The international ecosystem for accelerating the transition to Safe-and-Sustainable-by-design materials, products and processes

Anne Chloé Devic
SusChem España and IRISS project

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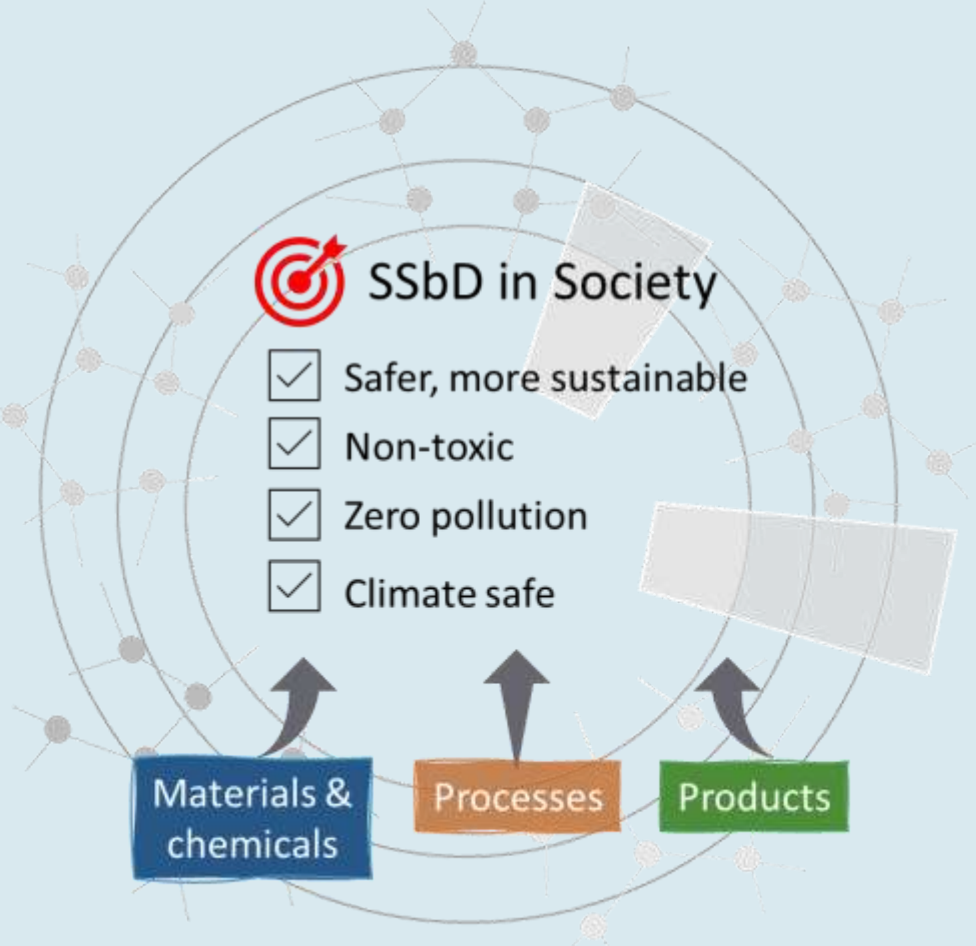
CH participants in Project IRISS receive funding from the Swiss State Secretariat for Education, Research, and Innovation (SERI)

Scope of the project

The IRISS project aims to connect, synergize and transform the SSbD community in Europe and globally towards a life cycle thinking

- Develop a **global permanent network** for long term cooperation between the networking members, engaging partners beyond the consortium, throughout and beyond the duration of the project
- Strongly support the **SSbD implementation** in industry **along value chains** to achieve more safe and sustainable products for society
- Focus on **materials including both products and processes**, considering the extensive progress to-date in chemicals and nanotechnology fields
- Establish cooperation mechanisms with relevant international initiatives to **align** and leverage the extensive international community
- Establish **synergy** with industry, EC and the projects that are working with SSbD concepts
- Building, sharing and transferring the **skills and knowledge** on SSbD



Our partners and network

NATIONAL TECHNICAL UNIVERSITY OF ATHENS

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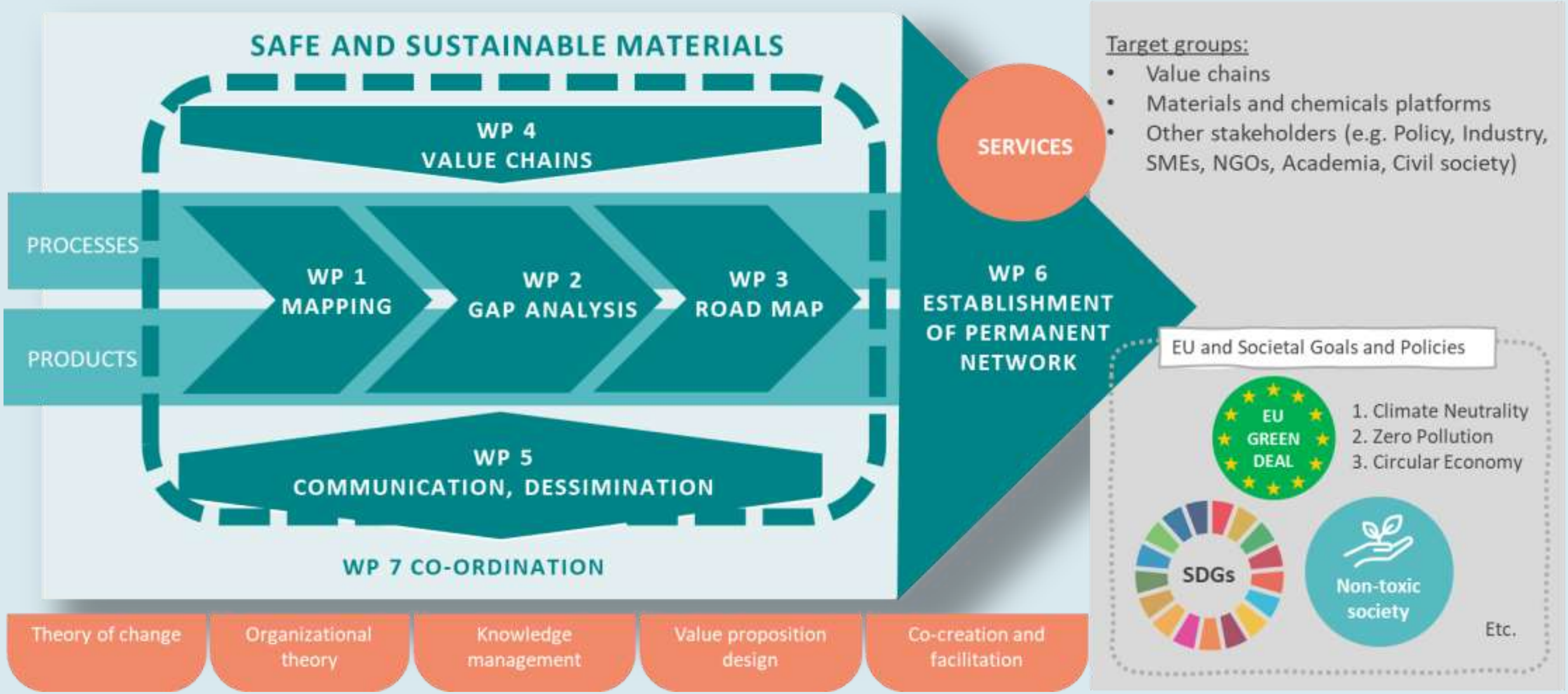
Organisation and activities



