SUSCHEM
European Technology Platform
for Sustainable Chemistry

Stakeholder Event 2023

—

Advanced Materials & Safe and Sustainable-by-Design Framework: Lighthouse matters for the future of European Research and Innovation

suschem.org

Opening and welcome

Eva SCHILLINGER, *SusChem Manager/ NTPs Coordinator*

COMPETITION LAW

CHECKLIST FOR MEETINGS

DO

Ensure strict performance in areas of:

Oversight / Supervision

- Have a Cefic/Sector Group Secretariat representative at each meeting
- Consult with appropriate counsel on all questions related to competition law;
- Limit meeting discussions to agenda topics;
- Provide each attendee with a copy of this checklist and have a copy available for reference at all meetings.

Recordkeeping

- Have an agenda and minutes which accurately reflect the matters which occur;
- Ensure the review of agendas, minutes and other important documents by appropriate staff or counsel, in advance of distribution;
- Fully describe the purposes, structures and authorities of the groups.

Vigilance

- Protest any discussion or meeting activities which appear to violate this checklist; ask for those activities to be stopped so that appropriate legal check can be made by counsel; dissociate yourself from any such discussion or activities and for the attendees, leave any meeting in which they continue (and have it minuted).

This checklist is for the conduct of Cefic-sponsored meetings. Prohibited discussion topics apply equally to social gatherings incidental to those meetings. The checklist is not exhaustive.

In case of doubt, contact Quentin Silvestre, Senior Legal Advisor at qsi@cefic.be

DON'T

Do not, in fact or appearance, discuss or exchange information not in conformity with competition law, including for example on:

Prices, including

- Individual company/industry prices changes, price differentials, discounts, allowances, credit terms, etc;
- Individual company data on costs, production, capacity (other than nameplates capacities), inventories, sales, etc.

Production, including

- Plans of individual companies concerning the design, production, distribution or marketing of particular products, including proposed territories or customers
- Changes in industry production capacity (other than nameplates capacities) or inventories, etc.

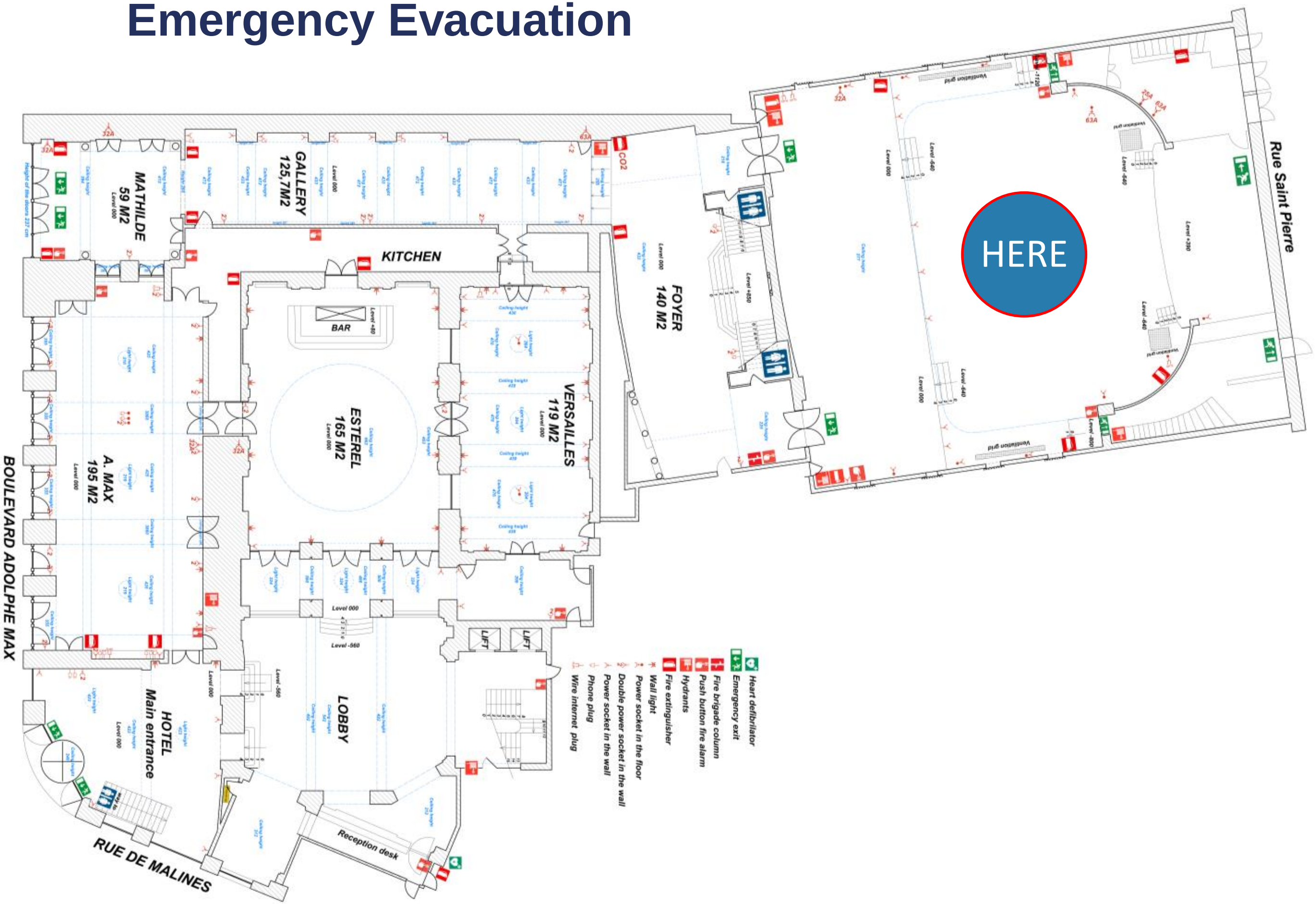
Transportation rates

- Rates or rate policies for individual shipments, including basing point systems, zone prices, freight, etc.

Market procedures, including

- Company bids on contracts for particular products; company procedures for responding to bid invitations;
- Matters relating to actual or potential individual suppliers or customers that might have the effect of excluding them from any market or influencing the business conduct of firms towards them, etc;
- Blacklist or boycott customers or suppliers.

Emergency Evacuation



Agenda - Morning

09:30 - 9:40	**Opening and welcome** ***E. Schillinger**, SusChem Manager/ NTPs Coordinator*
09:40 - 10:00	**Opening by SusChem Chairman** ***J.R. Wünsch**, Senior Vice President at BASF SE*
10:00 - 10:30	**The Transition Pathway for the Chemical Industry** ***Hans Ingels**, Head of Unit for Bioeconomy, Chemicals and Cosmetics – European Commission - DG for Internal Market, Industry, Entrepreneurship and SMEs (DG GROW)*
10:30 - 10:45	*Coffee break*

10:45 - 12:30

Safe and Sustainable-by-Design (SSbD)/ IRISS block

IRISS is the International ecosystem for accelerating the transition to Safe-and-Sustainable-by-Design materials, products and processes

- 10:45-11:05 Introduction to Sustainability assessment frameworks and to the European Partnership for the Assessment of Risks from Chemicals (PARC)
  ***Lya Hernandez**, Senior scientific advisor RIVM*
- 11:05-11:25 Overview of the IRISS project – strategic perspective
  ***Emma Strömberg**, Senior researcher polymeric materials and IRISS project coordinator, IVL*
- 11:25-11:45 SusChem NTP activities within IRISS
  ***Barbara Tišler**, SusChem Slovenia;*
  ***Stelios Bikos**, SusChem Greece;*
  ***Reinier Grimbergen**, SusChem Netherlands*
- 11:45-12.30: Panel discussion on the implementation of the SSbD framework
  ***Sofie Nørager**, Deputy Head of Unit European Commission Directorate-General for Research and Innovation - Prosperity – Industrial Transformation*
  ***Irantzu Garmendia Aguirre**, Project Officer, European Commission Joint Research Centre*
  ***Lya Hernandez**, RIVM*
  ***Barbara Tišler**, SusChem Slovenia*
  ***Emma Strömberg**, IVL*
  *Moderator: **Eva Schillinger**, SusChem*

12:30 - 13:30	*Lunch* ***SusChem National Technology Platforms (NTPs) stand area opening***
13:30 - 14:00	**NTP stands and networking**

Agenda - Afternoon

14:00 - 14:30	**Keynote: Feedstock needs to achieve climate neutrality** *Michael Carus, nova-Institut*
14:30 - 15:20	**Two parallel breakout sessions:** ○ AMI2030: Delivering on the Materials Manifesto – what is needed to (re-)gain EU Advanced Materials technology leadership? *Moderator: Philippe Jacques, EMIRI/AMI2030, SusChem Board Member* ○ Implementation of the SSbD framework: needs, challenges, opportunities for the SusChem community *Moderator: Thomas Görgen, Covestro, SusChem Board Member*
15:20 - 15:50	*Coffee break*
15:50 - 16:20	**Summary parallel sessions** *Philippe Jacques, EMIRI/AMI2030* *Thomas Görgen, Covestro*
16:20 - 17:15	**Panel discussion on Advanced Materials** "Which challenges do advanced materials need to overcome to deliver on the Green Deal targets and EU strategic autonomy?" ***Jürgen Tiedje**, Head of Unit European Commission Directorate-General for Research and Innovation - Prosperity - Industrial Transformation* ***Nicolas Cudré-Mauroux**, Chief Technology Officer Solvay* ***Katja Loos**, Professor for Polymer Science and Applied Chemistry Rijksuniversiteit Groningen* ***Fabian Weinhandl**, Head of GreenTech solutions at BDI* ***Paul Cordfunke**, Senior Consultant Lux Research* *Moderator: **Eva Schillinger**, SusChem*
17:15 - 17:30	**Closing remarks** ***J.R. Wünsch**, Senior Vice President at BASF SE*
17:30 – 18:30	**Networking & cocktails**

SusChem
European Technology Platform for Sustainable Chemistry

Opening by SusChem Chairman

—

Josef WÜNSCH, Senior Vice President at BASF SE

SUSCHEM
European Technology Platform
for Sustainable Chemistry

Keynote speech from the European Commission on the Transition Pathway for the Chemical Industry

Hans INGELS, Head of Unit for Bioeconomy, Chemicals and Cosmetics – European Commission - DG for Internal Market, Industry, Entrepreneurship and SMEs (DG GROW)

Transition Pathway for the Chemical Industry

SusChem Stakeholder Event

21st February 2023, La Plaza Hotel - Brussels

European Commission

1. Background

The 2021 updated Industrial Strategy

COM(2021) 350 final

- To co-create, in partnership with industry, public authorities, social partners and other stakeholders, **transition pathways** for ecosystems, where needed.
- Pathways offer a better bottom-up understanding of the **scale**, **cost, long-term benefits and conditions** of the required action to accompany the **twin transition** for the most relevant ecosystems, leading to an actionable plan in favour of sustainable competitiveness.
- **Priority to** tourism and energy-intensive industries (incl. **chemicals** and steel).

European Commission

The changing landscape for the EU chemical industry (1)

Global market share
- *Decreasing pattern (2030 forecast)*

Energy prices
- *Increasing, unstable*

Geopolitics
- *Russian war of aggression against Ukraine;*
- *China zero-Covid policy;*

Technology
- *Alternative feedstock*
- *Digitalisation*

European Commission

The changing landscape for the EU chemical industry (2)

Climate

Green Deal, European Climate Law, Landfill Directive, Packaging and Packaging Waste Directive, Waste Framework Directive, Sustainable Carbon Cycle, Sustainable Product Initiative, ETS

Energy

REPowerEU
Renewable Energy Directive
Industrial Emission Directive

Chemicals Strategy for Sustainability

Restriction Roadmap
Safe and Sustainable by Design
Toxic-free environment

Resilience

Update of the Industrial Strategy
Due Diligence in the Supply Chain
Advanced Materials manifesto and the critical raw material strategy

Digitalization

Digitalisation of Chemical Production
Data sharing
Product Passport

2. The outcome

The transition pathway for the Chemical Industry

- Publication: 27 January 2023
- Actionable plan co-developed by the European Commission with EU Member States, industry, NGOs and other stakeholders
- Based on 8 building blocks developed by Industrial Forum

Sustainable competitiveness
Investment and funding
Research and Innovation
Regulation and Public Governance
Access to energy and feedstock
Infrastructure
Skills
Social dimension

- It identifies about 190 actions needed for the twin transition and increased resilience

European Commission

Building Blocks	Topics
1. Sustainable Competitiveness	Topic 1: International competitiveness
	Topic 2: Reduction of unsustainable dependencies and supply chains vulnerabilities
	Topic 3: Safety and Sustainability
	Topic 4: Innovation and growth of SMEs
	Topic 5: New synergies
2. Investments and Funding	Topic 6: Fund for Green Investments
	Topic 7: Access to Funding
3. R&I, Techniques and Technological Solutions	Topic 8: Better conceptualisation of new techniques and technical solutions (TRL 1 to 5)
	Topic 9: Developing new techniques and technological solutions (TRL 6 to 7)
	Topic 10: Deployment of new techniques and technological solutions (TRL 8 to 9)
4. Regulation and Public Governance (Legislation)	Topic 11: More effective and predictable regulation
	Topic 12: Vertically and horizontally coherent legislation
	Topic 13: Effective and efficient enforcement
5. Access to energy and feedstock	Topic 14: Anticipate long-term needs for Energy and Resource Supply
	Topic 15: Economically viable purchase of clean energy
	Topic 16: Feedstock Substitution
	Topic 17: Process and resource efficiency
6. Infrastructure	Topic 18: Large-scale electricity and hydrogen infrastructure
	Topic 19: Development of new sustainable production facilities
	Topic 20: Sustainable transport of raw materials and chemical products
	Topic 21: Deployment of digital technologies
	Topic 22: Circularity: recycling and reuse infrastructure
7. Skills	Topic 23: Education (reskilling/upskilling the workforce)
	Topic 24: Sufficient supply of jobs at technical level
8. Social Dimension	Topic 25: Impact on workforce and consumers
	Topic 26: Improve gender diversity and equality in the sector

Example: sustainable competitiveness

- **Relevance for EU economy**:
  - ✓ EU chemical industry 4th largest industry in Europe (€499 bln sales in 2020);
  - ✓ However, its global market share is declining and forecasted to decline;
  - ✓ Therefore, need to ensure industry's continued competitiveness becoming more sustainable.

- **What should the industry do?** (some examples)

Topic 1: International competitiveness

- ➢ Drive international competitiveness
  - Analyse medium to long-term impacts of energy crisis on sustainable competitiveness
  - KPIs and Sustainable Development indicators
- ➢ Promote the market for sustainable products
  - SSbD framework
  - 'market pull' and incentives: sustainable products with higher costs

Topic 5: New synergies

- ➢ Facilitate the exchange of information
  - Euroclusters initiative
- ➢ Increase collaboration to de-risk investments
  - cross-border projects on the generation and supply of energy and feedstock
- ➢ Partnerships for innovation
  - Ensure shared access to the research and technology infrastructures as part of the European Research Area
  - joint cross-sectoral projects that qualify IPCEIs

Topic 2: Reduction of unsustainable dependencies and supply-chain vulnerabilities

- ➢ Gather supply-chain information
  - Undertake a strategic foresight exercise focusing on the EU open strategic autonomy (link with critical raw materials)
  - Assess the need to build up and maintain strategic stocks of critical raw materials within the EU

The outcome: a roadmap for the transition

1. **An action-oriented component** grouping the topics under three cross-cutting themes: collaboration for innovation; clean energy supply; and feedstock diversification.

2. **A technology component** identifying electrification, hydrogen, biomass, waste, Carbon Capture and Utilization (CCU) & Carbon Capture and Storage (CCS), as well as process efficiency as key technological contributors to the transition pathway.

3. **A regulatory component** that collects the existing legislation, including major research and innovation (R&I) initiatives, influencing digital and sustainable development of the chemical industry.

