




## Up2Circ – Boosting the Uptake of Circular Business Model, Product and Process Innovation

Horizon Europe 2021-2027  
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### **Sectorial Catalogue: Energy Intensive Industries**



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**Short Introduction to Energy Intensive Industries**


The Energy Intensive Industries (EII) ecosystem stands as a cornerstone of the global economic landscape, encompassing sectors that demand substantial energy inputs to drive their operations. These industries, ranging from manufacturing and chemicals to metals and mining, play a vital role in shaping economies and infrastructures worldwide. They make up more than half of energy consumption of the EU industry and are at the heart of the EU value chains. With deep reliance on energy resources, the EII ecosystem faces unique challenges and opportunities at the intersection of sustainability, innovation, and efficiency. EII Ecosystem covers the following sectors: Chemicals, Steel, Paper, Plastics, Mining, extraction and quarrying, Refineries, Cement, Wood, Rubber, Non-ferrous metals, Glass and Ceramics.

They supply intermediate products to each other and to many downstream sectors of the economy, are closely integrated with energy providers as well as with the waste and recycling industries due to their need for secondary raw materials.

EIIs have a strong record in reducing greenhouse gas emissions – between 1990 and 2015 they reduced emissions by 36%. This is further supported by EU Emissions Trading System, which incentivises energy-intensive installations to reduce emissions.

In 2019, energy-intensive industries (EII) accounted for 17% of the EU's greenhouse gas emissions. Key steps have been taken to decarbonize EIIs to meet climate neutrality goals. For instance, in April 2023, a revision to the EU Emissions Trading System was adopted to fast-track emissions reduction in energy-intensive installations. Additionally, the Green Deal Industrial Plan and the Net Zero Industry Act, introduced in February and March 2023 respectively, aim at modernizing, decarbonizing EIIs and scaling up clean technology manufacturing within the EU.

Key data:

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7.8 million people employed according to Eurostat.  
 4,55% of EU value added  
 548 000 firms (99,4% SMEs)  
 17% of EU greenhouse gas emissions in 2019

Introduction to the EII ecosystem by European Cluster Collaboration Platform:  
<https://clustercollaboration.eu/in-focus/industrial-ecosystems/energy-intensive-industries>

## Challenges for the sector with regard to sustainability demands

According to the Circular Economy Playbook for Chemical Industries compiled by SITRA (FIN), key forces accelerating shift towards sustainability and circular economy are:

- End consumers are demanding more sustainable products
- Brand owners are making voluntary commitments to sustainability
- Responsible investments are becoming the new norm
- Greenhouse gas reduction is crucial for slowing down global warming
- Regulation around sustainability is strongly increasing
- New technologies enabling circularity are constantly emerging and advancing

From regulatory side, key challenges for the Energy Intensive Industries (EII) sector in meeting sustainability demands include reducing greenhouse gas emissions, transitioning to cleaner technologies, and adhering to evolving regulatory frameworks. Notable regulations include the EU Emissions Trading System revision (2023) incentivizing emissions reduction, and the Green Deal Industrial Plan and Net Zero Industry Act (2023) promoting decarbonization and clean technology adoption. These frameworks outline EU's approach to achieving climate neutrality and sustainability in EIIs.

Mostly because of COVID, annual production dropped significantly in 2020 (ranging from around 22% for the steel sector, 10-16% for cement, 10-15% for flat glass and 1-11% for non-ferrous metals, amongst surveyed companies). This is largely driven by major drops in demand in downstream industries, notably in automotive and construction, starting in March 2020. Although most industries showed a strong recovery since the first wave of the pandemic, the growing uncertainty deteriorated the overall business sentiment and resulted in massive temporary layoffs. Uncertainty about global economic recovery looms over investment decisions needed to support ongoing activities of Energy Intensive Industries (EIIs) in the EU.



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## CE opportunities for the sector

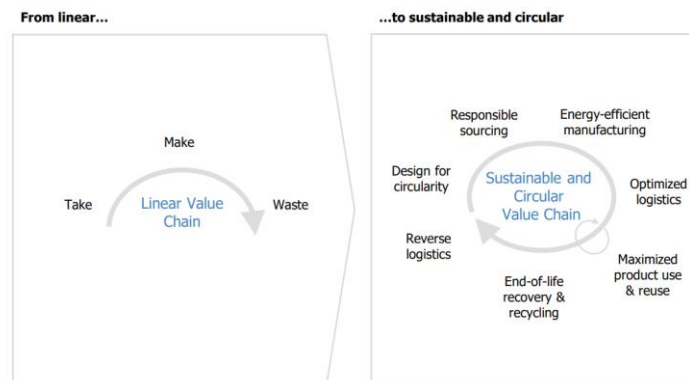


Figure 1 Linear vs Sustainable value delivery. Source: Circular Economy Playbook for Chemical Industries, SITRA

Key to successful circularity implementation lies in changing from the current linear value chains into sustainable and circular value chains across the industries involved (see figure 1). The High-Level Group on Energy-Intensive Industries (HLG EII) developed a Masterplan<sup>1</sup> containing recommendations to manage the transition to climate-neutrality while keeping the EII competitive. These recommendations served as input for the European Green Deal and the EU Industrial Strategy. The HLG EII share the ambition of the Paris Agreement and underline the transformation challenges this ambition implies. The Masterplan gives concrete recommendations on three themes:

- the creation of markets for climate-neutral, circular economy products;
- developing climate-neutral solutions and financing their uptake; and
- resources and deployment.

