European Commission

ISSN 2811-6925

Towards Single Market 2.0: European Green Deal effects on the EU's Industrial Ecosystems

SINGLE MARKET ECONOMICS BRIEFS

Economics Brief n°7

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The views expressed in this paper are solely those of the author and cannot be attributed to the European Commission.

EUROPEAN COMMISSION

Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs
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Single Market Economics Briefs

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PDF	ISBN 978-92-68-13176-3	ISSN 2811-6925	Doi: 10.2873/025041	ET-BD-24-002-EN-N

Manuscript completed in February 2024

1st edition

Luxembourg: Publications Office of the European Union, 2024

TOWARDS SINGLE MARKET 2.0: EUROPEAN GREEN DEAL EFFECTS ON THE EU'S INDUSTRIAL ECOSYSTEMS

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February 2024

Abstract
The European Green Deal adopted by the European Commission in December 2019 brought major opportunities to transform the EU's Single Market for the net-zero age. Various partnerships focused on the green and digital transitions, engaging large numbers of stakeholders from different EU countries and regions, and from multiple economic sectors and institutions, have been actively promoted since 2020, receiving substantive EU funding to ensure the Single Market's transition to the net zero economy. However, the impact of these partnerships on the Single Market remains largely unexplored. This paper aims to shed light on this aspect by looking at selected innovative partnerships in two key areas of the European Green Deal: Research and Innovation (financed through Horizon 2020 and Horizon Europe) and Cohesion policy (financed through Interreg Europe and the I3 instrument). The analysis was performed from an 'innovation system' perspective on the Single Market, and the innovation system 'functions' framework was used to identify partnerships' effects on the industrial ecosystems, in terms of knowledge and technology generation and diffusion; market formation and growth; resource mobilisation, governance, and creation of legitimacy/counteracting resistance to change.

As most partnerships are still running (they started in 2020-2021 and have various end points during 2024-2027), the available evidence is only partial. However, the findings suggest that the selected partnerships developed under the European Green Deal triggered positive effects in all these areas, paving the way for the transition to a new development stage - Single Market 2.0. These positive effects are unevenly distributed across the industrial ecosystems due to differences in the investment flows attracted: most R&I partnerships are concentrated in Energy (Renewables and Energy-Intensive sectors), Digital, Electronics, Agri-Food, Health, Construction, Aerospace and Defence, Mobility-Transport-Automotive, while Construction, Retail, Textile, Tourism, and Cultural and Creative Industries have few or no partnerships. While the uneven distribution of the selected partnerships across the industrial ecosystems may be a result of specific causes (e.g. differences in research intensity across the industrial ecosystems, structure and approach of the respective funding instruments, differences in the absorption capacity of the regional innovation ecosystems involved), it may affect the economic performance of the industrial ecosystems and their capacity to implement green transition economy in the longer run, creating new disparities within the Single Market. This calls for stronger synergies between the EU industrial and competition policies, innovation and regional development policies, and for more data to document the intricate ways in which these policies influence each other.

Acknowledgements: This paper has been written in the context of the author's appointment as an Advisor (Fellow) in the 2023-2024 Fellowship Programme for Economic Advice of the European Commission's Directorate General for Internal Market, Industry, Entrepreneurship and SMEs (DG GROW). We express our gratitude to Chief Economist Dr. Roman Arjona and his team: Josefina Monteagudo, Stefano Vannini, and Frank Vandermeeren for their feedback on previous versions of the paper. The opinions are those of the author and should not be considered as representative of the European Commission's official position.

1. Introduction

In December 2019 the European Commission adopted the European Green Deal as the European Union (EU)'s new growth strategy aimed to turn the Union into the first climate-neutral continent by 2050. At the heart of this transformation was the ambitious goal of reducing net greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels ("net zero emissions"). To that end, far-reaching objectives have been set: to supply clean, affordable and secure energy, to decouple economic growth from resource consumption and move towards a circular economy, to build and renovate in an energy- and resource-efficient way, to promote smart mobility, restore ecosystems and biodiversity, and design an environmentally friendly food system (European Commission, 2019). A comprehensive regulatory framework was adopted with a strong focus on sustainability in all EU policies and substantive public and private financial resources have been mobilised.

The European Green Deal initiated unprecedented transformations in virtually every element of the EU's society and economy. For the Single Market – the EU's unified and borderless economic area - the European Green Deal opened major avenues for innovative transformation of EU's industry for the net-zero age. Creation of new markets, breakthrough clean technologies, decarbonised economies and transformation of the energy systems, a rejuvenation of the industrial manufacturing base and new jobs for a newly skilled workforce, were key goals of the transformation. Various partnerships focused on the green and digital transitions have been actively promoted since 2020, engaging large numbers of stakeholders from different EU countries and regions, and from multiple economic sectors and institutions, and received substantive EU funding to catalyse the Single Market's transition to the net zero economy. However, the actual impact of these partnerships on the Single Market remains largely unexplored. This paper aims to shed light on this aspect by looking at selected innovative partnerships focused on the green transition in two key areas of the European Green Deal: Research and Innovation (R&I) and Cohesion policy. The analysis is performed from an 'innovation system' perspective to the Single Market, and the impact of these partnerships is examined along two lines: (i) sectoral coverage; and (ii) transformations within the industrial ecosystems from the perspective of the innovation system 'functions' framework (Hekkert et al, 2007; Bergek et al 2008).

2. The 'innovation system' of the EU Single Market

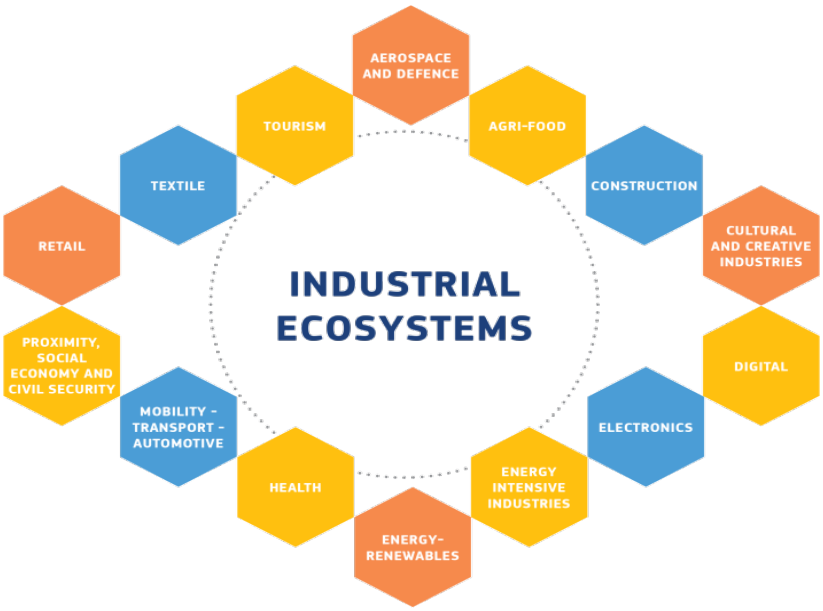
A cornerstone of European integration and the EU's economic and political project, the Single Market, also known as the internal market, seeks to guarantee the free movement of goods, capital, services, and people, known collectively as the "four freedoms" that are embedded in the Single Market legislative framework[1]. Integration of goods, services, capital, and people within the EU generated a wide range of benefits on multiple levels (European Commission, 2023) and an increase in the EU's GDP estimated at 8-9% on average over the last 30 years due to enhanced intra-EU trade flows, opening of domestic economies, increased competition, and lowered prices (in 't Veld, 2019). Similar positive effects are reported in the literature (e. g. Crespo Cuaresma et al, 2008; Campos et al. 2019) and are more visible in Central and Eastern Europe and smaller EU Member States (Matkowski and Próchniak, 2014; Lehtimäki and Sondermann, 2020). Nevertheless, at present, 30 years after the launch of the Single Market, European integration is still far from complete. Many barriers to proper functioning of the Single Market and the EU economy have been identified, some of which pertain to EU policy, while others relate to national regulation, administrative and business practices (European Commission, 2020). Strengthening the Single Market and boosting the European economy have been

[1] See a summary of the Single Market legislative framework at Internal market - EUR-Lex (europa.eu).

constant objectives on the EU agenda, and several policy documents took important steps in that direction[2].

For further advancing Single Market integration, a systemic vision on its structure and functionality is of the essence. The *New Industrial Strategy for Europe* (European Commission, 2020a) introduced the concept of **"industrial ecosystems"** as part of a new vision for the EU industry, and the first Annual Single Market Report 2021 (European Commission, 2021) developed the concept further, identifying **14 industrial ecosystems** based on their economic and technological relevance and their expected contribution to the decarbonisation, digitalisation, and resilience of the EU economy (Figure 1). The 14 industrial ecosystems represent approximately 70% of the EU economy and 80% of the business economy (as a share of value added). Initially used to capture uneven economic contraction effects across economic sectors caused by the COVID-19 pandemic and explore interdependencies between different economic actors, the 14 industrial ecosystems have been further developed with new foci, such as the resilience of the Single Market and industrial ecosystems, strategic dependencies, investments, and international partnerships across the industrial ecosystems (European Commission, 2023).

Figure 1: The 14 industrial ecosystems of the European Single Market



Source: European industrial strategy (europa.eu)

In a complementary approach to their original definition and use, the industrial ecosystems are seen in this paper as **a set of sectoral and technology innovation systems that interact and co-evolve within the EU national and regional innovation systems and are intricately connected internationally through multiple global value chains**. Multiple definitions provided in the literature for these types of systems legitimise this vision (see e.g. Andreoni, 2018; Malerba, 2002; Carlsson and Stankiewicz, 1991; Bergek et al. 2008; Carlsson et al., 2002; Carlsson, 2006; Coenen et al., 2012 for sectoral and technology innovation systems; Freeman, 1987; Lundvall, 1992; Cooke et al., 1997; Cooke 2001, for national and regional innovation systems). Strict delineations between all these types

[2] E.g. the Single Market Act, in its two parts: Single Market Act I (2011) and Single Market Act II (2012); the new Single Market Strategy (2015) and the Single Market Programme (2021) for the period 2021-2027.

of innovation systems within the Single Market are not relevant[3], considering the many ways in which the sectoral, technological, and geographical activities within the Single Market interact and cut across each other.

3. Overview of innovative partnerships focused on the green transition

A selection of innovative partnerships focused on the green transition in two key areas of the European Green Deal has been examined in this paper to assess the impact of the European Green Deal on the Single Market:

- **Research and Innovation (R&I) partnerships funded by Horizon 2020 and Horizon Europe programmes**.
  - ***The European Green Deal Call of Horizon 2020 (2014-2020):*** 73 projects, organized into five Working Groups with a short- to medium-term timeframe, from 2021 to various end points during 2024-2027[4].

  - ***European Partnerships under Horizon Europe (2021-2027):*** 49 projects associated with the Green Missions (Annex 2). Most projects are part of the thematic clusters of Pillar II "Global Challenges and European Industrial Competitiveness" of Horizon Europe: Cluster 1: Health (9 projects); Cluster 4: Digital, industry and space (10 projects); Cluster 5: Climate, energy and mobility (11 projects); and Cluster 6: Food, bioeconomy, natural resources, agriculture and environment (8 projects).

- **Cohesion policy partnerships funded by Interreg Europe and the I3 instrument**.
  - ***Partnerships under the European Territorial Cooperation (Interreg) programme, Strand C: Interreg Europe****:* 258 projects financed in 2014-2020[5]*,* as the 2021-2027 projects were still under evaluation at the time of writing (Annex 3). The programme finances two types of actions: Interregional cooperation projects and the Policy Learning Platform[6] that aim to help policy organisations improve their design of regional innovation and development policies and programmes. Both the regional and the policy-learning dimensions of the programme are relevant to the Single Market ecosystems.