European Commission

Action-oriented roadmap (1)

SUSTAINABLE COMPETITIVENESS
ACCESS TO ENERGY AND FEEDSTOCK
INVESTMENTS AND FUNDINGS
INFRASTRUCTURE
(SUPPORT TO) R&I, TECHNIQUES AND TECHNOLOGICAL SOLUTIONS
SKILLS
REGULATION AND PUBLIC GOVERNANCE (LEGISLATION)
SOCIAL DIMENSION

SHORT-TERM | MEDIUM-TERM | LONG-TERM

COLLABORATION FOR INNOVATION

- 2.1. Gather Supply Chain Information
- 2.2. Increase collaboration within sub-sectors
- 2.3 Make the most of existing international partnerships, including FTAs
- 3.2 Improve collaboration in value chains
- 4.3. Strengthen initiatives with SMEs under the European Innovation Council (EIC)
- 5.1. Facilitate exchange of information
- 5.2. Increase collaboration to de-risk investments
- 5.3. Support the development of partnerships for innovation
- 6.2. Develop hub structures
- 7.2. Provide a coordinated platform for funding
- 9.1. Foster collaboration and partnerships (R&I)
- 20.1. Increase the availability and capacity of multi-modal terminals that are close to industrial clusters
- 21.2. Deploy technologies to improve chemical manufacturing processes and data gathering
- 22.2. Improve the management of logistics for waste feedstock
- 25.1. Regional cohesion

Action-oriented roadmap (2)

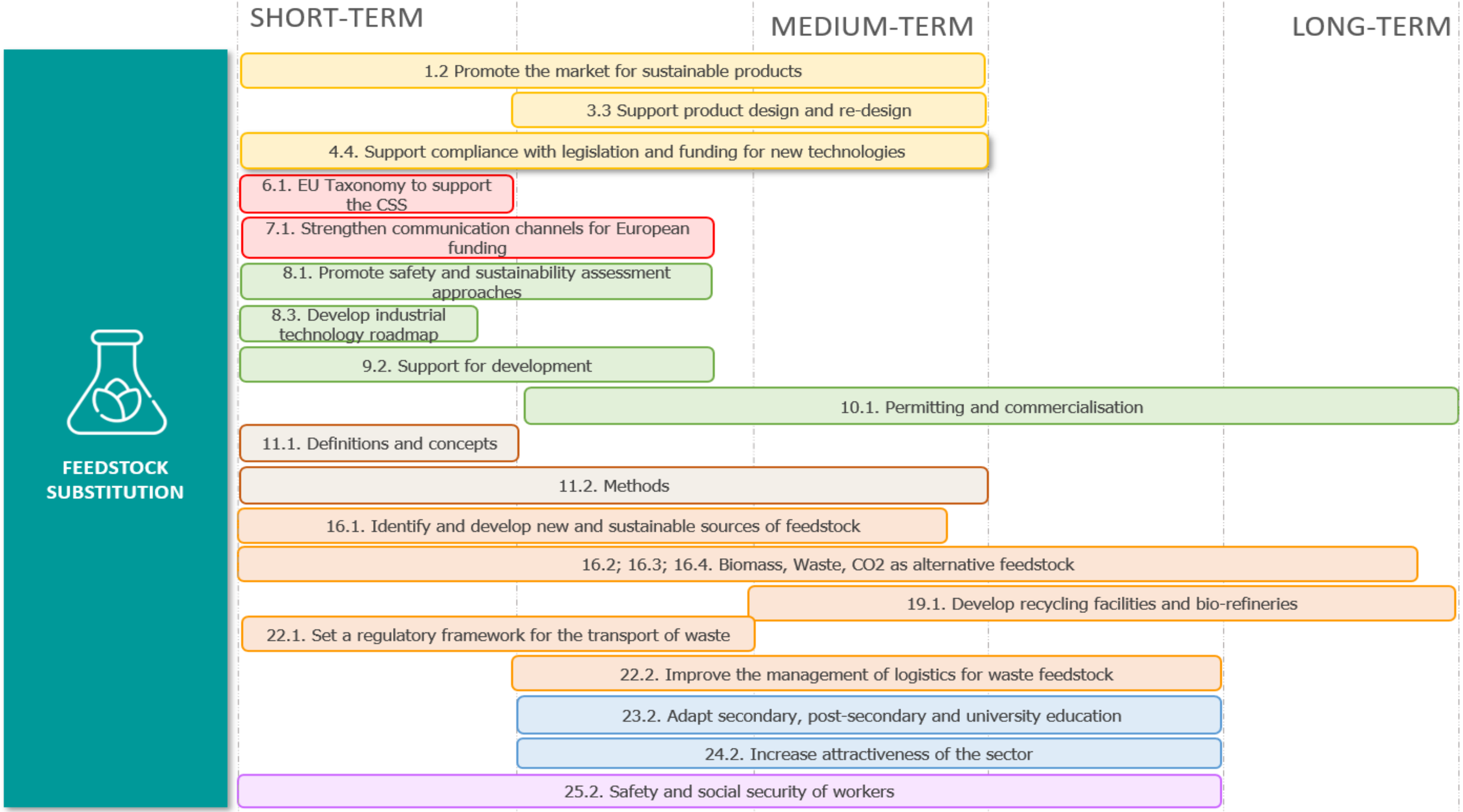
SUSTAINABLE COMPETITIVENESS
ACCESS TO ENERGY AND FEEDSTOCK
INVESTMENTS AND FUNDINGS
INFRASTRUCTURE
(SUPPORT TO) R&I, TECHNIQUES AND TECHNOLOGICAL SOLUTIONS
SKILLS
REGULATION AND PUBLIC GOVERNANCE (LEGISLATION)
SOCIAL DIMENSION

SHORT-TERM | MEDIUM-TERM | LONG-TERM

CLEAN ENERGY SUPPLY

- 2.4. Increase resource efficiency
- 6.3. Manage and convert existing assets
- 10.1. Permitting and commercialisation
- 14.1. Anticipate long-term needs for the supply of energy and feedstock resource
- 15.2. Ensure the competitive supply of clean energy
- 15.3. Improve Power-Purchase Agreements
- 18.1. Enable free flow of energy between countries
- 18.2. Develop a separate hydrogen infrastructure at EU level
- 19.2. Accelerate and improve permitting
- 20.1. Increase the availability and capacity of multi-modal terminals that are close to industrial clusters
- 20.2. Improve use of rail transport
- 23.1 Develop skills with a sustainability focus

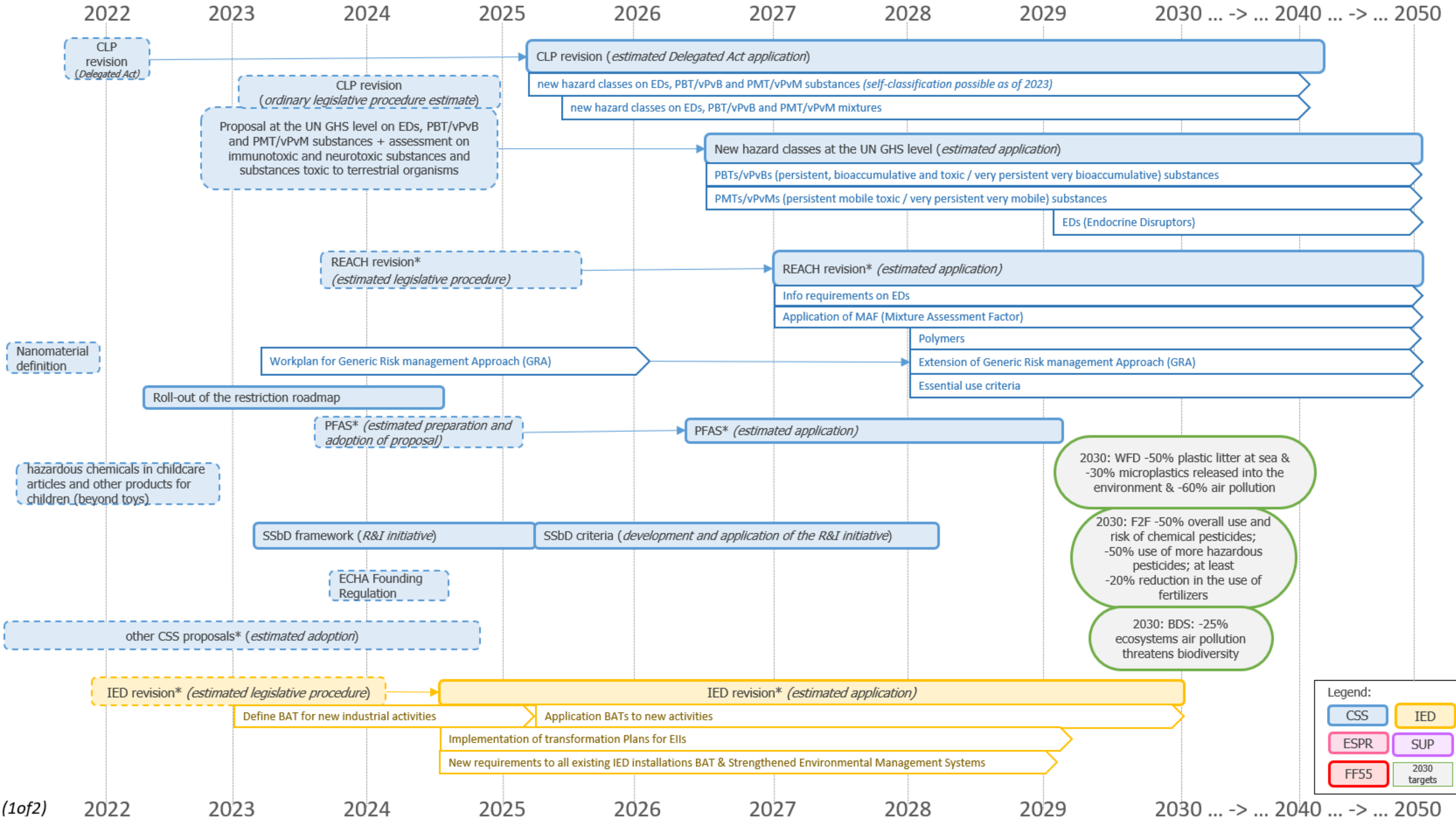
Action-oriented roadmap (3)

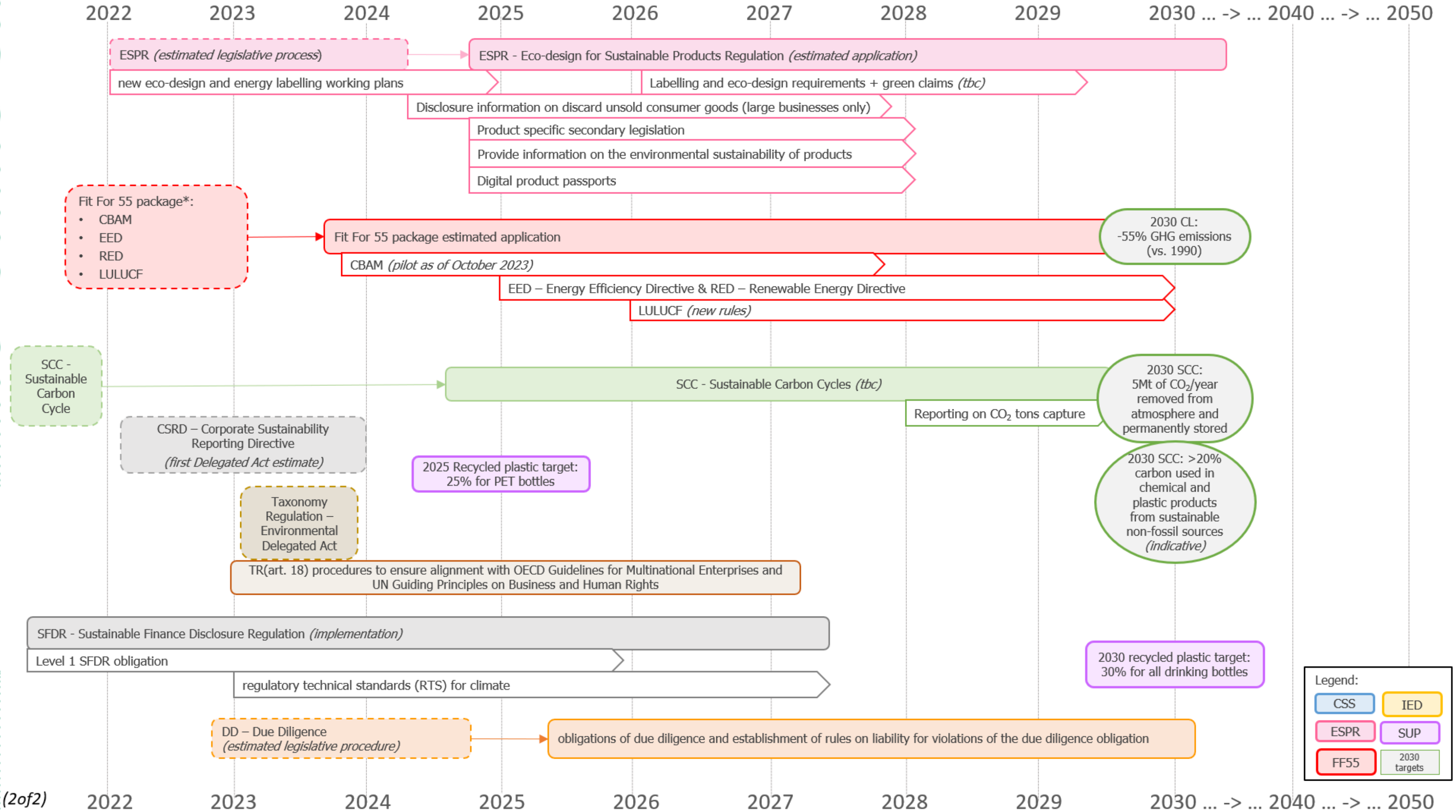


Technology roadmap

EU Initiatives supporting Technological Transition *(SET Action Plan)*	Actions *(as presented in Building Blocks – Part II)*	EU Initiatives
A) ELECTRIFICATION	6.2. Develop hub structures 8.3. Development of an industrial technology roadmap 14. Anticipate l-t needs for the supply of energy and feedstock resource 15.1. Channel investments for clean energy 15.2. Ensure competitive supply of clean energy 15.3. Improve Power-Purchase Agreements 18.1 Enable the free flow of energy between countries 20.1. Increase availability and capacity of multi-modal terminals close to industrial clusters 20.2. Improve use of rail transport	• REPowerEU • EU Renewable Directive • TEN-E Regulation • Proposal for a directive on Energy Efficiency
B) HYDROGEN	6.2. Develop hub structures 6.3. Manage and convert existing assets 15.1. Channel investments for clean energy 15.2. Ensure the competitive supply of clean energy 18.2. Develop a separate hydrogen infrastructure at EU level	• European Clean Hydrogen Alliance • Hydrogen and decarbonised gas market package
C) BIOMASS	4.3. Strengthen initiatives with SMEs under the EIC 8.1. Promote safety and sustainability assessment approaches 9.1. Foster collaboration and partnerships 16.2. Biomass as an alternative feedstock 19.1. Develop recycling facilities and bio-refineries (and exploit synergies with the chemical industry)	• Revision of the Renewable Energy Directive • INCITE (Industrial Emissions Directive)
D) WASTE	3.2 Improve collaboration in value chains 3.3 Support product design and re-design 8.1. Promote safety and sustainability assessment approaches 11.1. Definitions and concepts 11.2. Methods 16.3. Waste as an alternative feedstock 22.1. Set a regulatory framework for the transport of waste 22.2. Improve the management of logistics for waste feedstock	• Hubs4Circularity • Waste Framework Directive • Landfill Directive
E) CCU & CCS	6.3. Manage and convert existing assets 9.2. Support for development 16.4. CO_2 as an alternative feedstock 22.2. Improve the management of logistics for waste feedstock	• Hubs4Circularity • Sustainable Carbon Cycle
F) PROCESS EFFICIENCY	3.2 Improve collaboration in value chains 3.3 Support product design and re-design 5.1. Facilitate exchange of information (new synergies) 5.3. Support the development of Partnerships for Innovation 6.3. Manage and convert existing assets 17. Process efficiency 19.1. Develop recycling facilities and bio-refineries (and exploit synergies with the chemical industry) 20.1. Increase the availability and capacity of multi-modal terminals that are close to industrial clusters 21.2. Deploy technologies to improve chemical manufacturing processes and data gathering 25.2. Safety and social security of workers	• REPowerEU • Industrial Symbiosis • Revision of the Industrial Emission Directive

European Commission


2022
2023
2024
2025
2026
2027
2028
2029
2030 ... -> ... 2040 ... -> ... 2050
CLP revision (Delegated Act)
CLP revision (*estimated Delegated Act application*)
new hazard classes on EDs, PBT/vPvB and PMT/vPvM substances (*self-classification possible as of 2023*)
new hazard classes on EDs, PBT/vPvB and PMT/vPvM mixtures
CLP revision (*ordinary legislative procedure estimate*)
Proposal at the UN GHS level on EDs, PBT/vPvB and PMT/vPvM substances + assessment on immunotoxic and neurotoxic substances and substances toxic to terrestrial organisms
New hazard classes at the UN GHS level (*estimated application*)
PBTs/vPvBs (persistent, bioaccumulative and toxic / very persistent very bioaccumulative) substances
PMTs/vPvMs (persistent mobile toxic / very persistent very mobile) substances
EDs (Endocrine Disruptors)
REACH revision* (*estimated legislative procedure*)
REACH revision* (*estimated application*)
Info requirements on EDs
Application of MAF (Mixture Assessment Factor)
Polymers
Nanomaterial definition
Workplan for Generic Risk management Approach (GRA)
Extension of Generic Risk management Approach (GRA)
Essential use criteria
Roll-out of the restriction roadmap
PFAS* (*estimated preparation and adoption of proposal*)
PFAS* (*estimated application*)
2030: WFD -50% plastic litter at sea & -30% microplastics released into the environment & -60% air pollution
hazardous chemicals in childcare articles and other products for children (beyond toys)
2030: F2F -50% overall use and risk of chemical pesticides; -50% use of more hazardous pesticides; at least -20% reduction in the use of fertilizers
SSbD framework (*R&I initiative*)
SSbD criteria (*development and application of the R&I initiative*)
ECHA Founding Regulation
2030: BDS: -25% ecosystems air pollution threatens biodiversity
other CSS proposals* (*estimated adoption*)
IED revision* (*estimated legislative procedure*)
IED revision* (*estimated application*)
Define BAT for new industrial activities
Application BATs to new activities
Implementation of transformation Plans for EIIs
New requirements to all existing IED installations BAT & Strengthened Environmental Management Systems
Legend:
CSS
IED
ESPR
SUP
FF55
2030 targets
(1of2)
2022
2023
2024
2025
2026
2027
2028
2029
2030 ... -> ... 2040 ... -> ... 2050


