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2 Territory and Environment

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Material flow accounts Growth in society's stock of materials

As they expand, human societies amass a growing quantity of materials, mainly in the form of buildings and infrastructures, but also in the form of durable goods such as machines, cars and furniture. The stock of materials thus created is occupying ever greater areas at the expense of natural ecosystems. However, this stock of materials also constitutes a resource pool which, if properly managed, can reduce to a minimum our needs for new natural resources and our impact on the environment. This publication presents the first detailed estimates of the annual net addition to the stock of materials of Swiss society for the years 2002 to 2007.

Between 2002 and 2007¹, approximately 105 million tonnes of materials were used directly in Switzerland every year. Slightly less than a sixth of this amount was exported, approximately a third was consumed during the year and the rest was stockpiled for several years.

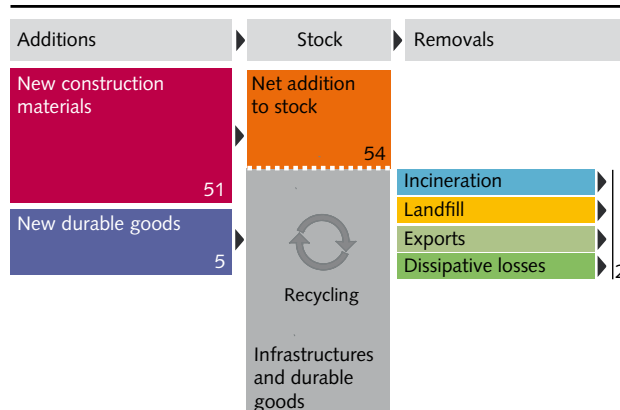
The materials consumed during the year are mainly food and fossil fuel products. They do not become part of the stock. Durable goods account for 8% of stocked materials, which total 56 million tonnes per year (Figure F1 and Graph G1). Depending on the type of material, these durable goods will remain in stock for an average of 2 to 30 years before being eliminated. The remaining 92% is made up of construction materials, assembled in the form of buildings or infrastructures over a period of several decades or centuries.

When buildings or infrastructures are demolished or durable goods eliminated, the recycled and reused materials do not leave the stock. In contrast, materials that are burnt, exported or landfilled leave the stock for good. In this way, approximately 2 million tonnes of materials flow as removal from the stock every year in Switzerland (Figure F1 and Graph G1). These removals also include dissipative losses such as building erosion or wear of car tyres.

The annual increase in the stock of materials (the difference between additions and removals) represents 54 million tonnes of materials or 7.2 tonnes per inhabitant. Swiss society therefore accumulates a weight equivalent to that of 11 Cheops pyramids per year.

Stock of materials of Swiss society: additions and removals

F 1



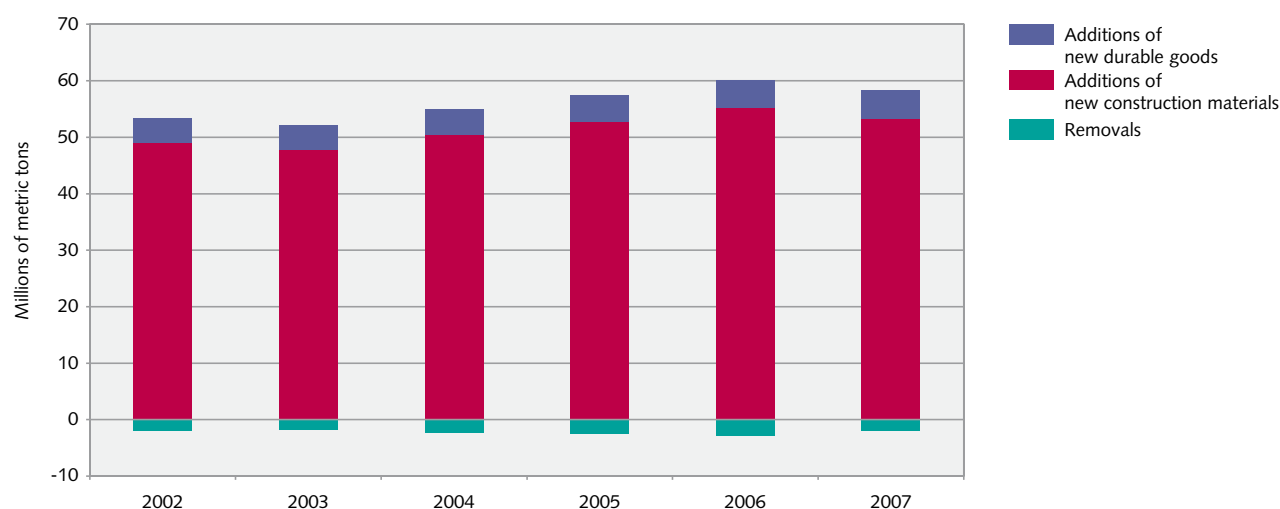
Data: averages 2002–2007 in million metric tons

