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Draft SEEA Technical Note on

Economy-wide Material Flow Accounting

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0. Background

At its 44th session in February 2013 the United Nations Statistical Commission (UNSC) endorsed an implementation strategy for the SEEA. One of the recommended activities within the implementation strategy was the preparation of training material and guides. One of proposed suite of materials are "SEEA Technical Notes", whose general purpose is to summarise, for a given topic, a range of relevant features and considerations, with the objective to point compilers in the right direction (and not to explain all of the relevant implementation and compilation stages).

The present document is a first attempt in that direction, concerning Economy-wide Material Flow Accounting.

SEEA Technical Notes: Economy-wide Material Flow Accounting

1. Introduction and general description

Material Flow Accounting (MFA) refers to a family of tools for monitoring physical flows of materials into, through and out of a given system (usually a part of the economy), based on methodically organised accounts in physical units. MFA describe the flows of materials due to human activities and help understand the relationships between the functioning of the economy and environmental pressures. Material flows can be accounted for – and subsequently analysed – at various scales and with different instruments depending on the issue of concern and on the objects of interest of the study.

The present note mainly concerns the most aggregated kind of MFA, Economy-wide MFA. The latter is characterised by:

- Referring to whole economic systems, typically national ones (but also regional or local ones without any methodological difference);
- Providing some detail on the flows as for the types of materials, but usually no disaggregation by industry or institutional sectors.

Air and water resources are only marginally included in Ew-MFA, i.e. insofar as they are embodied in other materials or as balancing items. As for air, it is neither scarce nor does its use cause any environmental damage. Water flows, on the contrary, are very important, and are described by another MFA tool. If water was included in Ew-MFA, the highly aggregated indicators derived from it (used e.g. for the monitoring of Resource Productivity) would be completely dominated by water and therefore not show anything concerning the flows of other materials.

2. Key questions and relevant aggregates and indicators[1]

[1] Based on OECD, 2008, Measuring Material Flows and Resource Productivity, Volume I – The OECD Guide, pages 20 and 28.

Material natural resources are a major foundation of economic activity and human welfare. Their efficient management and use is key to sustainable development is part of the many cross-sectoral issues with which governments are confronted.

The use of materials from natural resources in human activities has many environmental, economic and social consequences that often extend beyond the borders of individual countries or regions. This has a bearing on decisions cutting across many policy areas, ranging from economy, trade and technology development, to natural resource and environmental management, and to human health.

From an environmental point of view, the use of natural resources and materials has consequences that occur at different stages of the resource cycle and that affect the quantity and quality of natural resource stocks as well as the quality of ecosystems and environmental media. It has consequences on:

- the depletion of renewable and non-renewable resources.
- the reproduction capacity and natural productivity of renewable resources.
- the associated environmental burden (e.g. pollution, waste, habitat disruption) and its effects on environmental quality (e.g. air, climate, water, soil, biodiversity, landscape) and on related environmental services.

The type and intensity of these consequences depend on the kind and amounts of natural resources and materials used, the way these resources are used and managed, and the type and location of the natural environment from where they originate.

Material flow analyses supported with regularly assembled MF accounts and indicators can be useful in a variety of public and private policy settings. Conversely they do not lead to any particular government policies. There are three broad policy areas in which material flow analyses are particularly useful. These policy areas overlap and are handled by many different government agencies, ministries and departments. They are all concerned in one way or the other by sustainable resource use. They include:

- Economic, trade and technology development policies.
- Natural resource management policies
- Environmental policies

Ew-MFA aggregates are used, in particular, for the monitoring of resource productivity or resource use efficiency, in context such as Sustainable development indicators (e.g. the headline indicator adopted by the EU for the Sustainable Consumption and Production theme is GDP per unit of Domestic Material Consumption) and Green Growth (e.g. Demand-based and Production-based Domestic non-energy materials productivity in the OECD indicators set).

Ew-MFA are not the only type of information tools available and needed to support analysis and decisions in these areas. But they are the only tools that provide a holistic and integrated view of resource flows through the economy. Also, they help understand how flows of materials shift within countries and among countries and regions, and how this affects the economy and the environment within countries and abroad. The accounting approach allows consistent comparison of MF-based indicators and monetary National accounting aggregates,

e.g. for use in Resource productivity indicators. Moreover, when a complete balances of a system's material flows is compiled:

- a basic understanding is provided, concerning the relationships between resource inputs and material outputs, i.e. between the two ends of the man-made materials' transformation cycle. Pressures on the natural environment largely coincide with material flows at these ends;
- possible major inconsistencies between the various statistical sources may emerge as significant discrepancies between material inputs and material outputs of the economic cycle.