2022
2023
2024
2025
2026
2027
2028
2029
2030 … -> … 2040 … -> … 2050
ESPR *(estimated legislative process)*
ESPR - Eco-design for Sustainable Products Regulation *(estimated application)*
new eco-design and energy labelling working plans
Labelling and eco-design requirements + green claims *(tbc)*
Disclosure information on discard unsold consumer goods (large businesses only)
Product specific secondary legislation
Provide information on the environmental sustainability of products
Digital product passports
Fit For 55 package*:
• CBAM
• EED
• RED
• LULUCF
Fit For 55 package estimated application
2030 CL: -55% GHG emissions (vs. 1990)
CBAM *(pilot as of October 2023)*
EED – Energy Efficiency Directive & RED – Renewable Energy Directive
LULUCF *(new rules)*
SCC - Sustainable Carbon Cycle
SCC - Sustainable Carbon Cycles *(tbc)*
2030 SCC: 5Mt of CO_2/year removed from atmosphere and permanently stored
Reporting on CO_2 tons capture
CSRD – Corporate Sustainability Reporting Directive *(first Delegated Act estimate)*
2025 Recycled plastic target: 25% for PET bottles
2030 SCC: >20% carbon used in chemical and plastic products from sustainable non-fossil sources *(indicative)*
Taxonomy Regulation – Environmental Delegated Act
TR(art. 18) procedures to ensure alignment with OECD Guidelines for Multinational Enterprises and UN Guiding Principles on Business and Human Rights
SFDR - Sustainable Finance Disclosure Regulation *(implementation)*
Level 1 SFDR obligation
regulatory technical standards (RTS) for climate
2030 recycled plastic target: 30% for all drinking bottles
DD – Due Diligence *(estimated legislative procedure)*
obligations of due diligence and establishment of rules on liability for violations of the due diligence obligation
Legend:
CSS
IED
ESPR
SUP
FF55
2030 targets
2022
2023
2024
2025
2026
2027
2028
2029
2030 … -> … 2040 … -> … 2050

(2of2)

3. Co-implementation

Key elements of the Transition Pathway co-implementation process

Calls for pledges

Main objectives

- Encouraging stakeholders to commit to concrete and measurable actions
- Collect data to inform the monitoring and evaluation process

Interaction with stakeholders

Main objectives

- Establishing the governance of the process
- Setting priorities

Monitoring and Evaluation

Main objectives

- Develop KPIs to monitor and assess the actions for the twin transition

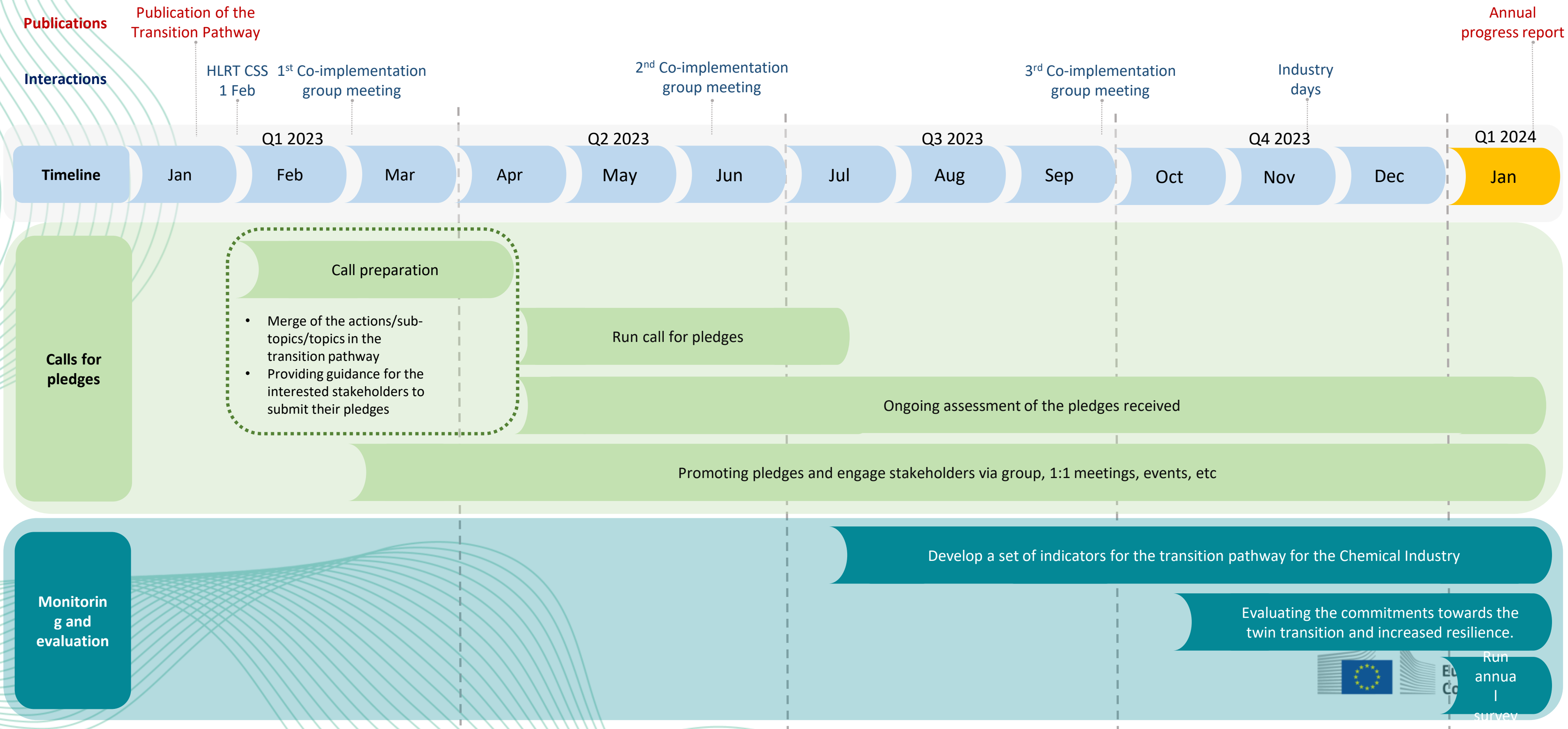
Publications: Annual progress report

Main objectives

- Assessing the status quo of the co-implementation
- Providing evidence on the actions taken and possible synergies among stakeholders

European Commission

Timeline for the co-implementation in 2023



Thank you!

SUSCHEM
European Technology Platform
for Sustainable Chemistry

Safe and Sustainable-by-Design (SSbD)/ IRISS block

IRISS is the International ecosystem for accelerating the transition to Safe-and-Sustainable-by-Design materials, products and processes

SUSCHEM
European Technology Platform for Sustainable Chemistry

Introduction to Sustainability assessment frameworks and to the European Partnership for the Assessment of Risks from Chemicals (PARC)

Lya HERNANDEZ, Senior Scientific Advisor RIVM

SUSCHEM
European Technology Platform
for Sustainable Chemistry

Overview of the IRISS project – strategic perspective

—

Emma STRÖMBERG, Senior researcher polymeric materials and IRISS project coordinator, IVL

suschem.org

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

Emma Strömberg
IVL Swedish Environmental Research Institute

Funded by the European Union

The project receives funding from the European Union's HORIZON EUROPE research and innovation programme under grant agreement n° 101058245

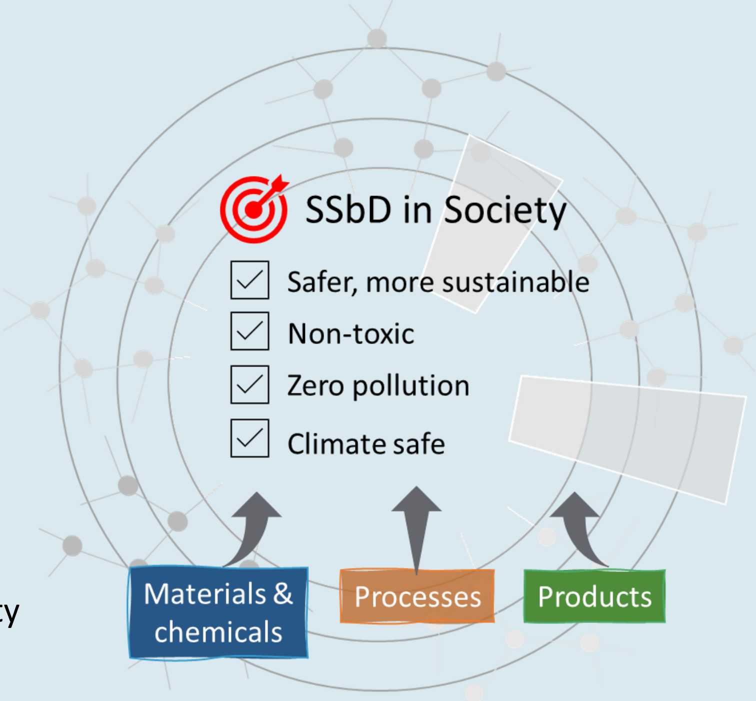
UK participants in Project IRISS are supported by UKRI grant 10038816

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

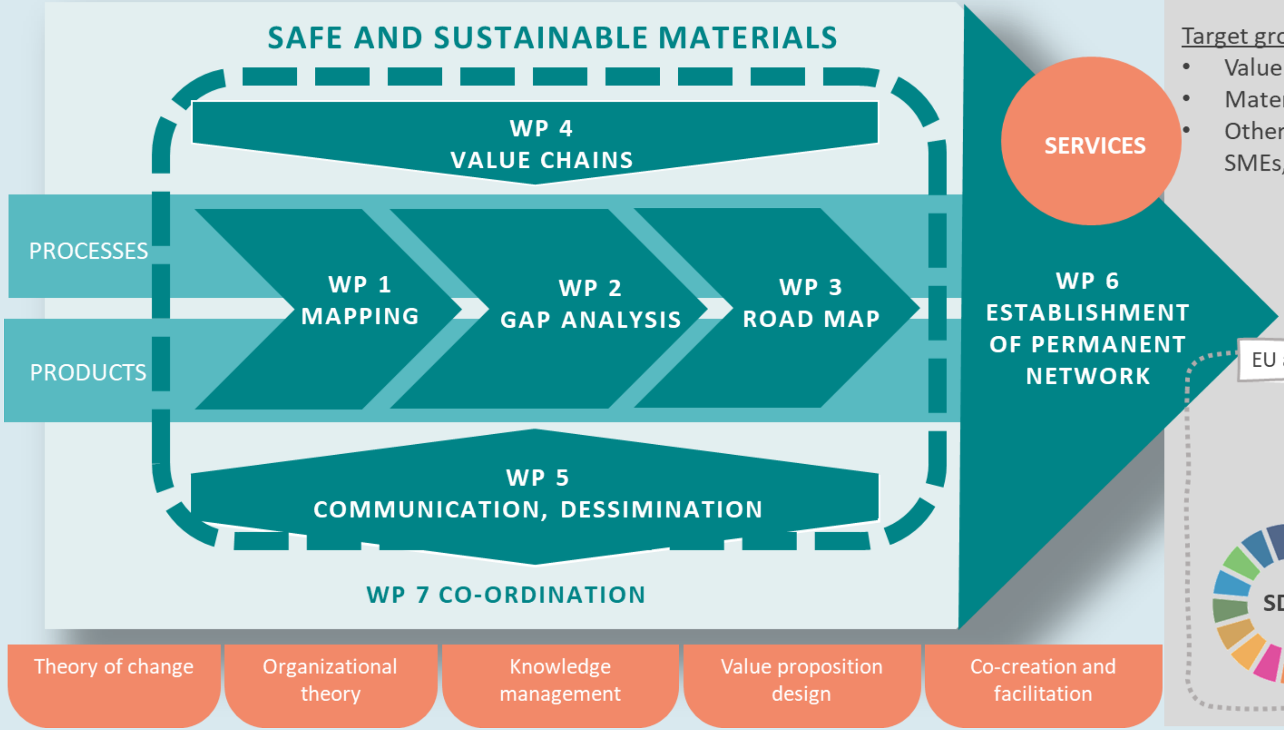
Scope of the project

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

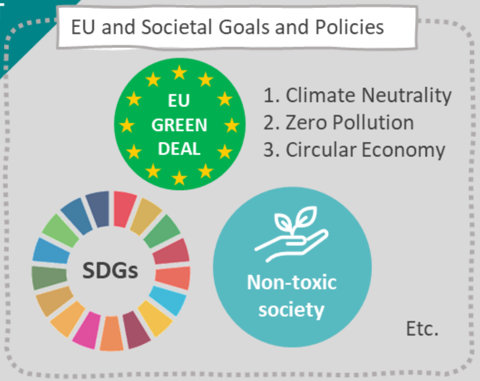


Organisation and activities



Target groups:

- Value chains
- Materials and chemicals platforms
- Other stakeholders (e.g. Policy, Industry, SMEs, NGOs, Academia, Civil society)



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

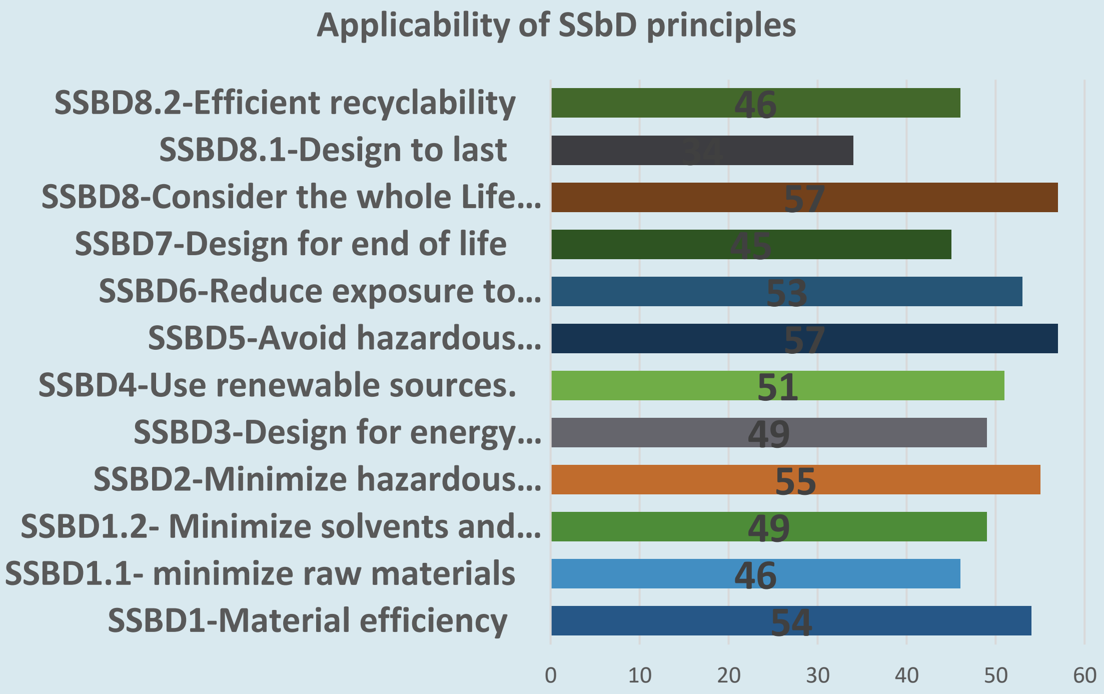
1-(Re)Design Phase

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

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

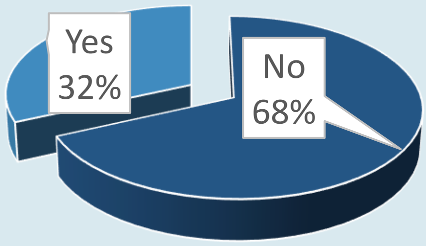
List of SSbD principles recomended by the JRC SSbD frame work

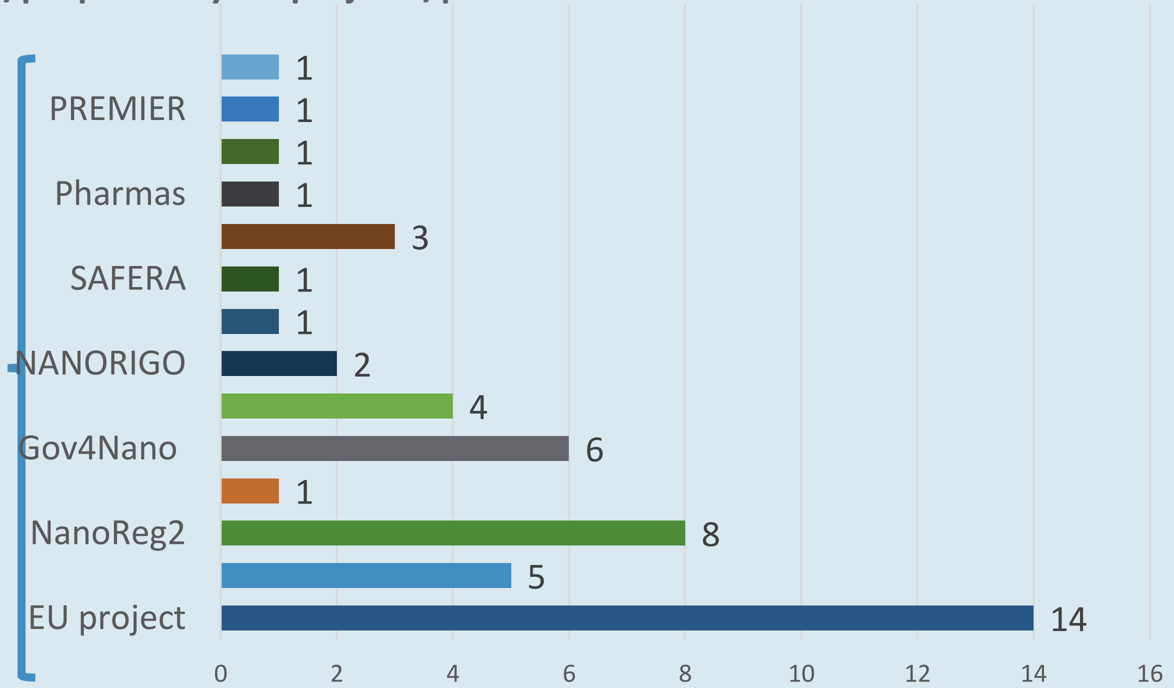
SSbD1	Material efficiency
SSbD2	Minimize the use of hazardous materials
SSbD3	Design for energy efficiency
SSbD4	Use renewable sources
SSbD5	Prevent and avoid hazardous emissions
SSbD6	Reduce exposure to hazardous substances
SSbD7	Design for end of life
SSbD8	Consider the whole Life Cycle



