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LCA results profiling and visualization

An application to R&D in the Powder Metallurgy sector to facilitate information assimilation and eco-design actions

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CONTEXT

Life Cycle Assessment results are often subject to misinterpretations by industrial players due to the need for specific knowledge to understand their complexity and completeness [1]. In the context of the **H2020 SUPREME project** we proposed to the **Powder Metallurgy (PM) R&D experts** a document called a “**Process Environmental Profile**” that gives a **visual representation of the environmental performance** of their area of expertise. This document aimed to be a support to get technical R&D experts to draw the conclusions usually made by LCA experts, and to **facilitate eco-design actions implementation** in the PM value chain.

METHOD

The objective of this work was to build a **simple 2 pages document** to restate in a clear way the LCA results of the different **powder metallurgy processes** evaluated in SUPREME (38 in total). The structure of the final document is inspired from FDES [2] and Product Environmental Profile format of the PEP Ecopassport program [3] and **adapted to a R&D context**. This format has been tested by PM SUPREME R&D experts during a workshop (Fig 1.) A questionnaire has been developed and sent to partners with their PEP to help them to identify environmental hotspots and **eco-design levers** for their processes and potential for PEP improvements (Fig 2.)



Fig 1. Testing Workshop for the PEP

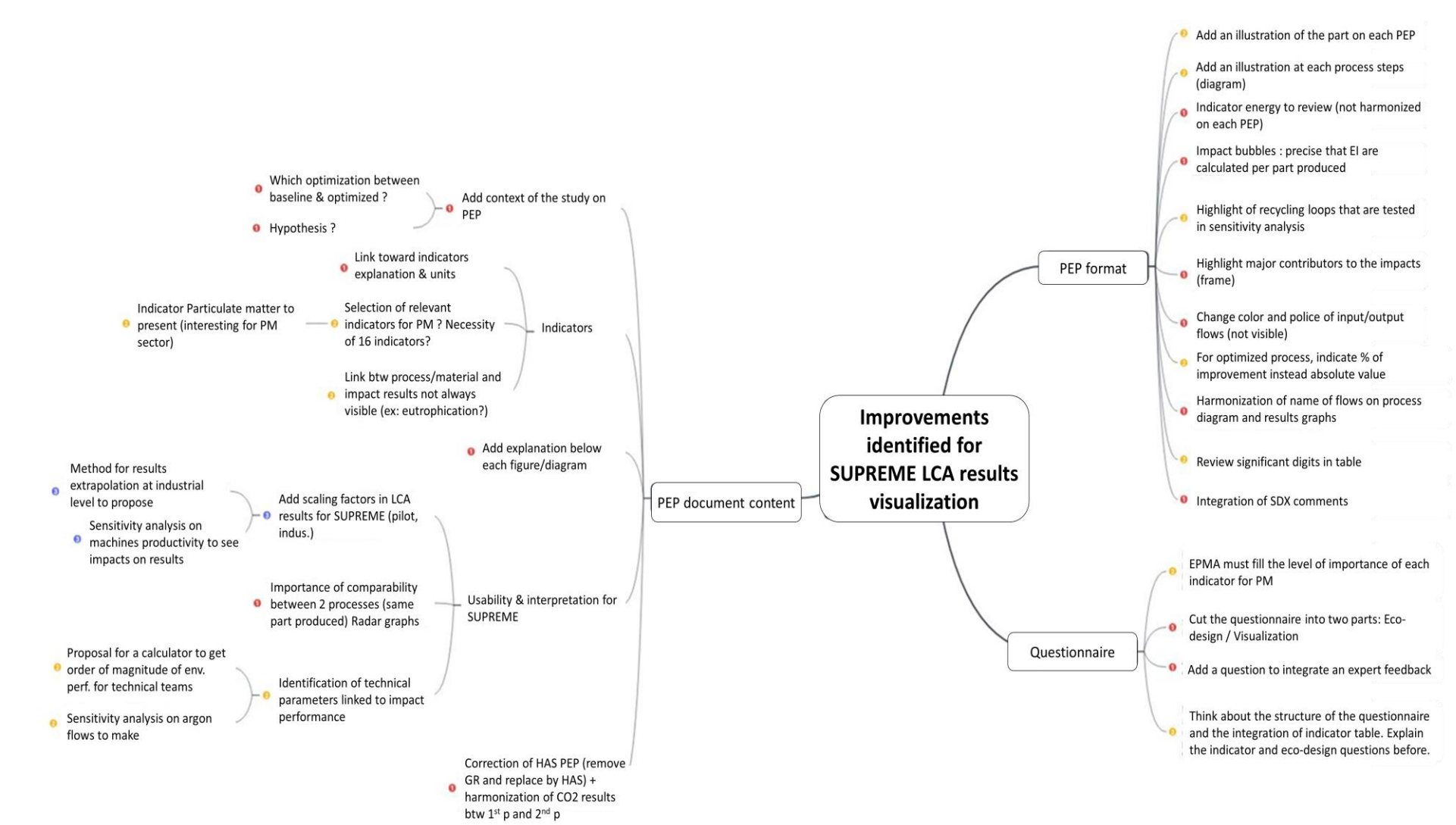
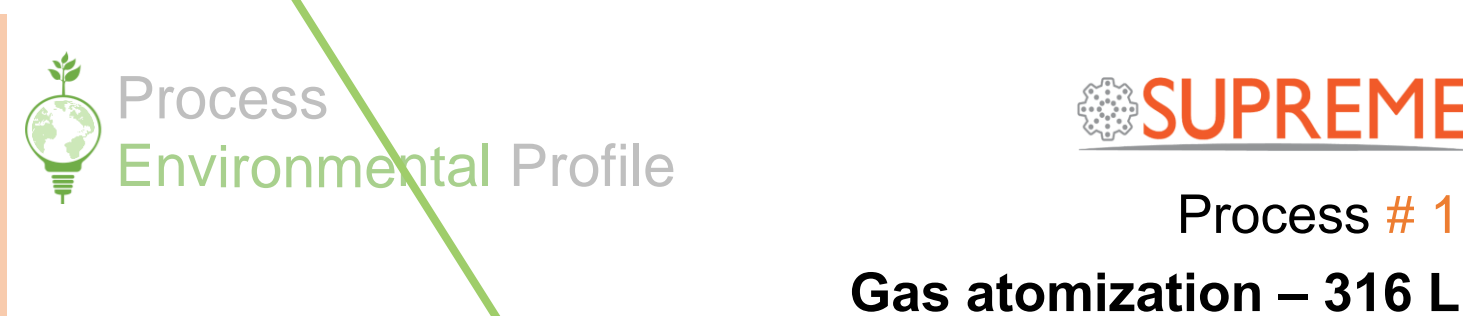


