

# Study to create competitiveness clusters for the circular economy

International examples and best practices

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CONSULT thinking ahead

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Sociedade Portuguesa de Inovação



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Fundo Europeu de  
Desenvolvimento Regional





# Agenda

1. Goal of this session
2. Key concepts
3. Examples of Circular Economy best practices
  1. Agro-food
  2. Construction
  3. Energy
4. Examples of industrial symbiosis
  1. Agro-food
  2. Construction
5. Resources





## Goal

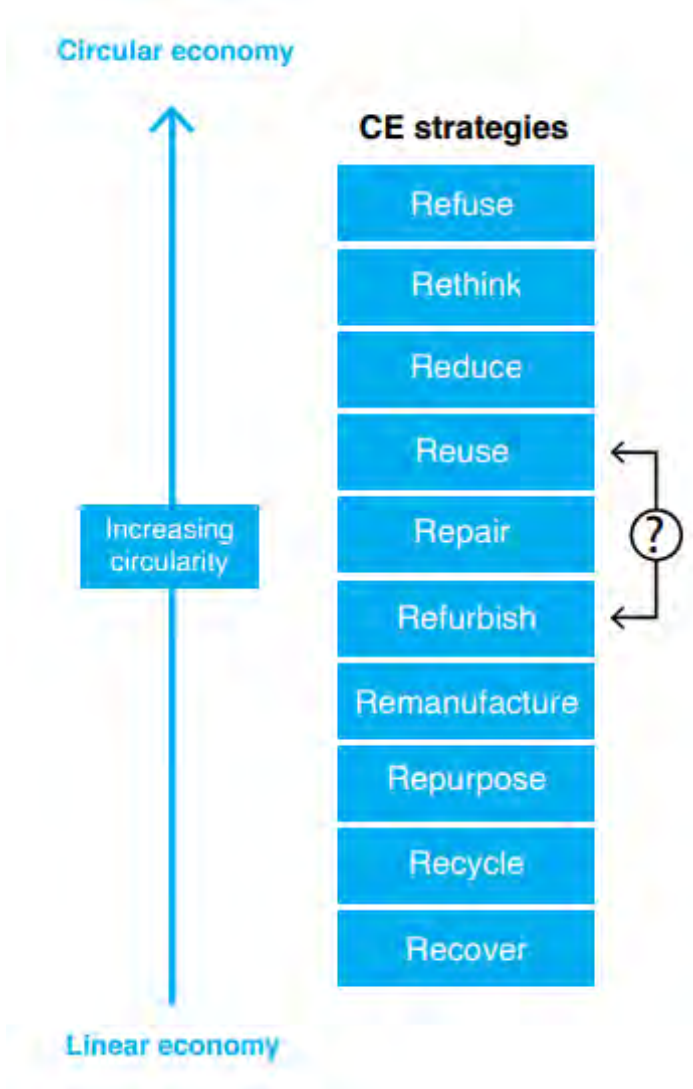
To provide a selection of best practices of circular economy and industrial symbiosis from an international viewpoint.

- Inspirational
- Relevant
- Value added
- Selection

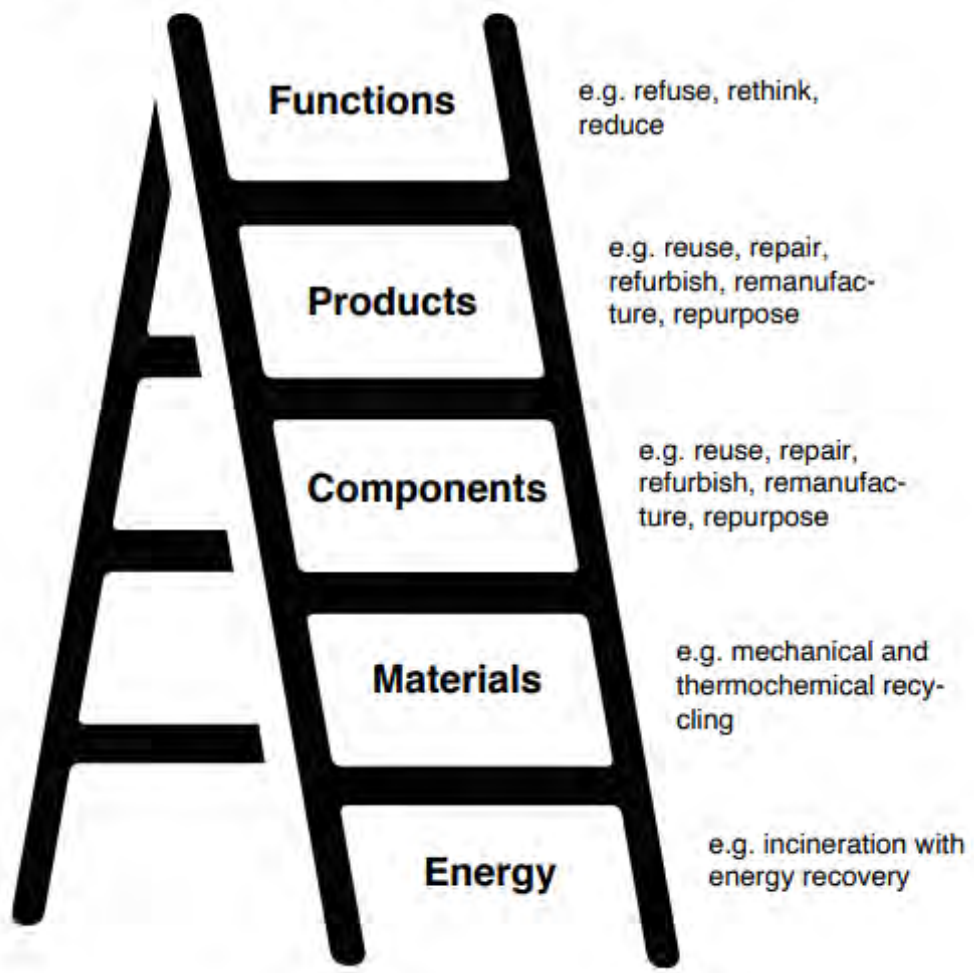
Qualification: CE and IS practices countless examples, unique properties yet similar underlying strategies, wide body of literature, research