Preliminary results - Safe by Design (SbD)

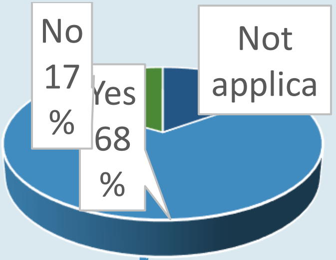
Applicability of SbD tools developed/proposed by EU projects/platforms





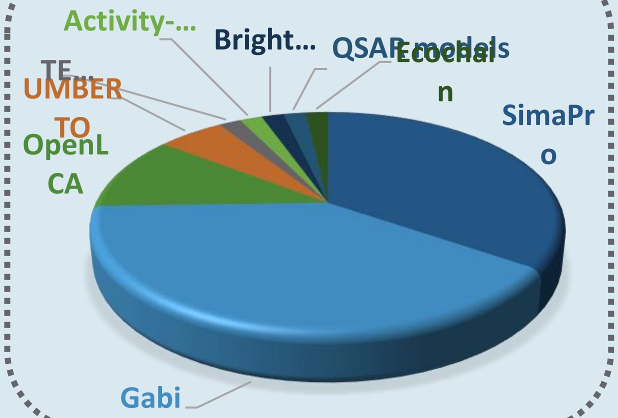
Preliminary results - Environmental dimension: LCA

Use of LCA Databases, Software and Impact Assessment methodologies

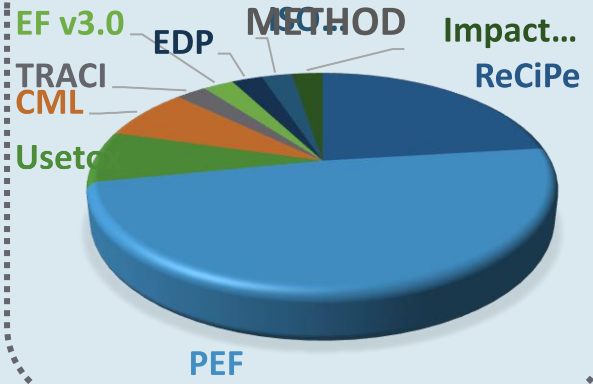


19% of the companies that replied use LCA

LCA SOFTWARES



LCA IMPACT ASSESSMENT METHOD



Databases: ECOINVENT (100%)

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)

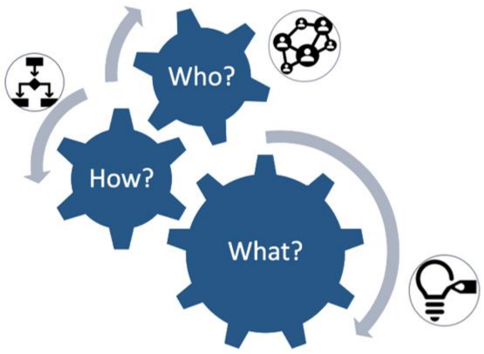
Textiles
(ETP; EU Technology Platform for the Future of Textiles & Clothing)

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)

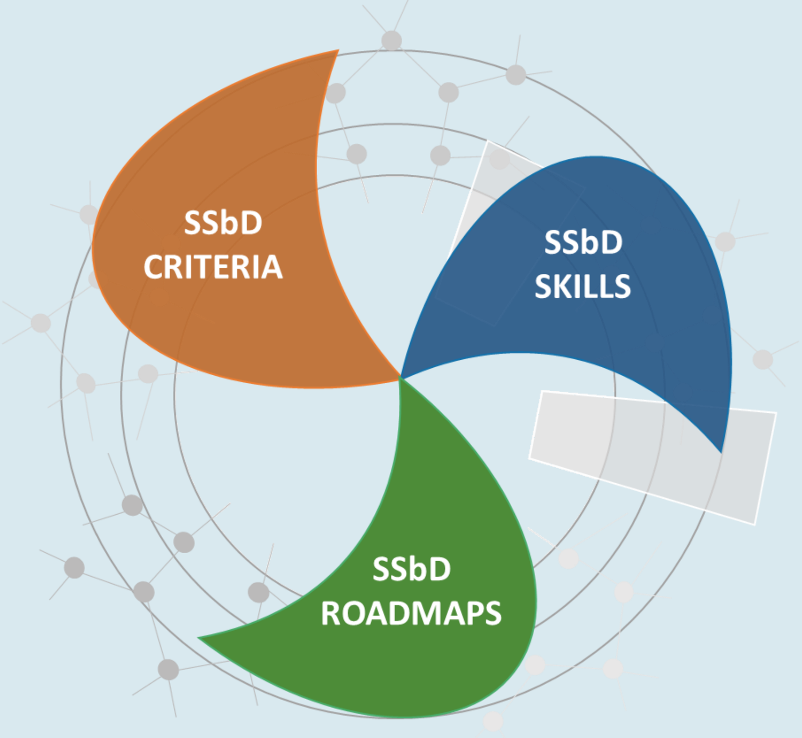


- **Development of value chain specific SSbD supportive roadmaps with agendas for:**
  - research needs
  - skills, competences and education needs, and
  - knowledge and information sharing needs
- **Translate the value chain specific SSbD supportive roadmaps to a generalized roadmap**

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**

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

Science:

Initial steps on operationalization of SSbD

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

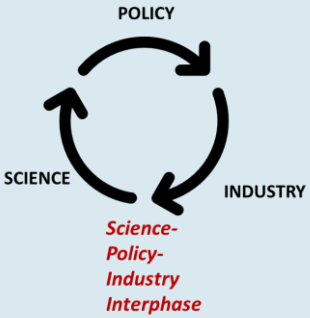
Bringing science to harmonization and standardization

- **IRISS-OECD synergies**

Policy:

IRISS structural dialogue with:

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



Industry:

Cefic coordinates SusChem NTPs and 6 value chains representatives

- **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)
- **Energy materials** (EMIRI; Energy Materials Industrial Research Initiative)
- **Electronics** (INL; International Iberian Nanotechnology Laboratory)
- **Fragrances** (IFRA; The International Fragrance Association) – new VC

Our partners and network

The project receives funding from the European Union's HORIZON EUROPE research and innovation programme under grant agreement n° 101058245

UK participants in Project IRISS are supported by UKRI grant 10038816

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

Funded by the European Union

IRISS

Contact and more information

Project coordinator:

Emma Strömberg,
IVL Swedish Environmental Research Institute
iriss@ivl.se

www.iriss-ssbd.eu

#IRISS_SSbD

IRISS – International SSbD network

Funded by the European Union

The project receives funding from the European Union's HORIZON EUROPE research and innovation programme under grant agreement n° 101058245

UK participants in Project IRISS are supported by UKRI grant 10038816

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

SusChem NTP activities within IRISS

Barbara TIŠLER
SusChem Slovenia

Stelios BIKOS
SusChem Greece

Reinier GRIMBERGEN
SusChem Netherlands

SUSCHEM
European Technology Platform
for Sustainable Chemistry

Panel discussion on the implementation of the SSbD framework

—

SUSCHEM
European Technology Platform
for Sustainable Chemistry

Irantzu GARMENDIA AGUIRRE

—

Project Officer, European Commission
Joint Research Centre

SusChem European Technology Platform for Sustainable Chemistry

Sofie NØRAGER

—

Deputy Head of Unit European Commission Directorate-General for Research and Innovation – Prosperity - Industrial Transformation

Panel discussion on the implementation of the SSbD framework

- Sofie Nørager, Deputy Head of Unit European Commission Directorate-General for Research and Innovation - Prosperity - Industrial Transformation, European Commission
- Irantzu Garmendia Aguirre, Project Officer, European Commission, Joint Research Centre
- Lya Hernandez, RIVM
- Barbara Tišler, SusChem Slovenia
- Emma Strömberg, IVL

- Moderator: Eva Schillinger, SusChem

SusChem
European Technology Platform
for Sustainable Chemistry

SusChem NTP activities

Dr. Barbara Tišler, member of the leadership team of SusChem NTPs, National Institute of Chemistry, Slovenia – SusChem Slovenia

—

Dr. Stelios Bikos, president of SusChem Greece

Dr. Reinier Grimbergen, TNO, Chairman of SusChemNL NTP and member of the Board of SusChem ETP

SusChem is a technology solutions provider and also the multi-stakeholder forum.

SusChem National Technology Platforms (NTPs) help to connect SusChem thinking with national and regional programmes.

17 National Technology Platforms

SusChem AT

SusChem BE

SusChem BG

SusChem CH

SusChem CZ

SusChem DE

17 SusChem NTPs

Around 20.000 members

SMEs
Industry
Governments
RTOs
Academia
Civil society

SusChem ES

SusChem FI

SusChem FR

SusChem GR

SusChem IT

SusChem NL

Chemistry and related fields

Interlinking of
Associations of chemical industries
with
Academia, research institutes
and
SMEs
and
startups

SusChem PL

SusChem RO

SusChem SE

SusChem SI

SusChem UK

Contributing to development of Strategic Research and Innovation Agenda

5 NTPs covering all regions of Europe actively involved in IRISS

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

IRISS

Funded by the European Union

Project funded by the European Union's HORIZON EUROPE research and innovation programme under grant agreement n° 101058245
UK participants in Project IRISS are supported by UKRI grant 10038816
CH participants in Project IRISS receive funding from the Swiss State Secretariat for Education, Research and Innovation (SERI)

The role of SusChem NTPs in the IRISS project:

- To identify available incentives for the uptake of SSbD criteria and to expand network

- To map potential collaboration-partners from industry, research organisations, universities and society

- to strengthen collaboration and information exchange between relevant actors

- to ensure provision of policy, applied science, industry and innovation linkage throughout EU and beyond, including SMEs and the wider society

- to build a permanent network

Methodology of SusChem NTPs about SSbD concept

From prudence with mobilizing stakeholders on SSbD to active engagement

Prudence because of:

Proposed hierarchical approach

It is not clear what the scope and the purpose of the assessment framework is

Active engagement because:

We need to spread objective information

We agree with the SSbD principles

We see the benefit of integrating some type of assessment during the innovation process

We encourage Strategic Research and Inovation Plan providing balanced overview of SSbD R&I Challenges

Activities of SusChem NTPs about SSbD concept

From informing to co-creating

Information on SSbD via:

Newsletters
Working groups
Workshops with stakeholders

Co-creation:

Collaborating with local authorities
Collaboration with academia – developing training courses
Within IRISS project large survey was launched about SSbD in practice

Conclusions so far

An estimation about the interest among SMEs about SSbD-training is challenging as most of the SMEs are not yet aware what it is and if it effects them. However, it can be assumed that they will get attracted by SSbD-training as soon as it is available in a format, that is useful for them.

Awareness rising about SSbD is needed.

New study programmes perfect places for integration of SSbD courses.

Hard and ongoing work.

Regional Structure of SusChem NTP Involvement in IRISS

Structure for clarity & efficiency

Collaborating Partners
(NTPs & other Networks)

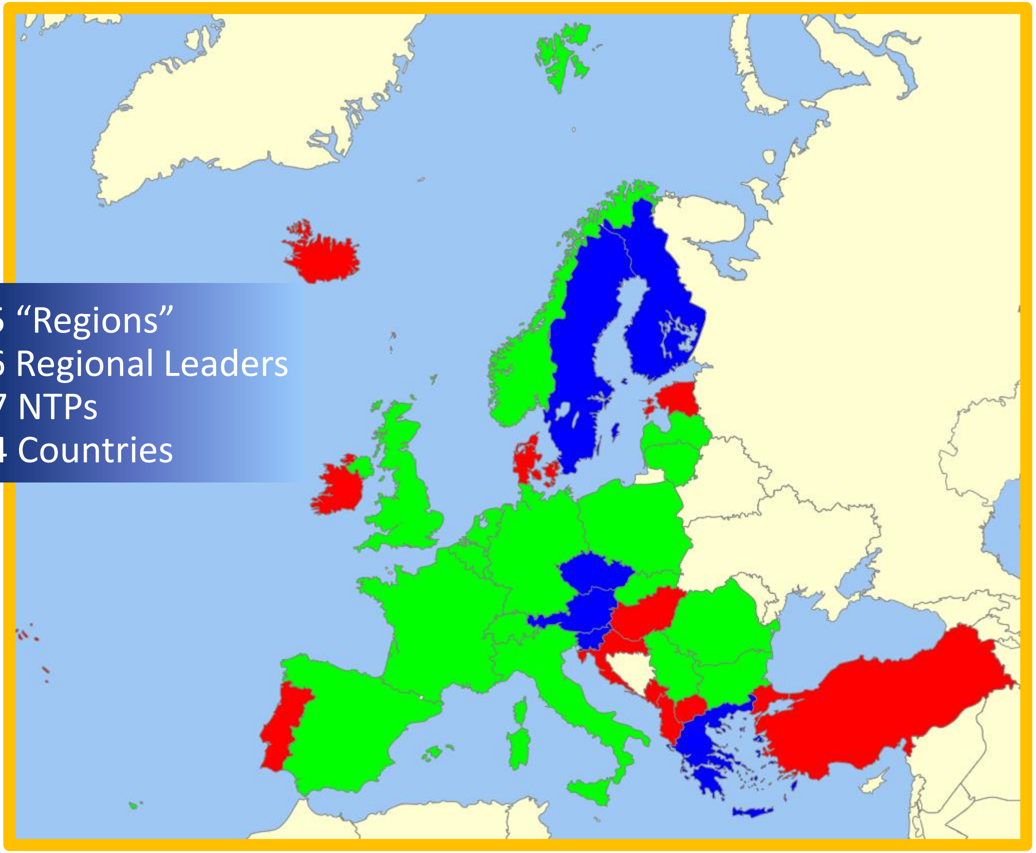
Networking Partners
(Regional Coordinator NTPs)

Network Partner College
(all 6 Networking Partners)

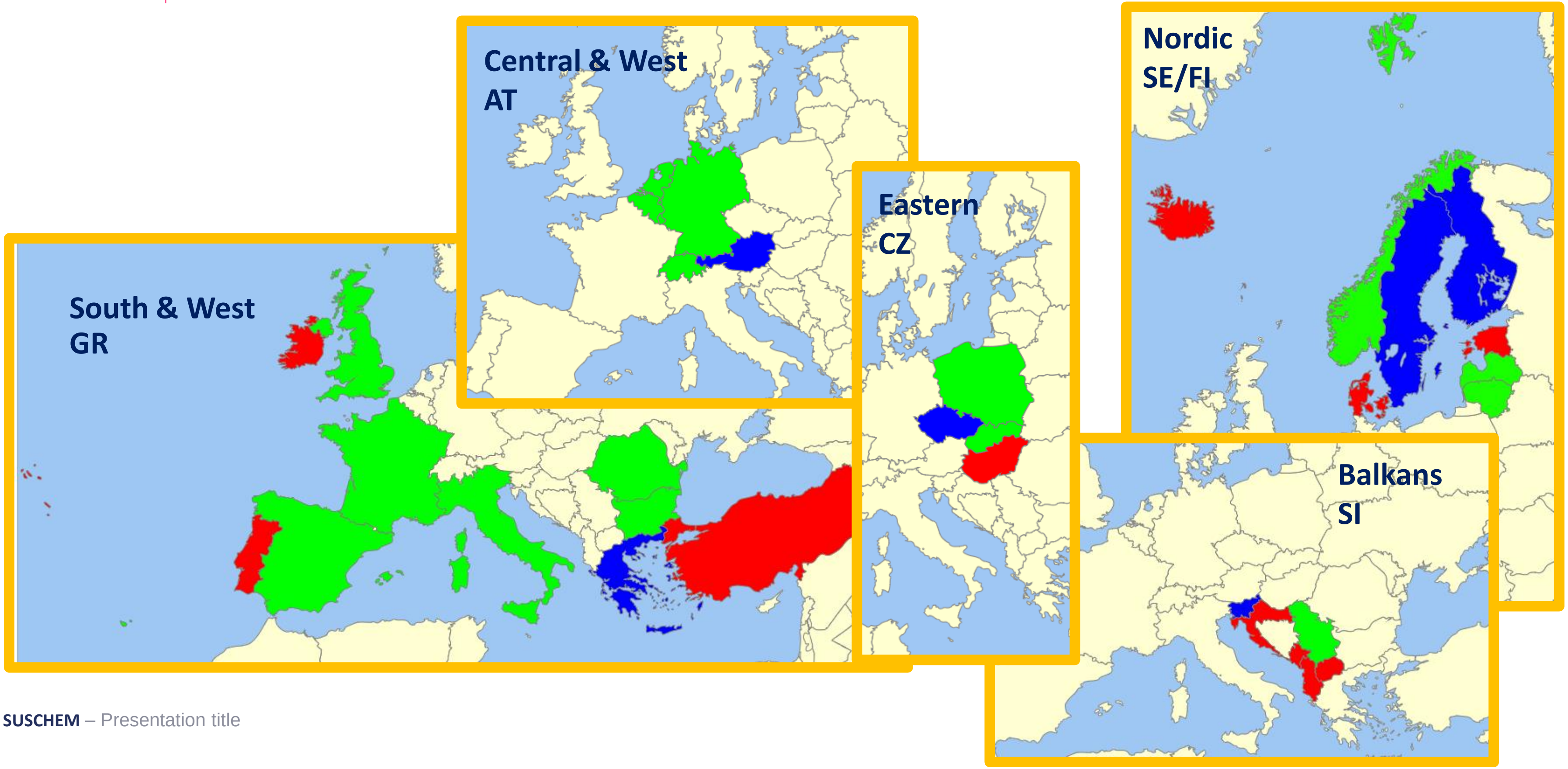
Network Liaisons
(SI, AT, GR)

Core Partners

5 “Regions”
6 Regional Leaders
17 NTPs
34 Countries



Regional Structure of SusChem NTP Involvement in IRISS



Dissemination Activities

National and Regional Activities

- Mapping of national stakeholders per value chain
- Verification of national stakeholders per value chain
- Optional national workshops on SSbD / IRISS per value chain
- Regional workshops on SSbD / IRISS per value chain

Europe-wide / International Events

- IRISS project events participation
- SSbD / IRISS thematic sessions

Project Activities

Core partner generated questionnaires & surveys

Passed to Networking Partners

to distribute to their members and the NTPs and others in their Region

possibly to distribute to their members, if applicable to fill-in

…and return to their association / network secretariat

…to feed back to the Networking Partner

…to return to the core partners who need the information.

