Classifications of Material Flows for SEEA-MFA

Issue paper presented at the 13th Meeting of the London Group on
Environmental Accounting
29 September - 3 October 2008,
Brussels, Belgium

Karl Schoer, consultant UNSD

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1. Introduction

1.1 Objective

The material flow accounts (MFA) of the SEEA describe flows of materials within the economy as well as those between the economy and the environment in weight units. For putting the MFA into practice it is recommended to establish a number of sub-accounts for almost all types of inputs from the environment and related products ("resource accounts") and for outzputs to the environment ("emission accounts"). Further it is suggested to implement economy wide material flow accounts (EW-MFA), which show all inputs and outputs of material to and from the national economy as a more general frame and which are fully harmonized with the general SEEA-MFA. Beyond MFA other physical flow accounts which use other physical units than weigh unit are established, namely energy flow accounts in joules and water flow accounts in cubic metres.

The recommended classifications underlying the material flow accounts should be tuned to the various types of physical supply and use tables for the MFA sub-accounts as well as the other physical flow accounts.

This paper presents a set of classifications to be recommeded for the purpose of the SEEA-MFA manual. Those classifications are harmonized as far as possible with the classifications used for the specific manuals on Energy (SEEA-E) and water (SEEAW). The proposals are built on the recommendations regarding classifications for physical flow accounts of the paper which was prepared by a Dutch working group[1].for the last London Group meeting. The recommendations of the paper were discussed and welcomed by the London Group.

The recommendations refer to following issues:

a) Separate classifications should be developed for the three main flow categories: materials (MFA); water; anden energy. Overlaps between these three main categories of physical flows should be consistently classified to the extent possible
b) Reconciliation of the SEEA classification of material flows with the classifications of the Eurostat MFA questionnaire;
c) Reconciliation of the SEEA waste classification with classifications of the European Waste Statistic Regulation**;**
d) Differentiation of waste by waste as a residual and waste as a product;
e) The classifications of the waste products in the CPC should match the waste residual classification;
f) The classification of cultivated biomass in the SEEA should be in line with the outcome of the discussion on the relation between the OECD guidance manual on EW-MFAcc and the SEEA 2003;
g) In addition to the flow classifications, classifications by purpose should be developed. These classifications would allow to specify how materials (e.g. packing), water (e.g. cooling) and energy products (e.g. for energy or non-energy purpose) are used, which is crucial for a better understanding of environmental impacts.

1.2 General considerations

The MFA of the SEEA is based on two essential principals. The first one is the full integration into the system of economic accounting (SNA) as a satellite system and the second one is

[1] Roel Delahaye, Mark de Haan and Sjoerd Schenau: Classification of physical flows, paper presented to the 12th meeting of the London Group on Enviromental Accounting, Rome, 17-19 December 2007.

the the principle of mass balancing.

Relationships to SNA: The MFA are an environment related satellite system to the SNA where the concepts, definitions and classification of the material flows follow the SNA as much as possible. SNA reports only the flow of products, but not of non-products which are mainly exchanged between the economy and the environment, but which in the case of waste or waste water can also circulate within the economy. Products are the result of a production process in the SNA sense. Inputs from the environment (natural inputs) are not produced and originate in the environmental sphere. Outputs to the environment are, with the exception of dissipatively used products (see section 2.3.4), are non-products which are the incidental and undesired outputs of production and consumption activities. The MFA portrays the flows of those materials in a systematic and comprehensive manner by physical supply and use tables (SUT) which show the origin and destination of materials by type of material. The physical SUT build on the concept of the the monetary SUT of the SNA, but extend those tables under an environmental perspective. For the physical SUT two principal types of classifications are required: (a) classifications of materials and (b) classifications of transactions.

For each type of the threed principal categories of flows of MFA – inputs of materials from the environment to the economy, outputs of materials from the economy to the environment and flows of materials between economic units (including the rest of the world economy) – a specific classification by type of material was developed, which is based on physical and or chemical characteristics. The proposed MFA classifcations refer as far as possible on already existing classification systems, preferably on those that are used by the economic accounting system. The product classification that is used for the SNA (CPC) is also applied for the MFA product classification. Moereover, CPC plays also an important role for establishing the classifications of non-product materials.

The MFA classifications of transactions are principally based on the characteristics of transactions in products as they are defined by the SNA. The transactions in products of the SNA show items like output and intermediate consumption (in a breakdown by industries) as well as final consumption, gross capital formation and imports and exports. In the MFA those principal transactions are applied for describing the flows of products as well as of non-product material in weight units. The principal transactions had to be amended by including the environment and by introducing further specific disaggregations that are relevant for environmental-economic anlysis.

Principle of mass balancing: The accounting principle of mass balancing is based on the physical law of conservation of mass that states that matter can neither be created nor destroyed[2].Following that principle the mass (weight) of all inputs of material to an entity over a certain time period equals the mass of all outputs from that entity plus the additions to stock over the same period.

The classifications for the purpose of MFA have to fit into that principle of mass balancing. Though the MFA classifcations are based on already existing classification systems, it was necessary to introduce some deviations in detail, especially in order to ensure compliance of the classifications with the mass balancing principle.

In chapter 2 of this paper a comprehensive proposal is presented for MFA specific classifications for the three principal categories of material flows.The definition and the classification for each principal category of material are introduced. That chapter covers the items b) to f) of the recommendations of the last London Group meeting. Item b) is addressed throughout the chapter, the items c), d) and e) are dealt with under section 2.3.3 on waste and f) is covered by section 2.2 (natural inputs).

In chapter 3 classification for the transactions in material for the purpose of MFA are

[2] Although this principle is not universally true (as nuclear reactions are able to transform mass into energy) it is a sufficiently appropriate formulation for the material exchange relations of macro systems.

presented. The item g) of the London Group recommendations is addressed in the sections 3.3 and 3.4. of this chapter.

2. Classification of materials by type of material and of principal flow category

2.1 Inputs from the environment

2.1.1 Definition of natural inputs

The economy draws materials from the environment as “natural inputs”, which originate from the environmental sphere and where generated by a natural or semi-natural process. Those materials are used as physical inputs for economic production and consumption processes where they are transformed either into other products or into residuals. Two principal categories of natural inputs have to be distinguished, “natural resources” and “balancing items”.

Natural resources are converted into products by crossing the border between the environment and the economy with the act of extraction, i.e. they have an economic value. Extraction is regarded as a production process (e.g. mining, abstraction of water, drilling of oil, collection and hunting of wild biota) by the SNA. This includes also own account extraction for final or intermediary consumption, like collection of fuel wood, extraction of construction material, water abstraction by households. For all materials regarded as natural resources there generally are entries for corresponding products in the classification of products (CPC). Natural resources cover biological resources, ores, minerals and water.

Regarding the demarcation of biological resources the SEEA-MFA applies different concepts: the “ecosystem approach”, the “harvest approach” and the “extended harvest approach” (see paper on harvest approach submitted to this meeting). The three approaches differ regarding the treatment of cultivated biological resources. The “ecosystem approach” regards only non-cultivated biological resources as natural inputs and cultivated biological resources are considered to be products that are created within the economy. In the “harvest approach” cultivated crops, plants and trees are viewed as natural inputs and the “extended harvest approach” includes also cultivated animal resources and cultivated aquatic resources as natural inputs. The harvest approach is recommended as the standard approach for SEEA-MFA for pragmatic reasons.

Balancing items input side originate from the environment and enter the economy. The have to be regaded in order to keep the principle of mass balancing. But unlike natural resources, those balancing items are not converted into products.They comprise the gazes and other natural inputs into production and consumption processes which are transformed into a part of a product – like soil minerals which are integrated into crops and plants - or into an output to the environment (air emission) by combustion processes or rewspiration of humans or cultivated anaimals. Also included are materials that enter the waste collection system, like contaminated soils, polluted dredging spoils and gardening waste, as far as it is handed over to the waste collecting system.

Unused material has to be mentioned as a borderline issue against balancing items. Unused materials can be generated as a spin-off of extraction of almost all types of natural resources or otherwise be moved on nation’s territoryon purpose and by means of technology. However, to be regarded as not entering the ecomomy those materials have to accomplish two criteria:

a) They are not fit or intended for economic use

b) They do not enter the waste collection system and are usually left behind at the site of production.

The following materials are regarded as unsused:

Mining overburden: In mining or quarrying the so called run of mine is considered as the used part of the total material activated by the extraction process. Run-of-mine production means that the total amount of extracted crude mineral that is submitted to the first processing step is counted, e.g. the metal containing ore. The remaining materials mainly include mining overburden which is removed and deposited (sand, gravel stones) at the site or interburden which is removed and filled. For the purpose of SEEA-MFA only that fraction of the materials that is used by the economy is regarded as extraction of a natural resource.

Construction works: Unused materials generated by construction works cover excavated soil for structures and non-hazardous materials dislocated by dredging of waterways. However, polluted (hazardous) materials from dredging work as well as polluted soils are collected by the waste collecting system and have therefore to be regarded on the input side as a balancing item.

Residues from cultivation of crops and trees: The total material output of the cultivation process comprises the primary products and the crops and tree residues. Only a part of the residues is used as a product, mainly for fodder of animals in case of straw and beet leaves or as firewood in case of the bark of trees. The other part of the residues remains unused and is usually left behind in the field or the forest

Residues from extraction of non-cultivated biological resources: Also the extraction of non-cultivated biological resources (e.g. fishing, hunting) may create “unused material”. The most important category of unused material generated by the extraction of non cultivated biomass is the by catch of fishing.