# Key concepts: strategies for increasing circularity & retaining material value



CE strategies with preservation of



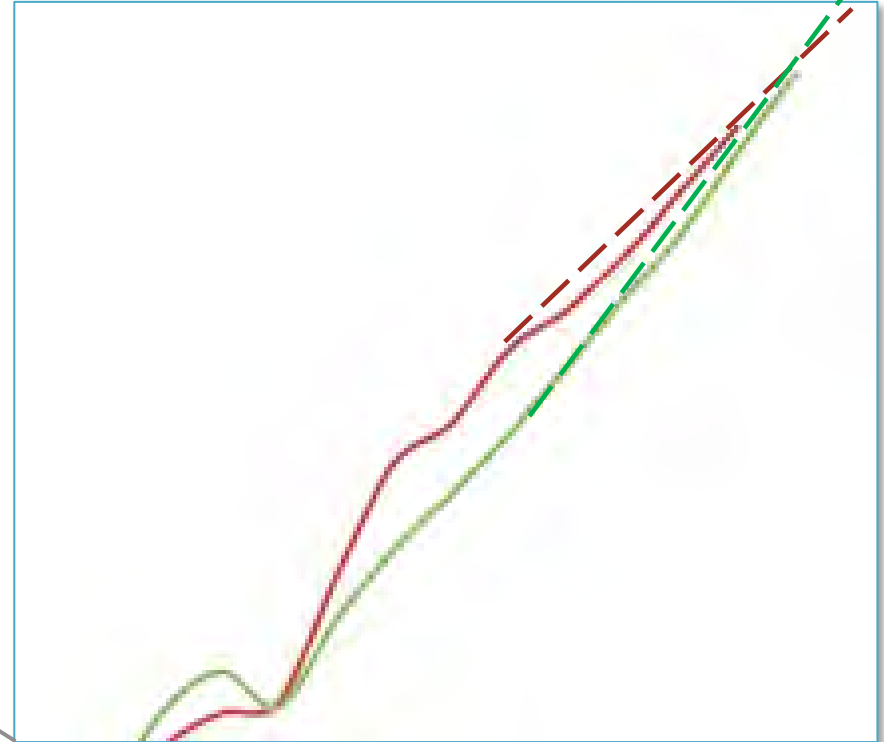
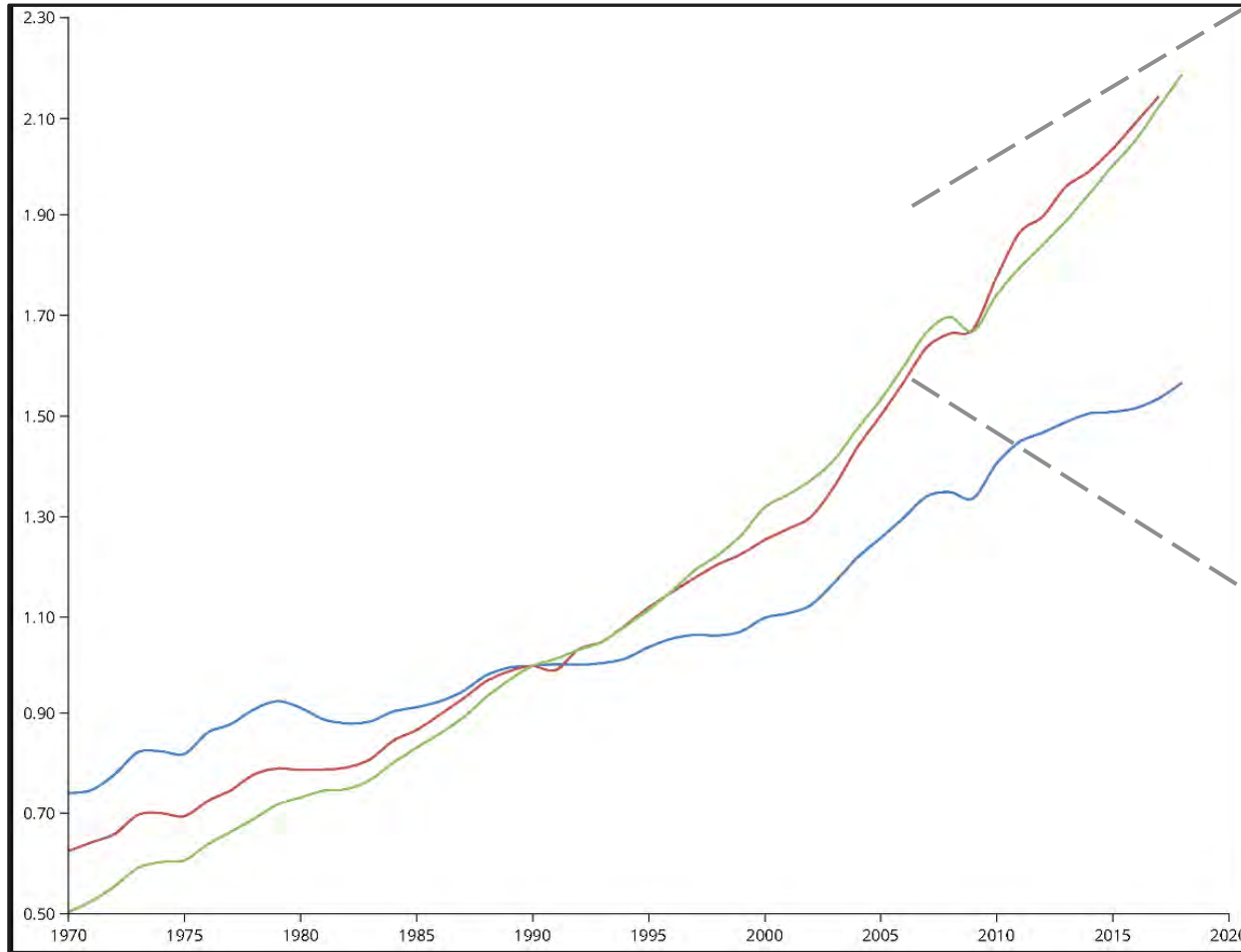
Ultimate goal:  
Reduction of the environmental footprint while creating value added; decoupling economic growth

