DEPARTMENT OF ECONOMIC AND SOCIAL AFFAIRS
STATISTICS DIVISION
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System of Environmental Economic Accounting

# SEEA Central Framework 2028 update

# Draft Guidance Note

# Issue B2: Treatment of losses (in physical flow accounts)

Stephan Moll (lead author)
with contributions from Michael Nagy

**Version for discussion at the SEEA CF Technical Committee meeting on 17-21 November 2025.**

# GUIDANCE NOTE Issue B.2 “Treatment of losses (in physical flow accounts)”

## 1 Introduction

### 1.1 Purpose of the Guidance note

1. The purpose of this guidance note is to provide guidance on the treatment of losses in SEEA-CF physical flow accounts. This guidance note is developed in the context of the update of the SEEA-CF and supposed to assist the chief editor.

2. The short description of issue B2: “Further clarifying treatment of losses (e.g. energy, water)” from the March 2025 final list of issues endorsed by the UN Statistical Commission (https://seea.un.org/sites/seea.un.org/files/documents/CF_update/seea_cf_issues_final_list_march_2025.xlsx) is:

   > “There are a number of issues related to losses which are not fully described in the SEEA CF, particularly on energy and water losses but also in the context of circular economy. Some papers which were drafted during the preparation of the SEEA CF could be reviewed to see if we can clarify the terminology and conceptual issues. In addition, this could be looked at in the context of sub-national or regional accounts and links to ecosystem accounting.”

3. Losses are introduced as part of the physical flow accounts in the SEEA-CF in Chapter III, see especially §3.100 – 3.103 and Table 3.4. Here, four types of losses are distinguished and described: losses during extraction, during distribution, during storage, and during transformation – referred to as ‘SEEA-typology of losses’ in the following.

4. The SEEA-CF also mentions losses in relation to residuals, namely being part of residuals. Residuals are one out of three types of physical flows defined by the SEEA-CF, referred to as ‘SEEA-typology of physical flows’ in the following.

5. The key questions – for clarification at conceptional level – is: **Are losses representable with the already existing SEEA-types of physical flows (natural inputs, products, residuals), or do losses require a separate statistical concept to be included in physical flow accounts?**

6. Once this conceptual choice is taken, this note is supposed to provide guidelines for recording losses in SEEA physical flow accounts and to clarify the terminology.

### 1.2 Process for developing the Guidance Note

7. This draft version 2 of the guidance note is based on an earlier draft version 1.1 discussed by task team B on 7 October 2025. **The group was in favour of describing losses by means of the SEEA-typology of physical flows (natural inputs, products, residuals) and to not establish a separate statistical concept for losses.** The group called for further elaboration of two particular cases: (1) ‘loss during distribution’ of electricity imported, and (2) ‘loss during storage’.

### 1.3 Structure

8. Chapter 2 reviews cases where international statistical guidelines use the term ‘losses’, which the quick reader may skip.
9. Chapter 3 relates the four types of losses mentioned in current SEEA-CF 2012 to the SEEA-typology of physical flows. It shows that losses are representable by means of natural inputs, products and residuals, and presents first brief guidelines for recording and terminology, i.e., labelling of residual row-classes.
10. Chapter 3 also includes a section (excursion) clarifying that output (SNA-code P1) must not be recorded net of recurrent losses from inventories, an issue raised earlier.

### 1.4 Links to other guidance notes

11. This guidance note B2 has links to the following other Guidance notes:

- A1: links to SEEA EA
- A9: Consistency with the SNA
- B1/B5: Description of PSUT and EW-MFA
- B7: Waste accounts
- D1: Carbon stock
- D3: Physical produced assets
- D4: Water as a produced asset
- D8: Atmosphere as an asset

## 2 Review of existing measurement and research

### 2.1 Introduction

12. In general, the term ‘losses’ bears many notions of meanings. One is ‘the fact or process of losing something or someone’ (Oxford English Dictionary). Another is ‘decrease in amount, magnitude, value, or degree’ (Merriam Webster). While the former notion is relatable to the concept of flows, the latter relates to the concept of asset or stock. Both concepts are connected insofar that stock changes constitute flows. A loss’ from a stock is at the same time a flow.
13. Statistical guidelines often employ the term ‘losses’ in its general, wider meaning, e.g., to circumscribe a certain phenomenon, principle or rule. In contrast to this, statistical guidelines also use the term ‘losses’ to denote <u>statistical concepts or items</u> that are specific, explicit and have a precise technical definition. ‘Gains and losses’ is a prominent example in SNA.

