

Monitoring industrial ecosystems

CULTURAL AND CREATIVE INDUSTRIES

Analytical report – 2024 edition

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Executive Summary

This report has been prepared within the 'European Monitor of Industrial Ecosystems' (EMI) project with the objective to analysing the green and digital transformation of industrial ecosystems and progress made over time, in this specific case, cultural and creative industries.

For greater clarity, the second edition of the Industrial Ecosystems series has divided the analysis into two sections meaning, 'green transition' and 'digital transition' followed by three subsections each showing: a) industry efforts, b) framework conditions and c) the impact on environmental and productivity.

The key findings of this year's analysis are being presented below:

Green Transition

What progress has the industry made in taking action for the environment?

- **In 2024, 65% of CCI companies surveyed adopted waste reduction measures and 58% implemented energy saving actions.** However, progress since 2021 has been relatively slow.

- **The most significant improvement occurred in product design,** where the share of CCI companies adopting related measures increased from 21% in 2021 to 33% in 2024. this is closely linked to relevant design activities, which are an integral part of the CCI.

- Moreover, 52% of CCI companies responding to the EMI Enterprise survey said that they invested in **energy-saving technologies**, marking a significant increase compared to the previous year.

- However, in 2024, it is only **19% of CCI companies that adopted strategies for climate neutrality**, showing a modest commitment.

- 61% of CCI companies relied on external financial resources for resource efficiency, which highlights the challenges that businesses in the cultural and creative industries face when it comes to finance the green transition by own means.

- **30% of CCI companies do not invest at all in environmental measures,** which calls the attention to solve the financing challenge and promote such actions in this ecosystem.

- However, it is important to note that **surveyed companies are planning to increase their investments in the future.** For instance, the percentage of CCI companies intending to invest 1-5% of their annual turnover is expected to rise.

- The importance of the green transition in CCI extends far beyond its sectoral boundaries and has critical implications for the green transition of other industrial ecosystems.

To what extent do framework conditions such as public financing and skills support the green transition?

- The EU Cohesion Policy's funding mechanisms support various initiatives that promote environmental sustainability within the CCI such as sustainable design. However, it is **a negligible share of the European Regional Development Fund that is addressing the green transition** of any CCI sector directly (although it supports projects where the CCI sectors such as the design sector plays a role in the green transition of the economy overall).

- **Under Horizon 2020, only 3% of the EU research and innovation funding allocated to CCI projects was directed toward supporting the green transition**, amounting to EUR 14 m for the period 2014–2021. **Horizon Europe allocated 7%** of the European Commission's funding for CCI projects that contribute to green transition initiatives so far (period 2022-2024).

- **15.5% of the Creative Europe programme** calls including a European organiser or destination had a thematic focus on environment and sustainability.

- **Organisations in the CCI industrial ecosystem employed in general 1.8 full time employees in green jobs** some or all of their time in 2024, which is a very low result. 60% indicated that they do not employ any professionals in green jobs that shows a clear skill gap in the CCI regarding the green transition.

- **4.5% of professionals registered on LinkedIn and employed in the CCI industrial ecosystem had a skill relevant to the green transition** in 2024, showing a low share but an increase from 2022.

- The share of online job advertisements requiring skills related to the green transition in 2023 was around 1%.

How is the industrial ecosystem's impact on the environment changing?

- The EU's **CCI's emissions totalled 18 million tonnes of CO2 equivalent in 2022** according to Exiobase data's consumption account. CO2 emissions of the CCI have gradually decreased over the period from 2015-2022.

- Most emissions from the CCI sector fall under GHG Scope 3, encompassing indirect emissions throughout the upstream and downstream value chain such as purchased goods and equipment, business travel or operation of data centres.

- **Material extraction has decreased** from 67 thousand megatons to 57.2 thousand megatons over the period from 2016 and 2022 according to consumption-based accounting. The material extraction following production-accounts slightly increased from 400 megatons in 2016 to 500 megatons in 2022.

- **Land use of CCI in the EU decreased** from 20 thousand km2 to 17.4 thousand km2 indicating the increasing importance of virtual space for creative and cultural industries.

- **Streaming services have a negative impact on the environment**. To run these services, infrastructure, namely, data centres, is essential. Currently, these facilities consume approximately 40-45 TWh, accounting for 1.4-1.6% of total EU electricity consumption.

Digital Transition

What is the progress of industrial efforts towards digitalisation?

- **In 2024, 30% of surveyed companies in the CCI have adopted a concrete strategy for the digital transformation**, however, the aggregate results hide wide differences among the cultural and creative subsectors. While the video games industry is highly digitalised, the performing arts sector remains largely analogue.

- Among advanced digital technologies, the **adoption of cloud technologies, Artificial Intelligence and the Internet of Things have increased the most** as captured by the EMI Enterprise survey in 2024. There is also some increase observed in the use of big data and augmented and virtual reality technologies.

- The **top 3 ranking of CCI subsectors with the highest tech startup activity were news media, design and video games in 2024.**

- **CCI companies invest around 1-5% of their annual turnover in cloud computing in general.** Regarding AI, 17% of the respondents invest less than 1% into artificial intelligence technologies.