Core partner generated training/informative material: disseminate through workshops, emails and social media

Examples

ES –

An SSbD Working Group has been created

An SSbD Webinar has been held

GR –

48 national stakeholders have been mapped

A S+W Region coordination meeting has been held

NL –

RIVM is the Dutch partner in the IRISS project

An SSbD 1 day symposium has been organized by NWO and ChemistryNL to be held on March 15th in Utrecht:

« Safe and Sustainable by Design: the small molecule challenge »

International Event Participation

Dedicated sessions in:

IndTech 2022, June 2022, Grenoble, FR

ESCAPE33, June 2023, Athens, GR

IUPAC 2023, August 2023, The Hague, NL

Program SSbD Symposium March 15th

NL – SSbD Symposium

« Safe and Sustainable by Design: the small molecule challenge »

- Universities (UvA. RU, UM)
- RTOs (RIVM)
- Chemical Industry (Shell, Avantium)
- Top sector Chemistry (ChemistyNL)
- Branche Organization of the Chemical Industry (VNCI)
- Funding (NWO)
- Government (I&W)

PROGRAMME 15 March 2023

Safe and Sustainable-by-design symposium: the small molecule challenge

Venue: NWO Utrecht, Auditorium

09.30 – 10.00	Welcome and coffee
10.00 – 10.05	Opening by Pieter Bruijnincx
10.05 – 11.05	**Lectures**
10.05 – 10.35	Lecture background/policy developments by Agnes Oomen (RIVM/UvA)
10.35 – 11.05	Lecture synthetic chemist perspective Chris Slootweg (UvA)
11.05 – 11.20	Coffee/tea break
11.20 – 12.20	**Lectures**
11.20 – 11.50	Lecture environmental chemist perspective by Ad Ragas (RU)
11.50 – 12.20	Lecture ethical perspective by Harro van Lente (UM)
12.20 – 13.15	Lunch break
13.15 – 14.30	**Interactive session**
13.15 – 13.30	Lecture industrial perspective by Michiel van Kuppevelt (VNCI)
13.30 – 14.30	Panel discussion with Tiny van der Werff (I&W), Gert-Jan Gruter (UvA), Demi Theodori (SER), Elsbeth Roelofs (MVO) and Jean-Paul Lange (Shell)
14.30 – 15.00	Coffee/tea break
15.00 – 16.00	**Interactive session** - building a community
15.00 – 15.15	Lecture NWA-programme *'Towards a practical Safe-by-Design approach for chemical products and processes'* by Annemarie van Wezel
15.15 – 15.35	Open discussion with the audience
15.35 – 15.45	Overview of relevant funding instruments by Marijn Goes
15.45 – 16.05	Open discussion with the audience
16.05 – 16.20	**Recap and closure**
16.20 – 18.00	Drinks

SUSCHEM
European Technology Platform
for Sustainable Chemistry

Keynote: Feedstock needs to achieve climate neutrality

—

Michael CARUS, nova-Institut

Feedstock nees to achieve climate neutrality – deep dive in embedded carbon

Renewable Carbon Concept and Initiative

Michael Carus, founder and CEO nova-Institute & executive manager of RCI

Feedstock nees to achieve climate neutrality – deep dive in embedded carbon

Renewable Carbon Concept and Initiative

Michael Carus, founder and CEO nova-Institute & executive manager of RCI

nova Institute
for Ecology and Innovation

Your partner in strategy, technology and sustainability

SCIENCE-BASED CONSULTANCY ON RENEWABLE CARBON FOR CHEMICALS AND MATERIALS

We support your smart transition to renewable carbon

nova-Institute was founded in 1994 and has a multidisciplinary and international team of more than 40 scientists

Get to know our experts at: nova-institute.eu/nova-team

RENEWABLE CARBON
Bio-based CO_2-based Recycling
Circular Economy

nova-Institut GmbH – SME

private and independent research institute;
multidisciplinary and international team of more than 40 scientists

Technology & Markets

- Market Research
- Innovation & Technology Scouting
- Trend & Competitive Analysis
- Supply & Demand Analysis
- Feasibility & Potential Studies
- Customised Expert Workshops

Sustainability

- Life Cycle Assessments (ISO 14040/44, PEF Conform)
- Carbon Footprint Studies and Customised Tools
- Initial Sustainability Screenings and Strategy Consultation
- Holistic Sustainability Assessment (incl. Social and Economic Impacts)
- GHG Accounting Following Recognised Accounting Standards
- Critical Reviews for LCA or Carbon Footprint Reports

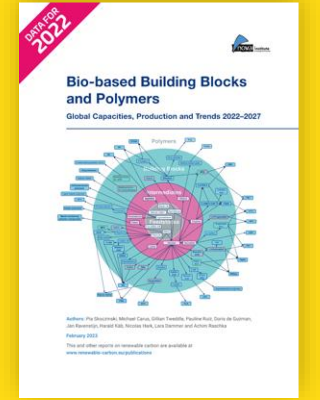
Communication

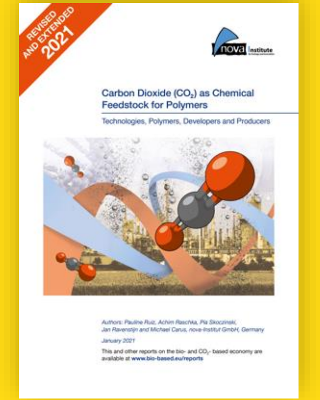
- Comprehensive Communication & Dissemination in Research Projects
- Communication & Marketing Support
- Network of 60,000 Contacts to Companies, Associations & Institutes
- Targeted Newsletters for 19 Specialty Areas of the Industry
- Conferences, Workshops & nova Sessions
- In-depth B2C Research

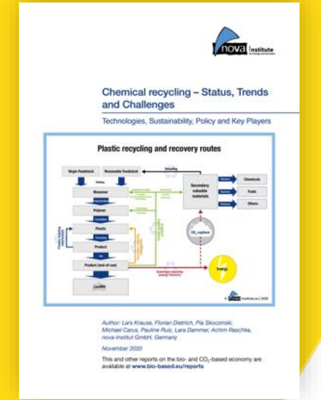
Economy & Policy

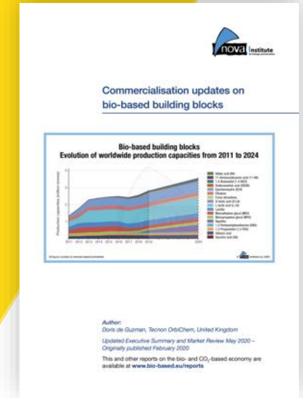
- Strategic Consulting for Industry, Policy & NGO’s
- Political Framework, Measures & Instruments
- Standards, Certification & Labelling
- Micro- and Macroeconomics
- Techno-Economic Evaluation (TEE) for Low & High TRL
- Target Price Analysis for Feedstock & Products

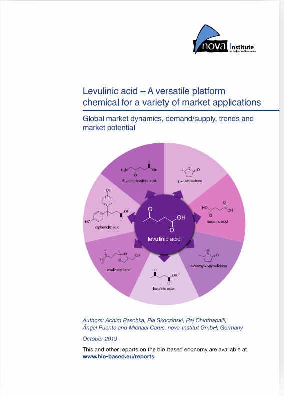
Market and Trend Reports on Renewable Carbon







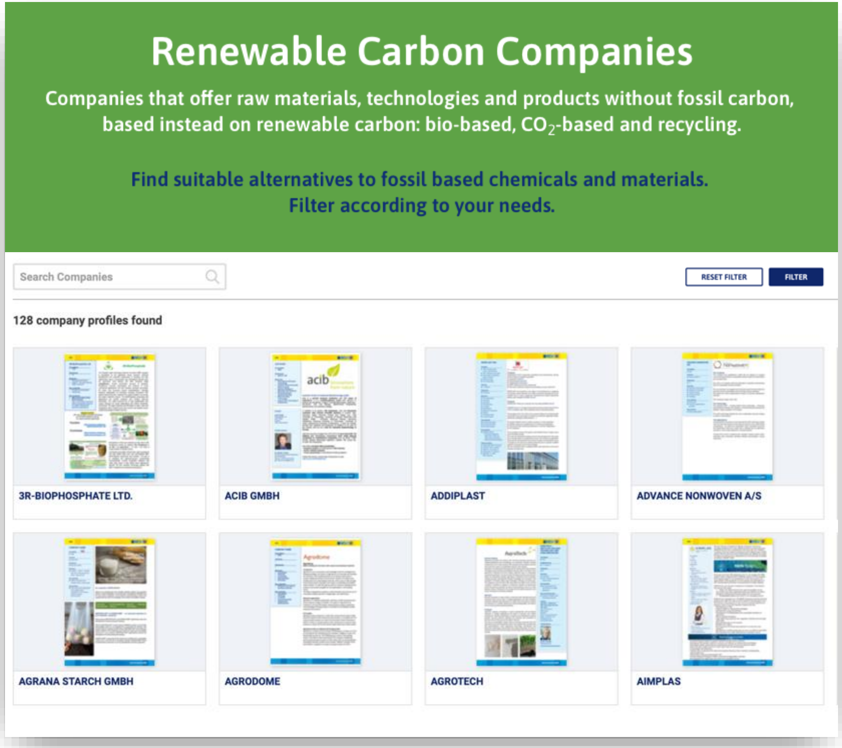




The Best Available on Bio- an CO_2-based Polymers & Building Blocks and Chemical Recycling

renewable-carbon.eu/commercial-reports

Renewable Carbon Companies (ReCaCo)

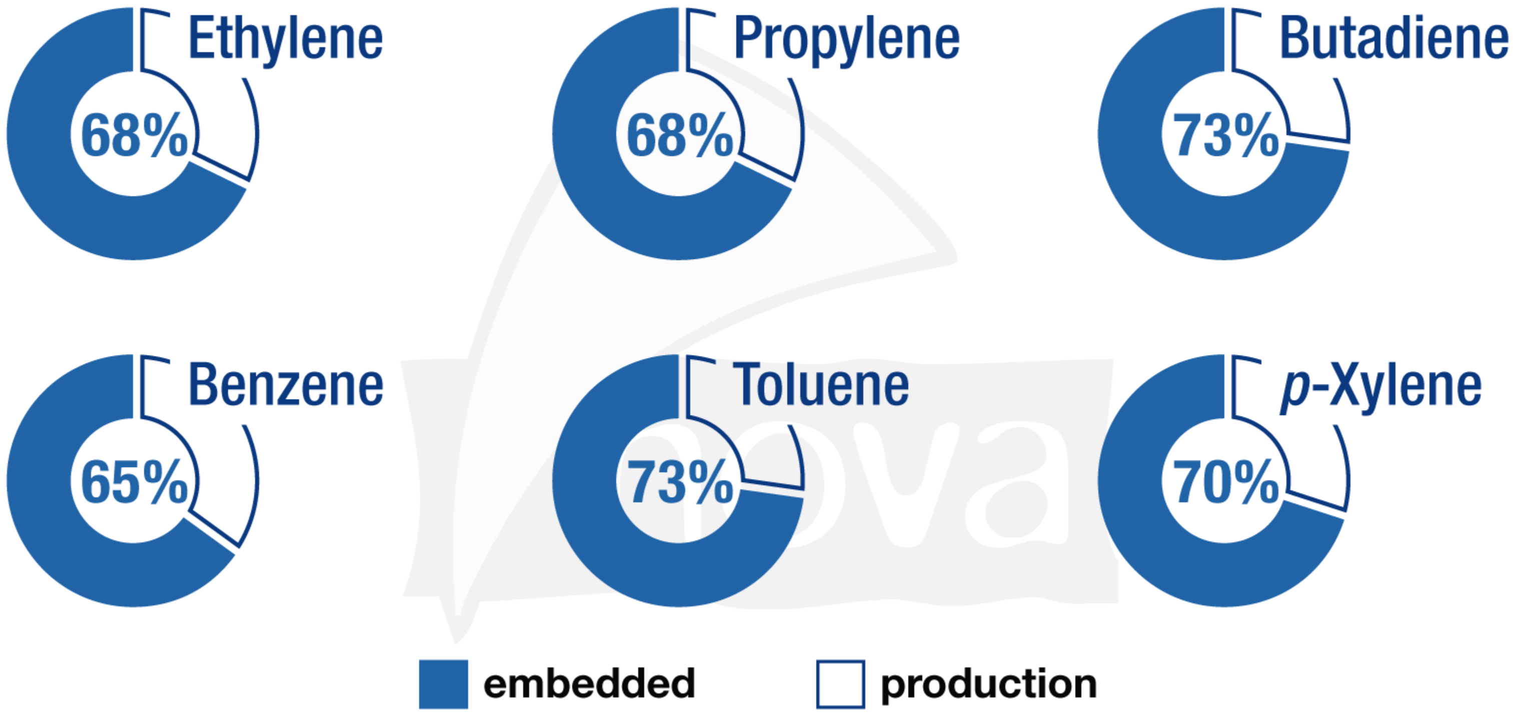


RENEWABLE CARBON COMPANIES

- up to 50,000 downloads of company profiles per year
- 128 companies in the database
- easy and direct access to products, services and experts of the renewable carbon economy worldwide – get visible for thousands of customers
- become a part of the ReCaCo with 2 pages for free

www.renewable-carbon.eu/companies

The invisible carbon footprint

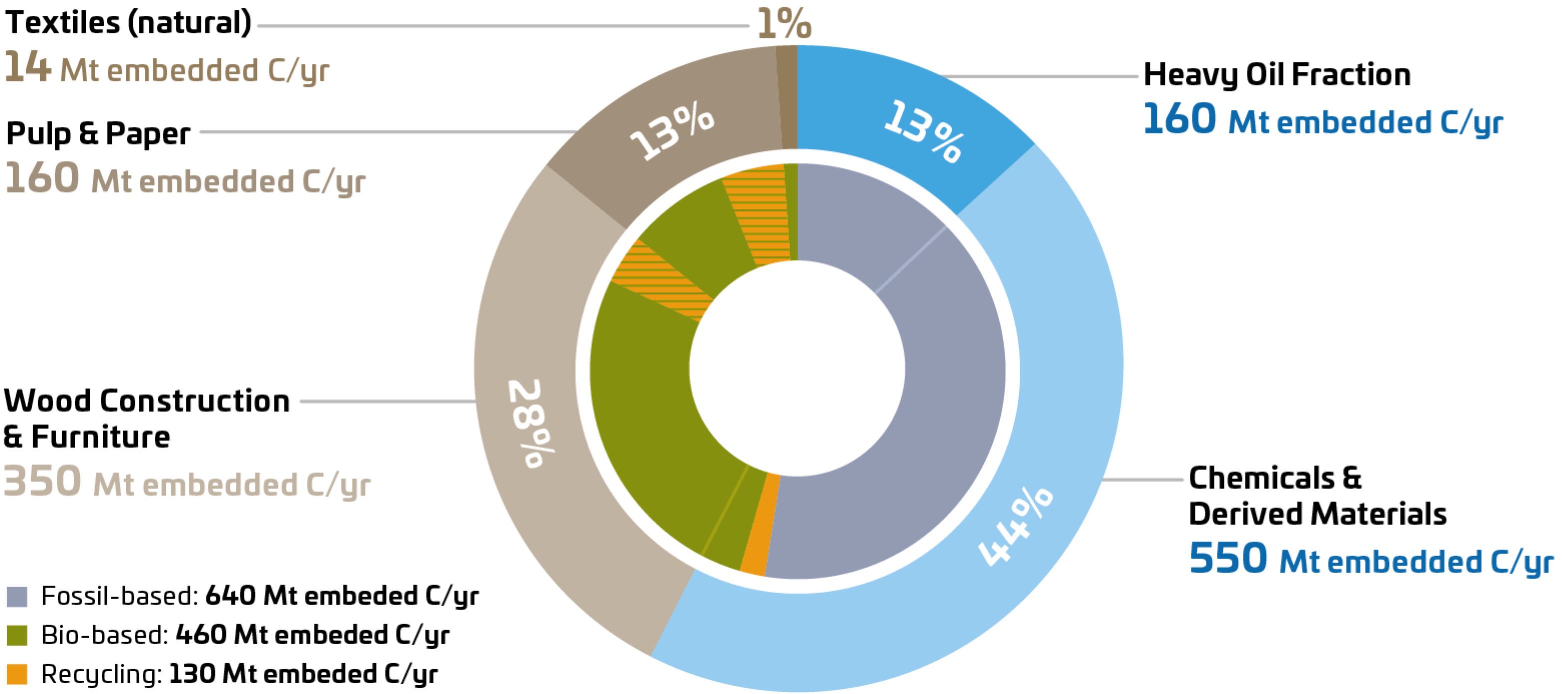


All figures available at **www.bio-based.eu/markets**

Ethylene, propylene, butadiene – Calculations by nova-Institute
Benzene, toluene, *p*-xylene – Source: BioBTX

Global Demand for Carbon Embedded in Materials and Chemicals

Total: **1200 Mt embedded C/yr** Reference Years: **2015–2022**



Main Sources: updated data using methodology based on Piotrowski et al. 2015, Levi and Cullen 2018, Plastics Europe 2022b, Skoczinski et al. 2022, FAO Global Forest Resource Assessment 2020

