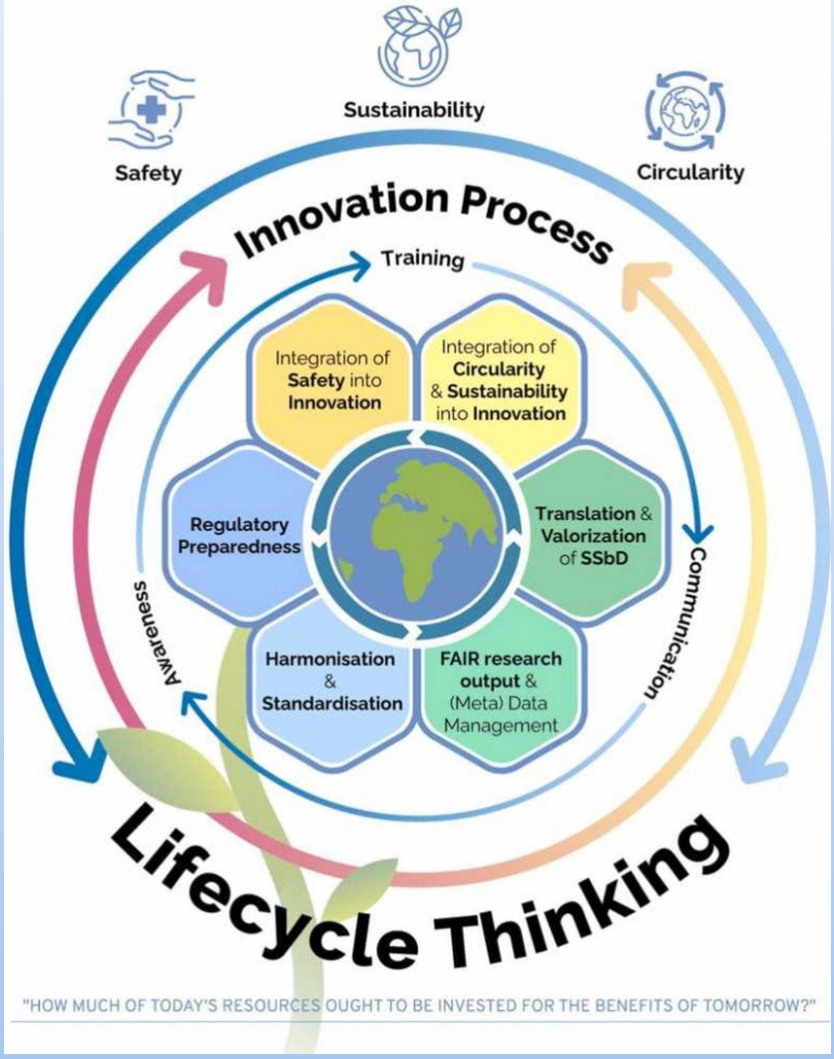
Designing Safe and Sustainable Materials and Chemicals

SSbD Implementation and Digitization

NSC Session

EUIndTech25, June 2-4, 2025, Kraków, Poland

NSC: history – identity – roadmap



The **N**etwork for **S**afety and sustainability of **C**hemicals and materials (NSC) maximises the synergies between European-level projects addressing the safety & sustainability of advanced materials & chemicals, and technologies enabled by the use of nanoforms. The studied aspects include toxicology, ecotoxicology, exposure assessment, mechanisms of interaction, risk assessment, life cycle assessment, and standardization.

represented today by:



Chair WG Education Coordination Team

Cassee F.R., Bleeker E.A.J., Durand C., Exner T., Falk A., Friedrichs S., Heunisch E., Himly M., Hofer S., Hofstätter N., Hristozov D., Nymark P., Pohl A., Soeteman-Hernandez L.G., Suarez-Merino B., Valsami-Jones E., and Gronewold M. **Roadmap towards Safe and Sustainable Advanced and Innovative Materials** (2024). *Comp. Struct. Biotechnol. J.* 25:105-26. https://doi.org/10.1016/j.csbj.2024.05.018