- Regarding the impact of AI on jobs, **72% of companies in the CCI ecosystem responded that the adoption of AI had no impact on reducing the number of employees**.

- A **significant portion of CCI businesses (50%) reported using AI systems provided by external service providers**, while only 24% have developed their own AI solutions in-house.

- The use of external service providers calls even more the attention to the role of tech startups in the digital transformation of the CCI.

- The analysis of the technologies in which tech startups are active in highlights the importance of **artificial intelligence and augmented and virtual reality**.

To what extent do framework conditions such as public financing and skills support the digital transition?

- The total number of ERDF projects in the CCI industrial ecosystem that supported the digital transition in 2014-2020 was 1 716. The analysis shows that about **15.7% of the total ERDF funding dedicated to CCI, notably EUR 1.18 bn supported the digital transition**.

- Among ERDF CCI projects contributing to the digital transition, **42% of the funding within digital transition related funding was allocated to projects related to advanced digital technologies specifically**.

- Under Horizon 2020, **43.1% of the EU funding to CCI projects contributed to the digital transition**. Under Horizon Europe a similar share contributes to CCI projects related to the digital transition.

- The share of professionals registered on LinkedIn and employed in the **CCI industrial ecosystem with advanced digital skills reached 8% in 2024, while with moderate digital skills 34%** showing a high increase from 2022.

- To effectively develop digital skills in the CCI, **adequate resources, structured processes, technical infrastructure, supportive leadership** are necessary that fosters digital growth, opportunities for staff to focus on their own digital development and an open space for discussions about digital challenges.

- The **share of online job advertisements requiring skills related to the digital transition in 2023 was high, 44% for moderate digital skills and 39% for advanced digital skills**.

What is the impact of digital technologies on competitiveness?

- The EMI Enterprise survey conducted with CCI companies indicates that the adoption of advanced digital technologies increased productivity around 10% overall.

- However, the adoption of digital technologies does not necessarily lead to a reduction in production costs. As a result, this industrial ecosystem experiences fewer economic gains compared to other industries that benefit more significantly from digital advancements.

- **The largest share of respondents reported an increase in productivity due to the adoption of Artificial Intelligence (AI),** making it the most impactful among advanced digital technologies. On the other hand, 6% of the respondents also indicated challenges in terms of implementation and reach a return on investment.

- Interestingly, 6% of respondents indicated a decrease in productivity as a result of adopting AI. This suggests that **while AI holds significant promise, some tools currently available on the market may not yet be fully optimised for the specific needs of the CCI sector.**

- A new digital technology emerging in the space of CCI and increasing productivity is **edge computing.** Edge computing is transforming for example the news media, audiovisual and music industries by processing data closer to its source, reducing latency, and enhancing responsiveness.

1. Introduction

1.1. Objectives

This report has been prepared within the '**European Monitor of Industrial Ecosystems' (EMI)** project, initiated by the European Commission, Directorate General for Internal Market, Industry, Entrepreneurship and SMEs and the European Innovation Council and SMEs Executive Agency (EISMEA). The overall objective of the project is to **contribute to the analysis of the green and digital transformation of industrial ecosystems** and progress made over time.

The EU's updated industrial strategy[1] has identified 14 industrial ecosystems[2] – one of them being **'Cultural and Creative Industries'**[3] - that is in the focus of this report. The industrial strategy defined industrial ecosystems as encompassing all players operating in a value chain: from the smallest startups to the largest companies, from academia to research, service providers to suppliers. The notion of ecosystems captures the complex set of interlinkages and interdependencies among sectors and firms across the EU. Industrial transition is driven by technological, economic, and social changes, and by green and digital technologies and the shift to the circular economy. The process is however characterised by complex, multi-level, and dynamic development. To make transition sustainable, technological change needs to be coupled with new business models, the necessary investments, skills, regulatory framework conditions and behavioural change across the ecosystem.

The indicator framework includes a **set of traditional and novel data sources that allow shedding new light on ongoing transformation patterns.** The novelty of the analysis lies in the exploratory and innovative data sources used across the different chapters. Due to its effort to analyse industrial ecosystems using a standardised set of indicators, the study cannot address all aspects of the green and digital transition. Therefore, additional analysis and industry-specific data sources should be used to supplement a full assessment.

Measuring performance and change is vital to allow policymakers and industry stakeholders to track progress over time and get feedback whether the system is moving in the desired direction. To measure performance, a dedicated **monitoring and indicator framework** has been set up for the purposes of this project with an aim to capture them in regular intervals (see the overview of the monitoring framework in Figure 1).