14. In the following, chapter 2 reviews cases where statistical guidelines use the term 'losses' in the latter specific way, i.e., in conjunction with well-defined statistical concepts and items. Reviewed are relevant international statistical guidelines, namely 2025 SNA, 2012 SEEA-CF, 2019 SEEA-Energy, and SEEA-Water, as well as in international guidelines for energy statistics and water statistics. The focus is laid on statistical concepts that include the term 'losses'.
15. The quick reader may skip chapter 2 and jump immediately to chapter 3.

## 2.2 Losses in the SNA

### 2.2.1 Introduction to SNA and 'losses'

16. The 2025 SNA employs the terms 'losses' and 'loss' in its general meaning and in specific cases for statistical concepts and items. A word-count reveals:
    - 'losses' = 460-times, of which 'gains and losses' = 209-times
    - 'loss' = 117-times
17. It is important to distinguish flows and stocks. Most often the SNA employs the terms 'losses' and 'loss' in conjunction with stocks and their respective changes. Stocks and flows are connected in so far that certain stock changes - recorded in asset accounts – constitute flows.
18. Table 1 provides an overview and classification of economic flows. They are composed of two types: *transactions* and *other flows*. The following analyses which economic flows are relevant for the issue of losses.

*Table 1: SNA classification of economic flows (SNA Chapter 4 – **B Flows**)*

| | | |
|---|---|---|
| **B.1 Transactions** | | |
| | Monetary transactions | |
| | | *Transactions with and without a recompense* |
| | | *Rearrangements of transactions for statistical purposes* |
| | | *Rerouting transactions* |
| | | *Partitioning transactions* |
| | | *Reassigning transactions* |
| | Non-monetary transactions | |
| | | *Barter transactions* |
| | | *Remuneration in kind* |
| | | *Payments in kind other than remuneration in kind* |
| | | *Transfers in kind* |
| | | *Internal transactions* |
| | Externalities and illegal actions | |
| | | *Externalities* |
| | | *Illegal actions* |
| **B.2 Other flows** | | |
| | Other changes in the volume of assets and liabilities | |
| | Revaluations (holding gains and losses) | |

19. Certain *transactions in products* related to inventories of finished goods are relevant for the issue of 'losses'. Some products are not sold in the same period they are produced in. Producers put those on temporary storage (inventories of finished goods) in order to sell them in later periods. Changes in inventories are defined as value of entries into inventories less the value of withdrawals and less the value of any *recurrent losses of goods held in inventories during the accounting period*. The latter is relevant for the issue of 'losses'. Transactions related to inventories of finished goods occur in two SNA accounts: *Production accounts* and *Supply and use tables*.

20. *Other flows* include economic flows that are non-transactions, i.e., without mutual agreement. There are two classes. The first is *other changes in the volume of assets and liabilities* which includes many different kinds of changes in assets, liabilities and net worth. Basically, it includes all changes in the value of assets and liabilities due to a change in volume due to quality change rather than due to changes in prices. This category of economic non-transaction flows is relevant for the issue of physical 'losses'. Examples are catastrophic losses (see Figure 1 below) which are recorded in the respective SNA account: *Other changes in the volume of assets and liabilities accounts*.

21. The second category of non-transaction flows is *Revaluations* which includes changes related to *holding gains and losses* arising from changes over time in the level of prices, including those arising from changes in currency rates for assets and liabilities expressed in foreign currency. *Revaluations* are immaterial and hence not relevant and further investigated here.

### 2.2.2 'Losses' in SNA's *Production accounts* and *SUTs* (flow accounts)

22. The 2025 SNA distinguishes a theoretical boundary for production which is broader than the production that is actually recorded in the integrated framework of the SNA. The following analyses refer to the latter ('recording boundary' of production).

23. Production accounts record economic flows related to the production of output. Part of output enters inventories of finished goods (§§7.115ff.) Some goods stored in inventories may be lost, referred to as '*recurrent losses due to wastage, theft or accidental damage'* (or '*recurrent losses from inventories'*).

24. The accounting framework of *supply and use tables* (SUTs) record the transaction related to the generation of output and how it is used, inter alia in form of changes in inventories. SUT do not record non-transaction flows and hence exclude *other changes in volume of assets and liabilities* (see Table 1).

25. The basic principle underlying the measurement of changes in inventories of finished goods is that output should be recorded at the time it is produced. In effect, goods only enter inventories when they are not immediately used for sale or other use in the period they are produced. Similarly, goods are withdrawn from inventories when the demand for the goods exceeds the amount produced in a period. No output is recorded when goods produced previously are withdrawn from inventories and sold or otherwise used.

26. In periods where the entries into inventories (output of the current period) is smaller than the withdrawal from inventories (output of previous periods), the changes in inventories turn negative.

27. Changes in inventories are recorded net in the use table of the SUT framework. A negative value in the use table under the column-heading 'changes in inventories' may lead to the assumption that the supply recorded in both, the supply and use table (total sum of the respective product-rows) is reduced and that it may also have an effect on the output.

