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Life cycle assessment of metal additive manufacturing parts

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Metal Additive Manufacturing (MAM)

MAM technologies have the potential to change the way manufacturing is designed, allowing:

- Production of complex geometries (not be possible, or too expensive, to achieve by conventional manufacturing)
- Fast prototyping and moulding
- New properties

Sectors

- Moulding
- Aerospacial
- Automotive

MULTI-FUN project scope

Innovation

- Nano-enabled materials
- Multi-material parts
- New MAM technologies
- Multifunctional complex parts

Expected Benefits

- Reduce parts weight;
- Reduce resources use, energy consumption and waste;
- Reduce environmental impacts (of complex metallic parts).

Challenges

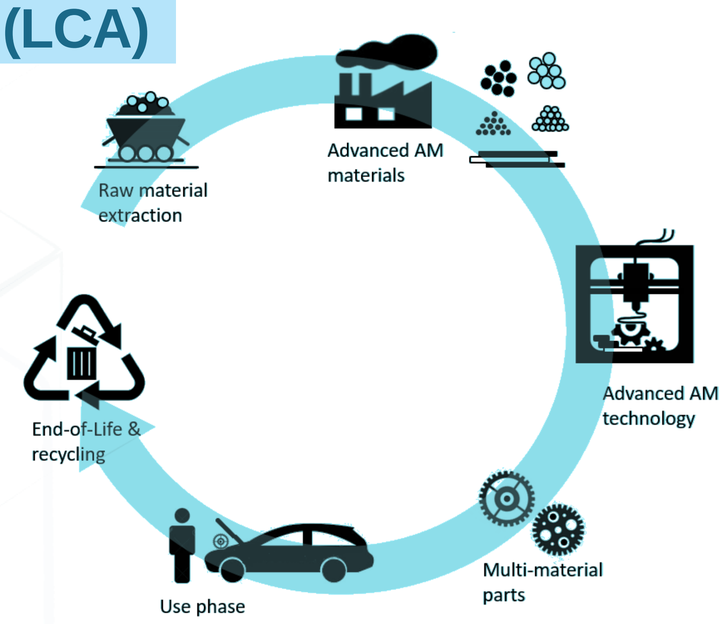
Lack of environmental life cycle studies focused on:

- MAM developments
- Nano materials
- Multi-functional equivanlence (functional unit)

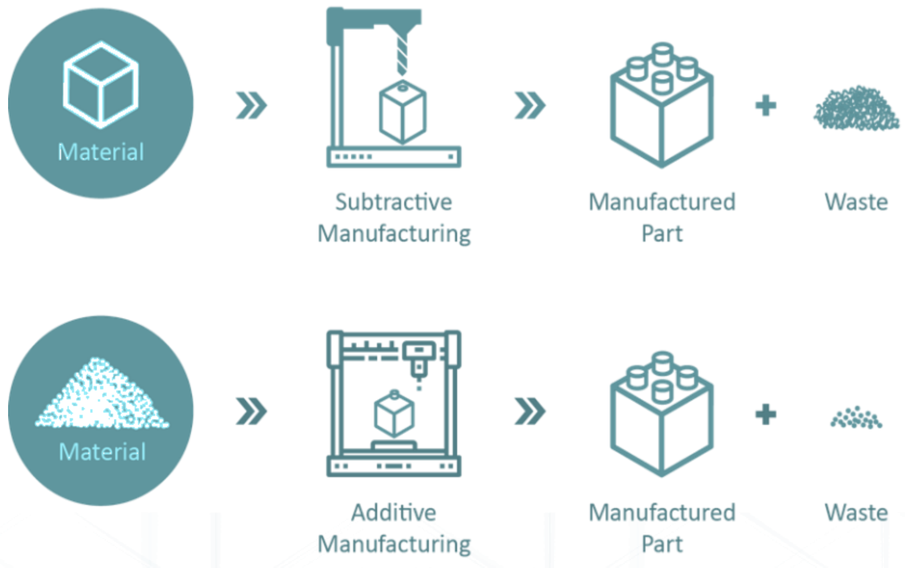
Life Cycle Assessment (LCA)

Supervising significant reduction of environmental impact and cost by LCA, LCC, and Eco-efficiency

