

# **Movements of materials accounts**

**1995-2010 Series**

Base 2010

## TABLE OF CONTENTS

- 1. Introduction.**
- 2. Aims.**
- 3. Definition and conceptual base.**
- 4. General framework of the movements of materials accounts.**
  - 4.1. Background
  - 4.2. Scope of the accounts
  - 4.3. Movements of materials
  - 4.4. Classification of movements of materials
  - 4.5. Delimitation of the system of movements for the accounts
  - 4.6. System stocks
  - 4.7. Aggregates: concepts and definitions
    - 4.7.1. National extraction
    - 4.7.2. Imports and exports
    - 4.7.3. National output processed for nature
    - 4.7.4. Input and output balancing entries
    - 4.7.5. Net accumulation of stock
- 5. Movements of materials accounts.**
  - 5.1. The account summarises the movements of materials in the economy.
  - 5.2. Sequential outline of the accounts
- 6. Main accounting balances and basic indicators derived from the accounts.**
  - 6.1. Main accounting balances
  - 6.2. Basic indicators derived from the accounts
- 7. Movements of materials accounts and national accounts. Relative indicators.**
  - 7.1. Efficiency indicators productivity and intensity of materials
- 8. Relations between the movements of materials account and the input-output physical tables.**
- 9. Estimate of the movements of materials accounts in Spain base 2010. Statistical sources used.**
  - 9.1 Sources of direct inputs and foreign trade
  - 9.2 Sources of processed national output and indirect and hidden movements
  - 9.3 Future works

## 1 Introduction

Efficient management of natural resources is fundamental to attain sustainable development. These provide raw materials, energy, food, water and land, in addition to environmental services. The consequences associated with their operation comprise environmental pressures derived from extraction, processing, use and removal of materials, and their international trade, determining the prices of raw materials and other goods, and the economy's productivity and competitiveness.

In this directorate, the ***Subject-based Strategy of the Commission European on sustainable use of natural resources***, followed by the Sixth Programme of Environmental Action of the European Community 2002-2012 aims to ensure that the consumption of resources and associated impacts do not exceed the capacity of environmental load; there is dissociation of economic growth from the use of natural resources. As a consequence, data are required to construct "decoupling" indicators from the economic growth of natural pressures, as well as environmental impact indicators. The European structural indicators includes the productivity of resources, an aggregate measure of the material efficiency of the economy and as for European sustainable development indicators, this also includes national consumption of materials, a basic indicator derived from the analysis of movements of materials.

The OECD is also working on this topic and in 2004 it adopted an initial recommendation on movements of materials and productivity of resources with the purpose of improving information in this field and establishing common measurement and indicator systems to assess the sustainability and efficiency of the use of materials resources by means of implementing methodologies and accounts. Subsequently, with the recommendation on productivity of 2008 resources, policies to improve the productivity of resources and the analysis of movements of materials and their environmental impact were promoted, improving information, accounts and indicators. As a consequence, a set of documents has been prepared on methodological systems for the measurement of movements of materials.

To implant and follow up policies that promote the sustainable use of resources and improve their productivity, we need quality information on the movements of materials to observe in an integrated way the movements of minerals, metals, energy, wood or water and their effects on the economy's productivity and quality of the environment.

Regarding international statistics, the movements of materials account has been developed as part of the ***system for environmental and integrated financial accounting*** which provides a detailed description of the interrelationship between the environment and the economy. Movements of materials accounts are consistent with national financial accounts using similar concepts and accounting rules.

From the methodological point of view, movements of materials accounts reveal the physical inputs of materials that enter the national financial system and outputs to other economies or the natural environment in physical units (tonnes). These accounts enable obtaining a set of aggregate indicators on the use of natural resources for which indicators can be derived on the productivity of resources, eco-efficiency, in relation to GDP and other financial and employment indicators, in addition to indicators on intensity of materials from lifestyles with the size of the population and other demographic indicators.

Among the works the INE has been carrying out in the field of statistics and environmental accounts, we find the estimate of the movements of materials accounts included in the priority European strategy of environmental accounts and which are prepared within the framework set out by EUROSTAT (European Statistics Office) in its methodological guide

“Economy-wide movements of material accounts and derived indicators”, published in 2000, and the compilation guide “Economy wide movements of material accounts: Compilation Guidelines for reporting to the 2009 Eurostat questionnaire”.

The INE, for the purpose of preparing the Spanish Statistical System for future requirements foreseen in the European Statistical System, began to carry out, as a pilot study, the estimates of the movements of materials account in 2002, the first pilot study with series 1996-2000, and in the year 2005, it published new estimates, with base 2000, of the 2000 and 2000-2006 series.

The base change presented in 2010 met the need to adapt to the requirements set out in **European Parliament and Council Regulation (EU) No. 691/2011, on Environmental Economic European Accounts**, finally passed on **6 July 2011**, and for which the Movements of Materials Accounts are a specific module which also improves some prior estimates with data obtained from national sources.

Eurostat's current methodological version, followed in these estimates, reflects the advances in efforts to standardise and harmonise the Movements of Materials Accounts in the United Nations and the OECD and during an initial phase of its development they incorporate national extraction, imports and exports.