### 2.2.3 'Losses' recorded in other changes in the volume of assets and liabilities account

28. Chapter 13 of the SNA (*Other changes in assets and liabilities accounts*) is concerned with the recording of changes in the values of assets and liabilities, and thus of the changes in net worth, between opening and closing balance sheets that result from flows that are not transactions, referred to as other flows. Transactions in assets and liabilities and the immediate consequences of transactions on net worth are recorded in the capital account and financial account, and as such outside the scope of supply and use tables (SUTs).

29. Nevertheless, the *Other changes in assets and liabilities accounts* includes an economic flow that might be of relevance for the issue of physical losses, namely *Catastrophic losses (K3)*. (see Figure 1)

*Figure 1: Catastrophic losses: excerpt from 2025 SNA*

**Catastrophic losses**

13.51 The volume changes recorded as catastrophic losses in the other changes in the volume of assets and liabilities account are the result of large scale, discrete and recognizable events that may destroy a significantly large number of assets within any of the asset categories. Such events will generally be easy to identify. They include major earthquakes, volcanic eruptions, tidal waves, exceptionally severe hurricanes, drought and other natural disasters; acts of war, riots and other political events; and technological accidents such as major toxic spills or release of radioactive particles into the air. Included here are such major losses as deterioration in the quality of land caused by abnormal flooding or wind damage; destruction of biological resources by forest fires, drought or outbreaks of disease; destruction of buildings, equipment or valuables in flooding, forest fires or earthquakes.

13.52 Catastrophic losses of financial assets are less common. However, it may be the case that foreign-owned real estate, for which a notional unit is identified, is destroyed in a natural disaster. If the value of the real estate is completely wiped out, the loss should be recorded as an other change in the volume of the (imputed) equity of the owner, as the notional unit effectively ceases to exist. However, if some value remains, the loss in value of the (imputed) equity should be recorded as a revaluation of the equity, while the loss in value of the real estate remains to be recorded as an other change in volume. This is because the direct investor technically owns equity in the notional unit and not the real estate itself.

13.53 Catastrophic losses of financial assets may also relate to cases where evidence of ownership depends on written records and these records are destroyed, as a consequence of which it may not be possible to re-establish ownership. Accidental destruction of currency or bearer securities may result from a natural catastrophe or political events.

## 2.3 Losses in the SEEA

### 2.3.1 Introduction to losses in SEEA

30. The various accounting modules of the SEEA may be grouped according to: monetary vs. physical accounts, and flows vs. asset accounts. The term 'losses' is employed in conjunction with asset accounts and physical flow accounts. The two accounts are partly related to each other (see SEEA-CF §§2.55ff. and Table 2.4) insofar that some of the additions to stocks and reductions of stocks as recorded in SEEA-type asset accounts coincide with physical flows recorded in physical flow accounts.

31. Section 2.3 of this guidance note focusses on the description of 'losses' in SEEA physical flow accounts. It analyses how the term 'losses' is addressed in relevant SEEA publications, namely SEEA-CF, SEEA-Energy and SEEA-Water. One can observe that the SEEA-Energy – which is the most recent SEEA handbook analysed here – provides the most detailed, clear and coherent descriptions for treatment of 'losses' in physical flow accounts.

### 2.3.2 SEEA-CF - utilitarian characterization of losses

32. In addition, chapter III makes some recommendations whether to record 'losses' or not according to a kind of utilitarian criteria:

| ***Loss Description*** | ***Recording Recommendation*** |
|---|---|
| (a) losses that may be necessary for maintaining safe operating conditions (§3.100) | No clear recommendation whether to record or not in §§3.100-3.103 |
| (b) losses that are unwanted (§3.100) and avoidable in the interest of the related economic unit (§3.102) | Clear recommendation to record (§3.102) |
| (c) losses of no interest to the related economic unit (§3.102) | Recommendation not to record (§3.102)<br>Notably: this also implies not to record those flows when they enter the economy in form of natural inputs. |

33. This utilitarian characterization adds to the confusions.

### 2.3.3 SEEA-CF - Four types of losses according to the stage in the production chain

34. Chapter III introduces the SEEA-typology of physical flows; i.e., the generic distinction made between natural inputs, products, and residuals. One may assume that 'losses' belong to residuals; e.g., the term 'losses' appears in the definition and classification of residuals (SEEA-CF §§ 3.73ff.). However, thinks are not so clear, calling for further clarification.

