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SURPASS

Practical Implementation of SSRbD in SURPASS Case Studies: Towards the Next Generation of Plastics for Different Sectors

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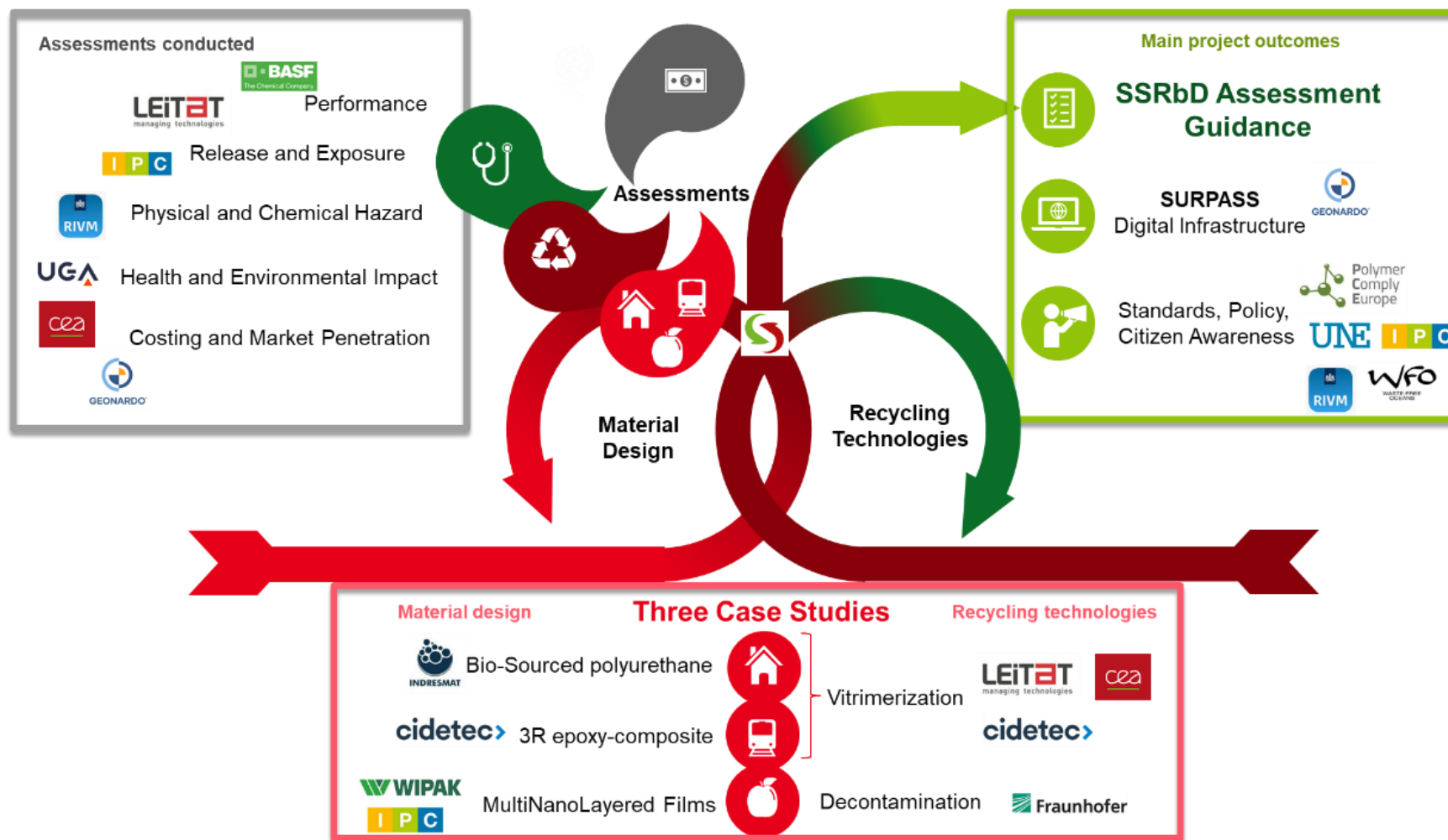
Workshop of SusChem SSbD Working Group



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Safe-, sUstainable- and R recyclable-by design P olymeric systems: A guidance towardS next generation of plastics



SSRbD SURPASS case studies



Transport

cidetec >



Lightweight epoxy-vitrimer to replace metal parts of the train structure

Construction



Bio-sourced polyurethane resins (PU) with enhanced vitrimer properties to replace Polyvinyl chloride (PVC) for window frames