Mapping SSbD methods and criteria

- State-of-the-art on **Safe-by-design criteria and methods** for materials and products (included in present regulations, operationalization or implementation of Safe-by design, examples of actual applications of safe-by-design)
- Methods will be mapped along the whole **design and innovation processes** (Stage Gate Model)
- Safety in materials (environmental and human hazards), production (worker exposure and safety, release during production) and use (use-phase exposure and end of life)
- Existing **sustainability criteria initiatives** (Ecolabels, Ecodesign directive…)
- **Existing SSbD frameworks**
- Mapping of developed sustainable methods, tools and criteria applied in **industry and in R&D projects**
  - Analysis of case studies
  - Deeper analysis of most relevant cases/companies/projects by interviews
- **Engineering tools** for the implementation of SSbD principles at design stage
- Sustainability **Environmental dimension: LCA** (Life Cycle Assessment), **Social dimension: S-LCA**

Survey on Mapping of SSbD initiatives

Content of the survey

- **SSbD principles** to be applied in the design
- **Engineering tools** for the implementation of SSbD principles at design stage
- **Safe by design** (SbD)
- Sustainability **Environmental** dimension: LCA
- End of life and design for **circular economy**
- Sustainability **Social** dimension: S-LCA
- **Skills** on SSbD
- SSbD **gaps**

Survey sent out to map the state-of-the-art of methods and criteria of existing SSbD approaches, covering safe materials, processes and products, including environmental impact, life-cycle costing and social impact.

Preliminary results - Applicability of SSbD principles

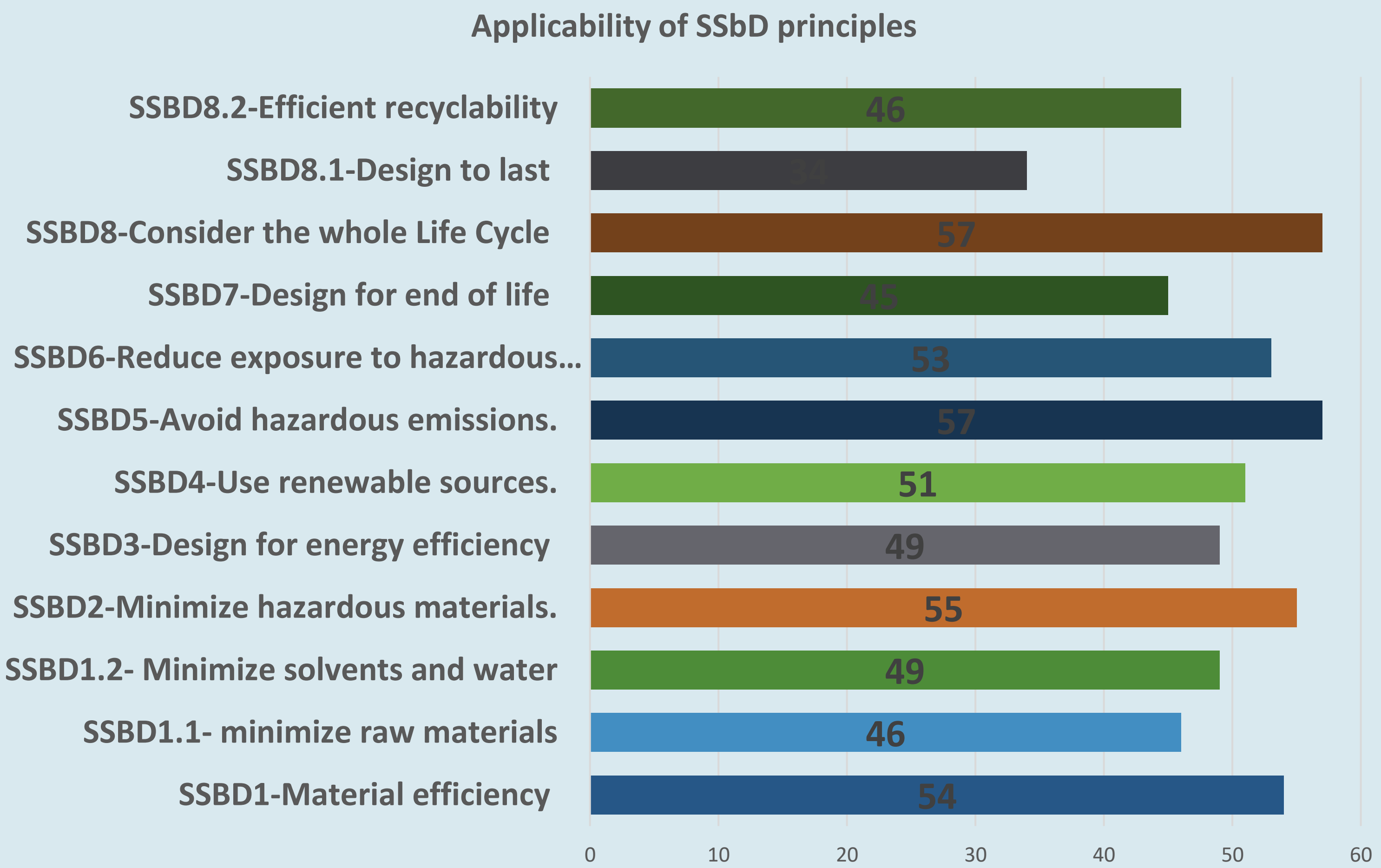
1-(Re)Design Phase

Design guiding principles are proposed to support the design of chemical an materials

- Green chemistry
- Green Engineering
- Sustainable Chemistry
- Safe by design

List of SSbD principles recomended by the JRC SSbD frame work

SSbD1	Material efficiency
SSbD2	Minimize the use of hazardous 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



Gap analysis in SSbD activities

- Harmonized methodology to establish the gap analysis approach
  - Aiming to identify suboptimal or missing strategies, structures, practices or skills from the sectors identified and mapped
  - Recommend steps that will offer opportunities for gap closure or approach convergence
  - Consideration of possible gender- and minority-specific aspects of the SSbD concept
- Workshop for stakeholders from HE projects related to SSbD
- Harmonisation of inputs to gap analysis from the NanoSafetyCluster and VCs
- Elaboration of the gap analysis of SSbD criteria, and priorities, including modelling and testing and recycling methodologies
- Map and address SSbD skills mismatches and competence gaps, to support enhancement of adequate skills at all levels - including in university programmes, research, industry and among regulators

Preliminary results - GAPS

Gaps for the SSbD approach to be easily applicable

- A **common understanding** of the SSbD concept is still missing
- A practical guideline and tools on how to implement the SSbD concept are missing
  - At present the **framework is too complex** for companies (SME especially) to comprehend and work with
- Harmonized assessment methodologies for **social and economic aspects** are still missing
- **Data** must be made findable, accessible, interoperable and reusable (FAIR)
- **Harmonized assessment methodologies** and **minimum requirements** need to be defined from the regulatory/policy side (in close cooperation with industry)
  - Threshold values for each SSbD criteria are missing: what is low emission and what is high emission?
- **Education** on SSbD needs to be encouraged within companies

Development of SSbD supportive roadmap

Packaging
(IPC; Industrial Technical Centre for Plastics and Composites)