Source: figure derived from Moraga G. (2021), p7



# Decoupling economic growth and environmental footprint

Relative change in main global economic and environmental indicators from 1970 to 2018



- Relative % change in global GDP - trend (approx.)
- Relative % change in material footprint - trend (approx.)
- Relative % change in global GHG emissions

Source: EEA (2021)



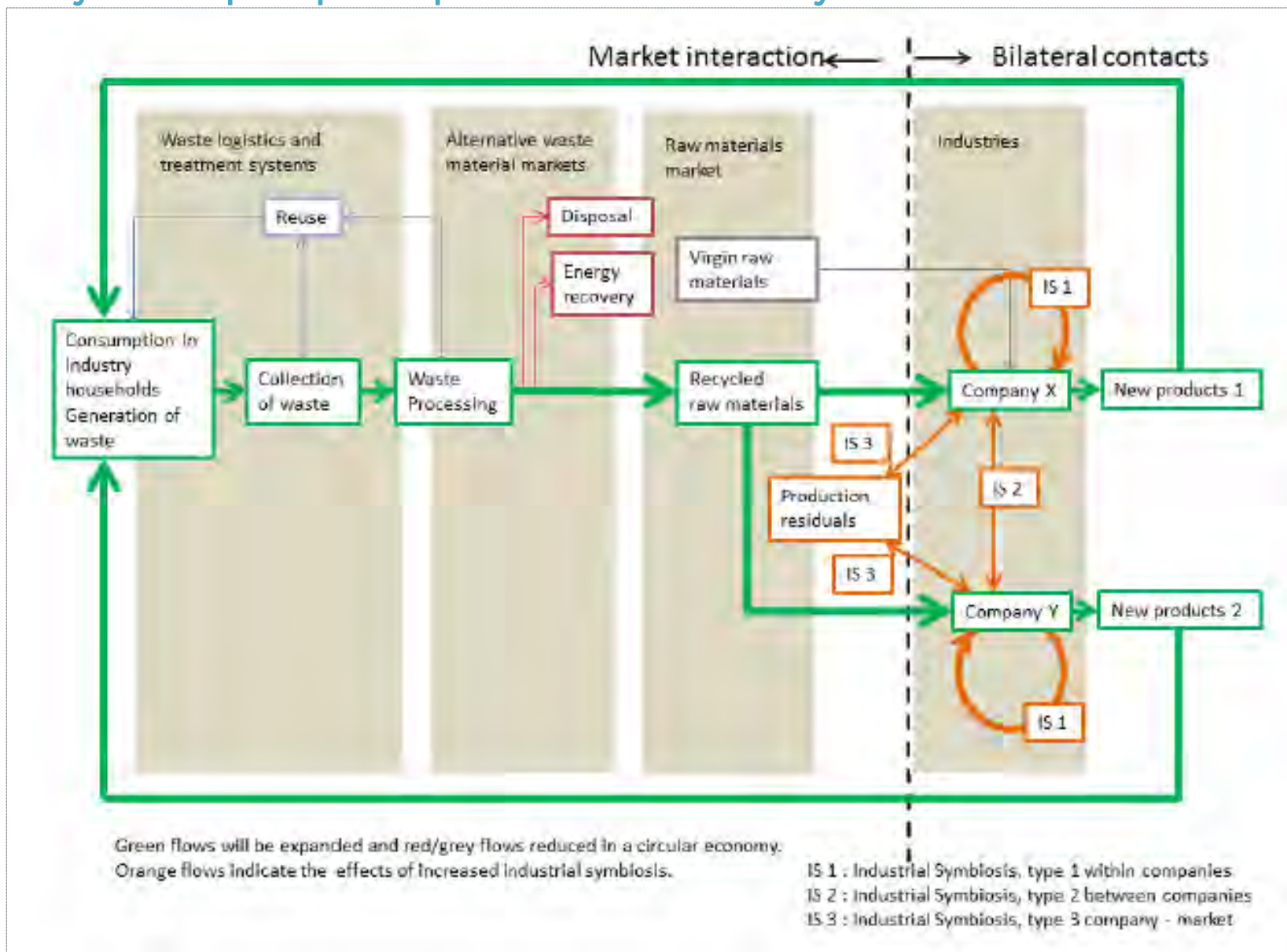
## What is Industrial symbiosis?