NSC: roadmap

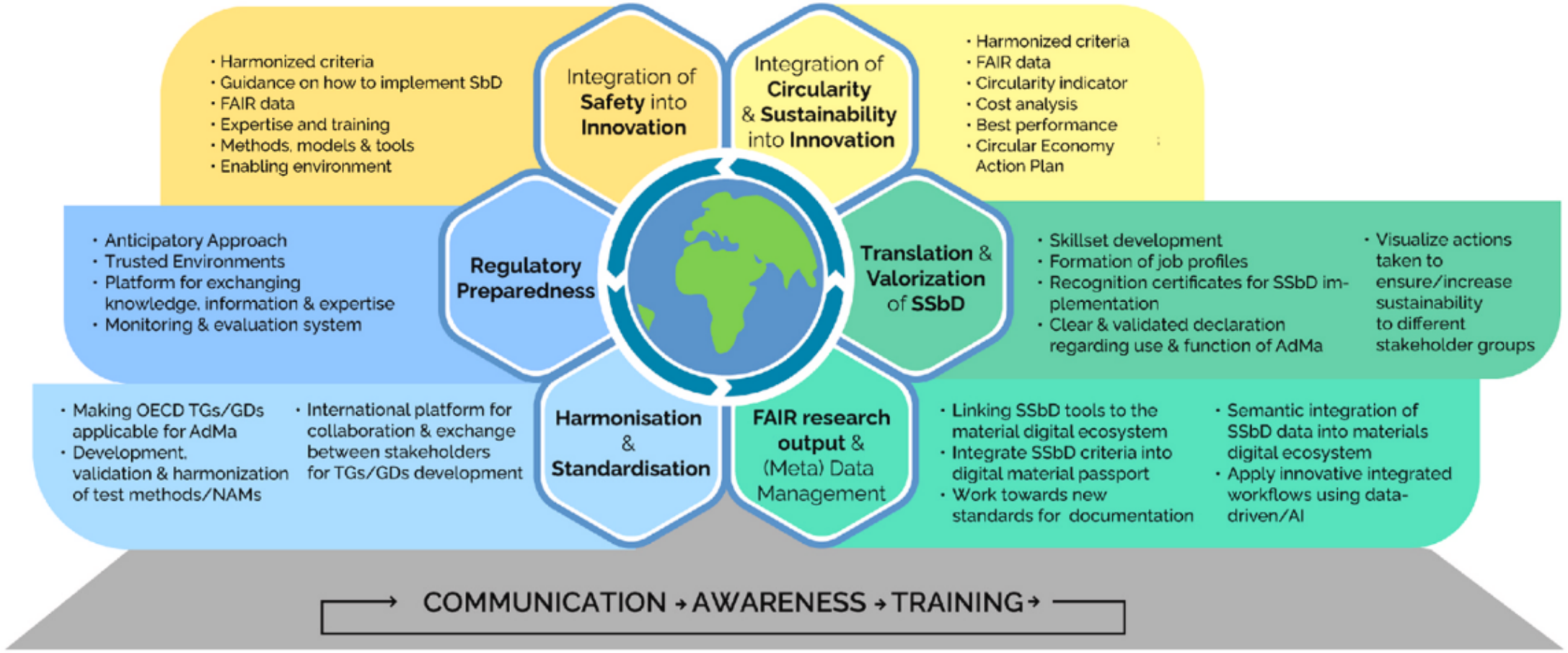
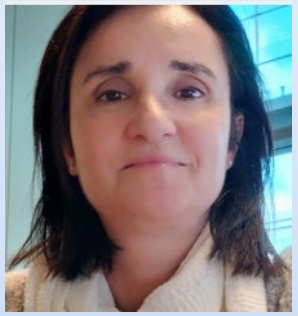


Fig. 2. : To take full advantage of the possibilities that innovative advanced materials actions are needed in several areas to ensure their safety and sustainability. This is summarised here and further detailed in the different sections of this document.

https://doi.org/10.1016/j.csbj.2024.05.018

Session overview



Moderator: Martin Himly (PLUS, AT)

Oral input: Eugenia Valsami-Jones (UoB, UK)

Oral input: Andreas Künkel (BASF, DE)

