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Emissions to Water Tables

Eurostat E.2: Environmental Accounts and Climate Change

Meeting of the

NAMEA Task Force on Water Accounts

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Emissions to Water Tables
Recommendations and Open Issues

Introduction

This paper presents the recommendations of the Task Force which where the outcome of the first two Task Force meetings. It is expected that the Task Force confirms these recommendations and can conclude on the open issues in order to find agreement on final choices.

The open issues include

- Import and export of wastewater and substances included
- The recording of diffuse emissions
- A final agreement on the list of substances to be recorded (Hg is still in question, total nitrogen is proposed as additional priority substance for Eurostat)
- A clarification related to BOD
- A proposal for the calculation of net emissions
- A proposal for key indicators

General approach and accounting conventions for the emission table

Obviously, the emissions to water table should also follow the general Supply-Use framework, i.e. the same conceptual framework as applied for the water flows, in order to enable a consistent and complete recording of the physical flow system.

This implies that the emission table(s) will have the same format: *flow* by *activity* matrices. The list of substances that are emitted by economic activities and received by water bodies are recorded in the rows and need to be specified. The column headings obviously have to be the same as defined in the water flow PSUTs (T1 and T2).

In the 2010 meeting of the Task Force the Task Force agreed and recommended to employ the SUT framework for setting up the emissions tables.

In the current version of the emission tables (see agenda item 3) the column “RoW” (in both the use and the supply table) are shaded in grey. This means that it remains empty per definition.

However, there are known cases in Europe where wastewater is exported or imported for treatment. That is why tables T1 and T2 – showing the water flows – also consider waste water flows from and to the RoW. E.g. several Austrian municipalities are connected to the urban wastewater treatment plant of Bratislava (Slovakia)). Other cases where wastewater is transferred between Germany and Austria or Belgium and France are known. Therefore, the column RoW should be blank instead of grey shaded.

Eurostat’s position is to allow data entry in the column “RoW” and to rename the column “’Final consumption by households” to “Households”

Furthermore, the name of the column “Final consumption by households” is misleading. Households do not consume emissions. Therefore, it is recommended to name this row “Households”.

Eurostat's position:
To consider the "import" and "export" of substances via waste water flows in the emission tables.
To rename the column “’Final consumption by households” to “Households”

Conclusions, decisions, recommendations by the Task Force:
1- …

2- …

Point and non-point (diffuse) sources

In the 2011 TF meeting Eurostat's the following suggestion regarding diffuse emissions from agriculture and urban runoff was approved:

a) To consider diffuse emissions to water from agriculture and assign them to agriculture industry (NACE 01)
b) To consider urban runoff as diffuse emission source and assign those to the sewage industry (NACE 37)
c) To record net emissions for diffuse sources.

SEEA-W (2007) refers to point and non-point sources (diffuse) for emissions as follows:

"Source of pollution are classified in point source and non-point source emissions. Point source emissions are those emissions for which the geographical location of the discharge of the wastewater is clearly identified. They include, for example, emissions from wastewater treatment plants, power plants, other industrial establishments. Non-point (or diffuse) sources of pollution are sources without a single point of origin or a specific outlet into a receiving water body. Pollutants are generally carried off the land by storm-water run-off or may be the result of a collection of individual and small scale polluting activities which for practical reasons cannot be treated as point sources of pollution. The commonly used categories for non-point sources include agriculture and urban areas.

Non-point source of emissions cannot be measured directly but need to be estimated through models which take into consideration several factors including the soil structure and the climatic conditions as well as the delay with which the pollutants reach the water table. Further, it is difficult to allocate non-point emission sources to the economic unit that generates them because of their nature.

Emission accounts include all point source emissions of pollutants in wastewater and those nonpoint sources for which physical flows are recorded in Chapter 3, namely urban runoff and irrigation water. Urban runoff is described in the emission accounts in terms of the pollutants deposited on urban areas and in the air, often as a result of transport or other economic activities. Returns of irrigation water and rainfed agriculture are described in terms of the pollutants which are added to the return flows from agricultural land, that is fertilizers and pesticides spread on the soil during infiltration into groundwater or runoff to surface water.

