Climate Benefits of Material Recycling

Inventory of Average Greenhouse Gas Emissions for Denmark, Norway and Sweden

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Popular summary

In a research project at the University of Gävle and the Technical University of Denmark average greenhouse gas emissions from material recycling have been collected and compared with both production of new raw material and with waste incineration. The studied materials are glass, aluminium, steel, plastics, paper and cardboard, and organic waste to compost and to digestion. More materials could not be included in the study due to lack of data. The results are based on a literature review of scientific articles and reports from public authorities and industry associations. They show that material recycling causes lower emissions of greenhouse gases than production with new raw material and it also causes lower emissions than waste incineration.

Material recycling causes lower emissions than production of new raw material

In the report greenhouse gas emissions from material recycling and from production of new raw material are compared. The results show that the emissions from material recycling are lower for all the studied materials (Table 1). As an example, the emissions for aluminium are 96 percent lower if recycled material is used than from production of new raw material. The climate benefit for aluminium can be calculated as the difference in greenhouse gas emissions per kg of material (10.6) multiplied by the amount of treated material (in kg).

Table 1. The climate benefit of material recycling compared with production of new raw materials

Material	Reduced emissions	
	kg CO_2-equivalents per kg material	percent
Glass	0.4	41%
Aluminium	10.6	96%
Steel	2.1	87%
Plastics	0.8	37%
Paper and cardboard	0.4	37%
Organic waste (composting)	0.02	27%
Organic waste (digestion)	0.07	87%

Material recycling causes lower emissions than waste incineration

Moreover, greenhouse gas emissions from waste that goes to material recycling are compared with those from incineration. To make the two alternatives comparable a broader systems perspective is applied, where both alternatives produce the same amounts of raw material and energy. The results show that the emissions from the recycling alternative are lower for all the studied materials (Table 2). For plastics and organic waste to digestion the emissions are more than 50 percent lower from the material recycling alternative than from the incineration alternative. To calculate the climate benefit for plastics the difference in greenhouse gas emissions per kg of material (2.7) can be multiplied by the amount of treated material (in kg).

Table 2. The climate benefit of material recycling and separate energy supply compared with incineration and production of new material*

Material	Minskade utsläpp	
	kg CO_2-equivalents per kg material	percent
Plastics	2.7	55%
Paper and cardboard	0.1	6%
Organic waste (composting)	0.03	21%
Organic waste (digestion)	0.09	54%

* The alternative 'material recycling and separate energy supply' here produces the same amounts of raw material and energy as the alternative 'incineration and production of new material'

Use of the results

The results can be used to show the climate benefits of material recycling in Norway, Denmark and Sweden today. They are intended for use by companies and industry associations for communication of the present performance in annual reports and similar publications, and on web pages. The can also be used by public authorities and contribute to discussions at a societal level, as long as it is recognised that they are averages for the existing system. With this data the climate benefit of material recycling of various materials, as well as the total climate benefit for various actors and for the industry as a whole, can be estimated. If the results are to be used to support future decisions specific and varying conditions have to be accounted for. It should be added that there are other factors than climate impact that are important, e.g., energy and resources, and other types of environmental impact such as eutrophication and diffusion of hazardous substances.