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R&I for industrial transition: ERA Industrial technology Roadmaps

From R&I to uptake and deployment – how EU and regions can support the green transition of industry

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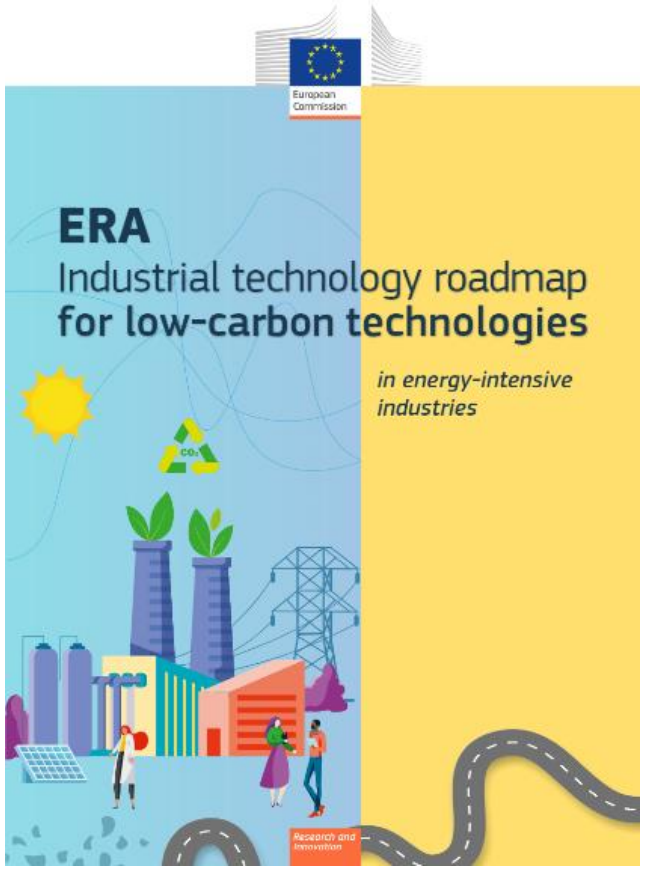
New ERA industrial technology roadmaps

The **New ERA Policy Agenda** thrives to *"accelerate the green and digital transition of Europe's key industrial ecosystems" (Action 12)*

To this end, **New ERA** industrial technology roadmaps are designed to *"speed up the transfer of research results into the real economy (…), allowing an efficient use of the full set of support mechanisms to crowd in private investments in key cross-border projects"*.

The roadmaps provide *key R&I input and actions to the transition pathways for strategic EU industrial ecosystems*, following the **updated Industrial Strategy**.



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Accelerating the green transition

Industrial technology roadmaps

- Evidence on technologies and state of play in TRL, investments and conditions
- Underpins outlook and conclusions for steps towards deployment

Areas addressed:

- Low carbon technologies in enery-intensive industries
  - Published 8 April 2022
- For circular industrial technologies in 3 industrial eco-systems – textiles, construction, energy-intensive industry sectors
  - Under preparation

EU policy context for low carbon industries

- Energy-intensive industries accounted for 17% of the EU's total greenhouse gas (GHG) emissions in 2019.
- Reduction of GHG emissions in these industries is a cornerstone to achieving the EU's climate goals for 2030 and 2050 (European Green Deal).
- Developing and deploying low-carbon technologies in these industries is key.

REPOWEREU TO CUT OUR DEPENDENCE ON RUSSIAN GAS

Decarbonising Industry by accelerating the switch to electrification and renewable hydrogen and enhancing our low-carbon manufacturing capabilities.

Russia's invasion of Ukraine strengthened the case for Europe to accelerate the green transition and become more energy efficient.

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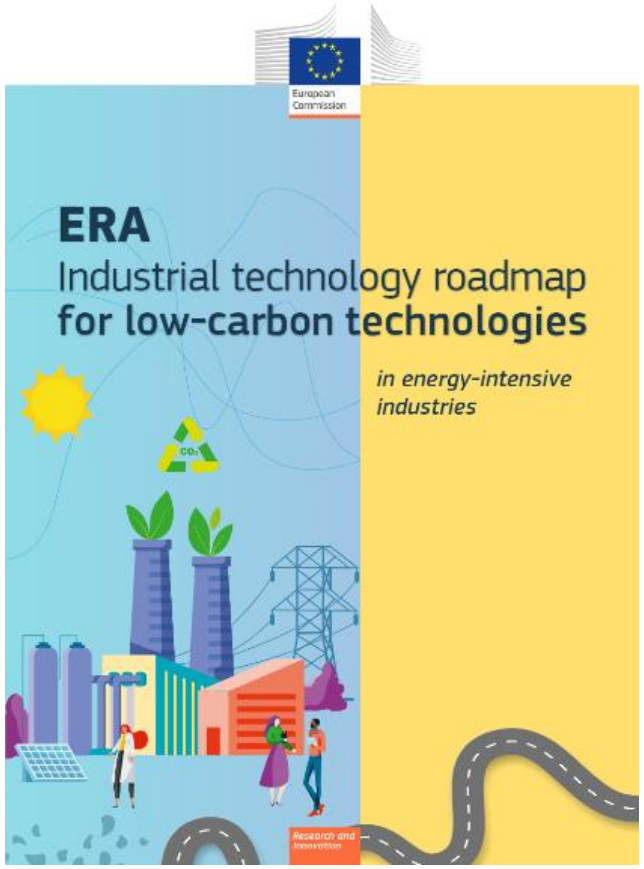
New ERA roadmap for low-carbon technologies in energy-intensive industries



