Standard documentation
Meta information
(Definitions, explanations, methods, quality)

on

Material Flow Accounts

This documentation is valid as of the reporting period:

2013

These statistics were the subject of a feedback quality meeting on 21 May 2012

Status: **23.01.2018**

STATISTICS AUSTRIA
Bundesanstalt Statistik Österreich
A-1110 Vienna, Guglgasse 13
Phone: +43-1-71128-0
www.statistik.at

Directorate Spatial Statistics

Organisational unit
Environmental and Energy Statistics

Contact person:
Sylvia Gierlinger
Tel. +43-1-71128-7184
E-mail: sylvia.gierlinger@statistik.gv.at

Contents

Executive Summary

The aim of the Material Flow Accounts is to show the **physical exchange process between society and nature**. The **flow of materials** is described in a time series starting in 1960 in four key flows: biomass, metal ores, non-metal minerals and fossil fuels.

Material Flow Accounts reflect the importance of resource inputs within an economic system. They illustrate the development of the resource efficiency and material intensity of the Austrian economy.

They are an integrated system of accounts and are prepared using a large number of basic statistics (products of Statistics Austria and external analyses). As such they represent a central element of the Environmental Accounts and supplement the overall description of the economic process delivered by the National Accounts (NA) from a monetary viewpoint. By recording physical flows between the economy and the environment they form an important source of data for sustainable policies.

The calculations follow the logic and criteria of the National Accounts (NA) and estimation methods are used in areas where the available data does not permit any other option.

The data required for calculation of the flow of materials is taken from a series of basic statistics from Statistics Austria (foreign trade statistics, energy balances, harvest statistics, etc.) and from external data sources (Austrian Montanhandbuch (Handbook on Mining and Metallurgical Industries), logging, etc.).

The most important indicators from the Material Flow Accounts are DMI (= **D**irect **M**aterial **I**nput)[1]) and DMC (= **D**omestic **M**aterial **C**onsumption)[2]).

Emissions from imported products that occur during production in their country of origin (ecological rucksack) are not considered during preparation of the Austrian material flow balances.

The results of the Material Flow Accounts, which are published annually, serve the following national and international objectives:

- to assess the orientation and development of resource consumption;
- as a contribution to the set of indicators covered in the project “How’s Austria?” by Statistics Austria which provides information on various dimensions of wealth and progress beyond GDP;
- for the preparation of collective material flow accounts and the collective estimation of raw material equivalents by the Statistical Office of the European Union (Eurostat);
- as a contribution to the monitoring of the Sustainable Development Goals (SDGs) of the United Nations (Goal 12: ensure sustainable consumption and production patterns).

In addition, the results are used in the NAMEA (National Accounting Matrix including Environmental Accounts).

[1] The DMI (domestic used extraction of abiotic materials + domestic used extraction of biotic materials + imports of biotic and abiotic materials) measures the direct extraction and use of materials for economic activities and represents the amount of primary materials used and exploited directly for production and consumption. This indicator is measured in tonnes.

[2] The DPO (domestic processed output, i.e. materials released back to nature) is the total weight of residual materials flowing to the domestic environment. This indicator includes air emissions, waste, material loads in wastewater and dissipative material losses, such as those resulting from product abrasion or corrosion or from fertiliser use in agriculture.

Material Flow Accounts – Important elements	
Main purpose of the statistics	Material flows within the Austrian economy in physical units
Observed unit / reporting unit / presentation unit	All solid, liquid and gaseous materials extracted from the environment or imported that flow into the economic system of a national economy
Type of statistics	Integrated system of statistics
Data sources/Survey techniques	Basic statistics of Statistics Austria • Foreign trade statistics • Austrian energy balances • Physical energy flow accounts (PEFA) • Road vehicles statistics • Short-term business statistics survey • Crop and livestock production data • Livestock • Supply balance sheets • Harvest statistics • Hunting statistics Other data sources • Austrian Montanhandbuch (Handbook on Mining and Metallurgical Industries), Federal Ministry of Sustainability and Tourism (BMNT) • Federal Waste Management Plan, Environment Agency Austria • Logging report, Federal Ministry of Sustainability and Tourism (BMNT) • Air emission and greenhouse gas inventory, Environment Agency Austria • Report on waste water treatment plants in Austria, Environment Agency Austria • "Grüner Bericht" (BMNT)
Reference period or due day	Calendar year
Periodicity	Annual
Survey participation	Not relevant
Legal bases	National legal basis: agreement under private law with the Federal Ministry of Sustainability and Tourism EU legal basis: Regulation (EU) No 691/2011 of the European Parliament and of the Council of 6 July 2011 on European environmental economic accounts
Regional breakdown	Austria
Availability of the results	t + 2 years
Other	Domestic concept, time series from 1960, revision of time series in the case of revisions in the basic statistics

1. General information

1.1 Objective and purpose, history

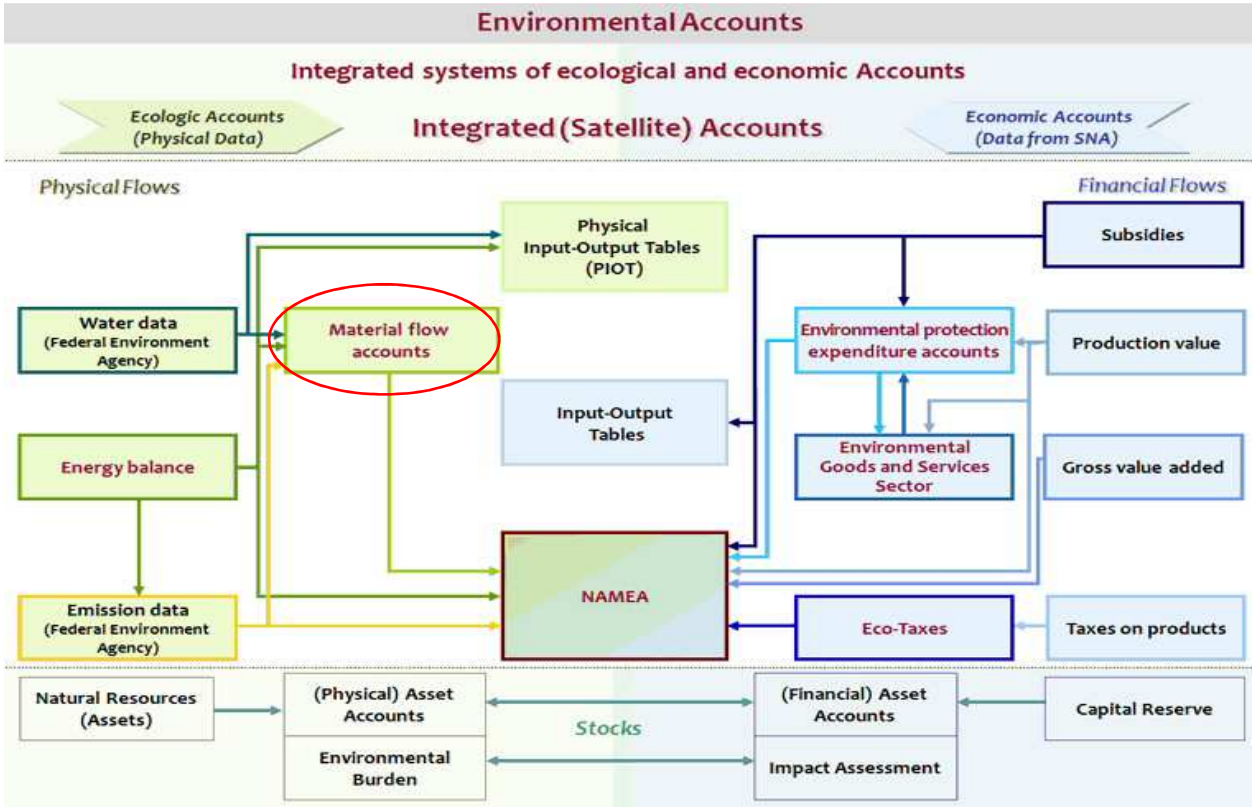
Environmental data can be found as cross-disciplinary material in many areas of statistics. It relates both to physical and financial variables since environmental statistics are concerned primarily with social and economic activities and their effects on environmental systems as well with the condition of and changes to media (soil, water, air, etc.). Environmental statistics are supplemented with data relating to responses (measures) of the state (e.g. the obligation for motor vehicles to be fitted with catalytic converters), enterprises, households and international organisations to existing or threatening adverse effects.

The tasks of environmental statistics relate primarily to

- environment-specific transactions in the National Accounts (NA) (environmental protection expenditure, environmental taxes, environment-oriented industries);
- **Material Flow Accounts** and physical accounts (material flows: raw materials, foodstuffs, goods, water, pollutants);
- the linking of monetary data and economic indicators relating to environmental impact caused by pollutant emissions, e.g. within the framework of a NAMEA matrix (National Accounting Matrix including Environmental Accounts);
- aspects of environmental quality (e.g. water, soil, ecosystems, species diversity, landscape, etc.) and
- natural resource accounts, although only to a limited extent.