## 2 Aims

Implementing the movements of materials accounts will enable having information from the movements module from the next Environmental Accounts community regulation. Movements of materials accounts have, among others, the following aims:

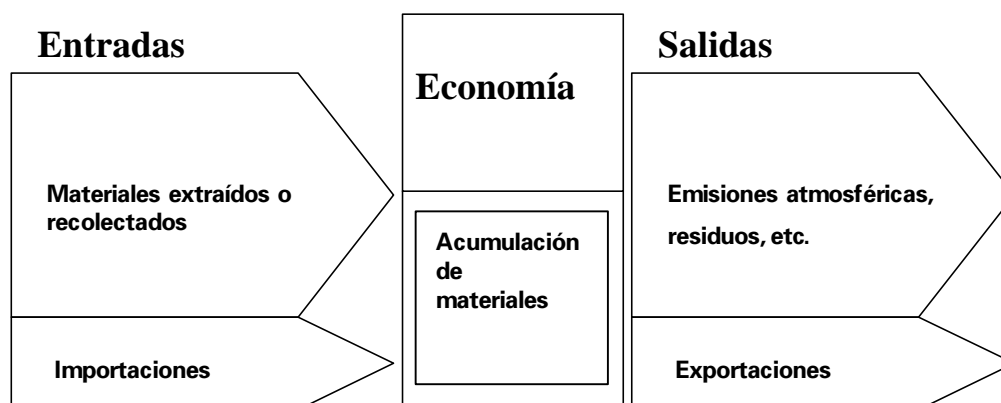
- Provide information on the structure and variations over time of the economy's physical metabolism.
- Obtain indicators on the productivity of resources and ecoefficiency, relating indicators for use of resources to GDP and other financial and job indicators.
- Provide indicators of intensity of lifestyle materials; these indicators are related to the size of the population and to other demographic indicators.
- Integrate the information into the national accounts.
- Provide statistical data given the political demands for this kind of information.

### 3. Definition and conceptual basis

The **movements of materials accounts** reveal the physical inputs of materials that enter the national financial system and the outputs to other economies or the natural environment. These are accounts in physical units (tonnes) describing extraction, transformation, consumption and eventual removal of chemical elements, raw materials or products.

The conceptual principle on which these accounts are based is the **principle of conservation of the material**, according to which this is neither created nor destroyed, only transformed. Although this principle is not universally true (nuclear reactions are capable of transforming mass into energy), it is a suitable formulation for relationships of material exchange in macrosystems. It may be applied to specific materials and substances, including fuels, strategic materials, wood, pesticides, waste, etc. The next outline shows a simplified representation of input, output movements and accumulation of materials in the financial system.

General outline of movements of materials in the economy



### 4. General framework of the movements of materials accounts

#### 4.1 Introduction

On a conceptual level, the movements of materials accounts have a close parallel with the financial accounts. On the practical side, this similarity may be more difficult to set out as in the economic accounts, since money is the transaction variable, we homogeneously add magnitudes and for the movements of materials accounts we cannot offer homogeneous aggregations as the materials modify their form and composition at each stage of the production and consumer chain.

The accounting framework used in movements of materials accounts is that of the **input-output tables or the origin-destination tables**. This framework provides two basic identities:

- By rows (movements of products) and for a given product, production plus imports is equal to internal demand plus exports of this product. Internal demand is the same as intermediate consumption, end consumption and gross formation of capital.

- By columns, the total input of materials is the same as the total output of goods and waste (waste, atmospheric emissions or dumping into water)

For the whole economy, the total amount of materials extracted or collected from nature and imported is equal to the total amount of residual externalities emitted into nature, raw materials imported and net accumulation of materials in the economy.

In practice, this general framework adapts to the characteristics of analysis of materials and general profile of its uses. The different applications to carry out may consist of very detailed tables or a simple presentation of indicators related to the consumption or requirements for materials. Therefore, for the analysis and follow-up of certain political actions, the accounts detailed with monetary financial information may provide measures on consumer trends or requirements for materials. The use of hazardous materials should require very detailed information because of its effect on the environment and health of the population.

## 4.2 Scope of the accounts

The movements of materials accounts should be consistent with the ***national financial accounts***. National accounts define the national economy as the set of activities and operations of resident financial agents that are focused on the national financial territory. Some transactions of these units are carried out outside the national economic territory and other transactions in this territory are carried out by non-resident units.

Therefore, for the movement of materials accounts it is necessary, just as for the national accounts, to apply the ***residency principle***. In accordance with this principle, the materials used by resident units outside the national territory should be considered as inputs from the national economy and the materials used by non-resident units in the national economic territory should be excluded from the accounting framework.

For the national accounts, the economic territory of a country is constituted by the geographic territory and by free trade areas, the national airspace, territorial waters and the continental platform located in international waters on which the country enjoys exclusive rights, territorial enclaves and sites located in international waters operated by resident units. The national economic territory does not include the extraterritorial enclaves from other countries or international organisations located in the geographical territory.

Territories outside the limits of the national financial territory comprise the "rest of the world". The aim of the rest of the world is to provide a vision of the set of interrelationships between the national economy and other economies.

As the aim for the movements of materials accounts is to set out and determine the existing movements between the economy and the environment in which this is implemented, a primary reference to consider would be defining the ***national environmental space*** as the geographic space of the national economic territory. The territories found outside the scope of the national environmental area are denominated environment for the rest of the world. For this reason, the environmental pressures generated by the national economy may differ from the environmental pressures generated in the national environmental area as the cross border movements of emissions and dumping by means of the natural environment are not part of these accounts.

### 4.3 Movements of materials

The movements of materials reflect the physical inputs of materials which enter the national financial system and outputs to other economies or the natural environment. Movements come as physical units (tonnes) and describe the extraction, transformation, consumption and final elimination of chemical elements, raw materials or products.