Water: All water used by production and consumption activities, be it water abstraction, use by biological metabolisms, processes like hydro-electric power generation, cooling processes, mining and so called urban run of is always regarded as a natural input to the economy for the purpose of the SEEA-MFA.

As flows of unused material can be important indicators for environmental pressures it appears appropriate to keep also track of that type material in the MFA. It is therefore recommended as an optional approach to supplement the MFA system by reporting the generated “unused materials” as a memorandum item. However the reporting of unused flows should be confined to dislocations of materials that might have some relevance in terms environmental impact.

2.1.2 Classification of natural inputs

The classification of natural inputs for MFA is shown in annex 2. The Central Product Classification (CPC) plays an essential role for establishing the classification for natural inputs. Natural resources are turned into a product by the act of extraction (or cultivation in the case of biological resources), i.e. all natural resource items have in principal a correspondent product item in the CPC, sections 1 and 2. Those items of the CPC were used for defining the natural resource items of the classification for natural inputs.

The biological resources of the natural input classification (A0) correspond to section 0 of the CPC. However for the purpose of MFA a distinction has to be made between cultivated and non-cultivated biological resources, due to the different approaches in the MFA for treating cultivated biological (see above). As far as biological resources are concerned, only the “extended harvest approach” treats all biological resources –whether cultivated or not-cultivated - as natural resources. The “harvest approach” recognizes cultivated crops and trees and non-cultivated biological resources as natural resources. The “ecosystem approach” regards exclusively non-cultivated biological resources as natural resources.

For the purpose of MFA all “resources from agriculture, horticulture and market gardening” (A.0.1) and “live animal resources (excluding meat)” (A.0.2) are regarded as cultivated. As far as the “forestry recources” (A.0.3) and the “fish and other fishing resources” (A.0.4) are concerned a distinction has to be made between cultivated and non-cultivated resources. It is assumedfor practical purposes that the non-wood forest resources (A.3.2) are exclusively

non-cultivated and that that item comprises all non cultivated plants and animals (excluding non-cultivated grazed biomass). The items “wood” (A.0.1.1, A.0.1.2) and “fish and fishing resources” (A.0.4.1, A.0.4.2, A.0.4.3) have to be further disaggregated into cultivated and non-cultivated.

The classification has to include all materials that cross the border between the environment and the economy. For the purpose of the harvest approach – where the generation of crops is regarded to take place in the environment, but animal cultivation is a production process within the economy - a all crops used for animal cultivation have to be regarded as a natural resource input into the economy. Those crops comprise fodder crops, used crop residues (e.g. straw or beet leves) that are used as fodder (or bedding) in animal cultivation and grazed biomass (grass taken up directly by cultivated animals).

In the SNA practice of monetary accounting the generation of those materials is rather regarded as an ancillary activity (intra unit flow). The result of an ancillary activity is neither recognized as a separate output nor as an intermediate input into the principal activity. However, for keeping the principle of mass balancing of the MFA those materials also have to be counted as inputs of natural resources which are turned into products by the act of extraction. As far as the classification of natural inputs is concerned used crop residues are included into the item “forage “resources etc.” (A.0.1.9). Grazed biomass regarded unter the code A.0.1.10. Grazed biomass is not covered by the CPC.

For the **non-biological resources** the items 11 to 16 and 18 of the CPC are used. The item 11 of CPC covers also agglomerated coal and lignite which have to be excluded from the natural input classification, as those items represent materials that where already processed further after the act of extraction of the natural resource. The same holds for concentrates of metals which are included into the items 12 and 13 of the CPC, but have to be excluded from the natural input classification.

Balancing items input side which are inputs into transformation processes but which do not become products itself by entering the economy do not have a counterpart in the product classification. Balancing items input side comprise oxygen for combustion processes, for respiration of cultivated anaimals and aquatic resources and human respiration, nitrogen for Haber-Bosch processes, carbon dioxide for respiration od cultivated crops, plants and trees, soil minerals and some other environmental materials which are activated by production processes and which enter the waste collection system (unused biomass from parks and gardening and contaminated soils and polluted dredging spoils). For the purpose of the harvest approach and the extended harvest approach the inputs of balancing otems into the biological metabolism (soild mineral, carbon dioxide and oxigen)l have to be excluded as intra-environment flows, as the biological metabolism is considered to take place in the environment.

2.2 Outputs to the environment

Except for dissipatively used products the materials that are discharged to the environment are residuals. Residuals are regarded as the incidental and undesired outputs from production and consumption processes within the economy which have no use for the generator.

Residuals can appear in solid, liquid and gaseous form. Very often residuals are directly discharged to the environment. But in other cases they can also be absorbed by the economy for intermediate use (recycling, incineration or other treatment) or final use (controlled landfills).

Materials that are activated by production activities but which are classified as unused (see 2.2.1) are not considered to be residuals, as, by definition, they do not enter the economy.

The classification of outputs from the economy to the environment covers six principal categories of residuals, “emissions to air”, “emissions to water”, “solid waste”, “dissipative loses”, “waste water” and the category “balancing items”. “Dissipative use of products” is a

further output from the econ omy to the environment.

2.2.1 Emissions to air

Emissions to air are gaseous or particulate materials released to the atmosphere from production or consumption processes in the economy. In MFA emissions to air comprise 14 material categories. The terminology for emissions to air follows international harmonised standards of emission inventories of IPCC, CORINAIR.

The National greenhouse gas inventories in the common framework of IPCC cover emissions to air that have a greenhouse gas potential, i.e. contribute directly and indirectly to global warming. Countries which signed the UN Framework Convention on Climate Change (UNFCCC) are requested to compile their national greenhouse gas inventories according to the respective IPCC (International Panel on Climate Change) guidelines. The guidelines cover the direct greenhouse gases CO_2 (carbon dioxide), CH4 (methane), N_2O (dinitrogen oxide), HFC (hydrofluorocarbons), PFC (perfluorocarbons) and SF6 (sulphur hexafluoride) as well as the indirect greenhouse gases NOx (nitrogen oxides), NMVOC (non-methane volatile organic components), CO (carbon monoxide), and SO2 (sulphur dioxide).

CORINAIR (CORe INventory of AIR emissions): Air emission data are also complied under the UNECE convention on long range transboundary air pollutants (LRTAP). The focus of this convention is on classical air pollutants. CORINAIR includes the pollutants CO, NH3, NMVOC, NOX, PM10, PM2.5, SO2.

The section on air emissions of the MFA classification provides a further breakdown for CO_2, N_2O and NMVOC by origin. The air emission inventories as well as the MFA indicators on air emission include only the items A.1.1 and A.1.2 (Carbon dioxide (CO_2) other than from respiration of humans and livestock), A.3.1 (Dinitrogen oxide (N_2O) other than from dissipative use as a product) and A.9.1 (Non-methane volatile organic compounds (NMVOC) other than from dissipative use as a product). CO_2 from respiration of humans and livestock have to be regarded as a balancing item for keeping the principle of mass balancing. Dissiapative use (see also section 2.3.4) of N_2O and NMVOC refers to use as a solvent in case of MNVOC and for narcosis in case of N_2O.

Emissions to air from controlled landfills (storage of waste within the economy), such as CH4 and N_2O have to be included to the air emissikons for the purpose of MFA. Emissions resulting from fertilizer application in agriculture, such as N_2O and NH3 are not accounted for in the category emissions to air as the application of the fertilizer itself is regarded as a residual flow to the environment. The subsequent emissions to air have to be a considered as a flow within the environment. The inclusion of these emissions thus would represent a double counting. They could be added though as a memorandum item.

Included into the air emissions are also:

a) **Heavy metals**: There are several different definitions of which elements fall in this class designation: According to one definition, heavy metals are a group of elements between copper and bismuth on the periodic table of the elements having specific gravities greater than 4.0.;

b) **Persistent organic pollutants (POPs)**: Persistent organic pollutants (POPs) are organic compounds that are resistant to environmental degradation through chemical, biological, and photolytic processes. Because of this, they have been observed to persist in the environment, to be capable of long-range transport, bioaccumulate in human and animal tissue, biomagnify in food chains, and to have potential significant impacts on human health and the environment;

c) **Particles** (e.g. PM10, Dust: PM10 are particles that vary in size and shape, up to 10 microns diameter and are made up of a complex mixture of many different species including soot (carbon), sulphate particles, metals and inorganic salts such as sea salt.

2.2.2 Emissions to water

2.2.2.1 Definition of emissions to water

According the SEEA manual on water (SEEAW) emissions to water describe the flows of pollutants added to wastewater as a result of production and consumption.. The direct discharge to water resources of heavy metals and hazardous waste not through wastewater is not covered in the water emission accounts but in the waste accounts as it involves the discharge of solid waste.

SEEAW covers the following emissions to water:

a) Pollutants added to wastewater and collected in the sewerage network;

b) Pollutants added to wastewater discharged directly to water bodies; and

c) Selected non-point sources emissions, namely emissions from urban runoff and from agriculture.

Not included are emissions from point sources, such as heavy metal and hazardous wastes not contained in waste water (included into solid waste) and pollutants resulting from in situ use (e.g. navigation, fishing etc.) and all non-point sources except for urban runoff, irrigation water and rain-fed agriculture.

For the sake of simplicity as wells as to maintain consistency with the water flows reported in the SEEAW a number of non-point source emissions are excluded. It is suggested that in a more comprehensive approach, all emissions to water would be included in the emission accounts. These include, for example, pollutants that reach the water bodies after leaking from landfill sites or having passed through natural land. As precipitation passes through waste, it collects polluting compounds including ammonia, heavy metals, chloride and oxygen-depleting substances which ultimately infiltrate the soil and reach a groundwater body. The same can occur when precipitation after having absorbed pollutants present in the air infiltrate natural land.