All these tasks are grouped together under the term Environmental Accounts (see Fig. 1). The Material Flow Accounts are a sub-project of the Environmental Accounts.

Fig. 1: Environmental Accounts



Source: Statistics Austria.- *) Net taxes on products (excluding subsidies)

"Natural resources such as energy sources, metals, minerals, biomass and water form the basis for our life on this planet and must therefore not be squandered carelessly at the cost of coming generations" – Resource Efficiency Action Plan (BMLFUW, 2010).

An absolute reduction in resource consumption and a clear increase in national resource efficiency not only have a positive effect on the environment because of the automatic lessening of waste, emissions and other environmentally damaging effects, they also contribute to the reliability of supply at national and global level (European Union, 2011[3]).

"The transition to a more circular economy, where the value of products, materials and resources is maintained in the economy for as long as possible, and the generation of waste minimised, is an essential contribution to the EU's efforts to develop a sustainable, low carbon, resource efficient and competitive economy. – The EU's action plan towards a circular economy (COM(2015)614).

Detailed analyses of resource consumption at sectoral and other levels can be performed with the aid of the Environmental Accounts (EnvA), which expand the National Accounts (NA) with the addition of environmentally relevant "satellite accounts".

One component of the EnvA is the Material Flow Accounts (MFA), which enable the physical process of exchange between society and nature to be depicted. The overall material flow is described here in four main material flows – mineral materials (metal ores and non-metal minerals), biomass and fossil fuels.

The data in the Material Flow Accounts serve the following national and international purposes:

- to assess the orientation and development of resource consumption;
- as a contribution to the set of indicators covered in the project "How's Austria?" by Statistics Austria which provides information on various dimensions of wealth and progress beyond GDP;
- for the preparation of collective material flow accounts and the collective estimation of raw material equivalents by the Statistical Office of the European Union (Eurostat);
- as a contribution to the monitoring of the Sustainable Development Goals (SDGs) of the United Nations (Goal 12: ensure sustainable consumption and production patterns).

In addition, the results are also used in the NAMEA (National Accounting Matrix including Environmental Accounts).

The background to the Material Flow Accounts is dealt with in the following section.

One of the most important tasks of humankind is to maintain our natural environment. As early as 1992, Agenda 21[4]), a product of the UN Conference on Environment and Development held in Rio de Janeiro, called for the more frugal use of natural resources such as drinking water and raw materials (wood, fossil fuels, etc.).

This call for the more sustainable management of natural resources is informed by various environmental aspects. For instance, unlimited extraction would not only affect the entire environment, our survival would also ultimately be threatened. It is only possible to counter this possibility if one knows the consumption level of renewable and non-renewable raw materials and can therefore counter the excessive extraction of non-renewable raw materials. In terms of sustainable resource use, it is important only to extract the amount of renewable raw materials that can at the same time be regenerated.

A further aspect relates to the effects of our activities on the environment. As well as being our immediate living space, we also view the environment as the supplier of raw materials for production, intermediate consumption and final consumption. It serves as a depository for waste and contaminants, which are either dumped or absorbed. The sum of these processes is known as the "industrial metabolism".

The extraction of resources and the establishment of infrastructure normally require the movement of large volumes of materials (e.g. extraction of mineral materials for the manufacturing and construction industries, the sealing of the soil with roads and buildings, flow regulation and hydropower plants, imports of fossil fuels, etc.). Although the volume of materials does not in itself indicate harmfulness, the environment can be directly or indirectly impacted to a considerable extent by the processing of the materials. These material flows are only partially depicted in the traditional National Accounts (NA).

---

[3] Resource-efficient Europe – a flagship initiative within the Europe 2020 Strategy.

[4] United Nations, Division for Sustainable Development, Rio de Janeiro, Brazil, June 1992: Agenda 21 is a comprehensive plan of action to be taken globally, nationally and locally by organisations of the United Nations System, Governments, and Major Groups in every area in which humankind impacts on the environment.

In order to be displayed to their full extent, such flows must be recorded and shown as part of the economy that cannot be measured in monetary terms (in euros) but in physical units (e.g. tonnes (t)), for instance emissions of pollutants into the atmosphere. The aim of the Material Flow Accounts, particularly in relation to the concept of "sustainable development", consists of the statistical recording of those material flows caused by economic activities that take place between the economy and the environment as well as within the economy.

Material flows that cross the boundaries between the environment and economy are recorded in the Material Flow Accounts. On the other hand, material flows within the economy are the subject of the physical input-output tables. The balancing of internal and "cross-boundary" material flows together forms the core of the EnvA, which in turn as a satellite system to the NA constitutes the link between environment and economy. Natural flows into or out of a geographical territory (e.g. cross-boundary flow of water in rivers or the cross-boundary transfer of air pollutants) are not included.

The Material Flow Accounts enable the significance of resource consumption within economic systems to be visualised. In particular, the link between environmentally relevant and economic processes was addressed in the course of sustainability discussions[5]) both nationally and internationally and forms one of the basic principles of the Material Flow Accounts, both in terms of the development of the concept and in its application. For instance, the indicators derived from the Material Flow Accounts, such as the DMI (direct material input) and the DMC (domestic material consumption), are used to examine resource efficiency and material productivity. Indicators derived from the Material Flow Accounts are also important for the evaluation of sustainability concepts. In addition, the relationship between the extraction of renewable and non-renewable raw materials can be displayed. For this purpose the inputs necessary for the economy are separated into biotic (renewable) and abiotic (fossil fuels and mineral materials – non-renewable) materials and depicted in four key flows: biomass, metal ores, non-metal minerals and fossil fuels.

An initial time series for material inputs into the Austrian economy was calculated in 1994 at the Institute (now Faculty) for Interdisciplinary Research and Continuing Education (IFF) - Social Ecology of the University of Klagenfurt (now Alpen Adria University) for the time period 1970 to 1990[6]). This was subsequently[7]) expanded in terms of methodology and timeframe (1960 to 1995). In 1998, the MFA in this form were added to the programme of work of Statistics Austria within the framework of a cooperation project between the IFF and Statistics Austria (then the Statistical Central Office) and subsequently performed at irregular intervals. In 2000, the time series for the period 1960 to 1995 was revised and the years 1996 and 1997 were added[8]). A plausibility test for the input side was performed at the time by means of a methodological further development for the input-output balance[9]). Since 2003, the MFA have been prepared annually. In 2007, the data presentation was adapted to the Eurostat standard tables[10]) and the manual issued by Eurostat on the practical preparation of Material Flow Accounts[11]). The manual and the questionnaires of this module of Regulation (EU) No 691/2011 are adjusted regularly, most recently in September 2013[12]).

In 2010, in a project commissioned by the former Federal Ministry for Agriculture, Forestry, Environment and Water Management (BMLFUW) and the former Federal Ministry of Economy, Family and Youth (BMWFJ) together with the IFF, an estimate of extraction of mineral raw materials for the period 1995 to

---

[5] The concept of the "sustainability strategy" goes back to the Brundtland Report: "The world must quickly design strategies that will allow nations to move from their present, often destructive, processes of growth and development onto sustainable development paths." (Brundtland Report 1987, p. 52).

[6] Steurer, A. 1994. Stoffstrombilanz Österreich 1970-1990 [Austrian material flow balance 1970-1990]. Social Ecology publication series. Volume 34. Vienna: IFF in-house publication (in German).

[7] Schandl, H. 1997: Materialfluss Österreich. Die materielle Basis der österreichischen Gesellschaft im Zeitraum 1960 bis 1995. Schriftenreihe Soziale Ökologie. Band 50. [Austrian material flows. The material basis of Austrian society in the period 1960 to 1995. Social Ecology publication series. Volume 50]. Vienna: IFF in-house publication (in German).

[8] Schandl, H.; Weisz, H. and Petrović, B. 2000. Materialflussrechnung für Österreich 1960 bis 1997 [Material flow accounts for Austria 1960 to 1997]. Statistische Nachrichten 55 (NF)(2); pp. 128-137 (in German).

[9] Weisz, H.; Schandl, H. and Fischer-Kowalski, M. 1999. OMEN – An Operating Matrix for Material Inter-relations Between the Economy and Nature. How to Make Material Balances Consistent. In: Kleijn, R.; Bringezu, S; Fischer-Kowalski, M. and V. Palm (eds.). Ecologizing Societal Metabolism: Designing Scenarios for Sustainable Materials Management. CML Report 148. Leiden: University Papers. pp. 160-165.

[10] Petrović, B. Materialflussrechnung, Inputreihe 1960 bis 2005, Projektbericht [Material flow accounts, input series 1960 to 2005, project report]. Statistics Austria 2007, Appendix, Description of Methodology.