  - ***The Interregional Innovation Investment (I3) instrument*****:** 25 active partnerships focused on interregional cooperation for the green transition identified in the I3 projects database (Annex 4). I3 builds on the experience of the interregional partnerships developed on the Smart Specialisation (S3) Thematic Platforms in 2014-2020, and combines regional cooperation and development with S3, connecting regional value chains and innovation ecosystems across the EU through commercialisation and scaling up of interregional innovation projects in strategic areas. I3 was designed on a three-dimensional format: inter-regional; innovation in Digital, Green transitions and Smart Manufacturing; and direct investments to companies, each with its own specific elements[7].

[3] As Archibugi and Lundvall's (2001) note: *"...it is useful to think in terms of 'technological systems' as a special version of innovation systems. A technological system is a combination of interrelated sectors and firms, a set of institutions and regulations characterizing the rules of behaviour and the knowledge infrastructure connected to it."* (Archibugi and Lundvall, 2001, p. X).
[4] See an overview of these projects by Working Group at Green Deal Projects Working Groups | Research and Innovation (europa.eu).
[5] See an overview of these projects by Priority Axis at Map - Europe cooperates - 258 projects - 2020.pdf (interregeurope.eu)
[6] Interreg Europe Programme Manual 2021.
[7] I3-FactSheet_0203_final.pdf (europa.eu)

The partnerships are 'place-based' at national level (the R&I partnerships) and at regional NUTS2 level (the Cohesion policy partnerships under the Interreg Europe and I3). The time frame covered by the analysis includes both the 2014-2020 and 2021-2027 multi-annual financial frameworks (MFFs). As most of the partnerships initiated in the 2021-2027 MFF started towards the end of 2021 or in 2022, they have not yet been subject to in-depth evaluations, so that partnerships of the 2014-2020 MFF that have been completed or are still running with different endpoints in 2024-2026 offered relevant insights for impact evaluation.

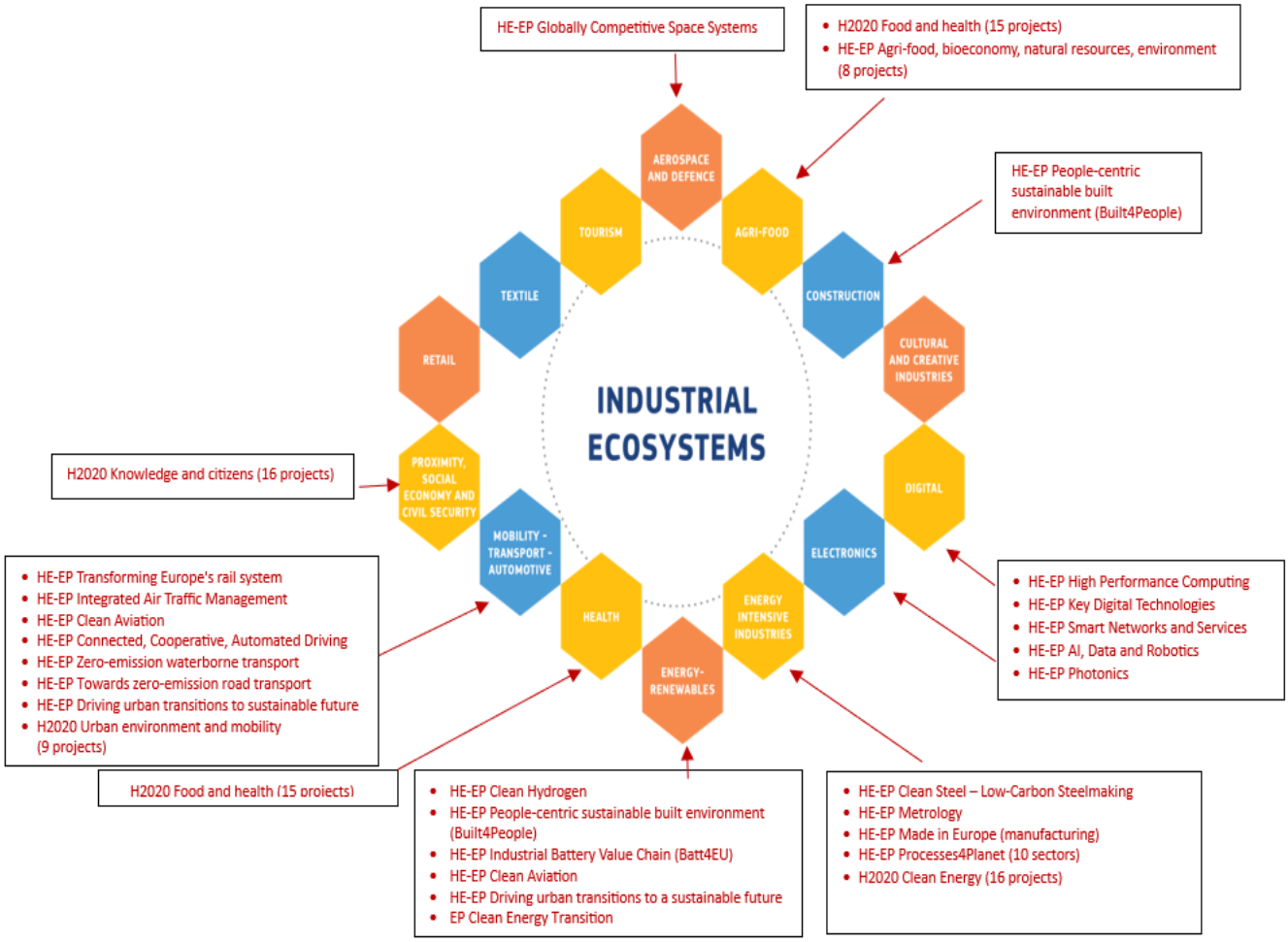
4. Partnerships' impact on the Single Market industrial ecosystems

4.1. Sectoral coverage of the Single Market industrial ecosystems

R&I partnerships financed by Horizon 2020 and Horizon Europe

Analysing the thematic coverage of the R&I partnerships relative to the 14 industrial ecosystems of the Single Market, one can observe that **most R&I partnerships are concentrated in Energy (Renewables and Energy-Intensive sectors), Digital and Electronics, Agri-Food, Health, Construction, Aerospace and Defence, Mobility-Transport-Automotive, while Construction, Retail, Textile, Tourism, and Cultural and Creative Industries have few or no partnerships** (Figure 2).

Figure 2: Research and innovation partnerships and the Single Market industrial ecosystems



H2020 European Green Deal Call - 73 projects
Clean Energy (16 projects)
Food and health (15 projects: 9 Food, 6 Health)
Urban environment and mobility (9 projects)
Knowledge and citizens (16 projects)

Horizon Europe European Partnerships (HE-EP) - 49 projects:
Cluster 1: Health (9 projects)
Cluster 4: Digital, industry and space (10 projects)
Cluster 5: Climate, energy, and mobility (11 projects)
Cluster 6: Food, bioeconomy, natural resources, agriculture, and environment (8 projects)
Partnerships in Clusters 4 and 5 cover several industrial ecosystems and were 'unpacked' into individual projects associated with the respective industrial ecosystems: Digital, Electronics, Mobility-Transport-Automotive, Energy, Aerospace and Defence, Construction.

Source: own elaboration

This uneven coverage of the 14 industrial ecosystems is a consequence of several factors:

- ***The research intensities of the respective ecosystems***: the ecosystems with higher R&D intensity attract more R&I partnerships (see the OECD 2016 classification of economic activities[8]):
    - *High, medium-high, and medium-R&D intensity ecosystems* (Aerospace and defence, Digital, Electronics, Health, Energy - Renewables and Energy-Intensive, Transport-Automotive-Mobility)
    - *Medium-low R&D intensity ecosystems* (Textile)
    - *Low R&D intensity ecosystems* (Agri-food, Tourism, Construction, Retail, and Cultural and Creative Industries). The sector of Agri-food with its large numbers of R&I partnerships is an

[8] OECD (2016), OECD Taxonomy of Economic Activities Based on R&D Intensity.

exception here, although it is considered as a (medium)/low-R&D intensity sector. This is due to the inter-disciplinary nature of the partnerships implemented in this sector, which include elements from other research-intensive sectors, especially digital, electronics and health[9].

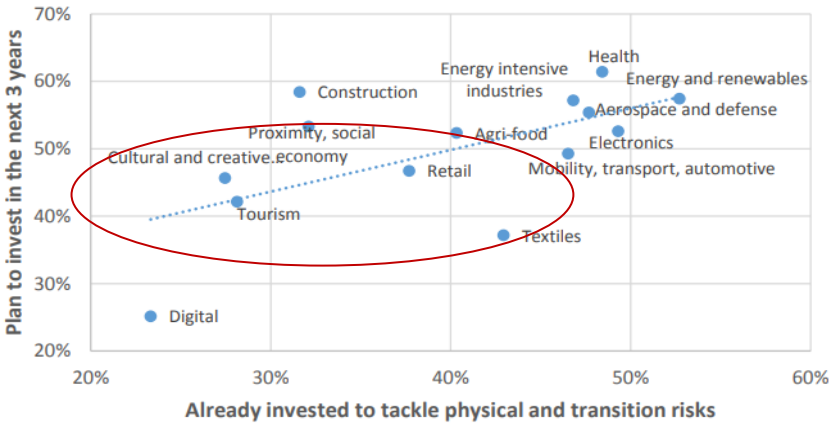
- ***The structure and the approach of the two funding instruments***. the Horizon 2020 European Green Deal Call targeted projects with a strong technology impact (technology development and demonstration, pilot applications, scalable innovative products and experiments). As these come primarily from sectors with high- and medium-R&D intensity, it is not surprising to see them in a higher number across the respective industrial ecosystems. Horizon 2020 European Green Deal Call also targeted projects with a strong social focus (governance, culture and behaviour, social innovation, civil society engagement and sustainability), so they are well represented in the Knowledge and Citizens group. The European Partnerships of Horizon Europe reflect the thematic clusters of Pillar II "Global Challenges and European Industrial Competitiveness": Cluster 1: Health; Cluster 4: Digital, industry and space; Cluster 5: Climate, energy, and mobility; and Cluster 6: Food, bioeconomy, natural resources, agriculture, and environment, that are also sectors with high R&D intensity. The social dimension is not much visible here, as it is addressed elsewhere - in Pillar III "EIT", mainly in the EIT Cultural and Creative Industries

- ***Differences in the absorptive capacities of the national and regional innovation ecosystems involved,*** considering that the industrial ecosystems are spread over various EU countries and regions, with different innovation assets and performances**.**

The impact of lower investment flows in the ecosystems with fewer or no R&I partnerships (Retail, Textile, Tourism, and Cultural and Creative Industries) is to some extent offset by the indirect benefits derived from the economic links and overlaps with the ecosystems with more R&I partnerships, particularly Digital, Energy and Mobility-Transport-Automotive, and the multi-sectoral scope of the R&I partnerships (e.g., greening of tourism services may be enabled by investments in renewable energy and sustainable water management; the textile industry can benefit from digital market places and virtual trade shows; the development of high-value smart textile and digitalised manufacturing can be accelerated by an using robotics and AI). However, this compensation remains limited and may affect the economic performance and capacity of these ecosystems to implement green technologies in the longer run. This risk is even more relevant considering that the economic performance of the Retail, Textile, Tourism, and Cultural and Creative Industries ecosystems has already been hard hit by the pandemic (European Commission, 2021). These appear also among the sectors with lower investment plans to tackle the climate change impact (Figure 3) and among the sectors where SMEs make the highest contributions to international value chains - more than 50% of value added (European Commission, 2023). The lower flows of R&I investments in these sectors may affect the competitiveness and performance of their SMEs in cross-border supply chains, where they may supply larger players within the ecosystem, even when they are not exporting themselves (Figure 4).

