



Contribution ID: 52

Type: **Poster Presentation**

Hidden Life Cycle Impacts of Metal AM in Regulated Industries

Additive Manufacturing (AM) has become increasingly popular in recent years due to its capability for rapid and on-demand production of parts, prototypes, and spare parts. It is often hailed as a “Green technology” due to lesser material usage compared to traditional manufacturing methods and possibilities for lightweighting the design. Many studies have focused on Life Cycle Assessments (LCAs) in AM and the important factors throughout the use phase of the product to be considered.

However, an often neglected aspect in the life cycle is the R&D and certification phase. In regulated industries, such as oil and gas, aerospace or the medical sector, specific standard requirements need to be met for AM parts, leading to extensive and sometimes destructive testing and the production of additional parts for certification. These additional steps are often overlooked in LCAs, because their impact is negligible in conventional mass fabrication. However, in one-of-a-kind manufacturing, these steps can significantly impact the overall LCA results. This research aims to qualitatively assess the impact of “digital quality assurance” versus “conventional quality assurance” in the context of metal additive manufacturing. By examining these methods, the study seeks to reveal the hidden LCA impacts and provide insights into how digital quality assurance can enhance the sustainability of AM in regulated industries.

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Track Classification: Process- and Quality Control & Sustainability