Fig 2. Improvements identified for the PEP

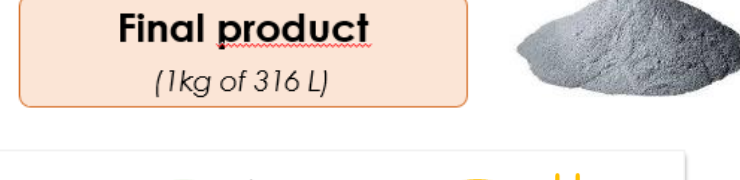
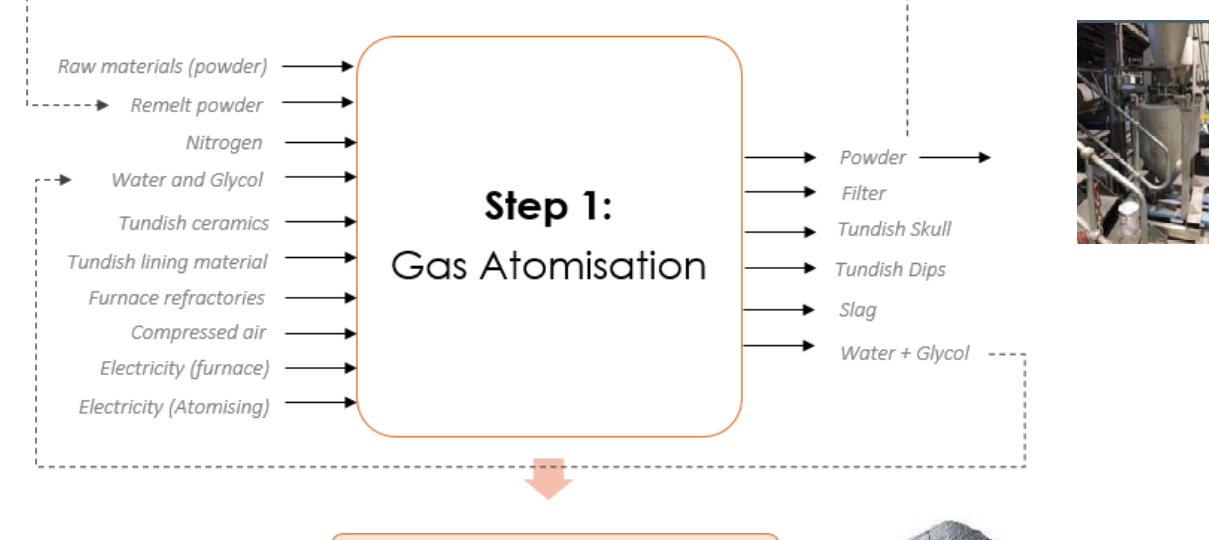
PROCESS ENVIRONMENTAL PROFILE ADAPTED TO R&D

Process diagram

- **Visual representation** of the analyzed process, with all input and output flows considered in the LCA.
- Support the interpretation of the results.
- **Reference flow** is indicated



01 - Process diagram and Environmental Impacts



Environmental impacts of the production of one kg of 316L powder by gas atomization

Indicator	Impacts Category	Unit	#01 Gas atomisation - ASL 316L - baseline	#01 Gas atomisation - ASL 316L - improved
1	Climate change	kg CO2 eq	6.81E+00	6.81E+00
2	Ozone depletion	kg CFC11 eq	6.32E-07	6.32E-07
3	Acidification	kg SO2 eq	2.57E+00	2.57E+00
4	Photochemical ozone formation, HSI	kg NMVOC eq	1.01E+01	9.90E+00
5	Respiratory inorganic	kg SO2 eq	1.94E+00	1.94E+00
6	Non-cancer human health effects	CTUh	4.05E-06	3.88E-06
7	Cancer human health effects	CTUh	3.55E-06	3.20E-06
8	Acidification terrestrial and freshwater	mol H+ eq	1.10E+00	1.09E+00
9	Eutrophication freshwater	kg P eq	1.40E-02	1.39E-02
10	Eutrophication marine	kg N eq	1.40E-02	1.39E-02
11	Eutrophication terrestrial	mol N eq	1.50E+01	1.47E+01
12	Ecotoxicity freshwater	CTUh	4.20E-03	4.14E-03
13	Land use	ha	7.81E+01	6.47E+01
14	Water scarcity	m3	3.50E+00	3.07E+00
15	Resource use, energy carriers	MJ	1.30E+02	9.95E+01
16	Resource use, mineral and metals	kg Sb eq	4.25E-04	4.24E-04