*Table 2: Types of losses according to stage of production (SEEA-CF2012 §§ 3.100ff.)*

| type of loss | description (SEEA-CF2012 §§ 3.100ff.) |
|---|---|
| Losses during extraction | …occur during extraction of a natural resource before there is any further processing, treatment or transportation of the extracted resource. Losses during extraction exclude natural resources that are reinjected into the deposit from which they were extracted. This may be the case, for example, for natural gas reinjected into a reservoir, or water abstracted from groundwater and reinjected into an aquifer. Some losses during extraction may also be recorded as natural resource residuals. |
| Losses during distribution | …occur between a point of abstraction, extraction or supply and a point of use. |
| Losses during storage | Losses of energy products and materials held in inventories. They include evaporation, leakages of fuels (measured in mass or volume units), wastage and accidental damage. Excluded from the scope of inventories are non-produced assets, even though they might be regarded as being stored. Thus, for example, the evaporation of water from artificial reservoirs is excluded from losses during storage. These reductions in the quantity of water resources are shown in asset accounts. |
| Losses during transformation | Energy lost, for example, in the form of heat, during the transformation of one energy product into another energy product. It is essentially an energy balance concept reflecting the difference in calorific value between the input and output commodities. Losses during transformation apply only to energy flows. |

### 2.3.4 SEEA-Energy

35. The System of Environmental-Economic Accounting for Energy (SEEA-Energy) – published in 2019 – is a statistical framework for energy-related information. The SEEA-Energy is a subsystem of the SEEA Central Framework and pursues consistency with it. The term 'losses' occurs 141-times in the SEEA-Energy.

36. SEEA-Energy include physical supply use tables and asset accounts which are connected partly. While certain components of the changes in stocks (for example, extraction of energy from natural inputs) appear in both the asset accounts and the supply and use tables, other components of the changes in stocks are not recorded in the supply and use tables. Examples of such changes include discoveries of mineral and energy resources, losses of energy from natural inputs following catastrophic natural events (SEEA-Energy2019 §2.53).

37. SEEA-Energy builds on the SEEA-typology of physical flows, namely natural inputs, products and residuals. Statements regarding energy residuals are widely associated with the usage of the term 'energy losses': Energy residuals comprise energy losses and other energy residuals. For energy losses the SEEA-Energy applies the four SEEA-CF categories of losses according to the stage of the production chain (SEEA-Energy §3.58, §§3.107ff).

38. The 2019 SEEA-Energy provides rather clear recording guidelines for the four types of energy losses, examples are presented in Figure 2:

*Figure 2: SEEA-Energy recording guidelines for losses – selected excerpts*

| |
|---|
| Losses during extraction: (SEEA-Energy §3.87). In principle, the inputs of energy from renewable sources should reflect the amount of energy that can be generated based on the technology put in place. In practice, inputs of energy from renewable sources are recorded in terms of the amounts of heat and electricity produced through the technology used to harness the energy. Consequently, in practice, losses of energy in the capture of energy from renewable sources are not included in the physical supply and use table. Energy from hydroelectric schemes is recorded here also in terms of electricity produced. |
| Losses during extraction: (SEEA-Energy §3.88). For inputs of mineral and energy resources, losses of energy during extraction are included in the total quantity of resources extracted from the environment, in line with the general treatment of natural resource residuals and losses. Entries for losses during extraction should also be made in the bottom section of the supply and use tables concerning energy residuals. |
| Losses during extraction: (SEEA-Energy §3.104). During the extraction process, businesses may undertake reinjection—as well as flaring and venting—of natural gas. These flows are recorded not as part of the intermediate consumption of energy products, but rather as flows of residuals, as described below. … |
| Losses during distribution: (SEEA-Energy §3.71). The supply of electricity includes the activity of distributing electricity to the final consumer. While the supply of gas through a system of mains is also included in this ISIC division, the activity of transporting gas through pipelines over long distances is considered to be a transport activity. Thus, in the supply portion of physical supply and use table, transmission losses related to electricity supply are attributed to the electricity supply industry, while losses related to gas supply are attributed to either the gas supply industry or the transportation industry, depending on where the losses occur. |
| Losses during storage: (SEEA-Energy §3.78). Where units are predominately engaged in storage activity related to energy products (such as gas), losses incurred during storage represent an end use of these products by the transportation and storage industry. |
| Losses during transformation: (SEEA-Energy §3.73). Waste is recorded in the physical supply and use table as an energy product for each industry supplying it. By convention, the energy from solid waste is shown as supplied from within the economy in the “accumulation” column of the supply table, and a matching positive entry is recorded in the use table in the column for the industry incinerating the solid waste. In cases where the waste has not been purchased (i.e., it is a residual rather than a product) and is used for electricity generation, that waste is nevertheless treated as a flow of energy from other industries. In the supply table, the related transformation losses are recorded against “waste” and are attributed to the electricity, gas, steam and air conditioning supply industry. |
| As a general recording principle, energy losses should be recorded to the owner of the energy product when the loss occurs. |
| (SEEA-Energy §3.104). … Losses should be attributed to the owner of the energy product when the losses occur. For example, if a product is lost after it has been handed over from the producer to the final user of the product, the loss is attributed to the final user and should not be recorded as part of the intermediate consumption of the energy producer. |