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¹ Unless indicated specifically, all the results presented in this publication refer to the average observed between 2002 and 2007.

Stock of materials: additions and removals

G 1



Source: FSO

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The majority of additions are construction materials

New building materials constitute the greatest part of stock additions (Graph G1). The change in these additions is therefore strongly linked to the consumption of materials in the construction sector. However, an increase in activities in this sector does not necessarily lead to a growth in stock inputs. The increased use of recycled construction materials can lead to a fall in the demand for new construction materials as well as to a fall in stock removals.

Minerals account for 93% of the composition of new construction materials. The remainder is composed of metals (3%), timber (3%) and plastic, asphalt and glass (1%) (Graph G2).

Gravel and sand represent 73% of construction material additions. Approximately 80% of gravel and sand are domestic in origin. Some of these non-renewable resources are starting to become scarce in certain regions, as is the case in the canton of Geneva. This means that sometimes these materials have to be transported a long way to reach building sites. In fact, raw minerals, including excavated material, currently represent almost 40% of the tonnage carried by domestic heavy vehicles. Gravel and sand, however, can sometimes be replaced by recycled materials.

Great diversity of new durable goods

Estimated additions of new durable goods increased from 4.3 to 5.1 million tonnes between 2002 and 2007. This increase of 18% should be seen in the context of the 4% increase in population and the strong growth of the industrial sector (+15% of gross added value in real terms) during this period.

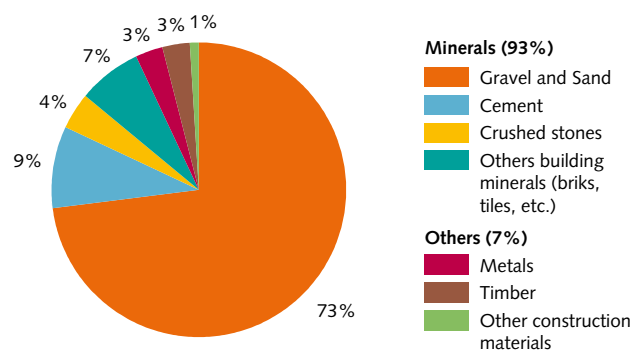
A third of the additions of new durable goods are composed of office and household equipment, i.e. mainly furniture (Graph G3). A further third of new durable goods is accounted for by the new machines used by industry. The last third is half accounted for by new transport vehicles, half by textiles, electronic equipment and other durable goods.

All durable goods together represent 8% of all additions. This low proportion of new durable goods is comparable to that observed in the Czech Republic (6% in 2002) or in the United States (on average 7% during the period 1975–1996).