- ▶ Industrial symbiosis (IS), as a part of the emerging field of industrial ecology, demands resolute attention to the **flow of materials and energy through local and regional economies**. Industrial symbiosis engages traditionally **separate industries** in a collective approach to competitive advantage involving **physical exchange of materials, energy, water, and/or by-products**. The key factors for industrial symbiosis are **collaboration and the synergistic possibilities** offered by geographic proximity. Industrial symbiosis considers a group of industrial plants and other actors which exchange energy, water, by-products and waste and aim at **reducing overall production cost**. (*Bilsen et al. (2015), p. 42*)





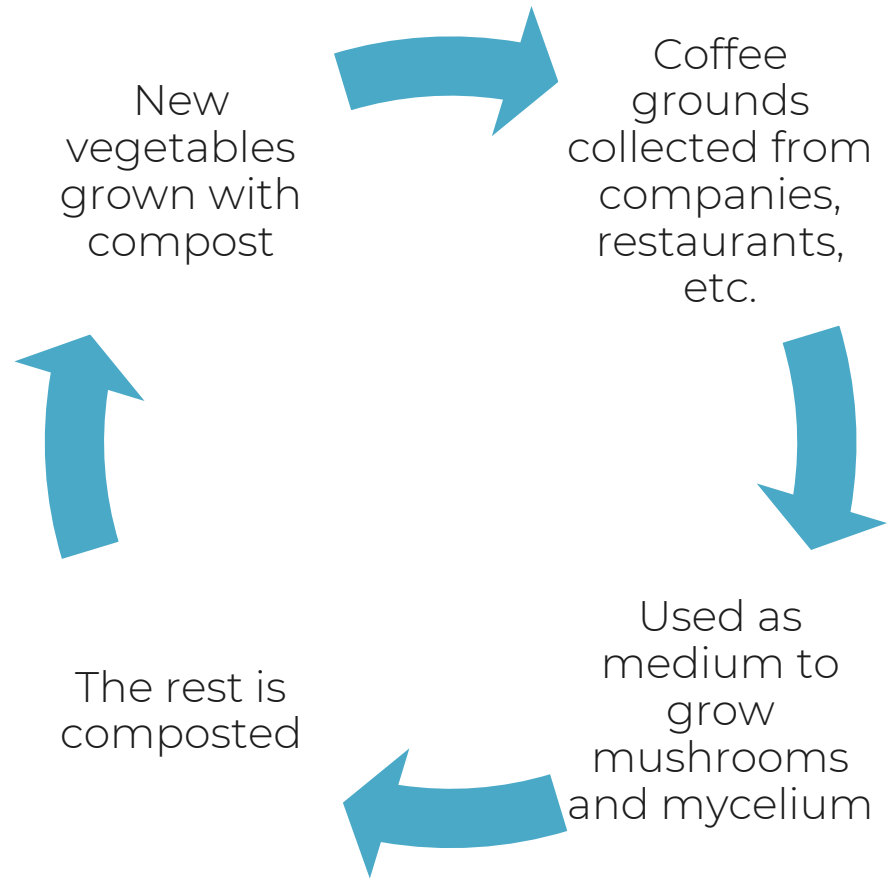
# Key concepts: principles of industrial symbiosis



Source: Bilsen et al. (2015), p29

# Circular economy in agro-food (1)

## ► Permafungi – Brussels, Belgium



Companies: [Ecovative](#), [Permafungi](#), [Eclo](#)





