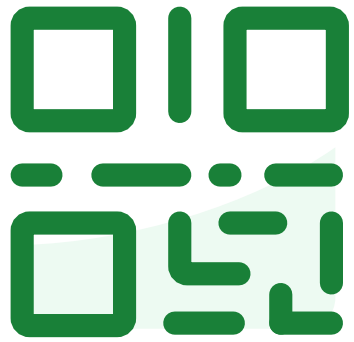


A Roadmap for Industrial Symbiosis Standardisation

Working Groups Plenary

EIT House, Brussels & online





**Join at slido.com
#4139323**



What kind of sectoral stakeholder are you?



I'm attending this Plenary to:

Welcome & Strategic Framing

Andreea Gulacsi

Director Policy & External Affairs, CEN and CENELEC

Industrial Symbiosis: Situation and Potential for Europe's Industries

Sebastian Engell

Chair of the Advisory and Programming Group of A.SPIRE
and Co-Chair of the P4P Partnership Board



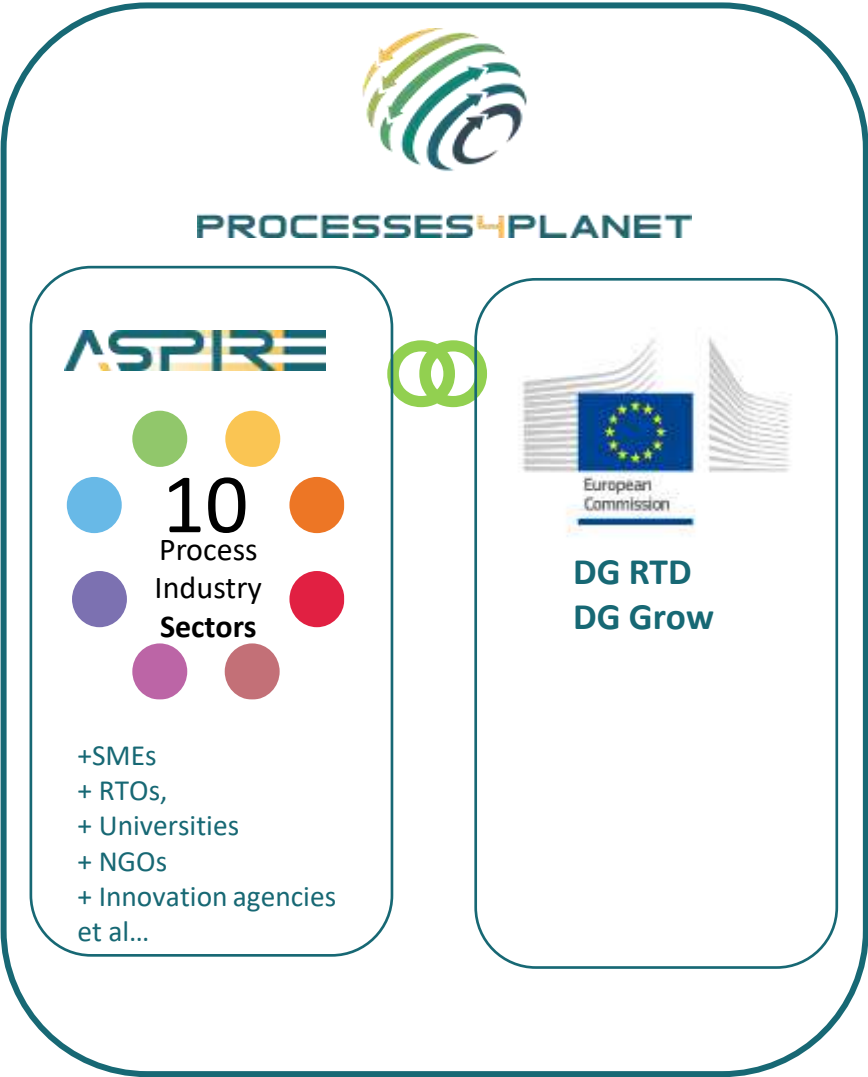


PROCESSES4PLANET

A.SPIRE & Processes4Planet Partnership

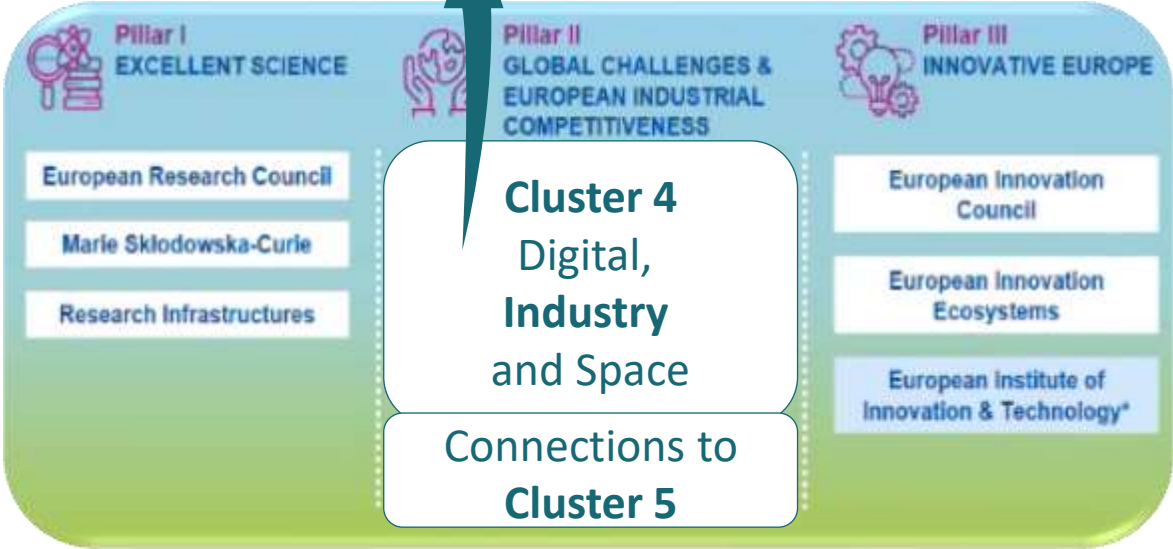
2025

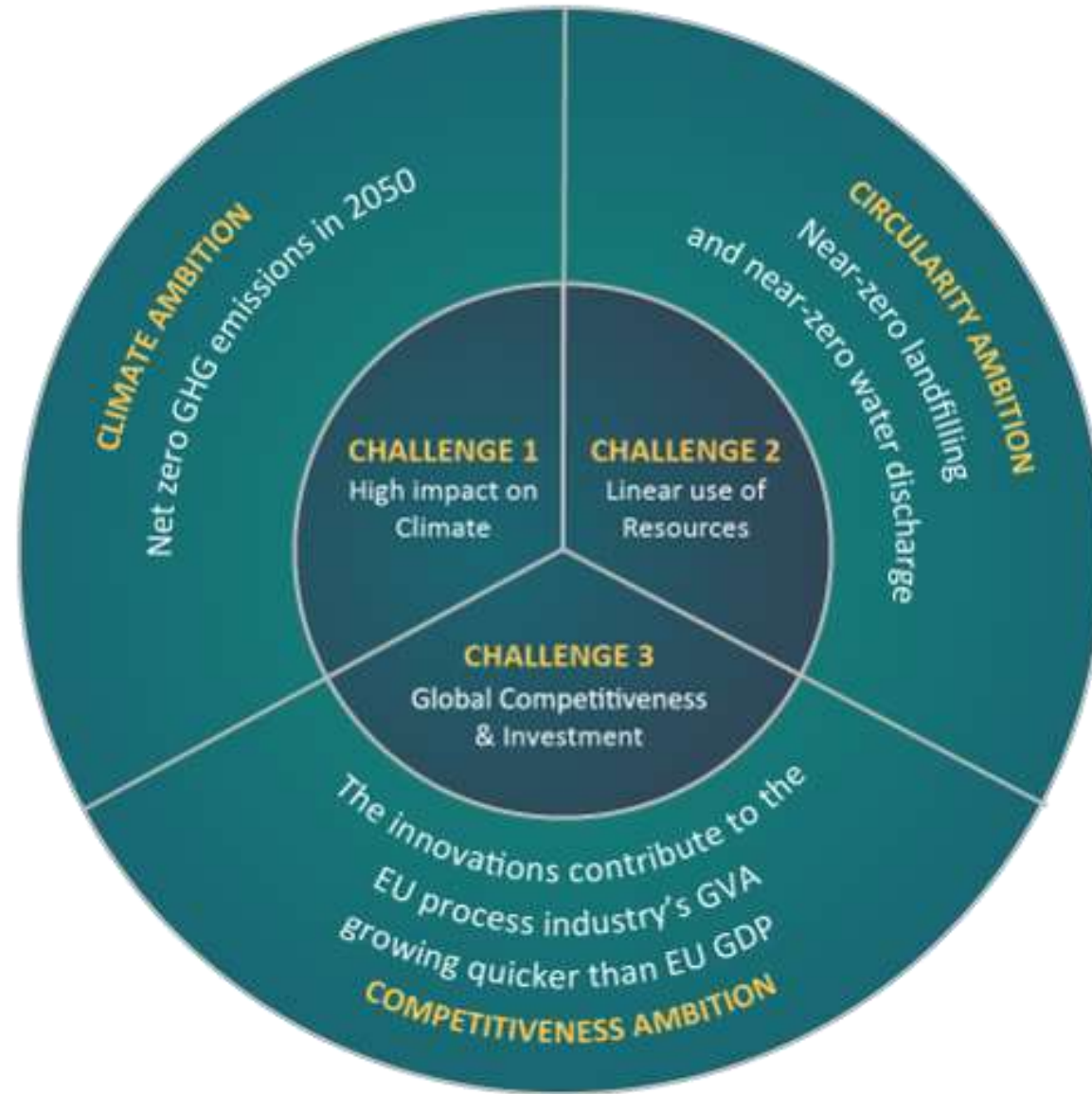




Co-programmed Partnership

MoU signed:
€1,3 bn exclusively for projects
27% more than in H2020





Industrial symbiosis,
industrial-urban symbiosis,
and Hubs4Circularity
are **important enablers!**

2021

- **Deploying industrial-urban symbiosis solutions** for the utilization of energy, water, industrial waste and by-products at regional scale
- **Hubs for Circularity European Community of Practice (ECoP)** platform
- **Plastic waste as a circular carbon feedstock** for industry
- Design and optimisation of **energy flexible industrial processes**
- **Ensuring circularity of composite materials**

2022

- **Circular flows for solid waste** in urban environment
- **Valorisation of CO/CO₂** streams into added-value products of market interest
- **Integration of hydrogen** for replacing fossil fuels in industrial applications
- **Circular and low emission value chains** through digitalisation

2023

- **Energy efficiency** breakthroughs in the process industries
- Modelling process industry transition to climate neutrality, sustainability and circularity
- **Hubs for circularity** for near zero emissions regions applying **industrial symbiosis** and cooperative approach to **heavy industrialized clusters** and surrounding ecosystems
- Sustainable and efficient **industrial water consumption**: through energy and solute recovery
- **Circular economy** in process industries: **Upcycling large volumes of secondary resources**

2024

- Optimisation of **thermal energy flows** in the process industry
- Renewable **hydrogen used as feedstock** in innovative production routes
- Turning **CO₂ emissions from the process industry to feedstock**
- **Hubs for circularity for industrialised urban peripheral areas**
- Breakthroughs to **improve process industry resource efficiency**



R&I Priority Themes

1. Electrification of the process industries
2. Alternative carriers of energy and their integration
3. Accelerated improvement of energy and material efficiency
4. CO2 capture and utilization
5. Circularity
6. Design and production of safe and sustainable materials
7. Digitalization and Industry 5.0

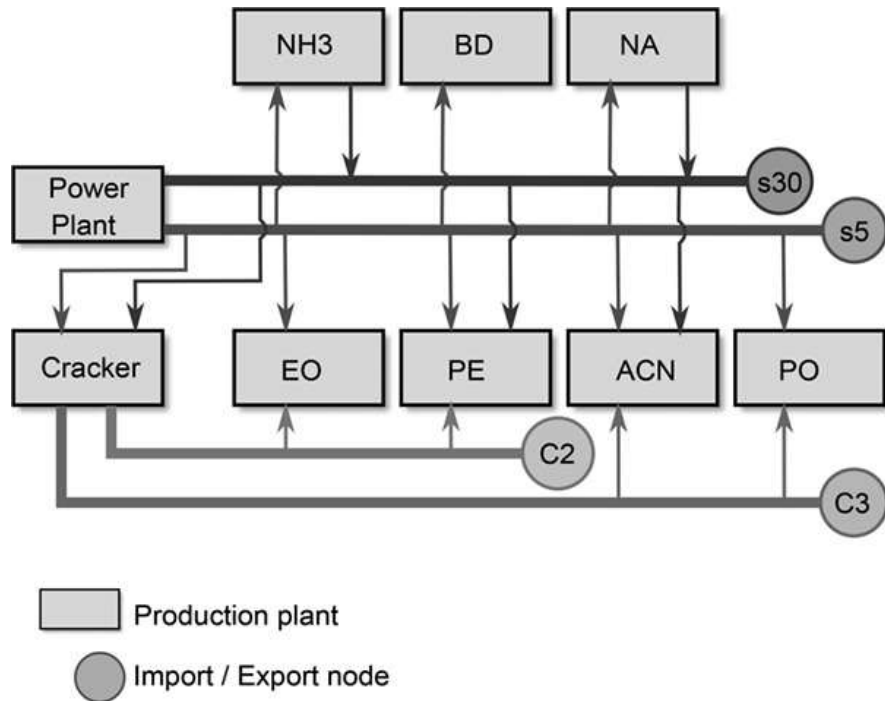
- The prototype: Verbund site of BASF in Ludwigshafen, 125 plants
 - Tight energy and materials integration
 - Multiple networks connect the plants
 - Minimization of waste streams
 - Central management
- Difficult times and new opportunities:
 - Plants under increasingly under different ownership
 - Priority on low-hanging fruit
 - Changes of technologies loosen or break existing integration
 - New infrastructures: CO₂, hydrogen
 - New cross-sectorial ties:
 - Electric power
 - Biogenic feedstock
 - End-of-use waste
- Uncertainty about the future framework conditions blocks investments

→ **Clean Industrial Deal**



In 5-10 years, the sites will look different!

Current petrochemical site



- Steam networks as main energy grids
- Energy input from fossil sources

Future

- Electrification
 - heat generation more local
 - Coordination with the power grid
 - Multiple storages
- CCS – new networks
- Hydrogen
 - Grid and local production
- New feedstock
- New ties to other sectors
- No centralized management any more

Similar e.g. for steel making: New production routes, different by-products

Apply a broad concept of industrial symbiosis and consider the upcoming evolution!

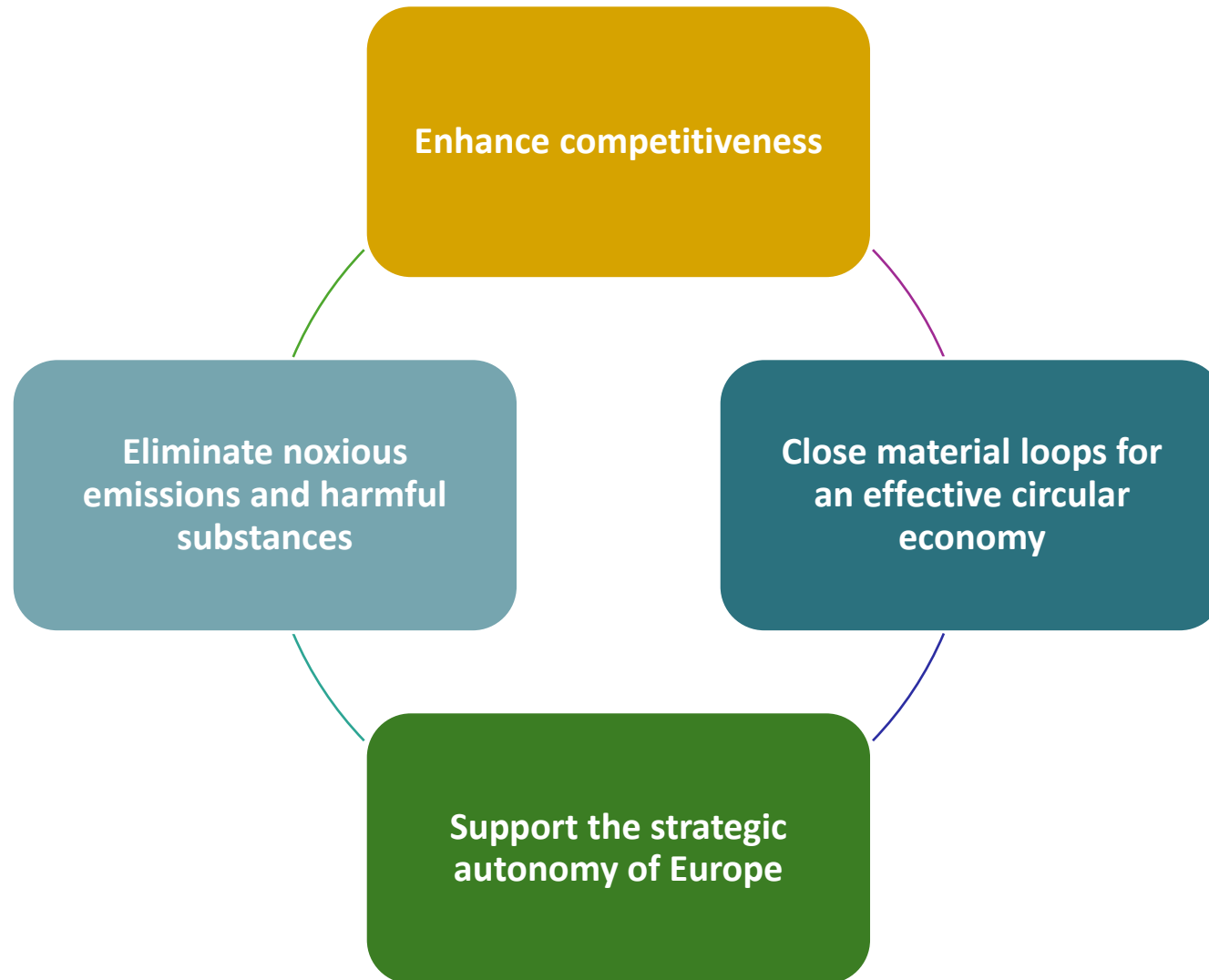
- Progress in providing feedstock to the process industries from secondary materials has not been as fast as hoped for.
- Circularity leads to complex networks of different (reverse) value chains.
 - Challenging sorting, extraction and separation processes
 - Effects of technological choices propagate along the chains.
 - The different steps are performed under different ownership – the whole chain must be economically viable but also the individual elements.
 - The total LCA must be positive.
 - If one element breaks, the whole chain breaks.
- Current and upcoming P4P calls demand an integrated look at the value chains / networks.