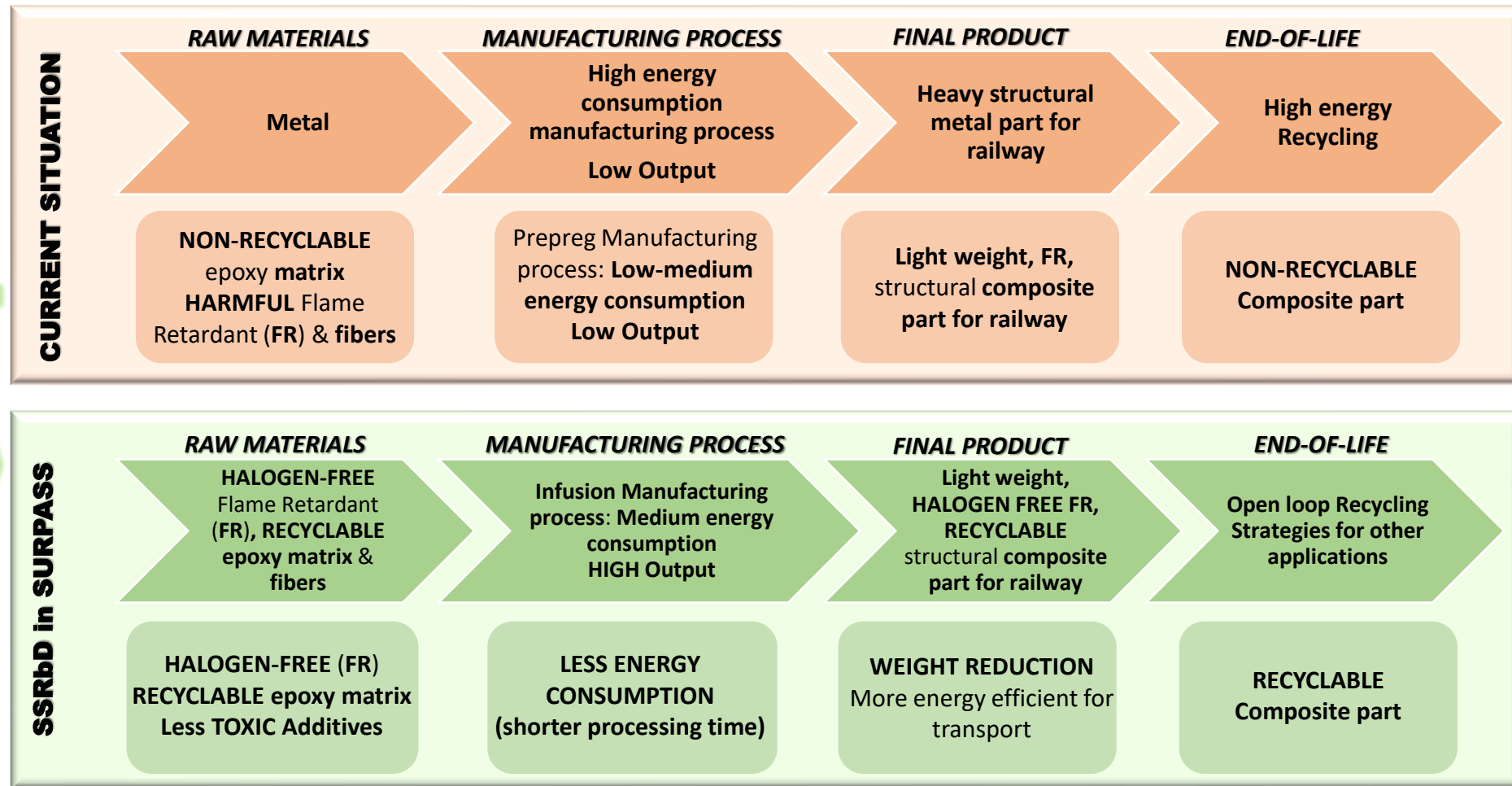
Packaging



Multi-NanoLayered films to replace current non-recyclable multi-layers films used in food packaging