In order to keep consistency of the whole system of MFA accounts (avoiding of double counting) it has to be noted that those flows of pollutants to water that result from from materials which have already been counted as a flow of residuals to the environment - as waste dumped to the environment, have to be regarded as flow within the environment which shouldld be reported as memorandum item only. Materials that enter the waste water through urban runoff and from agriculturul land (item c) belong to the letter type of flow, as in that cases materials enter the water that have already counted before as residual output to the environment as air emissions, dissipative use of products or dissipative losses.

2.2.2.2 Classification of emissions to water

The the classification of emissions to water has to provide a list of materials to be included. For practical reasons that list cannot cover all thinkable substances but should be confined to the most relevant pollutants. Most often this list is based on the country's environmental concerns as well as national legislation on water and, where applicable, international agreements. In the SEEAW as an example reference is made to a list of 12 categories of substances used for the EU Water Framework Directive (European Parliament and Council, 2000).

In the Eurostat manual on EW-MFA a simplified list of materials is used that represent an aggregation of the main categories reported in the emission statistics. That list includes the items Nitrogen compounds (N), Phosphorus compounds (P), Heavy metals, other substances and (organic) materials and materials dumped at sea. That simplified list was used for developing the classification of emissions to water presented in this paper. The only difference is that materials dumped at sea are regarded as waste in this classification and not as emissions to water (see classification of waste by destination, chapter 3.3).

For the measurement of the item “Other substances and (organic) materials” the following approach is recommendded: Organic substances are commonly reported in water emission inventories as indirect summary indicators. The most commonly used are BOD (biological oxygen demand), COD (chemical oxygen demand), TOC (total organic carbon), or AOX (adsorbable organic halogen compounds). All of these indicators are measuring organic substances in water by each using a different indirect method. The values reported for these indicators should therefore neither be included directly into an MFA, nor should they be aggregated. It is necessary to (1) decide for one of the indicators. The recommendation is to take TOC, if available, as it is the most comprehensive and sensitive indicator, and to (2) convert the reported quantity which only indirectly indicates the amount of organic substances to the quantity of the organic substance itself, by using a simplified stoichiometrical equation.

2.2.3 Solid waste

The above mentioned **definition** of residual as the incidental and undesired outputs from production and consumption processes within the economy which have use for the generator applies for solid waste accordingly. In the European Waste Statistics waste is referred to as materials for which the generator has no further use for own purpose of production, transformation or consumption, and which he discards, or intends or is required to discard. Waste is defined by a list of materials. Waste covers all solid residuals.

The following materials are not regarded as waste:

a) Materials that are reported under dissipative use of products or dissipative losses.

b) Waste materials that are directly discharged into waste water or air. They are accounted for in emissions to air or water respectively.

c) Solid residuals directly recycled or reused at the place of generation (i.e. within the establishment).

d) Materials that are classified as unused materials.

Waste can have an econonomic value or not. For establishing accounts on waste, special care has to be taken to demarcate products from non-products, as products are already covered in the accounts else where. Waste as a product can either result from ordinary production or consumption processes. Examples are Thomas slag, gypsium from raw gas washing in power plants or certain food processing residues. Waste products appear also as the output of waste treatment operations. According to the Euoropean approach the total output of waste treatment operations which is comprised of “secondary raw materials” and waste treatment residues is regarded to be waste. Only the treatment residues are non-products whereas the secondary raw materials are products.

Dissipative use of products (section 2.2.4) refers to some materials that are deliberately dissipated into the environment because dispersal is an inherent quality of product use or quality and cannot be avoided. Most of the dissipative use of products can be accounted to the cultivation of crops, plants and trees as fertiliser, pesticide and seeds. **Dissipative losses** are outputs of materials to the environment mainly resulting from abrasion, corrosion and erosion (section 2.2.5).

Emissions to air and to water are described above in sections 2.2.1 and 2.2.2. The direct discharge to water resources of heavy metals and hazardous waste not through wastewater is not covered in the water emission accounts but in the waste accounts as it involves the discharge of solid waste.

Waste recycled on site (internal recycling) is generally not regarded as waste. That provision aims to exclude the reporting of recycling wich is an integral part of the production process. Internal recycling refers to operations like processing of production waste in the

same or a similar process by which it was generated, the regenration of spent process materials in order to be used for the same or or a similar purpose, treatment and reuse of bitumen and gravel at road works at the construction, use of residuals from agriculture and horticulture for composting and/or fermentation. However, residues that are used as input to other production processes, like use of waste for energy recovery, farm manure from animal cultivation which is used as fertilizer for crop cultivation are not regarded as internal recycling. Residues from food consumption that are composted in the garden to be used as an input to production of crops and plants have – other than in the European waste statistics – to be counted as an waste output from consumption that is used after composting as an product input.

Unused materials can be generated as a spin-off of extraction of almost all types of natural resources as well as through construction works and some other production activities (see section 2.1.1).

For establishing the section on solid waste materials of the **classification** of outputs to the environment the European waste classification by type of material (EWC-Stat) has been utilized as the principal source. The EWC-Stat is a primirarily substance-oriented classification of waste for statistical purposes. Radioactive waste which is not covered by EWC-Stat had to be added for the purpose of the MFA classification. Unpolluted dredging spoils where excluded as they are considered to be unused materials (see 2.1.1). Using the EWC-Stat follows the recommendation of the last London Group meeting. The EWC-Stat is widely identical with the waste classification that was already applied for the SEEA 2003.

The section on waste of the classification of outputs to the environment provides an aggregated version (2-digit level). A more detailed version of the waste classification (3-digit level) is provided in annex 5. The more detailed version is especially useful for depicting waste flows within the economy, as itr wll be the subject of the MFA sub-module on waste. The EWC-Stat provides also a distiction between hazardous and non-hazardous materials. It is suggested to introduce such a distiction between hazardous and non-hazardous materials as an additonal option. In the EWC-Stat some items at the 3-digit level are classified unambigously as hazardous or non hazardous, other 3-digit items include both categories.

Reconciliation of EWC-Stat and CPC: A question that remains **unsolved so far** is the request of the London Group for reconciliating is the EWC-Stat classification for waste and the classification for waste in the CPC. The EWC-Stat has clear analytical advantages over the CPC treatment of waste. CPC in principle covers everything that is transacted including waste, disregarding wether it is a product or not. Therefore it appers necessary to develop a correspondence with EWC-Stat. However that is not an easy exercise as waste is scattered throughout many CPC categories (e.g. it is mentioned in 184 of the HS headings) and not restricted to CPC 39. Eurostat seems to be aware of the problem and are currently working on a correspondence with CN, which through HS should be easily linkable to CPC. Once this correspondence exists, it would be possible to either a) merge CPC with EWC i.e. replace the waste categories with EWC headings or b) leave CPC as it is but when constructing waste accounts use the EWC classification. We will have to wait for the resuls of the work done by Eurostat.

2.2.4 Dissipative use of products

Some materials are deliberately dissipated into the environment because dispersal is an inherent quality of product use or quality and cannot be avoided. Most of the dissipative use of products can be accounted to the cultivation of crops, plants and trees as fertiliser, pesticide and seeds. As far as gases and irrigation water are used dissipatively those materials are already included in the section on air emissions (A.3.2, A.9.2) and water (E.2.2) of the residual classification. Only the remaing dissipative use of products is covered in the section “Dissipative use of products n.e.c.”. There the items organic fertilizer (manure) (D.1), mineral fertilizer (D.2) sewage sludge (D.3), compost (D.4), pesticides (D.5), seeds (D.6) and other materials (D.7) are covered.

Organic fertiliser (manure): manure is organic matter, excreted by animals, which is used as a soil amendment and fertilizer. In the SNA practice of monetary accounting the generation of organic manure, as far as it is not traded in the market (intra unit flow), is regarded as an ancillary activity. The result of an ancillary activity is neither recognized as a separate output nor as an intermediate input into the principal activity. However, as those materials are regaded as output of dissipatively used products to the environment those materials have to be recognised as products for the purpose of MFA.

Mineral fertiliser: the fertilizer industry is essentially concerned with the provision of three major plant nutrients -nitrogen, phosphorus and potassium -in plant-available forms. Nitrogen is expressed in the elemental form, N, but phosphorus and potassium may be expressed either as the oxide (P2O5, K2O) or as the element (P, K). Sulphur is also supplied in large amounts, partly through the sulphates present in such products as superphosphate and ammonium sulphate.

Sewage sludge: sewage sludge means any solid, semi-solid, or liquid residue removed during the treatment of municipal waste water or domestic sewage. Although it is useful as a fertiliser and soil conditioner, sewage sludge, if applied inappropriately can also be potentially harmful to the water and soil environment and human and animal health. The application of sludge on agricultural land is therefore commonly regulated to protect the environment and human and animal health.

Compost: composting refers to a solid waste management technique that uses natural processes to convert organic materials to humus through the action of micro-organisms. Compost is a mixture that consists largely of decayed organic matter and is used for fertilizing and conditioning land. Compost that is created by internal recycling in crop production and gardening is not included.

Pesticides: a pesticide is commonly defined as "any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest". A pesticide may be a chemical substance or biological agent (such as a virus or bacteria) used against pests including insects, plant pathogens, weeds, molluscs, birds, mammals, fish, nematodes (roundworms) and microbes. Pesticides are usually, but not always, poisonous to humans. An extensive list and data of pesticides is provided in the PAN Pesticides Database[3]

Seeds: seeds are the encapsulated embryos of flowering plants.

