Editorial

In Defense of the Cumulative Energy Demand

Ever since the early development of LCA, the cumulative (primary) energy demand (CED) per functional unit has been the most important aggregated result of the inventory used for comparisons of product-related systems. The primary energy demand is the most meaningful parameter in judging the energy efficiency of systems since losses due to transformation and transport are fully taken into account. In addition to the cumulative process and transportation energy, it also contains the "feedstock energy", i.e. the primary energy equivalent of the materials produced from oil, coal, wood, etc. Surprisingly, in a recent ISO Draft International Standard dealing with inventory analysis [1], the CED is not even mentioned. Similarly, the CED has not been included in an otherwise very useful and comprehensive Swiss data base and in the impact assessment and valuation of a major German packaging LCA. Trying to understand this development, I have learned the following arguments:

1) If an impact assessment follows the inventory analysis, there is an apparent double counting with regard to resource depletion and other energy-related impact categories.
2) The CED is calculated from resource demand data which should therefore be considered as the primary indicators for energy consumption.

The first argument is correct for some impact categories, especially if fossil energy is the main energy basis in a given country or region. The second argument is also more relevant to fossil energy carriers, the energy content of which is calculated using the respective combustion heats.

The arguments, although partly correct, are not sufficient to remove the CED as the main aggregated value in the inventory analysis and as a valuable help in impact assessment and valuation. The main reasons why CED is so important in LCA are:

1) As indicated above, the CED is the only energy parameter which aggregates **all** forms of energy use over the whole life cycle; removing it would mean to practically exclude some forms of energy (especially non-fossil forms) from impact assessment.
2) The CED is a **sum parameter** which implicitly indicates the environmental interventions due to the energy consumption connected with the system analyzed.
3) The CED is derived from the inventory analysis and does not depend on any assumptions made or uncertainties inevitably involved in impact assessment. It is also available if no impact assessment is performed in a specific LCA (=LCI).
4) The accuracy of the well-established calculation of CED [2] is much greater than that of most (emission-based) characterization procedures.

Finally, it should be emphasized that, extending argument (2), there is a need for a simple sum parameter representing the precautionary principle. This does not mean that impact assessment is superfluous, but it is ridiculous to assume that the impact categories proposed according to present-day knowledge should cover **all** environmental interventions. Any "double counting" argument against CED is therefore premature and is primarely based on the assumption that we know already most, if not all, environmental interventions caused by human activities.

Of course, some impacts are not related to energy (e.g. highly persistent or toxic chemicals in small amounts) and do not significantly influence CED. These impacts can hardly be accounted for by any parameter which summarizes the main energy (CED) or mass flows (MIPS [3]). It is better, however, to have one or two parameters representing the precautionary principle and, thus, our limited knowledge, than none at all. I therefore suggest that CED be included explicitly into the impact assessment or valuation phase of LCA. Mass-related sum parameters complementing CED are MIPS and/or the sum of solid waste. As the specific impact categories, e.g. global warming, the sum parameter(s) represent potential rather than actual risks related to the system studied, although on a higher level of aggregation.

References

[1] ISO/TC 207, Draft International Standard DIS 14041: Environmental management - Life cycle assessment - Goal and scope definition and inventory analysis. In preparation

[2] VDI-Gesellschaft Energietechnik (Ed.): Cumulated energy demand. Terms, definitions, methods of calculation (in German). VDI Draft Guideline 4600, May 1995

[3] F. Schmidt-Bleek: Wieviel Umwelt braucht der Mensch? MIPS (*) – Das Maß für ökologisches Wirtschaften. Birkhäuser Verlag, Berlin 1994

** (MIPS stands for "Material Intensity Per Service unit"; in LCA-terms, service unit is synonymous with functional unit)*

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