Unused Materials Quantities Estimate in the Material Flow Accounting Context: Integration of Data Sources and Construction of Technical Coefficients

La stima delle quantità di materiali non utilizzati nel contesto della contabilità dei flussi di materia: integrazione delle fonti e costruzione di coefficienti di calcolo

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1. Material Flow Accounting: the unused materials

There has been increasing interest, in recent years, in the ecological dimension of sustainability, intended as long term equilibrium between the anthropic system demand of materials and the functioning of the natural system. This involves an interest also in official statistics on unused materials, otherwise quite neglected. Economy-Wide Material Flow Accounting (EW-MFA)\(^1\) provides an aggregate overview, in tonnes, of the annual material inputs and outputs of an economy: inputs and outputs from and to the national environment as well as imports and exports in physical terms. Inputs from the national environment means the extraction or movement of natural materials caused by human activities (i.e. extraction of fossil fuels, minerals, biomass harvest). Outputs to Nature are defined as all material flows entering the environment as a consequence of production/consumption processes (i.e. emissions to air and water, waste). Material inputs can be used or unused. Used refers to materials with the status of a product; unused flows are materials extracted or harvested, or otherwise moved on a national

\(^1\) See Eurostat (2001).
territory, which are not intended for use. Examples are soil and rock excavated during construction (buildings, roads and railways), overburden from mining and quarrying and unused biomasses from harvest. The present paper concerns the methodology for estimating the unused flows of materials of the Italian economy from 1980 to 2001 – referring to the unused materials from mining and quarrying and from biomass harvest – and is focused on data sources integration and the construction of technical coefficients (§ 2). Some results of the application are introduced in § 3.

2. Data sources integration and the construction of technical coefficients

Due to the scarcity of data sources on unused materials, Istat has devised an *ad hoc* methodology, with the aim of estimating some environmentally relevant flows of unused materials; the method consists of different modules according to the kind of flows. The first step involves a thorough search for all available data sources. When their quality and coverage is not adequate, the following step is to use technical coefficients, which allow to estimate the flows of the unused materials on the basis of the quantities of used materials taken from Nature. To that end, whenever sufficient information is available, for any given activity the ratio between the unused waste arising from the same activity and its output of used materials is estimated. When, on the contrary, the scarcity of information makes it impossible to calculate *ad hoc* coefficients fitting the Italian specificities, technical coefficients available in the international literature are adopted. In the EW-MFA context, the unused flows are composed by materials from soil excavation activities, from mining and quarrying activities and from biomass harvest. This paper refers to the estimate of the last two items representing almost half of the total unused flows of the Italian economy: it is in these cases a work of integration of data sources and of construction of technical coefficients is done.

Regarding mining and quarrying, reference is made to the international classifications concerning economic activities, products and waste, thus ensuring consistency in the basic data used. The main international classifications taken into account are the European Statistical Classifications of Economic Activities (NACE Rev. 1.1) and of industrial products (1997 PRODCOM list)\(^2\) as well as the European Waste Catalogue (EWC). Mining and quarrying (section C of the NACE Rev. 1.1.) is broken down into two subsections mining and quarrying of energy producing materials and mining and quarrying, except of energy producing materials. Concerning mining and quarrying of energy producing materials, specific coefficients based on data concerning the domestic Italian territory are calculated for oil and natural gas. From 1997 onwards these technical coefficients are calculated yearly as the ratio between the quantities of waste from drilling (source: ENI S.p.A.) and the extracted quantities (source: Ministry of Productive Activities). A weighted average of these coefficients is adopted for the years 1980-1997; such an average, weighted by the quantities of materials extracted in that period, is considered adequate given the slight variability in the annual coefficients