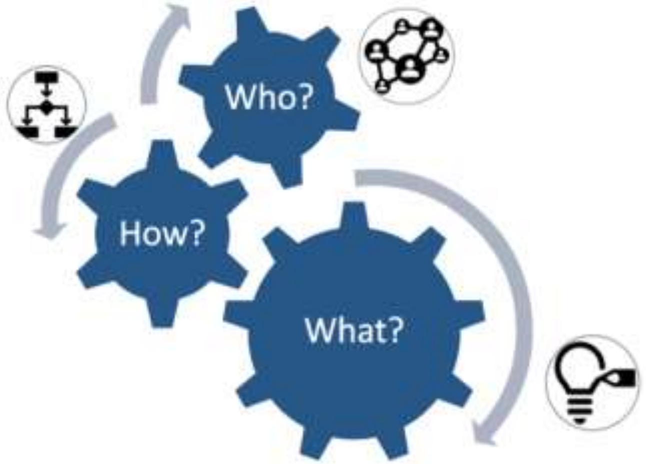
Textiles
(ETP; EU Technology Platform for the Future of Textiles & Clothing)

Automotive
(CLEPA; European Association of Automotive Suppliers)

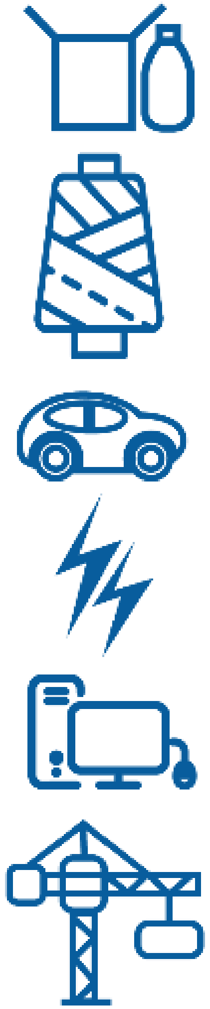
Energy materials
(EMIRI; Energy Materials Industrial Research Initiative)

Electronics
(INL; International Iberian Nanotechnology Laboratory)

Construction
(EFCC; European Federation for Construction Chemicals)



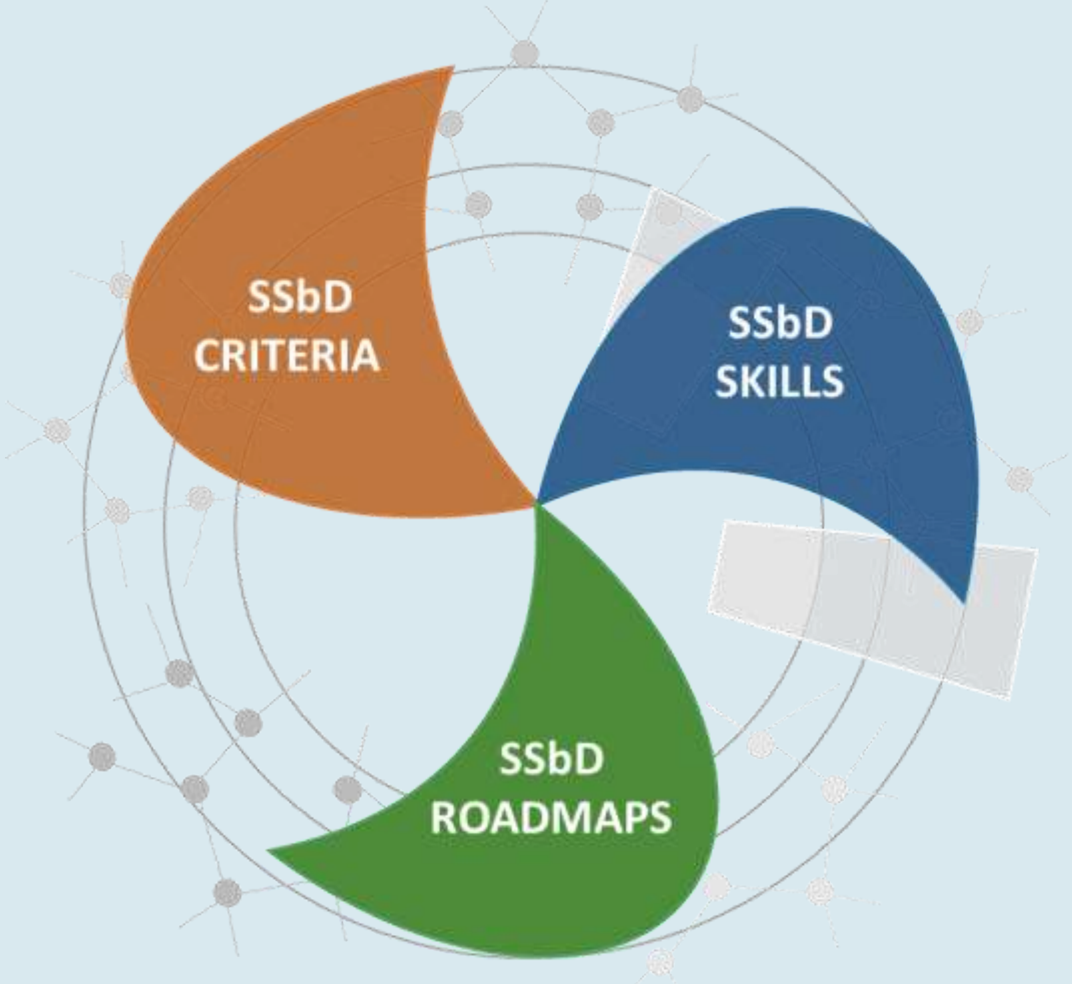
- **Development of value chain specific SSbD supportive roadmaps with agendas for:**
  - research needs
  - skills, competences and education needs, and
  - knowledge and information sharing needs
- **Translate the value chain specific SSbD supportive roadmaps to a generalized roadmap**



Value chains SSbD ecosystem

- Value chain analysis
- Baseline analysis of SSbD criteria - specificities and common grounds
- Value chain SSbD criteria gap analysis
- Uptake of the SSbD approach by the value chains
- Value chain-specific research and innovation roadmaps
- Engagement with additional value chain networks, internationalization and integration in the permanent structure

- Case studies for implementation of the SSbD framework



Analysis of the value chains, their stakeholders and initiatives

Goals:

- To support the state-of-the-art mapping activities in SSbD
- To obtain first insights on how to translate the EC framework to practical methodologies and tools for SSbD
- To identify the applicability of the framework, alongside challenges and barriers from a value chain perspective

Content:

- Mapping Value Chain Stakeholders
- Main safety and sustainability challenges
- **Recommendations on how to bring SSbD to practical applicability especially in SMEs**

