SUSCHEM
European Technology Platform
for Sustainable Chemistry

‘Safe-by-design for chemicals and materials’: innovation priorities

SusChem ETP *towards a new SusChem Strategic Research and Innovation Agenda (SIRA)*

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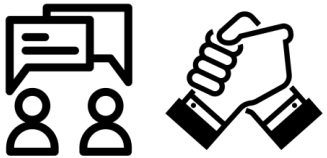
Presentation structure

1. SusChem ETP - linking with RD& I priorities at EU level;
2. New SusChem SIRA and innovation priorities (from societal to global challenges – H2020 to HEU and beyond);
3. Safe-by-design for chemicals and materials (objectives, RD& I actions and other enabling actions).

SusChem ETP – a European Technology Platform

SusChem ETP focus: Sustainable Chemistry and Industrial Biotechnology



1. Open multi-stakeholders forum

- Mobilizing and bringing together stakeholders from the **large Industry, SMEs,** *startups*, and **Academia (Universities & RTOs)**
- Promote knowledge transfer across the EU

2. Advisory instrument (technology priorities)

- Driving innovation, defining **tech priorities/ solutions** to **global challenges** and **EU priorities**
- **RD&I agendas** to be supported by both private and public funding (EU and national level)

Founding members& SusChem Board

Founded in 2004
6 founding members: Cefic, DECHEMA, ESAB, EuropaBio, GDCh, RSC

SusChem Board*

BASF, SOLVAY, EVONIK POWER TO CREATE, BAYER, CLARIANT, covestro, Solutex, GDCh, ROYAL SOCIETY OF CHEMISTRY, NWO Netherlands Organisation for Scientific Research, DECHEMA Gesellschaft für Chemische Technik und Biotechnologie e.V., EuropaBio The European Association for Bioindustries, cefic, EFCE **, VTT **

**Links w EARTO, DG-Grow and DG-RTD (EC)*
*** new members > March 2019*

SusChem NTPs network
A network across Europe - Bridging National and EU priorities

**NCPs ,*
***NTPs strong links with Industry and Academia at national level < --- > SusChem ETP*

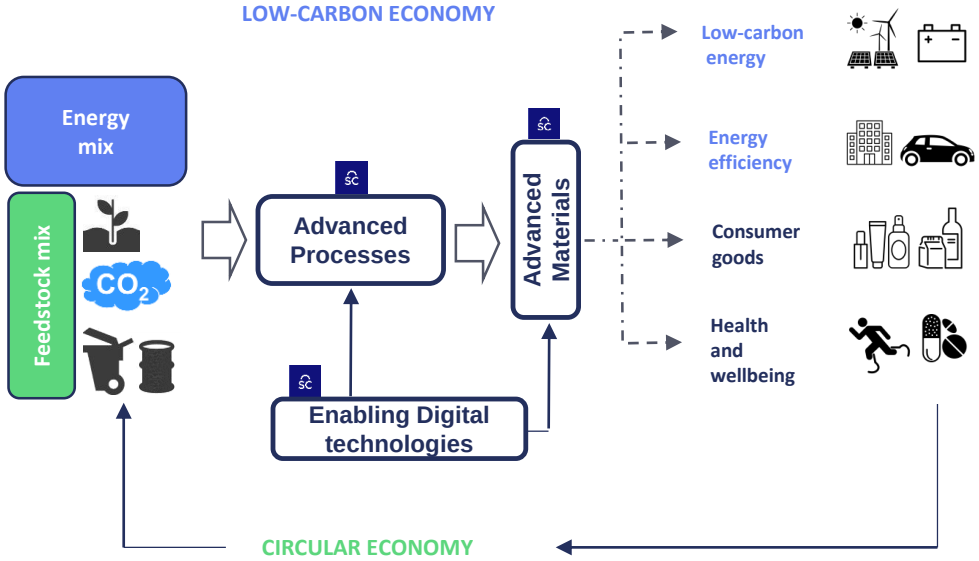
****17 SusChem NTPs (National Technology Platforms), including SusChem Bulgaria (since June 2018)*