Oral input: Garbiñe Guiu Etxeberria (DG RTD, European Commission),

- Panelists: Andreas Falk (BNN, AT), Mary B. Walsh (Honeywell, BE), Peter Klein (ITWM Fraunhofer, DE), Jacek Szymanski (Lukasiewicz-WIT, PL), Daniel Hubert (VistaNover, CH)





Session abstract

Developing safe and sustainable by Design (**SSbD**) materials and chemicals is crucial for advancing environmentally responsible practices in various industries. Effective implementation of SSbD principles requires **integrating safety- and sustainability**-related aspects at the **earliest stages** of product design. Here, **digitization** can play a vital role providing innovative tools for data analysis, **multi-objective-driven** material selection processes, and prospective life cycle assessment. These **interdisciplinary** technologies need to be based on collaboration among different **stakeholders** along the value chain, enabling the sharing of knowledge and best practice, facilitating and enhancing decision-making. Leveraging digital platforms enables **materials and chemicals value chains** to continuously monitor and improve the sustainability of their products.

The NSC-session will address the importance of **integrated approaches, data-related expectations, advantages, challenges** for ultimately **balancing ecological and economic** goals for a more sustainable future.

Output – Kraków Declaration

Safe-and-Sustainable-by-Design (SSbD)-guided innovation of materials and chemicals represents an **essential requirement** for any future product entering the European market, enabling **integration** of **functional performance, safety** and **sustainability.** Efforts need to be taken to facilitate **science-led** harmonization of **environmental, economic,** and **societal** requirements at early innovation stages. Such **well-balanced approaches require** a **multidisciplinary** collaboration further supported by tailored funding, interconnected on regional, national and international level to gain synergies of public investment.

Interoperable digitally enabled workflows covering **entire value chains** serving various sectors are needed. **Performance indicators** are required to be included in SSbD digitalization to foster and speed-up the uptake of innovative advanced materials in industrial production. Efforts need to be taken to improve **data quality** and **metadata completeness** to increase the **reliability** of predictions and generate greater **acceptance and trust.**

Upon SSbD implementation, focus shall be on **solution-oriented** approaches that need to include communication between all stakeholders. Market-focused **incentives** for SSbD implementation need to be established within the EU to generate **employment and economic growth** as part of the **green deal in Europe** and later **globally**.

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SSbD: science, needs, opportunities

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IRISS

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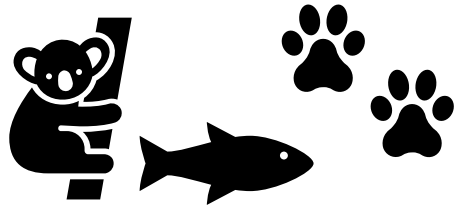
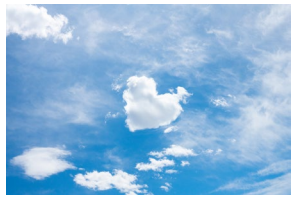


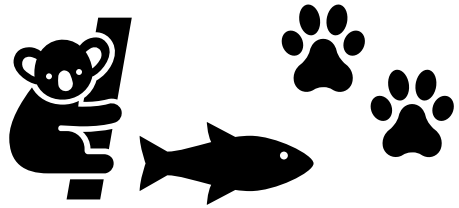



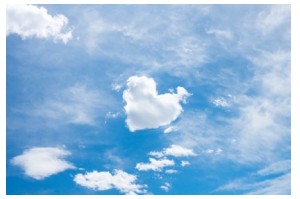

Can SSbD save the Earth? The challenges

Examples of Planetary Boundaries and Demands on Materials/Chemicals Innovation

- **Climate Change:** New technologies need to reduce GHG emissions across product lifecycle.
- **Biosphere integrity:** new materials/products must not harm biodiversity or disrupt ecosystems.
- **Preservation of resources:** minimise use/need/wastage of CRMs
- **Human/ecological safety:** Materials must be designed to avoid persistence, bioaccumulation, toxicity, and unknown environmental fate.
- **Land-System Change:** Raw material extraction and agricultural discharges must avoid deforestation and habitat loss.
- **Water protection/preservation:** Manufacturing processes should **reduce water use** and **avoid contamination** of freshwater systems with hazardous effluents.
- **Atmosphere/stratosphere protection:** Materials/Chemicals must be free from atmosphere polluting or ozone-depleting substances.
- **Ocean Acidification:** minimise CO_2 and other acidifying chemicals release.