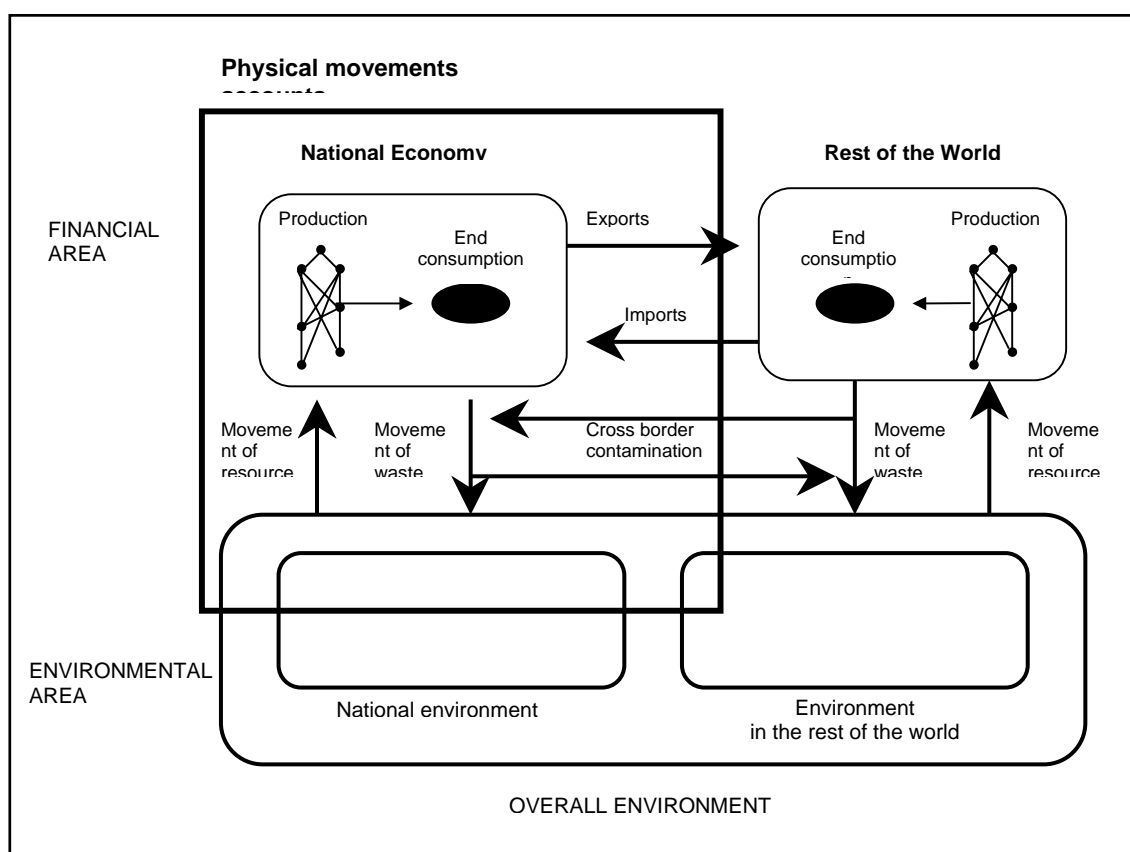
The movements of materials are classified into three categories: the raw materials which are supplies from materials extracted from the natural setting; products which are the end result of the production process and waste which are unwanted subproducts of the production and consumption processes.

The accounts may provide details adapted to the characteristics of the materials studied:

- Extraction/harvest (agriculture, forestry, mining and quarries)
- Transformation/conversion (refineries, basic metal industries)
- Intermediate uses (manufacturing industries)
- End uses (households)
- Accumulation (gross formation of capital, durable consumer goods)
- Imports/exports
- Waste (waste and emissions)
- Movements and accumulation in nature

The following outline presents the different movements.

## Physical movements and scope of accounting of physical movements



### 4.4 Classification of the movements of materials

The movements of materials can be grouped in different ways:

- Regarding their territorial dimension, to indicate their origin and destination, they are classified into ***national movements and movements from the rest of the world.***
- If we consider the product chain or its life cycle, movements are classified into ***direct movements and indirect movements;*** the former correspond to movements observed directly and the latter are obtained as a calculation of extraction needs at the origin of materials.
- To indicate whether materials enter into the economic system or not, movements are classified as ***movements of materials used in products and movements of materials not used in products.*** This classification is used exclusively for inputs of materials. Regarding outputs, the terms ***processed and unprocessed are used.***

By combining the different kinds of movement we end up with the following categories of inputs:



### Categories of inputs of materials

Product chain	Whether or not they are used in products	National or from the rest of the world	Term used
Direct	Used	National	Used national extraction
Not applied	Not used	National	Unused national extraction
Direct	Used	Rest of the World	Imports
Indirect	Used	Rest of the World	Indirect movements associated with imports
Indirect	Not used	Rest of the World	

**Hidden movements** are those mobilised intentionally and by technological measures but not considered suitable and not aimed to be used in the economy. Therefore, unused extraction comprised of extracted or mobilised materials in the national territory and unused by financial agents is denominated "unused national extraction". Land excavated during construction, sediments from dredging ports, waste from mining and biomass not used in crops are examples of these hidden movements. Eroded agricultural soil although not mobilised intentionally may also be included as a hidden movement.

Outputs may be grouped into the following categories:

### Categories of outputs of materials

Product chain	Processed or not	National or rest of the world	Term used
Direct	Processed	National	Processed national output
Not applied	Unprocessed	National	Disposal of unused national extraction
Direct	Processed	Rest of the World	Exports
Control	Processed	Rest of the World	Indirect movements associated with exports
Indirect	Unprocessed	Rest of the World	

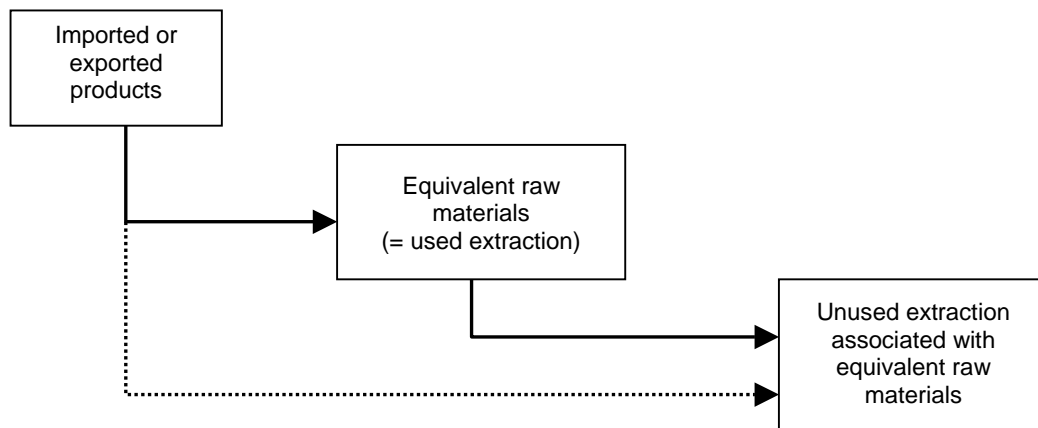
**Indirect movements** are only defined for the economy as a whole and refer to imports and exports of materials. These are those materials necessary to be obtained from materials at origin.