- **MULTIFUN OBJECTIVE:** 35% reduction of environmental impact and costs

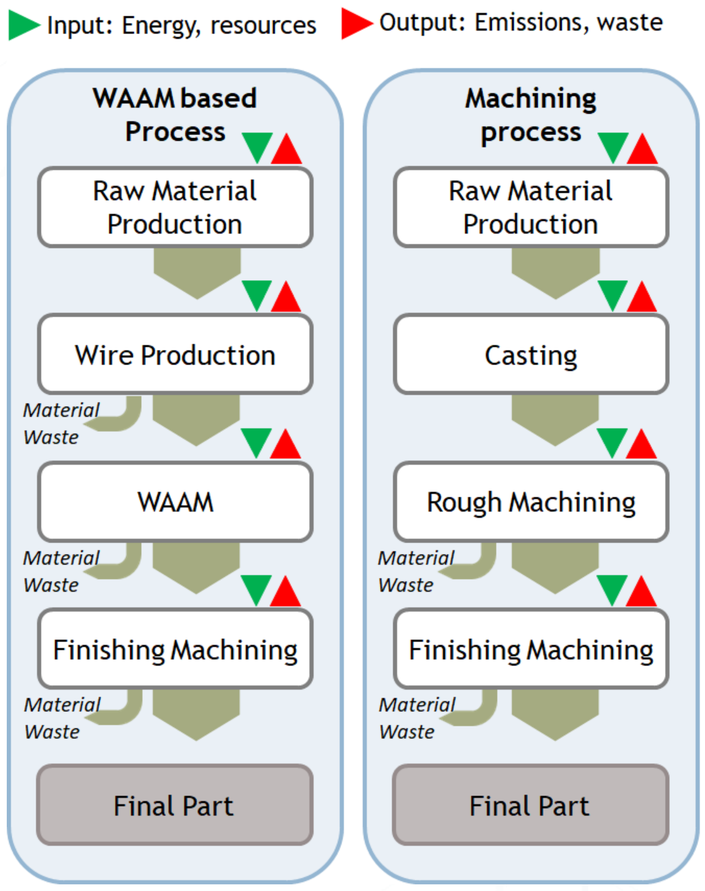


Sustainability of MAM vs Conventional Machining



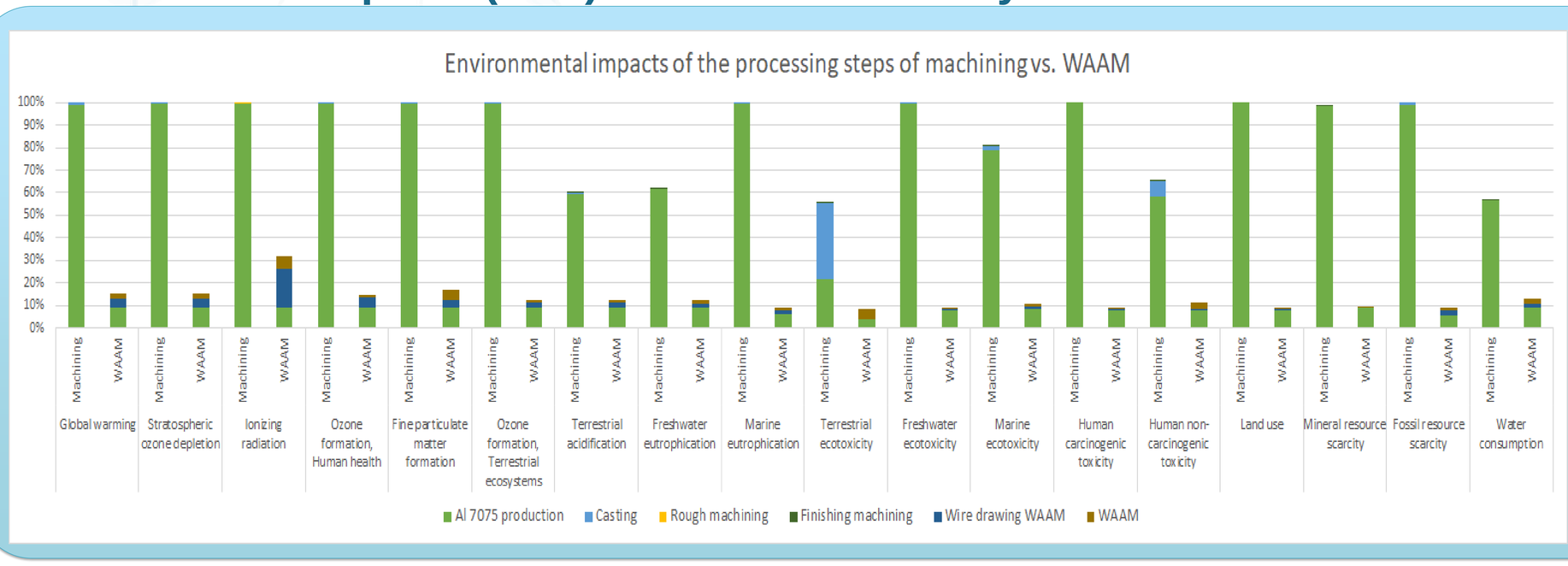
Adapted from (North, 2019)

System boundaries and alternative processes flow chart
For a potential aerospace part production



References:
Priarone, P. C., Pagone, E., Martina, F., Catalano, A. R., & Settineri, L. (2020). Multi-criteria environmental and economic impact assessment of wire arc additive manufacturing. *CIRP Annals*, *69*(1), 37–40. https://doi.org/10.1016/j.cirp.2020.04.010
North, E. (2019). 3D printing vs CNC Machining – Key differences. Retrieved from https://www.advancedadditivemanufacturing.co.uk/blog/3d-printing-vs-cnc-machining-key-differences/

Environmental impacts (LCA) based on secondary data



Cradle-to-gate environmental impacts for an aerospacial part (weigh of 3.5 kg), produced by WAAM or by machining. Life cycle inventory based on foreground data from Priarone et al. (2020) and *ecoinvent* v3.7

- WAAM part has 68-90% reduced environmental impacts *vs*. machined part;
- Alloy production (including raw materials extraction) represent more than 50% of the impacts of WAAM part, and around 95% of the machined part in most categories.

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www.multi-fun.eu

SCAN ME for more information regarding the project