The **methodological report** that sets the conceptual basis and explains the technical details of each indicator is found in a separate document uploaded on the EMI website. Moreover, some of the specific industry codes used throughout this analysis have been also included in Appendix B. The green and digital technologies considered in this study include the following:

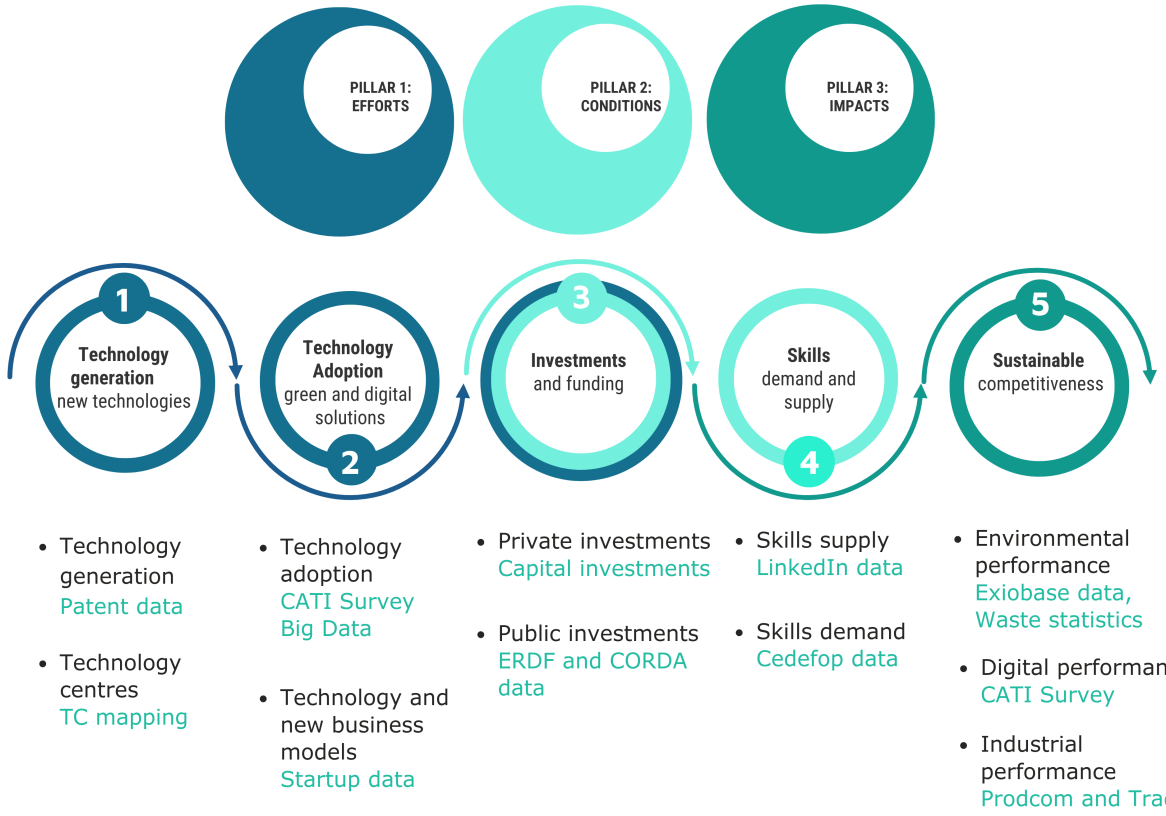
- Green transition technologies: advanced materials, biotechnology, clean production technologies, energy saving technologies, recycling technologies, renewable energy.
- Advanced digital technologies: advanced manufacturing and robotics, artificial intelligence and big data, augmented and virtual reality, blockchain, cloud computing, Internet of Things, digital security.

[1] European Commission (2020). A New Industrial Strategy for Europe, COM/2020/102 final and European Commission (2021). Updating the 2020 New Industrial Strategy: Building a stronger Single Market for Europe's recovery, COM(2021) 350 final

[2] The 14 industrial ecosystems include: construction, digital industries, health, agri-food, renewables, energy intensive industries, transport and automotive, electronics, textile, aerospace and defence, cultural and creative culture industries, CCI, proximity and social economy, and CCI

[3] The Annual Single Market Report defines the Cultural and Creative Industries as a diverse ecosystem encompassing sectors such as audiovisual media (including TV, video games, cinema, VR/AR), music, books and press publishing, advertising, cultural heritage (e.g., museums), performing arts (theatre, dance), and visual arts.

Figure 1: Overview of monitoring industrial ecosystems and relevant data sources



Source: Technopolis Group, IDEA Consult and Fraunhofer ISI

1.2. Scoping the cultural and creative industrial ecosystem

The cultural and creative industries are composed of multiple sub-industries. '*The biggest industries are audiovisual (TV, video games, VOD, cinema, VR/AR), music, books and press publishing, advertising, cultural heritage (museums, historical sites), performance (theatre, dance) and visual arts. In Europe, culture and creativity are regarded as a public good and may receive public support (e.g. public funds play an important role in the AV industry or the heritage sector) while many creative entrepreneurs are driving the creative economy (e.g. music, publishing and media, architecture, design). Cultural education is considered part of the ecosystem*'[4].