Transition to a new Partnership

- Processes4Planet will fade out after the 2027 calls
- We are working towards a new R&I Partnership to foster Resilient, Clean & Competitive European Process Industries
- Positive feedback from the Commission





- Competitiveness will be prioritized. Targets up to TRL 8.
- Broader view at emissions
- Raw materials from Europe will be valued more: metals and minerals, biogenic feedstock, secondary feedstock
- Strategic value chains must remain in Europe
- New and modified **materials and processes** to provide the best function in the most safe and sustainable manner, and to enable safe and sustainable re-integration of by-products and end-of-life materials into the production cycle or into the biosphere
- **Industrial symbiosis, industrial-urban symbiosis, and circular value networks are important contributors to all pillars!**

- Two identical calls in 2026 and 2027
- Projects must target **industrial demonstrators reaching TRL 7-8**
- Funding per project **15 – 25 M€**
- **Industrial leadership** required
- Go – no go moment before the contracting

3 technology areas

- Managing of carbon cycle (CCU and/or CCUS) - further optimization and demonstration of solutions
- Clean energy usage in production (electrification of the processes, integration of alternative clean energy carriers, demand side management including more effective on site renewable energy storage solutions)
- Circularity and resource efficiency (material, energy, water) of production processes: improvement by 30% until 2035 compared to current industrial values

- RISERS does great work in supporting industrial symbiosis, industrial-urban symbiosis and circular value networks!
- Support our industries by standardization, but do not make life difficult!
- Stay technology-neutral! Allow competition for the best solution in terms of cost and LCA!

Thank you very much for your attention!

Aligning the EU's Circular Economy Ambitions with Industrial Symbiosis

Valeria Botta

Programme Director, Environmental Coalition on Standards
(ECOS)



ecos

EU Policy Outlook on Circularity and Waste

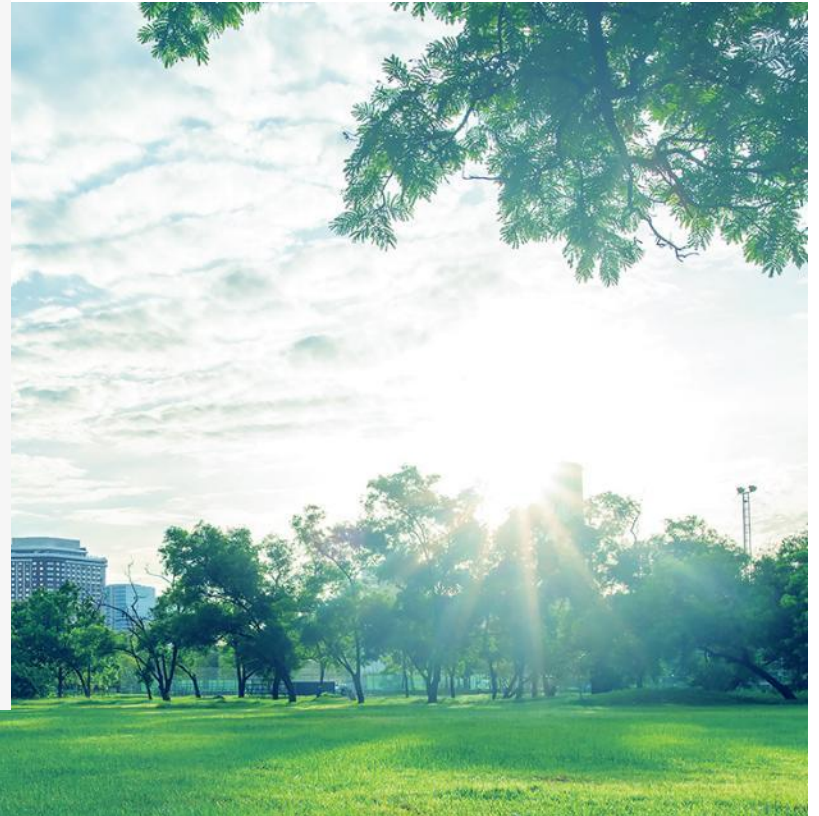
Valeria Botta Programme Director

November 2025

ECOS

Environmental Coalition on Standards

is an international NGO with a network of members and experts advocating for environmentally friendly technical standards, policies, and laws.

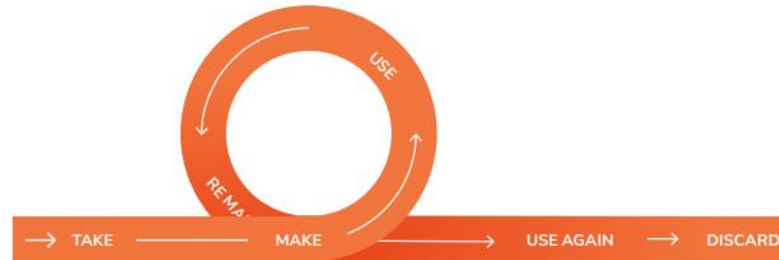


Linear VS Circular Economy

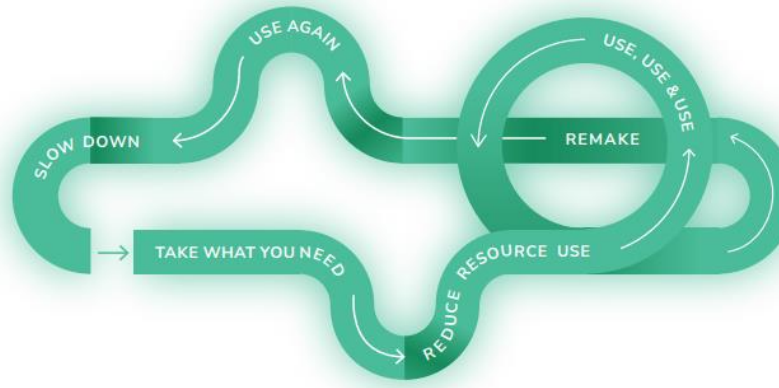
Linear
economy



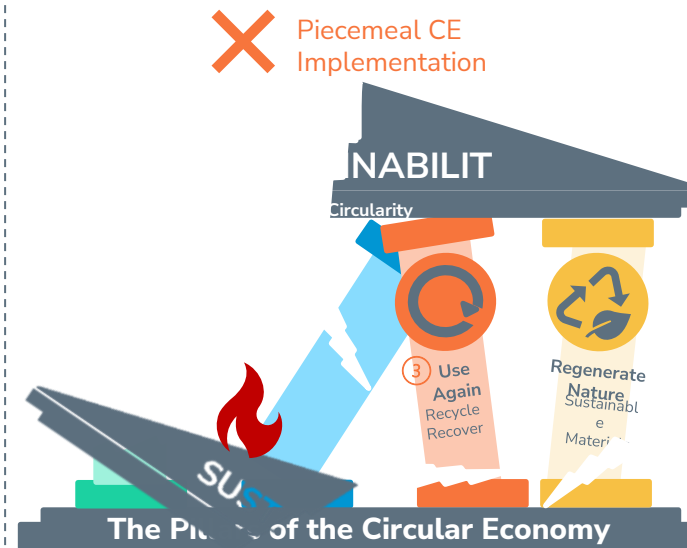
Recycling
economy



Circular
economy



The essential pillars needed to transition to a Circular Economy



Circularity from buzzword to reality

Letta's report: "Circular economy is the only possibility of saving the planet and changing the paradigm of present manufacturing, and will require a robust set of competencies, safeguarded intellectual property and the ability to convert these assets into innovation and a thriving industry"

2015



2020



2026



Robust standards can be powerful levers to support circular economy policy objectives.

Thank you



Environmental Coalition on Standards

c/o WeWork

Rue du
Commerce 31
1000 Brussels,
Belgium

se @ECOS_Standard

+32 2 899 7680

info@ecostandard.org

www.ecostandard.org



ECOS-NGO



ECOS is co-funded by the European Commission & EFTA

Working Group Updates I – Systemic Enablers

WG 01 Industrial Symbiosis in General &
the United Circles Project

WG 02 End-of-Waste

WG 03 Digitalisation & Data



Industrial Symbiosis Standardization Roadmap

WG 01

Industrial Symbiosis in
General

Plenary presentation
12 November 2025

James Woodcock, Senior Project Manager at
International Synergies Limited (ISL)

RISERS





**What terminology do you most
associate with Industrial Symbiosis?**

Why Industrial Symbiosis in General?

- § Lack of harmonised terminology and shared definitions:
 - § Terms such as “industrial symbiosis,” “by-product,” “co-product,” or “secondary raw material” are interpreted inconsistently in national policy frameworks, research initiatives, and private sector applications, leading to legal uncertainty and fragmented implementation.
- § Regulatory divergence:
 - § Differences in interpretation of waste and by-product status, coupled with complex permitting procedures, create significant barriers

Standardisation framework	recommendations
CEN Workshop agreement CWA 17354	- Workshop agreement has expired – replacement by new standard guidance document needed - Lacking sufficient standards for IS implementation - Guidance for stable mutual responsibility symbiotic relationships - Guidance for establishing trust structures and platforms for secure exchange of process data - Adopted by TC465 - Sustainable Cities and Communities to advance a new European standard on industrial symbiosis for sustainable cities - Now developing a standard to replace the CWA
CEN/TR 16957:2016 – Industrial Symbiosis – Core Elements and Implementation Approaches BS 8001:2017 0 Framework for implementing the principles of the circular economy	- Technical report detailing how to identify potential symbiosis relationships; how to implement transactions; how to evaluate impacts - Contain elements of industrial symbiosis

Introduction to project context

- § Focusing on 'IS in general'
- § Not creating new definition/standard
 - § Looking at HOW a standard, including an agreed definition, aids IS
- § Background to IS definition
 - § IS included in EU level policies (and beyond) since at least 2008
 - § Included in multiple Directorate agendas
 - § No single definition for IS – what is actually being discussed (including IS vs I-US)?
 - § Require single source of truth across all these instances, including Directorates
 - § The goal is to identify standardisation gaps, provide practical recommendations, and ultimately feed into the European standardisation system (CEN/CENELEC/ISO).

Opportunities for Progress

- § Developing a standardised IS definition, common terminology and shared metrics across sectors
- § Exploring diverse governance models, including facilitation along with ICT-based coordination mechanisms. Allow for fuzzy boundaries between models
- § Establishing a standards-based framework for transactions involving by-products, waste, and other resources (but cannot be too prescriptive).
- § Enabling large scale digital matchmaking platforms to increase visibility of available resources and potential partners.
- § Providing targeted financial incentives and sectoral funding schemes to support initial investments and infrastructure needs

Main points – Regulation

- § Simplify by-product classification and harmonise end-of-waste criteria across jurisdictions. Possible replacement of end of waste by standards
- § Streamline permitting processes and reduce administrative burdens for IS exchanges.
- § Promote governmental action plans, clustering initiatives, and awareness-raising to encourage adoption.
- § Encourage policy frameworks that mobilise initiatives, facilitate partnerships, and embed IS in sustainable industrial strategies.
- § Incorporate IS into EU taxonomy for (sustainable) finance facilitation purposes

Main points – Standardisation

- § Establish a standardised IS definition, common terminology, and shared metrics across sectors.
- § Create methodologies and tools for assessing the economic and environmental value of synergies, including logistics feasibility.
- § Integrate IS considerations into existing standards such as LCA, material flow analysis, and environmental management.
- § Consider developing a standard for symbiosis management systems to guide internal organisational structures

Main points – Cross-cutting measures (more advice rather than IS standards)



§ Strengthen Relationships and Collaboration:

- § Foster networks, clusters, and associations among industries, waste managers, logistics providers, knowledge agents, and government entities to build trust and identify opportunities.

§ Financing and Incentives:

- § Implement sectoral funding programmes, economic incentives, and public/private financing mechanisms to address investment barriers and support infrastructure acquisition.

§ Geographical and Logistics Optimisation:

- § Prioritise proximity in planning; partner with logistics companies to optimise resource transport, waste collection/segregation/treatment; use tools to evaluate distance-related feasibility.

Main points – Cross-cutting measures (more advice rather than IS standards)



§ Knowledge and Research Collaboration:

- § Engage R&D entities for practice-oriented studies, training, and dissemination to raise awareness of IS benefits.

§ Overcoming Social Barriers:

- § Foster environments of trust and involve intermediaries/promoters to reduce resistance and broaden stakeholder participation.

§ Internal Organisational Structures:

- § Establish dedicated IS teams or functions within companies to identify and manage synergies strategically.

Thank you!

Contact:

- James Woodcock
James.Woodcock@international-synergies.com

WWW.RISERS-PROJECT.EU





RISERS - PLENARY OF THE INDUSTRIAL SYMBIOSIS STANDARDISATION ROADMAP WORKING GROUPS

UNI – Italian Standards Body
12/10/2025



Funded by
the European Union

OUTLINE

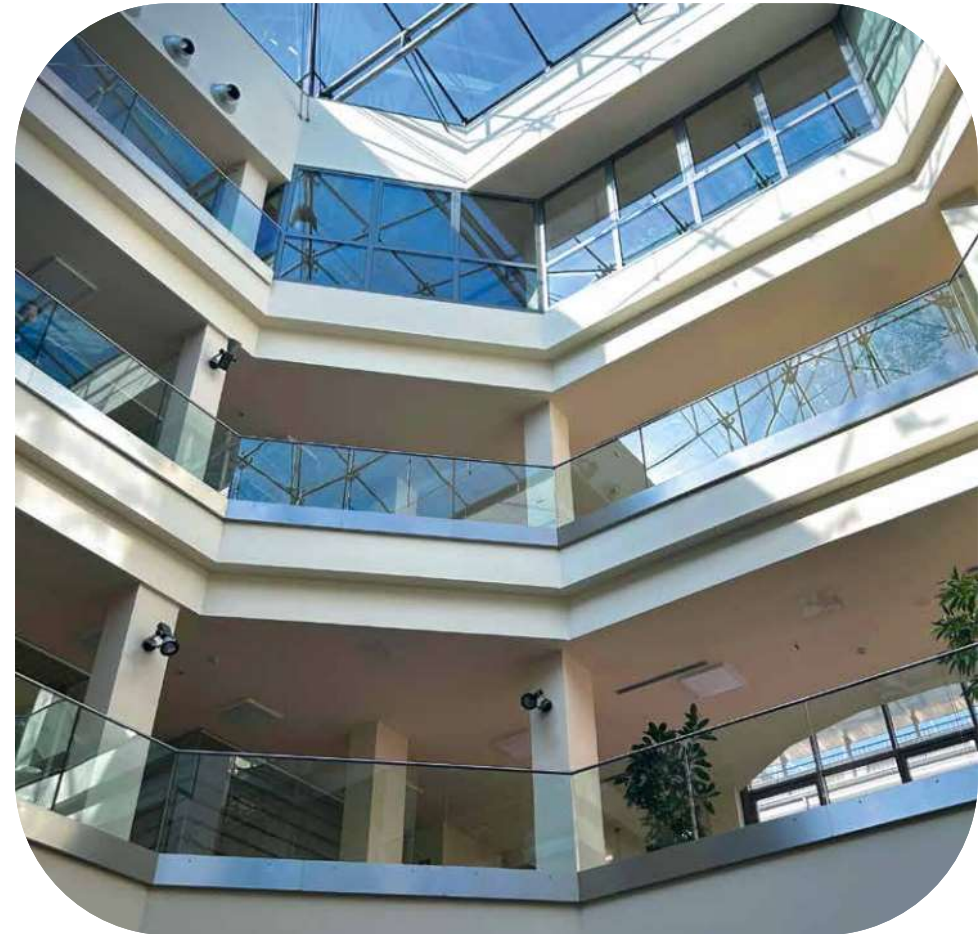
- 1. UNI - WHO WE ARE**
- 2. EU-FUNDED RESEARCH AND INNOVATION PROJECT**
 - a. UNITED CIRCLES - WHAT IS ABOUT**
 - b. UNITED CIRCLES - CWA DRAFT PROPOSAL**
- 3. STANDARDIZATION ACTIVITY**
 - a. CEN/TC 465 - OVERVIEW**
 - b. CEN/TC 465 - WG 04 FOCUS**

UNI – WHO WE ARE

UNI - Italian Standards Body is a **private, non-profit association** established in **1921**, officially **recognized under Italian law**, with headquarters in **Milan**.