SusChem& the contribution of Sustainable Chemistry

Innovation Ecosystem – Sustainable Chemistry

- EC consultations
- Technology-focused working groups (white papers)
- **SIRA development (advisory role on technology priorities/ EU funding)**
- Visionary projects (e.g. F^3 factory)
- Brokerage events (EU projects consortia, fostering other collaborative initiatives)
- Stakeholder events (public consultation & connecting stakeholders)
- SusChem NTPs network (supporting on all of the above)

SusChem& the contribution of Sustainable Chemistry – SusChem KETs



SusChem ETP – a holistic view on:
Sustainable Chemistry & Industrial Biotech)

New SusChem SIRA (launch date: 27.11.2019): Innovation priorities for societal challenges (links w SDGs and Horizon Europe)

The starting point

Current SusChem SIRA: Innovation priorities for societal challenges (links w H2020)

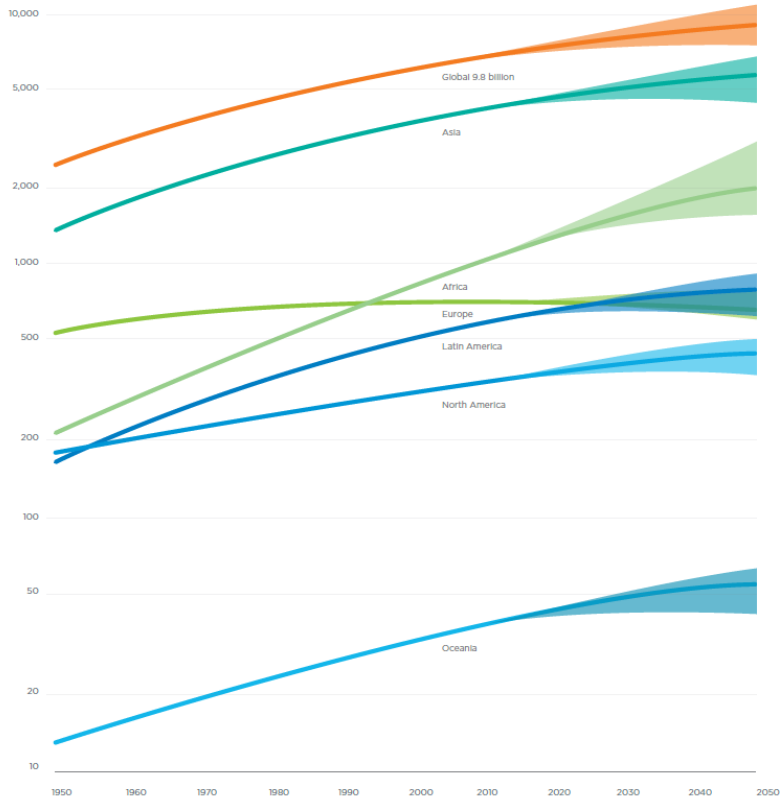
New SusChem SIRA

Technologies for A Better Future of Europe

**extract from confidential SIRA draft to be launched on 27.11.2019*

Megatrends – innovation in a rapidly changing environment

Source: UN 2015



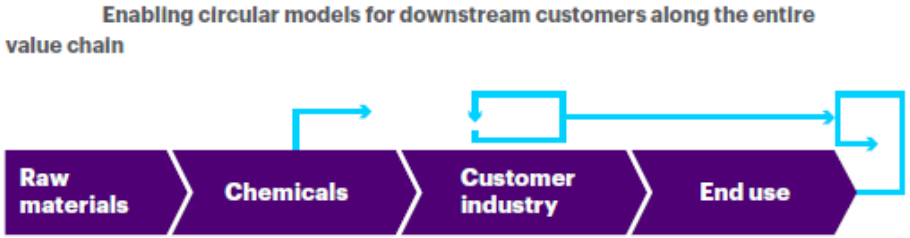
- Global rising population & economic growth
- Increasing volume of chemicals and chemical-intensive products*
- Enhanced need to ensure the sustainable use of natural resources but also the safety and overall sustainability of chemicals, materials, products and markets, especially under the global transition to circular economy.