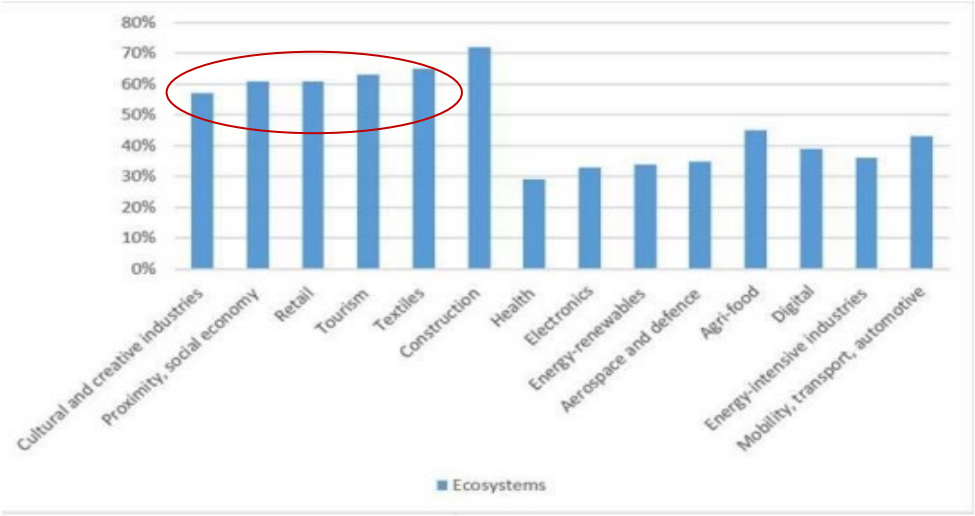
[9] E.g. the H2020 partnerships NeoGiANT that develops novel natural antimicrobial products for the control and prevention of diseases in animal production using advanced isolation techniques; SISTERS that develops technological innovations in packaging for processors and retailers; and ZeroW that develops commercial, digital tools and instruments to reduce food waste. Also, among the Horizon Europe Partnerships, the EP for Agriculture of Data combines geospatial and Earth observation datasets to support sustainable agriculture in the EU; the EP Accelerating farming systems transition: agroecology living labs and research infrastructure develops a network of living labs and research infrastructures accelerating the transition towards agroecology in Europe; and the EP for a Circular bio-based Europe develops technologies for sourcing and conversion of biomass into bio-based products focusing on multiscale biorefinery processing.

Figure 3: Investment plans to tackle climate change impact, by industrial ecosystem



Source: EIB Investment Survey (wave 2021).
Question: Now thinking about investments to tackle the impacts of weather events and to deal with the process of reduction in carbon emissions, which of the following applies?
Source: European Commission (2022), p. 33

Figure 4: SMEs contribution per ecosystems (in value added)



Source: European Commission (2023), p. 12, based on 2022 Annual Report on European SMEs

A certain compensation for the lower levels/lack of investment from the R&I partnerships may come for some of these ecosystems from other funding mechanisms, such as the Recovery and Resilience Plans (RRP)[10].

Interreg Europe and I3 partnerships

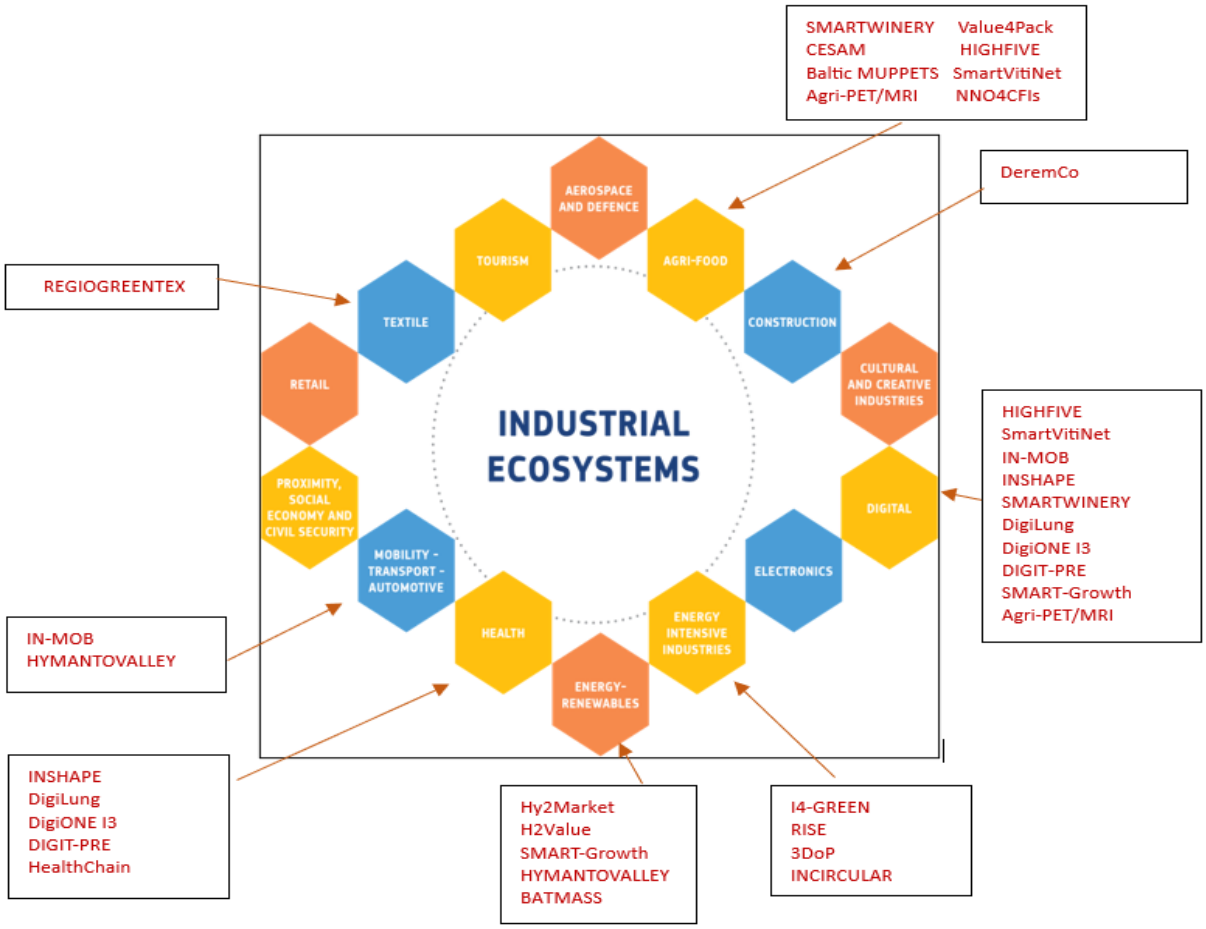
- **Interreg Europe**: The partnerships financed under the four priority axes of Interreg Europe indicate **a strong match of PA3 Low-Carbon Economy partnerships with the industrial ecosystems Energy (Renewables and Intensive industries) and Mobility-Automotive-Transport,** while partnerships under the other three priority axes have a multi-sectoral focus and a much more diffuse coverage of the industrial ecosystems, being associated with more than on ecosystem.

[10] For example, 15 RRPs have tourism-dedicated and tourism-related measures aimed to upgrade tourism infrastructures and facilities and increase the supply of high-quality and sustainable tourism products and services, by investing a total of EUR 11.35bn (2.6% of total RRF funding) in the Tourism ecosystem and services -see details at Ecosystems (europa.eu). Fiche Tourism.

Research and innovation (PA1)	SME competitiveness (PA2)	Low-carbon economy (PA3)	Environment & resource efficiency (PA4)
Innovation capacity (17)	Entrepreneurship (12)	Energy efficiency (14)	Biodiversity preservation (4)
Innovation ecosystems (12)	Innovation capacity of SMEs (9)	Low-carbon strategies (11)	Circular economy (11)
Innovation in sector (21)	Support to sector (24)	Renewable energy (9)	Natural & cultural heritage (28)
RIS3 (15)	Support to SMEs (21)	Sustainable transport (26)	Resource efficiency (24)

- **I3 instrument:** Most of the 25 I3 partnerships cover the Digital and Agri-food ecosystems (10 and 8 projects respectively), while the Textile and Mobility-Transport-Automotive have the fewest partnerships ((1 and 2, respectively), as shown in Figure 5. Several I3 partnerships have a multi-sectoral focus and have been associated to more than one ecosystem.

Figure 5: I3 partnerships and the Single Market industrial ecosystems



Source: own elaboration based on Funding & tenders (europa.eu)

4.2. Partnerships' impact on the industrial ecosystems from the perspective of the innovation system functions

- ***Functions: Knowledge development/Market formation/Entrepreneurial activities:***

The three functions are highly interconnected both all the partnerships, as the interaction of these three functions leads to the development of new technologies, technical solutions, products and services with market potential. Some specific aspects related to these functions are discussed below.

- ***Creation of knowledge and skills***

Both the R&I partnerships and the Interreg Europe and I3 partnerships encompass many knowledge and technology areas in which they contribute to knowledge and skills (see Annex 5):

- *The R&I partnerships:* reports, case studies, methodologies, scientific papers, policy briefs, tools and toolkits, models, indicators, new techniques and technical solutions, portals, customised support service and user-oriented services, peer-to-peer mentorship, conferences, brokerage events, matchmaking events, etc. The R&I partnerships also perform comprehensive research, prototype building, testing, demonstration, experimentation, validation and upscaling activities, leading to market formation, new business opportunities, investors and potential customers.
- *Interreg Europe and the I3 partnerships:* various platforms, websites, newsletters and social media channels, matchmaking and network events, hackathons, workshops and seminars, coaching, etc. *Interreg Europe partnerships* under PA1 Research and innovation contribute to knowledge development due to their support to innovation capacity, innovation ecosystems and sectoral innovation, while those under PA2 SMEs' competitiveness contribute to the entrepreneurial function, with their targeted support to entrepreneurship and the innovation capacity of SMEs. Partnerships under PA3 and PA4 contribute to knowledge development and market formation in a more diffuse manner, through the knowledge exchanges between network participants, various support schemes adopted, and exchange of good practices. *I3 partnerships* are focused on interregional cooperation around shared or complementary S3 priorities; innovation for close-to-market technologies; and dedicated investments to companies (mainly SMEs). As I3 partnerships also cover most of the industrial ecosystems (8 out of 14), these contributions are widely spread across these ecosystems.

- ***Experimentation, demonstration, testing of technical solutions and then upscaling, leading to introduction of new technologies (Annex 6)****:*

- *R&I partnerships* embed a variety of living labs, trials and pilots, City Hubs, large-scale demonstrators, etc. 'by design', as both the European Green Deal Call of Horizon 2020 and the European Partnership of Horizon Europe had an explicit focus on technology development and demonstration, transformation of ideas into pilot applications and demonstration projects, scalable innovative products users.
- *Interreg Europe and I3 partnerships* also include large numbers of pilots, technological platforms and large-scale demonstrators, etc. that advance technological performance and create awareness on the new technologies' potential, facilitating 'learning curves' both for producers and users.

In both cases, these activities are highly relevant considering the "European paradox" – the perceived failure of European countries to translate scientific advances into marketable innovations - and the policy recommendations aimed to reduce this effect[11]. They contribute to advances in technological performance and awareness on the new technologies' potential, facilitating 'learning curves' both for the producers and the users.

[11] See e.g., Dosi et al 2006, who argue for much less emphasis on 'networking' and much more on policy measures for strengthening both frontier research and corporate actors in the relatively weak European industry.

- ***Development of new/disruptive technologies and their integration (Annex 7*)*:*** this aspect is particularly relevant in the case of the European Partnerships under Horizon Europe and the I3 partnerships.

- ***Collaborations with upstream and downstream value chains, thus leveraging R&I investments, and enabling know-how spillovers to other sectors and industries****:* these linkages can enhance processes for the smart use of resources inside many industrial sectors, thus further enabling circular economy and the EU energy transition. Examples include the European Partnership for Clean Steel - Low Carbon Steelmaking and the I3 partnership HealthChain, for their co-development of innovative solutions with suppliers and ecosystem supporters (clusters or business associations) to increase their know-how and competitiveness.