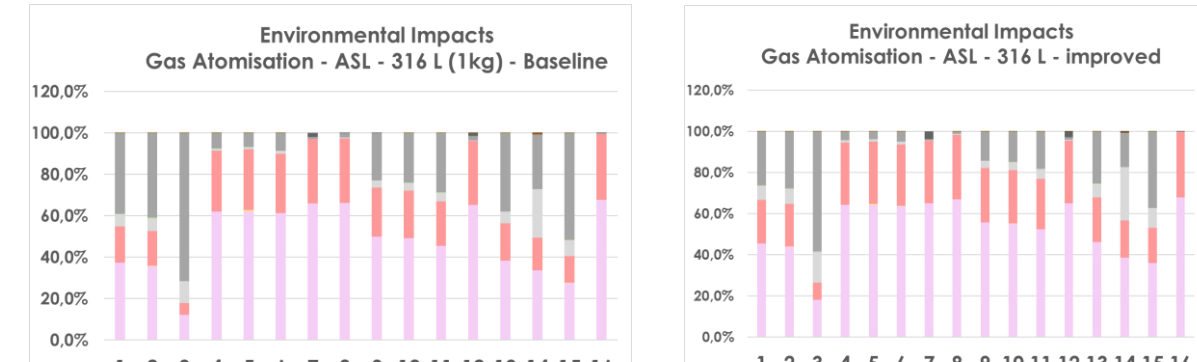
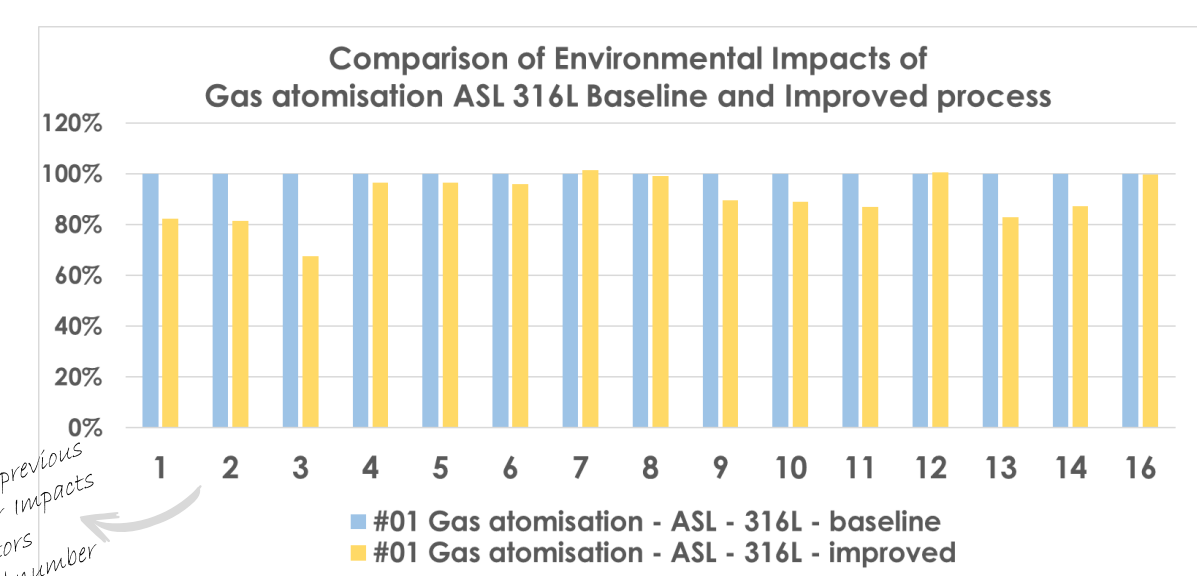
Environmental impacts

- 16 environmental impacts according to the EF 2.0 PEF method.
- 3 indicators highlighted : **Climate Change** (kg CO2 eq.), **Resource Depletion** (kg Sb eq.) and **Energy Consumption** (MJ)

Detailed results

- Identification of **main contributors** to the environmental impacts.
- Comparison of environmental performance **between a reference process and an optimized process**.
- Major flows contributing to the impacts are highlighted

02 - Detailed LCA Results & contribution of process flows



03 - General Information

- Results of Life Cycle Assessment (LCA) conducted according to NF EN ISO 14040:2006 & NF EN ISO 14044:2006 standards
- 16 Environmental impacts calculated according to official Environmental Footprint (EF) characterization factors, recommended by the European Commission: version EF 2.0
- Functional Unit : « The production of 1 kg of 316 L powder by gas atomization »
- Perimeter : Cradle to Gate analysis

General information

- Major **hypothesis, perimeter** of the study as well as detailed **functional unit**
- The **software, database and method** used for performing the LCA are indicated.

CONCLUSION

The PEP developed in the framework of the SUPREME project helped the **integration of eco-design actions** and LCA results interpretation for R&D processes optimization. Several improvements regarding CO2 emissions, metals and minerals resources and energy consumption were realized during the project to reach a **more sustainable powder metallurgy value chain** from mineral extraction to parts manufacturing (by additive and near net shape processes).