Other materials for dissipative use are salt and other thawing materials spread on roads (incl. grit) and solvents other than NMVOC.

2.2.5 Dissipative losses

Dissipative losses are unintentional outputs of materials to the environment resulting from abrasion, corrosion and erosion at mobile and stationary sources, and from leakages or from accidents during transport of goods.

2.2.6 Waste water

Following the definition of the SEEW manual waste water includes all waste water that is supplied to other economic units and the water that is returned to the environment. Excluded is water that is classified as water consumption. The concept of water consumption gives an indication of the amount of water that is lost by the economy during use in the sense that it has entered the economy but has not returned either to water resources or to the sea. That happens because during use part of the water is incorporated into products, evaporated, transpired by plan ts or simply consumed by households or livestock. The concept of water consumption used in the SEEAW is consistent with the hydrological concept.

The material classification for residuals does not provide any disaggregation for waste water. However, supplementary classifications of waste water by origin and destination are

[3] http://www.pesticideinfo.org/List_ChemicalsAlpha.jsp

presented in section 3.3 of this paper.

2.2.7 Balancing items

Balancing items on the output side „water vapor and other losses“ of the accounts are meant to equalise discrepancies resulting from data for material inputs. The items “evaporation of water from production processes other than from combustion of fuels or from other excorporated water”(G.1) and “losses in distribution of water not because of leakages” (G.2) cover the item “water comsumption” of the water accounts. As excorporated water is not regarded by the water accounts, the equivalent on the output side has to be introduced by the items G.3 und G.4 in order to balance the input and the output of non-water materials. It is assumed that the excorporation of water is widely covered by avaporation of that items. “Other water excorporation” results prodomintly from agricultural products. Imported drinks – to be balanced against exported drinks - can also play a role. For estimating that amount information of the water contend of those products has to be utilized.

2.3 Flows between economic units

The main flows of materials between economic units, which includes also the transactions with the rest of the world economy, are product flows. But additionally also non-product residual flows (waste and waste water flows and waste water emissions) have to be considered.

2.3.1 Products

In the MFA the concept of the material category products is generally designed in a manner in that is fully consistent with the concept of products of the SNA. The main difference applies to the unit of measurement. Whereas in the SNA stocks and flows of products are measures in monetary units in the MFA mass units are applied. Goods are material products. Insofar each good can be measured in monetary and in mass terms. In case of services a corresponding mass flow is the exception, as services are in principal immaterial products with a mass of zero. But there are some cases where the rendering of a service is connected with a transfer of material to the user, like restaurant services (food and beverages) or provision of social services in kind (e.g. medicines).

For the classification of products the MFA (see annex 4) uses the Central Product Classification (CPC). As the MFA is about flows of materials with a specific focus on flows which are relevant under an environmental perspective, a specific version of CPC was developed which uses in principal the two digit level. But the specific version shows more details where appropriate and covers service goods, which only in exceptional cases present material flows, in a highly aggregated manner.

The degree of aggregation for the special MFA version follows the special needs of that system and its sub-modules (for the system of MFA sub-modules see annex 1). Especially the items of section 0 and 1 and the sections 33, 34, 37, 39 and 41 are shown in a rather detailed manner as it is reqired for the modules “Economy-wide MFA” (EW-MFA), the different “resource accounts” and the waste accounts.

2.3.2 Residuals

The classifications by type of material for waste and waste water and waste water emissions have already been introduced in the sections 2.2.2, 2.2.3, and 2.2.6.

3. Classification of transactions in material

3.1 Principal transactions in material

The SNA portrays the process of production and consumption of products in the economy by

recording the transactions in products in a systematic and comprehenssive manner. Supply and use tables (SUT) are an importants tool for presenting those transactions by type of transaction and by type of product in monetary terms. The supply table shows the origin of products from production as “output” and from “imports” (rest of the world economy). The use table presents the destination of products by the categories “intermediate consumption” and the final demand categories “final consumption expenditure”, “gross capital formation” and “exports” (rest of the world economy).

That tool of SUT was adopted for presenting the flows of the MFA system. The physical SUT of the MFA follow fully the concepts and definitions of SNA. But as the scope of the accounts is extended in the MFA by including the interactions with the environment, the physical SUT had to be amended accordingly.

In the MFA flows are shown in mass units instead of monetary units. For including material flows that are relevant under an environmental-economic perspective, additonal categories of non-product materials and transaction – supply of material (natural inputs) by the environment and use of material (residuals) by the environment - had to be introduced.

Residuals are not only disposed to the environment but can also be exported, absorbed by producing units as intermediate consumption or stored in controlled landfills (final demand) within the economy. On the supply side residuals are not only generated by production activities or imported, but result also from final consumtion and controlled landfills (leakages).

The physical SUT for presenting the transactions in material in the MFA are shown in figure 1 in a schematic manner.

Figure 1

Supply and use tables for flows of materials

Mass units

Supplies

	Output	Final consumption	Gross capital formation	Controlled landfills	Imports	Environment	Total
Inputs from the environment							
Products within the economy							
Residuals within the economy							
Outputs to the environment							
Total							

Uses

	Intermediate consumption	Final consumption	Gross capital formation	Controlled landfills	Exports	Environment	Total
Inputs from the environment							
Products within the economy							
Residuals within the economy							
Outputs to the environment							
Total							

Covered by SNA

Additionally covered by MFA

The tables show that for covering those additional transactions the format of the SNA supply table (black shaded cells) had to be expanded by flows of outputs to the environment and of

residuals within the economy from production activities (output), final consumption, controlled landfills and rest of the world (grey shaded cells). For the use table, flows of natural inputs to intermediate consumption and final consumption had to be added and flows of residuals to intermediate consumption and the final demand categories controlled landfills and exports had to be introduced for the purpose of MFA.

For practical use those schematic tables have to be disaggregated further based on two principal groups of specific classifications. The first group refers to a breakdown of the principal categories of material by grouping them according to their physical or chemical characteristics (type of material). Those classifications were presented in the provious section 2 of this paper. The second group of classifications refers to a further disaggregation of the principal categories of transactions of the physical SUT by origin or destination of the material flows.

Below the most importants classifications are presented for disaggregating some of the transaction categories. In the SNA a breakdown by industries, which is based on ISIC, is used as the standard approch for disaggregating output of production and intermediate consumption by production activities. Due to the particular requirements of environmental-economic analysis it appears apropriate to apply some further specific classifications for disaggregating the categories origin and destination of materials flows.

This paper presents additional specific classificatios for disaggregating the transaction categories “output”, the “intermediate consumption”, “controlled landfills” and “environment”for the material categories of waste and of water. Further disaggregations for other transaction categories can also be useful for the purpose of MFA, like a classification for individual consumption purposes or of capital formation. But those items are not addressed by this paper

3.2 Classification of industries

Industries are defined as groups of establishments engaged in the same kind of productive activities The classification of industries is widely used in the MFA for not only disaggregating the output and the intermediate use of products, but also for the other categories of material. And indeed, the breakdown by industries plays a central role in the MFA for integrating the presentation of the flows or different materials and for integrating those physical accounting figures with the related monetary variables of the SNA.

Annex 5 shows the classification of industries (ISIC) proposed for MFA. The basic approach is, to use the 2-digit level of ISIC: However, the recommended standard classification of industries for MFA represents a specific version of the ISIC with some disaggregations below the two digit level, where considered to be necessary under an environmental perspective. The disaggregations below the 2-digit level are specifically designed for different sub-modules, like the more detailed presentation of agricultural branches for the module agriculture and other “resource accounts” or the greater detail for energy branches for the modules on energy and air emissions.

3.3 Classification of waste as a residual by destination

Using the industry classification for disaggregating the waste flows by origin is considered to be an appropriate approach, which is also used in the European waste statisticts. For analysing the destination of waste flows the standard breakdown of the physical SUT (figure 1) in combination with the industry classification can be a starting point, but for a more sophisticated analysis a waste specific disaggregation of destinations is desirable, which takes accounts of the different methods of intermediate consumption of waste, like recycling, incineration and other types of treatment, different types of permanent storage in controlled landfills (final use) within the economy and the different ways of discharging waste to the environment.

Therefore the proposed classifications of transactions in waste by destination (see annex 6)

provides three types of waste specific disaggregations:

a) Intermediate use by type of treament and recycling;

b) Controlled landfills by type of storage;

c) Environment by type of disposal.

For establishing that classifications the list of recovery and disposal operations of the EWC-Stat was regrouped in order to fit into the general format of the physical SUT for transactions in material.

3.4 Classifications of origin and destination of water flows

The additional classifications on transaction in water describe the origin and destination of water flows (see Annex 7). The classifications try to take account of the different environmental characteristics that are related to specific categories of origin or destination of water flows. The four classifications that are suggested here follow the specifications provided by the SEEAW manual. Further explanations on the individual items can also be found there.

The four classifications deal with the water abstraction by type of source, the use of water within the economy by type of use, the water returned to the environment by origin and the flow of waste water by type of destination.

The classification of **water abstracted** from the **environment** by source (**origin**) provides a disaggregation of water inputs from the environment to the economy by type of environmental water source. The abstraction from water resources is differentiated by surface water, groundwater and soil water. As abstraction from other sources are regarded: collection of precipitation and abstraction from sea.

The classification of **water as a product** by type of use (**destination**) shows a differention of the transaction categories intermediate use and final comsumption by the principal categories “water abstracted for own use”, “water abstracted for distribution” and “water for reuse”. Especially the water for own use is further disaggregated into the categories “hydroelectric power generation”, “irrigation water”, “mine water”, “urban runoff”, “cooling water” and “other”.

