

IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)  
Sustainable Approaches and Impact of Space Transportation Solutions on Earth + Space Environment  
and on General Safety (9-D6.2)

Author: Mr. Marnix Hendrik Gustaaf Verkammen  
Space Engineering Center (eSpace), Ecole Polytechnique Fédérale de Lausanne (EPFL), Switzerland,  
marnix.verkammen@epfl.ch

Dr. Andrew Ross Wilson  
Glasgow Caledonian University, United Kingdom, andrew.wilson@gcu.ac.uk  
Mr. Enrico Tormena  
ESA - European Space Agency, The Netherlands, enrico.tormena@ext.esa.int  
Mr. Tommaso Turchetto  
Politecnico di Torino, Italy, tommasoturchetto33@gmail.com  
Mr. Adrien Saada  
Space Sustainability Rating, Switzerland, adrien.saada@ssr.space

META-STUDY OF CURRENT PROPOSED LIFE CYCLE ASSESSMENT SINGLE-SCORE  
METHODOLOGIES FOR SPACE MISSIONS' ECO-DESIGN

**Abstract**

The growing environmental impact of the space industry is slowly incentivising space actors to consider and reduce the impacts of their space mission over its full life cycle, through life cycle assessment (LCA). Whilst LCA has become commonplace in the European space sector, its growing international utilisation has led the methodology to become a powerful asset in quantifying the impacts of space missions and space transportation systems over a number of environmental impact indicator, to act on reducing their impacts. Whilst it can be used to determine hotspots, a sufficient level of knowledge and expertise is required in order to prevent cherry-picking of specific well-known categories. Thus, single-score life cycle assessment methodologies are being developed to speed up the conclusions of LCA and to allow its implementation by engineers with less expertise.

With the European Space Agency (ESA) investigating the possibility of integrating the European Commission's Product Environmental Footprint (PEF) approach into their LCA framework, this paper compares the single-score methodologies that have already been developed and assesses their applicability for the space industry. To do this, a high-level meta-study of the different single-score methodologies for space missions has been conducted, by applying the methodology to a number of past LCA studies on space systems. General findings regarding the differences in scores are outlined to determine the applicability, advantages and drawbacks of the developed single-score methodology for initial and more detailed design phases of space missions and space transportation systems. Furthermore, the applicability of an LCA single-score to sustainability performance indicators such as the Space Sustainability Rating (SSR) is discussed, considering constraints such as data availability depending on mission development phases.