**2050 forecast: global chemical industry production to triple by mid-century*
IEA World Energy Outlook 2018

Graphic Source: Molecule managers, June 2018 , Cefic

Innovation in a rapidly changing environment - Transitioning to a more circular economy

- ENABLING EUROPE'S LARGER CIRCULAR ECONOMY: The chemical industry produces essential products and technology solutions **for the chemical sector and from the chemical sector** to enable circular models for downstream customers along the entire value chain.



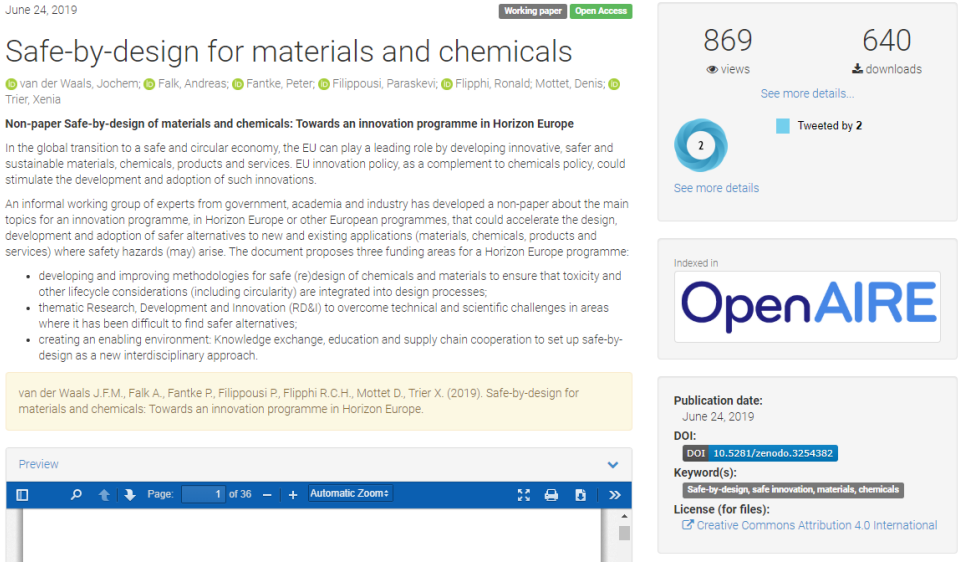
Source: Accenture; Taking the European Chemical Industry, into the circular economy

- Value chain links between the chemical industry and energy intensive industries.

Safe-by-design for chemicals and materials – need for clear objectives

Key starting point for SusChem (re: safe by design innovation priorities):

van der Waals J.F.M., Falk A., Fantke P., Filippousi P., Flipphi R.C.H., Mottet D., Trier X. (2019). Safe-by-design for materials and chemicals: Towards an innovation programme in Horizon Europe.



June 24, 2019

Working paper | Open Access

Safe-by-design for materials and chemicals

van der Waals, Jochem; Falk, Andreas; Fantke, Peter; Filippousi, Paraskevi; Flipphi, Ronald; Mottet, Denis; Trier, Xenia

Non-paper Safe-by-design of materials and chemicals: Towards an innovation programme in Horizon Europe

In the global transition to a safe and circular economy, the EU can play a leading role by developing innovative, safer and sustainable materials, chemicals, products and services. EU innovation policy, as a complement to chemicals policy, could stimulate the development and adoption of such innovations.

An informal working group of experts from government, academia and industry has developed a non-paper about the main topics for an innovation programme, in Horizon Europe or other European programmes, that could accelerate the design, development and adoption of safer alternatives to new and existing applications (materials, chemicals, products and services) where safety hazards (may) arise. The document proposes three funding areas for a Horizon Europe programme:

- developing and improving methodologies for safe (re)design of chemicals and materials to ensure that toxicity and other lifecycle considerations (including circularity) are integrated into design processes;
- thematic Research, Development and Innovation (RD&I) to overcome technical and scientific challenges in areas where it has been difficult to find safer alternatives;
- creating an enabling environment: Knowledge exchange, education and supply chain cooperation to set up safe-by-design as a new interdisciplinary approach.

van der Waals J.F.M., Falk A., Fantke P., Filippousi P., Flipphi R.C.H., Mottet D., Trier X. (2019). Safe-by-design for materials and chemicals: Towards an innovation programme in Horizon Europe.

