The European Commission`s Safe and Sustainable-by-Design Framework: Opportunities and Challenges for the transition of the chemical industry

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What is Safe and Sustainable by Design (SSbD)?

"Safe and sustainable-by-design can be defined as a **pre-market approach** to chemicals that focuses on **providing a function (or service), while avoiding volumes and chemical properties that may be harmful to human health or the environment**, in particular groups of chemicals likely to be (eco) toxic, persistent, bio-accumulative or mobile. **Overall sustainability should be ensured by minimising the environmental footprint of chemicals** in particular on climate change, resource use, ecosystems and biodiversity from a lifecycle perspective."
Taken from Chemicals Strategy for Sustainability (COM/2020/667 final)

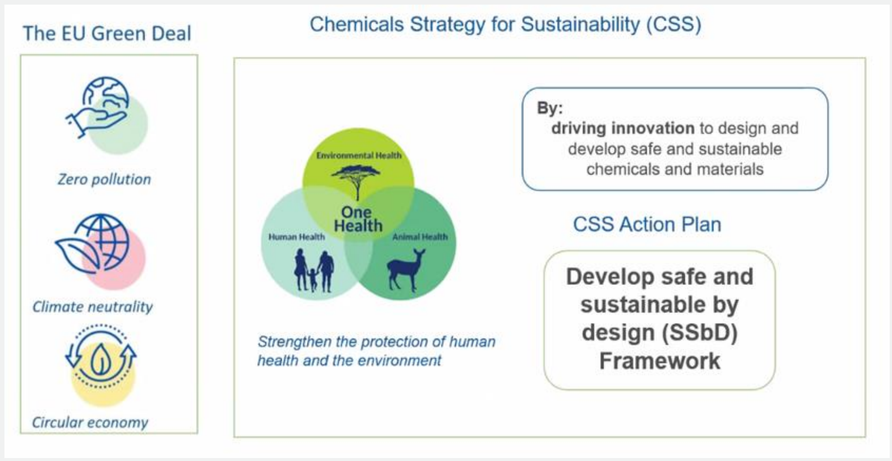
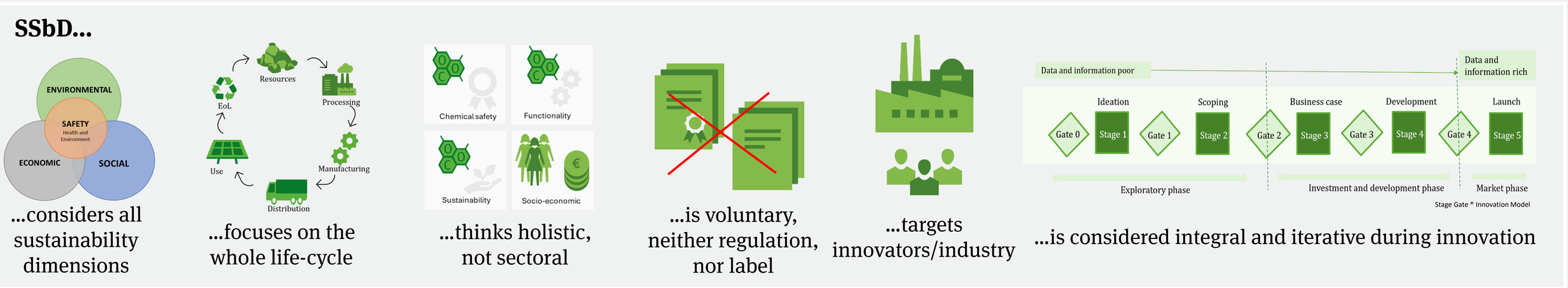


Fig. 1 The foundation of the EC SSbD Framework



The EC SSbD Framework

A **1st edition of the framework** (DOI: 10.2760/487955) was published in 2022 and introduced **criteria and evaluation procedures for an SSbD assessment.** The framework has been extensively tested and experiences were reported which let to a **revised SSbD Framework** (DOI: 10.2760/5103785) in 2025, amongst others introducing a **scoping analysis** to identify the SSbD system under consideration as well as a **scenario selection**.