### 2.3.5 SEEA-Water

39. To be elaborated later

## 2.4 Losses in energy statistics

40. This section looks at two references for internationally harmonized energy statistics:

- International recommendations for energy statistics (IRES)
- Joint annual questionnaires on energy statistics by International Energy Agency (IEA), Eurostat (ESTAT), and United Nations (UN) – encompassing five questionnaires:
    - AQ Electricity & heat
    - AQ Natural gas

- AQ Oil
- AQ Coal
- AQ Renewables & waste

41. Both sources have been screened for statistical concepts or items which are explicitly referred to as 'losses'. In a next step, those items have been assigned or grouped to the four types of losses as identified by SEEA. Table 3 provides an overview.

*Table 3: Statistical items in energy statistics assigned to the SEEA-types of losses*

| SEEA-type of losses | International Recommendations for Energy Statistics (IRES) | Joint annual questionnaires (AQ) by IEA, ESTAT, and UN |
|---|---|---|
| during extraction | • losses of geothermal heat after production (IRES, §5.19)<br>Note: primary production (output of primary products) is net of losses during extraction (IRES §5.10) Nevertheless, losses during extraction are recorded in energy statistics (IRES §§6.45ff.) | |
| during transformation | • venting and flaring of manufactured gases (IRES, §5.19)<br>Refinery losses (IRES §6.53) | AQ Electricity & heat:<br>***Transmission and distribution losses:*** All losses due to transport and distribution of electrical energy and heat. For electricity, losses in transformers which are not considered as integral parts of the power plants are also included.<br><br>AQ Natural gas:<br>Table 1 Supply ***Gas vented:*** The volume of gas released into the air on the production site or at the gas processing plant.<br>Table 1 Supply ***Gas flared:*** The volume of gas burned in flares on the production site or at the gas processing plant<br><br>AQ Oil:<br>Table 1 Supply ***Memo item – refinery losses***: Are the difference between Refinery intake observed and Gross refinery output. Losses may occur during the distillation processes due to evaporation. |
| during distribution | losses during the transmission, distribution and transport of fuels, heat and electricity (IRES, §5.19) | AQ Coal:<br>***Distribution losses:*** Report all losses which occur due to transport and distribution, as well as venting of manufactured gases. Manufactured gases which are flared should be reported in ***Final energy consumption – Other sectors - Not elsewhere specified (Energy)*** of<br>the Energy Sector.<br><br>AQ Electricity & heat:<br>***Transmission and distribution losses:*** All losses due to transport and distribution of electrical energy and heat. For electricity, losses in transformers which are not considered as integral parts of the power plants are also included.<br>Transmission losses: All losses that occur at the area of responsibility of the Transmission System Operator. |

| | | |
|---|---|---|
| | | Distribution losses: All losses that occur at the area of responsibility of the Distribution System Operator.<br>***Non-technical losses: Losses:*** Losses that are not related to the technical operation of the system (for example illegal appropriation of energy/theft)<br><br>AQ Natural gas:<br>Table 2 Consumption by sector ***III Distribution losses:*** Please report losses due to transport, distribution and storage, as well as any other pipeline losses. Natural gas used to operate the pipelines of the transport network / system should be reported in the Transport sector. Please include quantities lost as "boil-off".<br>***Transmission losses:*** All losses that occur at the area of responsibility of the Transmission System Operator.<br>***Distribution losses:*** All losses that occur at the area of responsibility of the Distribution System Operator.<br>***Non-technical losses:*** Losses that are not related to the technical operation of the system (for example illegal appropriation of energy/theft<br><br>AQ Oil:<br>Table 3 ***III. Distribution losses***: Report all losses which occur outside the refinery due to transport and distribution, including pipeline losses.<br><br>AQ Renewables & waste:<br>Table 2 ***Distribution losses***: Report all losses which occur due to transport and distribution. |
| during storage | | AQ Natural gas: storage losses are included in the reporting item ***distribution losses***! |
| n.a. | pilferage of fuels or electricity (IRES, §5.19) | AQ Electricity & heat / AQ Natural gas:<br>***Non-technical losses:*** Losses: Losses that are not related to the technical operation of the system (for example illegal appropriation of energy/theft) |