\(^2\) See the Statistical Classification of Economic Activities in the European Community (NACE Rev. 1.1); PRODCOM is for the EU production statistics on Mining and Quarrying, Manufacturing, and Electricity, Gas and Water Supply; the latter are Section C, D and E of the NACE Rev. 1.1.
obtained and the absence of significant changes in technology. For the other energy minerals extracted from domestic environment - such as coal, lignite and peat – as no data are available to estimate specific coefficients, technical coefficients available in the literature are adopted\(^3\). Concerning *mining and quarrying, except of energy producing materials*, the methodology for the construction of technical coefficients is based on an integration of administrative and statistical sources. This is carried out linking data on companies’ waste (administrative source: APAT) and data on companies’ production (statistical source: Istat) using companies’ fiscal codes, information that is present in both sources. For waste, the data used are those collected in the MUD form\(^4\), classified according to the EWC\(^5\), while for the production the data are provided by the PRODCOM survey, carried out by Istat since 1997. MUD and PRODCOM data are then used to calculate the numerators and denominators of technical coefficients that are referred to the different groups of activities included in *mining and quarrying, except of energy producing materials*. No similar calculation can be carried out at the product level, since in the MUD data on waste is not broken down by product. The available data do not allow to make a correct calculation for all the activities included in the NACE subsection *mining and quarrying, except of energy producing materials*. Applying the estimation procedure described, it has been possible determine the coefficients for two groups of activities only: *quarrying of stone* and *quarrying of sand and clay* (NACE 14.1 and 14.2). Concerning other minerals coefficients from literature\(^6\) are adopted.

The unused materials from biomass harvest include flows from *agricultural*, *forestry* and *fishing* activities. They are accounted for in dry weight (except fishing residues) because a valuation of the unused materials in humid weight would have been arbitrary, due to lacking information on the water content of the unused part of the plants. The unused materials from *agricultural* activities consist of the parts of plants that remain on the ground and are ploughed back into the soil. *Forestry* unused flows consist in minor branches and leaves remaining on the ground after the trees are felled. For both agricultural and forestry activities no data on unused flows are available, so it is necessary to construct an estimation procedure. The approach followed for quantifying these unused materials manages to take into account the specificities of the cultivar and species harvested in Italy. The estimation of the weight of these materials is made in two steps. In the first step the used materials removed (reported in the Istat harvest statistics as total weights at the time of harvest) are transformed in dry weight, consistently with data, generally available in the literature, concerning dry matter contents of used parts of the plants harvested. This is achieved through coefficients determined for each product/crop on the basis of laboratory tests performed by various institutions (source: FAO, European Universities). In the second step, the connected flows of unused materials are calculated in terms of dry matter, starting from the dry matter calculated for the harvested products, by means of ratios between agronomic residue and agricultural product, derived from technical manuals. To calculate the

\(^{4}\) The MUD (Modello Unico di Dichiarazione in materia ambientale) is a form to be compiled by all the companies that produce special waste in their activity.
\(^{5}\) In particular the data on “Waste resulting from exploration, mining, dressing and further treatment of minerals and quarrying”.
unused flows from *fishing* activities, coefficients reported by the Wuppertal Institute from a Greenpeace study are used.

### 3. Main results

The application of technical coefficients to used materials quantities led to the construction of unused material flows time series 1980-2001 generated by the Italian economy. Figure 1 shows the unused materials quantities from *mining and quarrying* activities and from *biomass* harvest. The data highlight that from 1980 to 2001 these unused quantities decrease by 16.8% from almost 46 million tons to less than 39 million tons. The trend, quite smooth until the end of the 1980s, in the following period presents some oscillations, with a sensible reduction in 1994 and a slow rise observed until 2001. The weight of each item on the whole amount of unused flows changes sensibly in the period analysed: in fact, although in 1980 unused material quantities from mining and quarrying account for almost 75% of the total, in 2001 each aggregate represents almost 50%. The figures show that the unused quantities from *mining and quarrying* decrease in presence of a growth of the correspondent used materials, while, on the contrary, the unused quantities from *biomass* grow although the used materials decrease. Given that the technical coefficients are unchanged through time, and considering that various materials and *cultivar* are included in the two aggregates, the phenomena described above are due to a composition effect. For *mining and quarrying* a greater extraction of materials with relatively low technical coefficients has taken place, while for *biomass* an increasing production of cultivar with relatively high coefficients has taken place.

**Figure 1: Unused materials flows from mining and quarrying and unused material flows from biomass harvest, Italy, 1980-2000, tons**

![Unused materials flows from mining and quarrying and unused material flows from biomass harvest, Italy, 1980-2000, tons](image)

### References


Eurostat (2001), *Economy-wide material flow accounts and derived indicators, a methodological guide*, Luxembourg.