

Analysis of life cycle steps, value chains, their stakeholders and initiatives

The EU Green Deal, guided by sustainability and the United Nations Sustainable Development Goals, focuses on climate neutrality, zero pollution, and circular economy practices. The EU acknowledges the importance of investing in and innovating safe and sustainable chemicals and products throughout their lifecycle to achieve these goals, as outlined in the Chemicals Strategy for Sustainability (CSS). The transition to safe-and-sustainable-by-design (SSbD) approaches is crucial at various levels, including research, industry, and society, and should be based on a lifecycle- and systems-thinking framework. This transition aims to enhance cost-effectiveness, accelerate time-to-market for products, anticipate future regulatory challenges, promote safer and more sustainable processes and products, and increase consumer acceptance. The IRISS project seeks to connect and transform the SSbD materials community globally, integrating safety, climate neutrality, circularity, and functionality of materials, products, and processes throughout their lifecycle to align with the EU Green Deal, CSS, and UN SDGs.

To support the implementation of SSbD strategies, especially for small and medium-sized enterprises (SMEs), this deliverable is part of an iterative series analyzing value chains using a cradle-to-cradle approach. The relevant stakeholders in specific value chains, such as packaging, textiles, construction chemicals, automotive, energy materials, and electronics, are identified and mapped. These assessments identify the major safety and sustainability challenges within each value chain.

For the packaging value chain, the challenges include reducing the use of harmful additives, promoting recyclability through monomaterial packaging, addressing the dispersion of microplastic, and optimizing polymer sorting for recycling.

In the textile value chain, challenges revolve around the environmental impacts of natural and man-made fiber production, processing chemicals and effluents, occupational health and labor rights in manufacturing locations outside Europe, and the impacts of dyeing natural fibers. Market-related challenges include ensuring reliability, traceability, and transparency of SSbD-related data and capacity building among small-to-medium enterprises.

In the construction value chain, the focus is on addressing the significant environmental footprint of concrete, including CO₂ emissions and water use, through the use of concrete admixtures that reduce emissions and facilitate recycling and reuse of concrete waste.

The automotive value chain faces challenges related to strict product requirements, complex supply chains, and increasing regulatory pressures. Balancing material durability with recyclability, life cycle emissions, final cost, and natural availability is crucial, necessitating thorough testing and material selection.

For energy materials value chains, the challenges lie in developing and implementing low-carbon energy technologies, ensuring safety, health, flexibility, inclusivity, and affordability. The focus is

on longer-lasting, repairable, recyclable, and energy-efficient products, reduced use of critical and hazardous materials, and efficient manufacturing processes with low carbon footprints. Additionally, ensuring the sustainable sourcing of raw materials and access to secondary raw materials through recycling is essential.

The electronics value chain faces challenges associated with resource-intensive production processes and difficulties in recycling end-of-life products. The production of electronic components requires various critical raw materials, involves energy-intensive processes and specialized chemicals. The complex structures of electronic products make separation and recycling challenging. Improving product designs and processes can support sustainability through renewable energy use, waste treatment, and proper end-of-life disposal.

This deliverable serves as a baseline for developing value chain-specific roadmaps, supporting the practical implementation of SSbD strategies in each sector. The industrial partners will update and expand these overviews in subsequent iterations.

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