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Safe-by-design, safe innovation, materials, chemicals

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‘Safe-by-design’ for chemicals and materials – setting objectives

A functional approach for safe-by-design

- ❑ Beyond drop-in replacements and towards ‘safe-by-design’
- ❑ Innovate from molecular level to higher levels: materials, products, processes and business models

Minimizing toxicity and combine with overall sustainability improvements (full lifecycle perspective)

- ❑ Minimize toxicity *(including persistency, bio-accumulation, and products of incomplete degradation/mineralization)*
- ❑ Safety broader than chemical toxicity, including microbiological safety and biosafety, when expanding to biotech
- ❑ Full life cycle perspective – consideration of combining with overall sustainability improvements

Innovation as a multidisciplinary approach

- ❑ Systemic thinking
- ❑ Multi-disciplinary approach: e.g. chemistry, biology, toxicology, sustainability assessment, product, materials and process design
- ❑ Extending to the integration of enabling digital technologies (from materials/process design to transparency in value chains)

An integrated and collaborative network

- ❑ Cross-value chain collaborations and communication: from chemicals and materials producers, to brand owners and end-users.
- ❑ Contribution of the full innovation ecosystem
- ❑ Knowledge sharing across sectors

‘Safe-by-design’ concept: an innovation opportunity

- ‘safe-by-design’ in line with Sustainable Chemistry
- An **innovation opportunity** (e.g. materials and process levels)
- An opportunity for the EU to take the lead in circular economy transition by developing innovative, safe and sustainable materials, chemicals, products and services for new or existing applications.

‘Safe-by-design’: Addressing RD& I and further enabling actions

- **Thematic research, development and innovation** driven by **functionality** relevant to**: materials, formulations and industrial processes;**

- **Methodological development or improvement** for any (re)design of chemicals and materials (integration of circularity);

- **Creating an enabling environment: knowledge development, networks formation and education** (focused RD& I actions and embedding ‘safe-by-design’ in a wider strategy).

Addressing thematic RD& I – functional approach

Innovating on material structures, product and process improvements can be given more emphasis.

Example focus areas:

Materials

- Water, Grease and dirt repellence
- Fire safety
- Plasticizing

Processes

- Process functions provided by solvents
- Process regulation
- Surface protection

Formulations

- Preservation
- Functions provided by surfactants

Example
Addressing thematic RD& I – Materials functional approach

MATERIALS	
WATER, GREASE AND DIRT REPELLENCE	• New materials design approaches to achieve inherent repellence performance. • Innovative repellent materials, using alternative chemicals with positive scores on safety and ability to mineralise.
FIRE SAFETY	• Innovative materials with inherently flame-resistant function. • Materials design to reduce additive exposure/leaching to the environment (intermediate solution).
PLASTICIZING	• Innovative materials with the same functionality (flexibility, durability) in the absence of hazardous additives (in final product and production process). • Novel, safe and sustainable material/alternative chemical combinations with plasticizing functions.

**extract from confidential SIRA draft to be launched on 27.11.2019*

Methodological development or improvement ('safe-by-design')

CRITERIA AND TARGETS	• Harmonized and validated criteria and science-based targets for safety and broader sustainability for the full life cycle of chemical/material/product/service, also addressing circularity. • Criteria, targets and methods applicability early in the (re)design process of chemicals and materials, ensuring consistency in evaluation and early stage prioritization.
EFFICIENT 'PREVENTIVE' TOXICOLOGY AND LIFE CYCLE TOOLS	• Efficient/flexible digital tools for integrating knowledge of toxicity into early design to evaluate safety impact ('Preventive' vs. 'predictive' toxicology). • Allow for more complex assessment via multiparametric toxicity but also LCA models (integration of risk assessment, LCA methodologies and circular design).
ACCESSIBLE DATA	• Make data available for designers [criteria for Findable, Accessible, Interoperable and Reusable (FAIR) data, open access databases)]. • Development of transparent, efficient and reliable methods to allow information transfer along supply chains (data sharing platforms).
STANDARDIZATION	• Involve standardization bodies to ensure optimum use of standards and development of new standards (data, methods, tools).