Packaging Value Chain

Maudez LeDantec
IPC , Institut Plastiques et Composites

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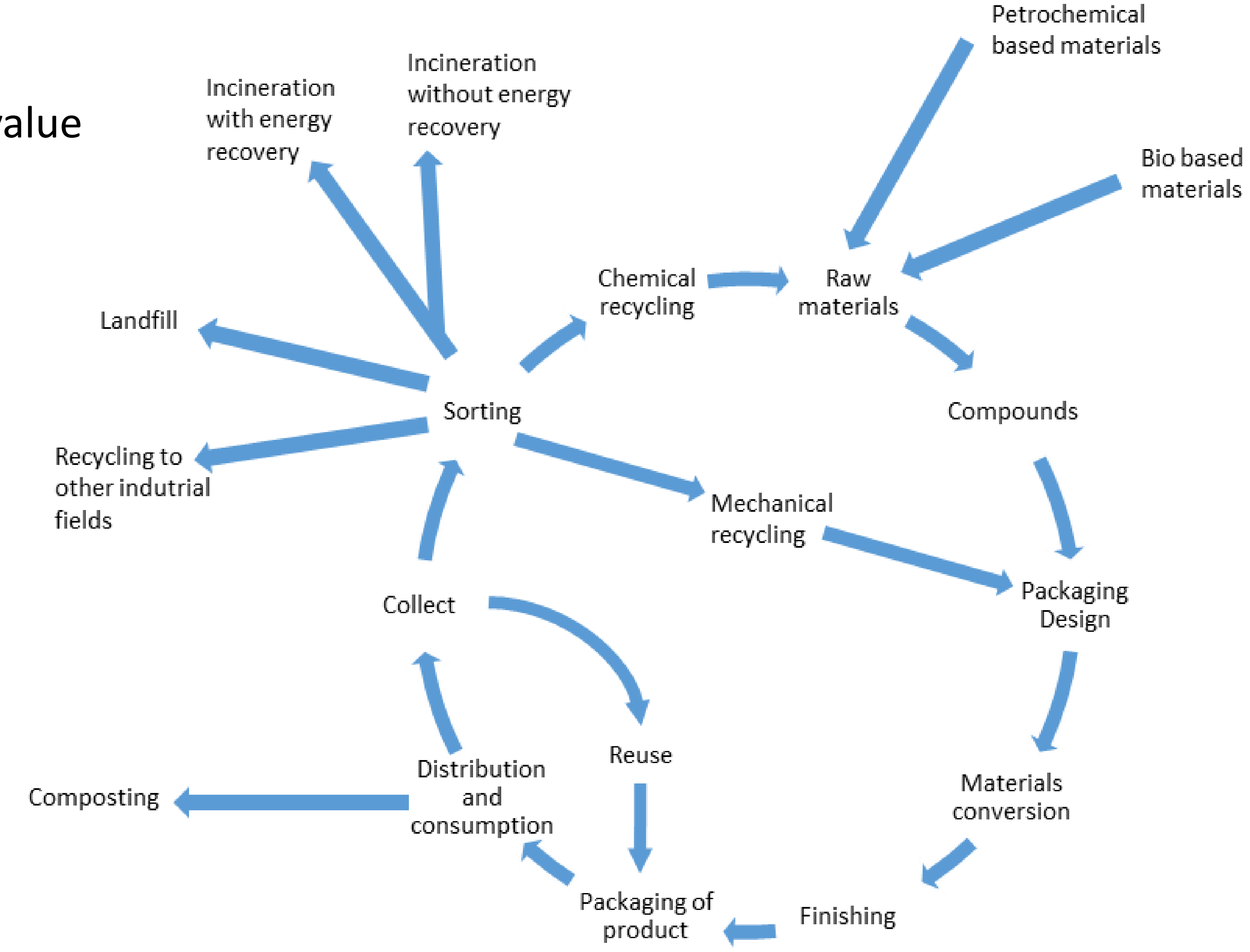
Mapping of Value Chain Stakeholders

- The plastics packaging value chain:



IRISS Value Chain - Packaging

Major safe and sustainability challenges

SAFETY	SUSTAINABILITY
reduction of **hazardous additives**	promotion of **recyclability** through production capability of monomaterial packaging
The dispersion of **microplastics**, which can be addressed by reducing or avoiding the production of microparticles	**effectively sorting** different polymers to optimize secondary raw materials



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Textiles Value Chain

Lutz Walter
European Textile Technology Platform (Textile ETP)

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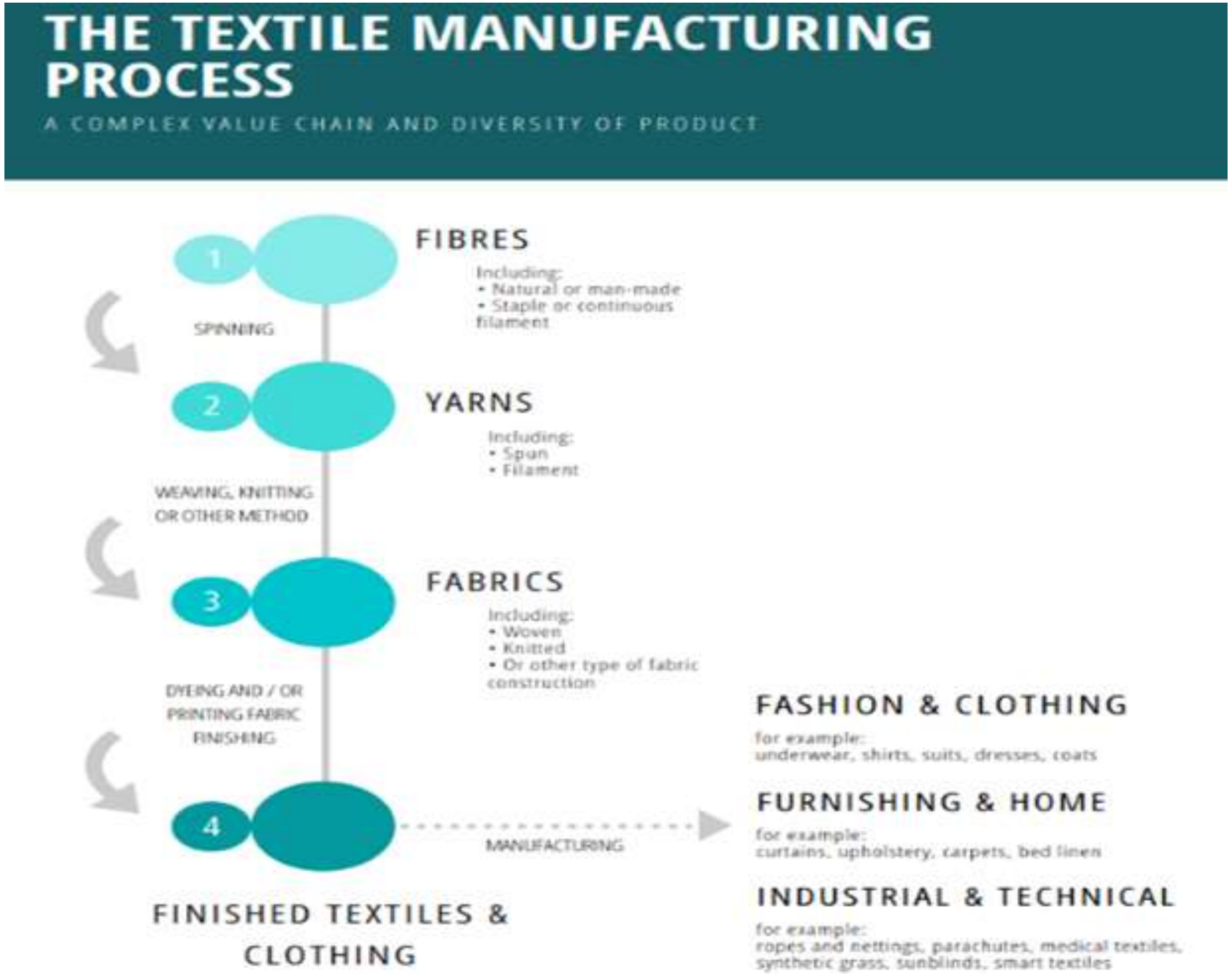
Mapping of Value Chain Stakeholders



Large-diversified industry:

- € 150 billion turnover, 145,000 companies, 99% SMEs
- Complex global value chain
- Highly diversified end markets: clothing & fashion, interiors & furniture, automotive, healthcare, construction, personal protection, sports, agriculture, environmental protection
- Wide variety of fast-moving/short-lived products (fast fashion, household textiles) and long-lived technical products (construction, automotive, aerospace applications)

IRISS focus on 2 sub-value chains

- **Workwear & protective clothing**
- **E-textiles & smart wearables**

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IRISS Value Chain - Textiles

Major safe and sustainability challenges

SAFETY	SUSTAINABILITY
Human health and ecological impacts of textile processing and functionalisation chemicals and effluents	**Environmental impacts** associated with the production of natural and man-made fibres and their subsequent processing and manufacturing to produce textiles incl. the **depletion of soil and water resources** in the production of natural fibres (especially cotton)
Dispersion/persistence of textile fibres & chemicals released in the environment during production, use and end-of-life (microplastics)	Assurance of **reliability, traceability and transparency** of SSbD-related data and information along complex global textile value chains and capacity building among small-to-medium enterprises making up most of the textile and clothing value chain
Safe recycling/disposal of end-of-life textile products	Improvement of **occupational health and basic labour rights** in textile and garment factories (mainly in lower cost manufacturing locations outside Europe)






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IRISS Value Chain - Construction

European Federation for Construction Chemicals (EFCC)
Dr. Ing. Johan Breukelaar – Director General

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Construction Value Chain

One type of **construction chemicals** is a concrete admixture called a **superplasticizer**. Superplasticizers improve the dispersion of cement particles, resulting in a high workability. In addition, they result in significant reductions in the water used, which results in a considerable increase in both durability and strength.

There are four different types of superplasticizers, which are salts of:

- Lignosulphonates (**LS**)
- Naphthalene sulphonates condensate (**NSF**)
- Polycarboxylate(s)/-ether (**PCE**)
- Melamine sulphonate (**MS**)

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Construction Value Chain

The **key value chain actors** of the superplasticizers are:

- **raw material manufacturers** (typically large companies)
- **superplasticizer manufacturers** (typically large companies)
- **superplasticizer users** (a range from companies, from very large to SME, with the majority being SMEs)
- **demolition and waste companies** (also a range of companies of different sizes)

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IRISS Value Chain - Construction

Main safety and sustainability challenges and opportunities

SAFETY	SUSTAINABILITY
CMR properties of some of the RAW MATERIALS used for some of (the classes of) superplasticizers	Significant reduction of GHG emissions
	Significant reduction of water use
	Significant increase in durability and strength
	Significant increase in workability
	Very high recycling rates (89% in the EU)






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Automotive Value Chain

Beatriz Ildefonso
European Association of Automotive Suppliers (CLEPA)

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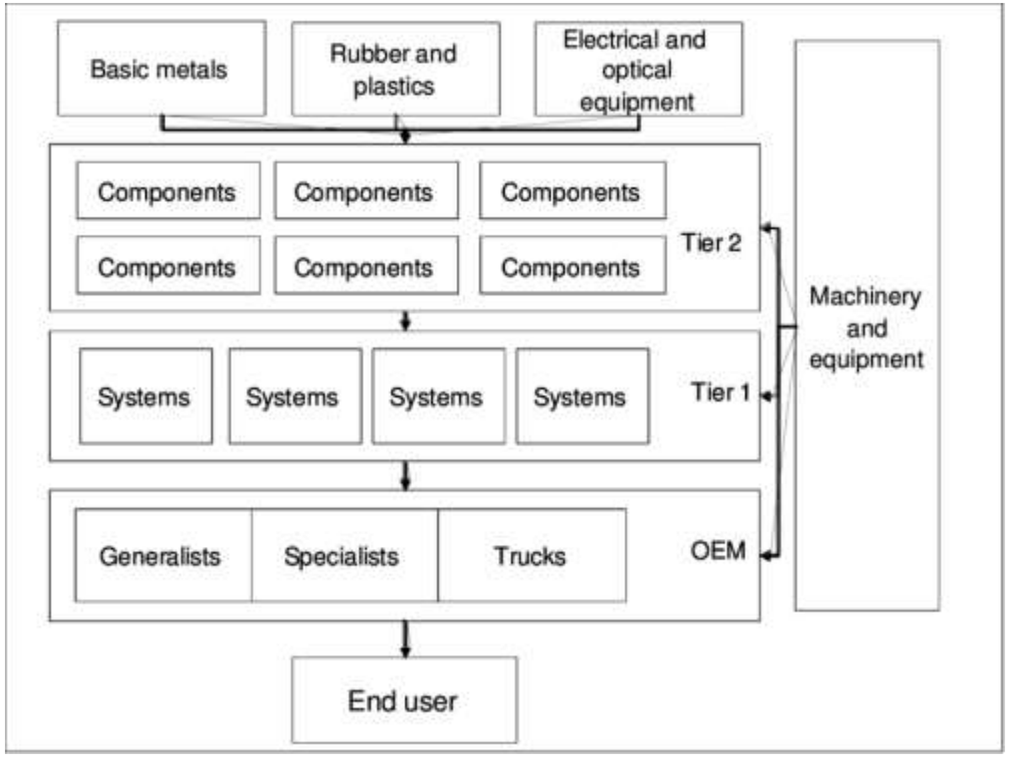
Mapping of Value Chain Stakeholders



- An average car is made of **30000 parts**: electrical and electronic components, lighting systems, interior, power train and chassis, body in white...
- A **broad range of raw materials** is used, but most of the vehicle weight comes from metals, plastics, glass, rubber.
- Materials selection by automotive suppliers follows **customers' expectations** and **legal requirements** (e.g. safety), but also **availability** and **reliability**.

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IRISS Value Chain - Automotive

Major safe and sustainability challenges

SAFETY	SUSTAINABILITY
Safety concept must consider **use and exposure**, and this needs to consider the whole product life-cycle in all its different potential applications and considering sustainability considerations	electrification: **high critical raw material** demands
	Traceability: very complex supply chains
	trade-offs: materials or substances that enable the **higher durability** of automotive parts, may **not be optimum for recyclability, life cycle emissions, final cost or natural availability**






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IRISS

Energy Value Chain

ENERGY MATERIALS INDUSTRIAL RESEARCH INITIATIVE (EMIRI)
Philippe JACQUES, Managing Director

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Mapping of Value Chain Stakeholders

The energy materials sector is very broad ranging from advanced materials for batteries, hydrogen, solar energy harvesting, wind energy harvesting, low carbon industries, light weighting for mobility to buildings.