We participate as a **partner** in the **EU-funded research and innovation project UNITED CIRCLES** - *Networked **industrial-urban symbiosis value chain** demonstrators for biomaterials, C&DW, circular water loops & WWTPs, driven by Hubs 4 Circularity.*

We develop standards across all sectors of the economy — for industry, commerce, services, and society at large, except for electrical and electrotechnical matters (CTI).



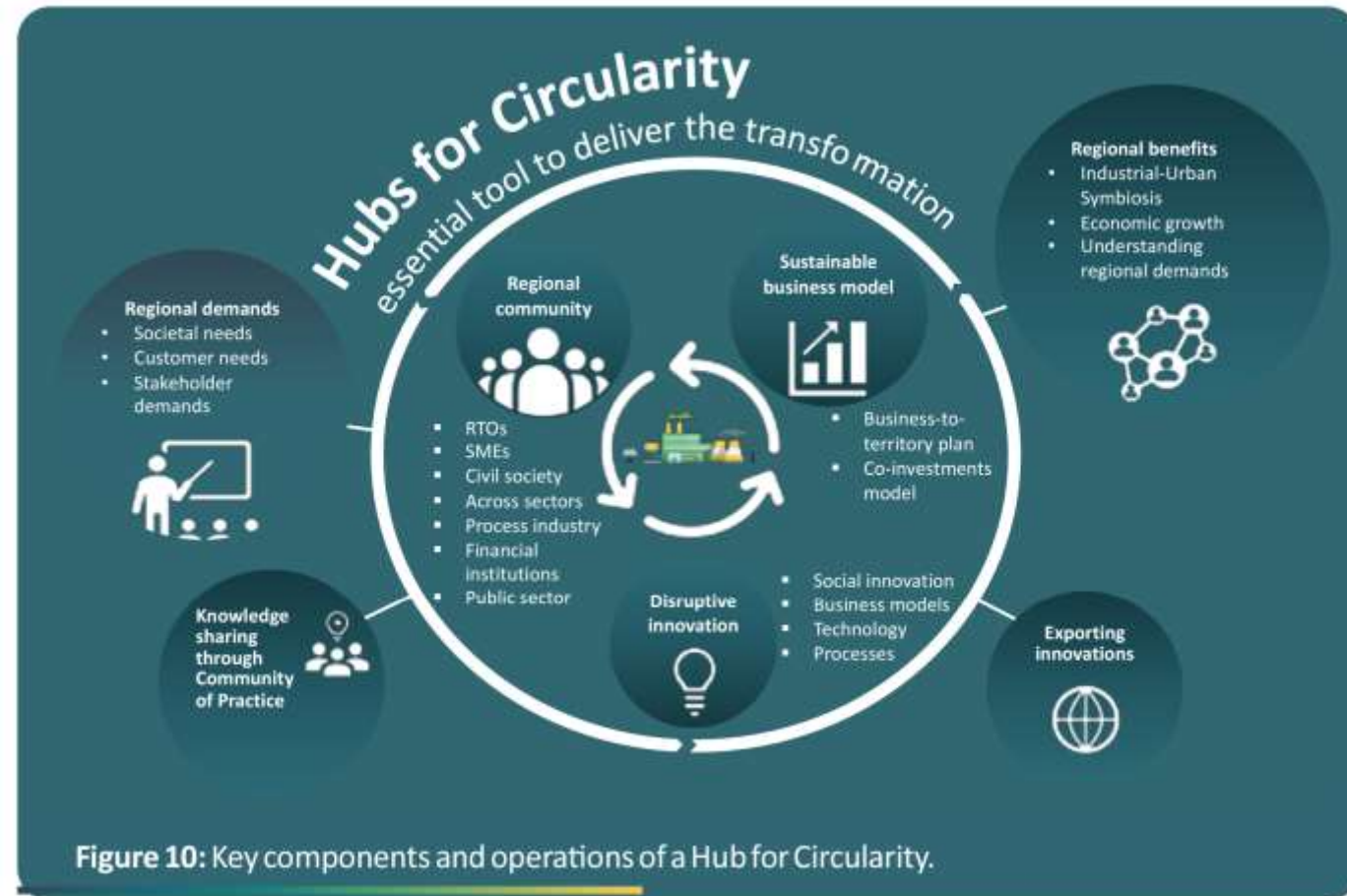
UNITED CIRCLES – WHAT IS ABOUT

The United Circles HORIZON project, involving close to **50 partners** (LP Fundacion CARTIF) across **14 countries** collaborating for **4 years** aiming to demonstrate three innovative **Industrial-Urban Symbiosis (IUS) value chains**.

These **value chains** focus on:

- upcycling **urban food waste**;
- **effluent** in wastewater treatment ;
- **construction and demolition waste** (CDW) into feedstocks for local industries.

each one embedded in a **Hub for Circularity (H4C)**, which will serve as a platform to govern and support their industrial-urban networks



Hubs for Circularity concept of the Processes4Planet partnership

UNITED CIRCLES – WHAT IS ABOUT



- **Seed Hubs: Ankara, Salamanca and Veneto regions** will each form a Hub 4 Circularity around technology demonstrator efforts for scaling to a mature circular value change.
- **Mirroring Hubs:** 4 mirrors to strengthen partnerships and explore the potential for replication of one or more of the demonstrators at full scale, and work towards bringing industrial investment to the region.
- **Demonstrators Hubs:** At least one advanced value chain demonstrator.

Each of the Demonstrator H4C will be followed by four Mirroring Hubs for replication



Southern Transdanubia, Hungary, starting H4C hosted by Digital Innovation Hub INM & water tech company Grunwald (GRUN), with commitment by City of Pecs.



Eastern Macedonia & Thrace, Greece. Starting H4C hosted by the regional authority (EM&T) and Technical Univ. of Athens (NTUA).



Gauteng, South Africa. Starting H4C hosted by University of Johannesburg (UoJ) with commitment from the City of Johannesburg & Gauteng government.



South-East England, UK. Starting H4C hosted by the community actor Tech Take-Back (TTB) & Kent County Council (KENT).

UNITED CIRCLES – CWA DRAFT PROPOSAL

In our project:

- **Specific WP:** Exploitation
- **Task:** Standardisation landscape scan and CWA delivery
- **Field:** Industrial-Urban Symbiosis (IUS)
- **Leader:** UNI
- **Participants:** ECOW, STEN, COM, ZEDO, SCYCA

CEN Workshop Agreement (CWA) is a reference document developed by the **European Committee for Standardization (CEN)**.

Key Features:

- Acts as a **pre-standard**, not an official standard from member organizations
- Tailored for **research** and **innovative topics**
- **Faster process** than formal standards



UNITED CIRCLES – CWA DRAFT PROPOSAL

Feasibility to Finance framework for Circular Infrastructure.

The UCs consortium elaborates a **Feasibility to Finance (F2F) framework**, central to bridging the gap between technological development and market uptake of the UCs demonstrators.

F2F framework establishes a structured, stepwise approach to **assess economic, financial, and risk-related aspects** of the **value chains**, enabling informed decision-making and investment readiness.

The **stage-gate logic**, combined with a **maturity scoring system**, establishes a **common language** for **H4Cs investors** while allowing **tailoring** to specific sectoral, infrastructural and territorial contexts.

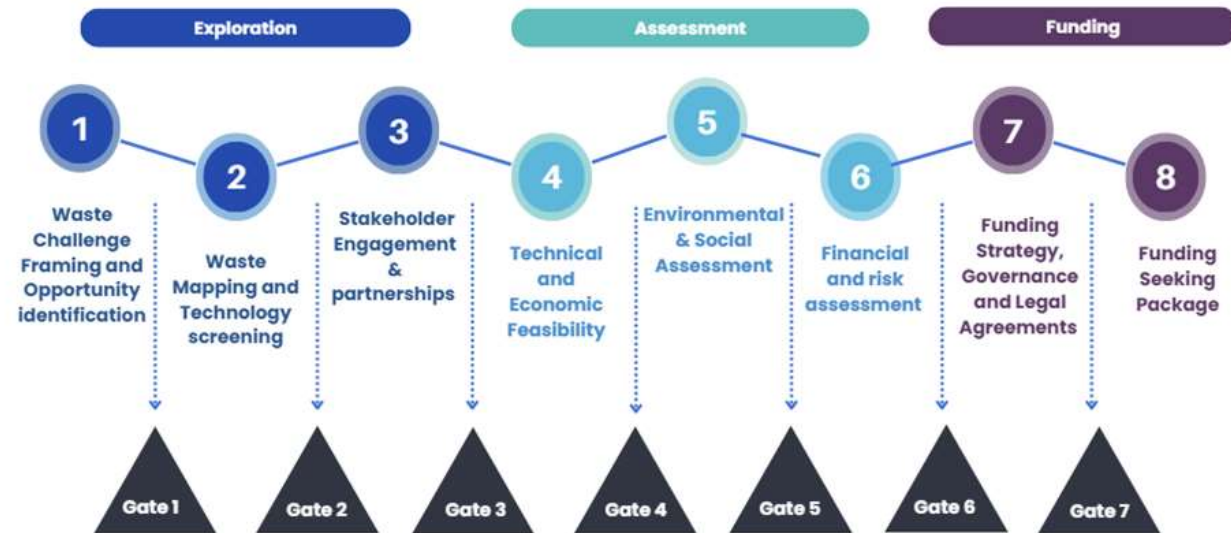


Figure 3 - The 8-Step Feasibility to Financing (F2F) Framework - from Task 2.3 H4C Infrastructure Feasibility towards Financing Framework - D2.3 Feasibility to Finance framework for Circular Infrastructure

CEN/TC 465 Sustainable Cities and Communities

SCOPE

The standardization work will focus on developing requirements, frameworks, guidance, and supporting tools that **promote sustainable development in communities** as defined by **ISO 37101**. Special emphasis will be placed on **innovative approaches** to **solution** and **service delivery**

OPERATIONAL AREAS

CEN/TC 465/WG 1-Nature-Based Solutions

CEN/TC 465/WG 2 -Services to citizens

CEN/TC 465/WG 3- Territorial Resilience Development

CEN/TC 465/WG 4- Industrial Symbiosis for Sustainable Cities and Communities

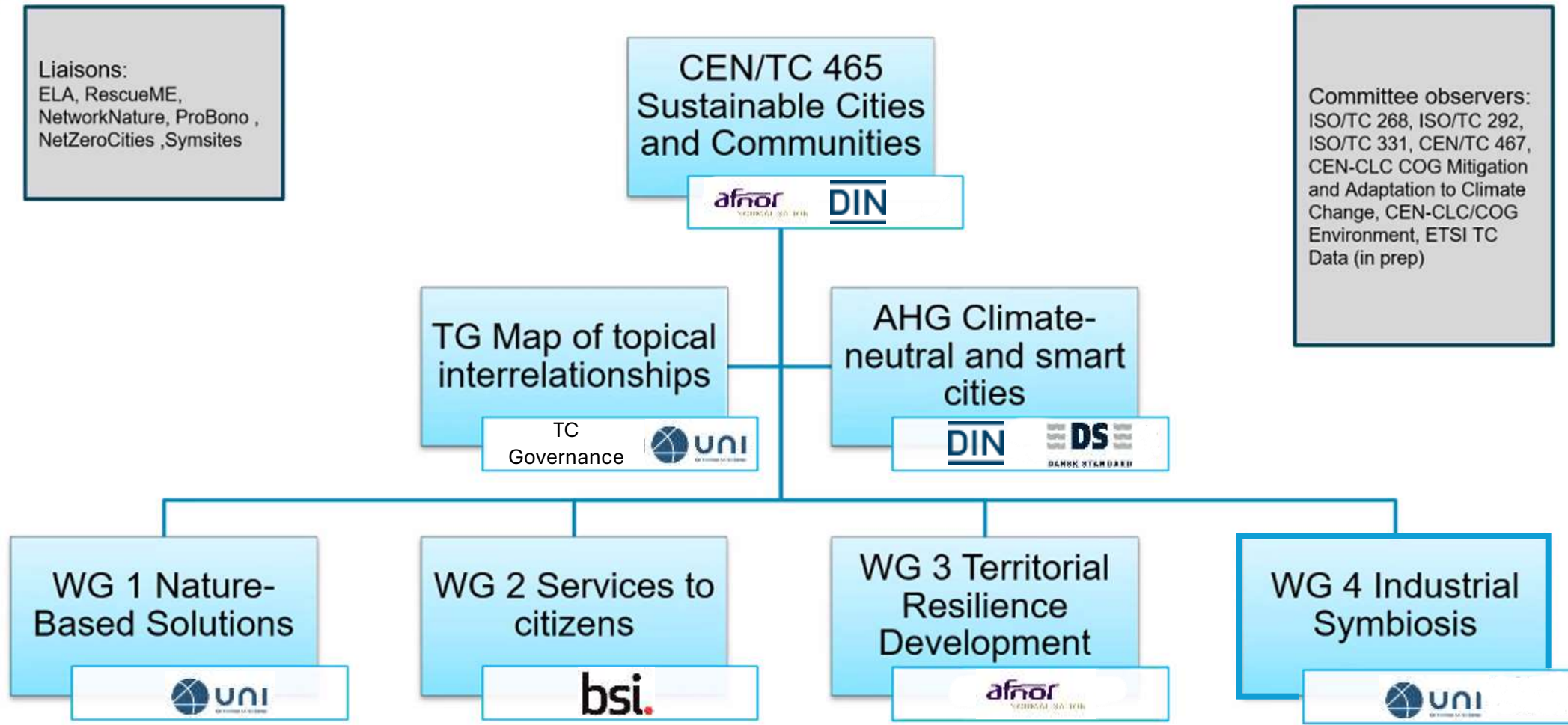
LINKS TO GLOBAL & EU GOALS

Through its work, TC 465 will assist cities and communities' decision-making in support of Europe's contributions to the implementation of the **UN SDGs**, as expressed in the **EU Green Deal** and the **EU Urban Agenda**



CEN/TC 465 - OVERVIEW

BUSINESS PLAN – STRUCTURE (AS OF AUGUST 2025)



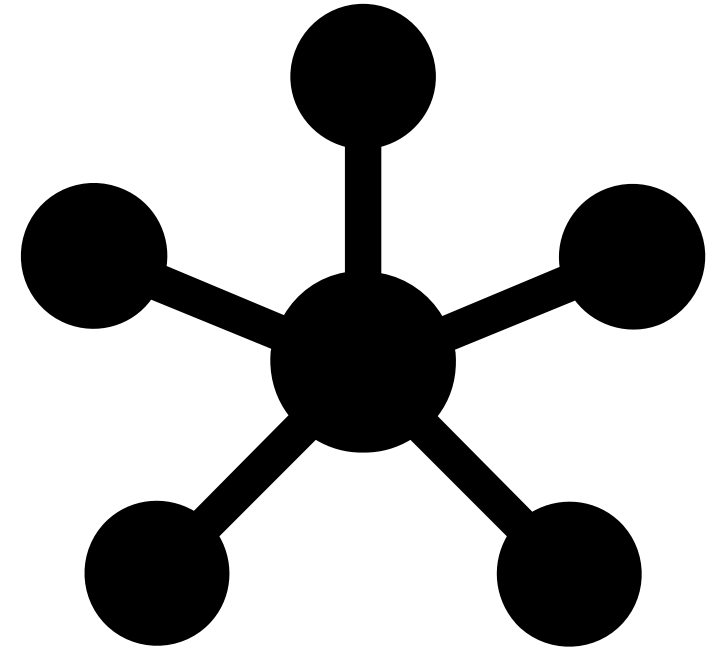
CEN/TC 465 - WG 04 FOCUS

CEN/TC 465/WG 04

Industrial Symbiosis for Sustainable Cities and Communities

Creation of WG 4 Industrial Symbiosis:

1. **Scope:** The Working Group on Urban Industrial Symbiosis aims at developing standards that support keeping resources in productive use for longer between industries, utilities and cities to foster sustainable and circular urban systems
2. **Work program:** Launching the development of new European Standards (EN) - **PWI 00465006** “Sustainable Cities and Communities Industrial Symbiosis to support Sustainable Cities – Core Elements and Implementation Approaches, building it on **CWA 17354:2018**.”
3. **Convenor:** D. Rachel Lombardi, Chief Executive in International Synergies Limited appointed as Convenor
4. **Balloting:** Opening date 2025-11-06 ; Closing date 2025-12-08



CEN/TC 465 - WG 04 FOCUS

CWA 17354:2018 Industrial Symbiosis: Core Elements and Implementation Approaches sets out the following **core elements** of Industrial Symbiosis