Transport Case Study in the context of SSRbD Framework

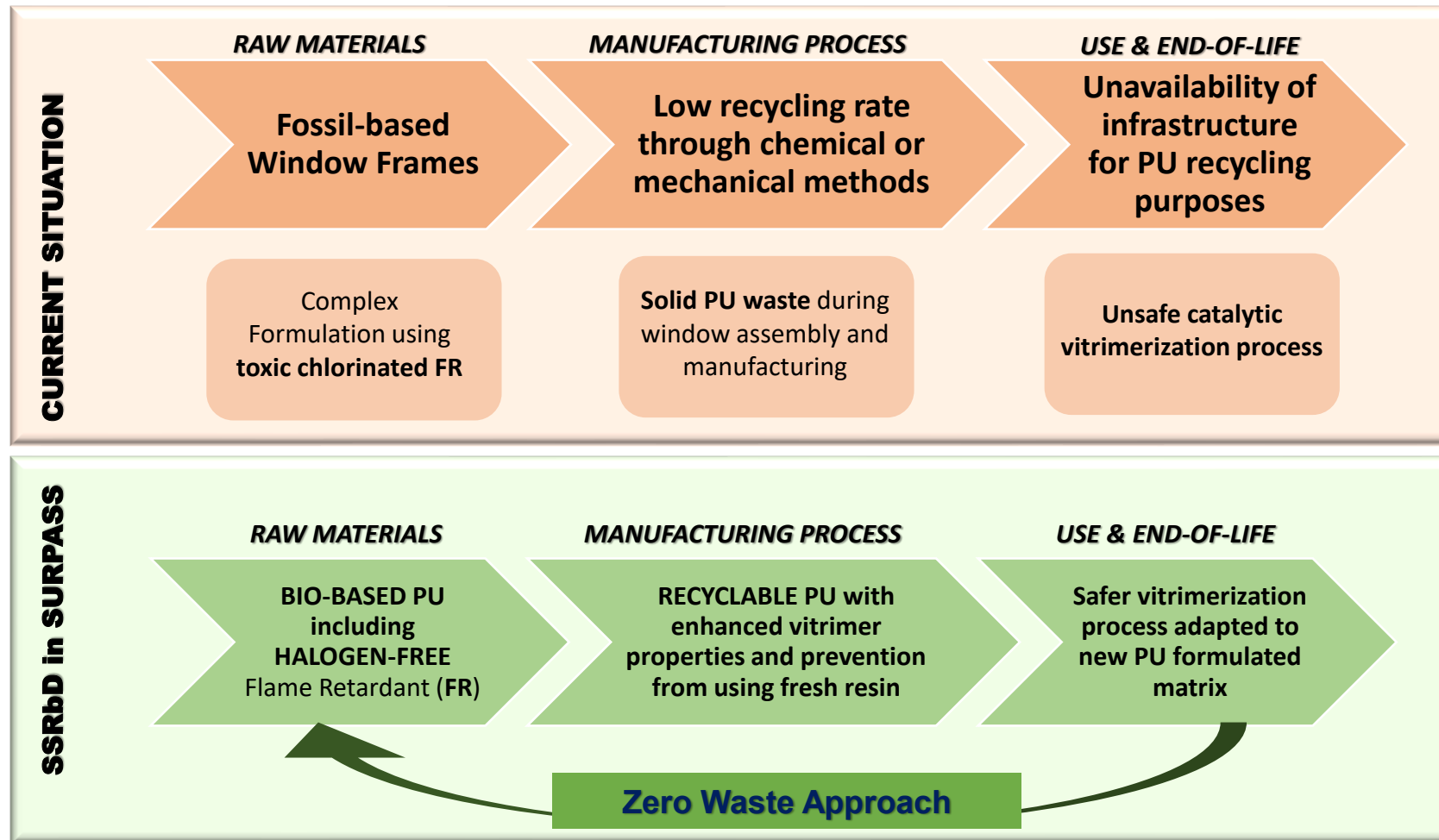


Design Principles

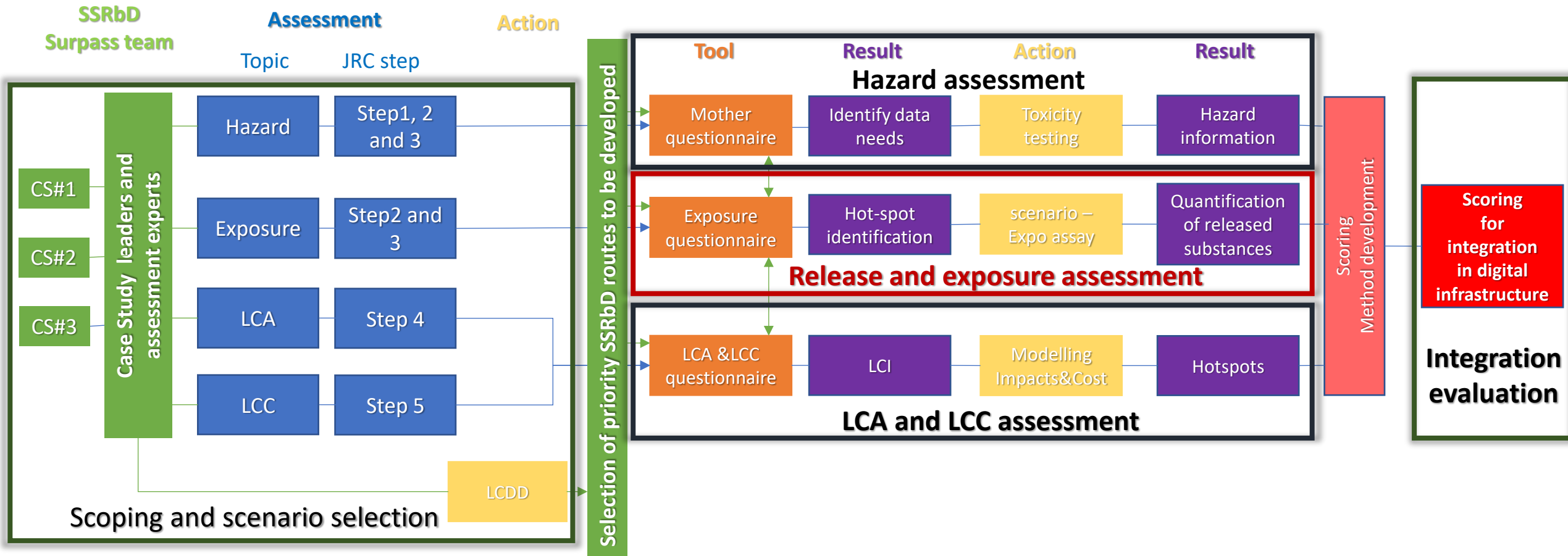
| | |
|-------|---|
| SSbD1 | Material efficiency |
| SSbD2 | Minimize the use of hazardous chemicals/materials |
| SSbD3 | Design for energy efficiency |
| SSbD4 | Use renewable sources |
| SSbD5 | Prevent and avoid hazardous emissions |
| SSbD6 | Reduce exposure to hazardous substances |
| SSbD7 | Design for end-of-life |
| SSbD8 | Consider the whole life-cycle |



Construction Case Study in the context of SSRbD Framework




Operationalize SSRbD assessment SURPASS



▪ Hazard Assessment Strategy towards the Development of SSbD Plastics

- Gather available toxicity data
- Optimize and perform toxicity testing (leachates, (N)IAS, microplastics...)
- Try to link physicochemical properties to toxicity

▪ Collecting/ Generating Hazard Data

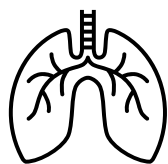
- 
- A large green arrow pointing downwards, indicating a sequential process.
1. Collect existing data
 - a. International agencies, like ECHA
 - b. Scientific literature
 2. QSAR modelling
For SURPASS:
 - focus on environmental toxicity
 - other hazards to a limited extend
 - explore the use of endocrine disruption QSARs for CS3 specifically
 3. In vitro testing



Hazard assessment



- Three different routes:



inhalation



dermal

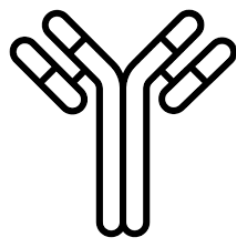


oral

- Eight different endpoints:



cytotoxicity

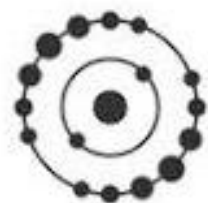


immunotoxicity

epigenetics



Acute aquatic toxicity



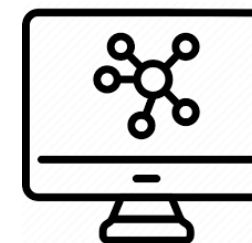
Oxidative stress



genotoxicity



Endocrine disruption potential



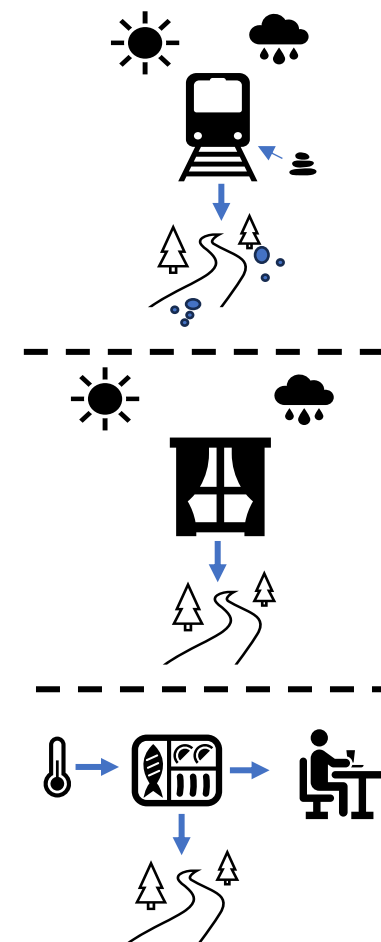
QSAR modelling for environmental toxicity



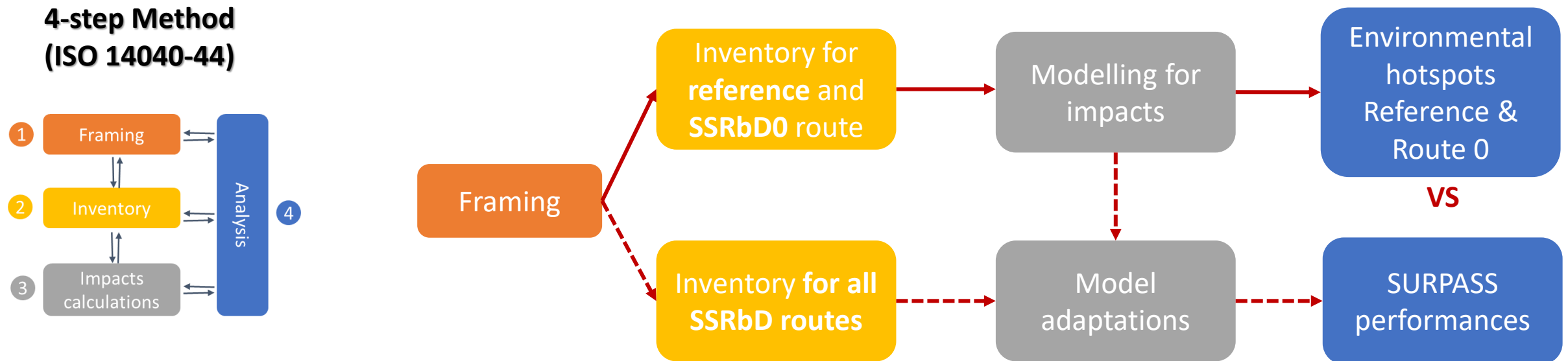
Exposure Assessment in the Context of SSRbD Framework



1. Develop a **questionnaire to support release hotspot identification** of substances/ materials and their potential transformations along the product life cycle via different routes
2. **Data gap analysis** based on existing data
3. Select **experimental tests to simulate exposure scenarios** for the identified hotspots
4. Quantify **release** of chemicals/ materials in each exposure scenario **for exposure assessment** purposes
5. Integrate **exposure and hazard data and LCA outputs** in the SURPASS e-infrastructure



- **Aim: Evaluation of environmental impact and performance of CS by LCA**
 - A comparison with reference technologies to assess the potential benefits of SURPASS technologies
- **Methodology applied**



LCC Strategy & Methodology



- Common methodology for the 3 CSs
- Common parameters aligned with LCA such as system boundaries, functional units, and LCI for all CSs

| DIRECT COSTS - OPEX 1 | |
|-------------------------|---|
| Material | =SOMME(Material)+SOMME(consumables)+SOMME(water_consumption) |
| Energy consumption | =SOMME(energy) |
| Ultimate wastes | =SOMME(w_recycling)+SOMME(w_incineration)+SOMME(w_landfill) |
| INDIRECT COSTS - OPEX 2 | |
| Labour | =engineer+worker1+worker2 |
| Annual running fees | =labourr_costs+Spare_costs+(Insurance/Annual_production_capacity) |
| Total OPEX | =Material+Energy consumption +Ultimate wastes +Labour+Annual running fees |
| CAPEX | |
| Total CAPEX | =equipment_acquisition+installation_cost |
| CAPEX per product | =Total CAPEX /(Annual_production_capacity*depreciation) |
| LCC | |
| Cost price | =Total OPEX +CAPEX per product |



SURPASS Integrated Approach for SSRbD Assessment in the Case Studies



Release/exposure

1. Identification of release hotspots for each life cycle stage.
2. Investigation of product/materials transformation processes along the life cycle.
3. Quantification of materials released.