On the inputs side, indirect movements are defined as movements of materials associated with imports themselves but which are not physically imported. In the case of outputs, these are movements of materials associated with own exports but which are not exported. Indirect movements therefore, are necessary inputs to produce an available product on the border to import or export, excluding the product mass itself. Different kinds of indirect movements are differentiated: processed and unprocessed used and unused indirect movements. Indirect movements can only be calculated once the used direct materials accounts have been completed.

Two aspects of indirect movements are differentiated:

- Indirect movements expressed as equivalent raw materials for imported and exported products; these movements measure the used extraction of materials necessary to provide the products.
- Indirect movements expressed as unused extraction of materials to provide the products.

### Calculation of indirect movements



#### 4.5. Delimitation of the movements system for the accounts

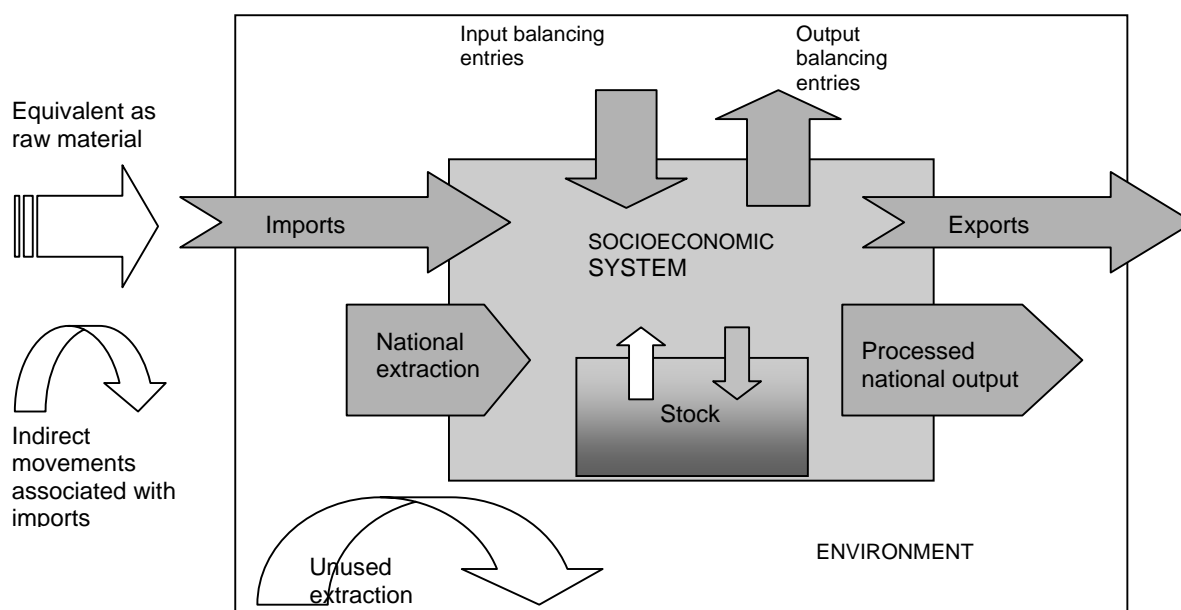
In practice it is difficult to attain a full balance of materials in the economy as not all inputs and outputs of materials have systematic follow up. Movements of materials accounts, according to the methodology prepared by Eurostat, consider the national economy as a "black box" for which only those movements which cross the limits of the national socio-economic system, both by uses and resources, are presented. **They consider:**

- Movements between the national economy and the natural setting: extraction of raw materials from the natural environment performed intentionally by financial agents and outputs from the financial system to the environment. Output movements to the natural setting imply that financial agents stop having control on the localisation and composition of materials. For example, fertilisers used on agricultural land are considered as such as the distribution and decomposition processes within soil and consequent emissions are difficult to measure and cannot be considered to be under financial control.
- Movements between the national financial system and the financial system from the rest of the world, that is, imports and exports of materials

Neither internal movements of the national financial system nor natural movements which occur within the national environment, nor those which occur within the national environment and the environment of the rest of the world **are considered**. Movements within the economy are reported in the input-output physical tables.

Therefore, a schematic representation of the movements considered in the movements of materials accounts would be the following:

## Movements accounted for in the accounts system



On the input side, we make a differentiation between national extraction, inputs and balancing input entries which include exchanges of water and air which should be considered to complete the balance sheet of materials.

On the output side, we differentiate between national output emitted into nature, exports and output balancing entries.

### 4.6. System stocks

Although in the context of movements of materials accounts the amounts of stocks are not accounted for, the magnitude of some stock variations is recorded. There are three kinds of socio-economic stock considered:

- Fixed assets produced, that is, infrastructures, buildings, etc. and durable goods for end household consumption.
- Human population and livestock.

Therefore, we can identify movements of materials which should be considered as inputs or outputs which leads us to an alternative definition of the system's delimitation:

- Input movements are all those material movements which serve as input to produce or reproduce socio-economic material stocks, measured at the crossover point of specific limits of the system.
- Output movements are released into the environment from the socio-economic system, measured at the point in which society loses control over the localisation and composition of materials.

This means that for a full balance of materials we have to include not only human and livestock feeding along with biomass pastured by the latter but also breathing of both should be considered as input and output. In addition, in theory, we would have to include population

and livestock ranch variations and, however, both may be ignored as insignificant compared to variations in fixed assets produced and durable goods for final household consumption.

Some stock, as a consequence, are considered natural instead of socio-economic stock in spite of the fact that they are part of the economic production system as are plantations and fish (except those coming from aquaculture) for which reason the variations in these are not recorded.

In short, it is the degree of control that society plays on production and reproduction of a stock which determines whether or not it is included in the socio-economic system, although there are practical reasons as well. Indeed, treating plants as part of the national economy would create the need to account for water, CO<sub>2</sub> and nutrients as primary inputs and it would be necessary to come down to this level.