- **Education and training activities (relevant skill sets and curricula) for industry professionals, SMEs, entrepreneurs, etc. and skills development**: these activities equip scientists and entrepreneurs with the knowledge and skills needed to build and manage successful businesses. For example, under Horizon Europe, the European Partnership Photonics provides education and training for advanced skills in photonics for professionals and value chain partners, design of long-term training and Master's courses for students, fostering life-long learning as well as on-the-job training and traineeships for workforce in photonics and photonics-enabled industries. The European Partnership Built4People provides training activities for the construction workforce and other relevant actors in the value chain, tools for training and certification.

- **Securing the presence of strategic industries in Europe as part of existing or future value chains and developing successful EU technologies supporting EU's competitiveness and technical sovereignty*:*** e. g.
Several European Partnerships under Horizon Europe exemplify this contribution, such as European Partnership for Clean Steel - Low Carbon Steelmaking, European Partnership on Photonics and the European Partnership on AI, Data and Robotics. Also, the I3 partnership HYMANTOVALLEY introduces a replicable green hydrogen ecosystem as an integrated model of hydrogen production, storage, transportation and utilisation for heat, power and mobility. A H2 value chain model is developed in a unique tri-modal transport and logistics system (inland water, rail and road) laying in Italy and near two corridors of the Trans-European Transport Network (TEN-T), plus a European Centre of Applied Research and Advanced Training on hydrogen.

All these activities contribute to market formation by driving market interest, creating demand that may attract financial support for emerging technologies, niche markets, new environmental standards. The partnerships facilitate data sharing and access, which can lead to the development of data-driven products and services for the existing markets or for new ones. Furthermore, by connecting businesses with an extensive network of partners and stakeholders both nationally and internationally, the partnerships can provide market access, facilitating the introduction of innovations to a broader customer base and allowing European innovations to access global markets. The focus on societal challenges that is present in several partnerships may also create opportunities for market formation in areas where innovative solutions are needed.

The partnerships support entrepreneurship not only through the direct activities mentioned above, but also indirectly, by fostering an environment where innovative ideas can turn into viable businesses. Start-ups and entrepreneurs collaborate with established businesses, universities and research institutions, have access to mentorship, to research findings and innovation networks that may accelerate the formation of new business ventures. Knowledge exchange and technology transfer between research institutions and industry partners, as well as business incubation and acceleration help start-ups and SMEs bring their innovative ideas to the market and navigate the venture formation

process. This can facilitate market entry and growth of start-ups, particularly in sectors with strict regulatory requirements, such as healthcare and aviation. The networking and matchmaking events that are organised by many partnerships connect entrepreneurs with potential partners, customers, and investors and create opportunities for entrepreneurs to showcase their innovations and build strategic relationships within the same sector or across sectors.

- ***Function: Knowledge diffusion/exchange through networks (Annex 8)***

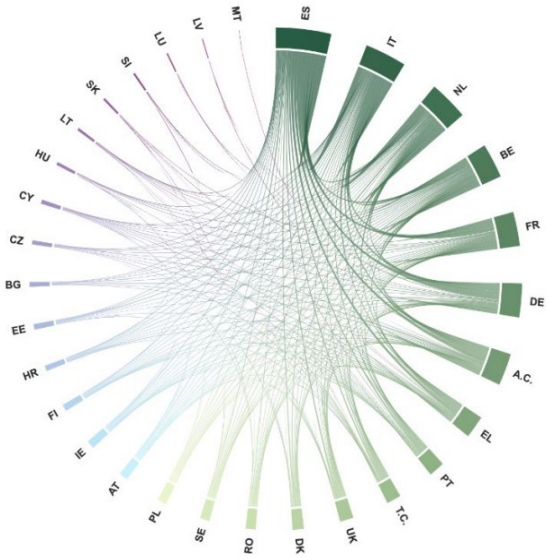
A key factor for knowledge diffusion/exchange through networks is the very **structure of all the partnerships' consortia and networks:** this has a Quadruple Helix format (university-industry-government-civil society stakeholders) and involves large professional networks from one or more industrial sectors with a broad regional and national geographical spread in Europe):

- *For the R&I partnerships under Horizon 2020 European Green Deal Call,* an evaluation of the response to the call (European Commission, 2021c) highlighted:
  - **A large participation of the private sector in the project consortia that comprise public and private institutions from several countries:** universities, research and technology centres, companies (SMEs and large companies), clusters, government authorities and other public bodies, civil society, NGOs, etc. The private sector has the largest participation (more than 40% of the applicants, of which about half are SMEs), followed by research and technology organisations (25%), higher education establishments (19%), public bodies (7%) and "other" - civil society, NGOs, international organisations, associations, etc. (approx. 10%) The high number of applications from the private sector was attributed to the Green Deal Call focus on mature technological solutions and innovation and demonstration actions, while public bodies' applications seemed to focus more on the demonstration and pilot activities in several topics.
  - **Broad international participation from EU countries, Associated countries, as well as third countries**: 1,778 successful participants selected from 75 countries. EU countries accounted for 90% of the successful participants, and of the EU requested contribution in the successful proposals, with Spain, Italy, Germany, Netherlands, Belgium, and France topping both lists (European Commission 2021c, p. 7). Most projects are concentrated in Western, Northern and Southern Europe, with a limited representation of Central and Eastern Europe countries (Figure 6).
  - **Large and dense collaboration networks**: over 26,000 collaborations of different types of organisations across 75 countries, with the densest collaborations between Private for-profit entities (excl. Higher or Secondary Education Establishments) and the Research and Technology Organisations (Figure 7).

Figure 6: Geographical coverage of partnerships under the European Green Deal Call of Horizon 2020

Source: Interactive projects map | Research and Innovation (europa.eu)

Figure 7: Collaboration between countries and between different types of participants in the partnerships under the European Green Deal Call Horizon 2020



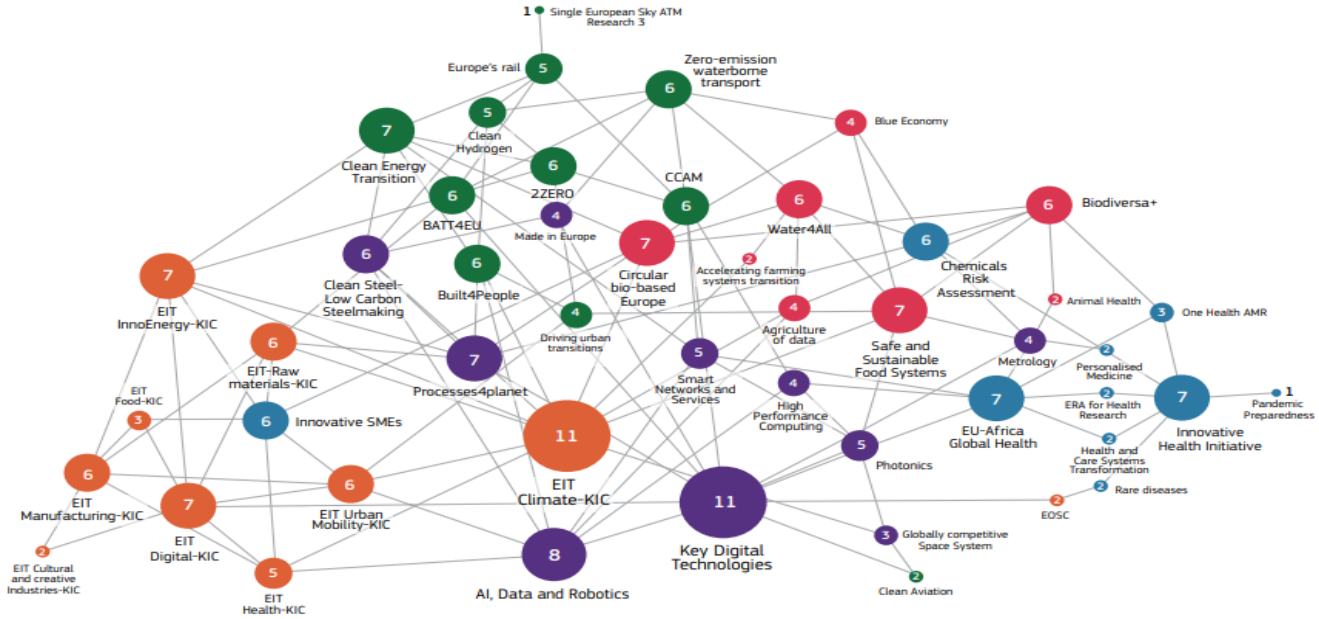
Associated (A.C.) and Third (T.C) Countries are grouped.

PRC: Private for-profit entities (excl. Higher or Secondary Education Establishments).
REC: Research and Technology Organisations.
HES: Higher or Secondary Education Establishments.
PUB: Public bodies (excl. Research Organisations & Secondary or Higher Education Establishments).
OTH: Others

Source: European Commission (2021a), p. 9 and p. 17.

For the European Partnerships under Horizon Europe, the Biennial Monitoring Report 2022 (European Commission, 2022a) identified an expansion of the networks with newcomer partners mostly from widening countries in Europe, especially Romania, Hungary, Bulgaria, Latvia and Luxembourg (p. 81) and strong collaboration and synergies between the partnerships, with EIT Climate-KIC and AI, Data and Robotics standing out with the largest number of planned coordinated and joint activities with other partnerships (Figure 8).

Figure 8: Planned coordinated and joint activities between the European Partnerships in Horizon Europe

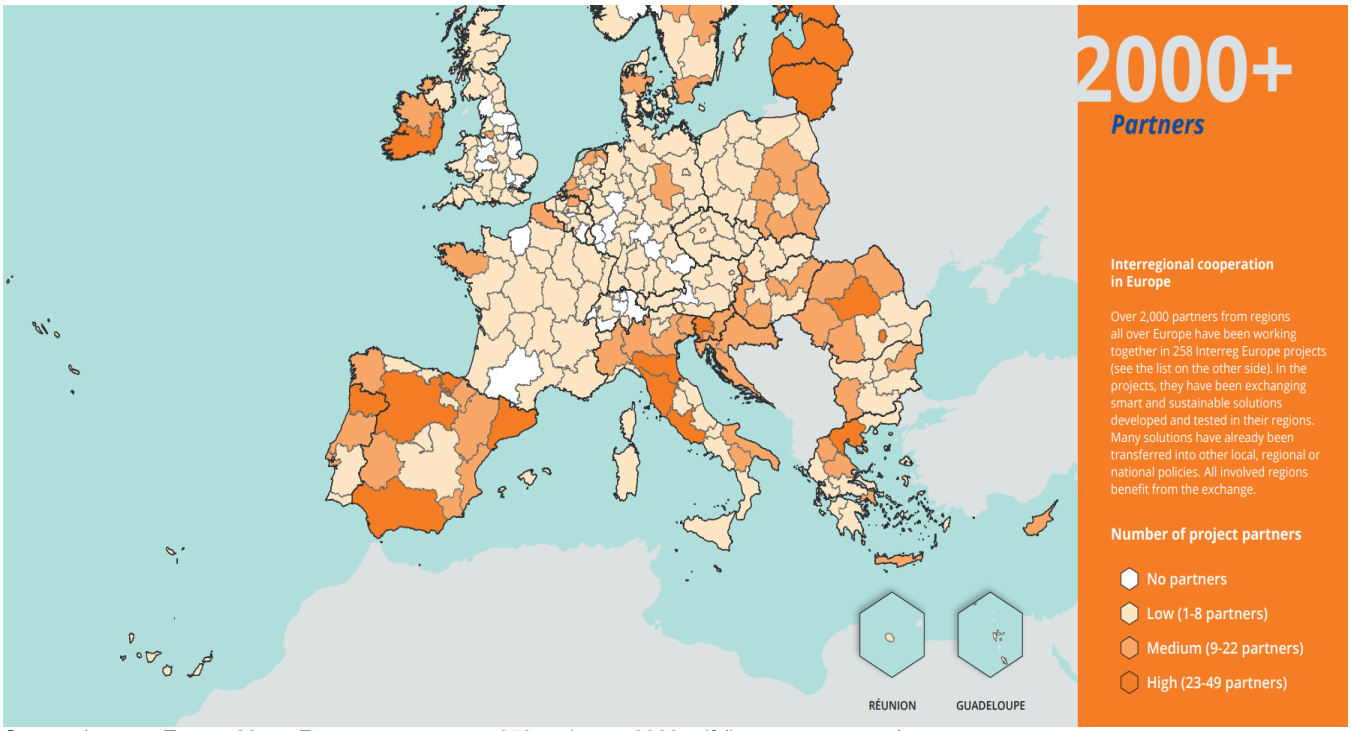


*Source: common indicators survey, November 2021. Cluster 1 – **blue**, Cluster 4 – **violet**, Cluster 5 – **green**, Cluster 6 – **red**, Cross-pillar – **orange***
Source: European Commission (2022a), p. 8.