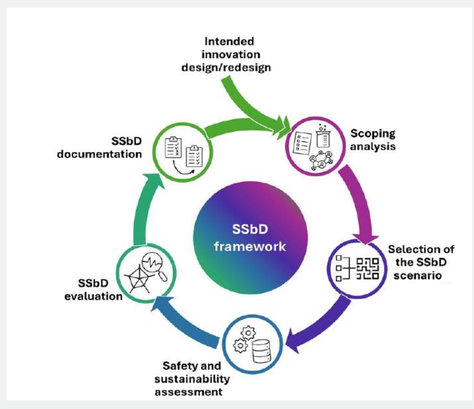


Fig. 2 The current EC SSbD Framework (Figure taken from DOI: 10.2760/5103785)

Opportunities for safe and more sustainable innovation

- **Voluntary** assessment to support decision-making in innovation
- **Common understanding** of SSbD principles
- **More efficient** identification of "hot spots of concern", need for re-design
- **Continuous improvement** towards safer and more sustainable chemicals, materials and products
    - **Iterative and tiered collection of safety and sustainability data**: higher TRL = better data availability and quality
    - **Systematic entry**: scoping analysis and scenarios allow various entry points into the assessment, depending on the maturity of the innovation and data availability (particularly for SMEs with limited resources)
    - **Detailed advice** on safety and sustainability assessments (environmental, social & economic) in line with regulatory risk assessment thinking
- **Strengthening competitiveness** by providing safer and more sustainable solutions
- **Regulatory relevance:**

SSbD supports innovators to **proactively prepare for relevant legal obligations** to early identify and address challenges relating to safety and sustainability ("fail early, fail cheap"):

- **facilitate regulatory acceptance and marketability**
- **avoid unacceptable risks or unsustainable innovations**
- **address trade barriers, economic inefficiencies and due diligence obligations**

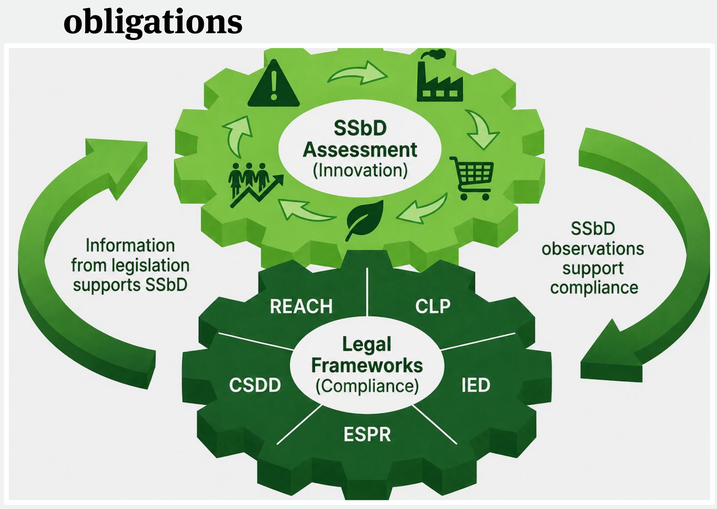


Fig. 3 Mutual benefit of the EC SSbD Framework and the EU legal framework (Figure developed with Notebook LM and adapted)

Challenges for implementing SSbD

- **Complex approach:** knowledge of regulatory safety assessment needed (e.g. CLP criteria) and sustainability assessment (e.g. Life Cycle Assessment)
- **Need for resources** (expert knowledge, iterative assessment), limited at SME-level
- **Data requirements**, dealing with missing data, data of varying quality (particularly in the early stages of innovation)
- Availability of **tools for SSbD**
- How to deal with **trade-offs**, how to enable **decision-making**?

- Need for **FAIR data, common data platforms**, **and predictive, simple methods** for early innovation (new approach methodologies, in silico, -omics, high-throughput)
- Need **for education and training on SSbD** (ongoing in various EU projects and presented at e.g. https://www.eu-parc.eu/ssbd/education-training)
- **Methodological guidance** by JRC in preparation

Current EU SSbD framework:

More information on the link of SSbD to EU legislation:

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