RENEWABLE ENERGY HARVESTING

- Photovoltaics
- Building integrated photovoltaics
- Concentrated Solar Power
- Wind Power

BATTERY ENERGY STORAGE

- Batteries for Electric Vehicles
- Batteries for stationary applications

HYDROGEN FOR MOBILITY

- Fuel Cells
  - Low temp. PEM
  - High temp. PEM
- Hydrogen storage tanks
- On-board H2 generation

CHEMICAL ENERGY STORAGE AND CCU

- Hydrogen generation by electrolysis (PEM; SO)
- Electricity generation from H2
- Carbon Capture and purification
- Catalytic conversion of CO2 into fuels, chemicals, and e-fuels

ENERGY EFFICIENCY

- Light weighting (transport)
- Insulation of buildings
- Thermal energy storage
- Lighting
- Glazing

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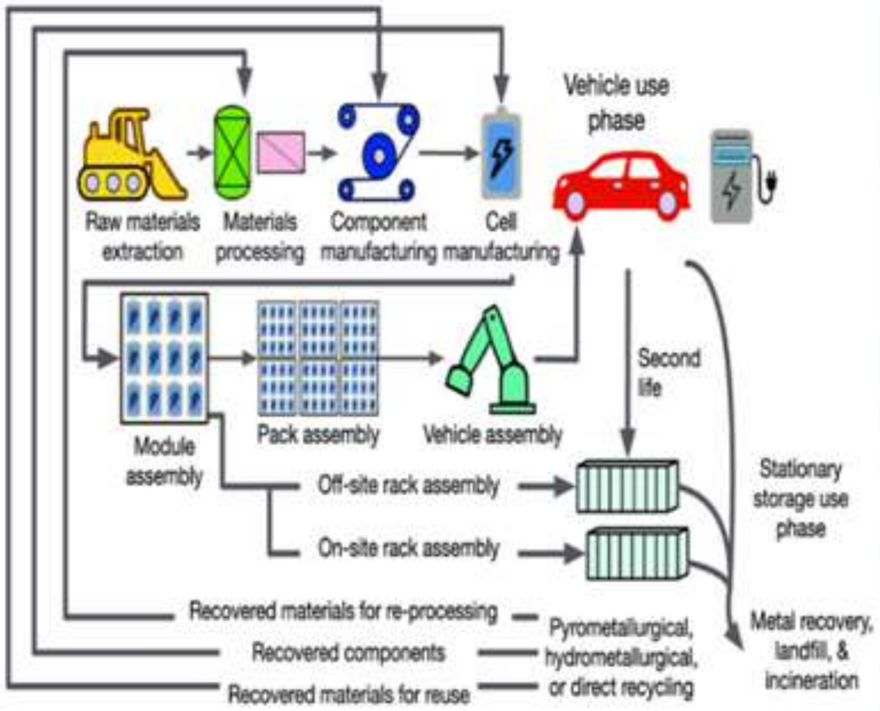
The Battery value chain as an example



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IRISS Value Chain - Energy

Major safe and sustainability challenges

SAFETY	SUSTAINABILITY
reduction of **hazardous materials**; Safety needs to be seen from the **whole value chain perspective** and adaptation of existing standards to encompass the **whole value chain** is to be considered	reduction of **critical raw materials** with a high demand (massive roll-out of low carbon energy technologies: renewable energy technologies, electro-mobility, energy storage, energy efficiency, technologies for decarbonisation of power and energy-intensive sectors)
	efficient **manufacturing process with lowest CO_2 footprint and sustainable sourcing of raw materials** by both securing access from resource-rich countries outside the EU and facilitating the creation of European sources
	efficient manufacturing environment for **water, energy, chemicals and waste**
	secure access to secondary raw materials through recycling in a circular economy and hence to optimise the recycling processes
	skilled workforce






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Electronics Value Chain

Dmitri Petrovykh
INL

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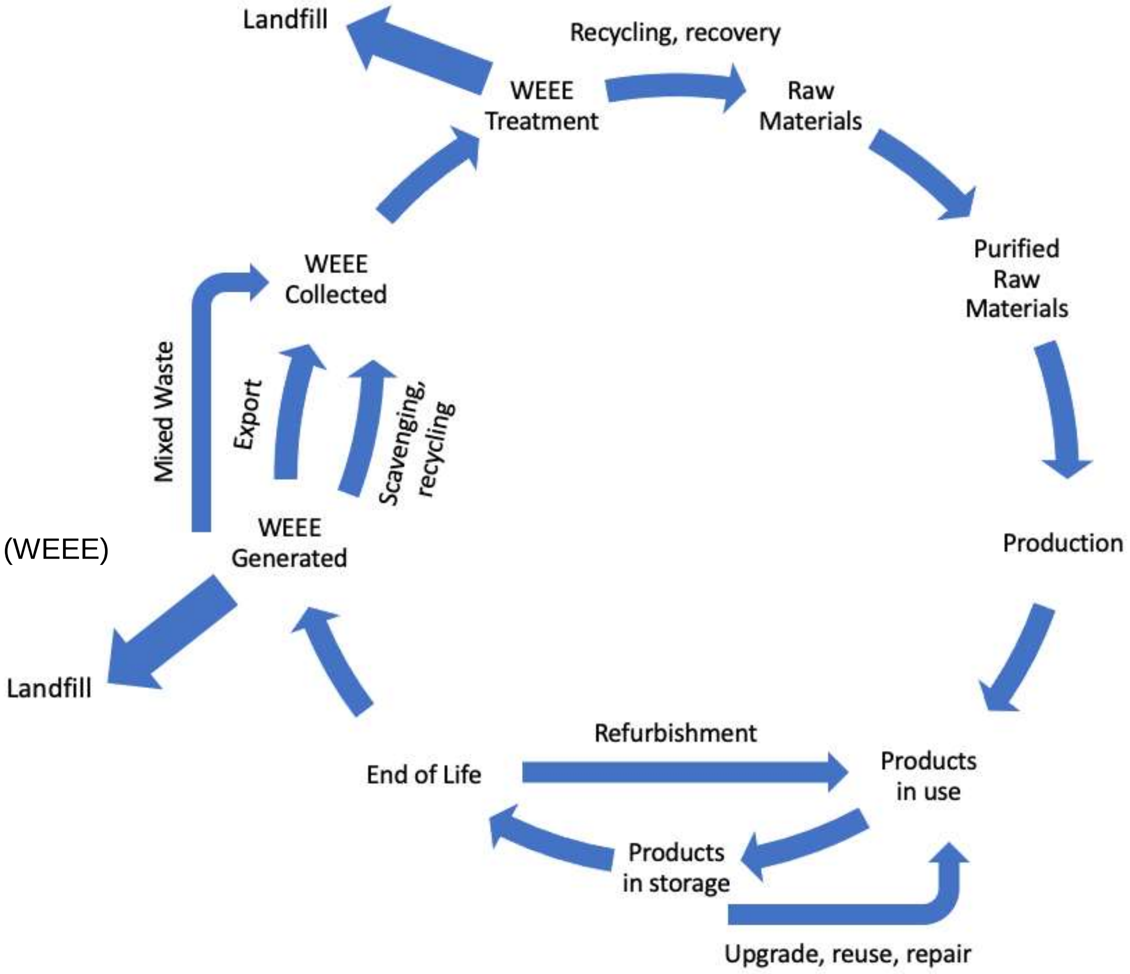
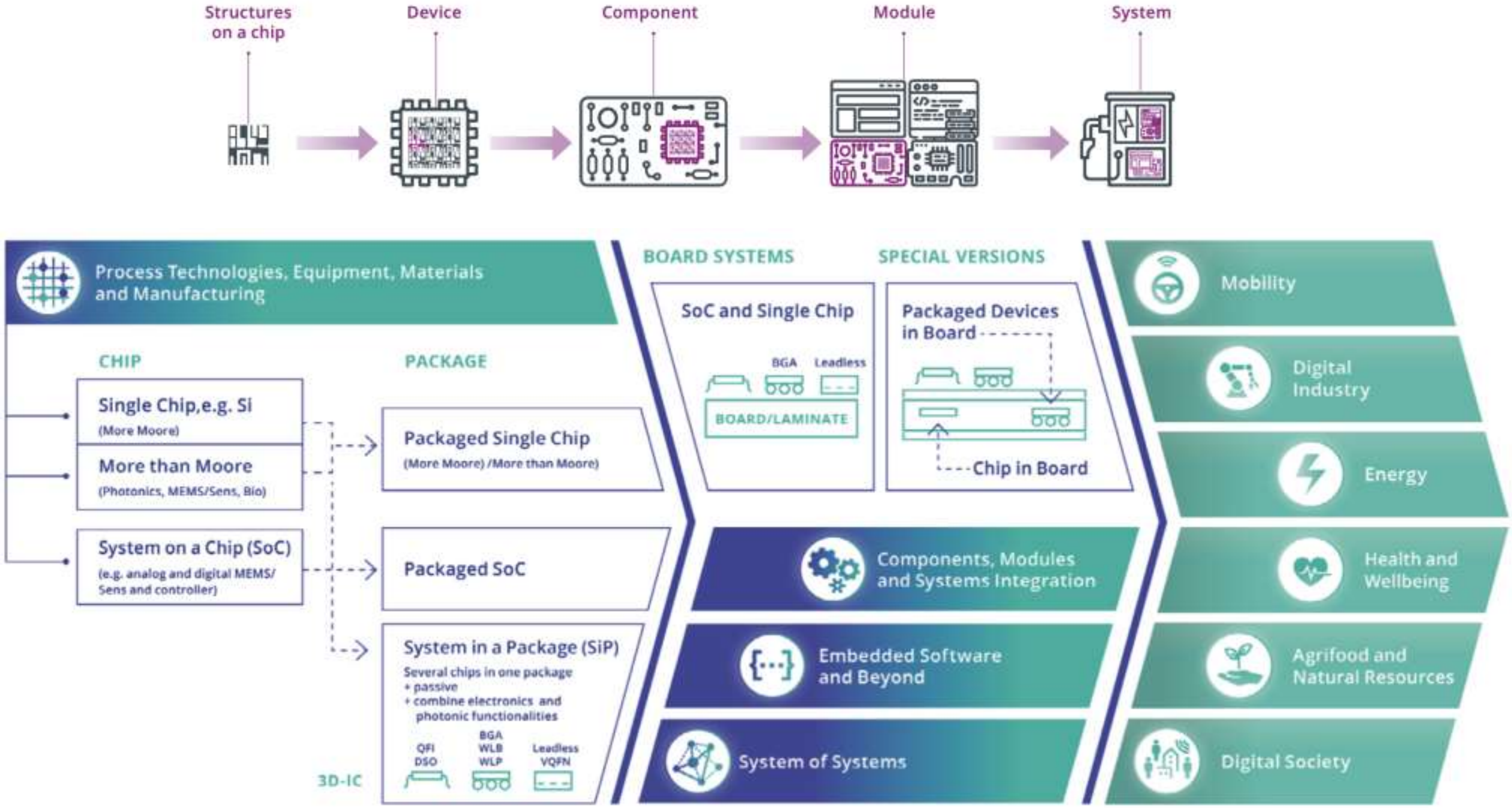
Lifecycle in the Electronics Value Chain