3. Core accounts

To be developed.

The main tables may be based on – and even partly coincide with - the Eurostat questionnaire and especially on tables A, B and D thereof.

Summary Physical Supply and Use tables (PSUTs), as described in general in table 3.2.1. of the SEEA-CF may be included, and these may be extended in order to accommodate information from other sources (e.g. value added, GDP, population) to provide the basic information set for the derivation of key aggregates and indicators.

4. Extensions and links[2]

Ew-MFA belongs to the broad family of SEEA Physical flow accounts for materials and has links to tools such as Business-level material flow accounting for supply chain management, Life-cycle analysis, Environmentally extended input-output analysis and other modelling based on Ew-MFA as well as on the more detailed kinds of MFA.

The basic principles of MFA can indeed be applied to a wide range of economic, administrative or natural entities, studying the flows of materials within the global economy or within the economy of a region or a country, within a territory, a municipality or a city, within a natural unit, such as a river basin or an ecosystem, within an economic activity or an industrial unit such as a firm or a plant.

At each of these levels, MFA helps understand the flows of natural resources and materials, their shifts and their economic and environmental implications. It helps locate the sources of environmental stress, identify risks of supply disruptions, identify opportunities for efficiency and productivity gains, and formulate ways to manage, control and reduce the adverse environmental impacts of resource use. This is of value in many policy areas and business strategies, especially in a context of population growth, economic and technological changes, with pressures to use resources in a way that is both economically efficient and environmentally effective.

A material flow study can in principle cover any possible relevant set of materials at various levels of detail, from the complete collection of all resources and products flowing through the system under analysis to groups of materials at various levels of detail and to particular products. It can also be applied to particular materials or even single chemical elements that

[2] Partly based on OECD, 2008, Measuring Material Flows and Resource Productivity, Volume I – The OECD Guide, page 40.

raise specific concerns as to the sustainability of use of the original natural resource, as to the environmental implications of their use or as to their economic or trade implications.

4.1 Additional industry or kind-of-material detail

Core, easy-to-compile Ew-MFA on the materials actually used by an economy, such as those presented in section 3 above, provide a first step into the knowledge of the interface between the economy and the environment, which is given by the physical dimension that the two systems have in common. Their extensions include:

- the reporting of *Natural resource residuals*, which captures the flows of material that are extracted but do not enter the economy as transactions and that are nevertheless important from an environmental point of view;
- the estimation of *Raw material equivalents* and of *indirect flows of Natural resource residuals*, which provide a picture of what the functioning of a part (national or regional system) of the global economic system implies or requires as for its resource (and residuals) demand;
- the construction of complete MF-balances of the national or regional socio-economic system, where all flows taking place at the output side (waste, additions to useful stocks, air and water emissions) of the socio-economic system are included in the account and compared to the inputs, with which they have to be coherent;
- the construction of detailed PSUTs, describing the flows of materials at all stages of the economic cycle ("opening the black box of Ew-MFA") and integrating information on flows from/to the environment, disaggregated by activity, with information on flows of products from/to economic activities and to final uses.

4.2 Links to other accounts

Waste (to be developed)

Emissions (t.b.d.)

Water (t.b.d.)

A distinction often found in MF studies is between material and substance flows, where substances tend to mean 'pure' chemical elements or compounds (e.g. heavy metals, chlorinated chemicals) and materials the actually observed flows of raw materials, underlying natural resources, products and residuals which are often, but not always, a mixture of various substances (e.g. fuels, water, timber, plastics, non-ferrous metals, total material throughput). This kind of accounts are dealt with in the SEEA under the "Product flow accounting" heading within the "Physical flow accounts for materials" section.

5. Compilation

T.b.d.

Established materials and guides exist and reference to them should be widely made for this section.

6. References and links

T.b.d

The tables included in the EU reporting tool for Ew-MFA, responding to EU Reg. 691/2011 (but also those for air emissions) are accompanied by exhaustive methodological and training material.

An ideal, complete and detailed PSUT system is developed step-wise in the OECD documents on *Measuring Materials Flows and Resource Productivity* (namely in *Volume 2: the Accounting Framework*, presented at the 11th Meeting of the London Group - Johannesburg, 2007 - and at the 3rd UNCEEA meeting - NY, 2008). Despite some terminology difference between it and the SEEA-CF (being the OECD document based on the 2003 SEEA), the description of this ideal system provides a valuable tool for understanding the material dimension of socio-economic life and a solid background into the logic of Flow accounts for materials in general.