## **4.7 Aggregates: concepts and definitions**

### **4.7.1. National extraction**

This includes the annual amount of solid, liquid and gaseous raw materials (excluding water and air) extracted from the natural environment to be used as input material into the financial system. The term "used" refers to the acquisition of value within the financial system.

The components of national extraction are classified into the following groups:

#### **Biomass**

This includes all the extracted vegetable origin and that directly consumed by the livestock ranch in addition to capture of fish and hunting of animals.

In accordance with agricultural statistics biomass is accounted for with the corresponding humidity content at the time of the harvest except for fodder crops and pasture biomass which, since they are usually measured with very different humidity content, a standardisation at 15% is established.

The biomass constituted by the livestock cabin and its derived products (milk, meat, eggs, etc.) are considered secondary products and therefore are not accounted.

Nor do we consider, for practical reasons, the production of biomass from subsistence agriculture and domestic orchards because, although within the system's limits, this is less important in Europe and there are no reliable data. The same occurs with waste from parks and gardens, grass, firewood, fodder, where a fraction is subject to subsequent reuse and whose growing interest in the strategies for sustainable use of resources could mean that this will be introduced into the accounts in the future.

#### **Metallic minerals**

Regarding metallic minerals, we have to differentiate several concepts:

- Unused extraction: this is comprised of dug up materials to access the mineral reserve.
- Used extraction: consists of the material contained by the metal.
- Metal content.

For national extraction, we consider used extraction, also known as gross mineral or 'gross ore', but the net metal content is added as a pro memory entry.

The frequency with which combined productions of different metallic minerals occurs makes it habitual to estimate *gross ores* corresponding to each one of the metals, as of the *gross ore* data from combined production.

### **Non-metallic minerals**

For non-metallic minerals, it is supposed that the differences between gross mineral and mineral production reported generally are not relevant.

### **Fossil fuels**

This includes carbons and other solid resources in addition to liquid and gaseous resources such as oil and natural gas.

#### **4.7.2. Imports and exports**

Unlike products included in the national extraction which are always raw materials, foreign trade includes all of them except those which lack weight (for example electricity) and may have a various degree of transformation, ranging from basic products, to semi manufactured or finished products.

In accordance with the agreements on foreign trade statistics for the United Nations and OECD, foreign trade products are accounted for with the weight they have when crossing the borders. Conversely, in the movements of materials accounts, products merely in transit are not accounted.

In the tables, imports and exports products are classified in accordance with their material composition, wherever possible based on the primary principal material component. The main divisions are similar to the structure of the aggregations from national extraction and the inclusion of products into one or the other aggregate is performed according to the coding of the Harmonised System-Combined Nomenclature implemented by the European Community on different coding levels, according to the detail needs of the different types of product (4, 6, 8 digits).

By virtue of the residency principle, both imports and exports include an adjustment entry for fuel providing for international transport: on the exterior, that purchased by resident units (imports) and in the interior that purchased by non-resident units (exports)

#### **4.7.3. National output processed for nature**

This is defined as the total amount of materials released into the environment after having been used in the national economy. These movements take place during processing, manufacture, use and final elimination stages of the production and consumer chain.

This is classified as:

- Emissions into the atmosphere.
- Waste deposited into landfills.
- Dumping into waters.
- Dissipation of products.

- Dissipated losses from materials.

The first 3 categories are those outputs by which materials are basically released into the environment into its three modalities air, earth and water while the latter two are residual categories which respond more to the particular form in which materials are released into the environment.

### **Emissions into the atmosphere**

These are gaseous materials or particles generated in the economy's production or consumption processes. This includes the categories: carbon dioxide, methane, nitrogen monoxide, nitrogen oxides, hydrofluorocarbons, perfluorocarbons, sulphur hexafluorocarbon, carbon monoxide, non-metallic volatile organic composites, sulphur oxides, ammonia, heavy metals, persistent organic contaminants, and particles.

### **Waste deposited into landfills**

This category includes only deposits in landfills and is classified for the purposes of movements of materials accounts into urban and industrial waste. This does not include other type of waste such as recycled, incinerated or emissions into the water or atmosphere.

### **Dumping into waters**

This includes substances and materials regardless of whether they receive processing of wastewater.

### **Dissemination of products**

The dissipation of products corresponds to a residual category by which an amount of materials is dispersed into the environment deliberately as a consequence of the use of products.

They are classified as:

- Organic fertiliser (manure)
- Mineral fertilisers.
- Sludge from wastewater.
- Compost.
- Pesticides.
- Seeds.
- Salt and other materials distributed to defrost roads.
- Solvents and others.

Both manure and sludge and compost should be accounted for as equivalent dry material. However, mineral fertilisers and pesticides are not accounted for in relation to the weight of their active substances but rather their total weight.

### **Dissipated losses of materials**

The losses dissipated from materials correspond to a residual category by which an amount of materials is dispersed into the environment by accident, simply as a result of the abrasion, corrosion, erosion and leaks.

They are for example, the wear and tear of rubber tyres; the particles released from the friction of products such as the brakes in vehicles; Corrosion, abrasion and erosion of infrastructures (buildings and roads); losses of chemical products because of road accidents; leaks from national gas conduits.

#### **4.7.4. Input and output balancing entries**

Although, as indicated, water and air movements are excluded from the movements of materials accounts, there are certain exchanges of air and material involved in material transformations which take place in certain processes and which significantly affect the balance of masses.

The balancing entries are estimates of these movements, which are not included in the remaining movements mentioned above, and which are counter-entries of some inputs and outputs which are included. They basically refer to:

- The demand for oxygen for combustion processes.
- Oxygen for human and livestock breathing.
- Nitrogen removed from the atmosphere during the Haber-Bosch ammonia production process.
- Steam emissions from the fuel's humidity content during the combustion process.
- Steam from the oxidation of hydrogenated components from the fuel during combustion.
- CO<sub>2</sub> and steam from human and livestock respiration.