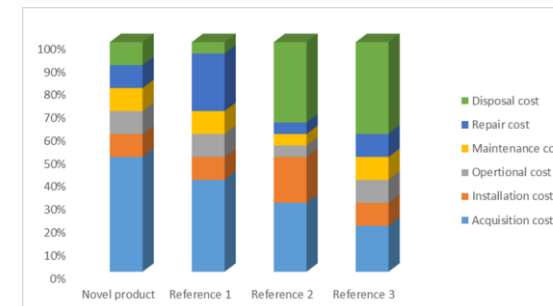
Hazard

1. Data collection on (eco)toxicological values.
2. Identification of data gaps.
3. Selection and execution of hazard testing.



LCA/LCC

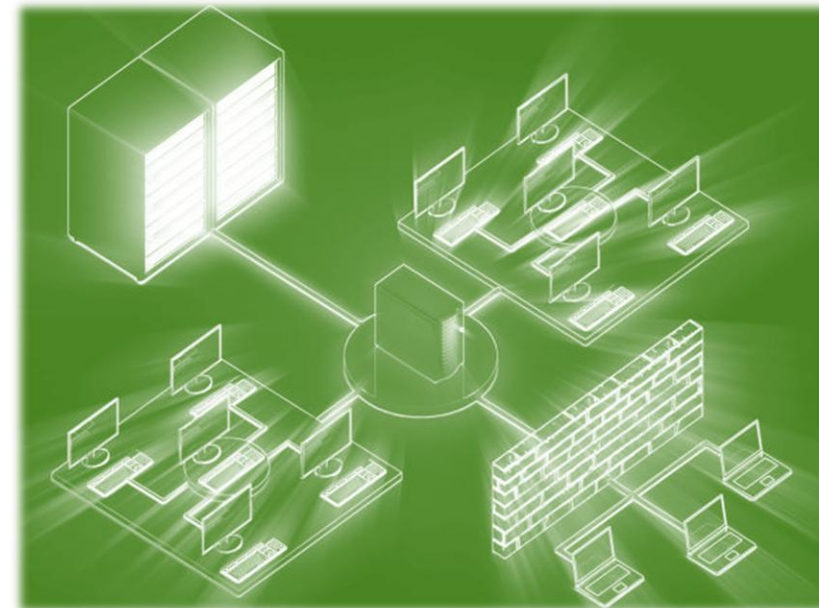
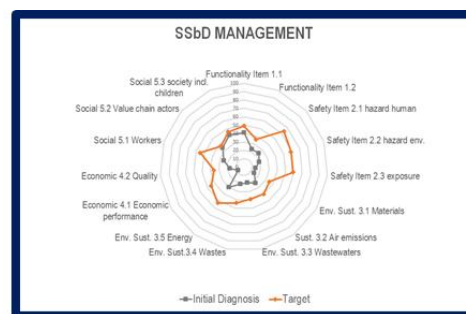
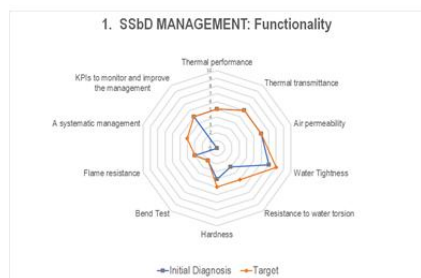
1. Environmental and cost hotspots identification
 - Impact categories
 - Cost categories
 - Contributing flows (matters, energy, waste, emissions)
2. Comparison between SSRbD alternatives



The SURPASS e-infrastructure



Scoring-based assessment to guide stakeholders (e.g., material designers, formulators and recyclers) to design SSRbD polymeric materials, including hazard, health, environmental and economic assessment using the **SURPASS digital infrastructure**



SURPASS SSRbD Integrated approach for alternative polymeric materials



Introduction ▾

(Re)design & Guidance ▾

Assessments ▾

Results & Resources ▾

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SSRbD Design Toolkit

Your open-access guide to **Safe-, sustainable- and Recyclable-by-design** Polymeric systems a Step towards next generation of plastics. This tool empowers innovators, especially Small and Medium-sized Enterprises (SMEs), to develop the next generation of polymeric materials by balancing performance, safety, environmental impact, and cost.

<http://surpass.geonardo.com>



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SURPASS

<https://www.surpass-project.eu/>

Thank you for your attention
Muchas Gracias



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