For Interreg Europe partnerships, the 258 projects financed in 2014-2020 involved over 2,000 organisations from European regions and prepared 1,668 action plans, translating the lessons learned from the projects into concrete actions in their own regions[12]: the projects involved close to 90% of NUTS 2 regions from all eligible countries, with a higher density of projects in the Southern, Eastern and Northern regions (Figure 9) and created a dense network of linkages across Europe through the partnerships of all four PAs. Improvements in regional policies have been achieved through over 16,000 policy-learning events, over 5,800 good practices, of which close to 3,200 validated for the good practice database, increased professional capacity for over 22,300 people, and over 1,600 action plans developed for the regions involved.

[12] Project results | Interreg Europe - Sharing solutions for better policy

Figure 9: Intensity of cooperation in NUTS 2 regions in Interreg Europe projects (2014-2020)



Source: Interreg Europe Map - Europe cooperates - 258 projects - 2020.pdf (interregeurope.eu)

- ***Function: Resource mobilisation***

This function is exemplified by the large amounts of investment mobilised by the partnerships from the EC, national budgets and the private sector, and their multi-annual allocation.

- **Horizon 2020 European Green Deal Call partnerships (73 projects):** €1 trillion from the EC (European Commission, 2021c). Among the five thematic Working Groups of these partnerships, Clean Energy received the highest allocation (€492 million), followed by Urban Environment and Mobility (€285 million)[13].
- **European Partnerships in Horizon Europe** (**49 projects):** €23.8 billion from the EC, €9 billion from Member States and Associated Countries, and €22.4 billion from Industry. Two thirds (67%) of these resources support Green Deal projects, in a significant increase (38%) relative to the predecessor Horizon 2020 (European Commission, 2022a, p. 6). Cluster 4: Digital, Industry, and Space and Cluster 5: Climate, Energy, and Mobility received the largest amounts, as shown in Table 1 below.

Table 1: Budget of the European Partnerships Horizon Europe (EUR million)

	EU contribution	Commitments from private partners	Commitment from public partners
Cluster 1: Health	2 710	1 439.88	711.37
Cluster 4: Digital, Industry, and Space	8 340	9 151.16	5245.79
Cluster 5: Climate, Energy, and Mobility	7 190	10 740	886.2
Cluster 6: Food, Bioeconomy, Natural resources, Agriculture, and Environment	2 046	1 000	960
Other pillars	3 594	No data available (KICs)	1 233.3

Selected from European Commission (2022a), pp. 219-223

- **Interreg Europe 2014-2020 (258 projects):** €359 million from the ERDF for the 258 projects and the policy-learning services of the Policy Learning Platform. This funding has a financial impact of €1,414 million in

[13] Green Deal Projects Working Groups | Research and Innovation (europa.eu)

total (of which €1,144 million from Structural Funds), demonstrating effectiveness in the implementation of Cohesion Policy[14].

- **I3 instrument:** €312.42 million from the ERDF for the period 2021-2024, divided into:
  2021-2022: €153.12 million (€75.8 million for 2021 and €77.316 million for 2022)[15]
  2023-2024: €159.30 million (€78. 862 million for 2023 and €80.44 million for 2024)[16]

- ***Function: Guidance of the search***

Considering the complex nature of the partnerships, the guidance of the search, in a broader sense of governance, can come from several partners (Annex 9): on the one hand, *from the European Commission through the design, implementation rules and the programme funding,* and on the other, *from public and the private stakeholders* (scientific and business communities, government authorities, citizens and civil society) through their contributions to the overall activities of the partnerships, setting industry trends, influencing changes in regulations, policies, and government support for specific industries or technologies contributions to policymaking, etc. These contributions are visible especially in the partnerships that involve large consortia within the same industry or across several industries from several countries in Europe.

- ***Function: Creation of legitimacy/Counteracting resistance to change***

This function is most visible in the *Horizon 2020 European Green Deal Call partnerships* Knowledge and citizens projects (Annex 10), which aim to determine behavioural changes in large populations' lifestyles and expectations for facilitating the implementation of the European Green Deal. The projects use various data collection and monitoring instruments, emerging technologies (sensors, applications), Citizen Science and other participative approaches to change behaviour, create awareness, produce practical tools, policy recommendations and advocacy activities to address the Green Deal priorities. All the projects engage large communities of citizens and institutions (schools, universities, SMEs, local authorities, etc.) in several countries and regions.

The Interreg Europe 2014-2020 partnerships also contribute to this function through the Policy Learning Platform that shares the knowledge created through the programme to Interreg Europe's community members and policymakers. The Platform's good practice database has over 3,000 expert-validated policymaking practices. The Platform also provides expert support through peer reviews, matchmaking events, policy briefs, policy articles and stories about good practices, thematic events. The website, thematic newsletters, and social media channels present success stories about projects and their good practices[17].

[14] Project results | Interreg Europe - Sharing solutions for better policy
[15] European Commission C(2021) 6152 final Commission Decision of 25.8.2021 on the financing of Interregional Innovation Investments instrument to be supported by the European Regional Development Fund and the adoption of the work programme for 2021-2022
[16] European Commission C(2023) 780 final Commission Decision of 6.2.2023 on the financing of the Interregional Innovation Investments Instrument by the European Regional Development Fund and the adoption of the work programme for 2023-2024
[17] INTERREG EUROPE Annual implementation Report 2022.

5. Conclusions

The analysis of selected R&I and Cohesion policy partnerships established under the European Green Deal in relation to the Single Market industrial ecosystems suggests that these partnerships set in motion innovative technological and industrial developments that co-evolve and reinforce each other and pave the way to Single Market 2.0. They integrate sustainability initiatives across several sectors and institutions and generate knowledge and skills in various scientific and technological areas that advance the ecosystems knowledge and technology base. The partnerships facilitated the introduction of various new or advanced technologies, and connected sectors, policy domains, and partners from several countries/regions, etc. The partnerships also contributed to the emergence and growth of new markets and business models for the economy of the future. They mobilised large amounts of public and private investments and engaged large and diversified multi-actor communities both across Europe and beyond, consolidating various types of networks (research, innovation, business, industrial, cultural) at EU, national, regional, international levels. Considering their geographic locations across the EU, the partnerships show various territorial concentrations of the knowledge, technology and industrial assets, within single nations or regions or in broad interregional or transnational consortia.

As most of the partnerships are still in the early days, there are several aspects that need more time, data and research efforts for an accurate assessment of impact:

- *The degree of absorption of the new technologies, business models, technological solutions* by the national and regional markets envisaged for these partnerships.
- *The degree of participation of various stakeholders* from the respective industrial ecosystems in the partnerships and the access to the benefits derived from the partnerships.
- *The growth potential in new technological domains and their impact on the region*, especially in the rural communities, considering the difficulty to anticipate market trends and set realistic targets when working with new technological solutions that are not yet in the marketplace.
- *The risk of creating new development gaps among the Single Market's industrial ecosystems, due to the uneven spread of the various investment flows mobilised by the partnerships.* The experience of S3 implementation can be useful in this respect, as that has shown that more developed regions with strong innovation, technology and industrial potential are likely to be further strengthened, while the less developed or transition regions that have various deficits in innovation, technology, industrial potential and institutional capacity will have even more difficulty to catch-up.
- *The sustainability of the investment beyond the funding period*
- *The capacity to counteract the losses of EU competitiveness determined by high energy prices and the relocation of important EU technological companies*
- *The resilience to economic and political events on national and international arenas with adverse societal reactions or perturb international supply chains* (changes in consumers' attitude, political crises, etc.)

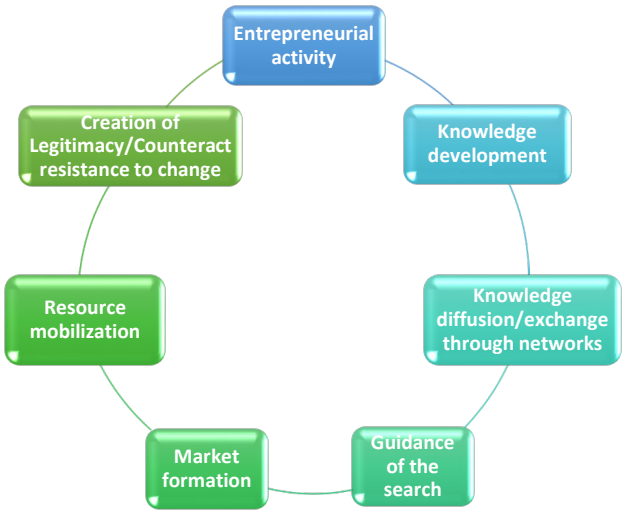
The partnerships' impact on the Single Market ecosystems demonstrates the need for a better understanding of the synergies between competition, industrial, innovation and regional development policies, as well as the need for more data and evidence to document the ways in which these policies influence each other. While synergies between innovation policy and cohesion policy have been documented in EC reports and scholarly papers [18], a broader view of the relations between

[18] See e.g. the EC 2022 report Synergies between ERDF programmes and Horizon Europe and Corpakis, D. (2019), *Powering Synergies Between Innovation Policy and Regional Development Frameworks: The Case of Smart Specialisation*, Proceedings of the II International Triple Helix Summit.

competition, industrial, innovation and regional development policies is much less explored and needs to be examined considering the new demands and challenges posed by the twin transition, sustainable development and the global economic downturn. Recent reports (UNCTAD 2023, OECD 2023) acknowledge the complementary or conflicting various ways in which competition and industrial policies interact in during policymaking and enforcement that can be with each other. Similar analyses of the relationship between the four policy areas need to be performed also in the context of the EU and the Single Market, to identify solutions and incentives to innovate.