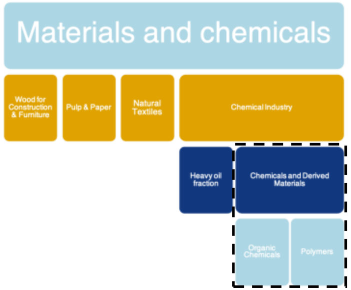
available at www.renewable-carbon.eu/graphics

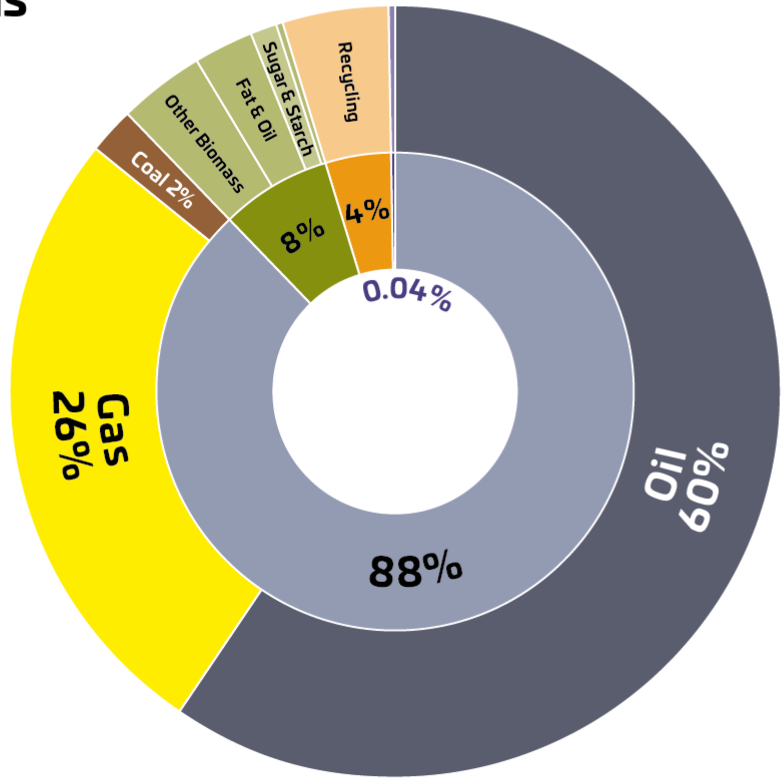
Global Supply for Embedded Carbon in Chemicals and Derived Materials
by Type of Feedstock

Total: **550 Mt embedded C/yr**

Reference Years: **2015–2022**

- Fossil-based: **480 Mt embedded C/yr**
- Bio-based: **41 Mt embedded C/yr**
- Recycling: **24 Mt embedded C/yr**
- CO_2-based: **0.2 Mt embedded C/yr**





available at **www.renewable-carbon.eu/graphics**

Main Sources: Updated data using methodology based on Piotrowski et al. 2015, Levi and Cullen 2018, Plastics Europe 2022b, Skoczinski et al. 2022

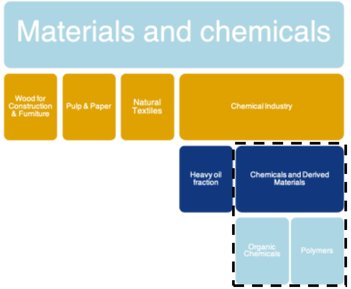
Consumption of Embedded Carbon for Global Chemicals and Derived Materials

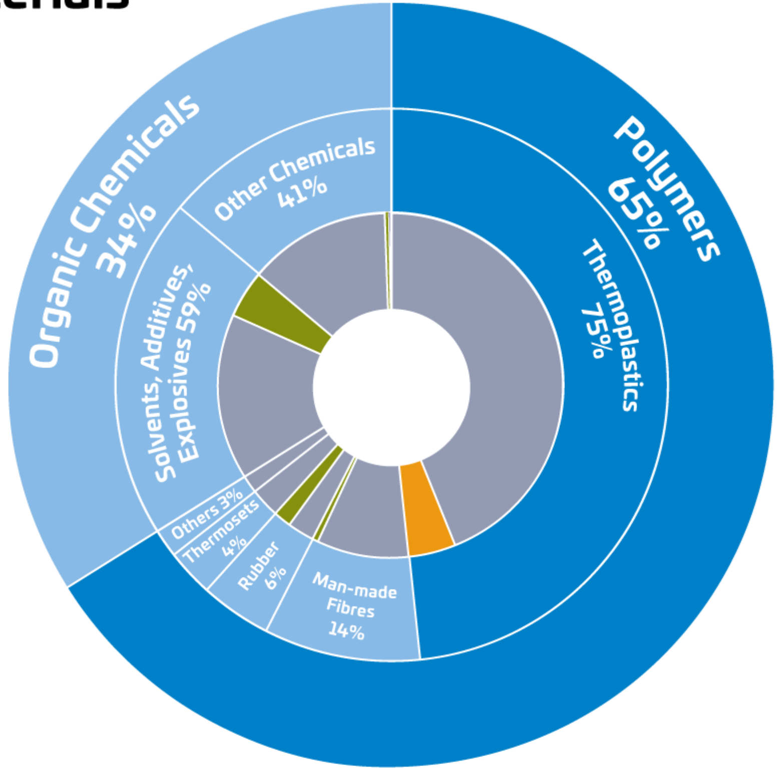
by Carbon Feedstock

Total: **550 Mt embedded C/yr**

Reference Years: **2015–2022**

- Fossil-based: **480 Mt embedded C/yr**
- Bio-based: **41 Mt embedded C/yr**
- Recycling: **24 Mt embedded C/yr**
- CO_2-based: **0.2 Mt embedded C/yr**





Main Sources: Updated data using methodology based on Piotrowski et al. 2015, Levi and Cullen 2018, Plastics Europe 2022b, Skoczinski et al. 2022, The Fibre Year Consulting 2022, ETRMA 2021

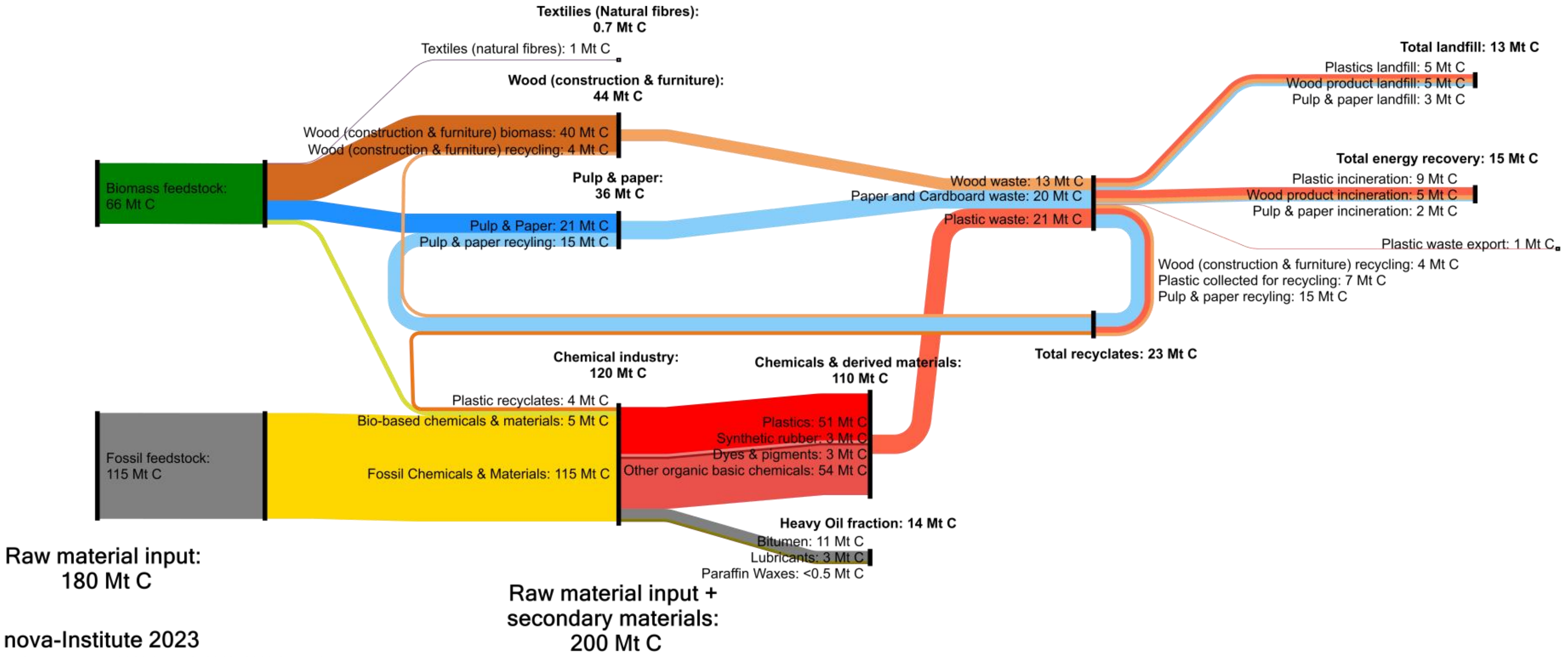
available at www.renewable-carbon.eu/graphics

Summary of global carbon flows today (Mt C / yr)

	World[1]		Global Materials & Chemicals[2,3]		Global Chemical Industry[2,4]		Global Chemicals & Derived Materials[2,5]	
Total	17000	100 %	1200	100 %	710	1004%	550	100 %
Fossil total	11000	63 %	640	52 %	640	91 %	480	88 %
Coal	4700		12		12		12	
Gas	2500		140		140		140	
Oil	3800		490		490		330	
Primary Biomass	6100	35 %	460	37 %	41	6 %	41	8 %
Cellulose	2700		370		3		3	
Sugar & Starch	1300		10		6		6	
Fat/Oil	500		14		13		13	
Protein	800		0		0		0	
Others[6]	800		63		20		20	
Recyclates, Secondary biomass	280[7]	2 %	130	11 %	24	3 %	24	4 %

1 - includes carbon input of fossil and biogenic raw materials plus recyclates in the world economy (food and feed, energy sector, transport, materials and chemicals)
2 - only embedded carbon; energetic use excluded
3 - includes chemicals and derived materials (plastics, rubber), including the heavy oil fraction (bitumen, paraffin waxes, lubricants) and bio-based industries wood for construction, pulp & paper, textiles)
4 - includes chemicals and derived materials (plastics, rubber), including the heavy oil fraction (bitumen, paraffin waxes, lubricants)
5 - includes chemicals and derived materials (plastics, rubber)
6 - includes lignin, natural rubber, etc
7 - includes material recycling and incineration Various sources; Various reference years, mainly 2018–2020

Flows of organic carbon in the EU-27 material & chemical sector



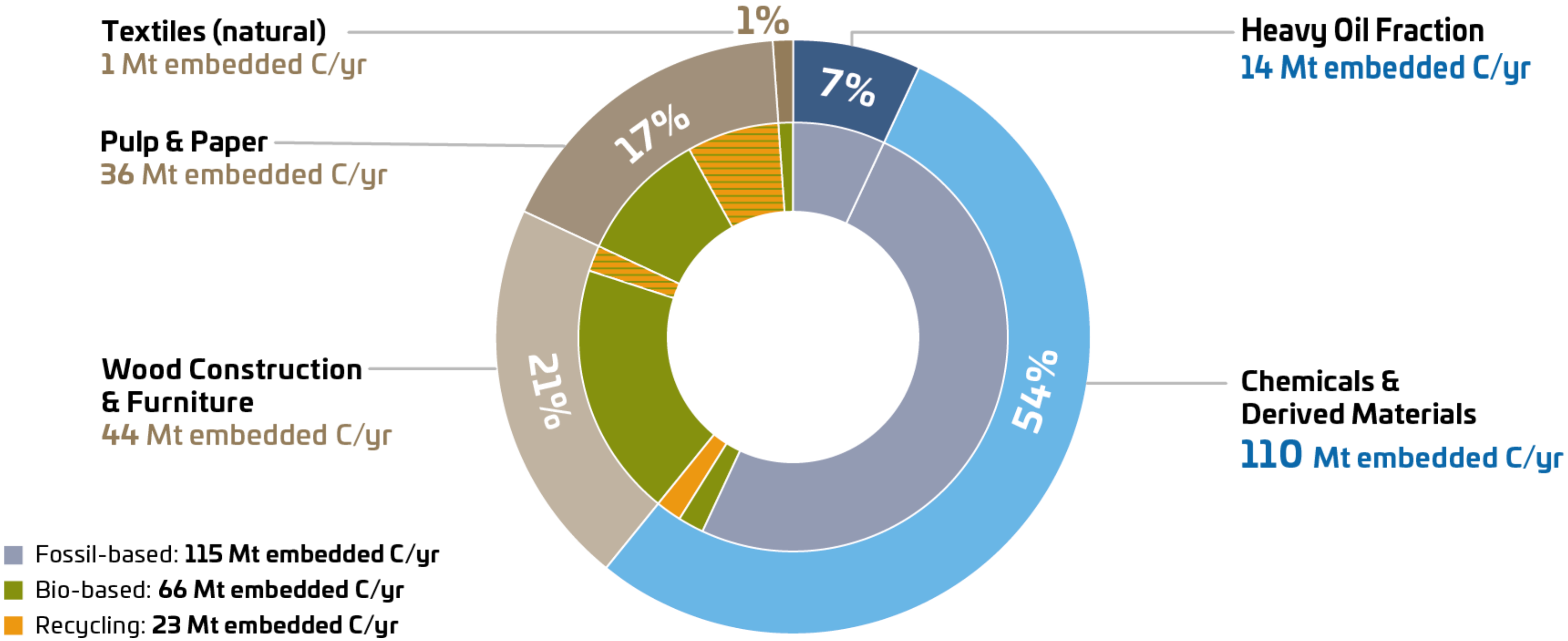
nova-Institute 2023

Reference Years: 2018 (waste); 2019, 2020 (others)
Main sources: own data based on Eurostat NACE class 20.1, Eurostat EU-27 energy balance 2018, JRC biomass flows 2020, Mantau 2012, CEPI 2020, Plastics Europe 2022
Differences in Supply and Demand due to losses and data inconsistencies. Values rounded to the second significant digit.

RENEWABLE CARBON INITIATIVE

EU-27 Demand for Embedded Carbon in Materials and Chemicals

by Sectors; Total: **200 Mt embedded C/yr** Reference Years: **2018–2021**

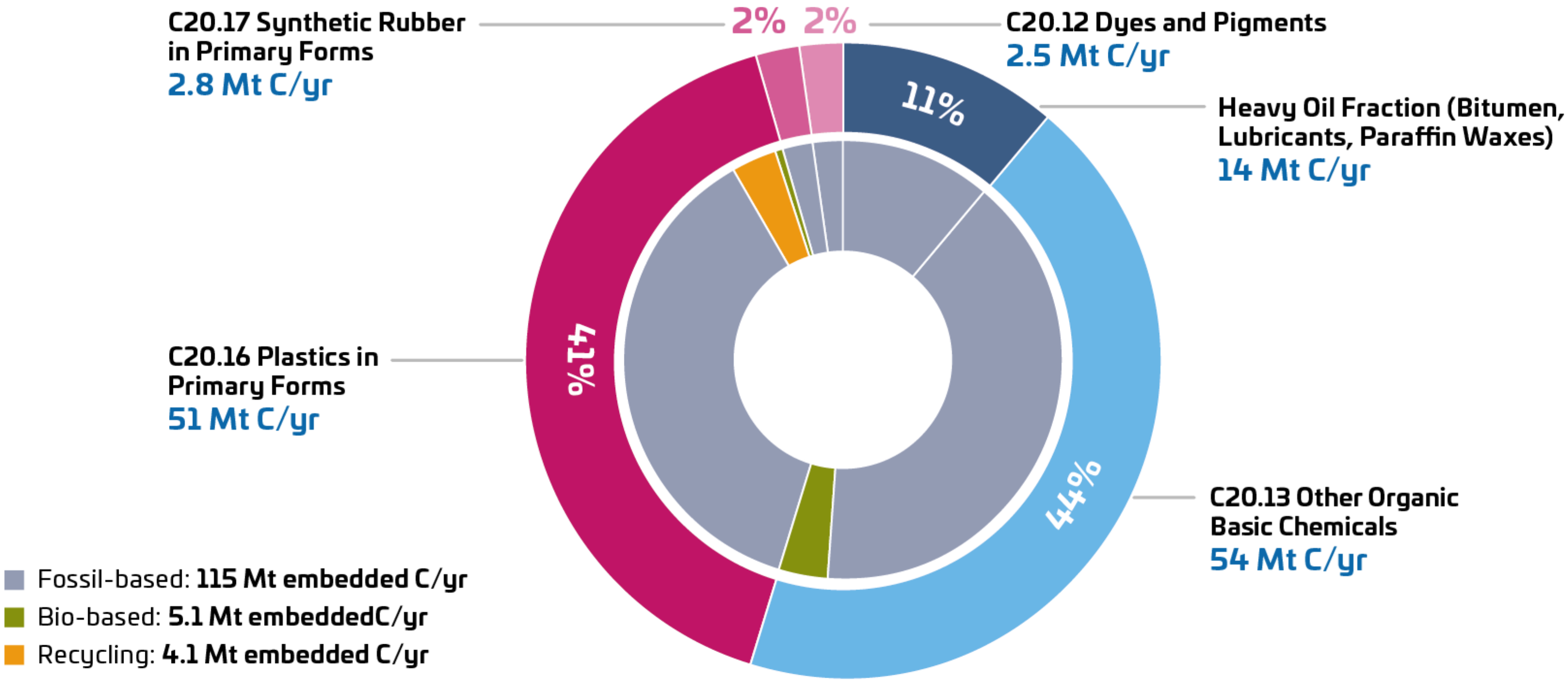


available at www.renewable-carbon.eu/graphics

Main sources: Own data based on Eurostat prodcom 2022, NACE class C20.1, Eurostat energy balance 2018, JRC biomass flows 2020, Mantau 2012, CEPI 2020, Plastics Europe 2022