[11] "Economy Wide Material Flow Accounts (EW-MFA) – Compilation Guidelines for Eurostat's 2011 EW-MFA questionnaire" (Eurostat, May 2011).

[12] "Economy Wide Material Flow Accounts (EW-MFA) – Compilation Guide 2013 (Eurostat 10. September 2013).

2008 was performed in order to eliminate any under-recording[13]). The results of the project were integrated into ongoing work and the existing time series was correspondingly revised.

1.2 Contracting entity

Federal Ministry of Sustainability and Tourism

1.3 Main users

Internal:

- Input for the Integrated NAMEA

External:

- Federal ministries, e.g. Federal Ministry of Sustainability and Tourism
- Federal Chancellery
- Interest groups
- University and non-university research institutes (WIFO, WU, IFF, Technical University of Vienna, Johannes Kepler University Linz, etc.)
- Organization for Economic Co-operation and Development (OECD)
- Statistical Office of the European Union (Eurostat)

1.4 Legal basis

Regulation (EU) No. 691/2011 of the European Parliament and of the Council of 6 July 2011 on European environmental economic accounts

Regulation (EC) No. 2150/2002 of the European Parliament and of the Council of 25 November 2002 on waste statistics

Regulation (EU) No. 1099/2008 of the European Parliament and of the Council of 22 October 2008 on energy statistics

The work performed currently on the Material Flow Accounts by Statistics Austria is based on the Agreement on the Supply of Data in the Area of Environmental and Energy Statistics (contract no.: UW.1.4.18/0074-V/2/2012), concluded between the Federal Ministry of Agriculture, Forestry, Environment and Water Management (BMLFUW) and the Statistics Austria Federal Institute. The term of the Agreement is from 1 January 2013 to 31 December 2017 inclusive. Negotiations with the BMNT regarding a new five-year agreement are currently under way.

2. Concepts and Processing

2.1 Statistical concepts and methodology

2.1.1 Statistical purpose

The purpose is the annual recording and tabular display of the material flows within the Austrian economy in physical units (tonnes), based on the basic statistics of Statistics Austria and external assessments (see the section "Data sources"). These material flows comprise the totality of all materials that enter the national economy, are processed internally and leave again within a specified period of time.

[13] Eisenmenger, N.; Milota, E. and Schaffartzik, A.: "Ressourcendaten – Verbesserung des statistischen Datenmaterials im Bereich natürlicher Ressourcen" ["Resource data – improvement of the statistical data materials in the area of natural resources], project report, Vienna 2011 (in German).

Material Flow Accounts deal with *one* aspect of the addition of environmental statistics to the National Accounts (NA) in the form of the Environmental Accounts (EnvA) satellite account. Satellite accounts have the task of depicting the effects of socioeconomic activities on the environment in a framework consistent with the NA without changing the accounts systems of the NA themselves. Their preparation is based on the premise that the NA do not adequately take into account the negative external effects of economic development (environmental impacts). The overall extraction by the national economy of natural resources from the environment is particularly highlighted in connection with the requirements of sustainable consumption and business behaviour.

The concept here is based on the view of national economies as input-output systems that maintain a metabolic relationship with nature and other national economies. National economies organise their relationship of material and energy exchange with nature within this economic (or social) metabolic system. Material is extracted from nature, processed, accumulated in the form of stocks of material in society (e.g. buildings, roads, vehicles and long-term consumer goods) and ultimately, at the end of the chain, returned to nature in the form of waste and emissions. The material metabolism thereby delivers a comprehensive picture of our environmental problems. The main themes of the environmental debate – waste and emissions – are only a small part of what the annual material flow involves[14]).

The input side of the Austrian material balance depicts the volume of materials input annually. Water and air inputs are not recorded. The balance includes materials (excluding water and air) that are taken from the domestic natural environment or imported from other national economies. This also serves to describe the system boundary of the balance on the input side, which forms a functional boundary between the Austrian national economy and nature as well as between the Austrian national economy and other national economies.

The recording of the annual material input differentiates between biomass, mineral materials, fossil materials and products. These highly aggregated material groups are compiled using a top-down approach on the basis of existing and periodically available data sources. The central data sources for the input side of the material balance are the agricultural statistics, mining statistics, parts of the industrial and commercial statistics as well as foreign trade statistics. The calculation of the annual material input is performed in line with and kept compatible with the logic and criteria of the National Accounts (NA). This leads to difficulties in those areas where material flows that are not (or not completely) economically assessed make a significant contribution in terms of volume to the overall material inputs, for instance mineral raw materials and grazed biomass.

In such cases plausible estimates or secondary statistics are used, whereby the basic principle is that the data sources used for the estimation processes must be available for multiple years at least. Special studies based on a single year are not used for the time series.

All materials flows, e.g. exports and transfers to the natural environment, from a socioeconomic system are included in the output accounts.

On the output side of the Material Flow Accounts some data, with the exception of exports, is only available in rudimentary form; increased use must be made here of calculation models in order to obtain continuous number series. The currently available series should therefore be viewed solely as approximate values that are to be added to and improved subsequently.

When creating the output series, available physical data is used, e.g. from the agricultural statistics, supply balance sheets, foreign trade statistics, Integrated NAMEA, Federal Waste Management Plan, emissions statistics, energy balances and material statistics. Similarly to the import series, the data reported there is converted, if necessary, into tonnes and/or derived from the available statistical data. No primary data is collected.

2.1.2 Observed unit / reporting unit / presentation unit

The **observed units** are all material flows within the Austrian national economy, both on the input side (extraction from the environment, imports) and on the output side (return to nature (emissions to air and water, waste) and exports).

[14] See the discussion by Jänicke 1995: Tragfähige Entwicklung: Anforderungen an die Umweltberichterstattung aus Sicht der Politikanalyse. In: Bringezu, S. Hrsg.: Neue Ansätze der Umweltstatistik. Ein Wuppertaler Werkstattgespräch [Sustainable development: Challenges for environmental reporting from the point of view of political analysis. In: Bringezu, S., publishers: New approaches in environmental statistics. A Wuppertal workshop discussion]. Berlin, Basel, Boston: Birkhäuser. pp. 9-25 (in German).

Reporting units

No dedicated surveys. For information on reporting units please refer to the relevant basic statistics.

Presentation units:

The material flows necessary for the national economy are separated into biotic (renewable) and abiotic (fossil fuels and mineral materials, non-renewable) materials and then depicted – on the input and output side – in four material flows: "fossil materials", "metal ores", "non-metal materials" and "biomass".

Input side

Domestic material extraction

(Domestic material extraction includes all solid, liquid and gaseous materials taken from the environment and that then flow into the economic system of a national economy.)

Biotic raw materials

- Biomass
    - Crops (excluding fodder crops)
    - Used crop residues, fodder crops, grass (directly grazed)
    - Wood
    - Wild fish catch, aquatic plants/animals, hunting and gathering

Abiotic raw materials

- Metal ores (gross ores)
    - Iron
    - Non-ferrous metal
- Non-metalic minerals
    - Non-metal minerals – primarily for industrial processing
    - Non-metal minerals – construction minerals
- Fossil energy materials/carriers
    - Coal and other solid energy materials/carriers
    - Liquid and gaseous energy materials/carriers

Imports

- Biomass and biomass products
    - Crops raw and processed
    - Crop residues and fodder crops
    - Wood and wood products
    - Fish capture and other aquatic animals and plants, raw and processed
    - Live animals other than aquatic animals, and animal products
    - Products mainly from biomass
- Metal ores and concentrates, raw and processed
    - Iron ores and concentrates, iron and steel, raw and processed
    - Non-ferrous metal ores and concentrates, raw and processed
    - Products mainly from metal
- Non-metallic minerals, raw and processed

    - Non-metal minerals – mainly for industrial use, raw and processed
    - Non-metal minerals – construction minerals, raw and processed
    - Products mainly from non-metal minerals
- Fossil energy materials/carriers, raw and processed
    - Coal and other solid energy products, raw and processed
    - Liquid and gaseous energy products, raw and processed
    - Products mainly from fossil fuels
    - Other products
    - Waste imported for final treatment and disposal

Output side

Domestic processed output

- Emissions to air
    - Carbon dioxide (CO_2)
    - Methane (CH_4)
    - Nitrous oxide (N_2O)
    - Nitrogen oxides (NO_x)
    - Hydrofluorocarbons (HFCs)
    - Perfluorocarbons (PFCs)
    - Sulphur hexafluoride
    - Carbon monoxide (CO)
    - Non-methane volatile organic compounds (NMVOC)
    - Sulphur dioxide (SO_2)
    - Ammonia (NH_3)
    - Heavy metals
    - Persistent organic pollutants (POPs)
    - Particles (e.g. PM10, dust)
    - Other
- Waste disposal
    - Disposal of municipal waste to the environment
    - *Memo item: Disposal of municipal waste to controlled landfills*
    - Disposal of industrial waste to the environment
    - *Memo item: Disposal of industrial waste to controlled landfills*
- Emissions to water
    - Nitrogen (N)
    - Phosphorous (P)
    - Heavy metals
    - Other substances and (organic) materials
    - Dumping of materials at sea
- Dissipative use of products
    - Organic fertiliser (manure)

- Mineral fertiliser
- Sewage sludge
- Compost
- Pesticides
- Seeds
- Salt and other thawing materials spread on roads (incl. grit)
- Solvents, laughing gas and other

- Dissipative losses (e.g. tyre abrasion, abrasion products, etc.)