The classification of **water returned to the environment** shows the returend water by **origin**. As the water for own use is usually directly returned to the environment after use the same categories as for classifying the destinations (hydroelectric power generation etc.) can also be used fore the origin. The distributed water is as a rule returned to the environment by the sewerage as treated water.

The classification of **destinations of waste water** flows refers to flows within the economy (intermediate consumption) and to the flows to the environment. The breakdown for the intra-economy flows differentiates by reused water and waste water.The flows to the environment are shown by type of water sources, as they were also used for the classification of water abstraction. Qustions to the >Londom >Group

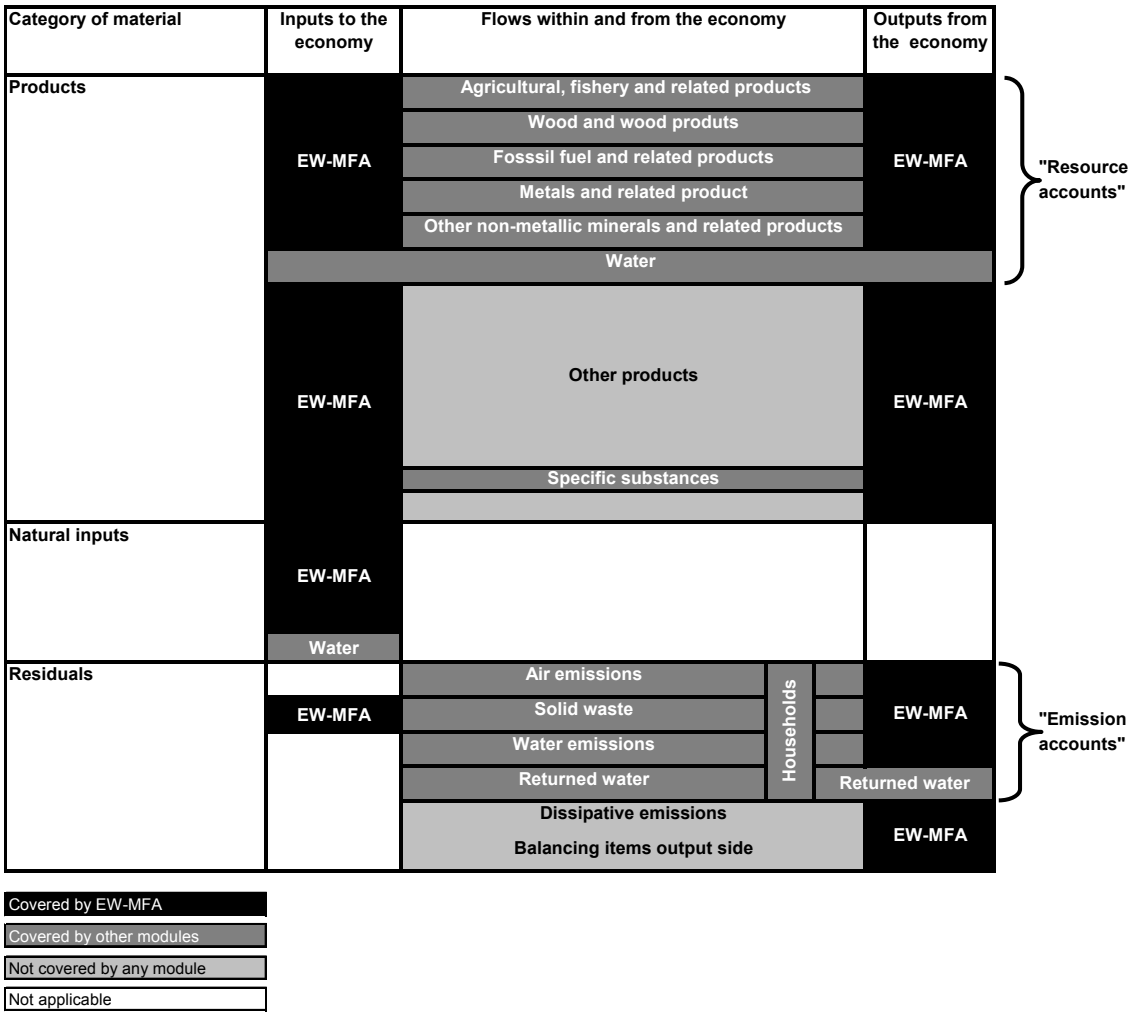
Annex 1: The MFA sub-modules

The SEEA-MFA will have two principal parts. In part one the general concept will be explained, including defintions, classifications, relationship to SNA and general physical supply and use tables. The second part deals with the issue of putting that system into practice. It is sugguested not to follow the comprehensive approach of populating the full conceptual framework of supply and use tables for all materials and all transaction categories with data, but - by following the practice in almost all countries which compile MFA - to concentrate on establishing a number of sub-modules which cover the most relevant parts of the system.

It will be recommended to establish sub-modules for almost all types of raw materials and related products ("resource accounts") and for residuals ("emission accounts"). Further it will be suggested to implement the economy wide material flow accounts (EW-MFA), which show all inputs and outputs of material to and from the national economy as a general frame.

The figure below illustrates the relationship between the different sub-modules in a schematic manner.

Coverage of material flows by specific sub-modules of MFA



The EW-MFA should play a central role as it covers all materials with the exception of water. It shows the interaction of the national economy with the outside world, but the flows within the economy are – except of some general waste flows - treated as a black box. The other sub-modules concentrate on the flows of material within the economy. The different resource

accounts focus on the transformation and the use of natural resources within the economy. For that purpose the flow of selected raw materials or groups of raw materials and related products (upstream or downstream the production chain) are reported. The different “emission accounts” record the generation (supply) of different types of emissions (e.g. air, solid waste) by economic activities and, as far as applicable, the use of that materials within the economy (recycling, treatment and permanent storage).

Annex 2: Classification of inputs from the environment by type of material

MFA code	CPC Vers. 2 (draft) code	EWC-Stat code	Description	Ecosystem approach	Harvest approach	Extended harvest approach
A	0 + 1		**Natural resources**			
A.0	0		**Biological resources from agriculture, forestry and fishery**			
A.0.1	01		**Resources from agriculture, horticulture and market gardening**			
A.0.1.1	011		Cereals			
A.0.1.2	012		Vegetables			
A.01.3	013		Fruits and nuts			
A.0.1.4	014		Oilseeds and oleaginous fruits			
A.0.1.5	015		Edible roots and tubers with high starch or inilin content			
A.0.1.6	016		Stimulant, spice and aromatic crops			
A.0.1.7	017		Pulses (dried leguminous vegetables)			
A.0.1.8	018		Sugar crops			
A.0.1.9	019		Forage resources, fibres, living plants, cut flowers and flower buds, unmanufactured tobacco, natural rubber, (including crop residues used for animal feed)			
A.0.1.10	n.a.		Grazed biomass			
A.0.2	02		**Live animals and animal resources (excluding meat)**			
A.0.2.1	021		Live animals			
A.0.2.2	022-025		Raw milk,eggs and other animal resources (excluding meat)			
A.0.3	03		**Forestry resources**			
A.0.3.1	031		Wood in the rough			
A.0.3.11	0311, 0312		Logs of coniferous wood; Logs of non-coniferous wood			
A.0.3.11.a			Logs of coniferous wood; Logs of non-coniferous wood, cultivated			
A.0.3.11.b			Logs of coniferous wood; Logs of non-coniferous wood, non-cultivated			
A.0.3.13	0313		Fuel wood, in logs, in billets, in twigs, in faggots or in similar forms			
A.0.3.13.a			Fuel wood, in logs, in billets, in twigs, in faggots or in similar forms, cultivated			
A.0.3.13.b			Fuel wood, in logs, in billets, in twigs, in faggots or in similar forms, non-cultivated			
A.0.3.2	032		Non-wood forest resources			
A.0.4	04		**Fish and other fishing resources**			
A.0.4.1	041		Fishes, live, fresh or chilled			
A.0.4.1.a			Fishes, live, fresh or chilled, cultivated			
A.0.4.1.b			Fishes, live, fresh or chilled, non-cultivated			
A.0.4.2	042		Crustaceans, not frozen; oysters; other molluscs and aquatic invertebrates, live, fresh or chilled			
A.0.4.2.a			Crustaceans, not frozen; oysters; other molluscs and aquatic invertebrates, live, fresh or chilled, cultivated			
A.0.4.2.b			Crustaceans, not frozen; oysters; other molluscs and aquatic invertebrates, live, fresh or chilled, non-cultivated			
A.0.4.9	049		Othe aquatic plants and animals			

