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Sustainable Approaches and Impact of Space Transportation Solutions on Earth + Space Environment and on General Safety (9-D6.2)

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SUSTAINABILITY OF END-TO-END SPACE TRANSPORTATION MISSIONS: MODELLING TECHNICAL AND ENVIRONMENTAL ASPECTS FOR EARLY PHASES ECODESIGN DECISION SUPPORT

Abstract

A large part of environmental impacts related to a product can be determined or influenced at the design stage. Ecodesign efforts in the design process of a space mission therefore need to be implemented in early phases. For (future) space systems, subject to long development phases, the amount and quality of data is not sufficient in phases 0 to B1 to perform a detailed life cycle assessment (LCA) to understand and mitigate their expected environmental impacts before the requirements are frozen. Simplified LCA combined with technical information is required to anticipate and tackle their environmental impacts.

The Assessment and Comparison Tool (ACT), providing such functionality, is in its second development phase. Originally developed to compute rapid LCAs of launch vehicles, its new objectives cover the wider scope of space transportation services, including space and ground segments. It will enable a more comprehensive set of systems boundaries, and embed improved features to provide valuable results in early design phases. These results can be used to support decisions about the architecture and the precise design of a system or mission.

ESA as the main customer and a pool of interested space players have been surveyed to understand their needs regarding a tool like ACT. Based on their inputs, the features of the tool are described in preparation for the implementation. Some come from the need to fill the data and knowledge gaps in LCAs of space systems, and to monitor and reduce the modelling uncertainties. Others provide users with prospective datasets, options to import data from previous studies or space-specific datasets, and

an estimation of the high altitude atmospheric impacts based on trajectory information and the latest estimation of emissions' characterization factors. Overall, enhancing the user experience by integrating ACT in the existing design process will facilitate the tool's adoption.

This paper describes the understanding of the users' needs and derived features to integrate a simplified LCA tool in early design phase of future space systems. It provides insights on architecture modelling, and capability of the tool to run simplified, space-specific, prospective LCAs. Moreover, it details the users' freedom to create and modify configurations and how the outcomes could support decisions in the ecodesign process.

A comparison between the simplified LCA embedded in ACT and other methods usable in early design phase will show differences in terms of entry barrier, data requirements, scope, usefulness for ecodesign, and reliability of the results.