## 2.5 Losses in water statistics

To be further elaborated

| **SEEA-CF** | **International Recommendations for Water Statistics (IRWS) and Joint Questionnaire on Inland Waters (JQ-IW)** | **Comments by Michael** |
|---|---|---|
| during extraction | Not covered by IRWS, but could conceptually include overspills and drainage water. E.g. Eurostat/OECD Joint Questionnaire on Inland Waters has a data item "Water returned without use" which is defined as "Water abstracted from any freshwater source and discharged into freshwaters without use, or before use. Occurs primarily during mining, construction activities or in connection with spring overflows. Discharges to marine waters as well as discharges after use are excluded." Remarks: In countries which draw significant amounts of their water supply from spring sources, spring overflows can also be counted as returned water if they occur at storage tanks after the water has been abstracted and transported through pipes. | |

| | | |
|---|---|---|
| during distribution | IRWS chapter 6: Losses of water in distribution (I.1) is the volume of water (CPC, Ver. 2, 1800) that is lost during distribution and transportation, between the point of abstraction and the point of use or between the points of use and reuse. The subcategories are theft, leakage, burst mains, evaporation, meter errors, unaccounted losses;<br><br>Losses of water sent for treatment or disposal in collection (I.2) consists of water lost from the system used to collect, treat or dispose of discharged water, including artificial open channels and trucks used to collect discharged water. | Is "theft" because of "pilferage of fuels or electricity (IRES, §5.19)" part of losses during distribution? |
| during storage | Currently not covered by water statistics. This could change if in the SEEA update water stored in "Artificial Reservoirs" would become a produced asset. Then losses due to evaporation and leakages could be covered here. | Could also include "theft" (both energy and water) |
| during conversion | Currently not covered by water statistics. Could conceptually cover "own use by the water supply industry" and "losses of water during wastewater treatment (leakages, evaporation)". | |
| | | |

| Physical data items for losses from distribution networks and sewerage systems | |
|---|---|
| **I. Losses of water** | **The volume of water (including wastewater) that is lost during distribution and transportation, between the point of abstraction and the point of use, or between the points of use and reuse (e.g., from mains, artificial open channels and trucks), within the territory of reference, per year. Includes water (CPC 18000) and wastewater.** |
| **I.1. Losses of water in distribution** | **The volume of water (CPC 18000) that is lost during distribution and transportation, between the point of abstraction and the point of use, or between the points of use and reuse (e.g., from mains, artificial open channels and trucks), within the territory of reference, per year.** |
| I.1.a. Due to theft | The volume of water taken illegally from mains, artificial open channels or trucks, or from other means of distribution or transport, per year. |
| I.1.b. Due to leakage | The volume of water slowly escaping from mains, artificial open channels and trucks through infiltration, small cracks, holes or gaps, between the point of abstraction and the point of use, or between the points of use and reuse, within the territory of reference, per year. |
| I.1.c. Due to burst mains | The volume of water escaping through breaks in large pipes used for distributing water, within the territory of reference, per year. |
| I.1.d. Due to evaporation | The volume of water escaping from distribution networks to the atmosphere (e.g., from artificial open channels used for distribution) due to vaporization of liquid water to gas, within the territory of reference, per year. |
| I.1.e. Due to meter errors | The volume of apparent water losses due to mistaken meter readings, malfunctioning meters and other meter errors, within the territory of reference, per year. Meters are devices that measure the quantity of water passing through a pipe. |
| I.1.f. Unaccounted losses | The volume of water that escapes from distribution networks in ways other than those classified above (i.e., not due to theft, leakage, burst mains, evaporation or meter errors), within the territory of reference, per year. |
| **I.2. Losses of water sent for treatment or disposal in collection** | **The volume of wastewater lost from sewerage systems, artificial open channels and trucks used to collect wastewater, within the territory of reference, per year.** |

## 2.6 Losses in guidelines for economy-wide material flow accounts

42. Economy-wide material flow accounts is another specific articulation of physical flow accounts. There are two international guidelines:

   a. 2018 Eurostat Handbook economy-wide material flow accounts (EW-MFA)

   b. 2021 UNEP Global Manual on Economy Wide Material Flow Accounting

43. The Eurostat handbook establishes the statistical item ***Dissipative losses (MF7.5)***. It is a sub-flow of what is termed domestic processed outputs (DPO). In SEEA-CF terminology it is a residual, i.e. a material flow from the economy to the environment.

> **4.7.5. Dissipative losses (MF.7.5)**
>
> 464. 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 the transport of goods.
>
> 465. This category includes various types of dissipative flows (abrasion from tyres, friction products, buildings and infrastructures and others). Many of them have never been quantified. It is recommended to fill in only those data that can be provided with a justifiable effort.