- The ERA roadmap for low-carbon technologies, developed together with Member States, industry and other stakeholders, provides a list of key emerging low-carbon technologies for energy-intensive industries.
- It outlines scenarios for the transition of energy-intensive industries to climate neutrality and tools for leveraging R&I investments to accelerate development and uptake of low-carbon technologies.
- It elaborates on R&I needs, including public and private R&I investments, green patenting activity and enabling conditions, including regulatory framework, valorisation and standardisation aspects.

Published on 8 April 2022

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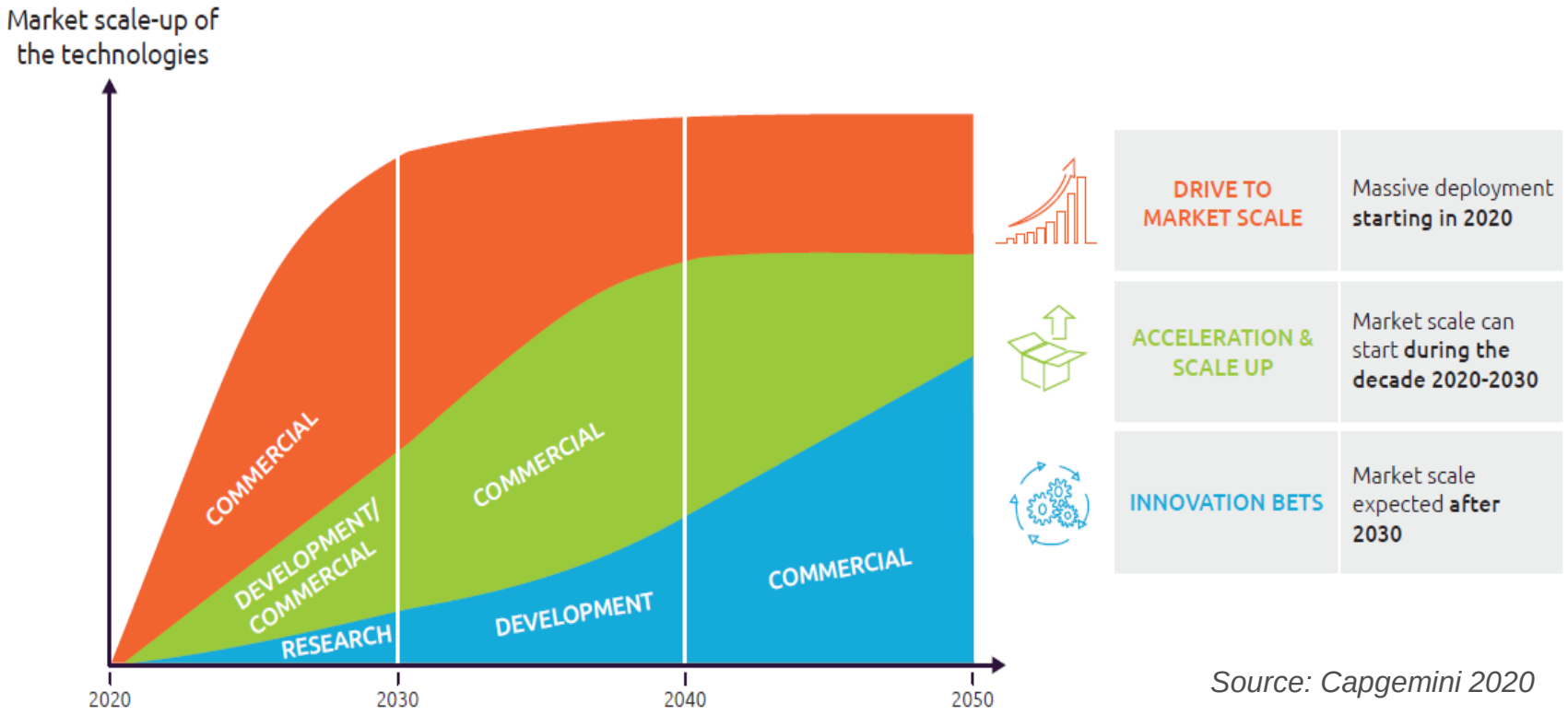
Most relevant ‘technological pathways’ (technology groups)