The cultural and creative industries are also described in the EU Regulation (EU) 2021/818 establishing the Creative Europe Programme (2021 to 2027) [5] as sectors that are based on cultural values and artistic and other individual or collective creative expressions. These sectors include '*architecture, archives, libraries and museums, artistic crafts, audiovisual (including film, television, video games and multimedia), tangible and intangible cultural heritage, design (including fashion design), festivals, music, literature, performing arts (including theatre and dance), books and publishing, radio, and visual arts'.*

The current statistical framework is based on the Guide to Eurostat culture statistics of Eurostat[6] developed in 2018. It covers heritage (museums, historical places, archaeological sites, intangible heritage); archives, libraries; books and press; visual arts (plastic arts, photography, design); performing arts (music, dance, drama, combined arts, and other

[4] European Commission, Annual Single Market Report 2021
[5] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32021R0818&from=EN
[6] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Culture_statistics

live shows); audiovisual and multimedia (film, radio, television, video, sound recordings, multimedia works, video games); architecture; advertising and arts/crafts.

Cultural and creative industries (CCIs) are vital drivers of economic growth, job creation, and innovation at local, national, and international levels. Arts, design, media, and cultural heritage, all contribute significantly to the economy by fostering creativity and stimulating new ideas. This creative energy fuels innovation not just within these sectors but also across broader industries like technology, manufacturing, and services, where creative input often leads to new products, services, and processes. Moreover, CCIs play a pivotal role in the development of knowledge-driven societies. By promoting creativity and cultural engagement, they help nurture critical thinking, problem-solving skills, and cross-disciplinary collaboration. According to Eurostat, cultural and creative industries employed 7.8 million people across Europe in 2023[7].

[7] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Culture_statistics_-_cultural_employment#Cultural_employment_.E2.80.94_overall_developments (Please note that the European Commission Annual Single Market report published in 2021 indicates another estimate notably 8.02 million people employed in the cultural and creative industries.)

2. Green transition

2.1. Industry efforts to green the industrial value chain

What progress has the industry made in taking action for the environment?

- **In 2024, 65% of CCI companies surveyed adopted waste reduction measures and 58% implemented energy saving actions.** However, progress since 2021 has been relatively slow.

- **The most significant improvement occurred in product design,** where the share of CCI companies adopting related measures increased from 21% in 2021 to 33% in 2024. this is closely linked to relevant design activities, which are an integral part of the CCI.

- Moreover, 52% of CCI companies responding to the EMI Enterprise survey said that they invested in **energy-saving technologies**, marking a significant increase compared to the previous year.

- However, in 2024, it is only **19% of CCI companies that adopted strategies for climate neutrality**, showing a modest commitment.

- 61% of CCI companies relied on external financial resources for resource efficiency, which highlights the challenges that businesses in the cultural and creative industries face when it comes to finance the green transition by own means.

- **30% of CCI companies do not invest at all in environmental measures,** which calls the attention to solve the financing challenge and promote such actions in this ecosystem.

- However, it is important to note that **surveyed companies are planning to increase their investments in the future.** For instance, the percentage of CCI companies intending to invest 1-5% of their annual turnover is expected to rise.

- The importance of the green transition in CCI extends far beyond its sectoral boundaries and has **critical implications for the green transition of other industrial ecosystems.**

This section reports on the progress of firms within the industrial ecosystem towards the green transition, focusing on the adoption of environmental technologies and circular business models. The section also examines the level of investment by CCI companies in the green transition including green technologies, renewable energy, and circular economy solutions.

2.1.1. Uptake of environmental technologies and circular business models

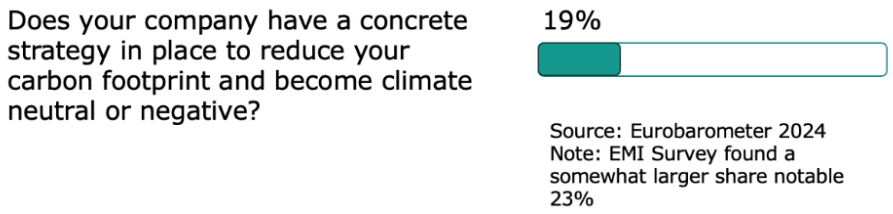
The adoption of technologies and circular business models in the cultural and creative industries has been investigated in detail by the Eurobarometer 2024 and has been complemented by a Computer Assisted Telephone-based Interview CATI -survey conducted as part of the EMI project over the period from July-September 2024 with a sample of 755 companies in the CCI[8].

[8] Sample size and breakdown is presented in Appendix B.

The results of the Eurobarometer survey indicate that **19% of the respondents in the CCI ecosystem had a concrete strategy in place to reduce their carbon footprint** and become climate neutral or negative in 2024 (an increase from 15% in 2022).

It has to be noted however that the predominance of micro and small SMEs, as well as freelancers in the CCI presents a significant challenge for implementing sustainable strategies. Smaller entities often have limited financial resources, expertise, and capacity to invest in sustainable materials, energy-efficient technologies, or circular business models. Additionally, compliance with environmental regulations and sustainability reporting can be burdensome for small businesses with minimal administrative support.