44. The UNEP Global Manual introduces ***Dissipative losses (D.5)*** as a residual category of its DPO account.

> **4.6 Dissipative losses**
>
> **4.6.1 Introduction**
>
> 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 accidents during the transport of goods. This includes abrasion from tyres, friction products, buildings and infrastructure, leakages (e.g. of gas pipelines), or from accidents during the transport of goods.
>
> There are only very few data available internationally. Matthews et al. (2000) report estimated data for the abrasion from tyres for Austria, Germany and USA.
>
> **4.6.2 Data compilation**
>
> This category includes various types of dissipative flows. Losses of materials due to corrosion, abrasion and erosion of buildings and infrastructure are assumed to be of significant size and environmental relevance. Another significant unknown flow is the loss of lubricants, which is estimated at about 50 per cent of total lubricant use.
>
> Many of these flows have never been quantified. It is recommended that only those data that can be provided with justifiable effort be completed. The air emission submissions to the UNECE Convention on

# 3 Conceptual options and treatments

## 3.1 Introduction

45. The SEEA-typology of physical flows (natural inputs, products, residuals) is taken for granted.

46. The current SEEA-CF uses the term 'losses' in at least three distinguishable ways, calling for clarification:

    a) In its general meaning, rather unspecific (see above section 2.1): denoting certain physical flows and /or describing their characteristics;

b) SEEA-typology of losses (see above section 2.3.3): a more specific categorisation of losses according to their occurrence-stage on the production chain;

c) Utilitarian characterization of losses (see above section 2.3.2): used to deviate recording recommendations (whether to record or not).

47. These three semantics create incoherent terminology. Particular need for clarification arises from the unclear relation between the SEEA-typology of losses and the SEEA-typology of physical flows.

48. At this stage, no need is seen to keep the utilitarian characterization. It could be removed from chapter III.

49. The key questions for clarification at conceptional level is: Are losses one form of residuals (products), or do losses constitute a separate statistical concept? The clarification of this key question effectuates coherent terminological use and guidelines for recording in the up-dated SEEA-CF.

50. The review of 'losses' in various statistical guidelines (see above chapter 2) seems not to evidence the clear case for introducing a 'new' concept for losses. There seems more evidence to describe losses by means of the SEEA-typology of physical flows.

## 3.2 General description of losses by means of the SEEA-typology of physical flows – and terminology

51. The following Table 4 presents a general description of the four categories of losses employing the SEEA-typology of physical flows (second column) and remarks on the recording in physical flow accounts (third column).

*Table 4: Relation between SEEA-types of losses and SEEA-types of physical flows*

| **SEEA-type of loss according to stage of production chain** | **Description in terms of natural inputs, products, residuals (SEEA- types of physical flows)** | **Recording in physical flow accounts (PSUT)** |
|---|---|---|
| during extraction | Extraction is the physically-balanced process whereby **natural inputs** are converted into **products**. The physical volume of **natural input** that does not end up in the **product** output is a **residual**, that is referred to also a 'loss during extraction'. | Extraction is a production activity and its physical inputs and outputs are recorded in physical supply and use tables accordingly.<br>Extraction activities may supply a range of various residuals next to those that physically originate from the natural input they are extracting (e.g., CO2 emissions from machines). In order to mark 'extraction losses' a dedicated residual class is advisable. |
| during transformation/conversion | Transformation is the physically-balanced process whereby **product** inputs are converted or transformed into **product** outputs. The physical amount of input **products** that do not end up physically in the amount of output **products** is a residual that either remains in the economy or is released to the environment by the very same transformation process. | All production activities are physical transformation processes and the related physical inputs and outputs are recorded in physical supply and use tables accordingly.<br>One might be interested in specific residuals from specific production activities, e.g., electric power plants. In such cases it seems advisable to create respective residual classes. |

| | | |
|---|---|---|
| during distribution | Distribution is a physically-balanced process whereby a given product is transferred from point A (origin) to point B (destination) without any transformation. The physical amount of the given product sent off at point A that does not reach point B (supposed destination) is either a residual in case it is lost for any further economic use, or a product in the case of theft implying that it is available for further use. | Distribution is a production activity and its immaterial output is the service of moving a good. The physical good itself is excluded from the physical inputs and outputs of the distributor. The transported good remains with its owner to whom the physical distribution loss is assigned in the PSUT recording.<br>The distribution might be linked to a change in ownership, in which case the 'PSUT-assignment' is less straightforward (see below). |
| during storage | Storage is here defined as an intra-economy physical stock of products or residuals. Its volume is increased by physical flows added (products or residuals), and its volume is decreased by physical flows (products or residuals) removed. Those removals that do not remain within the economy must flow to the environment and hence are residuals referred to as 'losses during storage'. | Additions and removals of intra-economy stocks are recorded as product and residual flows against PSUT column 'accumulation'. The exact whereabouts of residual removals from intra-economy stocks is not directly recognizable in the physical use table. I.e., it cannot be recognized whether a particular residual removal from stock remains within the economy or is released into the environment unless a specific residual-row-class is established for this particular case. |

52. From Table 4 one may preliminarily conclude that losses of the four types are representable by means of the SEEA-typology of physical flows (natural inputs, products, and residuals) in PSUTs.