## Circular economy in agro-food (2)

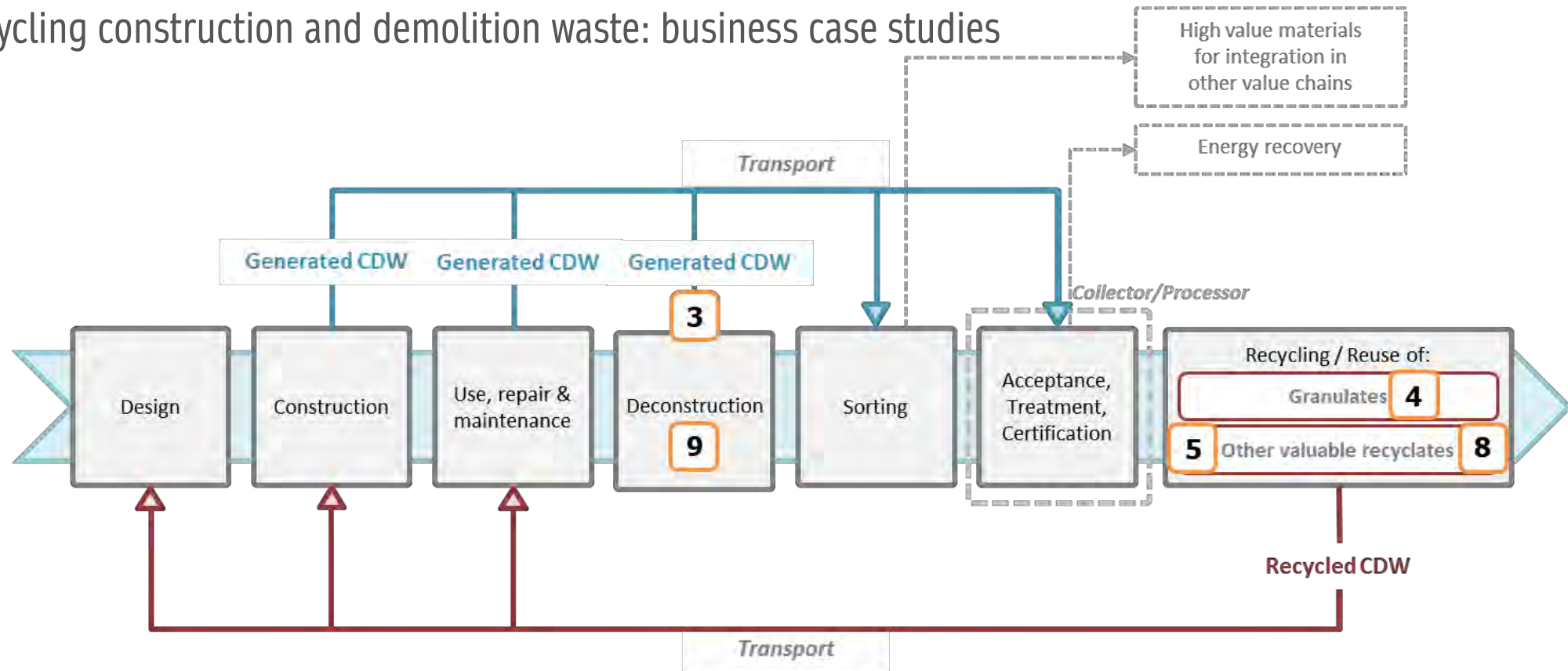
- ▶ Agro2Circular – New ways to upcycle agri-food packaging
- ▶ H2020 funded; 2021 – 2024; 16.7 mio (EU 14 mio)
- ▶ > 40 partners
- ▶ Link agriculture & chemistry & digitalisation
  - ▷ Fruit & vegetables waste -> nutraceuticals, functional foods, cosmetics
  - ▷ Multilayer plastic film packaging -> new recycling methods
  - ▷ Data Integration System for traceability and predictive decision tool in agrifood sector
  - ▷ Demonstration plant in Murcia (Spain)



Source: [TERRITORIAL CIRCULAR SYSTEMIC SOLUTION FOR THE UPCYCLING OF RESIDUES FROM THE AGRIFOOD SECTOR | Agro2Circular | Project | Fact sheet | H2020 | CORDIS | European Commission \(europa.eu\)](#)

# Circular economy in construction

## ► Recycling construction and demolition waste: business case studies



### Business cases

- 3:** Mobile mixed CDW processor/collector
- 4:** Stationary mixed CDW processor/collector
- 5:** Gypsum Processor
- 8:** Bricks Processor
- 9:** Selective Deconstruction

Source: Bilsen et al. (2018) p. 68

# Circular economy in energy production (1)

- ▶ Photovoltaics:
  - ▷ Ecodesign, labelling & tags
  - ▷ Integrated production & recycling
  - ▷ Refurbished solar panels (2<sup>nd</sup> hand)
  - ▷ Remanufacturing? Recycling (cost = new x 4)
- ▶ Wind energy
  - ▷ Ecodesign: increase durability, modular design: already done/limited
  - ▷ Ireland: recyclable reinforced plastic <-> composite materials
  - ▷ Reuse, repair: gear boxes, generators (cost savings)
- ▶ Lithium-ion batteries for energy storage and electromobility
  - ▷ Battery recycling: economically, technically difficult -> too little recycling capabilities
  - ▷ Design for recycling; lifetime increase; Reuse
  - ▷ Battery passport: QR code with technical info



Source: based on Graulich et al. (2021)

