Safe and Sustainable by Design framework for advanced materials: The HARMLESS approach

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1. Introduction

The European Framework for 'safe and sustainable by design' chemicals and materials (Caldeira et al. 2022) represents an important step towards the production of safer and more sustainable products. Yet, it requires resources not compatible with the expected commercial value at early innovation stages and recommends methods that are not applicable to emerging materials. To address such issues the HARMLESS project developed a SSbD framework that considers data availability and resources along the innovation process, is applicable to Advanced Materials (AdMa) and is cost-effective. It is aligned with the EU framework, complemented with a flexible stage-gate model and implements New Approach Methodologies (NAMs) tailored to AdMa.

2. SSbD framework

The HARMLESS SSbD framework includes three innovation stages (Figure 1): ideation and business phase, laboratory phase and pilot phase. It starts with the categorization module of AMEA (Advanced Material Earliest Assessment) at the first innovation stage, testing the applicability of the Framework to the business case. At each innovation stage, five different modules enable the assessment of 1) intrinsic safety, 2) occupational and environmental safety at production, manufacturing and end-of-life, 3) consumer and environmental safety at use, 4) environmental sustainability at production and manufacturing and 5) environmental sustainability at use and end-of-life.

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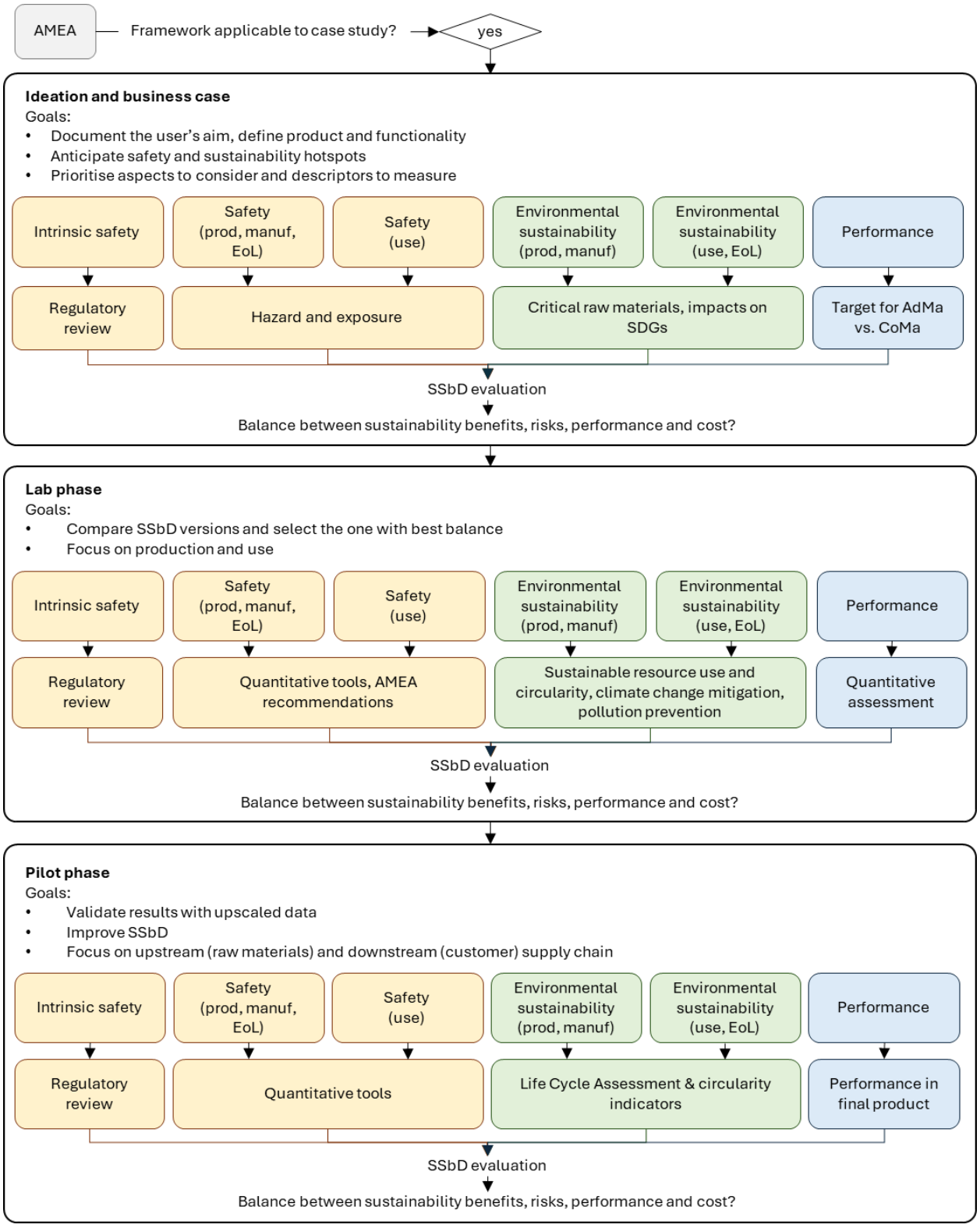

Figure 1: Overview of the HARMLESS SSbD framework

Within each module, design principles are given to guide the user in making a product as safe and sustainable as possible, and methods and tools are suggested to facilitate the SSbD assessment. NAMs are prioritized to make the SSbD assessment as cost-effective as possible. After all modules are completed, a gate enables the user to balance the safety and sustainability of their product with cost and performance, assessing the

relevance of going to the next innovation stage. This framework guides the creation of an online decision support system, which will be publicly available. The framework has been further tested with industrial case studies from the HARMLESS project.

3. References

Caldeira C, Farcal L, Tosches D, Amelio A, Rasmussen K, Rauscher H, Riego Sintes J, Sala S (2022) Safe and Sustainable by Design Chemical and Materials – Framework for the definition of criteria and evaluation procedure for chemicals and materials – Draft report for consultation. 76 pp.