Letters to the Editor

The Impact of Mineral Resource Depletion

In response to: Steen BA (2006): Abiotic Resource Depletion: Different perceptions of the problem with mineral deposits. Int J LCA 11 (Special Issue 1) 49–54

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Resource management, i.e. the extraction and processing of natural resources, is viewed as crucial for LCA studies, because the impacts of this stage may well surpass those of other life cycle stages (Udo de Haes 2006). However, it has been questioned whether resource use or depletion should be included in LCA studies (Finnveden 2005). The LCIA framework of the global life cycle initiative indicates that abiotic resources form part of the natural resources area of protection, as a safeguarded subject, i.e. an operational subject of direct value to human society (Jolliet et al. 2004). It therefore seems that, in general, there is consensus that resource depletion should be considered in LCAs. The recent contribution of Steen (2006) to the debate is therefore timely.

Steen highlights three divisions in the LCA community: the time perspective when evaluating impacts on abiotic resources; the separation of environmental and economic aspects; and whether the consequences of decreased availability should form part of the LCI or the LCIA.

The first has to do with the issue of scarcity and how to express it. Scarcity always has a time dimension; it can be interpreted as change in availability over time. This is difficult to address, as we know little about the future and less if it is further away. With minerals, scarcity is typically used synonymously with decreasing concentrations of mineral resources at some time in the far future. It is questionable if it is appropriate to incorporate the consequences of such long-term effects in LCA studies. Furthermore, many LCIA approaches mix scarcity as such with the difficulty of extraction, which can be viewed as double counting as the effects thereof, such as high-energy demand, are accounted for in other categories. It has been shown (Strauss et al. 2006) that a comparison of current use with known economical reserves provides a much different picture of scarcity than that obtained when concentration and difficulty of extraction are used. For example, platinum would not constitute a 'scarce' metal. Steen indicates that some in the LCA community are confident that future backup technologies would address scarcity issues. Within the LCIA working group it is recommended that the work of Müller-Wenk (1998) be deemed as current best practice for metal resources. To reduce uncertainty in the LCIA, it is subsequently argued to consider the present social contexts with a shorter time line in terms of reserves, e.g. 100 years. Of course it would be necessary to update such 'scarcity' on a regular basis, e.g. every 10 years.

The separation of environmental and economic aspects is an important issue to consider for the actual 'impact' of resource depletion, and specifically the comparison of one mineral resource to another. Steen argues that there is no environmental mechanism with a common node for abiotic resources; they are not exchangeable from an environmental perspective. Finnveden (2005) highlights the impacts of resource use on human welfare. The socio-economic value of mineral extraction can be vast in some regions and changes in the extraction industry can have enormous social consequences. As resources become scarce the quality of life for parts of society may be influenced, which, in turn, may have negative impacts on human health as a specific area of protection (Jolliet et al. 2004). Therefore it is argued that environmental and economic aspects cannot be separated; the complex relationship between increasing scarcity and human health consequences could form the basis for comparison between different mineral and other abiotic types of resources. As the LCA tool is used increasingly in the sustainability rather than the pure environmental context, more attention should be given to the dynamic interactions between nature and society, i.e. the emerging field of sustainability science (Clark and Dickson 2003).

The proposed approach within the LCIA working group to address the third issue is through system expansion, focusing on resource functionality and dissipative use with 'future consequence' to develop appropriate abiotic resource impact categories (Steward and Weidema 2005). However, in the case of minerals, the current situation regarding most metals is that a certain amount of usage is annually recycled,

normally requiring significant less energy and other resources compared with the extraction of virgin metal. Therefore the metals in use can be regarded as a global inventory of metals that is available to humanity. Virgin metal is added as required to this inventory (Strauss et al. 2006). For most metals only a small fraction is removed from the global inventory by dissipative use. This is the case for a relatively inexpensive metal such as iron and much more so for an expensive metal such as platinum. Therefore, if the foreseeable future, e.g. the next 100 years, is taken as a time line, it is argued that the attention should not only be on the dissipative use at present, but more so on the current increased usage of most metals particularly since 1960 (USGS 1960), due to an increasing population and an increasing usage per person that leads to the ongoing depletion of the natural reserves. A future scenario might be that human population and usage per person stabilise leading to a much-reduced demand on virgin materials.

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Abiotic Resource Depletion

Different perceptions of the problem with mineral deposits

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Abstract

Background Aims and Scope. Access to abiotic resources is vital for modern life styles. Except for ozone depletion, no other environmental threat has a potentially larger impact on our everyday lives than shortage of abiotic resources. In 'Limits to Growth' the Club of Rome identified depletion of ores and minerals as becoming a major problem during the first or second decades of the twenty-first century, and the idea was widely spread. Since then, the attitude to the problem has shifted, and many institutions, such as the European Commission, do not consider the problem acute and does not give it priority in their present action plans. Regardless of when it happens, however, the social consequences of a shortage of abiotic resources will be a major problem and the significance and nature of the problem will depend on what the world looks like then at the time and afterwards. This article discusses existing LCIA methods in relation to their views on the depletion problem.

Method. Review of existing LCIA methods in relation to depletion problem definitions.

Results and Discussion. Existing methods for characterisation and weighting of abiotic resources appear to be based on four types of problem definitions, although not always explicit: 1) assuming that mining cost will be a limiting factor, 2) assuming that collecting metals or other substances from low-grade sources is mainly an issue of energy, 3) assuming that scarcity is a major threat and 4) assuming that environmental impacts from mining and processing of mineral resources are the main problem. In addition to differences in assumptions about what will be the limiting factor, there are different views on what time scales are of interest and how to integrate the issue in LCA.

Conclusion. The main dividing line in views on abiotic resources has to do with time perspective. If only caring for the next hundred years or so, abiotic resources is a manageable problem. In taking an historic perspective with tens of thousands of years, abiotic resources become a major problem.

Recommendations and Outlook. Today there seems to be some consensus on focusing on developing characterisation methods based on future increase of impacts from using lower grade resources with consideration of resource functionality. It is essential that the choice of temporal focus is given enough attention.

Keywords: Abiotic resources; category indicator; cost; energy; exergy; impact category, indicator, LCIA, minerals; scarcity