waste electrical and electronic equipment (WEEE)

Integration in the Electronics Value Chain



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IRISS Value Chain - Electronics

Major safe and sustainability challenges

SAFETY	SUSTAINABILITY
require large volumes of specialized **(often toxic) gases, solvents, and solutions**	**resource-intensive production** processes
	difficulties in **recycling end-of-life products**; production processes typically combine the highly-purified raw materials in very complex structures, including at nanoscale or even molecular levels, making them **extremely difficult to separate at the end of life**
	production processes also are **energy-intensive and require large volumes of water**
	waste: the majority of **e-waste produced in high-income countries is currently exported to low-income countries** for dismantling and processing, where only a small fraction of the materials can be recovered: mainly precious metals and, to some extent, rare-earth metals, copper, aluminium
	high-performance electronics demanded by consumers and industrial users with no current alternative manufacturing approaches, make circularity nearly impossible to achieve by design






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Fragrance Value Chain

Stakeholders
Challenges
Recommendations

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ifra THE INTERNATIONAL FRAGRANCE ASSOCIATION

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What is a fragrance ?

- A fragrance is typically a mixture of around 60 to 80 ingredients in household products and can go up to several hundreds in fine fragrances.

- The perfumer's palette is composed of **thousands of substances – some of which are complex** (around 900 are natural complex substances), representing a small contribution by volume in the final product but playing **a major role in society**.

- The list of ingredients currently used by the fragrance industry in all products (consumer and professional uses) is publicly available on the IFRA Transparency list

- Fragrance is a cornerstone of European cultural heritage and shared prosperity.

Support : Hygiene, Malodor Control, Cleaning, Disinfection, Sanitation, Wellness

The IFRA-IOFI Sustainability Charter has five Focus Areas, moving through the value chain

Ensure **responsible sourcing** across F&F value chain

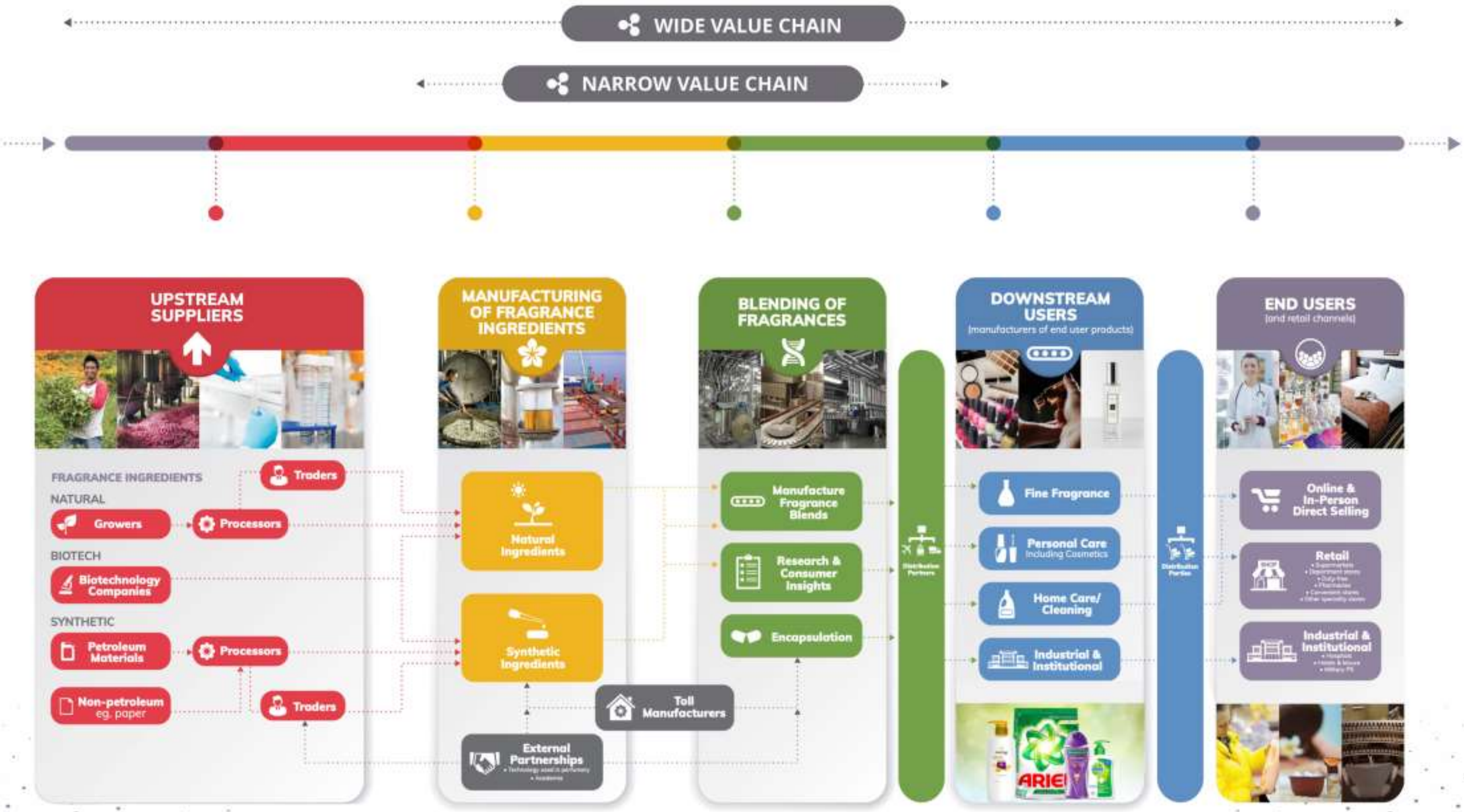
Reduce environmental footprint and address climate change