## Circular economy in energy production (2)

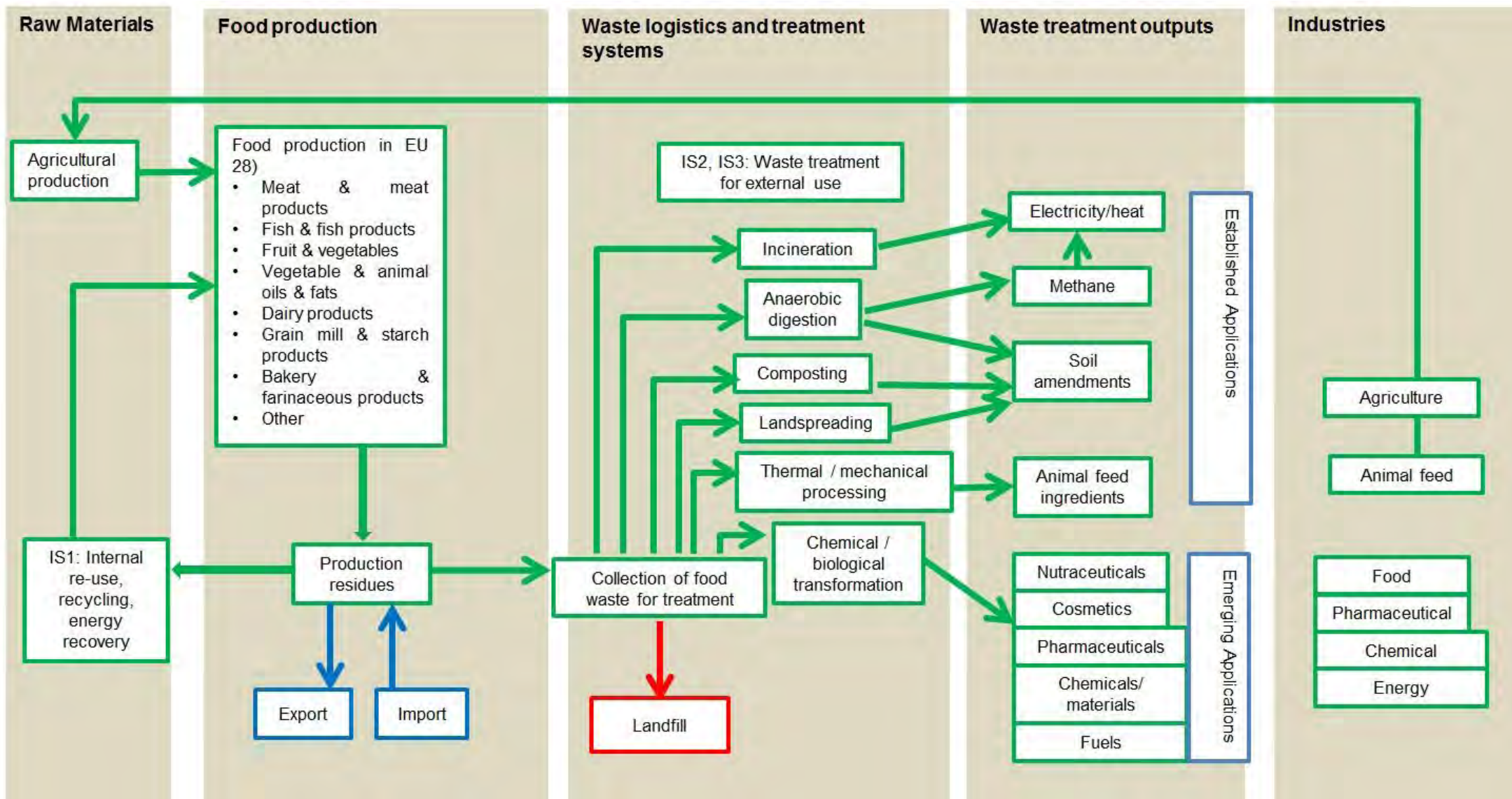
	Photovoltaics	Batteries	Wind turbines
Market trends / emerging waste streams	Waste stream emerges largely	Overload of recycling system	Massive growth of stream
Valuable raw materials	In, Ga, Ge, Si, Ag, Cu	LCO ok, rest not	L/HREE, B, Ni, Cu
Hazardous substances	Cd, Te, Se	Electrolyte + more	CF if incinerated
Risks in waste handling	Toxic metals, loss of resources	Fires	CF if incinerated
Logistics	Panel height	Expensive	Size challenging
Recycling infrastructure	Not (good) enough	Not (good) enough	Technology under development
Approaches to increase circularity	Design for recycling, remanufacturing	Refurbishment, second life	Reuse, increase durability
Best practice initiatives	Recycling of own products	Recycled content quota	Reuse of parts from EoL turbines
Policy gaps	Recycling goals, treatment standards	New EU regulation	Regulation is missing

Source: Graulich et al. (2021)