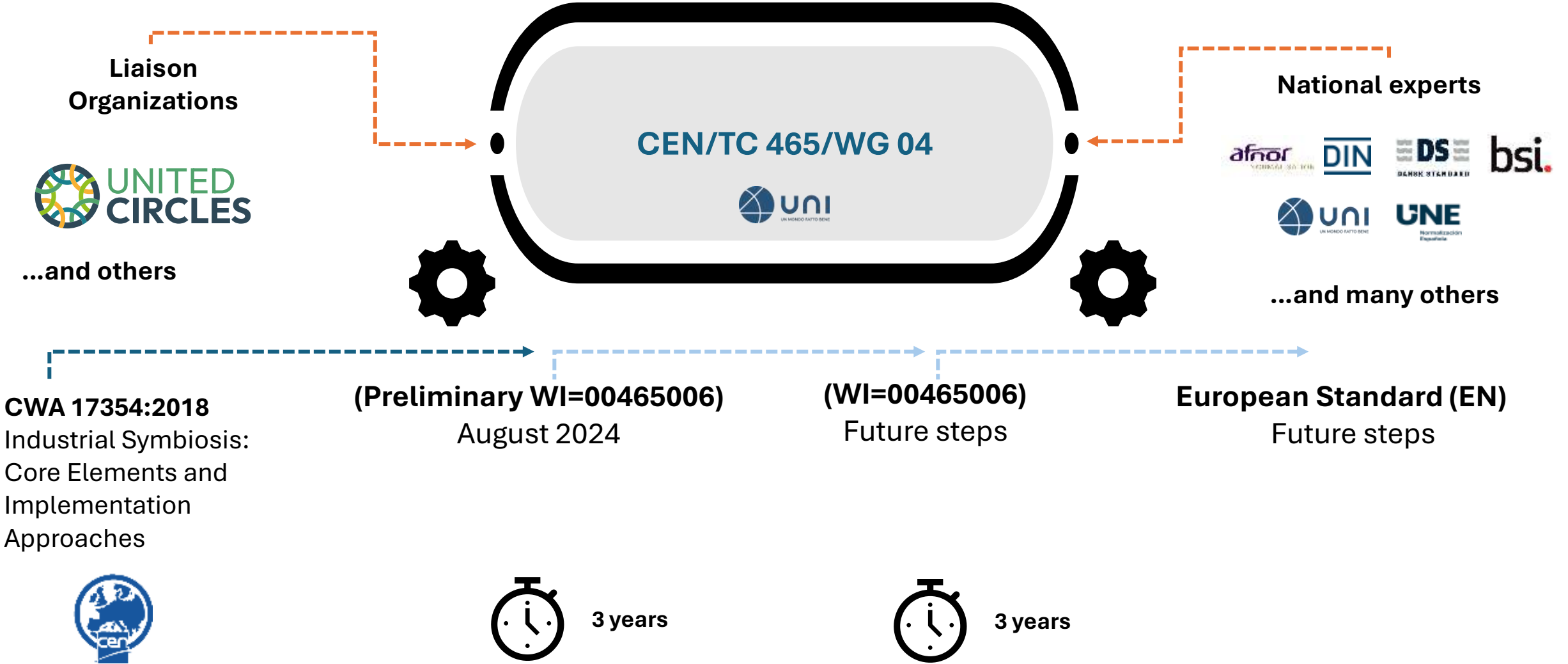
1. Returning underutilised resources (often called waste) to productive use.
2. Information about opportunities (e.g., data on other organisations' resources or new technologies) is required to be able to advance a synergy.
3. **Business conditions** to foster industrial symbiosis, which may be through **market conditions** (cost reduction, risk reduction, improved competitiveness) or through **policies and regulations** that specify definitions (for example, waste versus by-product) and responsibilities.

NB: Securing **business sustainability** is one of the **key drivers** of Industrial Symbiosis, alongside the implementation of a clear **monitoring and evaluation framework** to assess **return on investment** and to capture economic, environmental, and social impacts (best practice's indicator).

FREE



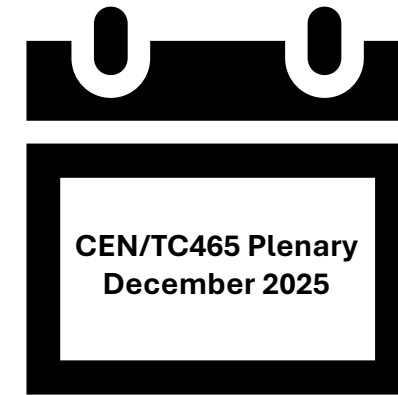
CEN/TC 465 - WG 04 FOCUS



CEN/TC 465 - WG 04 FOCUS

STAY TUNED!

Next Plenary Meetings – CEN/TC 465
meeting on the **11th of December 2025**;



We are planning to host the **CEN/TC 465 plenary meeting** in **Milan, September 2026**, along with the meetings of the related Working Groups (WGs).

Possible structure

- **General Assembly meeting** during the first three days;
- **United Circles Workshop** on the day after, following the TC plenary meeting (New CWA Update)



THANK YOU

Andrea Mora

Mail: andrea.mora@uni.com
Telephone: +39 0270024439



Funded by
the European Union



Industrial Symbiosis Standardization Roadmap

WG 02 End Of Waste

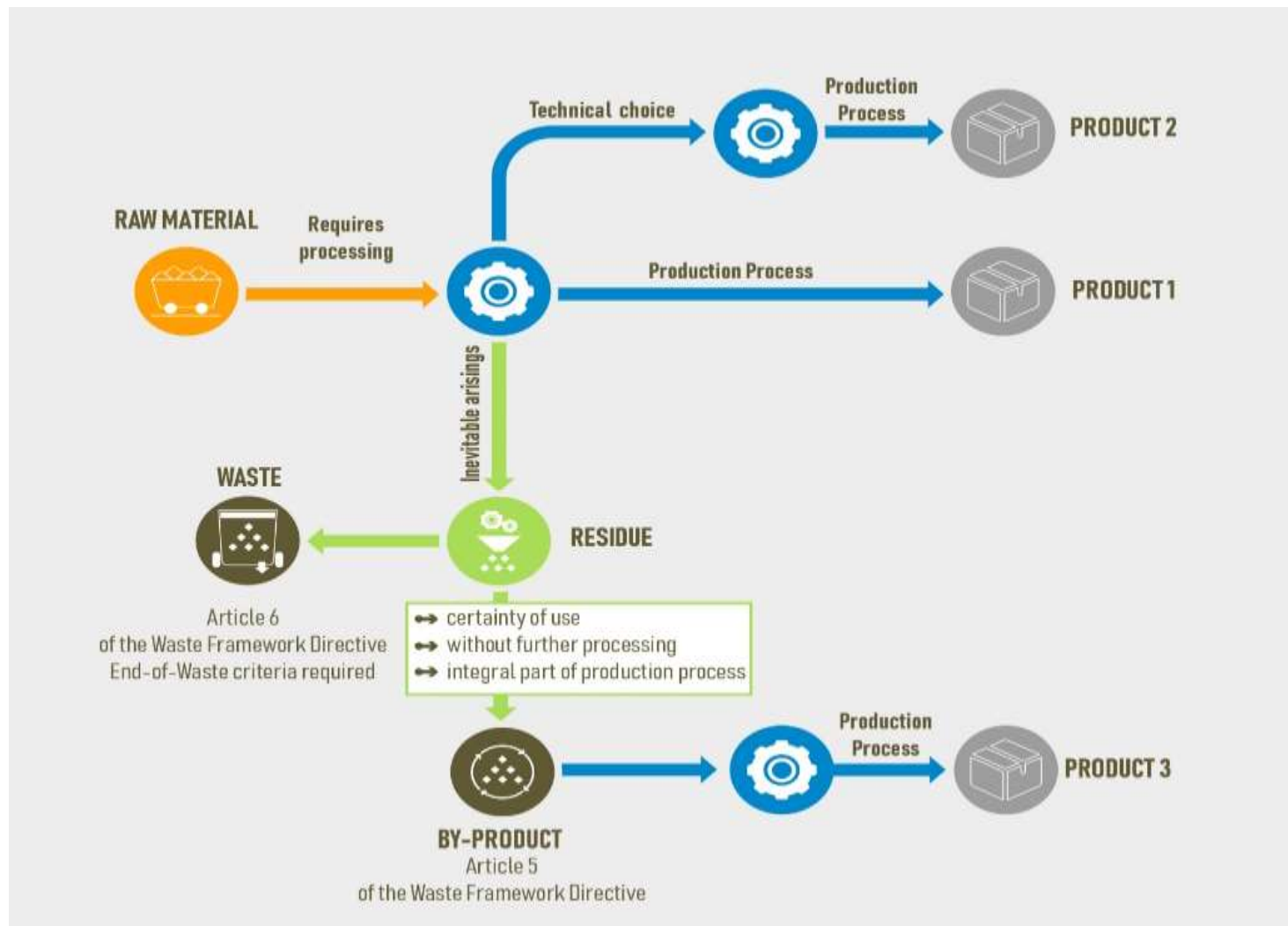
Plenary presentation
12 November 2025

Faye Page, Sustainable Business Practitioner at
International Synergies Limited (ISL)

RISERS



Context: Waste Framework Directive (2018/98/EC)



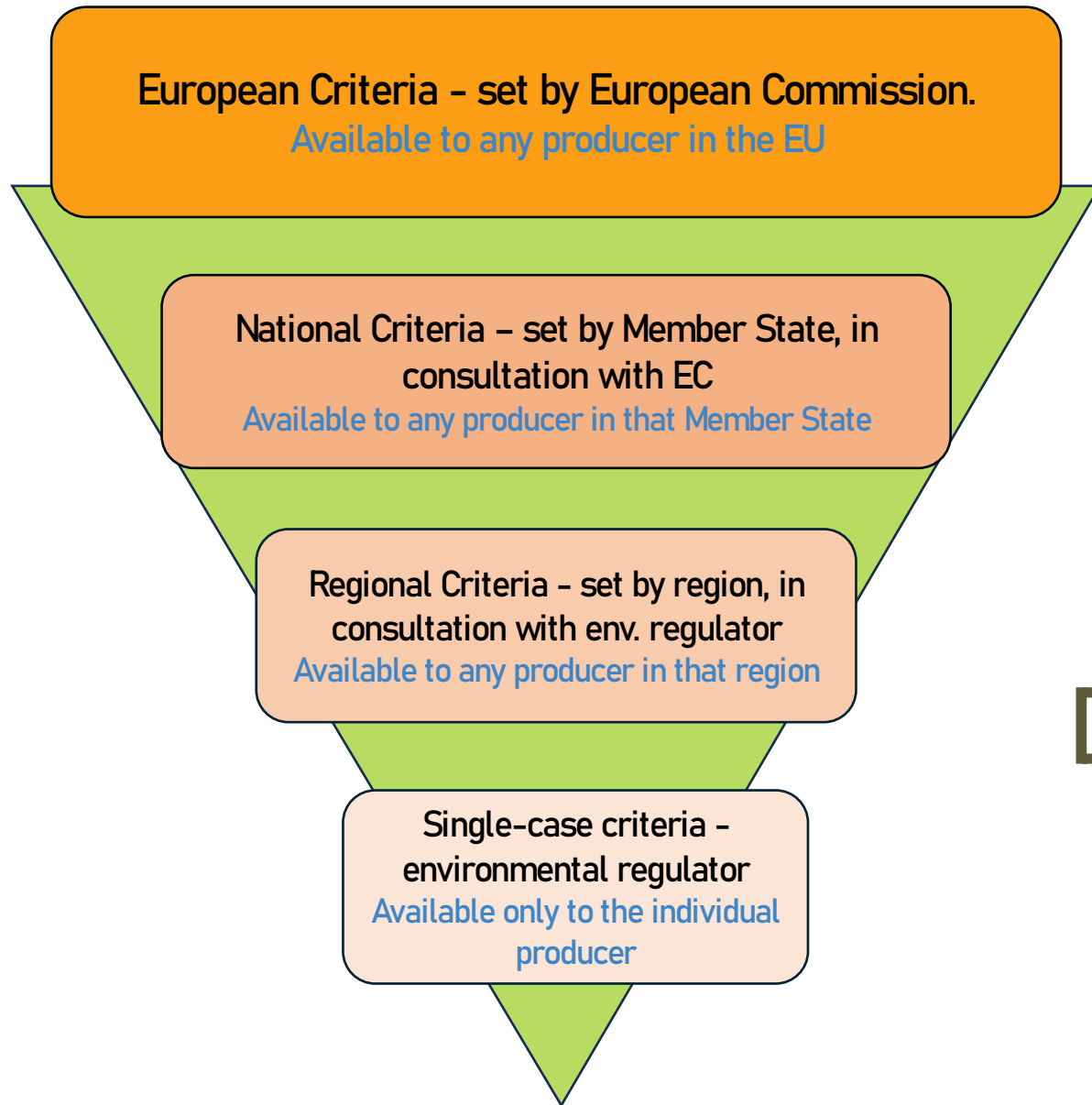
Current situation

Aim of Working Group 2

To inform the RISERS roadmap regarding the potential to adapt the methodology of EOW criteria production such that it more effectively supports IS adoption.



If “waste” could talk, what would it say about EoW rules?



Three in existence:

Copper scrap
Iron, steel, aluminium scrap
Glass cullet

Three in development:

Plastic
Textiles – reuse and recycling
Mineral fractions of C&D waste

Different levels of applying EdW criteria

Issues

- § Fragmented rules
- § Burden of proof
- § Regulatory uncertainty
- § Ongoing obligations
- § Market perception

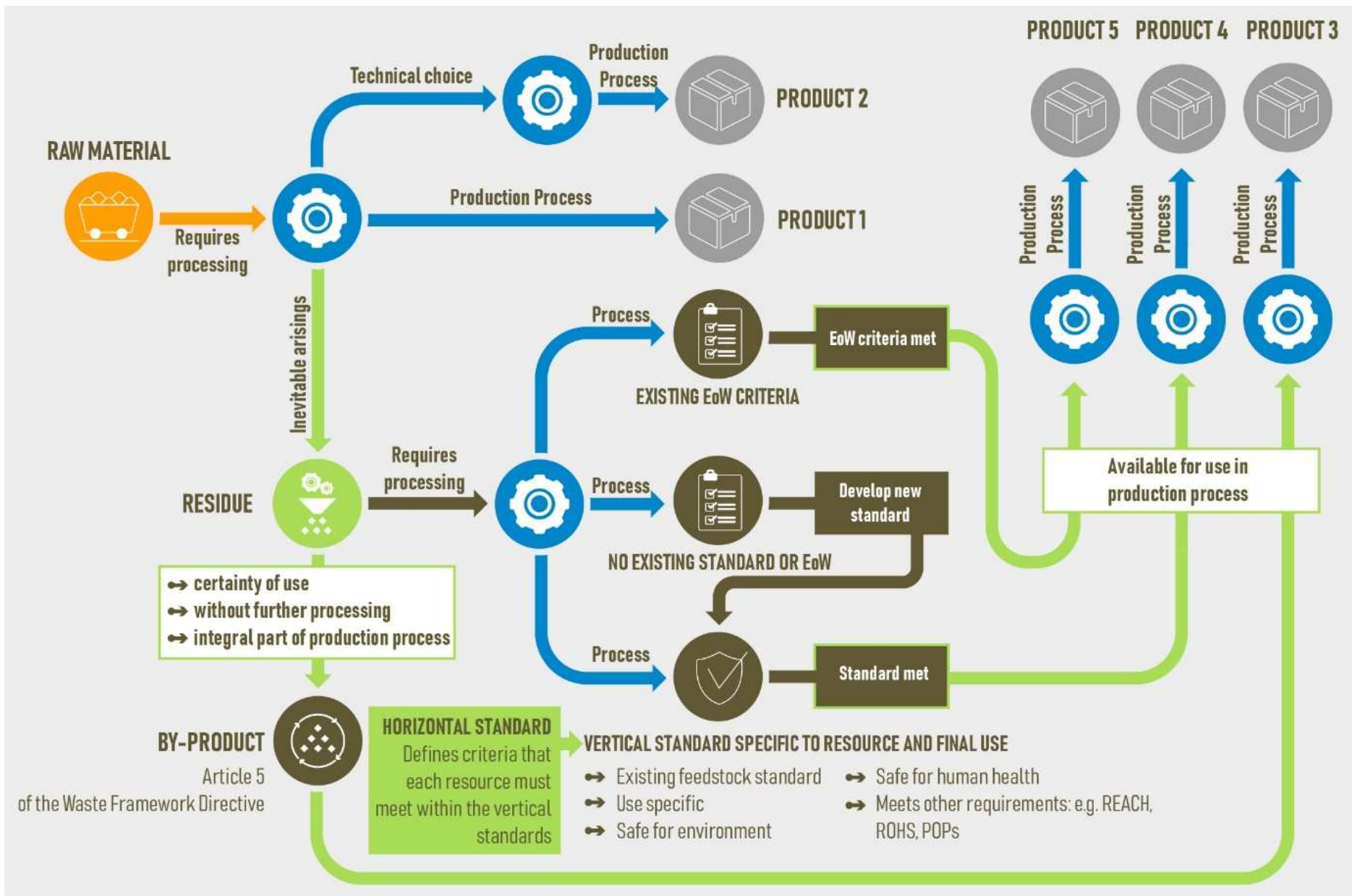
Proposal - Use standards to address EOW shortcomings

1. Horizontal Standard

- Defines the process for developing criteria (consistent across EU)
- Sets out what to include (treatment process, QA, compliance)
- References existing standards (REACH, POPS etc)
- Provides a common framework for harmonised implementation

2. Vertical Standards

- Tailored to individual waste / material streams
- Applicable across EU and covering multiple uses
- Alignment with EWC codes, quality standards, use restrictions and compliance requirements.



Proposed
solution

Outcomes and Impact

- § Quicker acceptance process
- § Increased market opportunities
- § Legal certainty
- § Market confidence
- § Protection of human health & environment
- § Streamlined industrial symbiosis 
- § Faster uptake of secondary materials 
- § Accelerated circular economy 

Thank you!

Contact

- Faye Page: faye.page@international-synergies.com
- James Woodcock: james.woodcock@international-synergies.com

WWW.RISERS-PROJECT.EU



Industrial Symbiosis Standardization Roadmap

WG 03 Digitalization & Data

Plenary presentation
12 November 2025

Robert Howard, Product Manager at
International Synergies Limited (ISL)



RISERS

WG 03 – Digitalization & Data – Introduction

- § Digitalisation and data are key enablers of industrial symbiosis.
- § There is massive potential in this space to help further industrial symbiosis opportunities.
- § Data is though fragmented and not standardised.
- § Trust and data governance are also issues.