Additions of new construction materials

Average 2002–2007

G 2

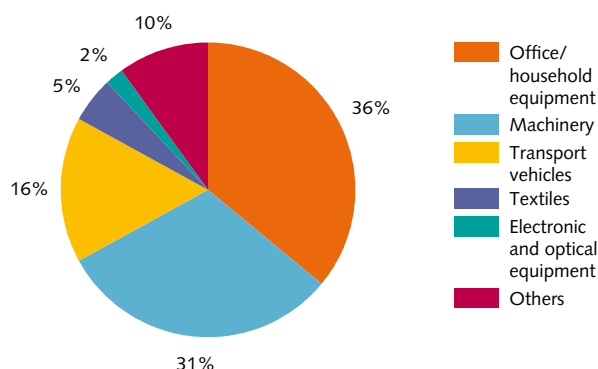


Source: FSO

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Additions of new durable goods Average 2002–2007

G 3



Source: FSO

© Federal Statistical Office (FSO)

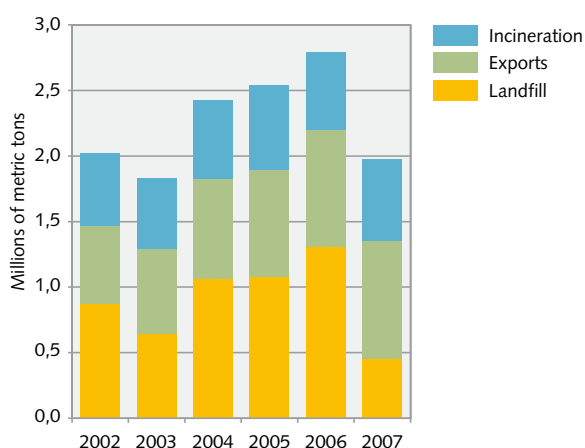
Few removals...

Removal from the stock is estimated to be between 1.8 and 2.8 million tonnes per year, i.e. approximately 25 times less than the additions (Graph G1). Generally, however, the change in removals runs parallel to that of additions. But estimating these removals is difficult and subject to major uncertainties.

Some 26% of removed material is burnt, 34% exported and 40% ends up in landfills (Graph G4). Dissipative losses represent 0.1% of removals. A large part of landfilled materials comes from construction minerals. Although a large proportion of building waste is already recycled, better reutilisation of this waste would result in a fall in the demand for new construction materials and prevent waste disposal sites from growing beyond capacity. The lack of space for getting rid of this inert waste is, in fact, becoming increasingly problematic.

Removals from stock of materials

G 4



Source: FSO

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... and a stock that grows annually by 54 million tonnes

The estimated net addition to stock fluctuated between 50.3 and 57.3 million tonnes between 2002 and 2007, i.e. between 6.8 and 7.6 tonnes per inhabitant. As removals are low, the change and the composition of the net addition to stock are very similar to that of gross addition (Graph G1).

All countries for which a stock variation has been estimated show growth. Thus, the growth in stock per inhabitant was estimated at 10 tonnes for the EU-15 in 1996, at 9 tonnes in Germany in 2001 and at 8 and 6 tonnes for France and Japan, respectively, in 2006.

A recent study by the Federal Office for the Environment (FOEN) estimated the total weight of the stock of buildings and infrastructure in Switzerland to be more than 3 billion tonnes. An annual increase in the stock of buildings and infrastructures of approximately 50 million tonnes indicates, therefore, a 1.6% annual growth rate of this stock. Such a rate, if it remained constant in the future, would lead to a doubling of the stock in less than 50 years.

Continued growth in stock is not sustainable

The stock of materials of Swiss society occupies surface areas (roads, buildings, etc.). Continued growth of this stock results mainly in the expansion of areas used for housing and infrastructures, frequently at the expense of natural or agricultural areas. In fact, between 1979/87 and 1992/97, housing and infrastructure areas increased by 13.3% in Switzerland. According to the partial results of the land use statistics for Western Switzerland, these areas continued to increase between 1992/97 and 2004/09. This leads to an increase in human pressure on the environment.

From another point of view, these materials are a precious reservoir of raw materials. Knowledge of the composition of these materials can allow predictions to be made on future waste flows and their potential re-use, thus avoiding the extraction of new natural resources.