Figure 2: Share of respondents in the CCI industrial ecosystem that have adopted a strategy to reduce their carbon footprint



Source: Eurobarometer survey 2024, n= 606

The Eurobarometer survey indicates that 65% of all the CCI companies surveyed adopted waste reduction measures and 58% implemented energy saving actions in 2024. However, progress since 2021 has been relatively slow. The most significant improvement occurred in product design, where the share of companies adopting related measures increased from 21% in 2021 to 33% in 2024. On the other hand, the least adopted measure has been the use of renewable energy, highlighting a gap in the ecosystem's green transition efforts.

Figure 3: Share of companies in CCI industrial ecosystem that have undertook specific actions to become resource efficient in 2021 and 2024.

Environmental measures	***Share of adoption (2021)***	***Share of adoption (2024)***
Minimising waste	63%	65%
Saving energy	58%	58%
Recycling, by reusing material or waste within the company	49%	52%
Saving materials	48%	50%
Saving water	41%	46%
Designing products that are easier to maintain, repair or reuse	21%	33%
Switching to greener suppliers of materials	30%	29%
Selling your residues and waste to another company	21%	23%
Using predominantly renewable energy	25%	22%

Source: Eurobarometer survey 2024, n= 606

Progress towards sustainable design is particularly important, extending far beyond the boundaries of the creative and cultural industries. Recent research emphasises the importance of integrating sustainability transitions into industrial design, urging companies to align their design processes with systemic considerations. A holistic approach is essential, ensuring that product development is interconnected with broader societal and

environmental shifts[9]. In this sense, the progress in design within CCI also has critical implications for other industrial ecosystems such as for example to the textiles industry (via sustainable fashion design) or automotive (via sustainable product design).

The lag in the transition to sustainability is also confirmed in a 2024 worldwide comparative study[10] on sustainability in the cultural sector, based on a survey of 206 theatres, opera houses, museums and cultural centres, of which 60% located in Europe. It indicates that in the last five years, 60% of the cultural organisations in the survey have started integrating sustainability into their strategies but are struggling to put them into practice. The lack of pressure from funders or visitors, a lack of sector-wide guidance and standards to take the first steps and a lack of resources (time, knowledge and funding) are elements mentioned for this slow participation from the CCI in the green transition.

A 2023 NEMO survey among European museums on climate and sustainability interventions[11] indicates that 37.7% of responding museums allocate resources to improve the sustainability of their operations, while 43.3% report they do not and 8.9% are unsure whether their museum invests resources in improving sustainability efforts. Results of a 2022 NEMO survey[12] indicate that 7 out of 10 museums state that climate change is relevant to their museums. At the same time, nearly 60% of museums surveyed indicate insufficient funding as a primary barrier for advancing their museums' sustainable transition. The lack of support from public administration or policy direction (38.8%) appears to be the second most frequently reported obstacle. Besides that, almost half of the responding museums state they do not have to report about sustainable practices of green developments to their funders. Research of national and local EU climate and sustainability policies reveals a considerable lack of transition policies that are inclusive of the CCIs[13].

Besides environmental measures, companies in the CCI also adopted specific green technologies. According to the EMI Enterprise Survey 2024, 52% **of CCI companies responding to the survey have invested in energy-saving technologies, marking a significant increase compared to the previous year.** Even if the CCI is not among the most energy intensive industries, energy saving within the sector is crucial for reducing environmental impact and costs[14]. The survey results also indicate a progress in terms of waste management, however, less so in the case of adopting clean production (eg in the case of broadcasting or film production), or circular business models.

Figure 4: Adoption of green technologies and circular economy models by companies in CCI

[9] Valderrama A, Elle M, Iuel-Jensen J (2024). The role of design in sustainable transitions: The case of mobility in Greater Copenhagen, Environmental Innovation and Societal Transitions, Volume 50,

[10] Müller, M., & Grieshaber, J. (2024). How sustainable are cultural organizations? A global benchmark. *Sustainability: Science, Practice and Policy*, *20*(1). https://doi.org/10.1080/15487733.2024.2312660

[11] Network of European Museum Organisation. (2023). Museums, Climate and Politics: Taking political action in the sustainable transition. In *Network of European Museum Organisation* [Report]. https://www.ne-mo.org/fileadmin/Dateien/public/Publications/NEMO_Report_Museums_Climate_and_Politics_11.2023_01.pdf

[12] Network of European Museum Organisations. (2022). Museums in the climate crisis. In *Network of European Museum Organisations*. https://www.ne-mo.org/fileadmin/Dateien/public/Publications/NEMO_Report_Museums_in_the_climate_crisis_11.2022.pdf

[13] Network of European Museum Organisation. (2023). Museums, Climate and Politics: Taking political action in the sustainable transition. In *Network of European Museum Organisation* [Report]. https://www.ne-mo.org/fileadmin/Dateien/public/Publications/NEMO_Report_Museums_Climate_and_Politics_11.2023_01.pdf

[14] Goethe Institute (2023). Culture & Creative Sectors & Industries driving Green Transition and facing the Energy Crisis, Voices of Culture

Green technologies	*Share of adoption (2023)*	*Share of adoption (2024)*
Energy-saving technologies	33%	52.92%
Waste management technologies	27%	33.07%
Clean production technologies	28%	31.13%
Advanced materials	27%	26.07%
Biotechnology	20%	21.00%
Circular industrial business models	19%	19.07%

Source: EMI Enterprise survey 2024, n= 755

There are specific areas where energy saving efforts are more important[15]. For example, in architecture and built cultural heritage, optimising energy use in facilities play a key role through efficient building design, LED lighting, and smart energy management systems. Promoting green ICT, sustainable web design, and sustainable digital consumption can address the environmental impact of energy-intensive digital technologies. This involves transparency from the ICT industry regarding their environmental impact.