Recommendations from HLG EII:

- Accelerate the move to circular economy to reduce greenhouse gas emissions through better material and resource efficiency across value chains
- Develop infrastructure reflecting an integrated approach including energy, transport and digital networks
- Introduce measures to assess products based on the appropriate and standardised life-cycle approach
- Develop technological solutions and design products that help achieve circularity
- Exploit underused potential for use of secondary raw materials
- Promote use of renewable and (carbon-based) recyclables beyond energy production

<sup>1</sup> <https://op.europa.eu/en/publication-detail/-/publication/be308ba7-14da-11ea-8c1f-01aa75ed71a1/language-en>



For each sector multiple technology options are being developed towards significant GHG reductions

Technology	Electrification (heat and mechanical)	Electrification (processes: electrolysis/ Electrochemistry excl. H <sub>2</sub> )	Hydrogen (heat and-or process)	CCU	Biomass (heat and feedstock) /biofuels	CCS	Other (including process integration)
Steel	xxx	xx	xxx	xxx	x	xxx	Avoidance of intermediate process steps and recycling of process gases: xxx Recycling high quality steel: xxx
Chemicals & fertilisers	xxx	xxx	xxx	xxx	xxx	xxx (*)	Use of waste streams (chemical recycling): xxx
Cement lime	xxx	o (cement) o (lime)	x (cement) x (lime)	xxx (cement, lime)	xxx (cement) x (lime)	xxx (cement and lime)	Alternative binders (cement): xxx Efficient use of cement in concrete by improving concrete mix design: xxx Use of waste streams (cement): xxx
Refining	xx	o	xxx	xxx	xxx	xxx	Efficiency: xxx
Ceramics	xxx	o	xx	x	x	o	Efficiency: xxx
Paper	xx	o	o	o	xxx	o	Efficiency: xxx
Glass	xxx	o	x	o	xxx	o	Higher glass recycling: xx
Non-ferrous metals/alloys	xxx	xxx	x	x	xxx	x	Efficiency: xxx Recycling high quality non-ferrous: xxx Inert anodes: xxx
<small>o: Limited or no significant application foreseen x: Possible application but not main route or wide scale application xx: Medium potential</small>				<small>xxx: high potential xxx: Sector already applies technology on large scale (can be expanded in some cases) (*): In particular for ammonia and ethylene oxide</small>			

Source: EU EII transformation Masterplan presentation, 21.01.2020:  
[1\\_21012020\\_tanuskevicius - masterplan\\_slides\\_0.pdf \(europa.eu\)](https://ec.europa.eu/euro-observatory/en/1_21012020_tanuskevicius_-_masterplan_slides_0.pdf)

Within the context of Energy Intensive Industries (EII), adopting circular economy principles presents unique opportunities and best practices to enhance resource efficiency, reduce energy consumption, and minimize the environmental impact associated with these sectors. Here's how circular economy concepts can be applied to EIs:

- **Resource Efficiency and Material Optimization:** EIs can focus on optimizing raw material usage, minimizing waste generation, and developing processes that extract the maximum value from inputs. By embracing resource-efficient manufacturing techniques and materials, such as lightweighting and composite materials, these industries can reduce their environmental footprint.
- **Industrial Symbiosis:** Encouraging collaboration between different industries and sectors to exchange waste materials, byproducts, or excess energy can create closed-loop systems where one industry's waste becomes another's input, reducing the need for new resources.
- **Waste Heat Recovery and Energy Recycling:** EIs generate significant amounts of waste heat. By implementing technologies like cogeneration, waste heat can be captured and repurposed for other processes, improving overall energy efficiency.
- **Circular Supply Chains:** EIs can establish circular supply chains that prioritize the reuse, refurbishment, and remanufacturing of components and products. This approach can lead to reduced energy consumption and a lower demand for new materials.