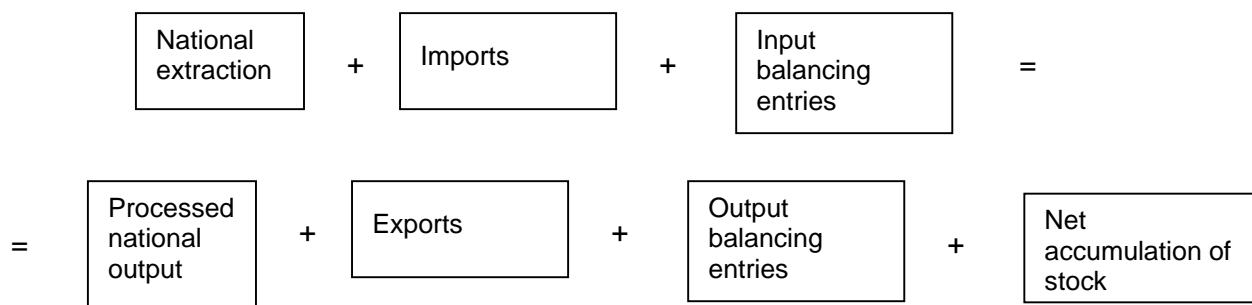
Input and output balancing entries are reported in specific tables and are not included in the aggregate indicators; However, a good estimate of these entries is necessary when we calculate net accumulation of stock as the difference between the total inputs and outputs for the balance of movements of materials.

#### **4.7.5. Net accumulation of stock**

This measures the actual physical growth of the economy, that is, the weight of construction materials used in buildings and other infrastructures and materials incorporated into durable goods such as vehicles, industrial machinery, etc. We obtain a balance between inputs and outputs.

## 5. Movements of materials accounts.

Once the different category of movements of materials is defined, a national equation of balance of materials can be presented in the following terms:



All magnitudes included in the accounts are physical amounts and are expressed in tonnes.

### 5.1. The account summarises the movements of materials in the economy

The summary account is comprised of the set of inputs and outputs from/to the natural setting, to/from the economy; this account enables obtaining different materials indicators.

#### Movements of materials in the economy summary account

RESOURCES	JOBS
<b>National extraction</b> Biomass Metallic minerals Non-metallic minerals Fossil fuels  <b>Imports</b>	<b>Emissions and waste</b> Emissions into the atmosphere Landfill waste Dumping into waters  <b>Waste of products and losses</b> Waste of products Dissipated loss of materials
<b>Direct input of materials</b>	<b>National output processed into nature</b>
<b>Unused national extraction</b>	<b>Disposal of unused national extraction</b>
<b>Total input of materials</b>	<b>Total national output into nature</b>
<b>Indirect movements associated with imports</b>	<b>Exports</b>
<b>Total need for materials</b>	<b>Total output of materials</b>
	<b>Net accumulation of stocks</b>
	<b>Indirect movements associated with exports</b>



## 5.2. Sequential outline of the accounts

In the sequential outline of accounts, resources appear on the one hand and uses on the other. By agreement, resources appear on the left and uses on the right. In the financial accounts, the term resources is used for those transactions which increase the financial value of the financial agent or sector. Uses list the transactions which reduce the financial value. For movements of materials accounts, movements which add amount of materials to the economy are recorded in resources; movements which reduce the amount of materials are accounted for in uses.

For the succession of accounts, the stock of materials is ahead of the balances of direct movements of materials because the stock enables estimating the net accumulation of materials in the economy.

### Direct input of materials account

Resources	Uses
<b>National extraction</b> Biomass Metallic minerals Non-metallic minerals Fossil fuels	
<b>Imports</b>	
	<b>Direct input of materials</b>

This account records as resources the direct input of materials in the financial system from the national natural environment and the rest of the world, that is, national extraction and imports. The account balance is the **direct input of materials**.

### National consumption of materials account

Resources	Uses
<b>Direct input of materials</b>	<b>Exports</b>
	<b>National consumption of materials</b>

For the consumption of materials account, resources includes the balance of the previous account direct input of materials and for uses, direct exports of materials.

The account balance is the **national consumption of materials**, which measures the total amount of materials directly used in the economy.

### Foreign trade account of materials

Resources	Uses
Imports	Exports
	Foreign trade balance of materials

For this account, foreign trade of materials account, resources includes the imports of materials and for uses exports of materials. The balance of the account is the **foreign trade balance of materials** which measures the economy's physical trade surplus or deficit, that is, imports minus exports. The physical trade balance is defined similarly for indirect movements associated with imports and exports.

### Processed national output account

Resources	Uses
<b>Emissions and waste</b> Emissions into the atmosphere Waste in landfills Dumping into waters  <b>Waste of products and losses</b> Waste of products Dissipated loss of materials	
	Processed national output

This account reports the total amount of materials released into nature after being used in the national economy. The account balance is the **processed national output**.

### Net accumulation of stocks account

Resources	Uses
<b>National consumption of materials</b>      Input balancing entries	<b>Emissions and waste</b> Emissions into the atmosphere Waste in landfills Dumping into waters  <b>Waste of products and losses</b> Waste of products Dissipated loss of materials  Balancing output entries
	Net accumulation of stocks

This account describes the total amount of materials accumulated in the financial system. Resources includes national consumption of material and for uses processed national output,

that is, emissions and waste and the dissipation of products and losses. The account balance is the **net accumulation of stock** in the economy.

### Balance sheet of direct movements of materials

Resources	Uses
<b>National extraction</b> Biomass Metallic minerals Non-metallic minerals Fossil fuels  <b>Imports</b>    Input balancing entries	<b>Emissions and waste</b> Emissions into the atmosphere Waste in landfills Dumping into waters  <b>Waste of products and losses</b> Waste of products Dissipated loss of materials  <b>Exports</b> <b>Net accumulation of stocks</b>  Balancing output entries
<b>National total employed persons</b>	<b>National total employed persons</b>

This account constitutes the total balance sheet of materials. Describe in physical units, the total amount of materials which enter the financial system, those released into nature after being used in the national economy and those which accumulate in the national financial system as stock. By definition resources and uses balance out.