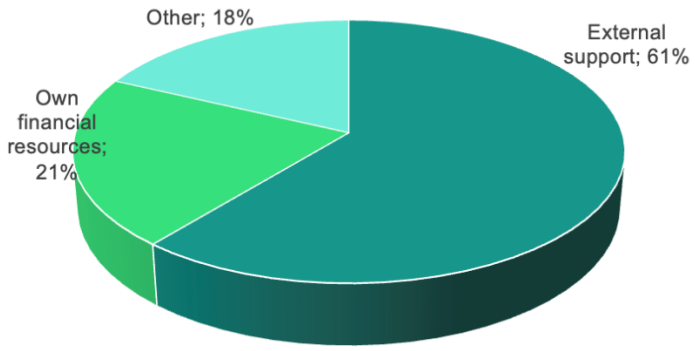
2.1.2. Private investments

Businesses in the cultural and creative industries face unique challenges when it comes to accessing finance, which differ from those encountered by companies in other sectors[16]. Funding requirements for CCIs vary widely, depending on factors such as the company's stage of development, the particular segment within the creative economy, and its position within the value chain. Public authorities are an important financier of the cultural and creative sectors, primarily by providing public grants for the creation, production, presentation, and preservation of arts and culture. It has been argued that crowdfunding has the potential to democratise the process of funding artistic and cultural ventures due to their role in facilitating the interaction between founders and a multitude of nonprofessional small investors through the use of the internet, without standard financial intermediaries[17]. On the other hand, the study titled as 'Crowdfunding for Culture'[18], financed by the EU-Commission as early as 2017, finds that crowdfunding, rather than being used for financing purposes, is also about community/audience development, democracy/participation and marketing/publicity.

Investments in CCI are undergoing significant development, driven by increased recognition of their economic impact and innovation potential. According to the results of the Eurobarometer survey, 61% of CCI companies relied on external financial resources for resource efficiency.

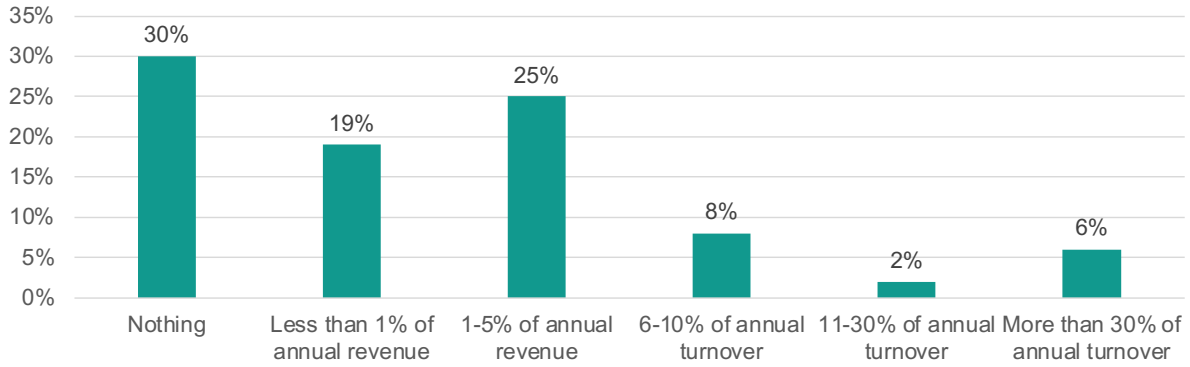
[15] Ibid
[16] OECD (2022), The Culture Fix: Creative People, Places and Industries, Local Economic and Employment Development (LEED), OECD Publishing, Paris, https://doi.org/10.1787/991bb520-en.
[17] Cicchiello AF, Gallo S, Monferrà S. Financing the cultural and creative industries through crowdfunding: the role of national cultural dimensions and policies. J Cult Econ (Dordr). 2023;47(1):133-175. doi: 10.1007/s10824-022-09452-9. Epub 2022 Jun 18. PMID: 38625194; PMCID: PMC9205763.
[18] https://www.crowdfunding4culture.eu/

Figure 5: Use of financial resources for resource efficiency and producing green products or services



Source: Eurobarometer survey 2024.