Exports are classified in the same way as imports

Selected balance items are shown as **additional information**, such as:

- Input-side
  - Oxygen for combustion processes
  - Oxygen for respiration of humans and livestock; bacterial respiration from solid waste and wastewater
  - Nitrogen for the Haber-Bosch process[15])
  - Water requirements for the domestic production of exported beverages
- Output-side
  - Water vapour from combustion
  - Gases from respiration of humans and livestock (CO_2 and H_2O), and from bacterial respiration from solid waste and wastewater (H_20)
  - Excorporated water from biomass products

2.1.3 Data sources, coverage

Data sources:

The following *basic statistics from Statistics Austria* are used for the Material Flow Accounts:

- Coal, oil, natural gas
  - Foreign trade statistics
  - Austrian energy balances
- Mineral raw materials (metal ores, non-metal materials)
  - Foreign trade statistics
  - Short-term business statistics
  - Supply and use tables
- Biomass
  - Foreign trade statistics
  - Crop and livestock production
  - Harvest statistics
  - Land use statistics

[15] The Haber-Bosch process is used for the synthetic production of ammonia from nitrogen and hydrogen.

- Hunting statistics

- DPO
  - Livestock
  - Supply balances
  - Road vehicle register
- Balancing items
  - Population
  - Livestock
  - Physical Energy Flow Accounts (PEFA)
  - Foreign Trade Statistics
  - Short-term business statistics

Other data sources

- Mineral raw materials (metal ores, non-metal materials)
  - Austrian Montanhandbuch, Federal Ministry of Sustainability and Tourism
- Biomass
  - Logging report, Federal Ministry of Sustainability and Tourism (BMNT)
- DPO
  - Federal Waste Management Plan, Environment Agency Austria
  - Air emission- and greenhouse gas inventory, BMNT
  - Report on waste water treatment plants in Austria, Environment Agency Austria
  - "Grüner Bericht" (BMNT)
- Balancing items
  - Air emission- and greenhouse gas inventory, BMNT

Coverage:

The Material Flow Accounts cover all material flows within the Austrian national economy.

2.1.4 Reporting unit and respondents

Not relevant for the Material Flow Accounts. For information on the reporting unit/respondents please refer to the relevant basic statistics used for the preparation of these statistics.

2.1.5 Survey format

Not relevant for the Material Flow Accounts as they are not a survey in the conventional sense. For information on the survey format please refer to the standard documentation (in German only) of the relevant basic statistics.

2.1.6 Sample characteristics

Not relevant for the Material Flow Accounts. For information on the sample characteristics please refer to the standard documentation (in German only) for the relevant basic statistics.

2.1.7 Survey techniques / data transmission

Survey techniques

The Material Flow Accounts are synthesis-based statistics and no separate data surveys are performed. The data to be used is available from basic statistics in electronic format (database files, Excel tables, etc.). This data is transferred to the current application in the form of database analyses. In addition, publications are used (manual data transfer from print publications or by downloading from the Internet).

Data transmission

Please refer here to the standard documentation (in German only) for the relevant basic statistics.

2.1.8 Survey questionnaire (including explanatory notes)

Not relevant for the Material Flow Accounts. For information on the survey questionnaire please refer to the standard documentation (in German only) for the relevant basic statistics.

2.1.9 Survey participation

Not relevant for the Material Flow Accounts. For information on the surveys please refer to the standard documentation (in German only) for the relevant basic statistics.

2.1.10 Variables surveyed and derived, indicators (including definitions)

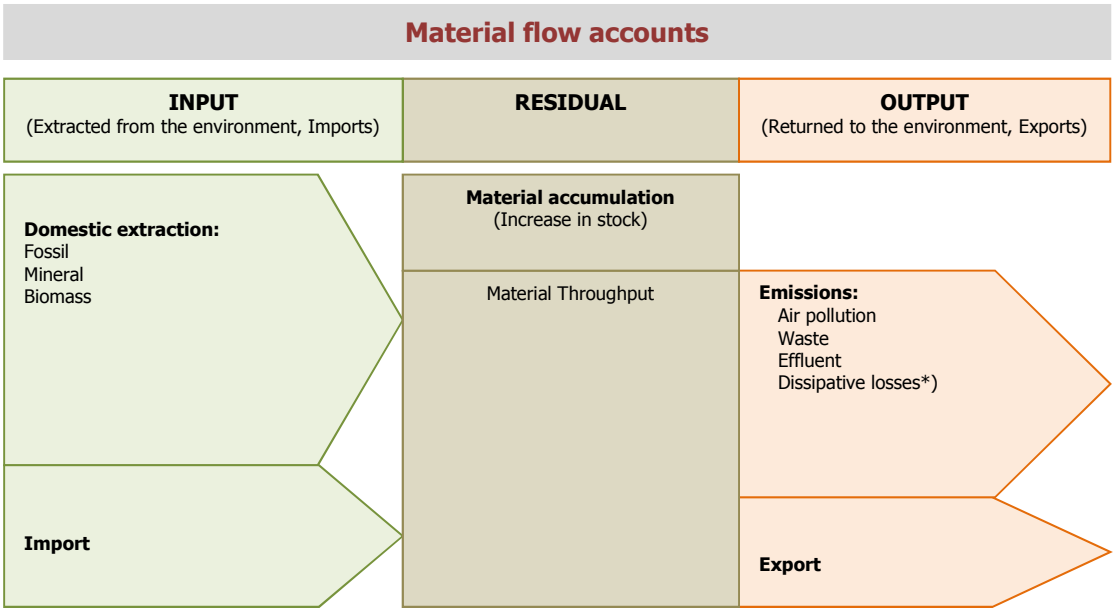
Survey items:

Not relevant for the Material Flow Accounts. For information on the survey items please refer to the standard documentation (in German only) for the relevant basic statistics.

Variables derived:

All material flows through socioeconomic systems are recorded and displayed in physical units (tonnes) in the Material Flow Accounts. Material Flow Accounts can be prepared for various socioeconomic systems, e.g. for companies, economic sectors, regions or national economies. In each case they cover the totality of all materials that a system takes in, internally processes and gives back again within a defined time period.

Fig 2: Basic scheme of material flow accounts



Source: EUROSTAT. -*) Tyre and brake abrasion are grouped together as dissipative losses.

In addition to the absolute values for the variables in the Material Flow Accounts (such as domestic extraction, imports and exports), indicators derived from the Material Flow Accounts are also analysed – e.g. DMI (direct material input) and DMC (domestic material consumption) – and are used amongst other

things to examine resource efficiency and material productivity. Indicators derived from the material flow analysis are also important for the evaluation of sustainability concepts.

2.1.11 Classifications used

The Material Flow Accounts are based on the Eurostat methodology manuals "Economy-wide material flow accounts (EW-MFA)" and "Economy-wide material flow accounting (EW-MFA). Manual 2016 on DPO and Balancing Items". The basic data is recorded within the ÖNACE divisions and groups based on the PRODCOM and Combined Nomenclature (CN) as well as the codes standard in agriculture (these do not however represent a classification in the strict sense of the former systems).

For more detailed information please refer to the standard documentation (in German only) for the relevant basic statistics.

2.1.12 Regional breakdown of the results

The results are shown for Austria.

2.2 Production of statistics, processing, quality assurance measures

2.2.1 Data capture

Not applicable for the Material Flow Accounts.

The basic data is prepared for the purposes of the Material Flow Accounts and displayed in the form of a matrix. For more information about collection of the basic data please refer to the standard documentation (in German only) for the relevant basic statistics.

2.2.2 Coding

Not relevant for the Material Flow Accounts. Coding is performed in the basic statistics. For more information please refer to the standard documentation (in German only) for the relevant basic statistics.

2.2.3 Editing and verification of data sources used

No separate plausibility checks are performed since it can be assumed that the data has already been subject to a plausibility check during its production. See also the standard documentation (in German only) for the relevant basic statistics.

However, where there are serious deviations from previous years, explanations are sought from the producers of the basic statistics and/or experts.

2.2.4 Imputation (where responses are missing or data incomplete)

Not applicable for the Material Flow Accounts. Imputation is performed in the basic statistics. Therefore, please refer to the standard documentation (in German only) for the relevant basic statistics.

