for the use of energy commodities; those that use the energy (no matter what the purpose) need to be attributed with that use.

It is also important to include secondary energy production and auxiliary or own-use production of energy. For example the use of biogas by sewage treatment plants as an energy source needs to be part of the data collection. Generally secondary and auxiliary energy production is covered well for the manufacturing industries but the non-manufacturing industries with potential energy sources such as biogas from sewage treatment and methane from landfills also need to be included in these types of energy surveys to capture these activities.

When converting supply and use tables into input-output tables there is an issue of homogeneous and non-homogeneous industries. Homogeneous I-O tables mean that secondary activities are reassigned to the industry in which this is the primary activity. For example, when a pulp and paper mill that uses its wood-based waste to generate electricity and it sells some of this electricity onwards, this electricity production activity is considered a secondary activity. In a homogeneous I-O system this secondary activity of electricity production is reclassified into the electricity production industry. In a non-homogeneous I-O system this secondary activity stays associated with the pulp and paper mill.

In general supply and use tables are not homogeneous. In addition there is a trend towards collecting data at the enterprise level and not at the more detailed establishment level because there is often a lack of data at the establishment level. This makes it more likely that in the future homogeneous industry grouping will be less common.

What is important with respect to energy is that the secondary activities of enterprises and establishments are treated in the same way in both the economic and the physical supply and use systems.

## 5.4 Energy commodities in different product classification systems

When combining statistics from different areas it is important that the same "things" are found in the categories from the different statistical areas. This is particularly important if prices, monetary amounts (production, imports, exports, intermediate consumption) and physical amounts are to be combined in calculations.

It is important that the information included in hybrid flow accounts about the quantity of energy produced or consumed is comparable to the similar information about energy produced or consumed in monetary values. One challenge is to define what energy commodities in the national accounts are equivalent to the energy commodities included in the energy statistics. A correspondence/bridge table between the energy products of these two systems should be developed – whether this can be done primarily at an international level or whether this must be done nationally needs to be determined.

The statistical classifications for products need to be reviewed by energy experts to see that there is a good and logical correspondence between the energy commodities classification systems and all of the economic product classification systems, such as SITC, HS, and CPA. At the same time the needs of the economic statistics, including variations in tax rates, prices, etc. also need to be considered in relation to these classification systems. Having grouping that make sense from a physical perspective and that make sense from an economic statistics perspective (different prices and tax levels) is desired.

# 6 Conclusion

The London Group needs to address the current problems relating to economy wide material flows and the hybrid accounts before these systems can be considered for inclusion in a version of the SEEA that is to be considered a statistical standard. When the current systems are viewed from an energy perspective and how energy is being included, it becomes clear that some revisions, better specifications and developments need to be considered. These SEEA-portions need to be put in order before they can be considered for inclusion in a standard for implementation by countries.

When considering the user needs of environmental-economic accounts with regards to energy statistics the following topics would be appropriate to communicate about to the appropriate groups:

1. The system boundaries needed by SEEA have a basis in the SNA and in particular the residence principle. The energy statistics should provide information that can be used to construct information according to the residence principle.
2. The supply and use of energy commodities needs to be equal and when it does not equal then adjustments need to be made. Recommendations/guidelines for making these adjustments need to be considered from both an energy statistics and economic accounts perspective.
3. Energy supply and use data need to be available according to institutional units and should be according to the appropriate standards such as ISIC/NACE.
4. Product classifications need to correspond in ways that make sense from physical, price, and product classification perspectives. The product classification systems HS/CPA/SITC and energy commodities classifications need to be evaluated from all of these perspectives and adjustments considered.

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