# Industrial symbiosis in agro-food (1): food production residues flow diagram

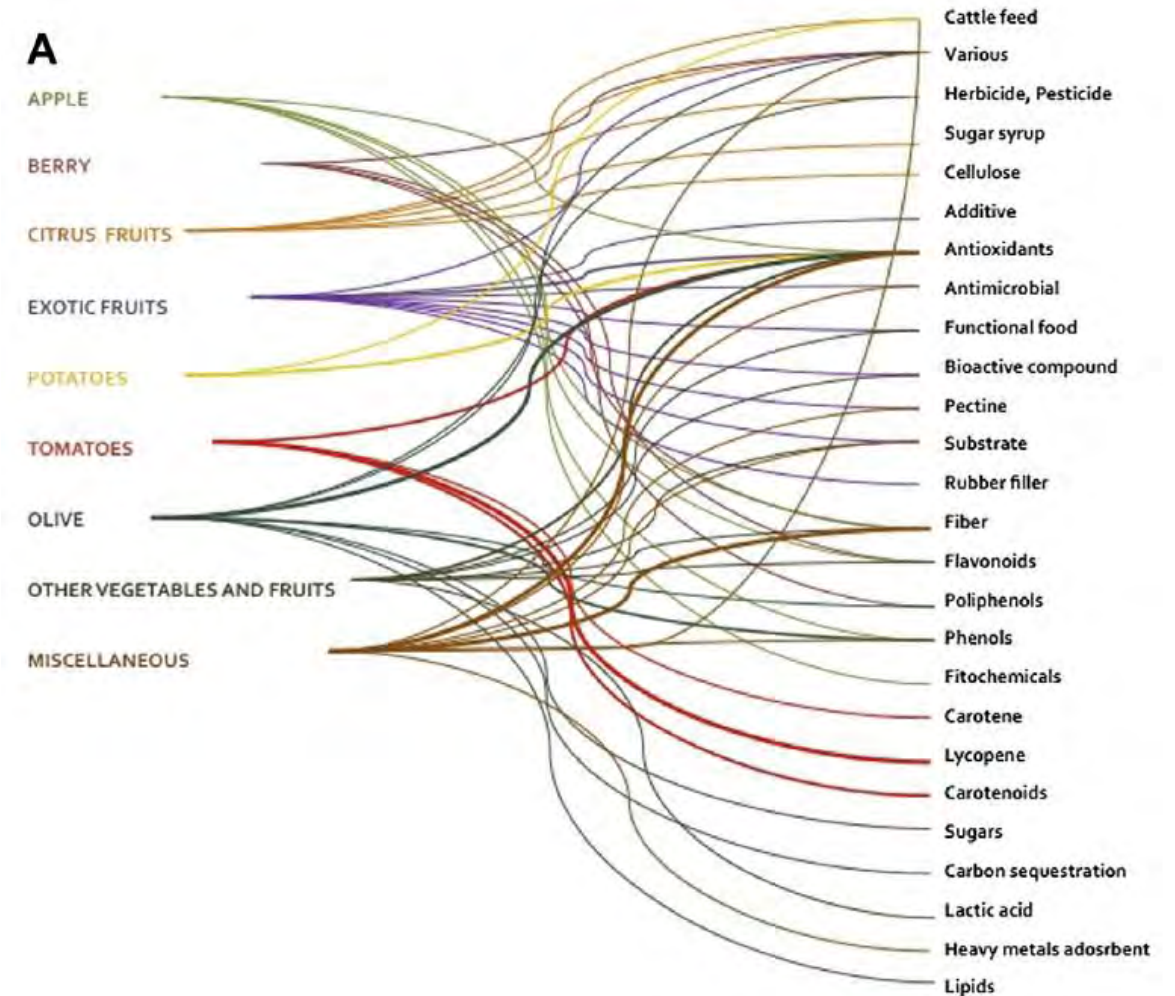


Source: Bilsen et al 2015



## Industrial symbiosis in agro-food (2): Examples of clusters and material compounds

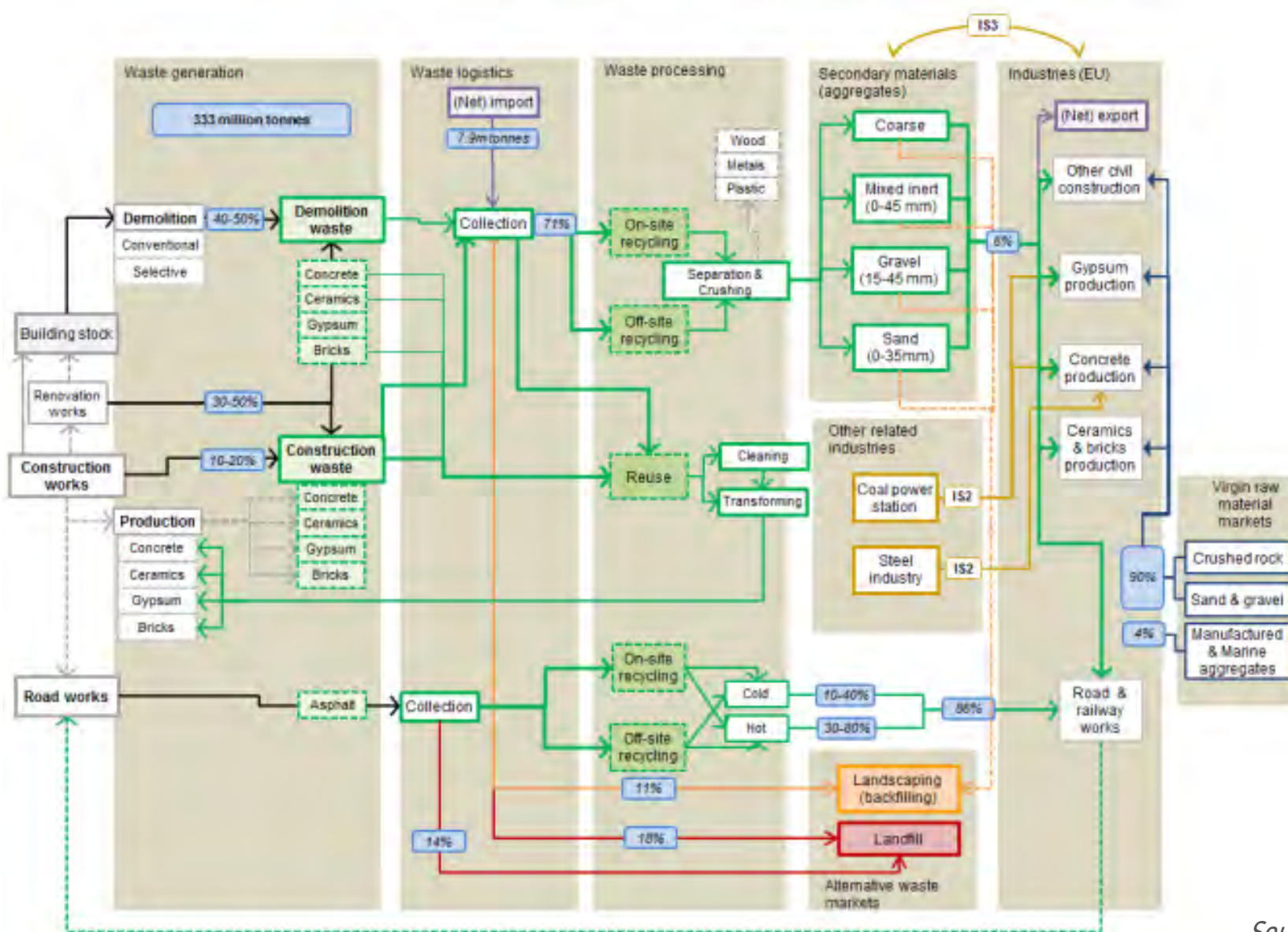
- ▶ Biopark Terneuzen (NL):
  - ▷ By-products & waste -> feedstock, energy
  - ▷ Food industry -> biomass (e.g. starch) -> chemistry (alcohol) -> cosmetics, pharmaceuticals, food
- ▶ Agro-industrial cluster of Bazancourt-Pomacle (FR - Reims)
  - ▷ Industry + agriculture + R&I activities
  - ▷ Wheat processing, sugar beet refinery, ingredients for cosmetics, 1<sup>st</sup> & 2<sup>nd</sup> generation of ethanol
  - ▷ Water & steam valorisation



Source: Referenced in Bilsen et al 2015, p 57



# Industrial symbiosis in construction



- Industrial symbiosis links
- Circular economy links
- Flows leaving the CE
- Virgin material flows
- Trade flows

Source: Bilsen et al 2015



## Resources

- ▶ [Homepage | European Circular Economy Stakeholder Platform \(europa.eu\)](#)
- ▶ Circular Week 2023: [CIRCULAR WEEK 2023 | International campaign for the circular economy and sustainable development.](#)
- ▶ Circular Cities and Regions Initiative: [Circular Cities and Regions Initiative | Circular Cities and Regions Initiative \(europa.eu\)](#)
- ▶ EEA (2022) Country profiles on circular economy in Europe [Country profiles on Circular Economy in Europe | Circular Cities and Regions Initiative \(europa.eu\)](#)

#CEstakeholderEU

**European Circular Economy Stakeholder Platform**

A joint initiative by the European Commission and the European Economic and Social Committee



**CIRCULAR  
WEEK 2023**