ANNEXES

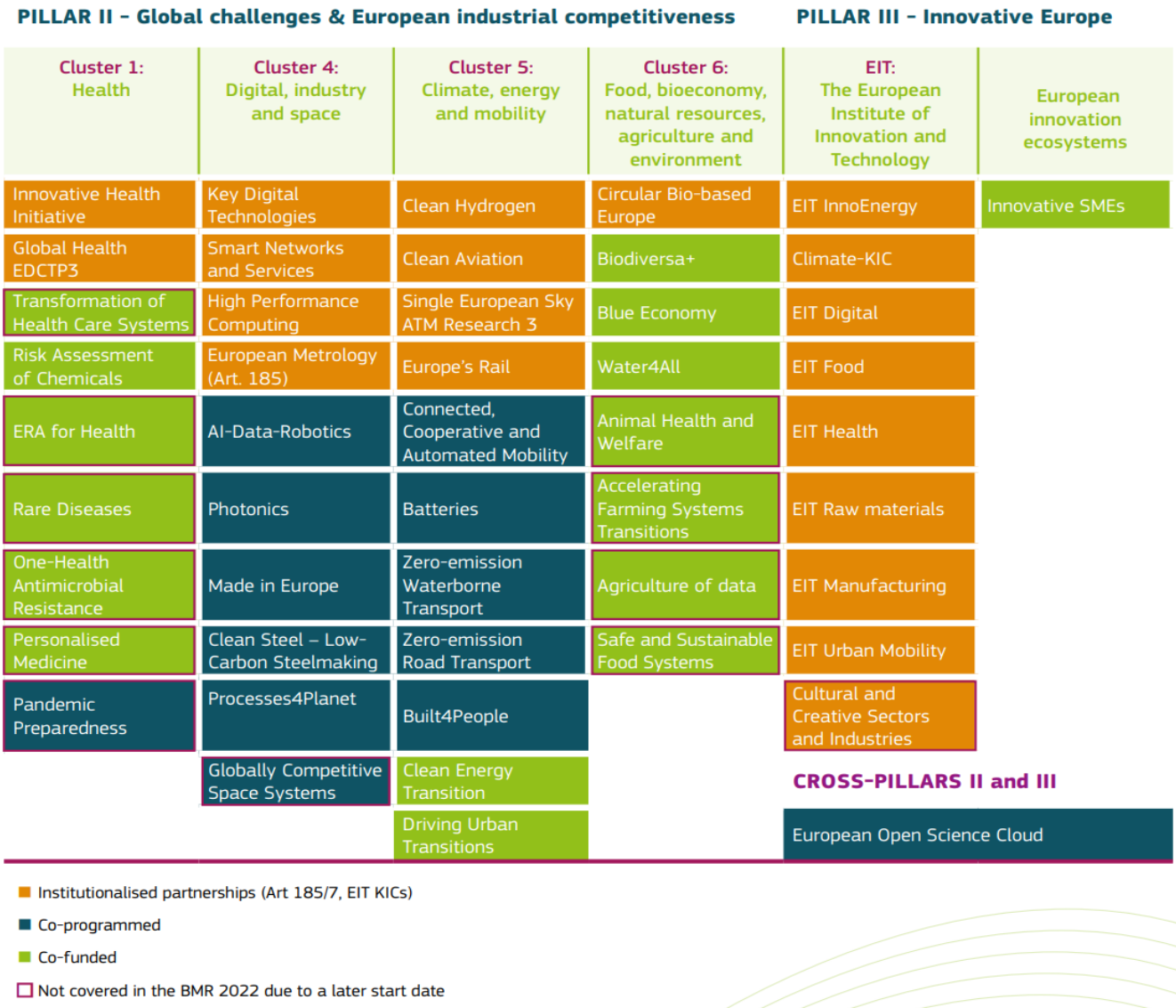
Annex 1: The seven functions of an innovation system and mapping indicators



System function	Mapping indicators
Knowledge development: learning activities on emerging technologies, markets, networks, users etc. That can include both learning-by-searching (R&D activities in basic science, inventions) and learning-by-doing (lab experiments, adoption trials). Mostly in universities and research institutions.	R&D projects, patents, and investments in R&D, increase in technological performance by means of 'learning curves'.
Knowledge diffusion/exchange through networks: activities that facilitate knowledge exchange between all the network components.	Partnerships between actors, number of workshops and conferences devoted to a specific technology topic, network size and intensity over time, patents, learning-by-using (users of technological innovations, e. g. through user-producer interactions)
Market formation: Activities that contribute to the creation of demand (financial support for the use of emerging technologies, mapping the number of niche markets, specific tax regimes for new technologies and for the use of competing technologies, new environmental standards that improve the chances for new environmental technologies, sustainable energy technologies.	Number of niche markets introduced, specific tax regimes for new technologies, new environmental standards that improve the chances for new environmental technologies
Entrepreneurial activities: translation of new knowledge, networks, and markets into new business opportunities by entrepreneurs who perform market-oriented experiments that establish change, both to the emerging technology and to the institutions that surround it. Entrepreneurial experiments can help clarify various uncertainties, learn about technologies and markets, reactions of consumers, government, competitors, and suppliers. The presence of active entrepreneurs is a good indication of a good performance of the innovation system.	New entrants, diversification activities of incumbent actors, experiments with the new technology, projects proving the usefulness of the emerging technology in a practical and/or commercial environment (experiments, demonstrations)
Resource mobilisation: financial, human, and material resources, infrastructures	Allocation of investments and subsidies, long-term R&D programmes set up by industry or government to develop specific technological knowledge, human capital to support an emerging technology, testing of new technologies in niche experiments, deployment of educational systems, large R&D facilities or infrastructures, natural resources, such as biomass, oil, natural gas.
Guidance of the search: can be performed by a variety of system components such as industry, government, market.	Specific policy or investment targets by governments or industries regarding the use of specific technologies; activities that can positively affect the visibility and clarity of specific needs among users; articles in professional journals that raise expectations about new technological developments; regulations and policies; changing prices, assessments of market opportunities, crises, promises and expectations expressed by various actors in the community.
Creation of Legitimacy/Counteracting resistance to change: support from advocacy coalitions and interest groups to counteract resistance from actors with interests in the incumbent system, e. g. by urging authorities to reorganize the institutional configuration of the system, political lobbies, advice on behalf of interest groups.	Rise and growth of interest groups and their lobby actions.

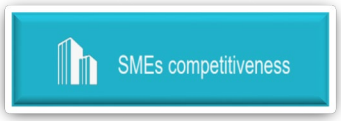
Source: own elaboration based on Hekkert et al (2007)

Annex 2: Overview of the European Partnerships under the 1st Strategic Plan of Horizon Europe (2021-2024)



Source: European Commission (2022a), p. 5

Annex 3: Interreg Europe Priority Axes 2014-2020 and 2021-2027

2014-2020	2021-2027	
 • Innovation capacity (17 projects) • Innovation ecosystems (12 projects) • Innovation in sector (21 projects) • RIS3 (15 projects)	 **Smarter Europe**	• Research & innovation capacities • Digitisation • SME competitiveness • S3, industry and entrepreneurship • Digital connectivity
 • Entrepreneurship (12 projects) • Innovation capacity of SMEs (9 projects) • Support to sector (24 projects) • Support to SMEs (21 projects)	 **Greener Europe**	• Energy efficiency • Renewable energy • Smart energy systems • Climate change • Water management • Circular economy • Nature & biodiversity • Zero-carbon urban mobility
 • Energy efficiency (14 projects) • Low-carbon strategies (11 projects) • Renewable energy (9 projects) • Sustainable transport (26 projects)	 **More connected Europe**	• Sustainable TEN-T • Sustainable mobility
 • Biodiversity preservation (4 projects) • Circular economy (11 projects) • Natural & cultural heritage (28 projects) • Resource efficiency (24 projects)	 **More social Europe**	• Education • Social inclusion • Integration of third-country nationals • Health care • Culture and sustainable tourism
	 **Europe closer to citizens**	• Integrated urban development • Integrated non-urban development
	 **Better regional governance**	• Policy governance

• **258 projects and policy-learning services offered by the Policy Learning Platform**
  - 65 projects PA1
  - 66 projects PA2
  - 60 projects PA3
  - 67 projects PA4
• **5 calls (2014-2020)**
• **Budget: EUR 359 million**
	• **134 project proposals 1st call (April-May 2022)** – under evaluation
	• project proposals 2nd call (March -June 2023) – under evaluation
	• project proposals 3rd call (in the 1st semester 2024) and 4th call (in the 1st semester 2025)
	• **Budget: EUR 130 million (1st call) + EUR 130 million (2nd call).**
	Budgets for the 3rd and 4th call to be decided	

Source: based on What is Interreg Europe? | Interreg Europe - Sharing solutions for better policy; Annual Implementation Report 2022.

Annex 4: I3 partnerships focused on the green transition

I3 partnership
De-and Remanufacturing for Circular Economy Investments in the Composite Industry (DeremCo) (December 2022 - November 2025) Lead country: Italy; Contributors: 29
Interregional investment for the sustainable supply of raw materials in the EU Green Energy Transition (I4-GREEN) (November 2022- April 2025) Lead country: Portugal; Contributors: 8
enHancing dIgital and Green growtH in the Food processing industry via Interregional innoVation invEstments (HIGHFIVE) (December 2022-November 2025) Lead country: Belgium; Contributors: 33
HYdrogen TO enter MARKets reducing carbon Emissions footprinT (Hy2Market) (February 2023 -January 2026) Lead country: Netherlands; Contributors: 36
Supporting the Regional Development of the Green Hydrogen Fuel Value Chain for Transportation in Estonia and Latvia (H2Value) (November 2022-November 2025) Lead country: Estonia; Contributors: 9
Smart and Sustainable Drone-assisted Viticulture Excellence Network (SmartVitiNet) (December 2022 - November 2025) Lead Country: Greece; Contributors: 11
Regions for Green Textiles REGIOGREENTEX (January 2023 - December 2025) Lead country: Belgium; Contributors: 44
Resilient Innovation Ecosystems for EU Value Chains RISE (November 2023 -October 2025) Lead country: Bulgaria; Contributors: 8
Optimisation of Production by 3DP 3DoP (January 2023 - December 2025) Lead country: Belgium; Contributors: 35
Nature-Based Business Model and Emerging Innovations to enhance Carbon Farming Initiatives (CFIs) while preserving Biodiversity, Water Security and Soil Health INNO4CFIs (September 2023 - August 2026) Lead country: Italy; Contributors: 14
Innovative Products For Sustainable Micromobility IN-MOB (October 2023 - September 2026) Lead country: Italy; Contributors: 12
INtegrating Cybernated Innovation to Raise the scale of Circular Units Looping Allied Regions INCIRCULAR (October 2023 - September 2026) Lead country: Slovenia; Contributors: 8
Hydrogen Valley in the Province of Mantova HYMANTOVALLEY (September 2023 - August 2026) Lead country: Italy; Contributors: 14
European cross regional innovation for Sports & Active Healthy Lifestyle INSHAPE (September 2023 - August 2026) Lead country: Netherlands; Contributors: 21
Efficient and sustainable smart wine production technology to boost European small and medium sized wineries competitiveness SMARTWINERY (November 2023 -October 2026) Lead country: Spain; Contributors: 4
EU circular BATtery valley for second life, recycling, and re-manufacturing of materials and black MASS — BATMASS (September 2023 - February 2026) Lead country: Italy; Contributors: 15
DIGItalisation of the COPD market with a LUNGshirt and a platform DigiLung (September 2023 - August 2026) Lead country: Estonia; Contributors: 6
DIGItal Infrastructure for ONcology in Europe DigiONE I3 (November 2023 - April 2026) Lead country: Belgium; Contributors: 26
DIGITAL tools delivering PREvention, prediction and remote care through a resilient EU value network to reduce health system stressors in a post-COVID world DIGIT-PRE (October 2022 - September 2025) Lead country: Sweden; Contributors: 10
Circular Economy and Sustainability solutions for Agrifood in the Mediterranean CESAM (September 2023 - August 2026) Lead country: France; Contributors: 9
Bridging investment opportunities to achieve the resilient European food packaging value chain Value4Pack (November 2023 - October 2025) Lead country: Poland; Contributors: 14
Boosting value chains in Health at regional and EU level HealthChain (January 2023 - December 2025) Lead country: Spain; Contributors: 19
Baltic MUssel Products for PET-foodS Baltic MUPPETS (December 2022 - November 2025) Lead country: Germany; Contributors: 13
Artificial intelligence-enhanced, sustainable growth of rare-earth materials-based laser crystals SMART-Growth (October 2023 - December 2025) Lead country: Germany; Contributors: 9
A portable in-field plant PET/MRI technology for the early crop stress detection Agri-PET/MRI (November 2023 - October 2026) Lead country: Germany; Contributors: 4

Source: selected from Projects & Results (europa.eu)