Carbon Demand for Embedded Carbon in the EU-27 Chemical Industry

Total: **120 Mt embedded C/yr** Reference Years: **2018–2021**



available at www.renewable-carbon.eu/graphics

Main sources: Own Data Based on Eurostat prodcom 2022, NACE class C20.1, Eurostat energy balance 2018, Plastics Europe 2022b, Plastic recyclates

Summary of EU-27 carbon flows today (Mt C / yr)

	EU-27[1]		EU-27 Materials & chemicals[2,3]		EU-27 Chemical industry[2,4]		EU-27 Chemicals & derived materials[2,5]	
Total	**1700**	**100 %**	**200**	**100 %**	**120**	**100 %**	**110**	**100 %**
Fossil total	1100	67 %	115	56 %	115	93 %	100	92 %
Coal	180		2.7		2.7			
Gas	270		16		16			
Oil	670		96		96			
Primary Biomass	500	30 %	66	32 %	5.1	4 %	5.1	5 %
Cellulose	185		55		0.5		0.5	
Sugar & Starch	145		2		1.5		1.5	
Fat/Oil	54		2		1.8		1.8	
Protein	58		0		0.0		0.0	
Others[6]	53		8		1.3		1.3	
Recyclates, Secondary biomass	38[7]	3 %	23	11 %	4.1	3 %	4.1	4 %

1 - includes carbon input of fossil and biogenic raw materials plus recyclates in the world economy (food and feed, energy sector, transport, materials and chemicals)
2 - only embedded carbon; energetic use excluded
3 - includes chemicals and derived materials (plastics, rubber), including the heavy oil fraction (bitumen, paraffin waxes, lubricants) and bio-based industries (wood for construction, pulp & paper, textiles)
4 - includes chemicals and derived materials (plastics, rubber), including the heavy oil fraction (bitumen, paraffin waxes, lubricants)
5 - includes chemicals and derived materials (plastics, rubber)
6 - includes lignin, natural rubber, etc
7 - includes material recycling and incineration
Various sources; Various reference years, mainly 2018-2020

Renewable Carbon from Biomass

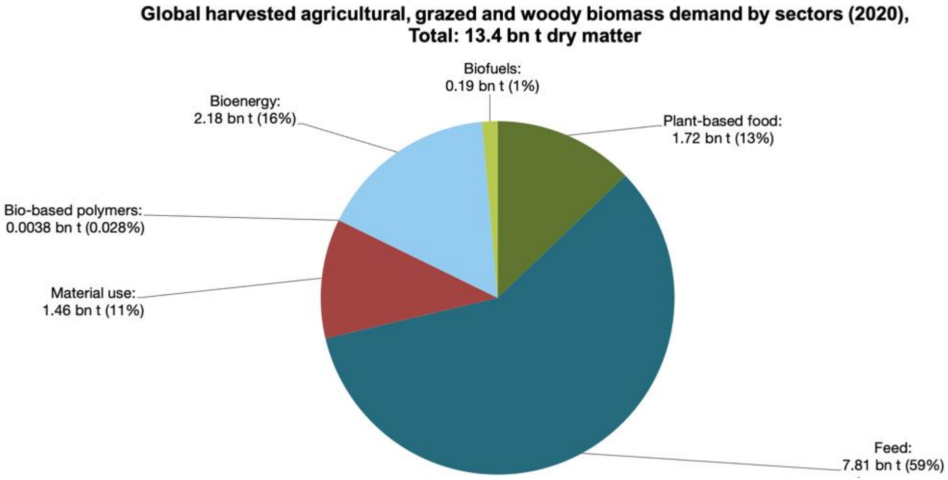
Pros in a nutshell

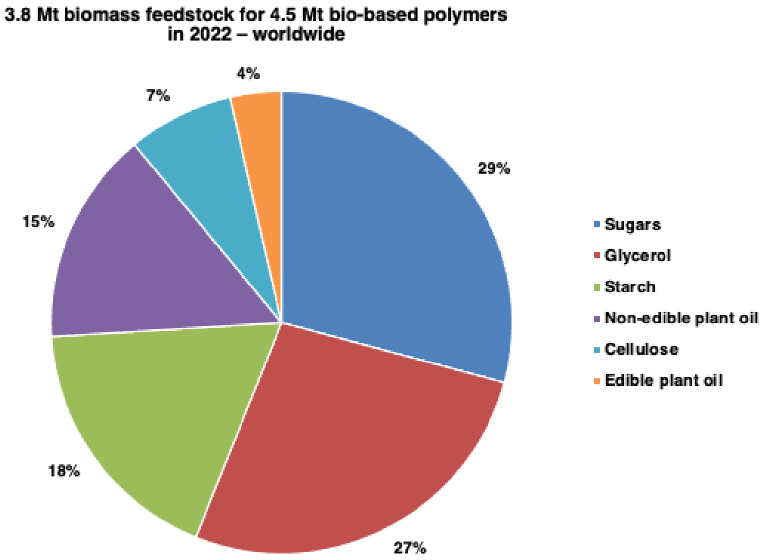
- Food crops:
  - Commodities, established in high volume, good logistics
  - Food crops: Protein-rich by-products
- Wide range of non-food feedstocks – no direct food competition, positive image
  - wood and lignocellulosic by-products and side streams
  - biogenic waste from industry and households
- Low GHG footprint compared with fossil resources
- New green chemical pathways
- Biotechnology as sustainable process technology

Cons in a nutshell

- Limited total volume
- Low land-efficiency
- Potential pressure on land and biodiversity
- Potential competition with food crops and a possible threat to food security

Biomass utilisation worldwide
First and second generation, total and for bio-based polymers





The 0.028 % share of biomass used to produce bio-based polymers translates into an area share of only 0.007 %. This is due to various factors: high-yielding crops (like sugarcane and maize) are used for the production of bio-based polymers, leading to a high area efficiency; the yields are not only used for polymer production but also for animal feed (the protein share) and thus only a part is allocated; and finally, because the biomass is a process by-product that uses no land (such as glycerol).

Renewable Carbon from CO_2

Pros in a nutshell

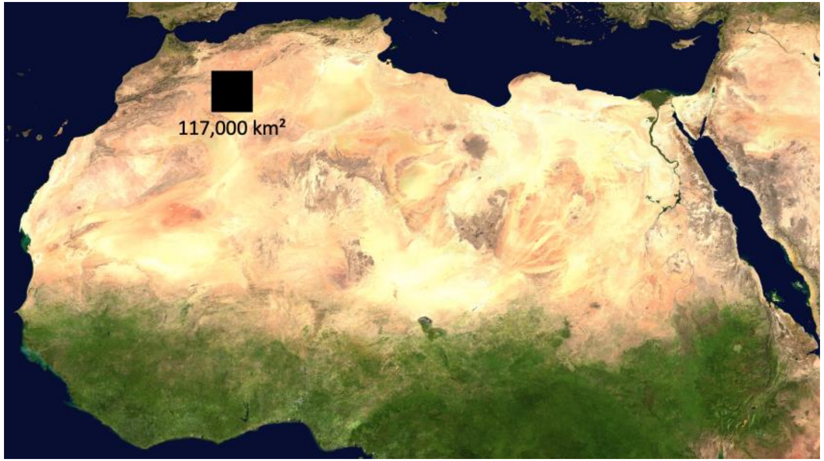
- Very high potential in volume (almost unlimited)
- Low demand for land and water, low carbon footprint
- High TRL technologies available
- Almost all chemicals and plastics can be produced from CO_2
- High employment potential
- Inexhaustible source of carbon for the next millennia
- Even “black” CO_2 carbon utilisation lead to relevant GHG reduction

Cons in a nutshell

- Potential lock in effects using fossil point sources
- Competition on limited renewable electricity
- High investment necessary

Absolute electricity demand and emission reduction potential

- Global carbon demand today: 450 Mt C (embedded carbon for chemicals)
- 2050 scenario: 1,000 Mt C
- To supply 1,000 Mt C
  - 11,000 kWh / $t_{methanol}$
  - 29 PWh_{el} / year is required
  - 117,000 km_2 desert area is required
  - **1.3% of the Sahara** desert
- Using completely decarbonised renewable energy, the reduction potential is **3.7 Gt CO_2 / year**
- Global CO_2 emissions today: **55 Gt CO_2 / year**



Renewable Carbon from Recycling

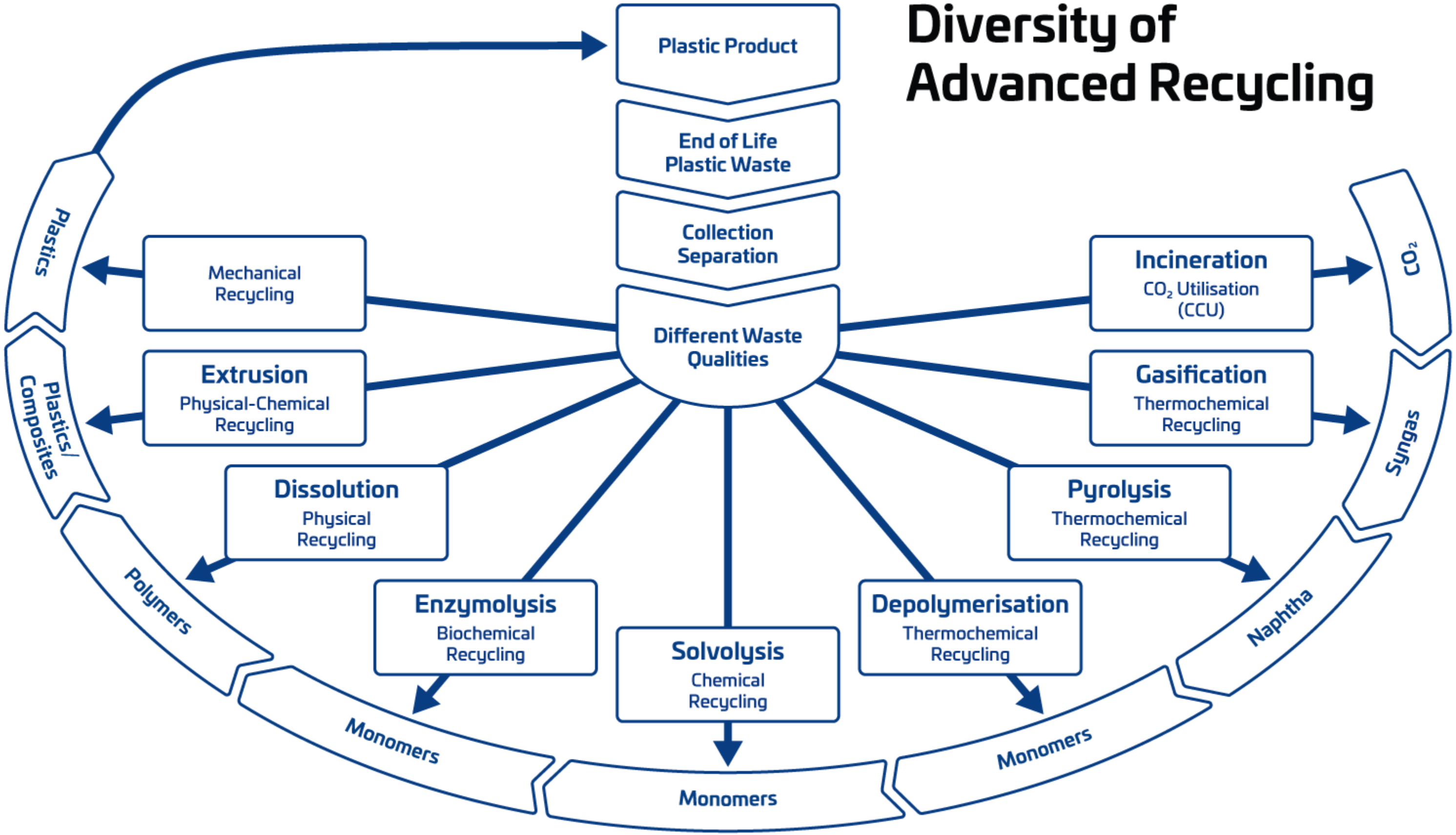
Pros in a nutshell

- Most important end-of-life option for plastics in the future circular economy
- Strong recycling targets in the European Union will guarantee access to renewable carbon from recycling
- Chemical recycling (different technologies): Basically no loss of quality compared to virgin feedstock

Cons in a nutshell

- Mechanical recycling: Limitation in quality, not allowed in many food applications
- Energy intensive processes
- Chemical recycling: early stage, first assessments on economic and environmental impacts available; investments waiting for clear political framework

Diversity of Advanced Recycling



available at www.renewable-carbon.eu/graphics

RENEWABLE CARBON INITIATIVE

Major challenges for chemical companies looking to switch from fossil to renewable carbon – the biggest transformation since industrial revolution

- **Which Carbon feedstocks** will be accepted and supported by policy in medium and long term?
- Which carbon will be **available in sufficient quantities** in the medium and long term to compete with the strongly supported bioenergy, biofuels and BECSS?
- How can the **competitiveness gap** be bridged during the transformation phase?
- When will there be clear **framework conditions** and political support?

The Risk: Without a clear policy framework and robust strategies, investments in a non-fossil / renewable chemical industry will be delayed and shifted to Asia and North America. **This is already happening** and Europe is losing innovation, sustainability options and competitiveness in a core industrial sector – threatening to cause dependencies that dwarf those on Russian crude oil and natural gas.

The Commission's paper on sustainable carbon cycles (Dec. 2021) was a milestone that gave hope to chemical innovators, but so far **without concrete follow-up.**

Where to invest and support?

Biomass

- **Food crops** – huge concerns that are not backed up by evidence; competition with bioenergy & biofuels
- **Cultivated agricultural biomass** – some member states expand the food crop concerns to non-food
- **Wood** – huge competition with subsidized bioenergy, advanced biofuels, bio-kerosine and BECCS
- **Biogenic side streams, by-products and waste** – huge competition with subsidized bioenergy, advanced biofuels, bio-kerosine and BECCS (REDII/III)
- **Demand for sustainability certificates** without providing any incentives
- Concerns to accept **Mass Balance and Free Attribution** (MBFA)

CO_2 utilisation, CCU / PtX

- **Biogenic CO_2 and Direct Air capture** – strong competition with e-fuels/kerosene (RED), BECCS and CDR; no support for BECCU
- **Fossil CO_2** – missing acceptance and competition with e-fuels/kerosene (RED) and CCS; no support for CCU; not part of ETS

Recycling

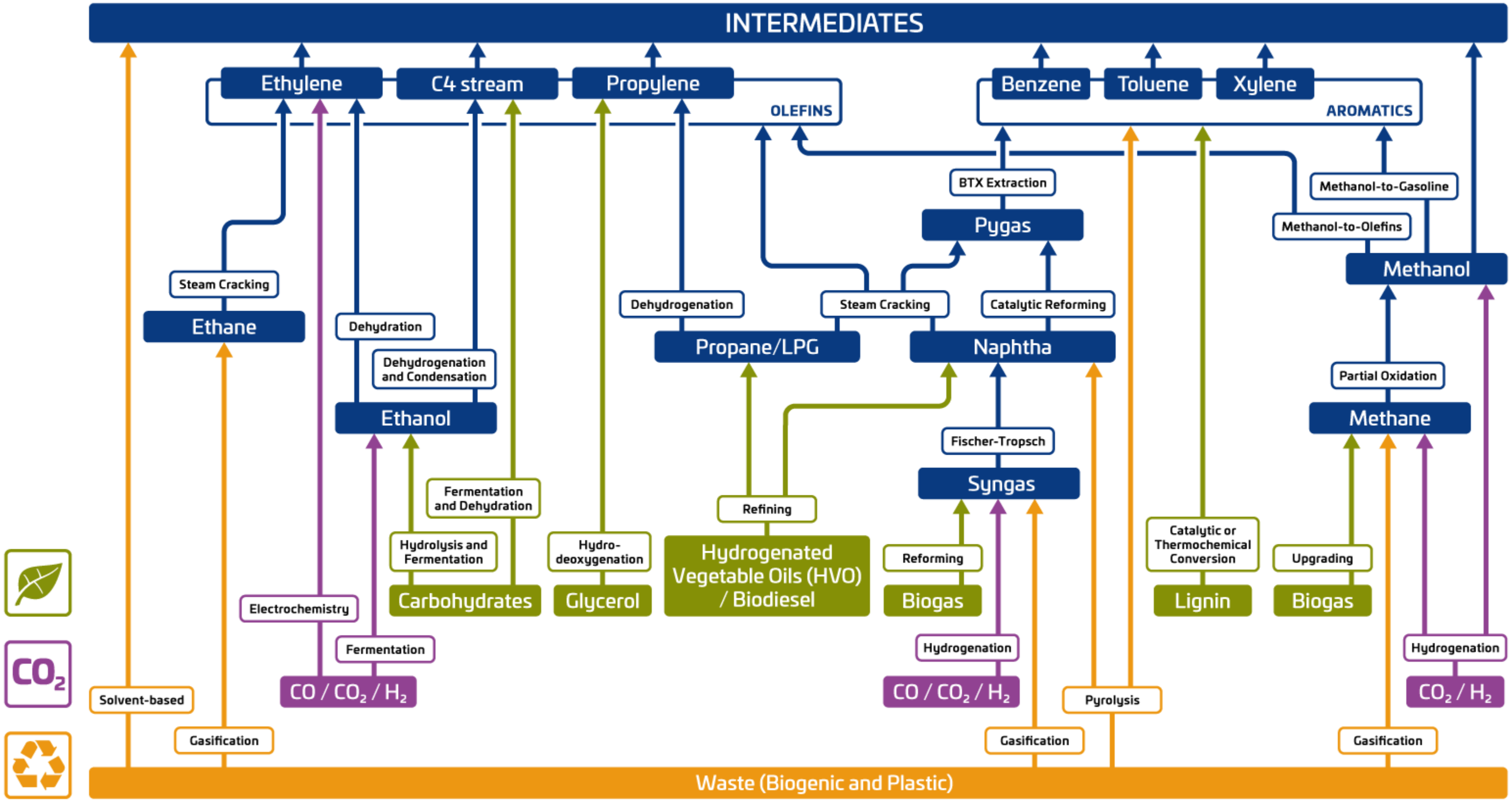
- **Chemical recycling** as a important carbon feedstock option – concerns and barriers, not counting in the recycling quota
- Concerns to accept **Mass Balance and Free Attribution** (MBFA)

Joel A. Tickner, Ken Geiser & Stephanie Baima (2022) Transitioning the Chemical Industry: Elements of a Roadmap Toward Sustainable Chemicals and Materials, Environment: Science and Policy for Sustainable Development

Figure 1.