**Circular Cities and Regions Initiative**

Supporting Europe's circular economy at local and regional level



**Eionet Portal**





# Bibliography

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- ▶ Bilsen et al. (2018) Development and implementation of initiatives fostering investment and innovation in construction and demolition waste recycling infrastructure – Final Report, Brussels, 05 January 2018, 197pp., on behalf of the European Commission, Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs, available at <https://publications.europa.eu/en/publication-detail/-/publication/3637d9db-1c3e-11e8-ac73-01aa75ed71a1/language-en/format-PDF/source-66396125>
- ▶ European Environment Agency (2021) Relative change in main global economic and environmental indicators, available at [Relative change in main global economic and environmental indicators — European Environment Agency \(europa.eu\)](https://www.eea.europa.eu/en/indicators/relative-change-in-main-global-economic-and-environmental-indicators)
- ▶ Graulich, K., Bulach, W., Betz, J., Dolega, P., Hermann, C., Manhart, A., Bilsen, V., Bley, F., Watkins, E., Stainforth, T. (2021) Emerging waste streams – Challenges and opportunities, Freiburg, 89pp. On behalf of the European Environment Agency, available at [Öko-Institut e.V.: Publikation \(oeko.de\)](https://www.oeko.de/ViewDoc.aspx?DocID=1388)
- ▶ Moraga (2021) Circular Economy Indicators. Starting from the concept of the in-use occupation of materials – Policy Report, CE Centre/UGENT, 12 pp. available at [20210906\\_PhD Gustavo.pdf \(vlaanderen-circulair.be\)](https://www.vlaanderen-circulair.be/20210906_PhD_Gustavo.pdf)



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