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- **Lifecycle Assessment and Design for Recycling:** Performing life cycle assessments (LCAs) can help identify areas for improvement in terms of energy consumption and resource usage. Designing products and processes with a focus on recyclability and ease of disassembly can enhance circularity.
- **Sustainable Materials and Alternatives:** Exploring alternative, more sustainable raw materials and inputs can help reduce the environmental impact of EIs. This might include using renewable energy sources and bio-based materials.
- **Digitalization and Advanced Manufacturing:** Utilizing digital technologies, like sensors, IoT, and data analytics, can optimize processes, reduce downtime, and enhance energy efficiency. Advanced manufacturing techniques such as 3D printing can also reduce material waste.
- **Circular Business Models:** EIs can adopt circular business models such as leasing, pay-per-use, or take-back schemes, which encourage the return of products after use for refurbishment, remanufacturing, or recycling.
- **Regulatory Compliance and Extended Producer Responsibility (EPR):** EIs can proactively engage with regulations and EPR policies to ensure responsible management of products throughout their lifecycle, including take-back and recycling obligations.
- **Employee Training and Stakeholder Engagement:** Raising awareness and providing training to employees and stakeholders about the benefits of circular economy practices can drive enthusiasm and commitment to adopting these principles.

By integrating circular economy principles into Energy Intensive Industries, these sectors can not only enhance their sustainability credentials but also reduce their energy consumption, decrease their dependence on raw materials, and contribute to a more resource-efficient global economy.

## Overview of tech-savvy SMEs that develop/offer solutions to increase circularity in the sector


There is a lot of new and upcoming technologies in the EI field. Below just some examples relevant to the sector (will be updated with examples as the Up2Circ project proceeds).

**Belotar** <https://www.belotar.com> (Finland) – Next generation buildign material Geoprime which enables making concrete without cement.

**Ioniqa** <https://ioniqa.com> (Netherlands) - With a cost- effective process, Ioniqa is able to close the loop for plastics, starting with PET plastics. This award winning innovation transforms all types and colors of PET waste into valuable resources for 'virgin- quality' new PET. Upcycling processes for other types of plastics are being researched and expected to be launched in the near future.

**Gr3n Recycling** <https://gr3n-recycling.com> (Switzerland) - Provides a chemical recycling technology for PET and polyester. Gr3n developed an innovative process, based on the application of microwave technology to alkaline hydrolysis, which provides an economically viable recycling process of Polyethylene Terephthalate (PET), allowing the industrial implementation.



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## Links to sector specific online contents, including sector specific funding opportunities, further information sources and reports

Below several funding opportunities (will be updated during the Up2Circ project)

**Horizon Europe** - EU's key funding programme for research and innovation with a budget of €95.5 billion. It tackles climate change, helps to achieve the UN's Sustainable Development Goals and boosts the EU's competitiveness and growth. [https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe\\_en](https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe_en)

**Interreg programs** –one of the key instruments of the EU supporting cooperation across borders through project funding. It aims to jointly tackle common challenges and find shared solutions in fields such as health, environment, research, education, transport, sustainable energy and more. <https://interreg.eu>

**InvestEU programme (European Invest Bank)** for highly risky projects with high policy added value eligible under the sustainable infrastructure and research, innovation and digitalisation policy windows. Top-up from Innovation Fund. [https://investeu.europa.eu/index\\_en](https://investeu.europa.eu/index_en)

**Innovation Fund 2020 – 2030**, 38 BEUR, Innovation in EII, renewables, energy storage, carbon capture, use and storage, [https://climate.ec.europa.eu/eu-action/eu-funding-climate-action/innovation-fund\\_en](https://climate.ec.europa.eu/eu-action/eu-funding-climate-action/innovation-fund_en)

**Enterprise Europe Network** for finding partners for Technology development and transfer: <https://een.ec.europa.eu/partnering-opportunities>

**EU plans / transition pathway** foreseen for each sector:

- <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52021SC0351>
- [https://single-market-economy.ec.europa.eu/industry/transition-pathways\\_en](https://single-market-economy.ec.europa.eu/industry/transition-pathways_en)

**The Circularity Gap Report** (<https://www.circularity-gap.world/2023>) gives specific info and links on:

- Food systems
- Built environment
- Manufactured goods and consumables
- Mobility and transport

**The Action Agenda** (<https://pacecircular.org/action-agenda>) is made up of five publications: plastics, textiles, electronics, food, and capital equipment.

There are further online contents for specific sectors, e.g:

**Construction:** <https://www.eea.europa.eu/themes/climate/cutting-greenhouse-gas-emissions-through/cutting-greenhouse-gas-emissions-through>

**Energy intensive industries / Chemical industry:** <https://www.sitra.fi/en/publications/circular-business-models-for-chemical-companies/>

**The Green Deal Industrial Plan** [https://ec.europa.eu/commission/presscorner/detail/en/ip\\_23\\_510](https://ec.europa.eu/commission/presscorner/detail/en/ip_23_510)



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**Publications from the European Commission**

European Commission, Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs, *Masterplan for a competitive transformation of EU energy-intensive industries enabling a climate-neutral, circular economy by 2050*, Publications Office, 2019, <https://data.europa.eu/doi/10.2873/854920>

European Commission, Directorate-General for Research and Innovation, *ERA industrial technology roadmap for low-carbon technologies in energy-intensive industries*, Publications Office of the European Union, 2022, <https://data.europa.eu/doi/10.2777/92567>



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