bio Intelligence Service

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ANALYSIS OF THE KEY CONTRIBUTIONS TO RESOURCE EFFICIENCY

Final Report

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vito vision on technology

Bio Intelligence Service - Scaling sustainable development
Industrial Ecology - Nutritional Health

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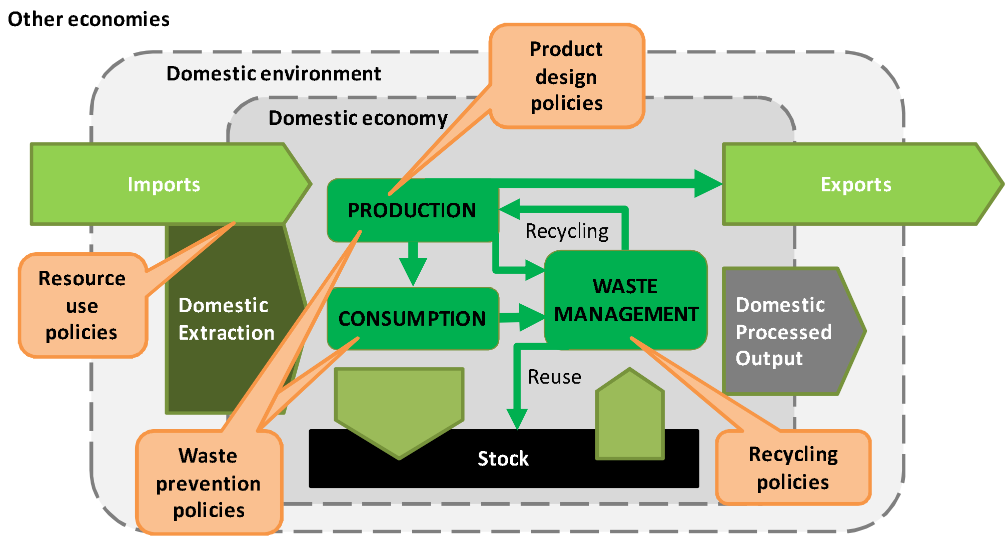
EXECUTIVE SUMMARY

Natural resources are fundamental for the economy and prosperity. They provide raw materials, energy, food, water and land, as well as environmental and social services. However, our current patterns of resource use, production, consumption and waste are unsustainable. The Earth has only finite resources, and the use of these resources places increasing pressure on our natural environment resulting in global warming, pollution and degradation of eco-systems and biodiversity. In order to reduce the environmental impacts related to resource use in the economy, we have to be efficient with the resources that we have.

Tracking the resource efficiency of economies is one way of understanding whether we are progressing towards sustainable development. An indicator often used for resource efficiency is the total amount of materials directly used by an economy (measured as domestic material consumption [DMC]) in relation to economic activity (measured as GDP). It provides an indication to whether decoupling between the use of natural resources and economic growth is taking place.

The objectives of this study is to assess in quantitative terms the extent to which recycling, waste prevention and improvements in product design together with existing policies contribute to overall material use and material productivity.



An overview of where the different resource efficiency policy areas contribute to material flows

Specific objectives of the analysis performed in this study are:

1. to assess the material savings and material productivity of current measures;
2. to assess the potential of achieving existing targets and by the full implementation of policies; and,
3. the potential of other possible methods, approaches and policies.

The study also considers the general environmental, economic and social implications and consequences of possible actions to improve material productivity.