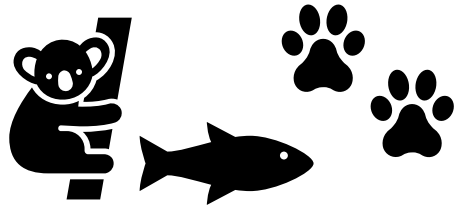


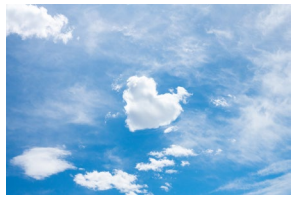




Can SSbD save the Earth? Yes

- **Prevent harmful materials from entering the environment** by embedding safety and sustainability at the design stage.
- **Accelerate circular economy transitions** by ensuring materials are recyclable, durable, and non-toxic across their lifecycle.
- **Reduce health risks** for workers, consumers, and ecosystems through proactive risk minimisation.
- **Align innovation with planetary boundaries** — avoiding pollution, toxicity, and resource overuse.
- **Foster public trust and social license** in materials innovation by demonstrating accountability and transparency.
- **Enable green industrial competitiveness** by positioning Europe as a global leader in sustainable materials.
- **Bridge science and policy** through shared frameworks for assessing and communicating risk, impact, and performance.



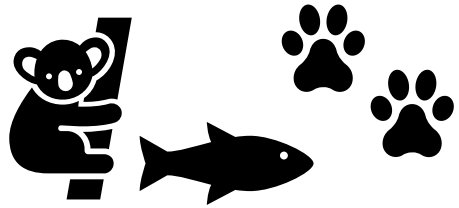


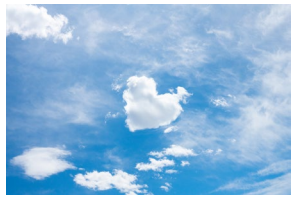




Can SSbD save the Earth? No

- **Lack of harmonised criteria and metrics** for what constitutes "safe" and "sustainable."
- **Fragmented data ecosystems;** poor access to FAIR data across safety, sustainability, and performance domains.
- **Insufficient incentives for industry** to adopt SSbD, especially where regulatory or market drivers are weak.
- **Limited tools for early-stage design** that integrate safety, lifecycle, and sustainability factors.
- **Skills and knowledge gaps** in applying SSbD across disciplines and innovation levels.
- **Regulatory inertia:** frameworks not keeping pace with advanced material complexity.
- **Implementation silos** between research, regulation, and industry, limiting systemic uptake.





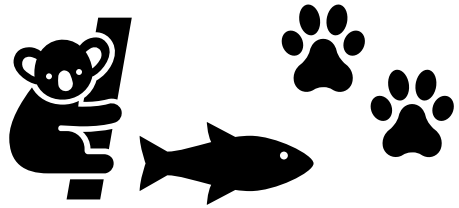



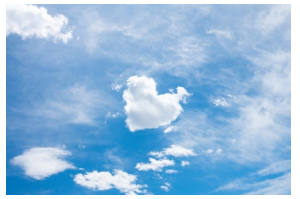

Can SSbD save the Earth? The role of science

A roadmap for turning "Yes" into reality:

- **Science is aligned with innovation**
- **Data and tools:** FAIR, tested, advanced
- **Investment in shared infrastructures:** material characterisation**,** testing, and validation — support SMEs.
- **Regulatory tool development:** standardisation.
- **Education:** train next generation of SSbD-literate scientists and innovators.
- **Stronger collaboration platforms** across research, industry, and regulators to break silos and accelerate implementation.






Can SSbD save the Earth? The role of NSC

NSC a catalyst for:

- *Underpinning of science*
- *Fostering collaborations*
- *Offering agile response to challenges*
- *Providing support and advice*

Thank you

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