For the sake of simplicity as wells as to maintain consistency with the water flows in the physical supply and use tables presented in Chapter 3, we exclude a number of non-point source emissions, although they affect the quality of water resources. 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 a landfill site 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."

As indicated in SEEA-W (2007) agriculture and urban runoff are the two important sectors which are source of non-point emissions. Additionally for the simplicity SEEA-W recommends to include diffuse emissions only from these two sectors. Therefore, Eurostat suggests to include diffuse emissions from agriculture and urban runoff in PSUTs.

SEEA-W (2007) considers diffuse emissions to water from agriculture as an emission of the agriculture industry (NACE 01) and (by convention) emissions from urban runoff as emissions to be assigned to the sewage industry (NACE 37).

Furthermore, it is important to distinguish net and gross loads for diffuse emissions. Gross emission for diffuse sources refer to the amount of pollutants that is released by the source (e.g. amount of fertilizers applied in agriculture). Net emission for diffuse sources refers the amount of pollutants (in mass unit) that reaches to the water resources (e.g. amount of nitrogen reaches to groundwater from fertilizers).

Eurostat recommends to record only net emissions for diffuse sources in PSUTs.

The determination of emissions from non-point sources is not a trivial task as it cannot be directly measured but has to be modelled. This results typically in data gaps (where such models are not used) and data inaccuracies. For user of the data it is important to know whether emissions of non-point sources are included in the emission numbers or not. The documentation can be done in three ways:

a) Splitting of the columns of each industry into “point source” and “non-point source: The advantages: detailed information is available in the tables which can be further processed. This information does not get lost when data is disseminated. The major disadvantage is that the tables will become larger and will look more complex at a first glance.
b) Explanation in footnotes: The advantage is that the tables will remain simple. The disadvantage is that footnotes often are not considered by the user of the data and information which is contained in footnotes cannot be processed automatically.
c) A further breakdown of the row classes in the Supply Table T 4 ("of which from non-point (diffuse) sources"). Same advantages as a)and keeping the columns consistent with monetary SUTs.

Eurostat recommends choosing between options a) and c).

Eurostat's position:
With regards to explicit recording of non-point source emissions in agriculture (NACE 01) and for the sewerage industry (NACE 37) Eurostat recommends choosing between options a) and c).

Conclusions, decisions, recommendations by the Task Force:
3- …
4- …

Substances to be recorded

The Task Force discussed and agreed upon the list of substances to be considered in its 2010 meeting:

Code	Label
E.1	BOD
E.2	COD
E.3	Suspended Solids (SS)
E.4	N-total
E.5	P-total
E.6	Cd
E.7	Cr
E.8	Cu
E.9	Pb
E.10	Ni
E.11	Zn
E.12	As

As regards Mercury (Hg), no clear decision was taken on whether to be included or not.

Eurostat’s priority will be on BOD, COD, Suspended Solids and N-total, and also P-total.

Excurse BOD:

The Biochemical Oxygen Demand (BOD) is along with the Chemical Oxygen Demand (COD) the most frequent parameter used to determine the organic matter content of wastewater. BOD only refers to the content of wastewater in biodegradable organic matter, that is the organic matter that can be easily destroyed (often 5 days at 20℃ and in the dark) by the biological life, mainly bacteria, present in the wastewater or added in certain cases. This is overestimated when nitrification processes, that also consume oxygen, are not inhibited (allylthiourea or acidification is often used as an inhibitor).

The five-day BOD (BOD_5), which is measured by a test stimulating biological oxidation during a five-day period is the parameter used in most European countries. It is also the parameter to which the Urban Wastewater Treatment Directive (91/271/EEC) refers. In some countries however, a seven-day BOD (BOD_7) is used or Total Organic Carbon (TOC) or Total Oxygen Demand (TOD). There is no commonly accepted relationship between BOD_5 and these parameters.

Eurostat's position is to refer in general to $BOD_{5(ATU)}$ as this would lead to maximum comparability across countries. However, if countries use a substitute parameter with a relationship to $BOD_{5(ATU)}$ commonly accepted by experts of the country, it is asked to provide figures in $BOD_{5(ATU)}$ and to provide the formula used. In other cases it is asked to mention which parameter is used alternatively.