The analysis results in a list of the **most relevant technological pathways** for the decarbonisation of energy-intensive industries at varying levels of technological readiness

Technological decarbonisation pathways in EII	Assessment of technology readiness (TRLs)	Application potential by sector
Electrification	**low/ medium**	High for chemicals, non-ferrous metals; iron & steel, ceramics, glass
Use of green hydrogen	**medium**	High for chemicals, iron & steel and non-ferrous metals
Carbon capture and storage	**medium/ high**	High for cement & lime, chemicals, iron & steel
Carbon capture for utilisation	**medium**	High for cement & lime, chemicals, iron & steel; but also for all other EII
Alternative fuels and feedstocks (excl. H2), bio-based resources, and integration of renewable energy	**medium/ high**	High for cement, chemicals, pulp & paper, non-ferrous metals, glass; but also for all other EII
Alternative materials and more energy efficient processes	**medium/ high**	High for cement & lime, chemicals, iron & steel, pulp & paper, non-ferrous metals, ceramics; but also for all other EII
Materials efficiency, secondary resources and waste valorisation (incl. recycling/CE and industrial symbiosis)	**medium/ high**	High for all EII

R&I investment needs

The roadmap points to **a gap between the current overall R&I investments** across energy-intensive sectors and the amount needed to reach EU Green Deal emission targets for 2030 and 2050.



Source: Capgemini 2020

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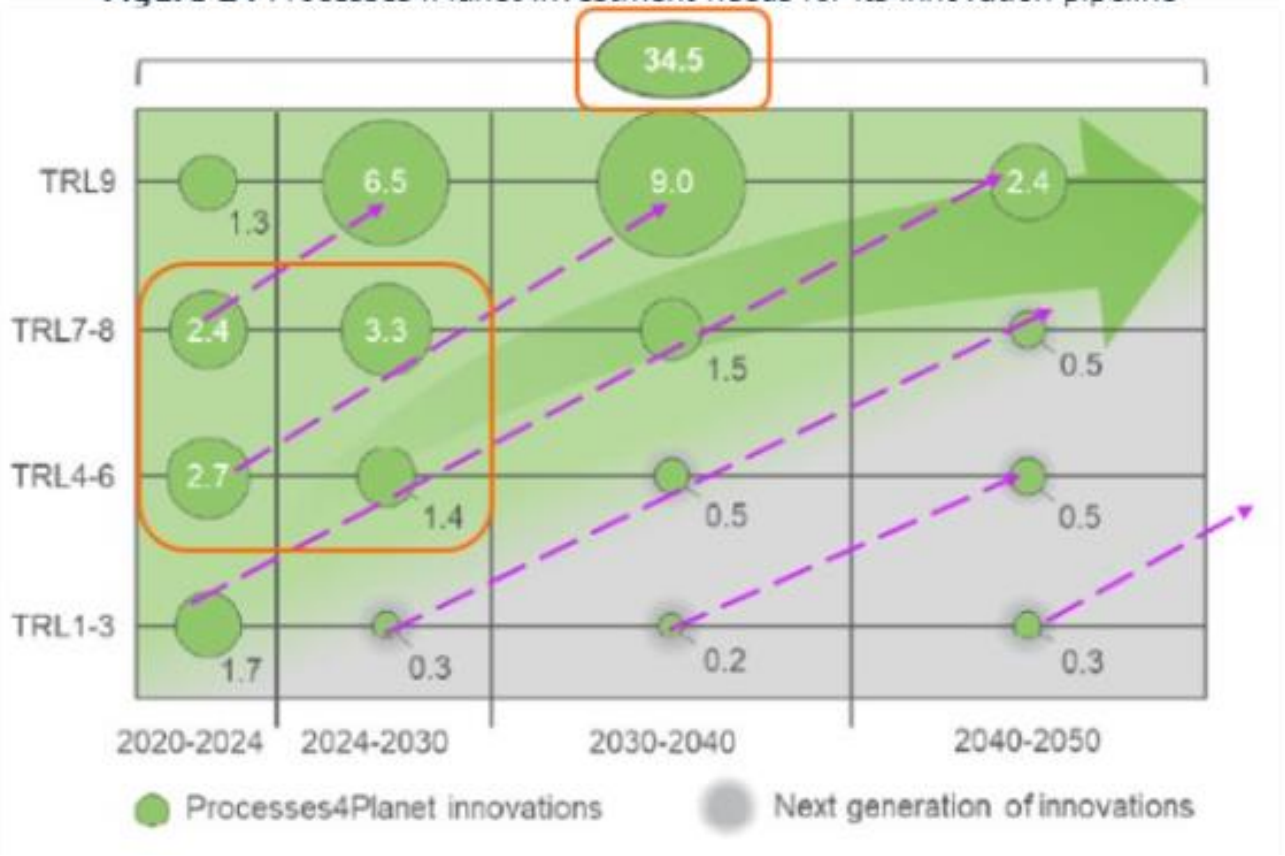
R&I investment needs

The biggest investment gap concerns investments in the coming years in **first-of-a-kind installations** for low-carbon industrial technologies and further deployment of mature technologies.