**extract from confidential SIRA draft to be launched on 27.11.2019*

Creating an enabling environment for ‘safe-by-design’

KNOWLEDGE DEVELOPMENT, NETWORKS AND EDUCATION	• Landscape analysis of existing disciplines, networks and organizations. • Network building as objective or condition in funded projects. • Higher education, workshops, challenges and competitions, bootcamps, educational networks as start of a process of internalizing safe-by-design in education and skills development.
SUPPLY CHAIN COOPERATION AND COORDINATION	• Scoping phase with stakeholders before technical research to: 1) analyse context of the innovation (potential barriers); 2) identify user needs and performance criteria; 3) identify appropriate levels of research (materials, processes, products, chemicals). • Data and knowledge sharing platforms across value chains and different sectors.

**extract from confidential SIRA draft to be launched on 27.11.2019*

An invitation

Link: http://www.suschem.org/events/suschem-stakeholders-event-2019

SUSCHEM
European Technology Platform
for Sustainable Chemistry

Thank you

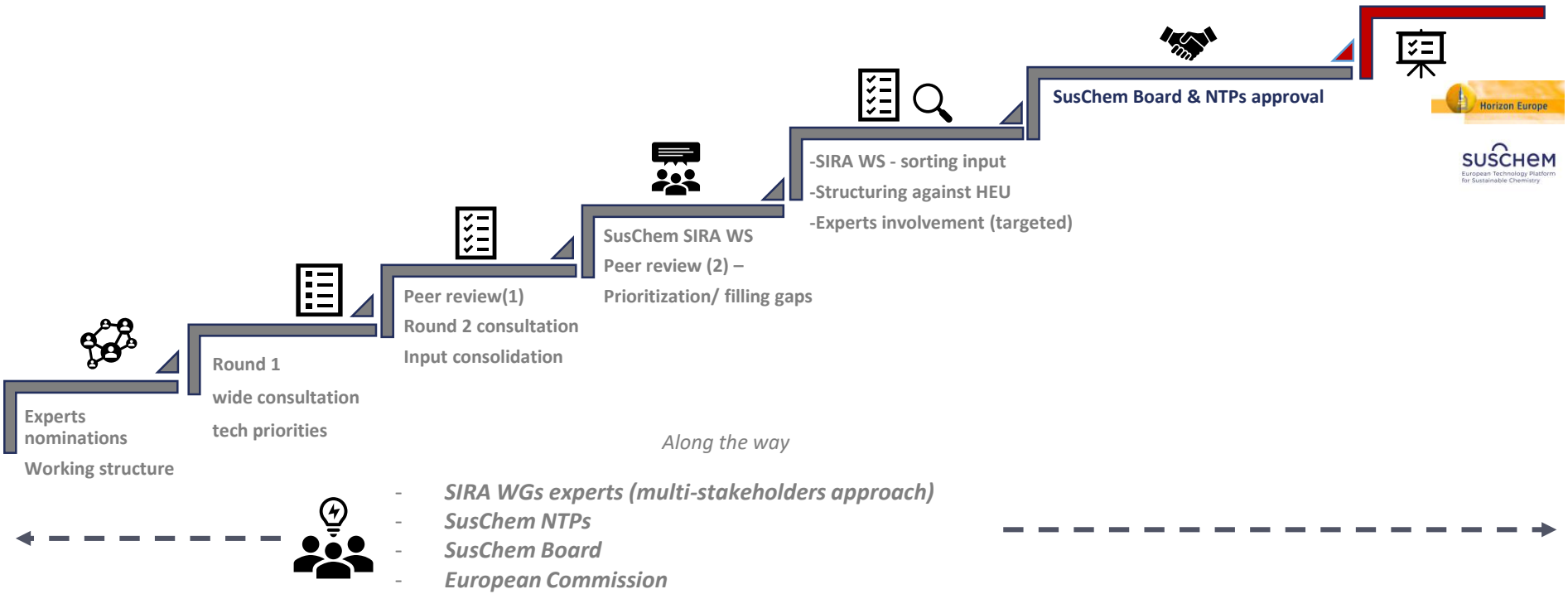
contact: vfi@cefic.be

Back-up slides

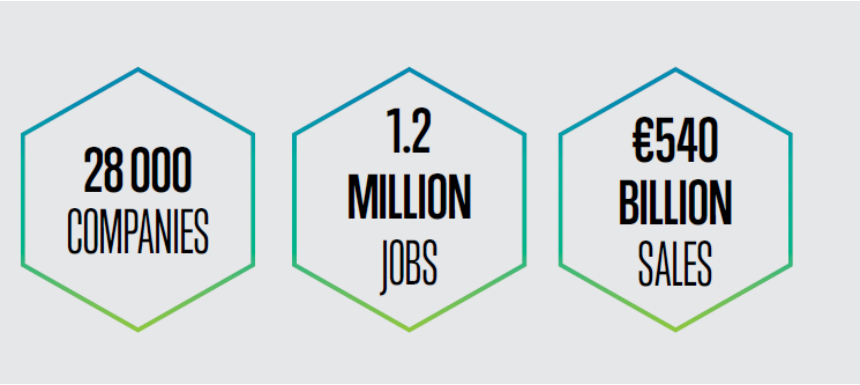
New SusChem Strategic Innovation agenda (SIRA) – HEU

SusChem priority for 2019

SusChem Stakeholders 2019
November 27, 2019
New SusChem SIRA communication



The chemical sector



Graphic Source: Molecule managers, June 2018 , Cefic

Back up – SusChem SIRA

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MATERIALS	
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FIRE SAFETY	• Innovative materials with inherently flame-resistant function. • Materials design to reduce additive exposure/leaching to the environment (intermediate solution).
PLASTICIZING	• Innovative materials with the same functionality (flexibility, durability) in the absence of hazardous additives (in final product and production process). • Novel, safe and sustainable material/alternative chemical combinations with plasticizing functions.
FORMULATIONS	
PRESERVATION	• Preservation systems based on alternative mechanisms (*e.g. combination of physical & chemical treatment*), maintaining shelf life and biosafety. • Mechanisms of antimicrobial activity with new chemical-material combinations (raw materials combinations/ synergistic effects and design approaches) with an increased specificity for target organisms.