Total nitrogen (N-total) is a measure for the sum of the four different nitrogen fractions organically fixed nitrogen, nitrate, nitrite and ammonium. Nitrogen has a high eutrophication impact potential and is in its form of ammonia (NH_3) toxic for fish, even in smaller concentrations. Ammonia results from high pH values and the availability of ammonium.
Emissions of nitrogen are regulated by European law, such as the Urban Wastewater Treatment Directive (91/271/EEC). Other legislation which includes reporting obligations involve the Water Framework Directive (2000/60/EC) and the e-PRTR Regulation (EC 166/2006). The OECD-Eurostat Joint Questionnaire on Inland Waters (table 7) also requires data on the generation and discharge of total nitrogen.
However, in national legislation it is often not the parameter N-total which is regulated, but its fractions ammonia, nitrate or nitrite. Another measure is "Total Kjeldahl nitrogen (TKN)" which is the sum of organic nitrogen, ammonia (NH_3), and ammonium (NH_4+) in the chemical analysis of water. To calculate total nitrogen (TN), the concentrations of nitrate-N and nitrite-N are determined and added to TKN.

Phosphorus is another important nutrient with high eutrophication impact potential. Even if the substitution of phosphates in household detergents has decreased emissions from households (EU Regulation No 648/2004 on detergents, concerning the use of phosphates), fertilizers used in agriculture are still an important source. Phosphorus occurs in natural waters and in wastewaters almost solely as phosphates. These are classified as orthophosphates, condensed phosphates, and organically bound phosphates. The parameter "Total Phosphorus (P-total)" is a measure of both inorganic and organic forms of phosphorus. Because of the high eutrophication impact potential European legislation regulates its use and emission. Legislation also requires reporting of emissions and concentration of P-total in surface waters. European legislation requiring reporting on P-total includes the Urban Wastewater Treatment Directive (91/271/EEC), the Water Framework Directive (2000/60/EC) or the e-PRTR Regulation (EC 166/2006). The OECD-Eurostat Joint Questionnaire on Inland Waters (table 7) also requires data on the generation and discharge of Total Phosphorus (P-total).

Because of its importance Eurostat proposes to add total phosphorus to the list of priority parameters.

For both substances nitrogen and phosphorus national data might not always be available in form of total nitrogen or total phosphorus but for its fractions (such as nitrate or dissolved phosphorus).

Eurostat's position is to refer in general to total nitrogen and total phosphorus as this would lead to maximum comparability across countries and also ensures consistency with the mentioned European reporting obligations. If countries should employ an alternative parameter this has to be clearly indicated.

In its 2011 meeting the Task Force also recommended that in the long-term perspective also other sources/substances (e.g. pesticides, pharmaceuticals etc) should be included. For the time being these substances can be added as memorandum items whenever possible.

Eurostat's position is that for the time being these substances should be included when they have been identified as a significant pressure in the implementation of the EU Water Framework Directive (2000/60/EC).

The Task Force is asked to find a final agreement whether to include Mercury in the list of substances. The Task Force is also asked to discuss the proposals which refer to total nitrogen, total phosphorus and to $BOD_{5(ATU)}$.

Eurostat's position:

- To refer in general to $BOD_{5(ATU)}$. Only in exceptional cases (no conversion possible) substitute parameters should be used (and this should be clearly indicated).