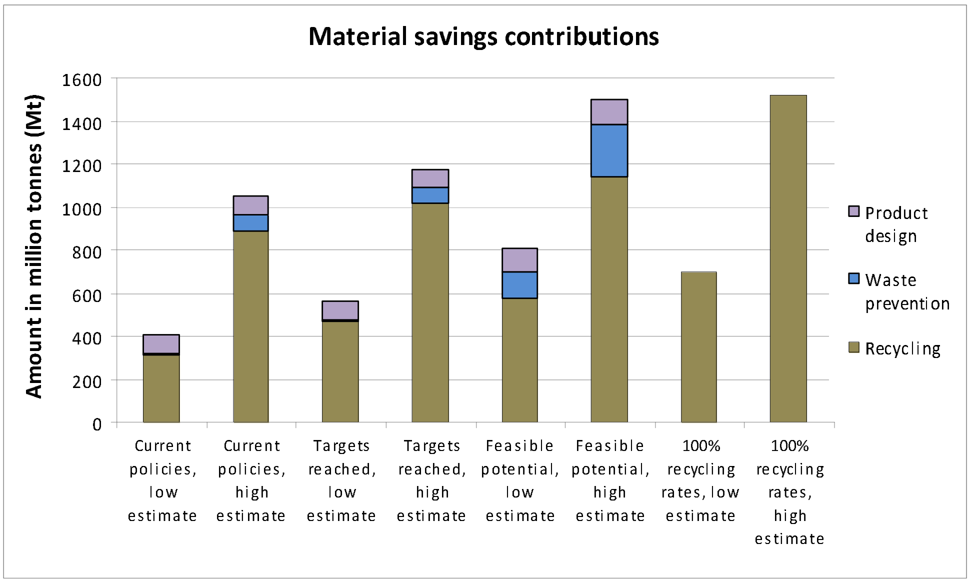
The resources investigated in this study are limited to non-energy materials: biomass (excl. wood fuel), minerals, metals and plastics. Furthermore the study assumes identical consumption patterns and population numbers when considering the different scenarios (current policies and practices; policies with targets reached; feasible potential, and; a theoretical 100% recycling rates) with and without recycling, waste prevention and ecodesign measures.

Data sources and methodology

Waste statistics from Eurostat and the European Topic Centre for Sustainable Consumption and Production formed the main source of data for the amounts of recycling in the EU-27. This data was complemented with data from industry associations and research institutions. There is a high degree of uncertainty in the waste data, particularly for construction and demolition waste, which constitutes the majority of waste in terms of weight. Estimates vary from 510 Mt to 970 Mt. The recycling amounts from production statistics were generally significantly higher than those reported in the national waste statistics, as the waste statistics do not capture all waste streams and might miss out several flows, whilst production statistics include internal material recycling flows. The data for waste prevention and product design is limited. Based on their recent implementation, there is a lack of measurement and no economy wide estimates exist. The estimates for waste prevention and product design are mainly based on case studies of material savings from local initiatives.

