

**The Clean Aviation workshop “Additive Manufacturing in Aviation”** was organised by Fraunhofer Institute of Chemical Technology (ICT) and Fraunhofer Institute for Laser Technology (ILT) as a hybrid event at ILT in Aachen on 17<sup>th</sup> to 18<sup>th</sup> January 2024.

In the Clean Aviation Joint Undertaking, the aviation industry is applying Additive Manufacturing (AM) in several projects. Material suppliers, manufacturers, research institutions and aviation industry are working collaborative together to increase the maturity on the one hand, decrease the ‘buy-to-fly’-ratio for metallic parts on the other hand and to collect the Life cycle inventory (LCI) data for Life Cycle Assessment (LCA).

The workshop in Aachen discussed topics of Additive Manufacturing to close the identified gaps in Life Cycle Assessment of AM. At the first workshop in 2019, the following gaps were identified: Powder production, reuse and recycling of used powders and recycling of supporting structures or fault parts as well as end of life scenarios. Furthermore, efficiency of equipment and new integrated processes, like hybrid AM, were discussed.

Nine high-quality presentations by powder manufacturers, industrial AM users from the Clean Sky 2 platforms, and research institutes comprehensively covered the entire life cycle spectrum. The workshop concluded with a visit to the ILT technical laboratories, where technical discussions delved into the latest applications and developments in AM directly at the shop floor.

In a concluding open panel, following observations and **take-home messages** are stated:

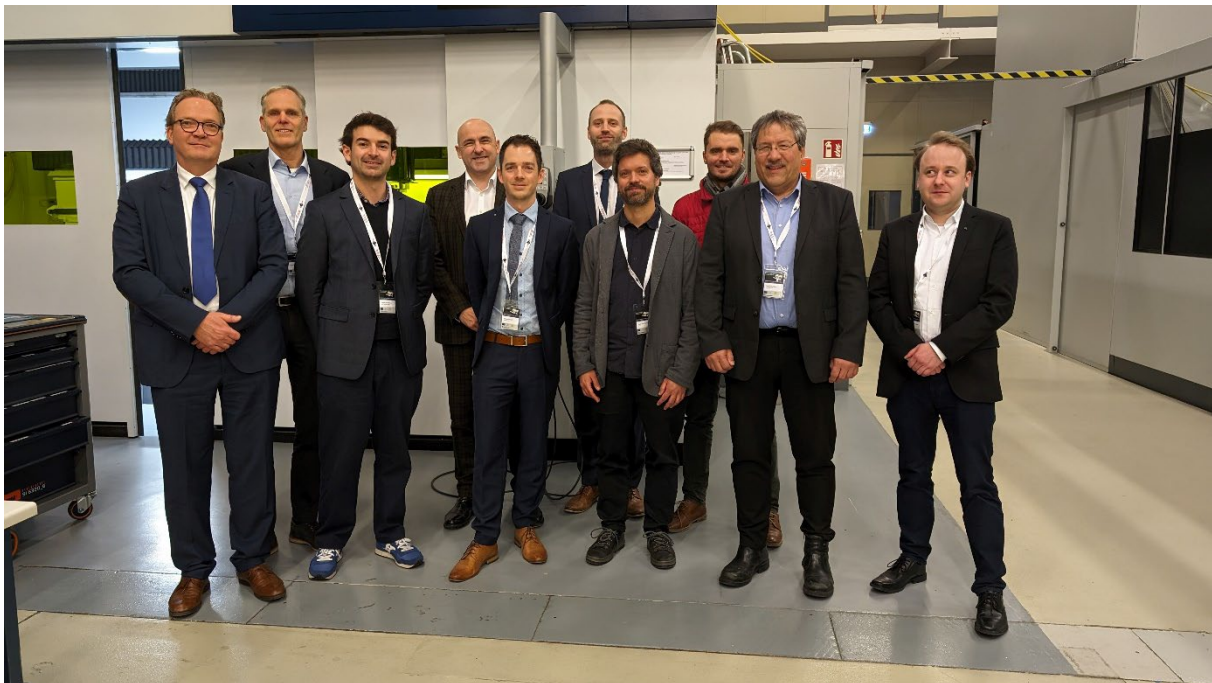
- Powder production
  - Powder particle size distribution has significant influence on the final product (quality)
  - Powder shape and surface influence product quality
  - Powder production scrap rate is varying between 5-15 % due to the fine fraction
  - Rare earths can have a significant impact on the LCA results, when they are included in the composition of AM powders
- Manufacturing
  - Compared to conventional machining the material properties are equal or could be even better
  - Efficiency depending on the size of the part (small parts need a pause to cool down and big parts need probably more than one laser system)
  - For LCA analysis the transport efforts could be neglected for unit processes. For part production, transport of powder and materials should be considered on industrial level
- Reuse and Recycling
  - Reuse and recycling of used powder is economically beneficial due to the high raw material prices
  - Recycling technology is available as well for supporting structures and fault parts and end-of-life parts
  - Circularity of powder materials is realized
  - Recycling for hybrid AM is under evaluation
- Certification



- There is still a need for improved powder certification (powder standards and manufacturing standards)
- Compared to the global metal use in aviation AM might be still a niche for smaller parts with a high degree of freedom for the design

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