A.0.4.9.a			Othe aquatic plants and animals, cultivated			
A.0.4.9.b			Othe aquatic plants and animals, non-cultivated			
A.1	1 (excl.17)		**Ores and minerals, water**			
A.1.1	11 (excl. 1102, 1104)		**Coal and lignite, peat (excl. agglomerated coal and lignite)**			
A.1.10	110 (excl. 1102, 1104)		Coal and lignite, peat (excl. agglomerated coal and lignite)			
A.1.10.1	1101		Coal, not agglomerated			
A.1.10.3	1103		Lignite, not agglomerated			
A.1.10.5	1105		Peat			
A.1.2	12		**Crude petroleum and natural gas**			
A.1.20	120		Crude petroleum and natural gas			
A.1.20.1	1201		Petroleum oils, and oils obtained from bituminous minerals, crude			
A.1.20.2	1202		Natural gas, liquefied or in the gaseous state			
A.1.20.3	1203		Bitumeous or oil shale and tar sands			
A.1.3	13ex		**Uranuim and thorium ores (excl. concentrates)**			
A.1.4	14 ex		**Metal ores (excl. concentrates)**			
A.1.4.1	141 ex		Iron ores, other than roasted iron pyrites (excl. concentrates)			
A.1.4.2	142 ex		Non-ferrous metal ores (other than uranium or thorium ores), excl. concentrates			
A.1.4.2.1	1421 ex		Copper ores (excl. concentrates)			
A.1.4.2.2	1422 ex		Nickel ores (excl. concentrates)			
A.1.4.2.3	1423 ex		Aluminium ores (excl. concentrates)			
A.1.4.2.4	1424 ex		Precious metal ores (excl. concentrates)			
A.1.4.2.9	1429 ex		Other non-ferreous metal ores (other than uranium or thorium ores), excl. concentrates			
A.1.5	15		**Stone, sand and clay**			
A.1.5.1	151		Monumental or building stone			
A.1.5.2	152		Gypsium; andrythe; limestone flux; limestone and other calareous stomne, of kind used for the manufacture of lime or cement			
A.1.5.3	153		Sands, pebbles, gravel, broken or crushed stone, natural bitumen and asphalt			
A.1.5.4	154		Clays			
A.1.6	16		**Other minerals**			
A.1.6.1	161		Chemical and fertilizer minerals			
A.1.6.2	162		Salt and pure soduim chloride; sea water			
A.1.6.3	163		Precious and semi precious stones; pumice stone; emery; natural abrasives; other minerals			
A.1.8	18		**Water abstraction**		1)	2)
B	n.a.		**Balancing items input side**			
B.1	n.a.		Oxygen for combustion processes			
B.2	n.a.		Oxygen for respiration of cultivated animals and aquatic resources			
B.3	n.a.		Oxygen for human respiration			
B.4	n.a.		Nitrogen for Haber-Bosch process			
B.5	n.a.		Carbon dioxide for respiration of cultivated crops, plants, and trees			
B.6	n.a.		Soil minerals			
B.7	n.a.	09.2 ex	Unused biomass from parks and gardening for waste collection			
B.9	n.a.	12.6	Contaminated soils and polluted dredging spoils			

Item included as natural input

Item not included as natural input

1) Excluding natural water taken up directly by cultivated crops, plants and trees

2) Excluding natural water taken up directly by cultivated crops, plants, trees and animals

Annex 3: Classsification of outputs to the environment by type of material

Classification of outputs to the environment

MFA Code	EWC-Stat code	CPC Vers. 2 (draft) code	Description
A			**Emissions to air**
A.1			**Carbon dioxide (CO_2)**
A.1.1			Carbon dioxide (CO_2) other than from biomass combustion and respiration of humans and livestock
A.1.2			Carbon dioxide (CO_2) from biomass combustion
A.1.3			Carbon dioxide (CO_2) from respiration of humans (balancing item output side)
A.1.4			Carbon dioxide (CO_2) from respiration of livestock (balancing item output side)
A.2			**Methane (CH4)**
A.3			**Dinitrogen oxide (N_2O)**
A.3.1			Dinitrogen oxide (N_2O) other than from dissipative use as a product
A.3.2			Dinitrogen oxide (N_2O) from dissipative use as a product
A.4			**Nitrous oxides (NOx)**
A.5			**Hydroflourcarbons (HFCs)**
A.6			**Perflourocarbons (PFCs)**
A.7			**Sulfur hexaflouride**
A.8			**Carbon monoxide (CO)**
A.9			**Non-methane volatile organic compounds (NMVOC)**
A.9.1			Non-methane volatile organic compounds (NMVOC) other than from dissipative use as a product
A.9.2			Non-methane volatile organic compounds (NMVOC) from dissipative use as a product
A.10			**Sulfur dioxide (SO_2)**
A.11			**Ammonia (NH3)**
A.12			**Heavy metals**
A.13			**Persistent organic pollutantsPOPs**
A.14			**Particles (e.g PM10, Dust)**
B		39	**Solid waste**
B.1	01	3994, 3999ex	**Compound waste**
B2	02	3995ex	**Chemical preparation waste**
B3	03	3995ex	**Other chemical waste**
B5	05	3993	**Health care and biological waste**
B6	06	3931-3936	**Metallic wastes**
B7	07	392	**Non-metallic waste**
B.8	08	3937, 3938	**Discarded equipment**
B9	09	391, 3999ex	**Animal and vegetable wastes**
B10	10	3991, 3999ex	**Mixed ordinary waste**

B11	11	3992	**Common sludges**
B12	12	3999ex	**Mineral waste**
B13	13	3999ex	**Solidified, stabilized and vitrified waste**
B14	n.a.	3999ex	**Radioactive waste**
C			**Emissions to water**
C.1			**Nitrogen compounds (N), excl. emissions from agriculture (dissipative use)**
C.2			**Phosphorus compunds (P), excl. emissions from agriculture (dissipative use).**
C.3			**Heavy metals**
C.4			**Other substances and (organic) materials**
D			**Dissipative use of products n.e.c.**
D.1	09.3	34654ex	**Organic fertilizer (manure)**
D.2		3461 - 3465 (excl 34654)	**Mineral fertilizer**
D.3	11.1	39920	**Sewage sludge**
D.4	09.2 ex		**Compost**
D.5		3466	**Pesticides**
D.6			**Seeds**
D.6.1		01111, 01121, 01131, 01141, 01151, 01161, 01171, 01181,	Seed of cereals
D.6.2		012 ex - 019 ex	Other seed
D.7			**Other products for dissipative use (e.g. materials spread on roads, solvents)**
E			**Dissipative losses (e.g abrasion from tires, friction products, buildings and infrastructure)**
F			**Waste water**
G			**Balancing items output side: water vapor and other water losses**
G.1			**Evaporation of water from production processes other than from combustion of fuels or from other excorporated water**
G.2			**Losses in distribution of water not because of leakages**
G.3			**Evaporation of excorporated water from fuel combustion**
G.4			**Other evaporation of excorporated water**

Annex 4: Classification of products

CPC Vers. 2 (draft) code	Description
0	**Agriculture, forestry and fishery products**
01	**Products of agriculture, horticulture and market gardening**
011	Cereals
012	Vegetables
013	Fruits and nuts
014	Oilseeds and oleaginous fruits
015	Edible roots and tubers with high starch or inilin content
016	Stimulant, spice and aromatic crops
017	Pulses (dried leguminous vegetables)
018	Sugar crops
019	Forage products, fibres, living plants, cut flowers and flower buds, unmanufactured tobacco, and natural rubber
02	**Live animals and animal products (excluding meat)**
021	Live animals
022-025	Raw milk, eggs and other animal products (excluding meat)
03	**Forestry and logging products**
031	Wood in the rough
0311, 0312	Logs of coniferous wood and logs of non-coniferous wood
0313	Fuel wood, in logs, in billets, in twigs, in faggots or in similar forms
032	Non-wood forest products
04	**Fish and other fishing products**
041	Fishes, live, fresh or chilled
042	Crustaceans, not frozen; oysters; other molluscs and aquatic invertebrates, live, fresh or chilled
049	Othe aquatic plants and animals
1	**Ores and minerals; electricity, gas and water**
11	**Coal and lignite; peat**
110	Coal and lignite; peat
1101	Coal, not agglomerated
1102	Briquettes and similar solid fuels manufactured from coal
1103	Lignite, not agglomerated
1104	Lignite, agglomerated
1105	Peat
12	**Crude petroleum and natural gas**
120	Crude petroleum and natural gas
1201	Petroleum oils and oils obtained from bituminous minerals, crude
1202	Natural gas, liquefied or in the gaseous state
1203	Bituminous or oil shale and tar sands
13	**Uranuim and thorium ores and concentrates**
14	**Metal ores**
141	Iron ores and concentrates, other than roasted iron pyrites
142	Non-ferrous metal ores and concentrates (other than uranium or thorium ores and concentrates)
1421	Copper, ores and concentrates
1422	Nickel ores and concentrates

1423	Aluminium ores and concentrates
1424	Precious metal ores and concentrates
1429	Other non-ferrous metal ores and concentrates (other than uranium or thorium ores
15	**Stone, sand and clay**
151	Monumental or building stone
152	Gypsium; andrythe; limestone flux; limestone and other calareous stomne, of kind used for the manufacture of lime or cement
153	Sands, pebbles, gravel, broken or crushed stone, natural bitumen and asphalt
154	Clays
16	**Other minerals**
161	Chemical and fertilizer minerals
162	Salt and pure soduim chloride; sea water
163	Precious and semi precious stones; pumice stone; emery; natural abrasives; other minerals
17	**Electricity, town gas, steam and hot water**
171	Electrical energy
172	Coal gas, water gas, producer gas and similar gases, other than petroleum gases and other gaseous hydrocarbons
173	Steam and hot water
174	Ice and snow
18	**Natural water**
2	**Food products, beverages and tobacco; textiles, apparel and leather products**
21	**Meat, fish, fruit, vegetables, oils and fats**
211	Meat and meat products
212	Prepared and preserved fish, crustaceans, molluscs and other aquatic invertebrates
213	Prepared and preserved vegetables, pulses and potatoes
214	Prepared and preserved fruit and nuts
215	Animal and vegetable oils and fats
216	Cotton linters
217	Oil-cake and other residues resulting from the extraction of vegetable fats or oils; flours and meals of oil seeds or oleaginous fruits, except those of mustard; vegetable waxes, except triglycerides; degras; residues resulting from the treatment of fatty substances or animal or vegetable waxes
22	**Dairy products**
23	**Grain mill products, starches and starch products; other food products**
24	**Beverages**
25	**Tobacco products**
26	**Yarn and thread; woven and tufted textile fabrics**
27	**Textile articles other than apparel**
28	**Knitted or crocheted fabrics; wearing apparel**
29	**Leather and leather products; footwear**
3	**Other transportable goods, except metal products, machinery and equipment**
31	**Products of wood, cork, straw and plaiting materials**
32	**Pulp, paper and paper products; printed matter and related articles**
33	**Coke oven products; refined petroleum products; nuclear fuel**
331	Coke and semi-coke of coal, of lignite or of peat; retort carbon
332	Tar distilled from coal, from lignite or from peat, and other mineral tars
333	Petroleum oils and oils obtained from bituminous materials, other than crude; preparations n.e.c. containing by weight 70% or more of these oils, such oils being the basic constituents of the preparations
334	Petroleum gases and other gaseous hydrocarbons, except natural gas