### Unused extraction account

Resources	Uses
<b>Unused national extraction</b> From biomass From mining and fossil fuels Ground excavation	<b>Elimination of unused national extraction</b> From biomass From mining and fossil fuels Ground excavation

This account describes the movements of materials mobilised intentionally and by technological measures but not considered appropriate and not aimed at being used in the economy.

Resources includes unused national extraction and for uses elimination of unused national extraction. The movements of inputs and outputs are consolidated in this account.

### Foreign trade account of indirect movements

Resources	Uses
<b>Indirect movements associated with imports</b> Used Associated with unused extraction	<b>Indirect movements associated with exports</b> Used Associated with unused extraction
	<b>Balance of indirect movements</b>

This account describes the indirect flows associated with imports and exports, which represent the materials necessary to obtain materials at origin. Resources includes movements of materials associated with imports themselves but which are not physically imported. For uses, the movements of materials associated with exports themselves but which are not exported. The account balance is the **balance of indirect movements** associated with imports and exports.

### Account for the total requirement for materials

Resources	Uses
<b>National extraction</b> Biomass Metallic minerals Non-metallic minerals Fossil fuels  <b>Imports</b>  <b>Unused national extraction</b> From biomass From mining and fossil fuels Ground excavation  <b>Indirect movements associated with imports</b> Used Associated with unused extraction	
	<b>Total requirement for materials</b>

The account on the need for materials in the economy reveals in resources all the inputs of materials which enter the financial system from the national environment and those coming from the rest of the world, imports, direct and indirect movements. The account balance is the **total requirement for materials** which measures the total basis of an economy.

## Consumption of materials account

Resources	Uses
Total requirement for materials	Exports  Indirect movements associated with exports Used Associated with unused extraction
	<b>Total consumption of materials</b>

This account describes the total consumption of materials. Resources includes the total need for materials obtained as a balance in the previous account and for uses the exports of materials in addition to indirect movements associated with exports themselves. The balance of this account is the **total consumption of materials** which measures the total use of materials associated with production and consumption activities, including indirect movements associated with imports and excluding exports and their associated indirect movements.

## 6 Main accounting balances and basic indicators derived from the accounts.

### 6.1 Main accounting balances

The **direct input of materials (DIM)** is defined as all solid, liquid and gaseous materials which enter the economy for use in the productive process or at end consumption. If we subtract exports from direct input of materials we obtain the **national consumption of materials (NCM)**, which measures the total amount of materials used directly in the economy.

If we add hidden movements from national extraction and indirect movements associated with exports to direct input of materials we obtain the **total need for materials (TNM)**, which measures the total base material of an economy. If from the total requirement for materials we subtract exports and indirect movements associated with these, we obtain the **total consumption of materials (TCM)**, which measures the total use of materials associated with production and consumption activities.

The **national processed output (NPO)** is defined as the total movement of materials introduced into the national environment, both during and afterwards from the productive and consumption process.

### 6.2 Basic indicators derived from accounts

A series of indicators that shows an "industrial metabolism" table can be shown from the balance sheet of materials. These indicators can be initially grouped into input, consumption and output indicators. In addition, other indicators can be derived such as those resulting from varying the limits set for the accounts or compiling the indicators based on groups of materials.

It is a moot point that indicators will be more relevant and useful in the long-term until there is sufficient experience over their use and analysis. The choice of the most significant indicators will depend on the political approach and proven usefulness and applicability for each indicator for the political analysis. It is possible to set up a series of criteria to select indicators:

- Ease of understanding the meaning of the indicator.
- Ease of compiling.
- Availability of data.
- Compatibility with the national accounts.
- Potential for political uses.
- Complexity of the indicator.

Of course, the use and efficiency of the resources end up being the most important aspects to consider for environmental and sustainability policies in the long term within the European Union. Among the aims set the need to substantially increase the efficiency of the financial system, thereby reducing the use of natural resources and the resulting negative impacts for the environment, are notable. In general, the following seem good candidates as central indicators: direct input of materials, total requirement for materials, national consumption of materials and total consumption of materials.

## **7. Movements of materials accounts and national accounts. Relative indicators**

For national accounts the use of the natural setting does not consider in the calculation any costs and therefore is not reflected in such significant figures as gross domestic product (GDP). Uses of the natural environment are recorded as other variations in assets and their assessment exclusively includes operating expenses for the natural resource. Consequently, if the GDP records the total assessment of uses of natural resources, which comprise production and consumer processes, this could relate accounting balances and indicators of movements of materials accounts such as national extraction or imports, with Gross Domestic Product (GDP) at constant prices to reveal trends in the efficiency of resources.

In the economy, as materials are processed, the goods and services produced will add value throughout the productive process. Monetary value generally increases when moving from raw materials to semi-manufactured products and finished products. Following end use of the product, the value of materials becomes worthless (recyclable waste and scrap) or even negative (waste and emissions)

At the same time, the amount of useful material is reduced as progress is made on the production and consumer process, because of losses (waste and emissions) caused at each one of the transformation stages.

In general, as added value increases, the material contained in products reduces. Consequently, in the economy's circular model, financial movements, money, physical movements, physical assets, move in the opposite direction. In this context, the interrelationships between the movements of materials accounts and national financial accounts, represented by gross domestic product, are made patent by means of consumption indicators for materials.

This way of relating physical and monetary indicators enables calculating efficiency indicators over the use of natural resources.

### 7.1 Efficiency indicators: productivity and intensity of materials

In relation to national accounts, two main aspects of movements of materials have been identified as politically relevant: The total amount of material used and efficient use of materials. The relative indicators which are usually handled relate to absolute indicators mentioned in the previous section with GDP at constant prices and at times with the number of inhabitants.

In the European Council of Lisbon 2000, the European Union set out the strategic aim of turning into the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and more social cohesion. The instrument for an objective assessment of the progress attained in managing these aims consists of a series of structural indicators (Lisbon indicators) including the **productivity of resources** as an aggregate measure of efficiency over the use of the economy's materials, which reveals whether "decoupling" occurs between the use of natural resources and growth of the economy. We use the ratio between GDP and national consumption of materials.