Annex 5: Partnerships' contributions to creation of knowledge and skills

R&I PARTNERSHIPS[19]	
Partnerships in the European Green Deal Call Horizon 2020	**European Partnerships under the 1st Strategic Plan Horizon Europe**
• **Clean Energy** (16 projects): large-scale hydrogen production, conversion of CO2 emissions from industrial processes into synthetic fuels; development of land-based renewable energy technologies and offshore renewable energy innovations. • **Climate change and biodiversity** (17 projects): prevention and management of wildfires, preservation and restoration of biodiversity in natural ecosystems, including coastal, water landscapes and forests; climate change adaptation and mitigation (with a highlight on urban areas). • **Food and health** (15 projects): reducing chemical and industrial pollution; developing circular value chains in the agri-food sector; innovative practices that support the Farm to Fork strategy. • **Urban environment and mobility** (9 projects): multi-modal connection and transport nodes and sustainable solutions for maritime and inland ports and airports, energy and resource efficiency in the built environment (buildings and neighbourhoods), and climate ambitions in cities. • **Knowledge and citizens** (16 projects): behavioural, social and cultural change for the Green Deal.	• **Cluster 1: Health** (9 projects): technologies tackling infectious and rare diseases, anti-microbial resistance and pandemic preparedness; diagnostics, treatments and vaccines against reemerging epidemics; risk assessment of toxic chemicals; personalised medicine; national/regional healthcare systems. • **Cluster 4: Digital, industry and space** (10 projects): supercomputing, quantum computing, service and data infrastructure; electronics and photonics; smart networks and services, 5G cyber-security toolbox and technology capacities for 6G systems; AI, data and robotics; Clean Steel - Low Carbon Steelmaking; metrology, manufacturing ecosystems for circular industries. • **Cluster 5: Climate, energy and mobility** (11 projects): digital and automation technologies for rail systems; digital technologies for air traffic management, air-ground integration and automation, airspace management and safe integration of drones; new aircraft technologies for clean aviation; clean hydrogen technologies; technologies for zero-emission and competitive long distance heavy-duty vehicles; connected, cooperative and automated mobility (CCAM) technologies and services; technologies for zero-emission waterborne transport, batteries, urban transformative transitions and clean energy transitions. • **Cluster 6: Food, bioeconomy, natural resources, agriculture and environment** (8 projects): accelerating farming systems transition: agroecology living labs and research infrastructure; animal health and welfare; geospatial and Earth observation datasets for agriculture; biodiversity monitoring; knowledge-based solutions and innovative governance models for Blue Economy; safe and sustainable food systems; sourcing and conversion of biomass into bio-based products and circular economy; water security.
COHESION POLICY PARTNERSHIPS[20]	
Interreg Europe partnerships	**I3 partnerships**
▪ Project activities in all Priority Axes* ▪ The Policy Learning Platform: ➢ Access to the knowledge created through the programme to thousands of Interreg Europe's community members and policymakers. Its good practice database now contains over 3,000 expert-validated policymaking practices. ➢ Expert support through peer reviews, matchmaking events, policy briefs, policy articles and stories about good practices, thematic events, participations in other thematic networks/project events, promotional events. ➢ Events organised by the programme or the Partner State's points of contact, and at thematic events (EU Regions Week, EU Green Week, EUSEW, etc.). ➢ Programme website, monthly and thematic newsletters, and social media channels that present success stories about projects and good practices[21].	• A knowledge exchange platform that brings together regions throughout Europe that work on different innovations to boost the production, transport, and use of green hydrogen (**Hy2Market**). • A dedicated multi-stakeholder digital platform to demonstrate 14 composite re-use business cases with tested sustainable economic, social and environmental outcomes, then replicated and multiplicated across European regions (**DeremCo**). • Specific activities (Challenges-Solutions-Funding Camp, Direct 'one-to-one' coaching, Support tool for investment decision) to disseminate solutions and create spillovers among companies outside of the consortium (**3DoP**). • Networking, workshops, on-site and virtual trainings, facilitation activities, identification of innovation investment projects through targeted measures, SME masterclasses, workshops, hackathons and individual support (**RISE**). • Workshops and seminars on technological innovations and solutions at key production steps, integrated with a digital monitoring and data analysis platform into an demo plant for full-scale demonstration (**SMARTWINERY**)

*** Examples of Interreg Europe partnerships by Priority Axis:**

- **STEPHANIE** (**PA1 Research and innovation)** is a partnership focused on space technologies based on photonics, which are considered as one of Europe's areas of key industrial competence, and the role played by EU regions in space policy. The project brings together 8 partners from 7 areas to ensure real benefits from space technology based on photonics, particularly in space and earth observation.
- **RuralGrowth** **(PA2 SME Competitiveness)** supports SME development by fostering green innovative solutions in small rural businesses, serving as a launchpad for SME competitiveness and a driver for the sustainable development in rural regions. The project developed SME innovation support schemes (novel products and services, branding and education programmes) for the benefit of the partners as well as their broader communities.
- **CLEAN** **(PA3 Low-carbon economy)** brings together regional partners that aim to increase energy efficiency in housing and public infrastructure by 4% through technology, open innovation and improved low-carbon policy instruments, as well as interregional learning and transfer of innovative policy and solutions. The beneficiaries include all stakeholders in each region's energy environment).

[19] Selected from Green Deal Projects Working Groups | Research and Innovation (europa.eu) and European Partnerships in Horizon Europe (europa.eu)

[20] Selected from INTERREG EUROPE Annual implementation Report 2022 and Projects & Results (europa.eu)

[21] INTERREG EUROPE Annual implementation Report 2022.

- **STAR Cities (PA4 Environment & resource efficiency/ Natural and Cultural Heritage)** aims at improving regional policies related to the tourism ecosystem existing along rivers, by protecting, promoting and developing natural heritage, biodiversity and ecosystems.

Annex 6: Partnerships' contributions to experimentation, demonstration and upscaling of new technologies

R&I PARTNERSHIPS[22]	
In the European Green Deal Call H2020 (2014-2020)	**In Horizon Europe 2021-2027**
• 11 Living Labs for an integrated management of extreme wildfire events in Europe (FIRE-RES) • 7 Living Labs to co-develop a framework for human-centred climate services (I-CISK) • 7 City Hubs to accelerate co-creation of services and upscaling, building on peer-to-peer learning and involvement of urban authorities, private sector, civil society (REACHOUT-Cities) • 9 Pilots to develop a systemic approach to coastal restoration (REST COAST) • 12 large-scale demonstrators across Europe for forest restoration and adaptation (SUPERB) • Field testing and demonstration of digital and space-based technologies and agro-ecological and organic practices in an aquaponic plant and open-field vegetable farms (PestNu) • Action and Knowledge Sites for restoration upscaling and sharing best practice experience and knowledge (WaterLANDS) • 16 MW scalable and fast-cycling modules for building a 100 MW electrolyser (GreenH2Atlantic). • 6 large-scale demonstration projects of climate positive circular communities in six cities in Czech Republic, Denmark, Italy, Netherlands, Norway, and Spain, showcasing over 50 innovations related to the construction and energy industries (ARV). • Citizen Science Lab - with a focus on women, young people, and hard-to-reach groups to provide the skills to co-design and undertake environmental scientific experiments (COMPAIR) • Eight Living Labs and a participatory Environmental Impact Hub, to collect data about climate change and environmental hazards and make it available to citizens to understand how their own behaviour can affect climate change and how they can reduce their carbon and environmental footprint (ICHANGE)	• Large-scale demonstrators of low-carbon technologies (clean steel production) leading to a 50% reduction in CO2 emissions by 2030 and by 80-95% by 2050 in at least 12 areas funded by the partnership (Clean Steel Partnership) • Pilots and full-scale trials to provide and validate enablers and solutions for full digitization of the European vertical industries in order to improve the business operation (Smart Networks and Services) • European Robotics Week - a citizen outreach event where academic laboratories and companies organize demonstrations, public hackathons, lectures and debates with the public (AI, Data and Robotics) • Demonstration and prototype projects covering TRL 5-7 scale (Photonics Partnership) • Digital Innovation Hubs with demonstrators, pilot sites, and field labs to test the digital transformation of manufacturing (digital platforms, AI, machine learning, simulation & modelling (digital twins), robust and secure industrial real-time communication technologies) and engage SMEs in the digital transformation (Made in Europe) • Hubs for Circularity (H4C) to catalyse regional industry-society collaboration by connecting various regional stakeholders to develop circularity and carbon neutrality, industrial-urban symbiosis and circularity (Processes 4Planet) • In-Orbit demonstration/validation for mature and disruptive space technologies (Globally-competitive Space Systems) • Very Large-scale Demonstrations (VLD) of mature concepts and technologies (Autonomous operations, Airport infrastructure for New Vehicles) (Integrated Air Traffic Management) • 34+ flagship demonstrators, 106+ other demonstrators contributing to the flagship demonstrators, 1000+ technologies by the end of the programme (Clean Aviation)
COHESION POLICY PARTNERSHIPS[23]	
Interreg Europe partnerships	**I3 partnerships**
124 pilot actions that involved 236 partners from 27 countries and 114 NUTS2 regions. Among them, 138 partners were from more developed regions (58%) and 98 (42%) from less developed and in transition regions.[24]	• A small-scale green H2 production pilot plant based on solar energy to test TRL9 technologies in the green H2 value chain in South Estonia and Northern Latvia (H2Value). The project aims to establish the first interregional green H2 value chain in Estonia and Latvia and activate the emerging H2 markets in these regions and in EU13) • Demo-cases for three industry-driven projects using digital solutions for food processing companies (HIGHFIVE). • New observational platforms and new ready-to-use sensors, to scale-up, pilot and bring to market an innovative holistic phytosanitary and plant protection system using unmanned aerial vehicles, and to create a Competence Centre for Precision Viticulture (SmartVitiNet) • Three industrial pilots (through TRL7-8 up to market uptake) and cross-regional scaling up by building a holistic solution that will link the three pilots to each other (DigiLung) • An interregional technological production platform for applying an AI-based imaging system into a multimodal plant imaging device for early crop stress detection and sustainable crop management and research (Agri-PET/MRI) • Pilot-testing of TRL6 technologies for the implementation of a systematic circular economy model within the textile industry across the EU (REGIOGREENTEX) • Two green pilots: 1) to recover rare earths minerals from iron mining waste, reducing environmental impact and alleviating EU dependence on foreign resources, with a particular focus on Neodymium; and 2) to extract strategic raw materials (Cu, Zn, Co) from low grade ores. The two pilots are expected to boost an interregional system thanks to innovative tools and regional investments to turn mining green (I4-GREEN). • Two pilots for developing and testing innovative micro-vehicles (MVs) products) (IN-MOB): a shared e-scooter service conceived particularly for tourists, considering the regulatory barriers, in Madeira

[22] Selected from Green Deal Projects Working Groups | Research and Innovation (europa.eu) and European Partnerships in Horizon Europe (europa.eu)
[23] Own selection based on INTERREG EUROPE Annual implementation Report 2022 and Projects & Results (europa.eu)
[24] INTERREG EUROPE Annual implementation Report 2022.