WG 03 – Topics Discussed

- § Digital Product Passports
- § Consensus Frameworks for Confidentiality and Trust
- § Reusing Proven Industrial Symbiosis Pathways
- § Interoperability of Data and Systems
- § Enhanced Resource Classification



What systems are you aware of which could hold useful data for Industrial Symbiosis?

WG 03 – System Integration

- § Relevant data in a wide range of systems.
- § Lots of existing technical standards for integrating systems.
- § Meaning and context of the data is key.
- § Standards are a vital way to achieve this.

WG 03 – Key Recommendation

Enhanced Resource Classification Standards

- § To successfully link systems, they need a common understanding of the data transferred.
- § Lack of cross sector classification of resources, with sufficient detail.
- § European Waste Catalogue Codes (EWC) have insufficient detail and imply the resource is a waste.
- § Could potentially augment existing codes (e.g. EWC) with functional, machine-readable metadata.

Thank you!

Contact

- Robert Howard: Robert.howard@international-synergies.com
- James Woodcock: james.woodcock@international-synergies.com

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Poster Sessions in the Lobby

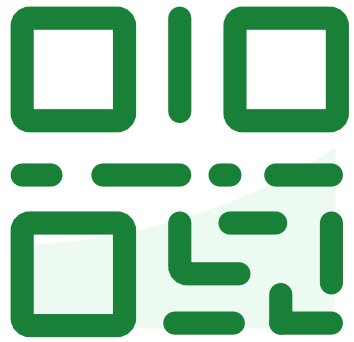
Hubs4Circularity	Aida Khalilova Climate KIC Belgium
Stan4Swap Project	Kirsten Glennung CEN and CENELEC
EURO-Titan Project	Beate Orberger Géosciences Conseils
United Circles Project	Andrea Mora UNI



Lunch Break & Poster Sessions

We are back at 13:15

Time	Session
13:15 – 14:15	Working Group Updates II – Sectoral Pathways (Part I)
	WG 04 Steel, Slag & Refractories – Christian Grunewald, DIN
	WG 05 Batteries – Rüdiger Meyer, Phoenix Contact
	WG 06 Packaging – Yotam Yosef Avital, Enspire Science
	WG 07 Waste Heat – Lieven Demolder, Ghent University
14:15 – 14:45	Coffee Break & Open Discussion
14:45 – 15:30	Working Group Updates III – Sectoral Pathways (Part II)
	WG 08 Textiles – Prof. Dr.-Ing. Sergej Rempel, TH Augsburg
	WG 09 Energy Data & Grids – Stavros Spyridakos, IEECP
	WG 10 Biomass – Dr. Manfred Kircher, KADIB-Kircher Advice in Bioeconomy
15:30 – 15:45	From Recommendations to Roadmap: What Comes Next
	Sebastian Vogel, RTD Collaboration, CEN and CENELEC
15:45 – 16:00	Closing Reflections – Connecting Policy, Practice and Standards for Industrial Symbiosis
	Chiara Coluccia, Circular Economy Expert, ICLEI European Secretariat



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Working Group Updates II – Sectoral Pathways (Part I)

WG 04 Steel, Slag & Refractories

WG 05 Batteries

WG 06 Packaging

WG 07 Waste Heat



WG 04 Steel, Slag and Refractories

Dr. Christian Grunewald



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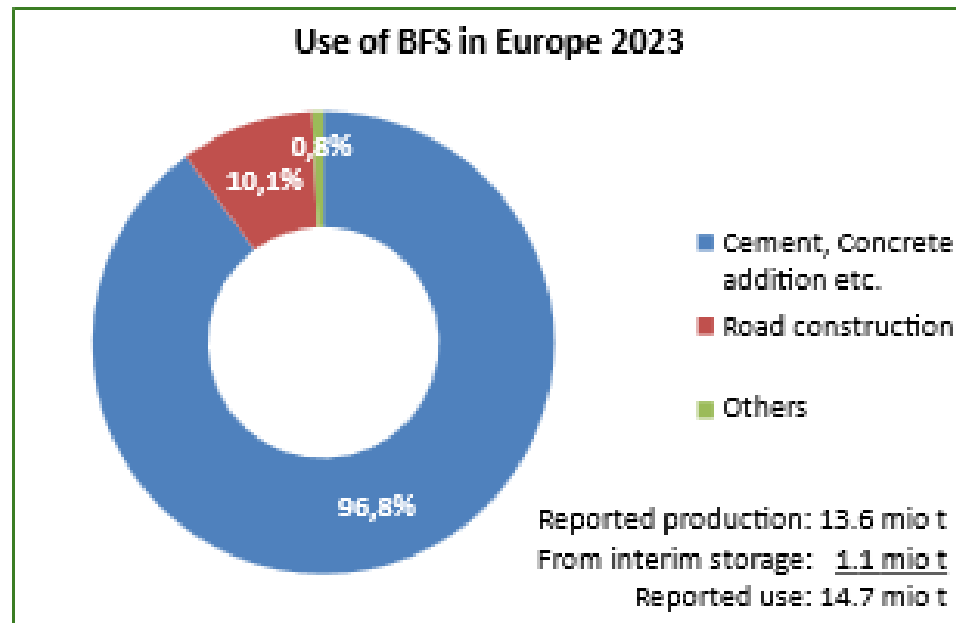


**What do you think of when you hear
“steel production” and “industrial
symbiosis”?**

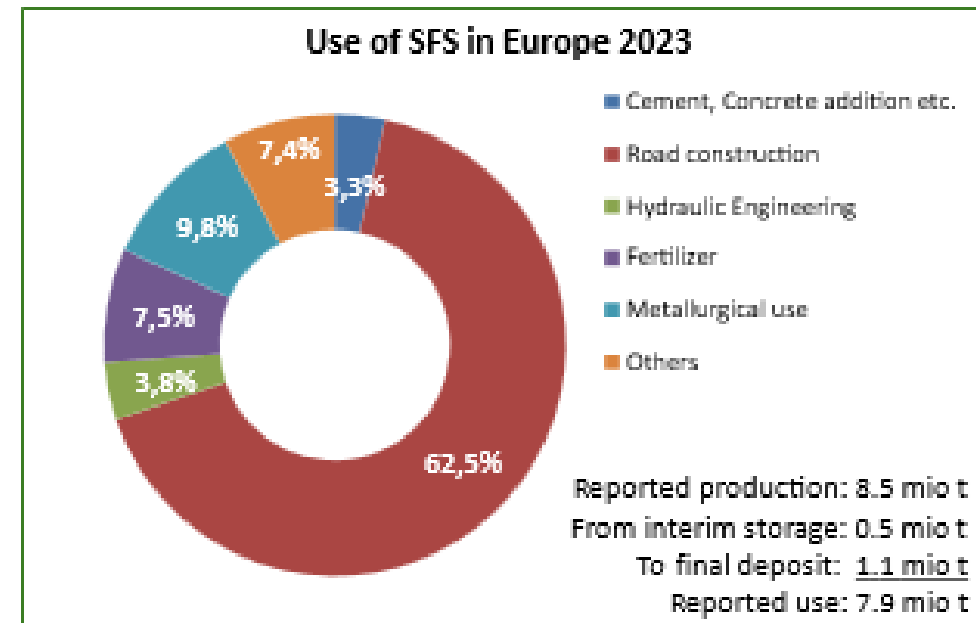
Steel production



Slag and its usage in cement



<https://www.euroslag.com/products/statistics/statistics-2023/>



Challenges and benefits

§ Challenges

§ Technical & economic:

- § variable composition
- § hazardous metals
- § Processing
- § transport & storage

§ Regulatory:

- § inconsistent classification
- § inconsistent environmental rules
- § traceability on original composition

§ Standardisation:

- § variable chemical composition
- § varying environmental performance reporting methodologies

§ Benefits:

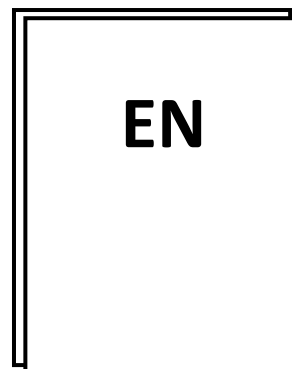
- § Reduced production of primary raw materials (reduced clinker production)
- § Lower associated CO₂ emissions
- § Reduced landfilling of slag

Recommendations

Slag properties
Characterization
Volumetric stability

Ferrous slags in
cement and
concrete standards

*standardization
request*



Supplementary
Cementitious
Material (SCM)

*standardization
request*

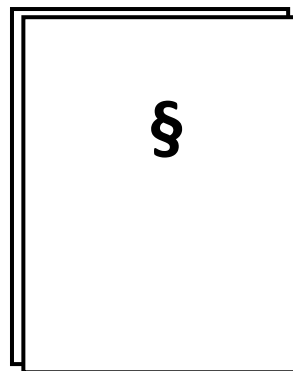
Slag treatment and
processing

Cement (EN) $\longleftrightarrow$ alignment Concrete (national)

Recommendations

**Include EAF/BOF slags
in harmonised
standards**

**end-of-waste criteria
BOF EAF slag**



**Consistent carbon
emissions allocation**



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WG 05 – Batteries

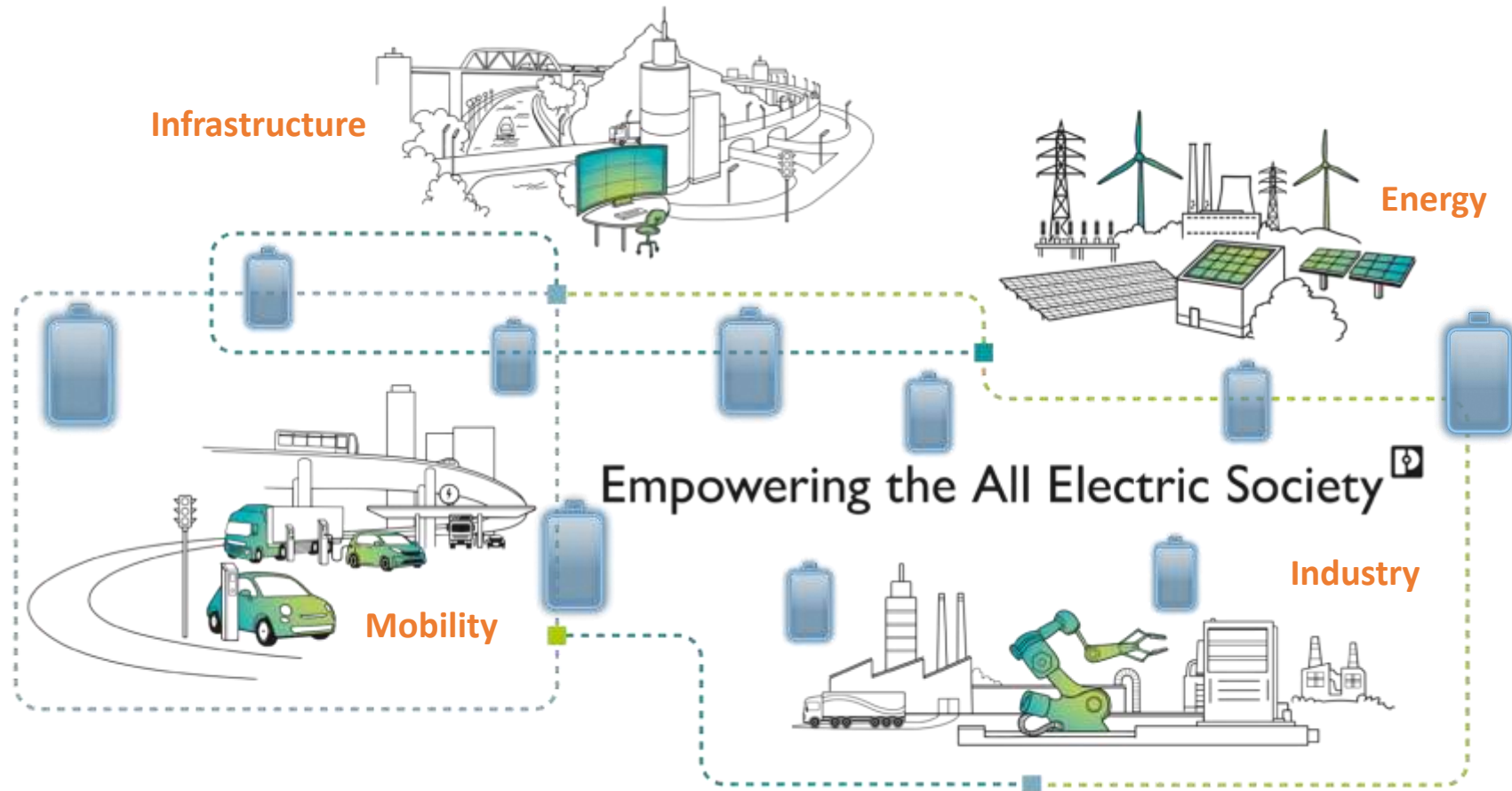
Dr. Rüdiger Meyer



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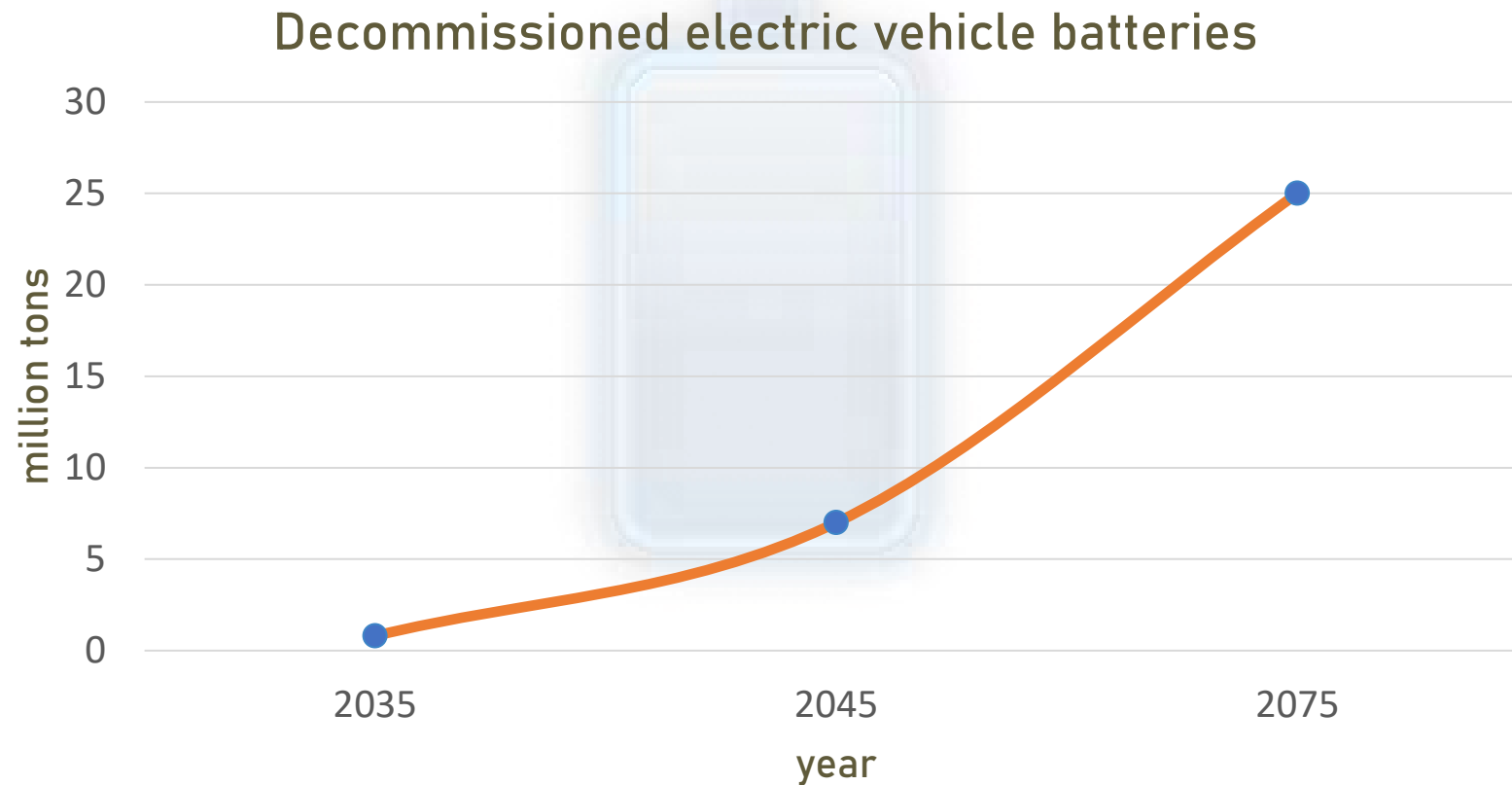
Introduction and Context

Batteries are essential for multiple applications.