53. Further, it seems advisable to create specific residual row-classes for the losses one is interested in. This relates to the clarification of terminology. SEEA-CF physical flow accounts may employ the term losses to label certain classes of physical flows. If appropriate and useful, one should refer to labels or class headings already established in international statistical guidelines (SNA, water and energy statistics).

### 3.3 PSUT-recording of 'losses during distribution'

54. Distribution is a service production activity and most commonly the distributor is not the owner of the transported good. Hence, the physical flow of the transported good is not recordable against the column of the distribution industry. The distribution loss of the transported goods is recorded as a residual supply against the industry that is the owner of the transported good.

55. The transportation/distribution of a goods might be connected to a change of ownership between two resident units or between a resident unit and a non-resident unit. In such cases the economic unit needs to be determined that owns the transported good at the time it is transported and lost. The SNA provides guidelines on the time of recording changes in ownership that can be applied (e.g., SNA 2025 §§ 4.185 ff.).

### 3.4 PSUT-recording of 'losses during storage'

56. A storage loss may be defined as a residual supply from an intra-economy stock that is absorbed by the environment. In order to make it recognisable in PSUT it is necessary to introduce a specific residual row-class (see bottom-right cell in Table 4).

## Excursion (clarification): Output must not be recorded net of recurrent losses from inventories

57. This section clarifies the question raised by Carl Obst in issue paper no. 17 (output to include losses from inventories of finished products). The main issue for clarification concerns recording of output in monetary supply and use tables vis-à-vis to net changes of inventories of finished goods, defined as follows:
    - \+ entries into inventories (produced in the accounting period)
    - – withdrawals from inventories (partly or entirely produced in earlier accounting periods)
    - – losses from inventories (partly or entirely produced in earlier accounting periods)
    - = net changes of inventories of finished goods

    Net changes of inventories may turn negative in case withdrawals and losses exceed the value of entries into inventories.

58. The question for clarification is whether a negative net change of inventories leads to a reduction of output recorded in the monetary use table? This again could imply that output is to be recorded net of losses from inventories. This question was raised by Carl Obst in issue paper 17 (date unknown to the author). The 2019 SEEA-Energy – which apparently was written later than issue paper 17 – is rather clear on this question and concludes that output must not be recorded net of losses from inventories. This is re-confirmed by this guidance note.

59. The numerical example in Figure 3 illustrates and proves that output is recorded including loss from inventories.

*Figure 3: Numerical example illustrating that domestic production output must not be recorded net of recurrent losses from inventories*

**Supply**

| Output (domestic production) P1 | Imports (RoW) P7 | |
|---|---|---|
| 680 | 80 | **760** |

**Use - domestic production and imports**

| Intermediate consumption P2 | Final consumption expenditure P3 | Gross fixed capital formation P51g | changes in inventories and valuables P52 + P53 -20 | | | | | | Exports (RoW) P6 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | entries to inventories | withdrawal from inventories -10 | | recurrent losses from inventories -35 | | changes in valueables P53 | | |
| | | | | produced in current period | produced in previous periods | produced in current period | produced in previous periods | | | |
| 100 | 120 | 500 | 25 | -5 | -5 | -5 | -30 | 0 | 60 | **760** |

**Use - domestic production**

| Intermediate consumption P2 | Final consumption expenditure P3 | Gross fixed capital formation P51g | changes in inventories and valuables P52 + P53 -5 | | | | | | Exports (RoW) P6 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | entries to inventories | withdrawal from -7 | | recurrent losses -18 | | changes in valueables P53 | | |
| | | | | produced in current period | produced in previous periods | produced in current period | produced in previous periods | | | |
| 90 | 110 | 490 | 20 | -2 | -5 | -3 | -15 | 0 | 40 | **725** |

**Use - imports**

| Intermediate consumption P2 | Final consumption expenditure P3 | Gross fixed capital formation P51g | changes in inventories and valuables P52 + P53 -15 | | | | | | Exports (RoW) P6 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | entries to inventories | withdrawal from -3 | | recurrent losses -17 | | changes in valueables P53 | | |
| | | | | produced in current period | produced in previous periods | produced in current period | produced in previous periods | | | |
| 10 | 10 | 10 | 5 | -3 | 0 | -2 | -15 | 0 | 20 | **35** |

## 4 References


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