335	Petroleum jelly; paraffin wax, micro- crystalline petroleum wax, slack wax, ozokerite, lignite wax, peat wax, other mineral waxes, and similar products; petroleum coke, petroleum bitumen and other residues of petroleum oils or of oils obtained from bituminous materials
336	Radioactive elements and isotopes and compounds; alloys, dispersions, ceramic products and mixtures containing these elements, isotopes or compounds; radioactive residues
337	Fuel elements (cartridges), for or of nuclear reactors
34	**Basic chemicals**
341 - 345, 347, 348	Basic chemicals other than fertilizers and pestizides
346	Fertilizers and pesticides
35	**Other chemical products; man-made fibres**
36	**Rubber and plastics products**
37	**Glass and glass products and other non-metallic products n.e.c.**
371	Glass and glass products
372 - 379	Other non-metallic products n.e.c.
38	**Furniture; other transportable goods n.e.c.**
39	**Wastes or scraps**
391	Wastes from food and tobacco industry
3911	Raw offal, inedible (including pigs' bristles, horse hair, animal guts, bird skins, feathers, bones and ivory)
3912	Bran and other residues from the working of cereals or legumes; vegetable materials and vegetable waste, vegetable residues and by-products, whether or not in the form of pellets, of a kind used in animal feeding n.e.c.
3913	Residues of starch manufacture and similar residues
3914	Beet-pulp, bagasse and other waste of sugar manufacture
3915	Cocoa shells, husks, skins and other cocoa waste; coffee husks and skins
3916	Brewing or distilling dregs and waste
3917	Wine lees; argol
3918	Tobacco refuse
392	Non-metal wastes or scraps
3921	Miscellaneous textile wastes
39211	Silk waste
39212	Waste of wool or of fine or coarse animal hair
39213	Garnetted stock of wool or of fine or coarse animal hair
39214	Cotton waste, except garnetted stock
39215	Other cotton waste; garnetted stock
39216	Waste of man-made fibres
39217	Worn clothing and other worn textile articles
39218	Rags, scrap twine, cordage, rope and cables and worn out articles of twine, cordage, rope or cables, of textile materials
3922	Waste of leather, leather dust, powder and flour
3923	Residual lyes from the manufacture of wood pulp, including lignin sulphonates, but excluding tall oil
3924	Waste and scrap of paper or paperboard
3925	Waste, parings and scrap of rubber (except hard rubber) and powders and granules obtained therefrom
3926	Used pneumatic tyres of rubber
3927	Waste, parings and scrap of plastics
3928	Sawdust and wood waste and scrap
3929	Other non-metal waste or scrap
393	Metal wastes or scraps

3931	Slag, dross, scalings and other waste from the manufacture of iron or steel
3932	Ash and residue (except from the manufacture of iron or steel), containing metals or metallic compounds, except precious metals
3933	Waste and scrap of precious metal
39331	Waste and scrap of gold or of metal clad with gold
39332	Waste and scrap of precious metal (except gold) or of metal clad with precious metal (except gold)
39333	Ash containing precious metal or precious metal compounds
3934	Ferrous waste and scrap
3935	Remelting scrap ingots of iron or steel
3936	Waste and scrap of other metals
39361	Waste and scrap of copper
39362	Waste and scrap of nickel
39363	Waste and scrap of aluminium
39364	Waste and scrap of lead
39365	Waste and scrap of zinc
39366	Waste and scrap of tin
39367	Waste and scrap of tungsten, molybdenum, tantalum, magnesium, cobalt, cadmium, titanium, zirconium, beryllium and thallium
39368	Waste and scrap of antimony and chromium
3937	Vessels and other floating structures for breaking up
3938	Waste and scrap of primary cells, primary batteries and electric accumulators; spent primary cells, primary batteries and electric accumulators
399	Other wastes and scraps
3991	Municipal waste
3992	Sewage sludge
3993	Clinical waste, including pharmaceutical waste
39931	Pharmaceutical waste
39939	Other clinical waste
3994	Waste organic solvents
3995	Wastes from chemical or allied industries
3999	Other wastes n.e.c.
4	**Metal products, machinery and equipment**
41	**Basic metals**
411	Basic iron and steel
412	Rolled, drawn and folded products of iron and steel
413	Basic precious metals and metals clad with precious metals
414	Copper, nickel, aluminium, alumina, lead, zinc and tin, unwrought
4141	Copper, unwrought; copper mattes; cement copper
4142	Nickel, unwrought; intermediate products of nickel metallurgy
4143	Aluminium, unwrought; alumina
4144	Lead, zinc and tin, unwrought
41441	Lead, unwrought
41442	Zinc, unwrought
41443	Tin, unwrought
415	Semi-finished products of copper, nickel, aluminium, lead, zinc and tin or their alloys
416	Other non-ferrous metals and articles thereof (including waste and scrap); cermets and articles thereof; ash and residue (except from the manufacture of iron or steel), containing metals or metallic compounds
42	**Fabricated metal products, except machinery and equipment**
43	**General-purpose machinery**
44	**Special-purpose machinery**
45	**Office, accounting and computing machinery**

46	**Electrical machinery and apparatus**
47	**Radio, television and communication equipment and apparatus**
48	**Medical appliances, precision and optical instruments, watches and clocks**
49	**Transport equipment**
5	**Constructions and construction services**
53	**Constructions**
531	Buildings
532	Civil engineering works
54	**Construction services**
6 - 9	**Other services**

Annex 5: Classification of waste by type of material

EWC-Stat code	CPC Vers. 2 (draft) code	Description	Waste: hazardous (h) and non-hazardous (nh)
	39	**Solid waste**	
01	3994, 3999ex	**Compound waste**	
01.1	3994	Spent solvents	h
01.2		Acid, alkaline or saline wastes	h+nh
01.3		Used oils	h
01.4		Spent chemical catalysts	h+nh
02	3995ex	**Chemical preparation waste**	
02.1		Off-specification chemical wastes	h+nh
02.2		Unused explosives	h
02.3		Mixed chemical wastes	h+nh
03	3995ex	**Other chemical waste**	
03.1		Chemical deposits and residues	h+nh
03.2		Industrial effluent sludges	h+nh
05	3993	**Health care and biological waste**	h+nh
06	3931-3936	**Metallic wastes**	
06.1		Ferro	nh
06.2		Non-ferro	h+nh
06.3		Mixed	h+nh
07	392	**Non-metallic waste**	
07.1		Glass wastes	h+nh
07.2		Paper and cardboard wastes	nh
07.3		Rubber wastes	nh
07.4		Plastic wastes	nh
07.5		Wood wastes	h+nh
07.6		Textile wastes	nh
07.7		Waste containing PCB	h
08	3937, 3938	**Discarded equipment**	
08.1		Discarded vehicles	h+nh
08.2		Discarded electrical and electronic equipment	h+nh
08.4		Discarded machines and equipment components	h+nh
09	391, 3999ex	**Animal and vegetable wastes**	
09.1	391	Waste of food preparation and products	nh
09.2	3999ex	Green waste	nh
09.3	3999ex	Animal faeces, urine and manure	nh
10	3991, 3999ex	**Mixed ordinary waste**	
10.1	3991	Household and similar wastes	nh
10.2	3999ex	Mixed and undifferentiated materials	h+nh
10.3	3999ex	Sorting residues	h+nh
11	3992	**Common sludges**	
11.1		Waste water treatment sludges	nh
11.2		Sludge purification drinking and process water	nh

11.4		Cesspit contents	nh
12	3999ex	**Mineral waste**	
12.1		Construction and demolition waste	h+nh
12.2		Asbestos waste	h
12.3		Waste of naturally occuring materials	h+nh
12.4		Combustion wasted	h+nh
12.5		Various mineral wastes	h+nh
12.6		Contaminated soils and polluted dredging spoils	h
13	3999ex	**Solidified, stabilized and vitrified waste**	h+nh
n.a.	3999ex	**Radioactive waste**	h