2.2.5 Grossing up procedures (weighting)

Not applicable for the Material Flow Accounts. Grossing up is performed in the basic statistics. Therefore, please refer to the standard documentation (in German only) for the relevant basic statistics.

2.2.6 Compilation of the final data set, (other) models and statistical estimation techniques used

Calculation models and estimation techniques are used in those areas where materials flows that are not (or not completely) economically assessed make a significant contribution in terms of volume to the overall material inputs, for instance mineral construction materials and grazed biomass.

In such cases plausible estimates (developed together with experts, e.g. IFF) or secondary statistics are used, whereby the basic principle is that the data sources used for the estimation processes must be

available for multiple years at least. Special studies based on a single year are not used for the time series.

The methods used for the calculation as well as the estimation factors used are based on the methodological guidelines in the Eurostat methodology manuals "Economy-wide material flow accounts (EW-MFA)" and "Economy-wide material flow accounting (EW-MFA). Manual 2016 on DPO and Balancing Items". They are broadly described and can be found in the methodology reports on the Input side and Output accounts. For illustration purposes the methods and calculation steps used for two example product groups are shown below.

Example 1 – Grazed biomass:

The volume of directly grazed grass (green fodder) can be estimated in two ways:

1. Supply calculation: Here the potential grass supply is calculated based on the area of grazing land
2. Requirement calculation: The requirement for grazing is calculated from the fodder requirement per ruminant x livestock numbers minus marketable and non-marketable fodder

The standard international practice is to use the lower of the two estimates.

Re. 1: Supply calculation:

Grass per unit of area x area of grazing land.

The following factors are used for productivity, i.e. the amount of grass per unit of area:

Mountain pastures and meadows are converted from 1973 onwards using yield factors based on the area in hectares. In accordance with Buchgraber[16]), mountain pastures are calculated at 100 kg/15 ha and mountain meadows at 100 kg/20 ha. This gives an average of 17.5 ha per 100 kg.

Re. 2: Requirement calculation:

The requirements for directly grazed grass are calculated as follows:

a. Marketable fodder minus fodder requirements of pigs and hens (weighted by egg production)
b. Result from a. x 1.5 (here it is assumed that marketable fodder has a higher energy value and therefore produces more)
c. Result from b. + non-marketable fodder
d. Fodder requirements of coarse fodder consuming livestock minus result of c.

Result: Grazed grass as dry mass – according to Eurostat a water content of 15% should be assumed for the MFA.

The calculation for Austria shows the result of the supply calculation being lower than that of the requirement calculation. Therefore, as described above, in accordance with standard practice the supply calculation is used for the preparation of the MFA.

Example 2 – Sand/gravel, clay/loam and limestone as components of mineral raw materials:

Loam and clay

The input of loam and clay can be estimated based on brick production, with 0.22 tonnes of crude clay required to produce 1 m² of bricks, and 2.2 tonnes of crude clay required to produce 1 m³ of bricks respectively.

Limestone

The input of limestone in cement production can be used as an approximation figure for estimation of limestone consumption:

Cement production (t) x 1.19 ≙ limestone for cement production

[16] Buchgraber, K., Ertragspotentiale und Artenvielfalt auf Grünlandstandorten im Berggebiet; MAB-Forschungsbericht: Landschaft und Landwirtschaft im Wandel [Yield potentials and species diversity in grassland regions in mountainous areas; MAB research report: Landscape and agriculture in transformation], Akademie der Wissenschaften, 22-23 September 2000, Vienna.

Sand/gravel

Sand and gravel are the main components in the production of cement and ready-mix cement, as well as important basic materials in road construction. With the assistance of empirical values (Eurostat Economy-wide Material Flow Accounts Questionnaire 2009), the consumption of sand and gravel for these purposes can be estimated as follows:

1. One tonne of concrete consists on average of 6% air, 11% Portland cement, 41% gravel or crushed stone, 26% sand and 16% water ⇨

$$\frac{\text{Production volume of ready-mix concrete (t) x input of sand (26\%) gravel (41\%)}}{100} \cong \text{sand and gravel consumption}$$

2. The input of sand and gravel in cement production is approx. 1:6.09 cement to sand/gravel:

$$\text{t cement consumption (= production + imports - exports) x 6.09} \cong \text{t input of sand and gravel}$$

3. Values for Germany can be used in order to derive an approximate estimate of the input of sand and gravel in road construction (new-build and maintenance):

	Tonnes of sand and gravel per km	
	for new-build	For annual maintenance
Highways/motorways	28,383	518
National roads	9,692	151
Federal state roads	8,719	76
District roads	6,777	65
Local roads	5,729	67

This approach, i.e. a consumption-side estimate, cannot be used for the MFA since insufficient information is available regarding the number of kilometres of new road construction and, particularly, the number of kilometres of maintenance work.

The estimates for the years up to 2007 are therefore based on the results of the short-term business statistics. The production of those companies that are not recorded in the short-term statistics because of their small size or sector classification was estimated.

Assuming that the production of the products under consideration takes place solely as characteristic production, the corresponding characteristic production can be calculated from the Structural Business Statistics (SBS). Since as a result of projections and estimates the SBS also includes production from enterprises not recorded by the short-term business statistics because of the cut-off criterion, these results were correlated with characteristic production according to the short-term business statistics. Using the estimation factors thereby derived, estimates were made for the production of those enterprises that do not form part of the short-term business statistics because of their small size.

From 2008 onward results from the estimate of units not subject to reporting obligations are available in the short-term business statistics because of the addition of model-based data (see the methodology report entitled Modellbasierte Datenergänzung der Konjunkturstatistik im Produzierenden Bereich [Model-based data additions in the short-term business statistics] (in German).

By using the supply table from the National Accounts, additional estimation factors can be obtained for production from mining and quarrying by economic sectors outside the manufacturing sector. Here it is assumed that the production of construction raw materials is limited in the non-manufacturing sector to the following product groups: natural sands (ÖPRODCOM 2000-2007: 14.21.11, ab 2008 ÖPRODCOM: 08.12.11) and granules, chippings and powder of stones; pebbles and gravel (ÖPRODCOM 2000- 2007: 14.21.12, ab 2008 ÖPRODCOM: 8.12.12), and that the relationship of the two groups to each other corresponds to the relationship in overall production to construction raw materials as per the first estimation step.

The calculation models used for the estimation of mineral raw materials are shown in detail in the methodology report entitled Ressourcendaten – Verbesserung des statistischen Datenmaterials im

Bereich natürlicher Ressourcen [Resource data – improvement of the statistical data in the area of natural resources] (in German).

2.2.7 Other quality assurance measures

The results of this project are presented to the contracting entity in the form of a project report. This is checked by the contracting entity – with assistance from outside experts – to ensure the various technical requirements are met and then officially accepted in accordance with the agreement.

The concept and any problems arising during the work and planned amendments are discussed in the regular (monthly) project group meetings with the contracting entity. The contracting entity and Statistics Austria both have the right to invite outside experts to these project group meetings.

The ongoing work and planned amendments are presented to and discussed with the contracting entity, special interest groups, data users and experts in an annual meeting with the Environment Advisory Committee. Recommendations from the Advisory Committee are – as far as is possible and feasible – taken into account.

The professional development of staff and the implementation of new methodological approaches are ensured by participation in workshops and working parties (Eurostat).

2.3 Publication (accessibility)

2.3.1 Preliminary results

Are not published.

2.3.2 Final results

Annually in July, t+2, i.e. data for 2016 are available in 2018.

2.3.3 Revisions

The term "revision" refers to the reworking of results, e.g. by the inclusion of new data, new statistics and/or new methods in the calculations. Here a distinction is made between ongoing revisions that relate to minor corrections for individual years and major revisions. The latter involve the fundamental reworking of the entire calculations. Since methodological discussions are still ongoing regarding the MFA, particularly at international level, revisions have been and will be performed from time to time. For example, the calculation is currently being adapted to the regulations of EU Directive 691/2011. Revisions are also required when revisions are undertaken within the basic statistics. In these cases the entire time series is normally revised in order to ensure comparability of the data over time.

2.3.4 Publication media

The results are published in the following publication media of Statistics Austria:

Internet:

Statistics Austria website – Environment

Statistische Nachrichten (in German only)

Statistisches Jahrbuch Österreichs (contents and headings in English, otherwise in German only)

The results are also forwarded to the contracting entity in the form of a project report.

2.3.5 Treatment of confidential data

Does not apply to integrated accounts systems in general as mostly anonymised data from specialised statistics is used. No individual data is used since the MFA relate to macroeconomic issues.

3. Quality

3.1 Relevance

Statistics are relevant if user needs can be optimally met.

To this end, the Material Flow Accounts are the subject of an annual Environment Advisory Committee working group meeting at which ongoing work and planned amendments are discussed with the contracting entity, interest groups, data users and experts. As far as is possible and feasible, any suggestions (regarding both content-related and publication-related aspects) are taken into account in the calculations.