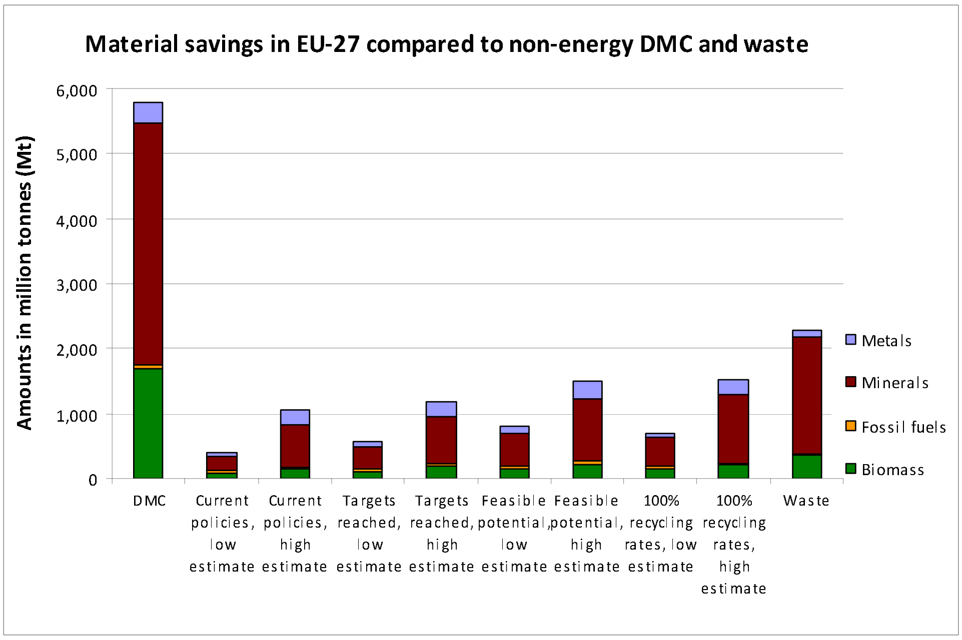
Material savings

In the investigation performed in this study of the contributions to material savings and efficiency, recycling has by far the largest contribution compared to waste prevention and product design. Waste prevention has not demonstrated any significant effects on material savings yet, but it is assessed that through leaner production and construction methods, more reuse and sustainable consumption patterns this could hold significant material savings without a negative effect on GDP. Design-oriented product policies have only showed limited material savings, but there is evidence that both packaging and electrical and electronic equipment has benefited considerably from ecodesign approaches. Ecodesign approaches show promise to further reduce material consumption in the economy through lightweighting, but also by supporting recycling and reuse.



An overview of material savings due to recycling, waste prevention and product design from current practices and policies as well as future potentials

Estimates for material savings range considerably depending on the source of waste statistics and assumptions made for waste prevention, e.g. from 406 Mt to 1048 Mt for material savings due to current policies and practices. This corresponds to 5 - 14% of total material consumption (including energy carriers). If only non-energy material consumption was considered, then these material savings would correspond to 7 – 18%.



Material savings in the EU-27 compared to non-energy related Domestic Material Consumption (DMC) and waste. As less than 2% of fossil fuels are used for plastics, this is almost not visible on the graph.

Future feasible potential for material savings from recycling, waste prevention and ecodesign is estimate to be from 11% to around 21% of total material consumption (including energy carriers). These potential material savings correspond to 15 – 28% if seen in relation to total non-energy related material consumption. These estimates do not take into account any additional savings arising from fossil fuel savings from reduced transport or lighter vehicles.

Construction materials recycling is by far the most important activity relevant for material savings. Metal recycling is important since it substitutes very material intensive up-stream processes related to mining and refining. Wood, paper and cardboard recycling has the largest contributions to biomass (forestry) savings. Reductions from food waste prevention are very small compared to overall consumption.

There is a high degree of uncertainly to the above values as the data they are based on is not very robust and several general assumptions have been made in order to perform the calculations. For some material streams the recycling data varies up to a factor 5. Overall the difference between the conservative estimates and high estimates is up to a factor 2.6. However, if controlled for the uncertainty of construction and demolition waste the difference is about 30%.

Environmental impacts

Three methodologies for calculating environmental impacts were chosen as most suited for the purposes of this study: land use, Ecological Footprint (EF) and Environmentally Weighted Material Consumption (EMC). Although all methods have their shortcomings, they are thought to provide a fair indication of different environmental impacts in relation to the key contributions to material productivity. Land use and EF caters more for biomass production and land use indicators, while EMC has a broad application for all types of material streams and environmental impact categories.

The reduction of land use in the EU due to material savings was only calculated for biomass materials as there is no direct relationship between the other material streams and land use. In any case the area of land taken for mining, production and landfill sites is very small in the EU and changes to this are considered insignificant. Regarding land use reductions for forestry and agriculture, the material savings from wood, paper and food that could be achieved from best practices implemented in all Member States would correspond to about 30 million ha of bioproductive area. Most of this would be forest area.

Material savings go hand in hand with reductions in environmental impacts. The Environmentally weighted Material Consumption (EMC) methodology was used to calculate the achieved and potentials for environmental impact reduction. Here it was calculated that 135 Mt of CO_2 equivalent (based on the conservative estimate) are current saved annually due to the contributions to material productivity from recycling, waste prevention and product design. Plastics, biomass and metals are the material streams with the highest contribution to reductions in this impact category. If all the recycling policy targets identified are reached, 176 Mt of CO_2 equivalent would be saved annually. In the cases of the maximum recycling potential and 100% recycling rates achieved, the annual amount of CO_2 equivalent emissions saved would be 278 Mt and 315 Mt, respectively. Plastics are the material stream with higher environmental impact reductions in the current situation and also with the highest improvement potential in the other three scenarios analysed. The reductions in greenhouse gas emissions do not take into account any additional savings arising from fuel savings from reduced transport or lighter vehicles.