Figure 24 Processes4Planet investment needs for its innovation pipeline



Source: Processes4planet roadmap

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Main outcomes

Key findings	Suggested actions
Gap between current R&I investments and levels needed to reach the Green Deal objectives	**Establish an industrial alliance or similar initiative for cross-sectoral low-carbon technologies in energy-intensive industries** **Facilitate specific national sectoral and cross-sectoral strategies or programmes with key stakeholders as part of ERA policy agenda**
A key barrier to rollout are the uncertainties around authorisations of first-of-a-kind installations	**Establish a community of practice to facilitate authorisation for FOAK installation for low-carbon industrial technologies**
Patenting filings in green inventions by major EU companies continue to increase, but the role of SMEs in them remains unclear	**Improve the knowledge on patenting for green technologies and for energy-intensive industries** **Facilitate further valorisation by exploring with industry the opportunity to open up IP on central (cross-sectoral) green inventions, widening the access to IP for licensing (e.g. patent pool) and knowledge transfer**
EU green standards for low-carbon technologies appear to be underdeveloped in some areas	**Cooperate with European standardisation organisations (e.g. CEN, CENELEC) and industrial partnerships to identify and fill main standardisation gaps for innovative LC industrial technologies**

Next steps

ERA Policy Agenda

The implementation of the roadmap helps accelerating the green and digital transition of Europe's key industrial ecosystems

Updated Industrial strategy

Roadmap findings will feed R&I priorities into the upcoming transition pathway for EU energy-intensive industries ecosystem

Next roadmap

Another roadmap on circular industrial technologies is in the making

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Ongoing preparation: ERA roadmap for circular industrial technologies and business models

- Circular industrial technologies and business models in 3 industrial ecosystems:
  - Energy-intensive industries
  - Textiles
  - Construction
- Under preparation with Member States and stakeholder input - to be published in Q4 2022
- Same structure as the low-carbon roadmap
  - 1 | Transition scenarios
  - 2 | Key technological pathways
  - 3 | R&I investments
  - 4 | Framework conditions

Circular industrial technologies for energy-intensive industries, textiles, and construction

Textiles

	Tech and non-tech solutions	TRL	Circularity potential	Negative effects	Economic performance	Startup attractiveness
Prep of material	• Alternative input materials	4-8	**	Likely	*	High
	• Virtual fabric sourcing	4	***	Likely	**	None
	• Design for sustainability (durability)		**	None		Low
Yarn to textile	• Circular dyeing technologies	1-6	*	Likely	*	Medium
	• Reduced use of inputs (chemicals, water)	4-8	***	None	**	Medium
Production	• Optimisation and waste reduction	9	*	None	***	Low
	• Artificial intelligence for quality and optimisation	3	**	Likely	**	None
Retail	• Sustainable packaging	4-6	***	None	***	Medium
	• Digitally enhanced shop: Leasing and rental models	4-6	*	None	**	High
Use	• Augmented/Virtual Reality for tailoring	7-8	*	None	*	None
	• Microfibre release minimisation	1-3	*	None	*	Low
	• Collaborative consumption models		***	None	**	High
End of lifecycle	• Sorting technologies	7-8	***	None	***	Low
	• Chemical recycling	4-6	***	Likely	*	Low
	• Digital product passports, blockchain	1-3	**	None	**	None
	• Textiles collection and resale		***	None	**	High

Construction

	Tech and non-tech solutions	TRL	Circularity potential	Negative effects	Economic performance	Startup attractiveness
Sourcing and Design	• Raw materials sourcing	4-6	***	Likely	***	None
	• Design and Development	4-8	***	None	***	Low
	• Green building design					
Production and use	• Construction and manufacturing approaches	4-9	*	None	**	Medium
	• Alternative use of inputs	4-8	***	Likely	**	Medium
	• Network-based models					
	• Space sharing					
	• Performance-based models					
Recycling	• Interface with Customer and User	4-8	***	None	***	High
	• Material Recycling Technologies	4-9	**	None	**	Medium
	• Take back and reuse					
Horizontal	• Digital Tools	4-6	**	None	**	High

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Circular industrial technologies for energy-intensive industries, textiles, and construction

