Comparison of resource depletion indicators: Quantitative differences and similarities

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Abstract

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Concerns regarding natural resource availability and supply have been growing in recent years. Consequently, many initiatives have been taken by national and supranational organizations to develop mitigation strategies to the foreseen limits to the material consumption of the human society. Life Cycle Assessment (LCA) has been used to evaluate the environmental consequences of activities within our society with the fundamental focus on damages to human health, ecosystem quality and natural resources. A broad selection of resource depletion assessment methods has been proposed for modeling the damage to natural resources; however, little consensus has been reached on a relevant safeguard object and modeling approach along the environmental mechanism.

To improve the basis for discussion, we present a quantitative comparison of major modeling approaches to assess abiotic natural resource depletion through comparison of indicator characterization factors and characterized impact scores based on impact assessment of a large inventory database of activity datasets of diverse products and services. The comparison includes the methods of CML 2001 (ultimate reserve and reserve base), EDIP 2003, Eco-indicator 99, EPS 2000, IMPACT 2002, ReCiPe 2008, Swart & Dewulf (2013), CEENE, CExD and SED.

The comparison identifies little agreement across the methods with the exception of CML (default), Eco-indicator 99, IMPACT2002+, ReCiPe, CEENE and CExD that all suggest consumption of energy resources to be the main driver for natural resource depletion.

For practitioners the choice of LCIA method for resource depletion is shown to be crucial for the outcome of the impact towards natural resources. Furthermore, most of the methods focusing on energy resource consumption have a very limited coverage of resources in their depletion models due to lack of data indicating a high risk for problem shifting towards the ones not included in the models. This emphasize the need for reaching consensus on how to proceed with resource depletion modeling in LCA with a special focus on balancing modeling complexity with resource coverage. Furthermore, clarification of the area of protection for natural resources must be obtained to ensure a coherent modeling along the environmental mechanism an avoiding double counting across other impact categories within the LCIA.