Conclusions, decisions, recommendations by the Task Force:
5- …
6- …

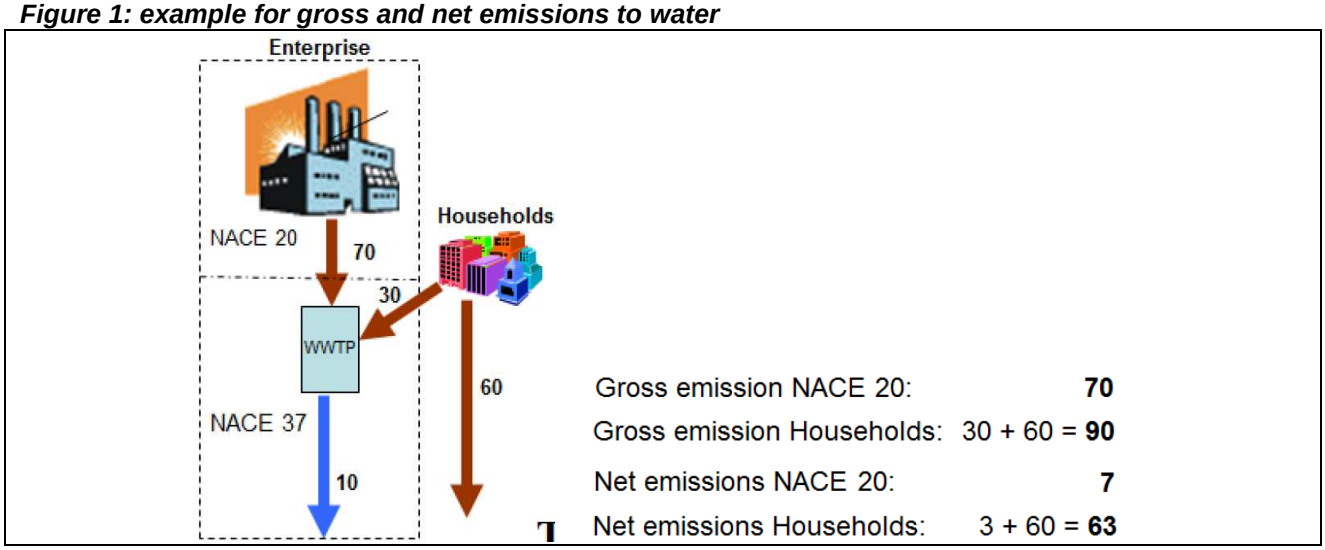
Key indicators (T.5)

Net emissions have to be calculated by reallocating the emissions of NACE 37 back to its sources. Only urban runoff is considered as an emission originating from sewerage activities (convention in SEEA-Water). Directly discharged gross emissions (from point sources and non-point sources) are equal to net emissions.

For the re-allocation of loads of NACE 37 the incoming loads to the sewerage sector (typically the sewer network, alternatively incoming load to the wastewater treatment plant) need to be known. They are equal to the gross emissions of the indirectly connected industries. The method to re-allocate the net emission can be done either by each individual treatment plant (if removal rates for the individual parameters are known) or via average removal rates for groups of treatment plants.

Figure 1 shows an example where an industry and households are connected to the same wastewater treatment plant. A part of the wastewater of the households is also discharged directly, without collection or treatment by ISIC 37.

Figure 1: example for gross and net emissions to water



The gross emission of the industry is 70 units which are supplied for treatment to a wastewater treatment plant (NACE 37). The gross emission of the households is 90 units, of which 30 units are supplied to the wastewater treatment plant. The wastewater treatment plant discharges 10 units after treatment, thus the removal rate is equal to 90%. The net emission of the industry can now be calculated as 70 units minus 90% (or 70 units multiplied by 10%). The net emission of the households is the sum of the emissions discharged directly (gross emission = net emission) plus the reallocated load from NACE 37 (30 units minus 90 % or 30 units multiplied by 10%).

The goal of calculating net emission is to allocate this amount of emission which is a pressure on the environment (= net emission) to the originating economic activity. This approach differs from classical water statistics, where all emissions of urban wastewater treatment plants (NACE 37) are considered as emissions from sewerage activities (NACE 37). Various methods to reallocate emissions exist.

The Emissions to Water Tables T3 and T4 record gross emissions. The removal rate and net emissions can be easily derived from T3 and T4 and e.g. be recorded the SEEA-W Table 4.2.A.

Net emission vectors can then be added to the Indicator Table T5.

Net emissions vectors are the basis for the calculation and recording of indicators in the Indicator Table T5. Eurostat's position is to use indicators which represent the net emissions as such, and "emission productivity" or (inverse) "emission efficiency". Recommended indicators are therefore (consistent with water use indicators):

- Net emissions
- Net emission per GVA (gross value added)
- Net emission per production output

Eurostat's position:

- To calculate indicators based on net emissions
- To present indicators which link the economic output with net emissions

Conclusions, decisions, recommendations by the Task Force:

7- …