	(Portugal); e-bikes and cargo-bikes to test the potential integration with public transport of MVs in Palermo (Italy

Annex 7: Contributions to the development of new/disruptive technologies and their integration

European Partnerships under Horizon Europe
• European Partnership on Smart Networks and Services: Development and deployment of capacities for 6G systems for future digital services and development of lead markets for 5G infrastructure and services. • European Partnership on Clean aviation: Development of the next generation of ultra-efficient low-carbon aircraft technologies, with novel (hybrid) electrical power sources, engines, and systems. These technologies will deliver net greenhouse gas (GHG) reductions of 30%, compared to 2020 state-of-the-art. The new aircraft with this performance is expected by 2035, enabling 75% of the world's civil aviation fleet to be replaced by 2050. Net CO2 reductions of up to 90% are expected when combined with the sustainable 'drop-in' fuels, or zero CO2 emissions in flight when using hydrogen as an energy source. • European Partnership for High Performance Computing: Development of a hyper-connected supercomputing, quantum computing, service and data infrastructure ecosystem. • European Partnership Clean Energy Transition: Development of renewable energy technology, demonstration and integration (fuels for clean mobility, carbon capture and storage, power in energy-intensive industries, heating, and cooling for energy efficiency in the building domain) and system change (e.g., energy infrastructures. • European Partnership Key Digital Technologies: Development of a new generation of electronic components and systems with much lower energy requirements systems, easier integration into the physical environment, and reduced need to move data to remote data centres for processing (thanks to advanced edge computing capabilities software. • European Partnership Towards Zero-Emission Road Transport: Development of zero tailpipe-emission road transport in Europe with a system approach and integration of results of the enabling technologies partnerships, such as Clean Hydrogen, Batteries for Europe and the Key Digital Technologies Expected results by 2030 are the wide deployment of zero-emission, affordable user-centric solutions, CO2 emission reduction and air quality improvements, introduction of zero-emission and competitive long distance heavy-duty vehicles. • European Partnership on Metrology: Development of disruptive technologies in metrology, including quantum technologies, nanotechnology, and advanced measurement techniques that can have a significant impact on various industries, including healthcare, manufacturing, and communications.
I3 partnerships
• BATMASS: TRL6+ circular technologies and processes for battery materials used to implement the first EU Circular Battery Valley through a portfolio of cross-regional investments. Four Demonstrators (or 'Demo lighthouses') aim to create an integrated interregional ecosystem to scale up, commercialize and deploy breakthrough GreenTech, accelerating market entry and international replication across EU regions and beyond. Technology transfers between less developed, transition and developed regions are expected to structure this emerging value chain and anchor it into regional innovation ecosystems • INCIRCULAR: A unique process technology implemented in Slovenia while sourcing technologies come from Spanish and French regions (process/digital twinning) to produce bioplastic sourced 100% from recycled plastic, 100% recyclable and presenting technical properties similar or better to current petro-plastics. This enables cross-regional tech transfer through TRL6 to 9 and supports the setup of an interregional circular ecosystem that will scale at EU level.

Source: own elaboration based on European Partnerships in Horizon Europe - European Commission (europa.eu) and Funding & tenders (europa.eu)

Annex 8: Partnerships with large professional network of public and private organisations from one or more industrial sectors and broad national and regional geographical spread

European Partnerships under Horizon Europe
• European Partnership on Clean aviation: is a Joint Undertaking that connects the EC and the aeronautics industry into a public-private Partnership (PPP) focused on the development of the next generation of ultra-efficient low-carbon aircraft technologies, with novel (hybrid) electrical power sources, engines, and systems The new technologies and architectures developed in the programme are monitored through the *Impact Monitoring Framework*. • European Partnership for High Performance Computing: Development of a supercomputing,. is a Joint Undertaking that enables the EU and 27 participating states to coordinate their supercomputing strategies and research agendas and pool together public and private investments. The Partnership implements a hyper-connected supercomputing, quantum computing, service and data infrastructure ecosystem for a network of HPC competence centres serving large industry users and SMEs, researchers, public administrations and industry across Europe. • European Partnership Made in Europe includes partners from the manufacturing industry in Europe that is represented by the European Factories of the Future Research Association (EFFRA) - a non-for-profit, industry-driven association promoting the development of new and innovative production technologies. The partnership supports sustainable manufacturing in Europe and global leadership in technology, circular industries, and flexibility. The EFFRA Innovation Portal was developed in cooperation with the EC as an online resource for sharing information about all the projects performed in the framework of the partnership. • European Partnership Processes4Planet (P4Planet) brings together at least 10 leading sectors of the European process industry (cement, steel, ceramics, chemicals, engineering, minerals and ores, non-ferrous metals, water, refineries, and pulp or paper) that aim to achieve circularity and overall climate neutrality by 2050 while enhancing their global competitiveness. This is a co-programmed public-private partnership established between A.SPIRE – as the private entity – and the EC in Cluster 4: Digital, Industry and Space. Knowledge diffusion and exchange take place through the *Hubs for Circularity (H4Cs)* that consist of self-sustaining economic industrial ecosystems for full-scale Industrial-Urban Symbiosis (I-US) and Circular Economy, and *the First-of-a-kind (FOAK) large scale plants* of one or more new technologies, integrated in their value chain(s) and deployed by the process industry.

Interreg Europe partnerships
• Consortia vary in size from low (1-8 partners) to high (23-49) partners. • Different patterns have been observed subject to the development level of the region: for the more developed regions, the highest number of partners were in the projects under PA1 Research and Innovation (37), while for the less developed and transition regions, the highest number of partners were in the partnerships under PA3 Low-carbon economy (32)
I3 partnerships
• Consortia vary in size from 4 to 44 partners (the largest partnerships are Regions for Green Textiles REGIOGREENTEX (44 partners) and Optimisation of Production by 3DP Opti3DoP (35 partners) • Wide geographic coverage in Europe.

Source: own elaboration based on European Partnerships in Horizon Europe - European Commission (europa.eu); Interreg Europe Annual Implementation Report 2022; and Funding & tenders (europa.eu)

Annex 9: Partnerships' contribution to the guidance of the search

Guidance by the European Commission: novelties in programme design and governance	
European Partnerships in Horizon Europe[25]	• *Coherent criteria for all European Partnerships*: (i) Directionality and additionality; (ii) Coherence and synergies; (iii) Transparency and openness; (iv) International visibility; and (v) Flexibility of implementation. Partners' objectives and long-term vision are agreed upon in Strategic Research and Innovation Agendas (SRIAs). • *A more strategic and impact-oriented approach to EU priorities and stronger synergies with other initiatives at EU, national or local level,* based on a common vision, a critical mass of investments and joint activities agreed upon in the common SRIAs, a focus on more disruptive changes in European R&I systems and technological solutions, and an extended engagement of stakeholders. • *A new Strategic Coordinating Process*, centred on a core *Partnership Knowledge Hub* that coordinates interactions and meetings between the stakeholders; an annual Partnership *Stakeholder Forum* that brings together the whole community for networking, sharing of experiences, and a *biennial monitoring report (BMR)* that provides the evidence base to inform strategic assessment of the partnerships. The first report was published in May 2022 and the second is planned for 2024. • *An intervention logic that focuses on transformational failures (e. g. shortage of skills or critical mass or cross-sectoral cooperation), in addition to market and systemic failures).*
Interreg Europe 2014-2020 partnerships[26]	• Selection of topics: better focused for more effective results. • Mid- to long-term monitoring by the regional partners of the impacts of the exchange of experience on the territories concerned, to demonstrate the value of cooperation and the value of the investment. • The Policy Learning Platform and its support to the local and regional governments in sharing knowledge, planning and implementing policies and programmes for regional development. • Greater emphasis on improving programmes that are part of the EU's cohesion policy (i. e. Investment for Growth and Jobs and European Territorial Cooperation programmes). • First time participation of private non-profit bodies, next to public bodies and bodies governed by public law.
I3 partnerships[27]	• The first European instrument for interregional investments in the S3 priority areas of EU countries and regions. • S3 used as an integrated and place-based innovation strategy that can interconnect regional innovation ecosystems for tailored investment in new value chains. • Seeks to reduce the fragmentation that hinders the EU-wide transition to a new growth model and build synergies with other funding instruments that could complement the financing from ERDF. • Seeks to strengthen co-governance in S3 platforms between lead-regions and lead-DGs for supporting the investment pipeline of S3 partnerships
Guidance of the search by the public and private sector: contributions to regulations and policymaking	
• European Partnership Clean Aviation connects the EC and the aeronautics industry into a public-private Partnership (PPP). The partnership influences policies and regulations related to cleaner aviation, and supports initiatives to reduce aviation emissions, in line with the European Green Deal's objectives to make aviation more sustainable. These initiatives involve regulatory changes to promote the use of sustainable aviation fuels and low-emission aircraft. • European Partnership on Clean Hydrogen focuses on hydrogen technologies and their potential to decarbonize various sectors. It influenced the development of the European Hydrogen Strategy, which aims to promote hydrogen as a clean energy carrier. This strategy includes regulatory and policy measures to support hydrogen production, infrastructure development, and market uptake. • Key Digital Technologies European Partnership (KDT) promotes digitalization, including high-performance computing and artificial intelligence. Its work has contributed to the EU's Digital Europe programme, which supports digital innovation and aims to create a regulatory framework for artificial intelligence, ensuring responsible and ethical AI deployment. • European Partnership on Metrology advances regulations and standards by collaborating on metrology-related initiatives. For instance, the work on quantum technologies aligns with the EU's efforts to develop standards for quantum technologies, shaping the regulatory landscape in this emerging field.	

Source: own elaboration

[25] European Commission (2022a)

[26] Interreg Europe Programme Manual 2021, p. 8

[27] Friends of Smart Specialisation. Response to the public consultation on the Interregional Innovation Investment (I3) supported by the ERDF. 30th September 2020

Annex 10: Contributions to creation of legitimacy/counteracting resistance: R&I partnerships 'Knowledge and citizens'

Partnership	Purpose
ACCTING (AdvanCing behavioural Change Through an INclusive Green deal)	To understand the unequal impact of Green Deal policies on vulnerable groups, prevent inequalities, and produce knowledge and innovations to advance behavioural change at individual and collective levels for an inclusive and equal European Green Deal
AURORA (Empowering a new generation of near zero-emission citizens)	To change citizens' behaviour and attitudes towards energy. Implemented as a demonstrator in 5 European countries where it aims to upgrade social communities (four university communities and one rural deprived area), to new civic consortia, to generate the first generations of Near Zero-Emission Citizens as ambassadors for sustainable energy behaviour.
COMPAIR	To use Citizen Science for strengthening citizens' capacity to monitor, understand, and change their environmental impact, both at a behavioural and policy level. A Citizen Science Lab will run experiments to supplement gaps in official air quality data to co-create more effective social actions and influence city policy.
ECF4CLIM (A European competence framework for a low carbon economy and sustainability through education)	To develop, test and validate a European Competence Framework (ECF) for transformational change, which will empower the educational community to act against climate change and towards sustainable development. It applies a novel hybrid participatory approach, rooted in participatory action research and citizen science, to co-design the ECF in selected schools and universities.
GreenSCENT (Smart Citizen Education for a Green Future)	To develop the GreenComp (European Sustainability Competence Framework) using both expert and researcher input and advice, citizen participation, and stakeholder engagement. The framework is tested in different European regions, different educational levels (from primary schools to higher education - about 45 schools and universities across the EU). Pilots will implement collaborative learning, debates, research-based learning, inquiry-based learning, and demonstrators, to include digital, physical and hybrid technologies.
I-CHANGE	To provide citizens with practical tools and sensors, knowledge and solutions to reduce their own personal carbon and environmental footprint and to support climate adaptation and mitigation, triggering social innovation. Eight interactive Living Labs across Europe, Israel and Burkina Faso and a participatory platform - Environmental Impact Hub – will collect heterogeneous data and make it available to citizens, policy makers and other actors.
PSLifestyle (Co-Creating a Positive and Sustainable Lifestyle tool with and for European Residents)	To enable citizens to actively create data while monitoring their lifestyle-induced climate impact and behaviour. The collected data will be used to create a digital application to co-research, co-develop and uptake everyday life solutions for climate change. It aims to engage a total of 4 million EU citizens.
REAL_DEAL (Reshaping citizens' deliberation for the European Green Deal)	To stimulate a pan-European debate to reshape citizens' and stakeholders' active participation in deliberative democracy around the European Green Deal from a wide range of disciplines (environmental rights and the law of public participation, ethics and responsible innovation, gender studies and ecofeminism, psychology, geography, urban planning and sustainability studies). It includes the EU's largest civil society networks advocating on the environment, climate, sustainable development, local democracy, and the European movement, youth climate, social justice and women's organisations, small businesses, universities and research institutes, civil society organisations.
SOCIO-BEE (Wearables and droneS fOr CIty Socio-Environmental Observations and BEhavioral ChangE)	To use Citizen Science (CS) and emerging technologies (portable air quality sensors) for community engagement and social innovation to empower communities to adopt more sustainable behaviour and reduce air pollution.

Source: selected from Green Deal Projects | Research and Innovation (europa.eu) (Knowledge and Citizens Working Group)

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ET-BD-24-002-EN-N

Publications Office
of the European Union

DOI: 10.2873/025041
ISBN: 978-92-68-13176-3