Energy-intensive industries

Chemicals

	Tech and non-tech solutions	TRL	Circularity potential	Negative effects	Economic performance	Startup attractiveness	Need for policy action
Material sourcing	• Innovative materials of the process industries	4-6	**	Likely	***	High	Yes
	• Inherent recyclability of materials	4-6	**	None	**	None	Yes
	• Regeneration of spent solvents	9	**	None	**	None	Yes
	• Recycling acids, alkaline, saline wastes	4-6	***	None	***	None	Yes
	• Plastic waste recyling technologies (thermo, bio, etc)	4-8	**	Likely	**	High	No
Production	• Biomass-tolerant processes, Biomass pre-treatment processes	9	**	None	**	Medium	Yes
	• Use of CO2 and CO as a building block in polymers	4-6	**	Likely	*	Low	Yes
	• Chemical reactions	4-9	*	None	**	None	Yes
	• AI and machine learning for discovering new catalysts	4-6	*	None	**	None	Yes
	• Valorisation of wastewater in metal production	7-8	**	Likely	**	Medium	Yes
Recycling	• Data sharing platforms and data security	4-7	***	Likely	***	Low	Yes
	• Coordination & management of connected processes	4-6	**	None	***	Low	Yes
	• Distributed ledger technologies	4-7	**	None	**	None	Yes
Horizontal	• Modelling and simulation tools in material design	9	*	Likely	**	Low	Yes
	• Digital twins and digital processes in plant engineering, data collection	7-8	**	Likely	***	Medium	Yes

Steel

	Tech and non-tech solutions	TRL	Circularity potential	Negative effects	Economic performance	Startup attractiveness
Design	• Optimisation of the product design	3-8	***	None	**	Low
Production	• Industrial symbiosis / reuse of waste from other industrial processes	2-8	***	Likely	**	Medium
	• Water efficiency	3-5	**	None	**	High
	• Heat recovery	1-4	**	None	**	None
	• Optimisation of the sintering/firing process	1-5	**	None	***	None
	• Resource use minimisation	6-7	**	Likely	*	None
End of life	• Recycling technologies	3-6	***	None	***	Medium
	• Recycling of post-consumer ceramic	6-7	***	None	***	Low
Horizontal	• Digital technologies (e.g. passport, monitoring)	1-8	**	None	***	Low

Ceramics

	Tech and non-tech solutions	TRL	Circularity potential	Negative effects	Economic performance	Startup attractiveness
Residue valorisation & content recovery	• Use of carbon-fibre-reinforced polymers in EAF	4-6	*	not likely	**	None
	• RecoDust for Fe and Zn recovery from BOF dust	4-6	*	not likely	**	None
	• Leaching process for Zn recovery from BOF sludge	4-6	**	not likely	**	None
	• Digitalization tools for CE focusing on monitoring	4-6	***	not likely	***	Medium
	• Zn recovery from Hisarna filter dust	4-6	*	not likely	*	None
	• Induction furnace & bath injection for Zn recovery	7-8	*	not likely	*	None
	• MIDREX residue agglomeration for reuse in DR	7-8	*	not likely	*	None
	• Waste plastic gasification for syngas production	4-6	**	not likely	*	None
	• Slag utilization strategies	7-8	**	not likely	***	None
	• Two-step dust recycling of EAF dust	7-8	*	likely	*	None
	• Reuse of waste refractories	7-8	***	not likely	***	None
	• Scrapyard management using sensors & machine learning	4-6	***	not likely	***	None
Scrap characterisation	• Xray technology, infrared scanning , laser object detection	4-8	*	not likely	*	None
	• Artificial Intelligence detection system technology	4-6	***	not likely	***	None
Sorting	• Robotic metal scrap cutting	4-6	**	likely	***	None
	• LIBS for automatized sifting of mixed waste streams	4-6	**	not likely	**	None