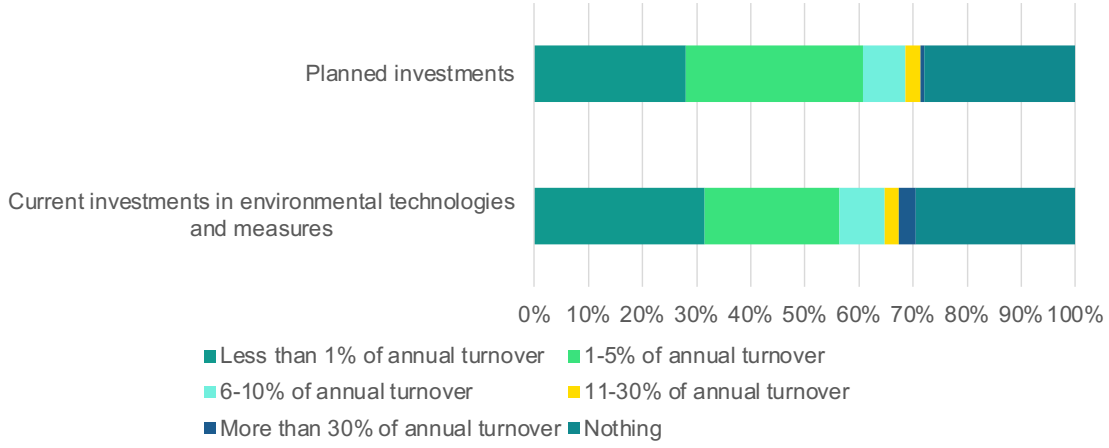
Figure 6: Share of CCI companies investing, on average, per year, a percentage of their annual revenue/turnover to be more resource efficient.



Source: Eurobarometer survey 2024

The findings of the EMI Enterprise Survey 2024 complement the Eurobarometer survey and **indicate that 30% companies do not invest in environmental measures but 25% allocate between 1-5% of their annual turnover to such investments.** However, it is important to note that surveyed companies are planning to increase their investments in the future. For instance, the percentage of CCI companies intending to invest 1-5% of their annual turnover is expected to rise.

Figure 7: Current and planned investments in environmental technologies in the CCI



Source: EMI Enterprise Survey 2024, n=755

2.2. Framework conditions – assessment of the broader ecosystem supporting the green transition

To what extent do framework conditions such as public financing and skills support the green transition?

Public funding:

- Although several EU public programmes support the green transition and the CCI, there is still room to enhance public support at the intersection of environmental sustainability, innovation, and various creative sectors. Strengthening this support could further drive the sectors' development while promoting greener practices.

- The CCIs are not consistently included in climate and sustainability policies across Europe. However, research proves that **they can play a vital role as partners in Europe's sustainable transformation, if they receive adequate support.**

- The EU Cohesion Policy's funding mechanisms support various initiatives that promote environmental sustainability within the CCI such as sustainable design. However, it is only a **small share of the European Regional Development Fund** that is addressing the green transition of any CCI sector directly.

- The Recovery and Resilience Facility addresses the green transition of CCI such as funding renovations to increase energy efficiency of cultural buildings and sites and safeguarding heritage sites from climate change.

- Under **Horizon 2020, only 3% of the EU research and innovation funding allocated to CCI projects was directed toward supporting the green transition**, amounting to EUR 14 m for the period 2014–2021.

- **Horizon Europe allocated an increased share notably 7% of the European Commission's funding for CCI projects that contribute to green transition** initiatives so far (period 2022-2024).

- **15.5% of the Creative Europe programme calls including a European organiser or destination had a thematic focus on environment and sustainability**.

Skills:

- Organisations in the CCI industrial ecosystem employed in general **1.8 full time employees in green jobs some** or all of their time in 2024, which is a very low result. 60% indicated that they do not employ any professionals in green jobs that shows a clear skill gap in the CCI regarding the green transition.

- **4.5% of professionals registered on LinkedIn and employed in the CCI industrial ecosystem had a skill relevant to the green transition** in 2024, showing a low share but an increase from 2022.

- The share of online job advertisements requiring skills related to the green transition in 2023 was low around 1%.

Framework conditions that support the green transition refer to various structural and institutional elements that create an enabling environment for businesses to transition towards more sustainable and environmentally friendly practices. These conditions are crucial for driving the adoption of green technologies and fostering circular economies. Key components of these framework conditions include public policy, skills demand and supply and demand-side factors among others that are analysed in the sections below.

In this report, only a selection of key funding instruments has been analysed, although other public programmes also exist that can support the green transition.

2.2.1. Public investments

2.2.1.1. European Regional Development Fund

The **EU Cohesion Policy's** funding mechanisms support various initiatives that promote environmental sustainability within the CCI[19]. A 2022 report from the European Commission to the European Parliament, Council, EESC and Committee of the Regions[20] highlights how cohesion policy supports measures that reduce the environmental footprint of cultural institutions and sites. These measures include energy efficiency upgrades, renewable energy adoption, waste management solutions, and circular economy practices. Additionally, it promotes the development of green infrastructure, a factor crucial for sustainable cultural tourism, for example.[21] Nonetheless, the analysis of Cohesio data shows that only a negligible share of the European Regional Development Fund is dedicated specifically to the green transition of any CCI sector directly.