The methodology underlying the Material Flow Accounts is also internationally agreed and has been discussed and further developed in working groups and workshops at the OECD and Eurostat.

The results of this work are presented to the contracting entity (BMNT) in the form of a project report. The contracting entity checks that the report fulfils technical requirements and officially approves it in accordance with the agreement.

The concept and any problems arising during the work as well as the results are discussed in the regular (monthly) project group meetings with the contracting entity. The contracting entity and Statistics Austria both have the right to invite outside experts to these project group meetings.

The data in the Material Flow Accounts is used for the following purposes:

- Gaining Information on the effects of society's action, particularly in relation to the responsible management of natural resources (resource efficiency). This data is used not just by the contracting entity but also by university and non-university research institutes.
- Reporting to Eurostat

3.2 Accuracy

Accuracy is defined as the assumed extent by which the final results deviate from the variables actually to be measured. The actual value is however unknown.

A key problem relating to the issue of the accuracy of the Material Flow Accounts is that the MFA are compiled on the basis of a variety of different data sources, which can each be checked for accuracy individually to a certain extent but are practically impossible to assess in quantitative terms as a whole or in terms of their contribution to the final results. Conventional benchmarks for measuring the accuracy of statistics (confidence interval, etc.) cannot therefore be used in the case of the MFA.

The results of the MFA are generated from a wide range of varied data. These information building blocks are generally adapted to the basic concepts of the MFA or integrated as additional components into other data systems. There are often different explanatory models for much of the information available. The specified variables and aggregate figures have to be prepared based on this body of information.

In some cases the basic statistics used for the MFA do not provide a complete overall picture (because of cut-off limits or orientation towards certain sub-sectors of the economy); for this reason the data is supplemented with estimates. Examples include: raw material extraction by small enterprises, unused extraction of biotic raw materials, etc.

The sampling-related and non-sampling-related errors in the basic statistics, which are used in the calculation of the MFA figures, may certainly also be present in the MFA results; there is also the issue of possible distortions as a result of estimated additions and deductions, other estimation procedures and forward projections of time series. Due to these factors, it is not possibly to quantify the errors with complete certainty.

3.2.1 Sampling effects

Only relevant to the Material Flow Accounts in the form discussed above.

3.2.2 Non-sampling effects

As a synthesis-based product the Material Flow Accounts depend on the availability and quality of diverse basic statistics (see also the relevant standard documentation (in German only)).

3.2.2.1 Quality of data sources used

Internal: see the relevant standard documentation (in German only) for the basic statistics.

External: the good quality of data from external, officially published data sources (e.g. Environment Agency Austria, federal ministries, etc.) may be assumed; nevertheless, the data is "checked" for any inconsistencies and irregularities while it is being used and the data producer is questioned if necessary.

3.2.2.2 Coverage (misclassifications, undercoverage / overcoverage)

Basic statistics, particularly in this case the short-term business statistics which are so important for depicting the volume of mineral materials, are never complete for a number of different reasons. The quality and up-to-date nature of the registers is one factor. Other factors include companies that refuse to report data as well as deadlines for the processing of surveys where further efforts to achieve completeness are not taken for cost/benefit reasons.

Misclassifications can occur in the assignment of foreign trade data (CN codes) to the relevant product groups since in terms of imports from abroad, it is not just the raw materials that are taken into account. Finished and semi-finished goods in the individual material groups as well as the "Other products" group – which includes products for which clear assignment to a particular material category is not possible – are also taken into account.

3.2.2.3 Missing responses (unit non-response, item non-response)

Missing responses do not apply to the Material Flow Accounts. Since they may occur in the basic statistics, please refer to the relevant standard documentation (in German only).

3.2.2.4 Measurement errors (entry errors)

Measurement errors do not apply to the Material Flow Accounts. Since they may occur in the basic statistics, please refer to the relevant standard documentation (in German only).

3.2.2.5 Processing errors

None known.

3.2.2.6 Model assumption effects

These effects are particularly significant in relation to calculations of volume and usage – and therefore also to the Material Flow Accounts – because a number of assumptions need to be made due to the diverse nature of the information used and the complete lack of observability of some transactions. Because discussion of this far-reaching topic goes beyond the scope of standard documentation, please refer to the relevant literature[17] for more information.

3.3 Timeliness and punctuality

Data acquisition and recording

Timeliness (t+2) is primarily determined by the availability of the basic statistics.

[17] e.g.: Franz, A.: Entwicklung einer Öko-VGR in Österreich: Input-Output als Alpha und Omega: Schnabel, H. (ed.), Öko-integrative Gesamtrechnung–Ansätze, Probleme, Prognosen [Development of environmental national accounts in Austria: Input-output as alpha and omega, in: Schnabel, H. (ed.), Eco-integrative integrated accounts approaches, problems and prognoses], published by de Gruyter, Berlin–New York, 1993.

Franz, A.: Volkswirtschaftliche Gesamtrechnungen: Das Statistische System der Makroökonomie, Österreichische Studien zur Amtlichen Statistik [National accounts: The statistical system of the macro-economy, Austrian studies on official statistics], Austrian Central Office of Statistics, Vienna, 1994

Richter, J.: Kategorien und Grenzen der empirischen Verankerung der Wirtschaftsforschung [Categories and boundaries of the empirical anchoring of economic research], Lucius & Lucius, Stuttgart, 2002.

Data processing and adjustment

When the basic statistics are revised, these revisions are taken into account in the calculation and any corrections to previous years are published with the current results.

Publication of data

The results of the MFA are sent in a timely manner, i.e. by 31 December of the calendar year, to the contracting entity based on the conditions of the agreement with the Federal Ministry of Sustainability and Tourism. Timeliness (t+2) must be considered in relation to the availability of the basic statistical data.

3.4 Comparability

3.4.1 Comparability over time

The concepts and definitions used in the Material Flow Accounts are based on the Eurostat methodology manual "Economy-wide Material Flow Accounts and derived indicators". In principle, there is therefore comparability between the individual reporting years since 1998. That said, because of modifications to the form of presentation, the data series are available in an internally consistent time series since 1960.

Comparability within a published time series may be impaired if one of the fundamental basic statistics itself has been modified or new calculation regulations defined by Eurostat are to be implemented.

3.4.2 Comparability over region

The data is published at Austrian level. In order to ensure international comparability, a method that is standard across Europe is used. However, deviations may occur as a result of frequent differences in the ways in which the national statistical systems of the individual countries are organised; this is despite statistical legislation that applies throughout the EU.

For instance, the results for Austrian foreign trade statistics are analysed and published by Statistics Austria from the point of view of Austria following the national approach. Because of existing differences these results cannot be compared directly with the results for Austria published by Eurostat, which are analysed following the Community approach, even though both approaches are based on the principle of special transactions. For details please refer to the standard documentation for foreign trade statistics.

3.4.3 Comparability over other domains

Comparability across economic sectors and material groups is ensured by the use of the ÖNACE and/or PRODCOM and CN classifications.

3.5 Coherence

The input series of the Material Flow Accounts (MFA) are also found in the Integrated NAMEA (National Accounting Matrix including Environmental Accounts). This involves a grouping together of economic and environmental data, thus enabling a direct comparison of parameters from both areas in a sectoral breakdown. Data from the National Accounts relating to production value, value creation and employed persons is contrasted with the following environmental accounts (in their present state of development): final energy consumption, material flow accounts, waste, environmental protection expenditure, environmental taxes and air emission data.

There are also opportunities to make comparisons with the results of the goods input statistics, the short-term business statistics survey, foreign trade statistics and other basic statistics. However, the data published within the framework of the MFA for seemingly identical characteristics may differ from data in these specialist statistics. This is largely the result of methodological differences but also lies in the nature of a system of economic accounts that uses a large number of different data sources for the calculation of a characteristic, whereas for instance in the specialist statistics the same characteristic is surveyed directly as primary data. In these cases the characteristics differ in terms of the differing focuses of the statistics, i.e. the specialist statistics focus on microeconomic aspects whereas the MFA focus on macroeconomic aspects affecting the whole economy. In particular, estimates are often made within the MFA for units and elements not present within the primary surveys.

4. Outlook

Production-related aspects:

No changes are envisaged in the foreseeable future.

Content-related aspects:

In accordance with the requirements of the Regulation on European environmental accounts, material flows must be depicted from 2013 onward (reporting year 2011) in the form of a matrix as laid down in NACE*64 and expanded to include non-used materials (e.g. excavated soil).

Publication-related aspects:

In terms of the publication media used, no changes are planned in the foreseeable future. Amendments may be made to the reports, tables and charts published; these would primarily relate to content.

Glossary

The following terms and abbreviations are used in the Material Flow Accounts[18]:

DE (**D**omestic **E**xtraction): measures the types and volumes of biotic and abiotic materials that are taken from nature as a source of raw materials within a specific time period.