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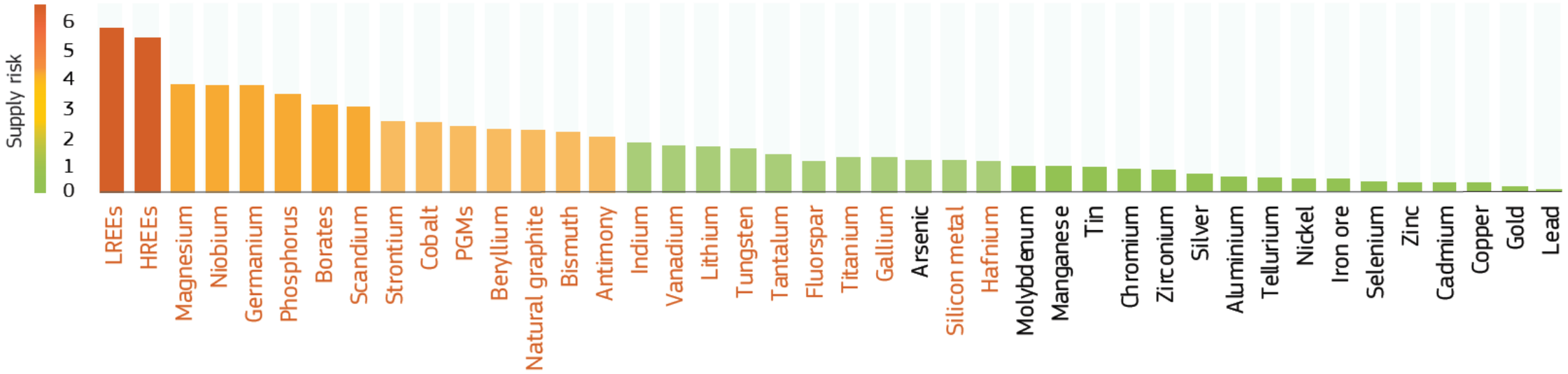
Circular industrial technologies for energy-intensive industries, textiles, and construction

- **Critical Raw Materials circularity & EU's technology sovereignty**

The roadmap analyses the existing evidence on reducing strategic dependencies on critical raw materials for the targeted ecosystems, through R&I driven actions (i.e. technologies for collection, sorting and recycling of CRMs waste).



Source: JRC CRM list 2020

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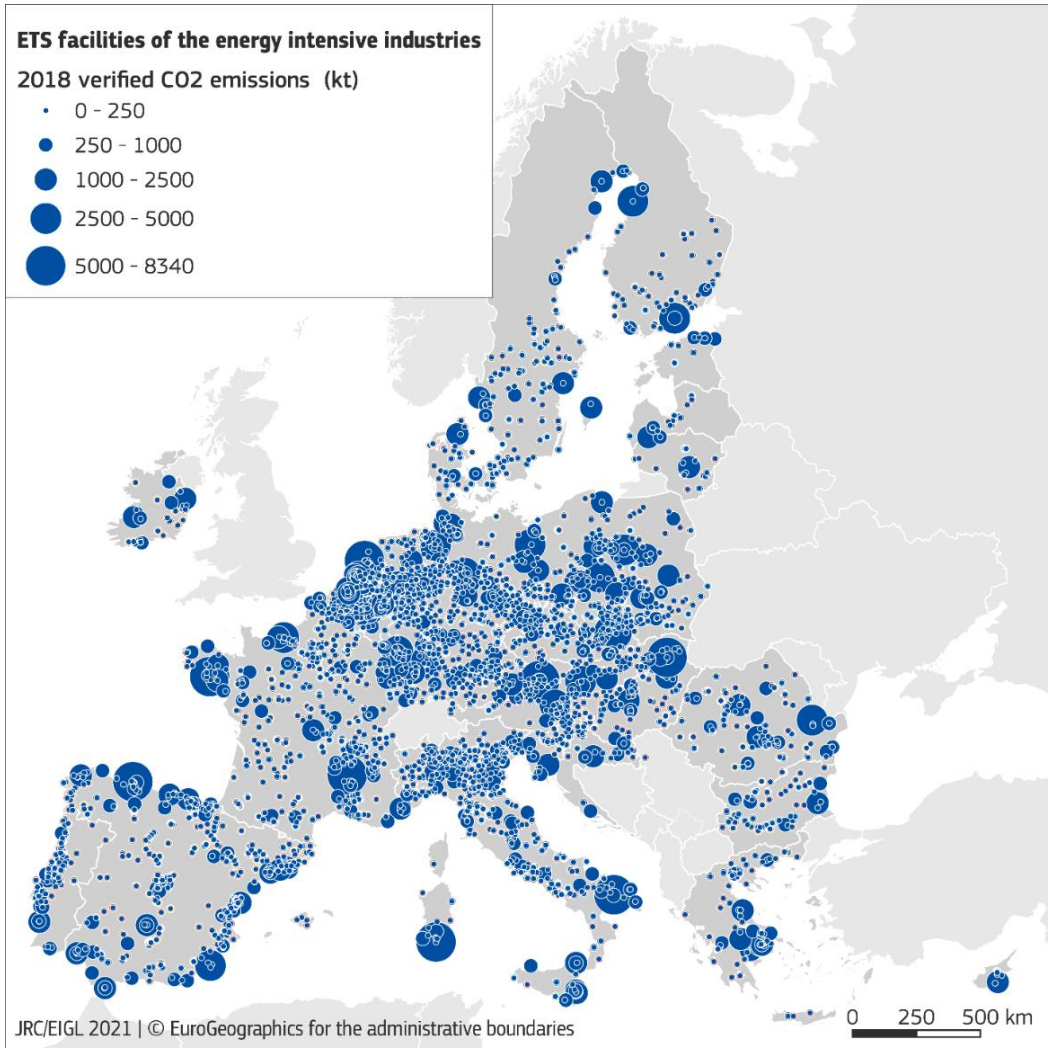
Links with the Vanguard Initiative
Geography of energy-intensive industries