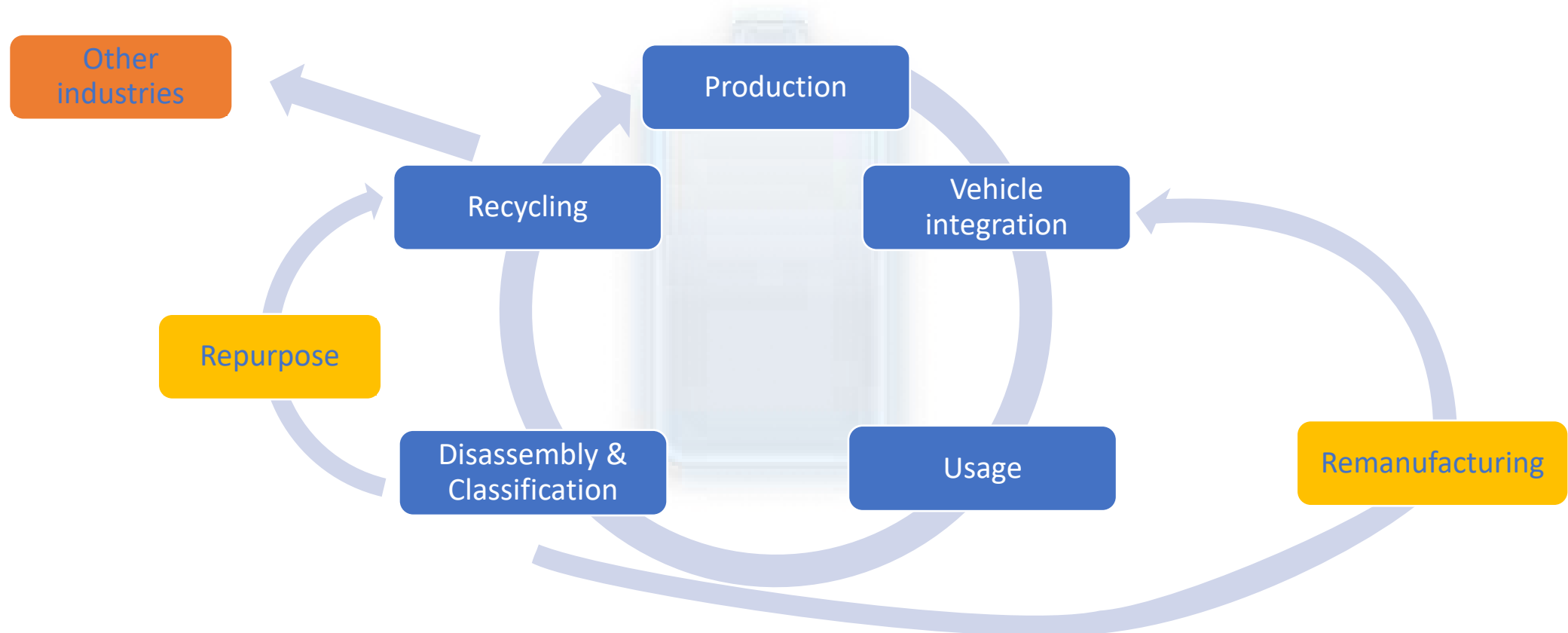
Introduction and Context

A growing number of batteries will reach its end-of-(first-)life in the near future.



Introduction and Context

Many batteries can still be used in a variety of ways before their definite end-of-life.



Introduction and Context

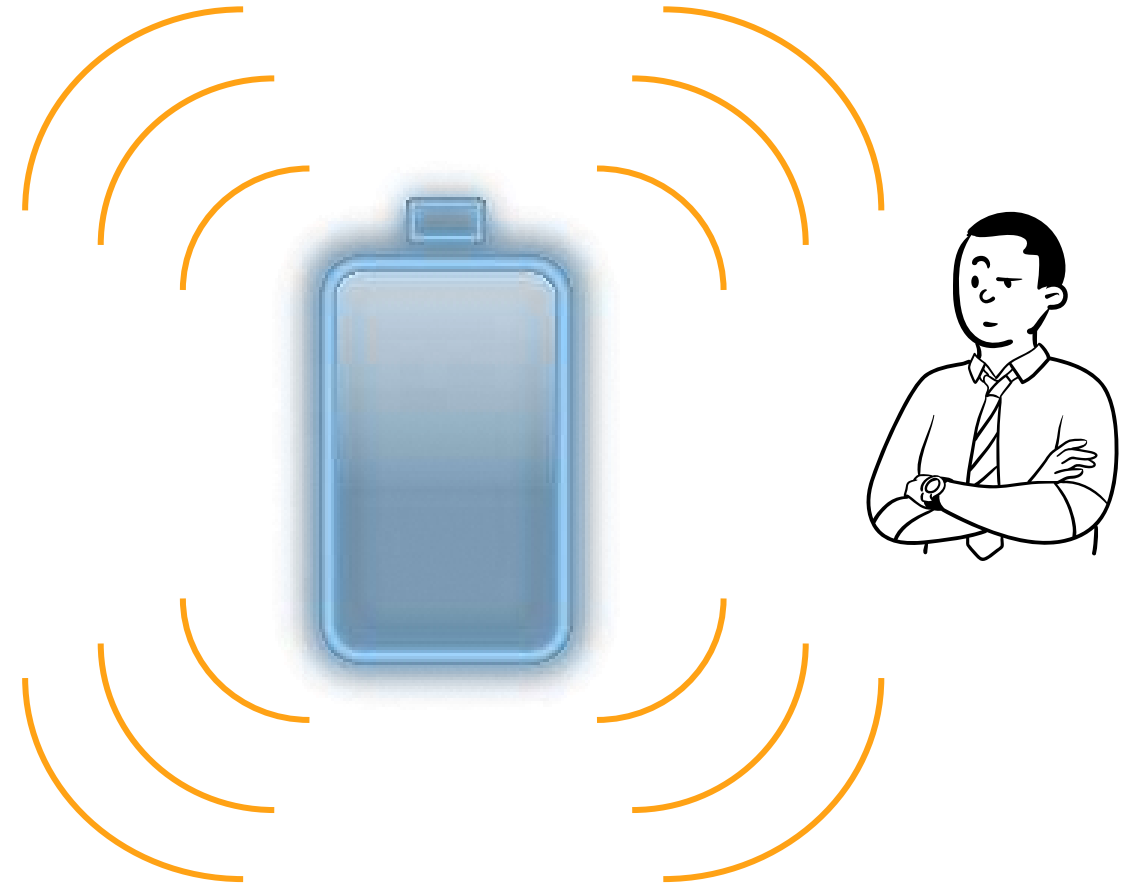
Efficient recycling of waste batteries will become essential to ensure raw material access within Europe.

The word "RESILIENCE" is written in large, blue, uppercase, sans-serif letters. The letters are slightly tilted upwards from left to right. The word is set against a light gray, rectangular background that has a rough, hand-drawn border.

Challenges

§ Reliable analyzing of used batteries in terms of suitability for repair, reuse, repurpose or recycling

- § Performance
- § State of health
- § Safety



Challenges

- § Accessible battery data for legitimately interested parties
 - § Status information
 - § Disassembly and repair instructions
 - § Ownership



Challenges

- § Composition and quality of recyclates
 - § Suitability for battery production again
 - § Suitability for other industries



Recommendations

- § Fortunately, the European *Battery Regulation* and *Ecodesign for Sustainable Products Regulation* already addresses most of the mentioned challenges.
- § Several standards are in progress or even in place.



Recommendations

- § Main tasks from the perspective of the working group:
 - § Standards – Enable analysis and description of residual material composition and quality after recycling for further usage in battery production or other industries
 - § Regulations – Create sufficient infrastructure to realize safe and efficient battery treatment after end-of-(first-)life





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Industrial Symbiosis Standardization Roadmap

WG 06
Packaging

Plenary

Yotam Yosef Avital (Enspire.Science)
Yotam.avital@enspire-science.com

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Agenda



1. Opening & Context
 - § Framework and Participants
 - § Introduction
2. Synergies
 - § Challenges
 - § Standard Recommendations
3. Research and Legislation



What do you think are the key features of packages that limit IS in them?

The unique features of packaging



1. Low cost
2. Discardable
3. Product specific

Opening and Context – Why a survey?

§ Meetings and Participants

- § 1 Meeting:

- § 9 registered (4 RISERS)

- § 5 attending (2 RISERS)

§ Survey: In total 9 Contributions

§ Survey Details

- § 16 Questions

- § 6 are predefined, 10 are free text

- § Target: experts in plastic/packaging

- § Answers included identifying information

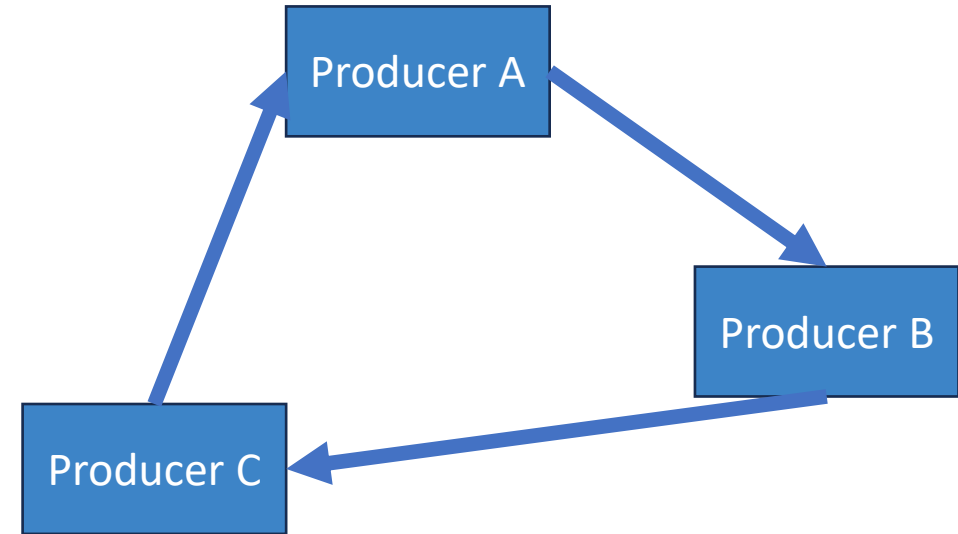
Opening and Context – Introduction

- § Essential yet discardable
- § Legislation exists but limited
 - § Packaging and Packaging Waste Regulation (PPWR),
 - § European Plastics Strategy
 - § National Extended Producer Responsibility (EPR) schemes
- § Goal: Less use of virgin material
- § Way: Re-use by design
 - § Modular
 - § Logistic
 - § Quality and Safety



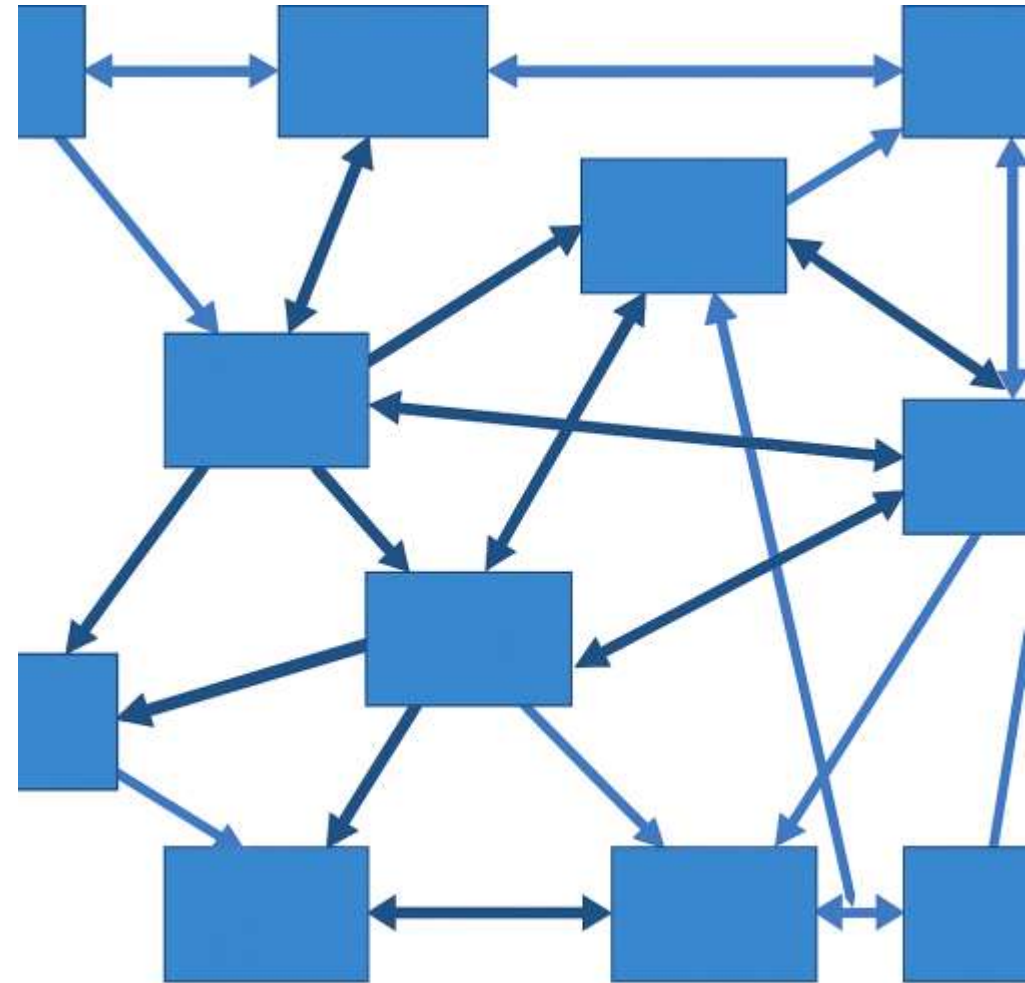
4 IS are recommended

RISERS



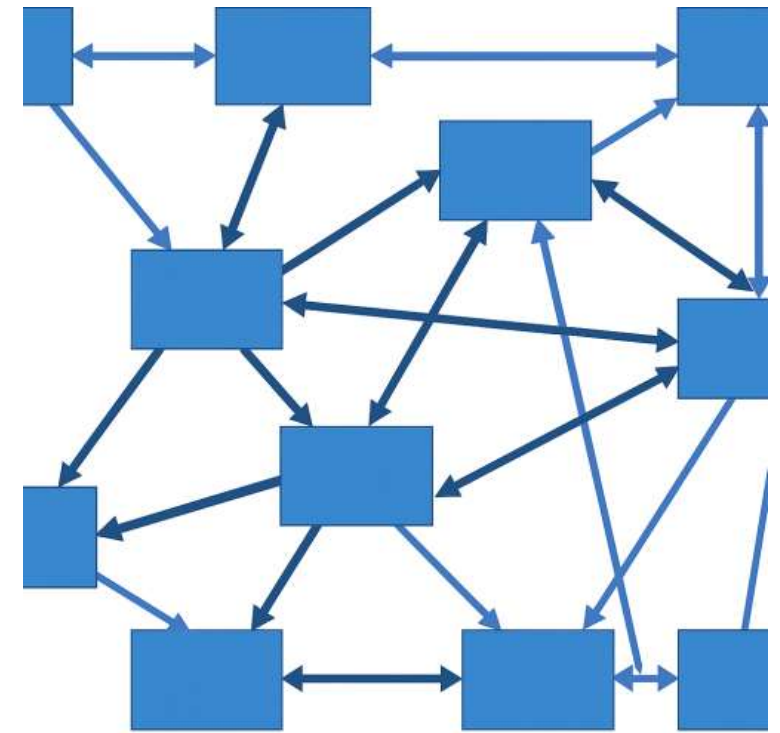
4 IS are recommended

RISERS



Recommendation – Standards

- § Domains of cross-use of packages
 - § Safety and visibility
 - § Shape (for products and packages)
 - § Labeling
- § Input (bio-)materials
- § Simpler composition for recycling
- § Logistic infrastructure
 - § Transportation
 - § Matchmaking
 - § Storage



Recommendation – Research and Legislation

Research needs

§ Design

- § Transfer
- § Dismantle
- § Distinguish

§ Safety

- § Contact with products
- § Bio-material reuse
- § Repurposing in other sector (e.g. fertilizer)

§ Logistics and economic models

Legislation

§ Incentive tools

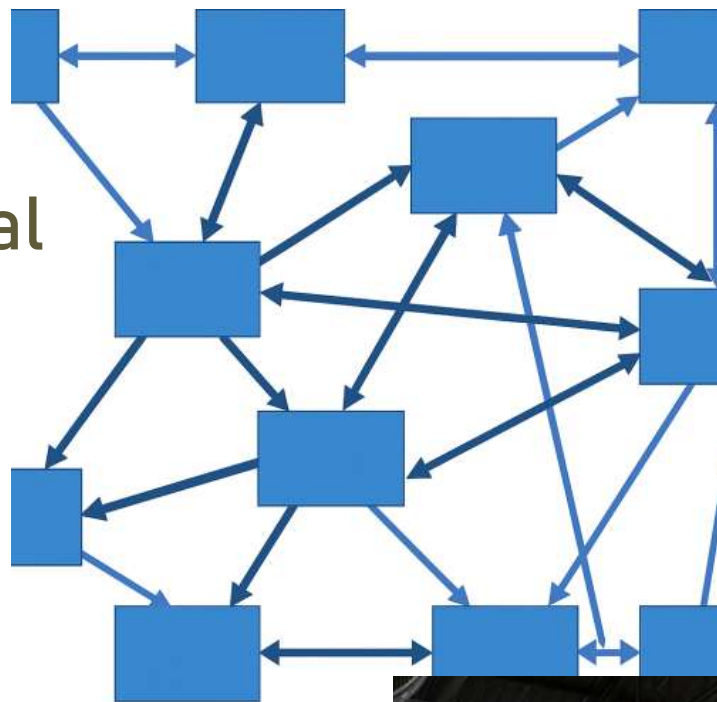
- § Tax
- § Training
- ~~§ Subsidising~~