Conversely, the productivity of resources in addition to national consumption of materials and their components (used national extraction, imports and exports) are used as indicators to assess the follow up of the European Union's Sustainable Development Strategy.

To measure the **intensity of materials** the reverse of productivity is used, that is, CNM/GDP or IDM/GDP, although at times ratios can also be used considering the number of inhabitants instead of GDP.

The differences between indicators of direct inputs of materials and national consumption of materials may be of some importance, especially in economies with a major dependence on foreign countries as regards exports of materials. In this case, it is worth preparing both kinds of indicators, GDP at constant prices generated by tonne of material consumed and GDP by tonne of input material, to analyse the trends in productivity of natural resources and directly study how the distance between input and national consumption of materials evolves over time.

There are other factors to consider when analysing both kinds of accounts, materials and economies and interpreting other indicators such as the foreign trade balance of materials, which reveals the degree of material dependence with the outside, and the net accumulation of stock of materials.

## 8. Relationships between the movements of materials account and the input-output physical tables

Input output physical tables (IOPT) report the movements of materials within the financial system, in addition to between the financial system and the environment. They also report the accumulation of materials in the economy but not the stock of natural capital or the stock of produced capital.

The tables present the environmental changes caused by human activities such as use of natural assets both as a source of raw material and drain for waste.

For natural assets the following differentiation is made, the assets produced, financial assets, which include cultivated plants and animals linked to agriculture and livestock, and unproduced assets. Natural assets not produced are aimed at reporting the use made by the economy of the natural setting.

Biological metabolism has to be considered to maintain identity between inputs and outputs. As in the movement of materials accounts, the IOPT can reveal the variation in intensity and efficiency of materials from an economy over time.

Thanks to the presentation of movements of materials, detailed by activity branches, the IOPT provide more comprehension of the reasons underlying these changes. In addition, they reveal the efficiency of materials by activity branches as they may be used to analyse movements of materials, revealing not only the direct inputs of materials and outputs of economic activities but also indirect movements of production and consumption. The analysis of direct, indirect inputs and accumulation of materials (or emissions) may be applied to the political analysis.

At the same time, the possibility of integrating the IOPT with monetary input-output tables enables analysing the effects of political measures (taxes, subsidies, environmental regulations) designed to reduce the consumption of materials and energy or the generation of waste. The effects of the variation in prices on movements of materials and energy can also be modelled and analysed. The system also breaks down the information into subsystems which correspond to different production branches and end use categories with an estimate of the indirect movements of materials within the economy and the movements associated with products by economic activity branches and different end use categories.

## 9. Estimate of the movement of materials accounts in Spain base 2010. Statistical sources used

The quality of the estimates of movements of materials accounts depends on their **internal consistency** and international comparability. The consistency includes guaranteeing the following requirements:

- They only include data which comply with the definition of limits of the movements of materials accounts system.
- All data are expressed in tonnes.
- There is no duplicate accounting.
- The compilation of data is exhaustive. It is necessary to estimate the lack of data, when this occurs.



- We must guarantee that data come from sources with the necessary quality.

The sources from which movements of materials accounts for Spain, base 2010 are prepared, are mentioned below.

### 9.1 Sources of direct inputs and foreign trade

The ***Spain Mining Statistic*** published by the Ministry of Industry, Tourism and Trade is the statistical source to estimate most direct movements related to the national extraction of fossil fuels, metallic and non-metallic minerals. However, data relating to *gross ores* from metallic minerals have been estimated and facilitated by the ***Geomining Institute of Spain*** (IGME)

Regarding biomass the ***Statistics Yearbook from the Ministry of the Environment and Marine and Rural Affairs*** (MARM), enables estimating the biomass of primary crops, fodder crops and waste from crops in addition to wood, hunting, collection and continental fishing. The conversion of tonnes of fodder crops to its equivalent with 15% humidity was performed by means of an estimate process with the assistance of MARM. The data corresponding to maritime fishing, come from the ***FAO statistics***.

As for imports and exports, the ***Spanish foreign trade statistics*** published by the Ministry of Industry, Tourism and Trade with data from the Spanish Inland Revenue, offers specific information to estimate the amount of products imported and exported into physical biomass units, metallic and non-metallic minerals, fossil fuels and other products, by types of product.

### 9.2 Sources of processed national output and indirect and hidden movements

Regarding outputs, the ***surveys on the generation of waste by economic activities*** (industry and services) and the ***survey on the collection and processing of urban waste from the Spanish National Statistics Office***, will provide both the waste and landfill into water. As for atmospheric emissions, the results of accounts on atmospheric emissions and energy uses of NAMEA will be used in movements of materials accounts as they are consistent with the residency principle. ***Accounts on atmospheric emissions published by the Spanish National Statistics Office*** will be those used in this section.

The estimate of hidden movements and indirect movements associated with imports and exports will be performed by means of equivalent raw materials (used extraction) and unused extraction associated with raw materials. Wherever possible, national coefficients will be used to estimate these movements in case they are available on a timely basis. In any case, the ***Wuppertal Institute for climate, environment and energy***, offers a series of technical coefficients for each one of the materials, both imported and extracted directly, which correspond to equivalent raw materials and unused extraction, classified by countries which export these raw materials. This will enable having a matrix which calculates both types of movements.

In some cases, it may be observed that exports of certain materials are greater than national production because a portion of these comes from imports. We should therefore consider that indirect movements associated with these exports will not be accounted for as in physical terms they are fictitious.

In the case of unused biomass extraction, three aspects may be considered: the ruling out of maritime fishing, which according to a Greenpeace study represents 25% of captures; losses

of wood in forestry; and losses of soil because of erosion of crop areas, calculated from estimates of the Spanish forestry plan.

### **9.3 Future works**

This publication presents with base 2010 the series relating to national extraction, imports and exports. As estimates of movements of processed national output are completed, in addition to hidden and indirect movements, they will be incorporated into the publication.