Source: Vanguard Initiative website

Links with the Vanguard Initiative
Thematic areas

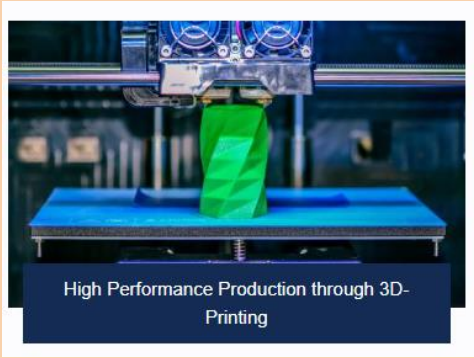
Low-carbon technologies in energy-intensive industries


Advanced Manufacturing for Energy Related Applications in Harsh Environments

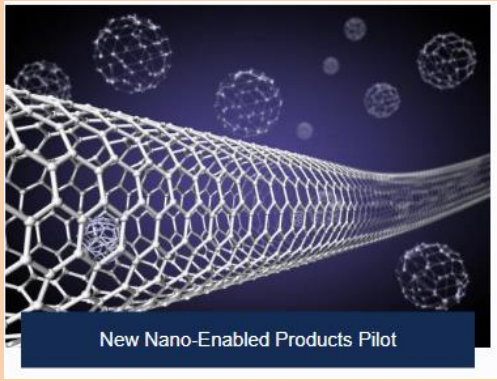

Artificial Intelligence

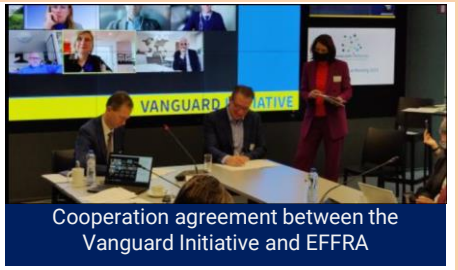
Circular technologies in energy-intensive industries, construction and textile ecosystems


Bio-Economy


High Performance Production through 3D-Printing


Efficient and Sustainable Manufacturing (ESM)


New Nano-Enabled Products Pilot

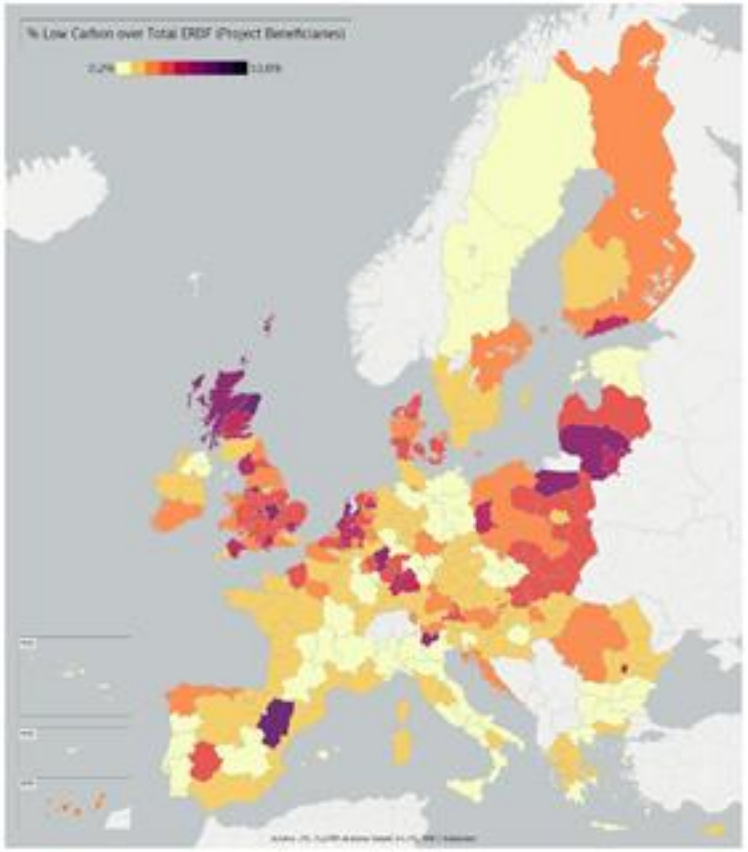


Cooperation agreement between the Vanguard Initiative and EFFRA

Links with the Vanguard Initiative
The role of regions

- Findings from the low-carbon roadmap:
  - Not all Member States with high emission intensity allocate significant ERDF funding to low-carbon projects.
  - For example, overall ERDF funding intensity for low-carbon projects (R&I and beyond) is comparatively low across all regions in Belgium and Austria and Estonia.
  - Some Member States have national R&I schemes, which also support decarbonisation investments in energy-intensive industries, but their relevance and magnitude for development and uptake of low-carbon technologies is difficult to gauge.

