The added value of combining a bottom up with a top down approach for assessing the environmental impact in a specific context such as space missions

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Author: An Vercalsteren
Co-Authors: Ann Van der Linden, Jorrit Leijting, Katrien Boonen, Luc Bierque, Theo Geerken

In order to elaborate a methodological framework and database for space missions and to identify environmental hot spots from a life cycle perspective, the European Space Agency commissioned a consortium of VITO, Pré Consultants and QinetiQ to perform a Life Cycle assessment (LCA) of a satellite mission. The paper will discuss the bottlenecks and present the methodology applied in this specific context, illustrated by clear examples.
The assessment of the life cycle impacts of space missions is very challenging due to sector-specific characteristics, such as the use of special materials and the custom made components which have a much lower product output/overhead ratio compared to mass produced products. Furthermore, data collection on space missions can be rather difficult due to confidentiality issues and limited time availability to model a very complex life cycle. A specific pilot case on solar panels (domestic versus space-specific solar panels) was performed to better understand the challenges of applying LCA to space applications and to compare results of a bottom up (process-based LCA) with a top-down (IO) approach. Ultimately, the LCA model which we applied for the space mission uses a combination of physical and cost data in a so called hybrid LCA.

Another issue is the time-consuming nature of modelling the environmental impact of man-hours (services such as research) in high-tech contexts with LCA databases. On top, this approach still might cause an underestimation of the impacts. Therefore, the environmental impact of man-hours is in this case also modelled with IO data.

This study indicates that using only easily retrievable process-based data may lead to an underestimation of the environmental impact of a space mission. The hybrid LCA approach is a very useful and cost-efficient method for estimating environmental impacts from the space sector, as the truncation errors in process-based LCA may be very high due to the complexity of the supply chains and the importance of services (man-hours). IO-databases are based on a top-down approach and thus include the whole supply chain. The combination of process-based LCA data on well-known materials and processes and IO (cost-based) data on the remaining materials and processes provides the best of two worlds: details and completeness.