Dissipative losses: comprise tyre and brake abrasion. They therefore relate exclusively to materials that are output to the environment by the use of vehicles. The unit of measurement is tonnes.

Dissipative use of products: includes all material outputs that are deliberately dispersed into the environment and for which an economic or social benefit – e.g. an increase in soil fertility or road safety – can generally be assumed. In this process the composition of these materials changes or they are completely absorbed by the environment. Dissipative use is broken down into the following items: organic fertilisers (consisting of commercial fertilisers, compost and applied sewage sludge), mineral fertilisers, pesticides, seeds and salt and other thawing materials spread on roads. The unit of measurement is tonnes.

DMC (**D**omestic **M**aterial **C**onsumption): measures the total volume of materials used for consumption within a national economy. In contrast to DMI, it takes exports into account. The unit of measurement is tonnes. Domestic material consumption is calculated as follows: direct material input (DMI) – exports (biotic and abiotic products) = domestic material consumption (DMC).

DMI (**D**irect **M**aterial **I**nput): the direct material input (domestic used extraction of abiotic materials + domestic used extraction of biotic materials + imports of biotic and abiotic materials) measures the direct extraction and use of materials for economic activities and thus constitutes the volume of primary materials used and exploited directly for production and consumption. The unit of measurement is tonnes.

DPO (**D**omestic **P**rocessed **O**utput): the DPO (materials released back to nature) is the total of residual materials released back to the domestic environment. This indicator includes air emissions, waste, material loads in wastewater and dissipative material losses, such as those resulting from product abrasion or corrosion or from fertiliser use in agriculture.

Index: indices allow the direct comparison of trends in quite different variables, provided the same year is chosen as the base year (e.g. 1990 = 100).

Material outputs to the environment are characterised in that humans lose control over the location and composition of the output material at the time of output.

Material extraction from the environment is the deliberate extraction of materials by humans.

Material intensity = DMC/GDP: the "material intensity" indicator shows the relationship of domestic material consumption (DMC) to gross domestic product (GDP). It therefore indicates how many kilograms of materials are consumed or transferred in order to achieve one euro of value creation.

PTB (**P**hysical **T**rade **B**alance): equals the physical difference between imports and exports.

RMC (**R**aw **M**aterial **C**onsumption): the sum of all used resources, including input materials of imports and exports in the relevant country of manufacture.

Resource efficiency or **material efficiency** = GDP/DMC: resource efficiency is an indicator that reveals the dependence of economic growth on resource consumption. The figure for material efficiency indicates the level of economic performance achieved in euros per tonne of material inputs.

[18] See also: Measuring Material Flows and Resource Productivity - Glossary of Terms, OCED, 2007

List of abbreviations

AGR	Austria Glas Recycling GmbH
BMNT	Federal Ministry of Sustainability and Tourism
EnvA	Environmental Accounts
Eurostat	Statistical Office of the European Union
IFF	Faculty for Interdisciplinary Research and Continuing Education at the University of Klagenfurt
MFA	Material Flow Accounts
NA	National Accounts
NAMEA	National Accounting Matrix including Environmental Accounts
OECD	Organization for Economic Co-operation and Development
WIFO	Austrian Institute for Economic Research

Reference to supplementary documentation/publications

Supporting literature:

Bittermann, Wolfgang (1994): Sektorale Ökobilanzen (auf regionaler Ebene) [Sectoral environmental balances (at regional level)], in: Statistische Nachrichten 7/1994, Vienna, pp. 590-593 (in German).

Bringezu, Stefan; Fischer-Kowalski, Marina; Kleijn, René and Palm, Viveka (eds.) (1997): Regional and National Material Flow Accounting: From Paradigm to Practice of Sustainability. Wuppertal: Wuppertal Institute for Climate, Environment and Energy.

Daxbeck, H.; Merl, A.; Obernosterer, R.; Brunner, P.H. (1994): Die Stoffflussanalyse als Instrument für eine nachhaltige urbane Entwicklung. Studie zur Wiener Internationalen Zukunftskonferenz–WIZK [Material flow analysis as an instrument for sustainable urban development. Study for the Vienna International Future Conference]. Institute for Water Quality and Waste Management, Technical University of Vienna (in German).

Eisenmenger, Nina; Milota, Eva and Schaffartzik, Anke (2011): Ressourcendaten - Verbesserung des statistischen Datenmaterials im Bereich natürlicher Ressourcen, Projektbericht [Resource data – improving statistical data in the area of natural resources, project report], Statistics Austria, Vienna (in German).

Eisenmenger, Nina; Krausmann Fridolin; Milota, Eva and Schaffartzik, Anke (2011): Ressourcennutzung in Österreich – Bericht 2011 [Resource use in Austria – 2011 report], Federal Ministry of Agriculture, Forestry, Environment and Water Management, Federal Ministry of Economy, Family and Youth, Vienna (in German).

Eurostat (2013): Economy-wide Material Flow Accounts (EW-MFA). Compilation Guide 2013. Luxemburg: Eurostat.

Eurostat (2016): Economy-wide material flow accounts (EW-MFA) Manual 2016, draft version (13. September) on DPO and Balancing items. Luxemburg: Eurostat.

Fellinger, Rupert (1991): Versuch einer Chlor-Stoffstrom-Bilanz für Österreich [Pilot chlorine material flow balance for Austria]. Vienna: Ecology Institute (in German).

Fischer-Kowalski, Marina; Haberl, Helmut; Payer, Harald; Steurer, Anton and Zangerl-Weisz, Helga (1991): Verursacher bezogene Umweltinformationen, Kurzfassung [Polluter-related environmental information, summary]. Vienna: Dept. of Social Ecology (in German).

Fischer-Kowalski, Marina and Haberl, Helmut (1993): Metabolism and Colonization. Modes of Production and the Physical Exchange between Societies and Nature. In: *Innovation – The European Journal of Social Sciences* 6(4), pp. 415-442.

Fischer-Kowalski, Marina (1998): Society's Metabolism. The Intellectual History of Material Flow Analysis, Part I, 1860-1970. In: *Journal of Industrial Ecology* 2 (1), pp. 61-78.

Fischer-Kowalski, Marina and Hüttler, Walter (1999): Society's Metabolism. The Intellectual History of Material Flow Analysis, Part II: 1970-1998. In: *Journal of Industrial Ecology* 2(4), pp. 107-137.

Fischer-Kowalski, Marina; Rosa, Eugene A.; Sieferle, Rolf P. and Smetschka, Barbara (eds.) (2001): *Nature, Society and History. Long Term Dynamics of Social Metabolism. Special Issue of Innovation – The European Journal of Social Sciences*. Vienna: ICCR (Innovation – The European Journal of Social Sciences. Special Issue.

Gerhold, Susanne (1990): Stoffstromrechnung: Verpackungsmittel [Material flow accounts: packaging], in: Statistische Nachrichten 5/1990, Vienna, pp. 308-312 (in German).

Gerhold, Susanne (1990): Stoffstromrechnung: Pestizide [Material flow accounts: pesticides], in: Statistische Nachrichten 7/1990, Vienna, pp. 453-461 (in German).

Gerhold, Susanne (1992): Stoffstromrechnung: Schwermetalle [Material flow accounts: heavy metals], in: Statistische Nachrichten 4/1992, Vienna, pp. 321-329 (in German).

Gerhold, Susanne (1992): Stoffstromrechnung: Holzbilanz 1955-1991 [Material flow accounts: timber balance 1955-1991], in: Statistische Nachrichten 8/1992, Vienna, pp. 651-656 (in German).

Gerhold, Susanne (1994): Stoffstromrechnung: Asbest [Material flow accounts: asbestos], in: Statistische Nachrichten 1/1994, Vienna, pp. 48-51 (in German).

Gerhold, Susanne (1994): Stoffstromrechnung: Wasch- und Reinigungsmittel [Material flow accounts: washing and cleaning agents], in: Statistische Nachrichten 3/1994, Vienna, pp. 236-239 (in German).

Gerhold, Susanne (1994): Problemorientierte Umweltindikatoren – Diskussion eines Konzeptes [Problem-oriented environmental indicators – discussion of a concept], in: Statistische Nachrichten 7/1994, Vienna, pp. 594-602 (in German).

Gerhold, Susanne (1994): Stoffstromrechnung: Holzbilanz 1991-1993 [Material flow accounts: timber balance 1991-1993], in: Statistische Nachrichten 12/1994, Vienna, pp. 1009-1012 (in German).

Gerhold, Susanne (1995): Problemorientierte Umweltindikatoren – Erfahrungsbericht [Problem-oriented environmental indicators – empirical report], in: Statistische Nachrichten 7/1995, Vienna, pp. 376-393 (in German).