FUNCTIONS PROVIDED BY SURFACTANTS	• Sustainable production of alternative surfactants, combining safety and life cycle sustainability performance, accounting for the feedstock impact and especially further considering biodegradability according to standards. • Rational formulation (re)design, understanding the behavior of new/alternative surfactants in complex mixtures/formulations and their implications on the product performance and the production scaling up.
PROCESSES	
PROCESS FUNCTIONS PROVIDED BY SOLVENTS	• Innovative materials (*e.g. biomimicry and stimuli-responsive materials*) with reduced surface treatment requirements. This option brings challenges to overcome beyond material performance, extending to effects on process flexibility whereas the impact on material circularity must be considered. • Process innovation to avoid and reduce the volumes of hazardous solvents in production. This could include process intensification or completely novel processing routes. • Alternative formulations/chemicals for process solvents (e.g. bio-based alternatives) upon thorough screening of their respective sustainability and safety profile.
PROCESS REGULATION	• Relevance to chemical curing: inherently strong and versatile polymers - innovative foams and resins, tackling cost and scalability challenges.
SURFACE PROTECTION	• Alternative materials (e.g. polymer engineering, nanotopography) that are inherently resistant to corrosion or fouling. • Development of new techniques for surface treatment (e.g. metal surface treatment processes alternatives (e.g., vapor deposition. ultrasonic or UV techniques).

*Additional functionalities for consideration: **Materials**: UV-stabilisation and anti-oxidants; **Formulations**: stabilisation, colorants, mechanical abrasives and include solid mixtures/ formulations; **Processes**: preservation for process fluids, additives and fuels.

** **Relevance to Materials and formulations design:** Microplastics could refer to the undesired release and accumulation of particles into the environment. Hereby, the release might be a consequence of intentionally added microplastics or resulting from use during the product lifecycle (use phase and end-of-life) (i.e. wear and degradation).