Source: David Gerratt/DG Communications.

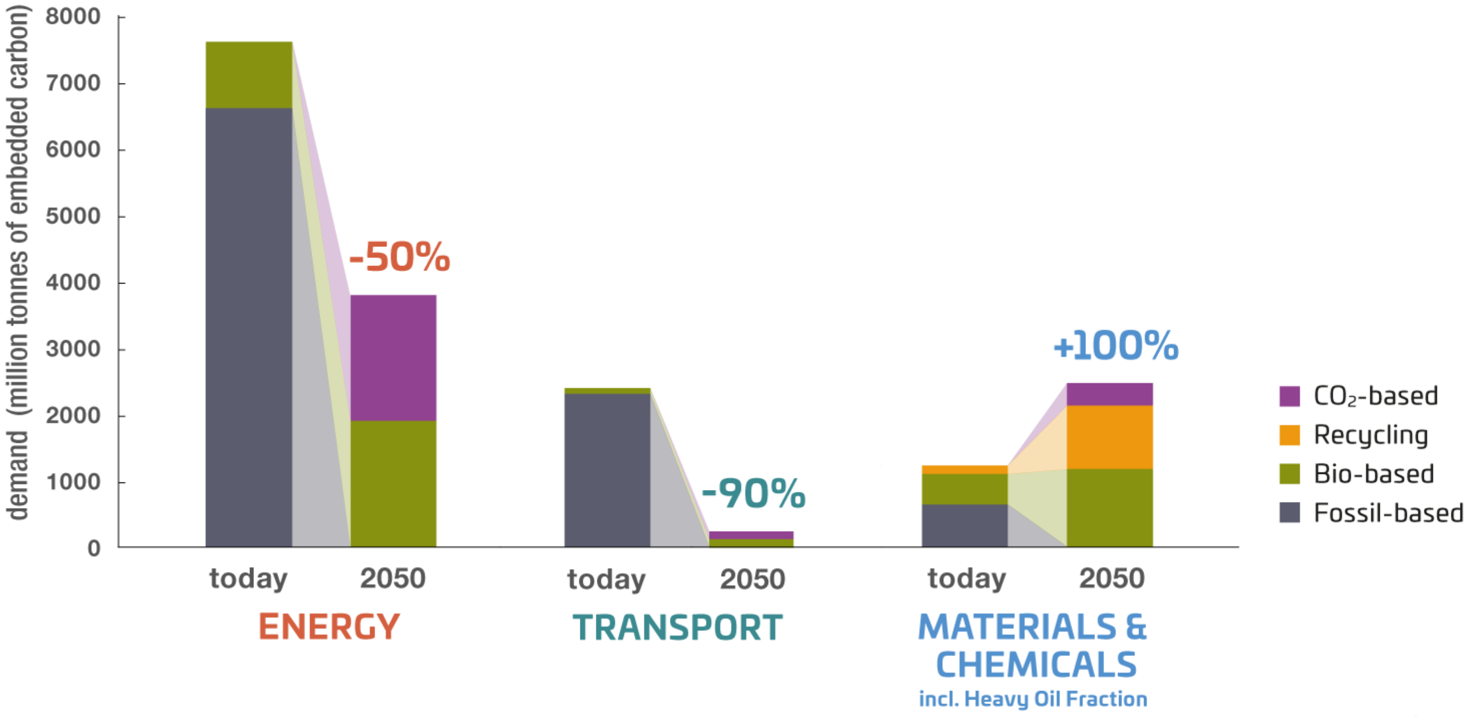
Renewable Carbon Refinery



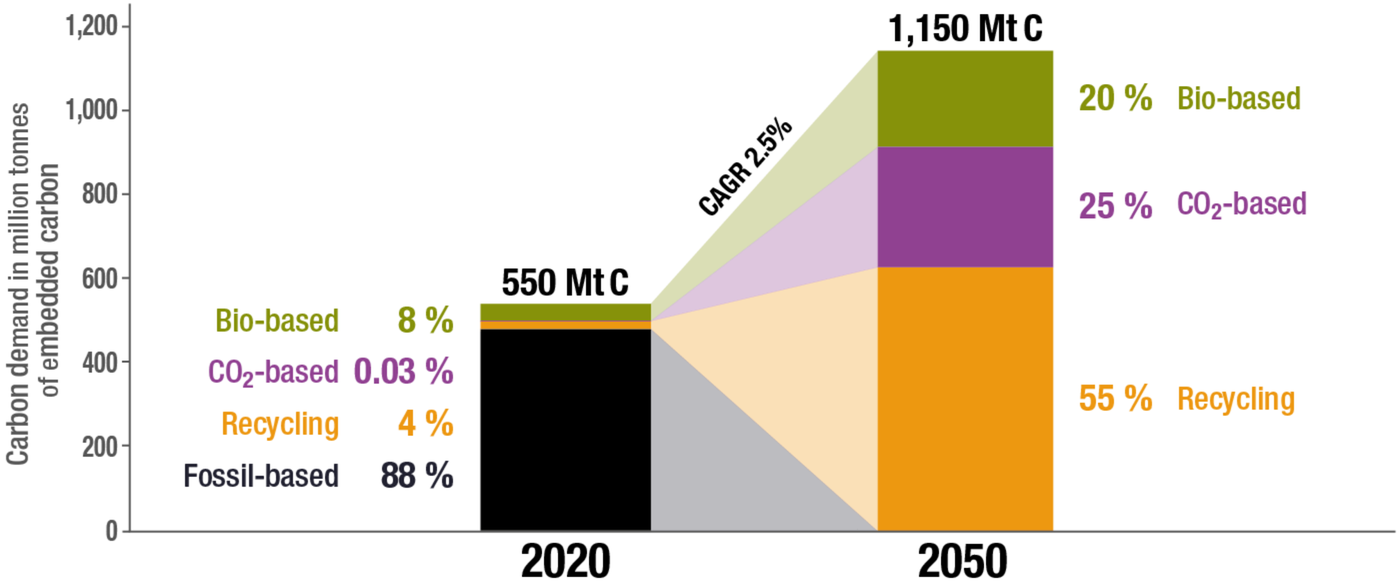
available at www.renewable-carbon.eu/graphics

Embedded Carbon Demand for Main Sectors

Today (2015–2020) and Scenario for 2050 (in Million Tonnes of Embedded Carbon)



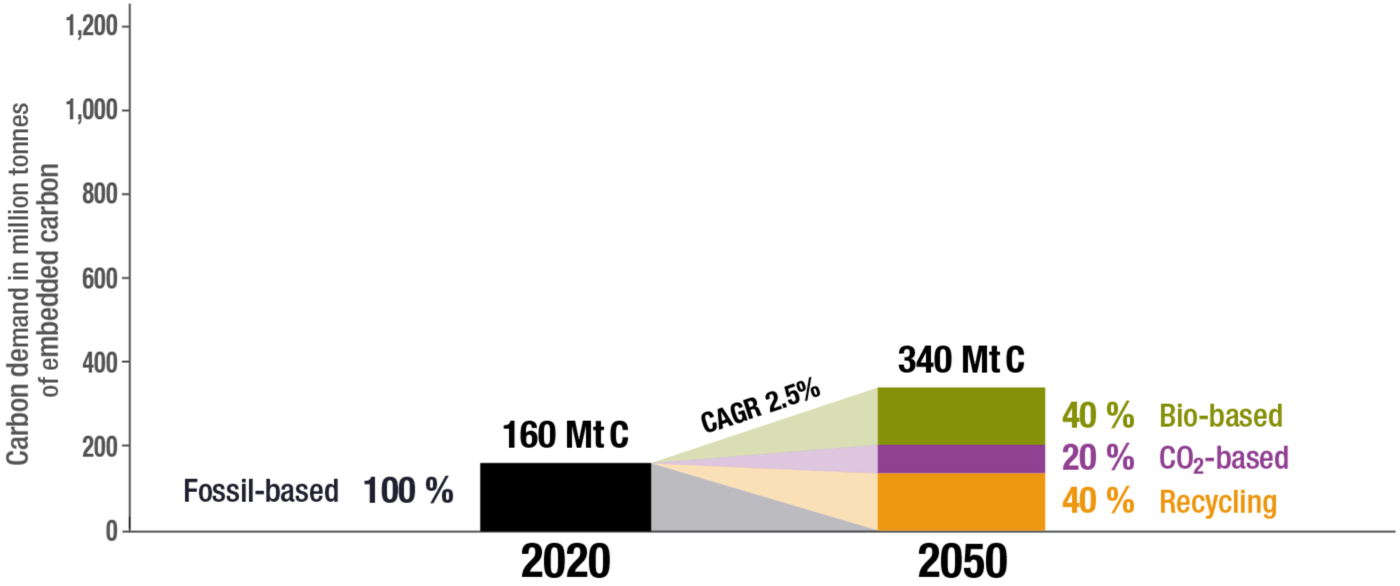
Carbon Embedded in Chemicals and Derived Materials



available at www.renewable-carbon.eu/graphics

Carbon Embedded in the Heavy Oil Fraction

(Bitumen, Lubricants, Paraffin Waxes)



available at www.renewable-carbon.eu/graphics

Nine Recent Studies on the Future of Chemical Industry: A Deeper Look at Scenarios on the Supply of Alternative Carbon Feedstocks

Report	Scope	CAGR	Share Bio-based	Share CO_2-based	Share Recycling
Ishii et al. / Systemiq 2022	Chemical Industry (cracker) 2020–2050	3%	up to 43%	up to 45%	up to 3%[1)]
OECD 2022	Plastic Sector 2019–2060	2.4%	3%	–	12%
RCI/nova 2023	Chemical Industry (cracker & more) 2020–2050	2.5%	20%	25%	55%
RCI/nova 2023	Chemical Industry (heavy oil fraction) 2050	2.5%	40% (mainly lignin & pyrolysis oil)	20% (mainly FT)	40% (pyrolysis oil)
Lange, J.-P. 2021 (Shell)	Chemical Industry (cracker & more) 2020–2100	a) 4% by 2050, 2% by 2100 b) 4% by 2025, 2% by 2100	40% (1G 10%, 2G 30%)	10%	50% (mech. 15%, chem. 35%)
Orth et al. 2022	Plastic Sector 2020–2050 (EU)	4%	90% renewable carbon (authors use the term “zirkuläre Rohstoffe”), 10% fossil carbon		
Meys et al. 2021 (Carbon Minds)	Chemical Industry (cracker) 2050	ca. 4%	21%	33%	45% (20% mech. 25% chem.)
CEFIC 2021, iC2050	Chemical Industry (cracker) 2050 (EU 27)	**high electr.:** 2.2% **circ.:** 1.1% **sust.** biomass: 2.3% **CO_2 capt.:** 1.1% (4 scenarios based on feedstock demand)	**high electr.:** 27% (60% fossil) **circ.:** 17% (54% fossil) **sust. biomass:** 35% (53% fossil) **CO_2 capt.:** 1% (88% fossil)	**high electr.:** 13% (60% fossil) **circ.:** 29% (54% fossil) **sust. biomass:** 12% (53% fossil) **CO_2 capt.:** 11% (88% fossil)	**low:** 35% (mech. 27%, chem. 8%) **medium:** 48% (mech. 31%, chem, 17%) **high:** 65% (mech. 33%, chem. 32%)
Material Economics 2019	Plastic Sector 2050 (EU)	scenarios show lower demand in 2050 because of efficiency	27 to 33% (three scenarios); bio-based plus CO_2 “at least 38%”	CO_2 as feedstock is covered, but without separated quantification	25 to 53%[2)] (three scenarios), max. 62%

1) Recycling is here mainly understood as virgin demand reduction, not as a supply option. 3% are the biogenic part only.

2) Sum is below 100%, because there are also shares for “circular economy in major value chains” and different kinds of stream cracking (with and without CCS).

RENEWABLE CARBON INITIATIVE

renewable-carbon-initiative.com

Michael Carus
Executive Manager
michael.carus@nova-institut.de

Christopher vom Berg
Executive Manager
christopher.vomberg@nova-institut.de

"Shape the Future of the Chemical and Material Industry"

MEMBERS OF THE INITIATIVE

ADM, Alfa Laval, ALPLA, avantium, BASF, Beiersdorf, BioBTX, BOREALIS, Braskem, CLARIANT, clariter, Cosun Beet Company, COVATIONBIO, covestro, DOW, ECONIC, EVONIK, Firmenich, FKuR, futerro, Givaudan, GREENLYTE Carbon Technologies, Peter Greven, Henkel, H&R, IBB Netzwerk GmbH, iff, IKT Kunststofftechnik Stuttgart, ITA RWTH Aachen University, Kemira, kuraray, LanzaTech, Leibniz-Institut für Verbundwerkstoffe, Lenzing, Lubrizol, MANE, NESTE, NORCE, nova, PCC SE, reckitt, SCGC, SHV ENERGY, stahl, SÜDZUCKER GROUP, SULZER, SUNCOAL, symrise, TC, TripleW, TÜV AUSTRIA, uniper, UPM BIOFORE BEYOND FOSSILS, VAUDE, Verbio, WACKER

PARTNERS OF THE INITIATIVE

bioplastics MAGAZINE, CO2 VALUE EUROPE, ECBF, ecp-news, Global CO2 Initiative University of Michigan, GO!PHA, Textile Exchange, WWF

Save the Date!

CELLULOSE FIBRES CONFERENCE 2023
Cologne (Germany) 8–9 March

Conference on CO_2-based Fuels & Chemicals 2023
19–20 April • Cologne (Germany)

RENEWABLE MATERIALS CONFERENCE 2023
23–25 May 2023 | Siegburg/Cologne

ADVANCED RECYCLING Conference 2023
28–29 November 2023 | Cologne

Contact:
Mr. Dominik Vogt
+49 (0) 2233 48 14 49
dominik.vogt@nova-institut.de

Sponsoring:
Mr. Guido Müller
+49 (0) 2233 48 14 44
guido.mueller@nova-institut.de

All conferences at
www.renewable-carbon.eu/events

Thank you for your attention!

Dipl.-Phys. Michael Carus

CEO
+49 (0) 2233 48 14-40
michael.carus@nova-institut.de

Renewable Carbon Economy
Markets & Marketing
Sustainability & Policy

Stay in touch: **renewable-carbon.eu/newsletters**

SusChem
European Technology Platform
for Sustainable Chemistry

– Two parallel breakout sessions

Two parallel breakout sessions

Implementation of the SSbD framework: needs, challenges, opportunities for the SusChem community

AMI2030: Delivering on the Materials Manifesto – what is needed to (re-)gain EU Advanced Materials technology leadership?

Moderators: Thomas GÖRGEN, Covestro/SusChem Board
Philippe JACQUES, EMIRI/SusChem Board

SUSCHEM
European Technology Platform
for Sustainable Chemistry

Implementation of the SSbD framework: needs, challenges, opportunities for the SusChem community

Moderator: Thomas GÖRGEN, Covestro/SusChem Board

SUSCHEM
European Technology Platform
for Sustainable Chemistry

Panel discussion on Advanced Materials: "Which challenges do advanced materials need to overcome to deliver on the Green Deal targets and EU strategic autonomy?"

Panel discussion on Advanced Materials
"Which challenges do advanced materials need to overcome to deliver on the Green Deal targets and EU strategic autonomy?"

- Jürgen Tiedje, Head of Unit European Commission Directorate-General for Research and Innovation - Prosperity - Industrial Transformation
- Nicolas Cudré-Mauroux, Chief Technology Officer Solvay
- Katja Loos, Professor for Polymer Science and Applied Chemistry Rijksuniversiteit Groningen
- Fabian Weinhandl, Head of GreenTech solutions at BDI
- Paul Cordfunke, Senior Consultant Lux Research

- **Moderator:** Eva Schillinger, SusChem

SUSCHEM
European Technology Platform
for Sustainable Chemistry

Jürgen TIEDJE

Head of Unit European Commission Directorate –
General for Research and Innovation - Prosperity –
Industrial Transformation

SUSCHEM
European Technology Platform
for Sustainable Chemistry

Nicolas CUDRÉ-MAUROUX

—

Chief Technology Officer Solvay

suschem.org

Katja Loos

—

Professor for Polymer Science and Applied Chemistry
Rijksuniversiteit Groningen

SusChem
European Technology Platform
for Sustainable Chemistry

Fabian Weinhandl

—

Head of GreenTech solutions at BDI

Paul CORDFUNKE

—

Senior Consultant Lux Research

suschem.org

Closing remarks

J.R. Wünsch, Senior Vice President at BASF SE

SusChem
European Technology Platform
for Sustainable Chemistry

Thank you!

suschem.org