§ Support system

- § Sector specific guidelines
- § Materials

Conclusions

- § Packages are essential
 - § Finance is important
 - § Different approach
- § Semi-local solutions
- § Supporting research and legislation is key
- § Simplicity is key
- § In that spirit



RISERS

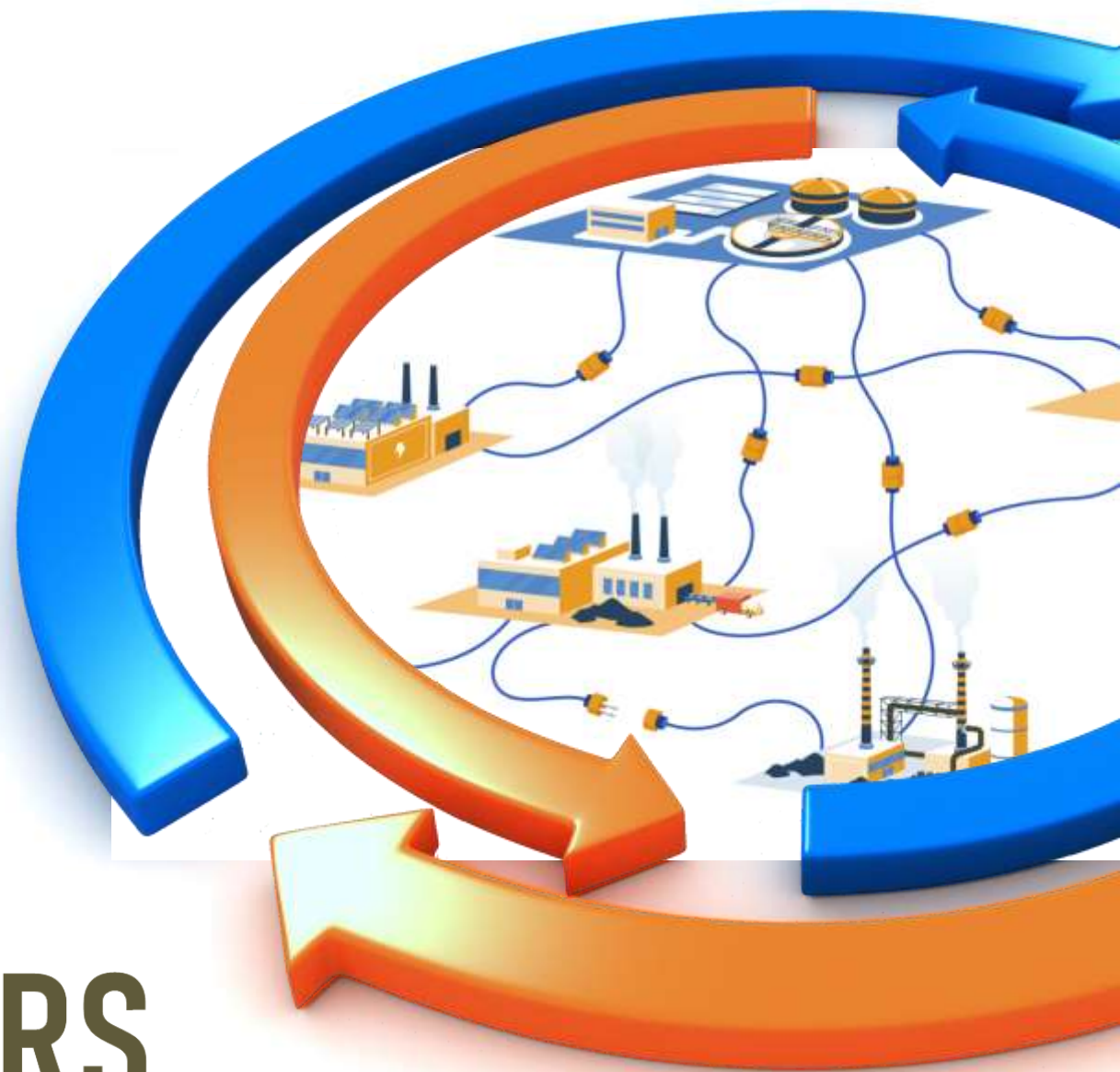
Thank You

Industrial Symbiosis Standardization Roadmap

WG 07 Waste Heat

Plenary meeting

Lieven Demolder
2025-11-12 - Brussels



RISERS

Agenda



Opening & Context

- § Meetings and Participants
- § Introduction
- § Regulatory Frameworks

Synergies

- § Challenges
- § Recommendations

General Recommendations

Opening and Context

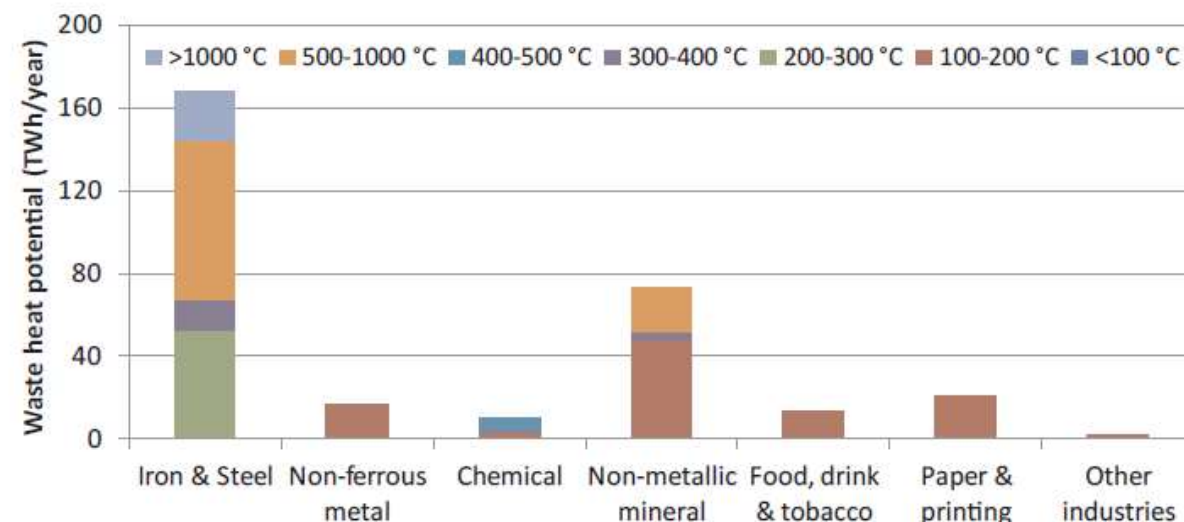
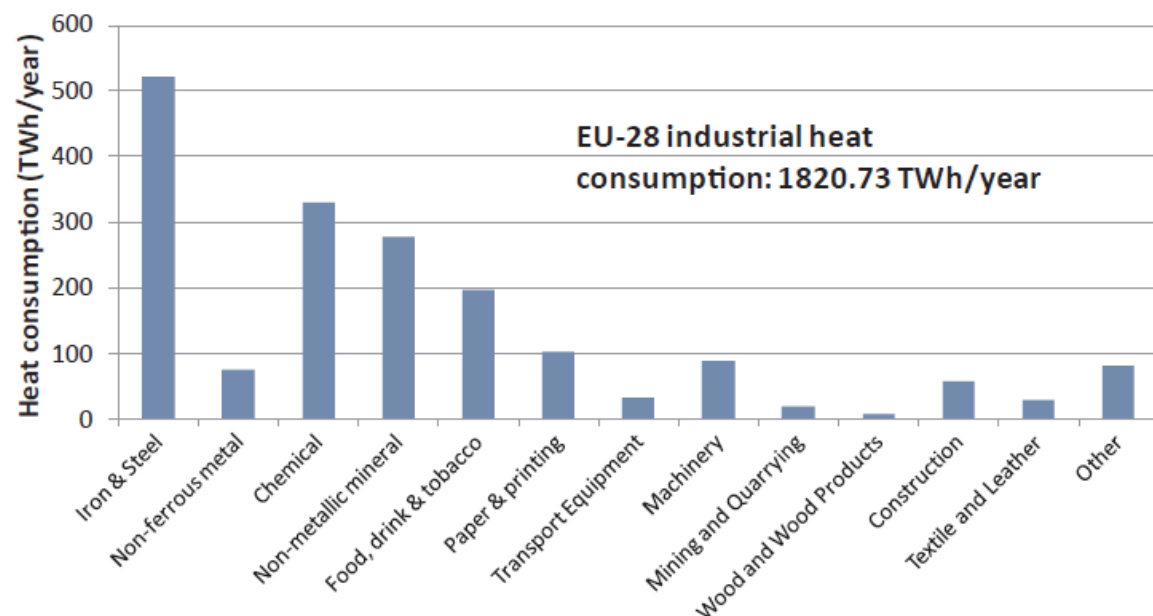
§ Meetings and Participants

Moderators: Lieven Demolder (Ghent University), Sebastian Vogel (CEN-CENELEC)

Participants: Apostolos Korkolis (Polyeco), Edwin Van Ruijven, Faye Page (ISL), Irina Celades, James Woodcock, Jina Knoke, Luca Neumann (Euroheat), Murat Mirata (University of Linköping), Roberta Montesano (RINA), Sara Buonomo (Turboden), Veronika Wilk (AIT), Anshuman Pandey (TNO), Miguel Ramirez (TNO), Gaia Balzarini (Danfoss)

- § Industrial waste heat arises as a by-product from various sources, including industrial processes, power generation, and data centre operations
- § Repurposed for applications such as space heating, industrial processing, or integration into district heating and cooling systems.
- § 415 PJ (<95°C)–940 PJ (<25°C) (sEEnergies project, 2015)
- § Additional 1200 PJ Accessible Urban waste heat (ReUseHeat, 2019)

Industrial waste heat availability



Industrial heat consumption by sector (left) and resulting waste heat potential (right) (after M. Papapetrou et al. using Eurostat 2015 data)

Challenges

§ Technical

- § Limited interconnection between potential suppliers and users.
- § Absence of standardised classification methods for waste heat sources, including temperature, availability, and quality parameters.
- § Insufficient deployment of LT heat recovery technologies and supporting infrastructure
- § Lack of advanced monitoring systems, leak detection, and tools for system balancing.
- § Need for large industrial HPs for upgrading low-grade waste heat to usable temperatures.
- § Enable new business models and accelerate industrial decarbonisation

§ Regulatory

- § Fragmented responsibilities across authorities for permitting and infrastructure planning.
- § Lengthy permitting processes, particularly for small-scale networks.
- § Inconsistent treatment of waste heat in EU directives and national frameworks.
- § Lack of mandatory municipal heat mapping and planning in several regions.
- § Need for robust policy frameworks, market signals for grid services, and cross-sector cooperation

Challenges

§ Economic

- § Mismatch between high investment needs for infrastructure and uncertain long-term returns
- § Competitive fossil gas prices reducing business case for waste heat projects
- § Absence of targeted financial support schemes or favourable market conditions

§ Social and organisational

- § Limited public awareness of waste heat recovery benefits
- § Reluctance to share operational and location data due to confidentiality
- § Concerns regarding dependency between suppliers and users
- § Complexity of project implementation for end-users and communities

Priority synergies

§ Related to waste heat

- § Industrial waste heat to district heating networks
- § Data center heat recovery
- § Waste heat to industrial cluster integration
- § Waste heat recovery with heat pumps
- § Waste heat conversion to electricity

§ Regulatory Frameworks

- § EED, REDIII, EPBD, European Green deal and national SECAPs, etc.

§ Standardisation Framework

- § EN 15316/15377 series, CEN/TC 107 (DH&C), CEN/TC 113 (HPs), CEN/TC 371 (EPB), CEN/TC 182 Refrigeration systems, IEA-IETS Task XV working group Industrial Excess heat recovery, etc.

General Recommendations

§ Regulatory Improvements

- § Create incentives for high-impact synergies
- § Mandate transparent data sharing and reporting
- § Facilitate cross-border and intersectoral cooperation
- § Integrate waste heat potential in urban and regional energy planning
- § Create transparency and integrate accountable IS benefits in environmental and CE legislation
- § Support the development of DHC & related infrastructure

§ Standardisation

- § Create protocols for waste heat classification and metering to ensure interoperability
- § Create contract templates for waste heat supply, incl. technical specifications, performance guarantees, and sustainability reporting requirements.
- § Provide liability clauses which mitigate concerns around dependency across parties.
- § Reduce overall project complexity for end-users/communities



Which regulatory/standardisation initiative could create the most significant leverage on the valorisation of industrial waste heat?

References & contact

§ References

- § Michael Papapetrou et al. Industrial waste heat: Estimation of the technically available resource in the EU per industrial sector, temperature level and country; Applied Thermal Engineering 138 (2018) 207–216
- § ecm.ugent.be
- § biblio.ugent.be
 - § Greet van Eetvelde; Nienke Dhondt, Francisco Mendez, Samie Maqbool, Hélène Cervo

§ Contact

- § ecm@ugent.be
 - § lieven.Demolder@ugent.be; greet.vaneetvelde@ugent.be



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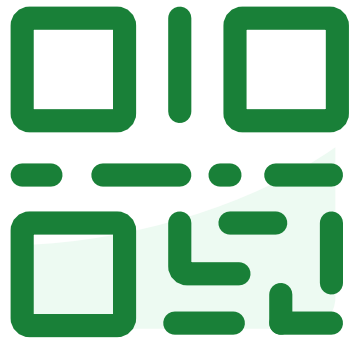
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Coffee Break & Open Discussion

We are back at 14:45



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Working Group Updates III – Sectoral Pathways (Part II)

WG 08 Textiles

WG 09 Energy Data & Grids

WG 10 Biomass



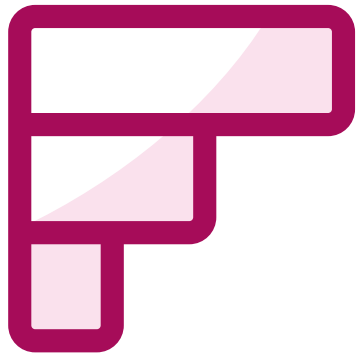
WG08 Textiles

Prof. Dr. Sergej Rempel

TH Augsburg



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What happens to your old clothes?

① The Slido app must be installed on every computer you're presenting from

slido

Textile industry

global fiber production (2021): 113 million tons
61 million tons polyester
25 million tons cotton

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€17.5 billion revenue of the
German textile industry



Textile consumption
4th largest cause of
environmental pollution
and climate change in
the EU

1.5 million employees
in the EU

Textile consumption doubled
between 2000 and 2015

Situation today

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1.6 million tons of used clothing in Germany

Textile waste:
more than just clothing

Linear economy:



production

use

disposal

Fast fashion: growing quantities and low quality

Variety of materials complicates recycling

1% fiber to fiber recycling

73% of used textiles are either used for energy recovery or landfilled

Construction industry

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Responsible for
50% resources

Responsible for 35% CO₂



2.1 billion €
net turnover in EU

Up to 15 million employees in the EU

Mission

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Next Steps

RISERS

DIN



Enspire
science

cen CENELEC

DIN

eit RawMaterials
Connecting materials

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**International
Synergies**

Fraunhofer
ISI

**GHENT
UNIVERSITY**

IETU
Instytut Ekologii
Terenów Uprzemysłowionych

ISO

Thank you

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WG 09: Energy Data & Grids

Stavros Spyridakos

Energy Efficiency and Stakeholder Engagement
Expert

Institute for European Energy and Climate Policy



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Introduction to the topic

Technical Feasibility & EU-wide Impact – Energy Data and Virtual Power Plants

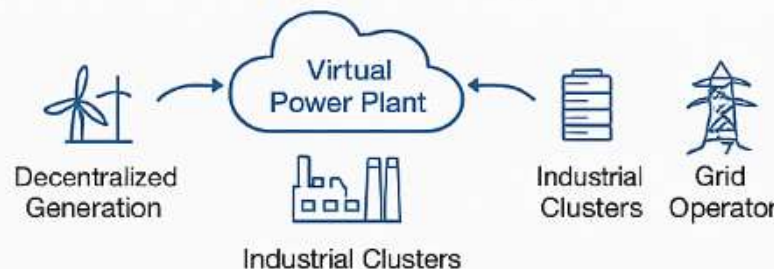
Context & Rationale

Industrial clusters are shifting towards data-driven flexibility to manage growing shares of renewable energy. Variability in solar and wind generation demands new solutions that synchronise consumption with availability.

Virtual Power Plants (VPPs) enable this coordination by linking decentralised generation, storage, and industrial loads into unified networks capable of balancing demand and supply in real time. These systems form the backbone of a flexible, decarbonised industrial ecosystem.