Enhance well-being of employees; ensure a rewarding labour environment

Be at the **leading edge of product safety**

Be a **transparent and reliable partner** for society and stakeholders

GLOBAL FRAGRANCE VALUE CHAIN



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Major Safety and Sustainability Challenges

Safety	Sustainability
Application mainly in consumer products: **No CMR 1 or CMR like substances**	Carbon Footprint: Transition towards use of **renewable raw materials/feedstock**
New to CSS: **No Most harmful Chemicals** (including ED, PBT, Respiratory Sensitizers, STOTs, Immuno- and Neurotoxicants)	Environmental Footprint: **Deforestation, Energy and Water Use, Agricultural Use** (for natural ingredients)
No Skin Sens 1 A (Restriction on Skin Sens 1 B)	End of Life: Limited circularity, thus high **biodegradation** needed
Low environmental toxicity	
Exposure assessment must be considered	

Trade-off between Safety and Sustainability, Substances of Concern and Environmental Sustainability




ifra THE INTERNATIONAL FRAGRANCE ASSOCIATION

Recommendations on how to bring SSbD to practice from the Fragrance Value Chain Perspective

- Fragrance industry is very experienced in '**<u>Safe by Design</u>**'
  - However, not all new hazard classes can be tested or predicted especially without additional animal testing
- Fragrance industry is relatively **<u>specific in its innovation process</u>**:
  - No Most harmful Chemicals since direct consumer use
  - Limited circularity, thus biodegradation high in focus
  - Carbon footprint reductions via biogenic carbon, mass balance with renewable raw material, process innovation
- **<u>Complex value chains</u>** increase burden on Life Cycle Assessments and trigger complex (compliant) data exchange
- Fragrance industry recommends a **<u>sector specific SSbD assessment</u>**
  - With focus on relevant safety factors, but including exposure and risk assessments
  - With focus on relevant sustainability factors, but excluding e.g. circularity, durability etc
  - With focus on solutions for data sharing along complex value chain

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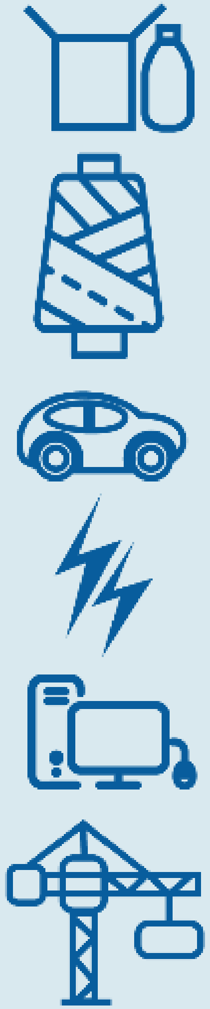
Recommendations from value chains

How to bring SSbD to practice

- SSbD "stamp" or "certification" for chemical material (as Safe certification) available on material datasheets to facilitate the use of these material by product producers
- Facilitate access to experts who can evaluate and validate material or parts. Use model of expert platforms to ease the data access to companies (especially SMEs)
- Producers need to work preferentially with local material producers, in order to facilitate exchanges and improve material knowledge
- Distinguish between vital vs. nice-to-have product performance properties (personal protection vs. fashion effect) & consumer vs. professional products/applications
- Make SSbD practically manageable for SME designers, product developers and manufacturers
- Develop accessible, easy-to-use management tools, platforms, tutorials and trainings
- Well defined and acceptable limits for safety and sustainability criteria, depending on use case and informed by whole life-cycle information



Recommendations from value chains

How to bring SSbD to practice

- Increased dialogue in the value chain and across sectors to raise awareness on parallel challenges and best-practices on design for safety and sustainability
- Continued incentives to innovation, e.g. to support the development of digital tools for supply chain management and more efficient end of life handling
- Innovation always goes with trade-off decisions between safety, sustainability but also performances, cost, user experience, societal benefits,… All dimensions must be considered
- By-design needs enablers: methodologies, digital tools, data, data, data (safety and sustainability data are often missing at the start of the innovation process…)
- SSbD awareness and compliance can be most effectively addressed in the design (and novel concepts) for simple products, e.g., where flexible and organic materials can be used. There are overlaps between electronics, textiles, automotive, and energy value chains
- Build on existing regulations (Reach, Battery directive, product passport,…) and sectorial initiatives/roadmaps (Battery 2030+, Batteries Europe, Batt4EU,…)

Establishment of an EU Led International permanent network

- A structure for continuous cooperation and services to network members, potential members, network associates as well as other stakeholders with interests in SSbD
- Strengthen collaboration and information exchange between relevant actors along the value chains
- Build a platform containing services addressed to different key target groups
    - Training service for SMEs
    - Service for start-ups to boost business collaboration with industry
    - Co-creation service to establish hubs for specific value chains
    - Knowledge exchange services
    - Knowledge sharing services

Towards an efficient science-policy-industry interface

Building structural and efficient information sharing process and network

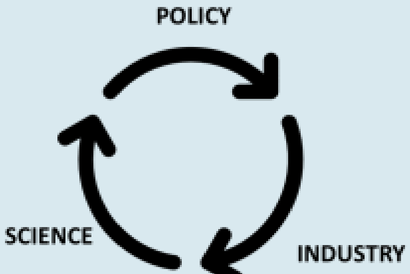
JRC TECHNICAL REPORT

Safe and Sustainable by Design chemicals and materials

Policy:

IRISS structural dialogue with:

- **EC RTD**
- **EC JRC**



Science-Policy-Industry Interphase

Science:

Initial steps on operationalization of SSbD

- **IRISS-NSC collaboration**
- **IRISS-PARC collaboration**
- **IRISS-ongoing H2020 and HE projects**

Bringing science to harmonization and standardization

- **IRISS-OECD synergies**

Industry:

Cefic coordinates 6 value chains representatives with the support the SusChem NTPs network

- **Packaging** (IPC; Industrial Technical Centre for Plastics and Composites)
- **Textiles** (ETP; EU Technology Platform for the Future of Textiles & Clothing)
- **Construction chemicals** (EFCC; European Federation for Construction Chemicals)
- **Automotive** (CLEPA; European Association of Automotive Suppliers)
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JOIN THE NETWORK

https://iriss-ssbd.eu/english/ivl/project/iriss/join-the-network.html

IRISS

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www.iriss-ssbd.eu

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IRISS – International SSbD network

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