Annex 6: Classification of industries

ISIC (Rev. 4) code	Description
A	**Agriculture, hunting and forestry**
01	**Crop and animal production, hunting and related service activities**
011-013	Crop production
014	Animal production
015, 016	Mixed farming, support activities to agriculture and post-harvest crop activities
017	Hunting, trapping and related service activities
02	**Forestry, logging and related service activities**
03	**Fishing and aquaculture**
031	Fishing
032	Aquaculture
B	**Mining and quarrying**
05	**Mining of coal and lignite**
06	**Extraction of crude petroleum and natural gas**
07	**Mining of metal ores**
071	Mining of iron ores
072	Mining of non-ferrous metal ores
08	**Other mining and quarrying**
C	**Manufacturing**
10	**Manufacture of food products**
101	Processing and preserving of meat
102	Processing and preserving of fish, crustaceans and molluscs
103	Processing and preserving of fruit and vegetables
104	Manufacture of vegetable and animal oils and fats
105	Manufacture of dairy products
106	Manufacture of grain mill products, starches and starch products
107	Manufacture of other food products
108	Manufacture of prepared animal feeds
11	**Manufacture of beverages**
12	**Manufacture of tobacco products**
13	**Manufacture of textiles**
14	**Manufacture of wearing apparel**
15	**Manufacture of leather and related products**
16	**Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials**
17	**Manufacture of paper and paper products**
1701	Manufacture of pulp, paper and paperboard
1702	Manufacture of corrugated paper and paperboard and of containers of paper and paperboard
1709	Manufacture of other articles of paper and paperboard
18	**Printing and reproduction of recorded media**
19	**Manufacture of coke and refined petroleum products**
191	Manufacture of coke oven products
192	Manufacture of refined petroleum products
20	**Manufacture of chemicals and chemical products**
201	Manufacture of basic chemicals, fertilizers and nitrogen compounds, plastics and synthetic rubber in primary forms

202	Manufacture of other chemical products
203	Manufacture of man-made fibres
21	**Manufacture of basic pharmaceutical products and pharmaceutical preparations**
22	**Manufacture of rubber and plastics products**
23	**Manufacture of other non-metallic mineral products**
24	**Manufacture of basic metals**
241	Manufacture of basic iron and steel
242	Manufacture of basic precious and other non-ferrous metals
243	Casting of metals
25	**Manufacture of fabricated metal products, except machinery and equipment**
26	**Manufacture of computer, electronic and optical products**
27	**Manufacture of electrical equipment**
28	**Manufacture of machinery and equipment n.e.c.**
29	**Manufacture of motor vehicles, trailers and semi-trailers**
30	**Manufacture of other transport equipment**
31	**Manufacture of furniture; manufacturing n.e.c.**
32	**Other manufacturing**
33	**Repair and installation of machinery and equipment**
D	**Electricity, gas, steam and air conditioning supply**
35	**Electricity, gas, steam and air conditioning supply**
351	Electric power generation, transmission and distribution
352	Manufacture of gas; distribution of gaseous fuels through mains
353	Steam and air conditioning supply
E	**Water supply; sewerage, waste management and remediation activities**
36	**Water collection, treatment and supply**
37	**Sewerage**
38	**Waste collection, treatment and disposal activities; materials recovery**
381	Waste collection, treatment and disposal activities; materials recovery
382	Waste treatment and disposal
383	Materials recovery
39	**Remediation activities and other waste management services**
F	**Construction**
41	**Construction of buildings**
42	**Civil engineering**
43	**Specialized construction activities**
G	**Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods**
45	**Wholesale and retail trade and repair of motor vehicles and motorcycles**
46	**Wholesale trade, except of motor vehicles and motorcycles**
47	**Retail trade, except of motor vehicles and motorcycles**
H	**Transportation and storage**
49	**Land transport; transport via pipelines**
491	Transport via railways
492	Other land transport
493	Transport via pipelines
50	**Water transport**
501	Sea and coastal water transport
502	Inland water transport
51	**Air transport**
52	**Warehousing and support activities for transportation**
53	**Postal and courier activities**
I	**Accommodation and food service activities**
55	**Accommodation**

56	**Food and beverage service activities**
J	**Information and communication**
58	**Publishing activities**
59	**Motion picture, video and television programme production, sound recording and music publishing activities**
60	**Programming and broadcasting activities**
61	**Telecommunications**
62	**Computer programming, consultancy and related activities**
63	**Information service activities**
K	**Financial and insurance activities**
64	**Financial service activities, except insurance and pension funding**
65	**Insurance, reinsurance and pension funding, except compulsory social security**
66	**Activities auxiliary to financial service and insurance activities**
L	**Real estate activities**
68	**Real estate activities**
M	**Professional, scientific and technical activities**
69	**Legal and accounting activities**
70	**Activities of head offices; management consultancy activities**
71	**Architectural and engineering activities; technical testing and analysis**
72	**Scientific research and development**
73	**Advertising and market research**
74	**Other professional, scientific and technical activities**
75	**Veterinary activities**
N	**Administrative and support service activities**
77	**Rental and leasing activities**
78	**Employment activities**
79	**Travel agency, tour operator, reservation service and related activities**
80	**Security and investigation activities**
81	**Services to buildings and landscape activities**
82	**Office administrative, office support and other business support activities**
O	**Public administration and defence; compulsory social security**
84	**Public administration and defence; compulsory social security**
P	**Education**
85	**Education**
Q	**Human health and social work activities**
86	**Human health activities**
87	**Residential care activities**
88	**Social work activities without accommodation**
R	**Arts, entertainment and recreation**
90	**Creative, arts and entertainment activities**
91	**Libraries, archives, museums and other cultural activities**
92	**Gambling and betting activities**
93	**Sports activities and amusement and recreation activities**
S	**Other service activities**
94	**Activities of membership organizations**
95	**Repair of computers and personal and household goods**
96	**Other personal service activities**
T	**Other service activities**
97	**Activities of households as employers of domestic personnel**
98	**Undifferentiated goods- and services-producing activities of private households for own use**
U	**Activities of extraterritorial organizations and bodies**
99	**Activities of extraterritorial organizations and bodies**

Annex 7: Classification of flows of waste by destination

Classification of waste for intermediate consumption (treatment or recycling)

EWC-Stat code	Description
R 1	Use principally as a fuel or other means to generate energy
R 2	Solvent reclamation/regeneration
R 3	Recycling/reclamation of organic substances which are not used as solvents (including composting and other biological transformation processes)
R 4	Recycling/reclamation of metals and metal compounds
R 5	Recycling/reclamation of other inorganic materials
R 6	Regeneration of acids or bases
R 7	Recovery of components used for pollution abatement
R 8	Recovery of components from catalysts
R 9	Oil re-refining or other reuses of oil
R 10	Land treatment resulting in benefit to agriculture or ecological improvement
R 11	Use of wastes obtained from any of the operations numbered R 1 to R 10
R 12	Exchange of wastes for submission to any of the operations numbered R 1 to R 11
R 13	Storage of wastes pending any of the operations numbered R 1 to R 12 (excluding temporary storage,pending collection, on the site where it is produced)
D 8	Biological treatment not specified elsewhere in this Annex which results in final compounds or mixtures which are discarded by means of any of the operations numbered D 1 to D 7 and D 9 to D 12
D 9	Physico-chemical treatment not specified elsewhere in this Annex which results in final compounds or mixtures which are discarded by means of any of the operations numbered D 1 to D 8 and D 10 to D 12 (e.g. evaporation, drying, calcination, etc.)
D 10	Incineration on land
D 11	Incineration at sea
D 13	Blending or mixing prior to submission to any of the operations numbered D 1 to D 12
D 14	Repackaging prior to submission to any of the operations numbered D 1 to D 13
D 15	Storage pending any of the operations numbered D 1 to D 14 (excluding temporary storage, pending collection, on the site where it is produced)

Classification of waste for controlled landfills

EWC-Stat code	Description
D 1	Deposit into or on to land (e.g. landfill, etc.)
D 3	Deep injection (e.g. injection of pumpable discards into wells, salt domes or naturally occurring repositories,etc.)
D 4	Surface impoundment (e.g. placement of liquid or sludgy discards into pits, ponds or lagoons, etc.)
D 5	Specially engineered landfill (e.g. placement into lined discrete cells which are capped and isolated from one another and the environment, etc.
D 12	Permanent storage (e.g. emplacement of containers in a mine, etc.)

Classification of waste for discharge to the environment

EWC-Stat code	Description
D 2	Land treatment (e.g. biodegradation of liquid or sludgy discards in soils, etc.)
D 6	Release into a water body except seas/oceans
D 7	Release into seas/oceans including sea-bed insertion
n.a	Other dumping of waste to the environment

Annex 8: Classifications of origin and destination of water flows

Classification of water abstracted from the environment by source

MFA code	Description
1	**Abstraction from water resources**
1.1	Surface water
1.2	Groundwater
1.3	Soil water
2	**Abstraction from other sources**
2.1	Collection of precipitation
2.2	Abstraction from sea
	Total

Classification of water as a product by type of use

MFA code	Description
1	**Water abstracted for own use**
1.1	Hydroelectric power generation
1.2	Irrigation water
1.3	Mine water
1.4	Urban runnoff
1.5	Cooling water
1.6	Other
2	**Water abstracted for distribution**
2.1	Losses of distribution
2.1.1	Leakages
2.1.2	Other losses (e.g. evaporation, appearant losses)
2.2	Net distributed water
3	**Water for reuse**
	Total

Classification of water returned to the environment by origin

MFA Code	Description
1	Hydroelectric power generation
2	Irrigation water (dissipative use as a product)
3	Mine water
4	Urban runoff
5	Cooling water
6	Losses in distribution because of leakages
7	Treated wastewater
8	Other
	Total

Classification of waste water by destination

MFA code	Description
1	**Waste water supplied to other economic units**
1.1	Reused water
1.2	Waste water to sewerage
2	**Waste water returned to the environment**
2.1	**To water resources**
2.1.1	Surface water
2.1.2	Groundwater
2.1.3	Soil water
2.2	**To other sources (e.g. sea water)**
	Total waste water