Industrial readiness and integration potential

- **Industrial-scale adaptability**
Suitable for energy-intensive applications: scalable across multiple sites and clusters.
- **Moderate technical requirements**
Uses existing IoT-SCADA, and EMS systems with low retrofitting needs.
- **Interoperability & cybersecurity**
Builds on standardized communication protocols (IEC 91950, ISO 19950, (IEC 62445)
- **Digital intelligence.** AI and digital twins enable predictive control and optimization in real conditions,
- **Secure data exchange.** Trust frameworks under EU Data Act ensure confidentiality and verifiable *As4Trust*



Quantified Impacts

5–10 %
reduction in electricity costs

11–29 billion €
avoided grid investment

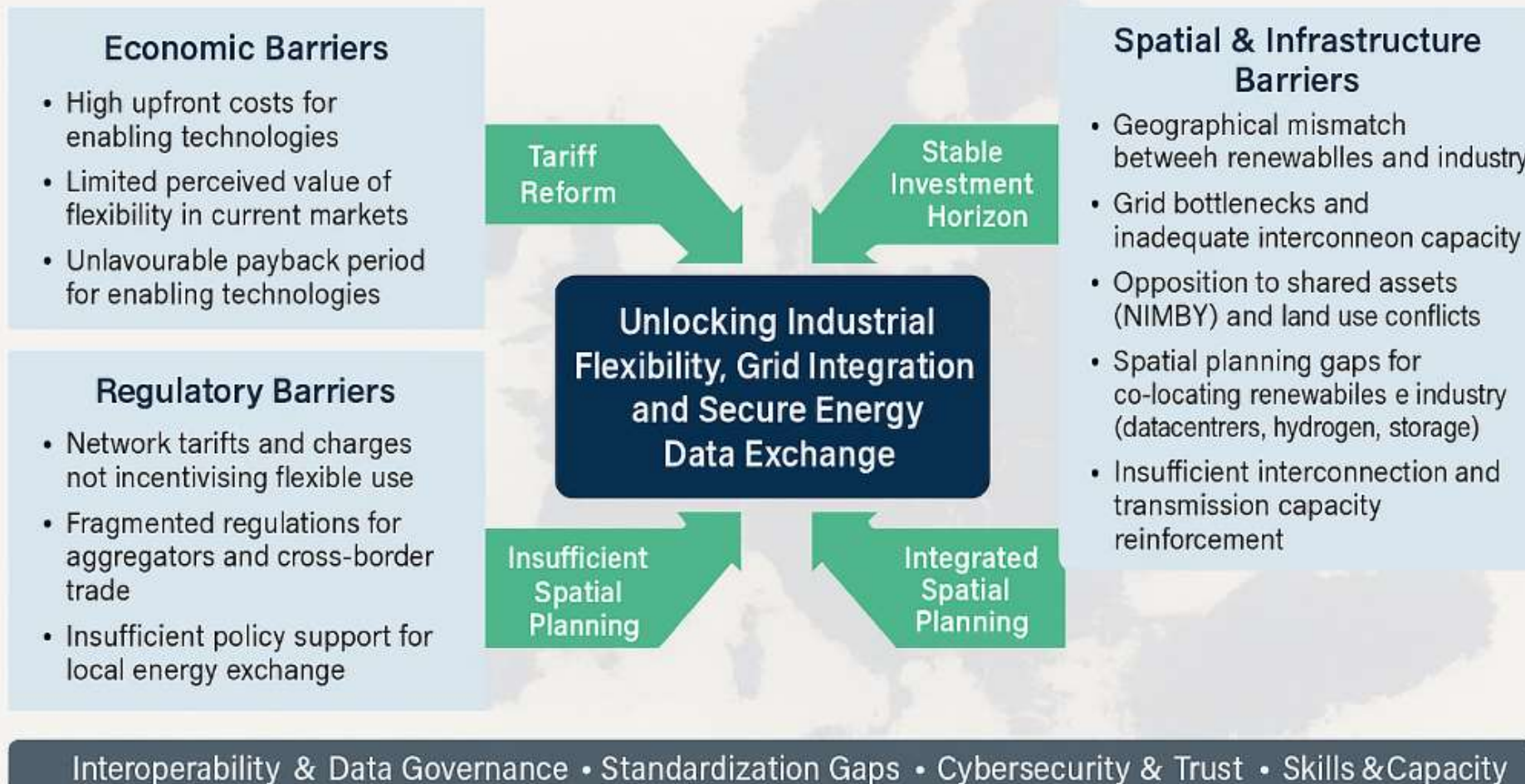
71 billion €
consumer savings

2.7 billion
avoided peak generation

From isolated assets to coordinated clusters
Supplying sectors (manufacturing, transport & heavy industry) provide flexibility, which receiving sectors (grid operators, energy communities) utilize to stabilize supply over valid time horizons.

Main Barriers and Challenges

Economic, Regulatory and Spatial Bottlenecks to Large-Scale Flexibility Deployment



Synergy Areas for Grid – Industry Collaboration

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Energy Flexibility
Services for
Industrial Symbiosis



Shared Renewable
and Storage
Infrastructure



Industrial IoT
Integration for
Smart Grids



Local Energy
Exchange and
Community Grids



Data-Driven
Production Planning
and Predictive
Optimization



Digital Energy
Twins for Grid-
Industry Integration



Cybersecure
and Trusted
Energy Data Spaces



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Enabling Industrial Flexibility and Shared Renewable Assets



Synergy 1 – Energy Flexibility Services

Regulatory Recommendations

- Harmonise market access and remuneration rules for industrial aggregators under Electricity Market Design and *Network Code on Demand Response*
- Recognise decentralised data governance and verification mechanisms for flexibility settlements

Impact Enhanced grid stability, reduced emissions, and cost-efficient flexibility deployment

Enhanced grid stability, reduced emissions, and cost-efficient flexibility deployment



Synergy 2 – Shared Renewable and Storage Infrastructure

Regulatory Recommendations

- Enable collective self-consumption and direct line models in industrial clusters
- Simplify grid connection and metering procedures under RED II and IEMD

Standardization Priorities

- Develop interoperable interfaces using IEC 61850, IEC 62933, and ISO 50001
- Certification for shared assets ensuring safety, interoperability, and cybersecurity

Impact Local resilience, reduced congestion, and shared investment efficiency

Enabling Smart Grids and Local Energy Markets



Synergy 3 – Industrial IoT Integration for Smart Grids

Regulatory Recommendations

- Standardise interface protocols for industrial IOT and SCADA systems to enable seamless data flow with grids
- Enhance cybersecurity frameworks under IEC 62443 to protect grid-data integration

Improved
grid
efficiency

Impact Improved grid efficiency and resilience through predictive control and real-time analytics



Synergy 4 – Local Energy Exchange and Community Grids

Regulatory Recommendations

- Introduce regulatory schemes for peer-to-peer industry energy trading
- Enhance data access and integration for power sharing and grid cooperation

Standardization Priorities

- Design metering standards and settlement mechanisms for local grids using ISO 1401 and IEC 62058/62059
- Standardize interfaces for data sharing an peer-cooperative models

Impact Decreased reliance on grid infrastructure and enhanced collaboration

AI, Twins, and Energy Data Ecosystems

RISERS



Synergy 5 – Data-Driven Production Planning

Regulatory Recommendations

- Integration and standardization of digital twins and AI across grid and industrial sectors
- Linking demand planning with Energy Performance Of Buildings Directive (EPBD) targets

Improved energy efficiency
and cost optimization



Synergy 6 – Digital Energy Twins for Grid-Industry Integration

Standardization Recommendations

- Alignment ISO 23247 Digital Twin Framework for Manufacturing with IEC 61850 and ISO 17800
- Establish data protocols for interoperability between industrial and grid assets

Standardization Recommendations

Incorporation EU Data Act, GAIA-X and Common European Data Spaces principles for energy data spaces
Define security standards for confidentiality, integrity, and availability



Synergy 7 – Cybersecure and Trusted Energy Data Spaces

Regulatory Recommendations

- Facilitate technical security standards for energy data spaces
- Ensure alignment with the EU Data Act and European Common Data Space for Energy

Improved energy efficiency
and cost optimization

Questions to trigger further discussion

- § What do you think is the biggest barrier to industrial participation in flexibility markets?
- § In one sentence, what would make you or your organization more willing to invest in flexibility technologies?
- § Which area do you think will have the biggest impact on the future of industrial energy flexibility?

Thank you

Stavros Spyridakos

e: stavros@ieecp.org

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Roadmap Working Groups

WG10 Biomass

Manfred Kircher; KADIB

November 12th, 2025



Presentation Outline

1. Biomass
2. Biomass Use and Cross-sectorial Synergies
3. Regulations, Standards, Monitoring
4. Challenges
5. Recommendations

Biomass

comes in different qualities and states of aggregation

Biomass

Biomass use and
cross-sectorial
synergies

Regulations,
Standards, Monitoring

Challenges

Recommendations

Primary biomass

- Agriculture
- Forestry
- Fishery and aquaculture



Fotos: © KADIB

Residual biomass

- Residuals from fractionation
 - Solid, liquid
- Residuals from transformation
 - Solid, liquid, gaseous



Fotos: © KADIB



CO₂

Biowaste

- Non-recyclable waste materials
- Contaminated residuals
- End of Life materials
 - Solid, liquid, gaseous



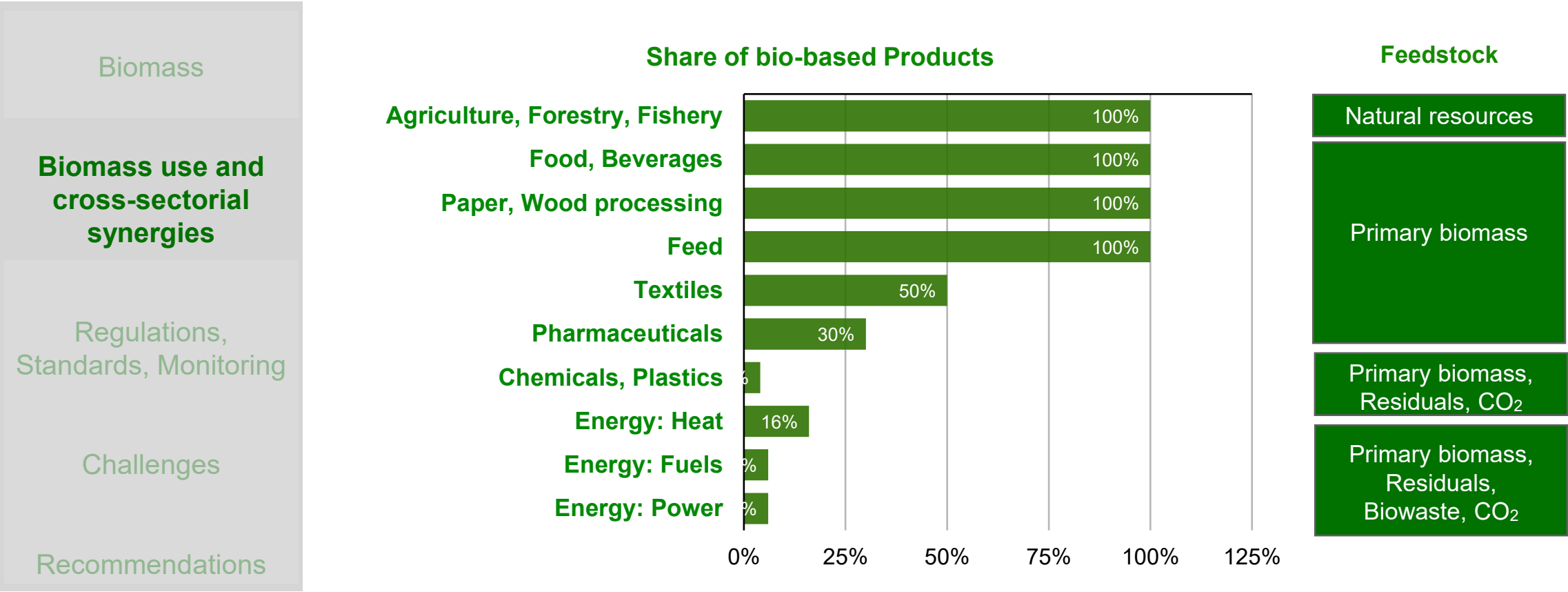
CO₂

CH₄

Foto left: Waste transport, Germany. Wikimedia Commons / Kora27. https://upload.wikimedia.org/wikipedia/commons/8/8b/Müllabfuhr_in_Sachsen_IMG_0731WI.jpg
Foto right : Sludge; Wikimedia Commons / US Fish and Wildlife Service. <https://commons.wikimedia.org/wiki/File:Sludge.jpg>

Biomaterials

serve food, materials and energy markets



Source: Kircher M. (2020) Bioökonomie im Selbststudium. Unternehmensstrategie und Wirtschaftlichkeit. Springer Spektrum (modified)

Biomaterials valorisation is regulated, standardised, and monitored

Selected examples:

Regulations

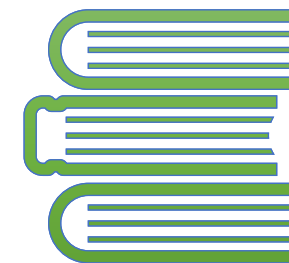
- EU-Waste Framework Directive
- EU-Circular Economy Action Plan
- EU-Ecodesign for Sustainable Products Regulation (EU-ESPR)
- EU-Emission Trading Scheme (EU-ETS)
- EU-Renewable Energy Directive (REDIII)
- National Waste Management Regulation

Standards

- ISO17225 (solid biofuels)
- EN14961 (wood pellets and chips)

Monitoring

- Eurostat



Some regulations and standards do not support material use of biomass, bio-residuals and biowaste

Selected examples:



Regulations

- Despite **EU-Waste Framework Directive, EU-REDIII, EU-Circular Economy Action Plan**, and other regulations, bio-residuals and biowaste is used for energy rather than material purposes
- **EU-Emission Trading Scheme (ETS)** does not price SCOPE 3 emission (including CO₂ coming from embedded carbon)
- National **Waste Management Regulation** prioritises composting or biogas fermentation of biowaste

Standards

- Inconsistent classification and quality standards (e.g. **EoW criteria**)

Monitoring

- Incomplete data on the availability and use of biomaterials (e.g. **Eurostat**)

Supporting the use of biomass, bio-residuals and biowaste by REGULATION

Selected examples:

Recycling and energy recovery

- Prioritise the material use of biomass before energy recovery or composting
- Prioritise the use of carbon-rich fractions for material use before recovering the mineral fraction for fertiliser

End-of-Waste (EoW), End-of Life (EoL) criteria

- Align EoW/EoL criteria EU-wide to facilitate cross-border trade
- Establish clear EoW criteria for recycling biowaste

EU-ETS

- SCOPE1,2: Include CCU from biogenic sources in the GHG inventory
- SCOPE 3 (fossil CO₂) to be priced to support embedding bio- instead of fossil carbon in products



Supporting the use of biomass, bio-residuals and biowaste by STANDARDIZATION



Selected examples:

Feedstock standards and specification

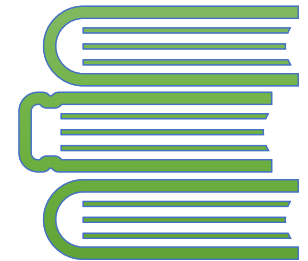
- EU-wide standards for bio-feedstock classification, certification, and quality control, focusing on input rather than output specification

Food standards

- Establish detailed standards for cultivation media used for mushrooms, insects, and other food-related applications

Fertiliser standards

- Create harmonised standards for organic fraction separation and processing for high-quality fertilisers



Supporting the use of biomass, bio-residuals and biowaste by MONITORING



Selected examples:

Data collection

Collect and provide complete and transparent data in accordance with scientific standards on availability, properties, use and recycling of biomaterials (biomass, residuals, biowaste), fossil- and biogenic GHG (Eurostat, National reporting)

Monitoring

Monitor biomass and derived products including utilisation and recycling based on relevant performance indicators



Summary



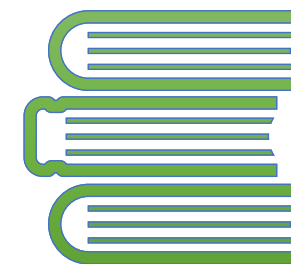
Regulations, standards, and monitoring

must be revised to support

the cascade use of biomass

including **recycling of residues and biowaste**

into **materials, energy, and plant nutrients.**



Thank you!

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From Recommendations to Roadmap: What Comes Next

Sebastian Vogel

RTD Collaboration, CEN and CENELEC

A closer look at RISERS

RISERS

January 2024 – December 2026

Coordinator:

Enspire
science

Partners:

cen **CENELEC**

Fraunhofer
ISI

GHENT UNIVERSITY
International Synergies
DIN

eit RawMaterials
Connecting materials
European Union

IETU
Instytut Ekologii
Terenów Przemysłowych
ISQ

Goal:
Enable a common
European framework
for Industrial
Symbiosis through
standards that
connect policy,
practice and research

Current Stage:
standardisation roadmap
under preparation,
Technical Committee
consultations starting

more than 100
experts from industry,
policy and research

Expected impact:

- § Remove technical and regulatory barriers to Industrial Symbiosis
- § Strengthen uptake of R&I results in standards
- § Support Europe's circular and climate objectives



The RISERS Standardisation Roadmap

Towards a European Framework for Industrial Symbiosis Standards

What is a standardization roadmap?

- § A guide to standardisation priorities and needs with actionable recommendations

How is RISERS covering the whole industry?

- § Mapping $\approx$ 800 European & international Technical Committees
- § 10 Working Groups (End-of-Waste, Batteries, Packaging, Biomass, etc.)



Next steps (2026):

- § Consolidate results → publish “living” Roadmap (Jan 2026)
- § Launch public consultation & Technical Committee dialogue
- § Final roadmap booklet by Dec 2026



Which TCs do you think we should consult first?

Join Us – Shaping Europe's Industrial Symbiosis Future



- § We also need you to co-develop the roadmap:
 - § Industries and clusters to complement standardisation ideas
 - § Policymakers to align CEA implementation
 - § R&I projects to connect results with standards
- § Public consultation starting in January 2026!





In one or two words: what do you think is the ‘missing link’ for putting IS into practice?

Closing Reflections – Connecting Policy, Practice and Standards for Industrial Symbiosis

Chiara Coluccia

Circular Economy Expert, ICLEI European Secretariat

Closing Remarks





What is your key takeaway from today?



After today's Plenary event I leave:

Thank you for your attention

Contact RISERS

info@risers-project.eu

Project facts

1 January 2024

Project Start

31 December 2026

Project End



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