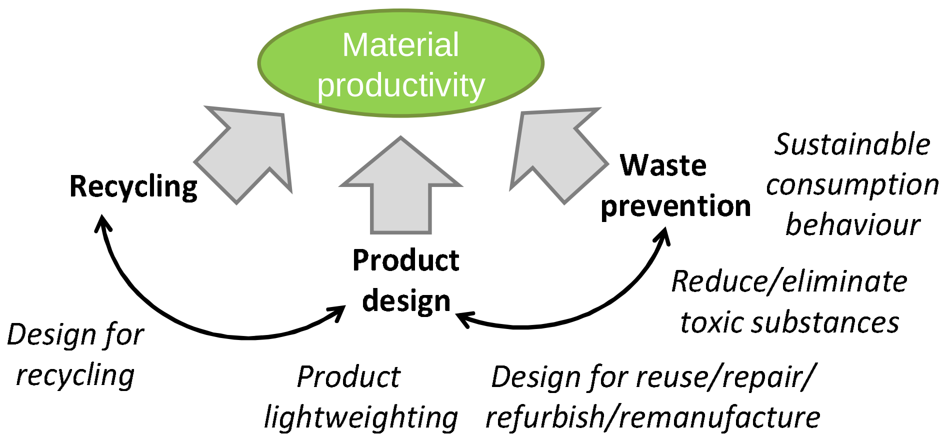
- **Socio-economic impacts**

The impacts of recycling, waste prevention and product design were analysed in relation to employment and competitiveness. A review of the existing knowledge was provided, but no direct relationship with increased material productivity could be determined. In general, direct-employment in all EU-27 eco-industries in 2008 reached approximately 3.4 million whereas it was at 2.8 million in 2004[Error! Bookmark not defined.]. Waste management and recycled materials have important annual growth rates, 7.1% and 10.6% respectively, and usually in countries where the rate of waste recycled is high (i.e. Germany), the rate of employment in this sector is also high.

However, the net jobs creation due to increasing material productivity should be calculated accounting the number of jobs created and the possible job losses. The assessment of direct job losses, transformation, and substitution is difficult to determine because no data is readily available.

- **General implications and consequences**

In the study it is estimated that recycling has by far the largest contribution to material productivity (currently and also future potential), but it would seem that waste prevention through reuse and consumption behaviour could contribute significantly. In order for material productivity to increase, product design is the key to achieve greater amounts of recycling and waste prevention.



How product design is key to achieving greater material productivity through recycling and waste prevention

To increase resource efficiency through recycling, waste prevention and product design policies, one must consider the various material streams and their application:

- Construction materials constitute the largest material flow, but most go into stock (buildings and infrastructure) for the benefit of future generations
- Waste prevention is most suitable for addressing food, whilst recycling and product design can address the supporting systems surrounding the food cycle (e.g. packaging)
- Rare metals play a critical role in high-tech products (incl. environmental technologies), efforts should be made to ensure that these materials are never wasted

Resource efficiency is an indicator that measures the input and output of natural resources in the economy in relation to GDP. The EU's Resource Strategy has the dual objective of decoupling resource use from economic growth and decoupling environmental impacts from resource use. This study has investigated the contributions of recycling, waste prevention and eco-design polices and measures that contribute to the overall resource efficiency and reduction in environmental impacts. When considering whether targets for resource efficiency should be put forth, as they have been done for energy efficiency, it should be noted that as resource efficiency is based on the relationship of the input and output of resources, the focus so far has been more on the economic aspects rather than the actual reduction of overall resource use.

If the real goal of sustainability is to ensure that the non-renewable resources are not wasted and the renewable resources are only exploited in a way that allows the resource stock to regenerate itself and continue to fulfil the needs of future generations, then the focus should be on the actual amounts of resources that enter and leave the economy. Likewise resource efficiency cannot be used as a proper proxy for reducing environmental impacts on for example biodiversity, as these often depend on actual amounts of emissions locally. The amount of natural resources we have and the endpoints of environmental impacts are absolute, whilst resource efficiency is relative.