A sustainable society should strive for a stabilisation of the weight of its stock of materials. Zero or very slight growth in stock, combined with weak in- and output flows, is a sign that the economic system is materially self-sufficient, thanks in particular to the recycling of construction minerals and metals.

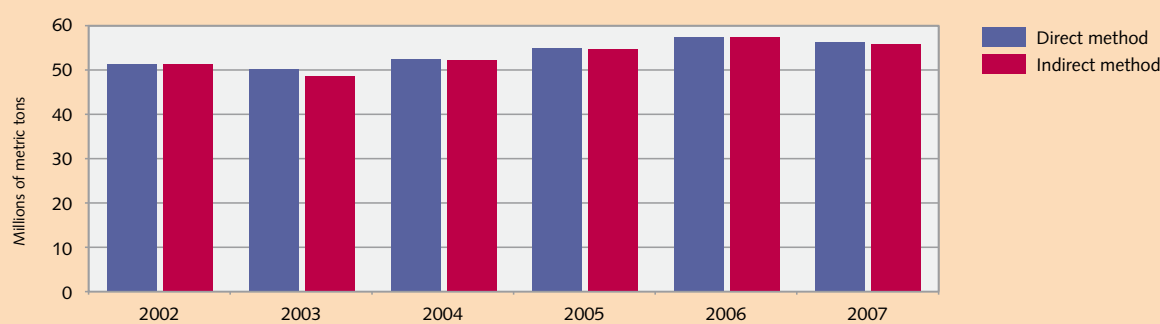
Box 1: Two methods for the same indicator

The Net Addition to Stock or NAS, can be estimated as done in the current study, according to a direct method, by calculating the difference between the new materials which are added each year to the stock and the used ones which leave the stock as removal (Figure F1). Currently there is no unified method at international level of calculating this addition according to this direct approach. The results shown here are a compilation of data and estimates from different sources such as the statistics of foreign trade, waste statistics or the annual reports from the construction industry. The «living» part of stock, i.e. human beings and livestock, has also been taken into account. It is however extremely low, as it accounts on average for less than 0.1 % of net addition to stock (NAS). This explains why it is not shown in the graphs.

There is also an indirect method of calculating the net addition to stock. This second method was developed by Eurostat, the statistical office of the European Union and comes from the material flow accounts (FSO 2008. *Switzerland's material needs* Swiss environmental statistics N° 14 (published only in French and German)) and is done by calculating the difference between all input flows (imports, domestic extraction and balancing items on the input side) and all output flows (exports, domestic processed output and balancing items on the output side). The indirect method has the disadvantage of not showing the composition of the net addition to stock and also involves the risk of accumulating estimation errors made while calculating other flows.

Comparison of the results from both methods shows that growth over time is identical but that the estimations made using the direct method are, on average, 1 % higher than those made using the indirect method (Graph G5). This relatively small difference highlights the uncertainties that still exist regarding the estimation of material flows.

Comparison of net addition to stock obtained by direct and indirect methods G 5



Source: FSO

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Material flow accounts

Due to its economic activities, Switzerland moves and uses large quantities of materials: it extracts natural resources, manufactures products and consumes goods. Raw materials are extracted in Switzerland or abroad, are transformed into products, are often transported over large distances, are sometimes stocked for years, sometimes recycled, before being discarded, sooner or later, into the environment, in the form of waste or other emissions. The material flow accounts (EW-MFA for Economy-Wide Material Flow Accounts), is a statistical tool developed by Eurostat, which enables the total of these flows to be quantified.

Environmental accounting

Environmental accounting is an ecological complement of national accounts. It aims to improve our understanding of growing interactions between the economic and environmental spheres and to take due account of them in policy making. Its elaboration by the FSO is based on the development of the NAMEA (National Accounting Matrix including Environmental Accounts), the material flow accounts and the economic environmental accounts.

Additional information available on the internet

Environmental accounting:

www.bfs.admin.ch/bfs/portal/fr/index/themen/02/05.html

Material flow accounts:

www.bfs.admin.ch/bfs/portal/fr/index/themen/02/05/blank/dos/03.html

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