Climate change damage functions in LCA – (1) from global warming potential to natural environment damages

Energy use often is the most significant contributor to the impact category ‘global warming’ in life cycle impact assessment. However, the potential global warming effects on the climate at regional level and consequential effects on the natural environment are not thoroughly described within LCA methodology. The current scientific understanding of the extent of climate change impacts is limited due to the immense complexity of the multi-factorial environmental changes and unknown adaptive capacities at process, species and ecosystem level. In the presentation we argue that the global warming impacts from a product system being studied in an LCA must be seen in context with the changing future background situation. This background situation is among other things affected by e.g. cumulative atmospheric greenhouse gas emissions of yet unknown magnitude. Here, we define climate change damage on the natural environment as climate change driven environmental changes. The man-made environment such as cultivated land, infrastructure and urban areas is not considered. Hypothetical climate change damage functions representing both sensitive and robust responses were analyzed in relation to cumulative green house gas emissions. An attempt was made to link these hypothetical damage functions with current experimental evidence of biological and biogeochemical responses to a changing growth environment. Each LCA stage involves uncertainty due to e.g. choice, modeling, sampling and measurement errors apart from natural variation. Error propagation throughout the stages of the LCA is thus needed. The relative uncertainty (expressed as the coefficient of variation) of the product related emission, of the background situation and of the natural environment responses were compared. It seemed that the overall relative uncertainty of a characterization factor for climate change might be at least 64%-152% indicating a large variability around the unknown mean climate change damage.

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