Gerhold, Susanne; Bittermann, Wolfgang (1994): Ökologische Gesamtrechnung: Sektorale Ökobilanzen und problemorientierte Umweltindikatoren [Environmental accounts: sector environmental balances and problem-oriented environmental indicators], in: Statistische Nachrichten 7/1994, Vienna, pp. 586-589 (in German).

Gerhold, Susanne; Steurer, Anton (1993): Ökologische Gesamtrechnung: Stoffstromrechnung Düngemittel; Düngemittelabgabe [Environmental accounts: material flow accounts for fertilisers; fertiliser outputs], in: Statistische Nachrichten 4/1993, Vienna, pp. 285-289 (in German).

Haas, Willi and Krausmann, Fridolin (2004): What do social systems consume? A case study at the local level. In: *Journal of Industrial Ecology*, submitted June 2003.

Haberl, Helmut; Fischer-Kowalski, Marina; Krausmann, Fridolin; Weisz, Helga and Winiwarter, Verena (2004): Progress Towards Sustainability? What the conceptual framework of material and energy flow accounting (MEFA) can offer. In: *Land Use Policy* 21(3).

Heinrich, Maria (1995): Bundesweite Übersicht zum Forschungsstand der Massenrohstoffe Kies, Kiessand, Brecherprodukte und Bruchsteine für das Bauwesen hinsichtlich der Vorkommen, der Abbaubetriebe und der Produktion sowie des Verbrauchs. Zusammenfassung. Berichte der Geologischen Bundesanstalt. Heft 31 [National overview of research into bulk raw materials – gravel, gravel sand, crusher products and quarry stone for the construction industry in relation to supplies, excavation facilities, production and consumption. Summary. Reports of the Austrian Geological Institute]. Vienna (in German).

Hohenecker, J. (1980): Futtermittelbilanzen für Österreich – Schema und Berechnung für die Wirtschaftsjahre 1972/73 bis 1976/77 [Fodder balances for Austria – system and calculation for the years 1972/73 to 1976/77], Institute for Agricultural Management and the Food Industry, University of Soil Cultivation, Vienna (in German).

Hüttler, Walter; Payer, Harald; Schandl, Heinz (1994): Stofffluss Österreichs, Forschungsprojekt "Wirtschaftswachstum und Stoffwechsel–Vorstudie für den Aufbau einer Stoffbilanz Österreich" [Material flows in Austria, research project "Economic growth and metabolism – preliminary study for the establishment of an Austrian material balance"], 1994, Vienna (in German).

Hüttler, Walter; Payer, Harald; Schandl, Heinz (1995): Nationale Materialbilanzen als Instrument einer ökologischen Ressourcenpolitik [National material balances as an instrument of environmental resource policy], in WIFO monthly report 11/1995, pp. 713-718, Vienna (in German).

Hüttler, Walter; Payer, Harald; Schandl, Heinz (1995): Materialfluss Österreich [Austrian material flows], IFF Social Ecology publication series Volume 44 (in German).

Krausmann, Fridolin (2004): Milk, Manure and Muscular Power. Livestock and the Industrialization of Agriculture. In: *Human Ecology*, in press.

Krausmann, Fridolin; Haberl, Helmut; Erb, Karl-Heinz and Wackernagel, Mathis (2004): Resource flows and land use in Austria 1950-2000: Using the MEFA framework to monitor society-nature interaction for sustainability. In: *Land Use Policy* 21(3), pp. 215-230.

Matthews, Emily; Amann, Christof; Fischer-Kowalski, Marina; Bringezu, Stefan; Hüttler, Walter; Kleijn, René; Moriguchi, Yuichi; Ottke, Christian; Rodenburg, Eric; Rogich, Don; Schandl, Heinz; Schütz, Helmut; van der Voet, Ester and Weisz, Helga (2000): *The Weight of Nations: Material Outflows from Industrial Economies*. Washington, D.C.: World Resources Institute.

Obernosterer, R. (1994): Flüchtige Halogenkohlenwasserstoffe (FCKW; CKW; Halone). Stoffflussanalyse Österreich [Volatile halogenated hydrocarbons (HCFC; CFC, halons). Austrian material flow analysis].

Thesis at the Institute for Water Quality and Waste Management, Technical University of Vienna (in German).

Schaffartzik, Anke; Krausmann, Fridolin; Eisenmenger, Nina (2011): Der Rohmaterialbedarf des österreichischen Außenhandels [The raw material requirements of Austrian foreign trade]. Social Ecology Working Paper 125. Vienna: IFF Social Ecology (in German).

Schandl, Heinz and Schulz, Niels B. (2002): Changes in United Kingdom's natural relations in terms of society's metabolism and land use from 1850 to the present day. In: *Ecological Economics* 41(2), pp. 203-221.

Schandl, Heinz and Schulz, Niels B. (2002): Industrial Ecology: the UK. In: Ayres, Robert U. and Ayres, Leslie W. (eds.): *A Handbook of Industrial Ecology*. Cheltenham, Northampton: Edward Elgar, Vol. 26, pp. 323-333.

Schandl, Heinz and Weisz, Helga (2002): Links between Macro and Micro Material Flows. The Aggregated Physical Input-Output-Table as an Integrative Feature of MFA and a Precondition for a Sectoral Approach. In: Kurabayashi, Yoshimasa et al. (eds.): *The Progress in Environment and Resource Accounting Approach. A Principle to the Global Environmental Issues*. Tottori: Imai Syuppan Co. Ltd, pp. 92-99.

Schandl, Heinz; Grünbühel, Clemens M.; Haberl, Helmut and Weisz, Helga (2002): Handbook of Physical Accounting. Measuring bio-physical dimensions of socio-economic activities. MFA-EFA-HANPP. Vienna: Federal Ministry of Agriculture and Forestry, Environment and Water Management, 1-75.

Schandl, Heinz; Hüttler, Walter and Payer, Harald (1999): Delinking of Economic Growth and Materials Turnover. In: *Innovation – The European Journal of Social Sciences* 12(1), pp. 31-45.

Schandl, Heinz; Weisz, Helga and Petrović, Brigitte (2000): Materialflussrechnung für Österreich 1960 bis 1997 [Material flow accounts for Austria 1960-1997]. In: *Statistische Nachrichten* 55 (NF)(2), pp. 128-137 (in German).

Schandl, Heinz and Zangerl-Weisz, Helga (1997): Materialbilanz Chemie - Methodik sektoraler Materialbilanzen [Chemical material balance – methodology of sectoral material balances]. Vienna: IFF Social Ecology (Social Ecology Working Paper; 47) (in German).

Schandl, Heinz (1998): Materialfluss Österreich: Die materielle Basis der Österreichischen Gesellschaft im Zeitraum 1960-1995 [Austrian material flows: The material basis of Austrian society in the period 1960-1995]. Vienna: IFF Social Ecology (Social Ecology Working Paper; 50) (in German).

Steurer, Anton (1992): Stoffstrombilanz Österreich 1988 [Austrian material flow balance 1988]. Vienna: IFF Social Ecology (Social Ecology Working Paper; 26) (in German).

Steurer, Anton (1994): Stoffstrombilanz Österreich 1970-1990 Inputseite [Austrian material flow balance 1970-1990 – input side]. Vienna: IFF Social Ecology (Social Ecology Working Paper; 34) (in German).

Weisz, Helga; Amann, Christof; Bruckner, Willi; Schandl, Heinz (2001): Material Flow Analysis and Environmental Indicators. The Positioning of MFA in the European Discussion about Environmental Indicators. Austrian Ministry of Agriculture, Forestry, Environment and Water Management. Vienna.

Weisz, Helga; Amann, Christof; Eisenmenger, Nina; Krausmann, Fridolin and Hubacek, Klaus (2003): Economy-wide Material Flow Accounts and Indicators of Resource Use for the EU 1970-2001. Wien: IFF Social Ecology; draft final report to Eurostat.

Weisz, Helga; Krausmann, Fridolin; Amann, Christof; Eisenmenger, Nina; Erb, Karl-Heinz; Fischer-Kowalski, Marina and Hubacek, Klaus (2004): The physical economy of the European Union: Cross-country comparison and determinants of material consumption. Submitted to Ecological Economics 4/2004.

Weisz, Helga; Schandl, Heinz and Fischer-Kowalski, Marina (1999): *OMEN-An Operating Matrix for material interrelations between the Economy and Nature. How to make material balances consistent*. CML report 148 – Section Substances & Products, Leiden: Centre of Environmental Science (CML).

Annex

Links to the following sub-documents are contained in this standard documentation:

Methodology description for input series

Methodology description for output series

Economy-wide material flow accounts (EW-MFA)

Economy-wide material flow accounting (EW-MFA). Manual 2016 on DPO and Balancing Items

OECD Manual for Measuring Material Flows and Resource Productivity - THE OECD GUIDE

Measuring Material Flows and Resource Productivity - Glossary of Terms, OCED, 2007