% of total EU funding in low-carbon technologies



Note: Projects relating to low-carbon technologies were identified through text analysis.
Source: JRC TEDAM analysis based on JRC-WIFO database.

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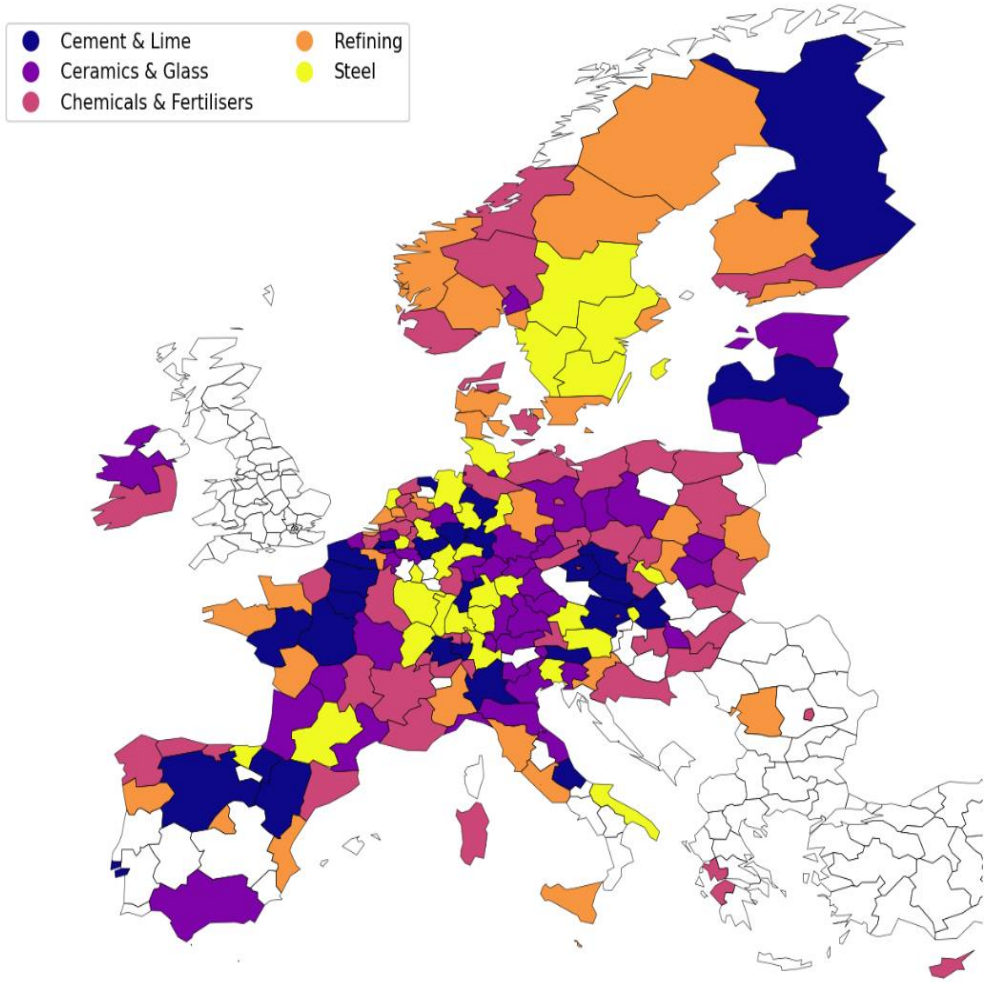
Links with the Vanguard Initiative
The role of regions

Top EII-related technologies by NUTS2 region



Note: The colour of each region in the map reflects the EII-related CCMT technology in which the region performed best in terms of patenting output over the period 2010-2018. The attribution of patents to geographical region is based on applicant information.

Source: JRC SETIS elaboration of PATSTAT data for the EU Industrial R&D Investment Scoreboard.

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Opportunities for regions to connect to tech roadmaps

- R&I priorities + stakeholders' (industry, SMEs) participation in EU programmes – Horizon Europe
  - Partnerships: Processes4Planet, Clean Steel, Made in Europe, Bio-based Europe, Robotics, Hydrogen
  - EIT Knowledge and Innovation Communities
- Hubs4Circularity – demonstrators, towards « first of a kind » installations (Horizon Europe)
- Regional innovation ecosystem development for the green transition of industry (e.g. technology infrastructures, clusters)
- Industrial Alliances, communities of practice

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Useful links

For more information please see:

Press release

Infosheet

ERA roadmap for low-carbon technologies in energy-intensive industries

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Thank you!

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