As the CCI relies significantly on public funding, public institutions play a pivotal role in driving green transition initiatives. A notable example is Green Regio[22], a sub-group of the Cine Regio network, which includes 43 regional film funds across Europe. This initiative supports audiovisual professionals in adopting sustainable practices and promotes the green transition in the film industry. Green Regio has facilitated the creation of several pan-European tools such as the Green Film, Eureca, and the ECOPROD Charter, which offer certification systems for film productions, carbon footprint calculators, and access to green providers. These collective efforts have raised awareness and fostered knowledge-sharing on sustainable film production practices, policies, and measures.

2.2.1.2. The Recovery and Resilience Facility

The **Recovery and Resilience Facility (RRF)[23],** established as part of the EU's response to the COVID-19 pandemic, contributes to the creative and cultural industrial ecosystem by providing financial support aimed at driving the green and digital transitions[24]. The Facility is particularly focused on helping businesses to recover from the economic impacts of the pandemic while enhancing their resilience to future challenges.

Overall, total estimated expenditure in the cultural sector amounts to EUR 11.7 bn, across 18 Member States, which corresponds to 1.8% of the total expenditure in the plans. This expenditure is matched with **141 measures (15 reforms and 126 investment measures)** across the 18 Member States[25]. Moreover, the cultural and creative industries may also benefit from horizontal measures that are not sector specific.

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[19] See: https://culture.ec.europa.eu/funding/cultureu-funding-guide

[20] European Commission (2022). Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the cultural dimension of sustainable development in EU actions COM/2022/709 final. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2022:709:FIN

[21] IDEA Consult, imec-SMIT-VUB, KUL-CiTIP, Amann S. and Heinsius J. 2024, Research for CULT Committee – EU culture and creative sectors policy – overview and future perspectives, European Parliament, Policy Department for Structural and Cohesion Policies, Brussels. https://bit.ly/4cnfOFg

[22] https://www.cineregio.org/subgroups/green_regio/

[23] https://commission.europa.eu/business-economy-euro/economic-recovery/recovery-and-resilience-facility_en

[24] The COVID-19 crisis had significant impact on the CCI. The halt of cultural activities, the closure of museums, libraries, archives, galleries and heritage sites, the cancellation of events, festivals and tours, as well as art, design and fashion fairs and trade shows, led to significant losses of revenues across the EU, with a 70% drop in box-office sales in 2020 for cinema operators, 76% drop in attendance at music venues, and up to 75-80% losses for museums in popular touristic regions. In addition, televisions suffered a drop in advertising revenues of 20%, while news publishers reported up to 80% loss during the lockdowns in the same year. Only the video games industry reported a significant increase in turnover for major EU players in 2020.

[25] https://ec.europa.eu/economy_finance/recovery-and-resilience-scoreboard/assets/thematic_analysis/scoreboard_thematic_analysis_culture.pdf

The Figure below provides a distribution of expenditure on CCI in Member State Recovery and Resilience Plans (RRPs).

Figure 8: Share of expenditure on CCI in RRPs (figure will be updated)



Source: https://ec.europa.eu/economy_finance/recovery-and-resilience-scoreboard/assets/thematic_analysis/scoreboard_thematic_analysis_culture.pdf

Various approved RRPs of EU Member States that address the CCI, financial investment from the RRF is specifically foreseen to support the green transition. In terms of thematic focus, investments in the green transition in the CCI relate, for example, to **renovations to increase energy efficiency of cultural buildings and sites** (Croatia, Italy, Portugal, Slovakia), **safeguarding heritage sites from climate change** (Greece) as well as **incentives for green and climate-friendly projects by cultural actors** (Austria and France).[26] This list is not exhaustive and more projects address the green transition.

2.2.1.3. EU Framework programmes for Research and Innovation

In this study, the full funding data available from the EU Framework Programmes for Research and Innovation, in particular from Horizon 2020 (2014-2020) and Horizon Europe (2021-2027 – notably the period covered at the time of writing this report) has been analysed. While the primary focus areas of these programmes are research excellence and tackling climate change, the programme fosters connections between cultural and sustainability goals as well. For instance, Cluster 2 on Research and innovation on cultural heritage and CCIs includes projects supporting the green transition or Cluster 5 on Climate, Energy and Mobility specifically addresses the intersection[27] by funding projects that combine research on cultural preservation with environmental responsibility. In this way, cultural projects also contribute to climate neutrality in other sectors, for example, by bringing forward traditional and innovative practices, techniques and materials resulting from cultural heritage research.[28]

Under Horizon 2020, **only 3% of the EU research and innovation funding allocated to CCI projects was directed toward supporting the green transition**, amounting to EUR 14 m for the period 2014–2021. This focus has been intensified under Horizon Europe, where 7% of the European Commission's funding for CCI projects contributes to green

[26] https://ec.europa.eu/economy_finance/recovery-and-resilience-scoreboard/assets/thematic_analysis/scoreboard_thematic_analysis_culture.pdf

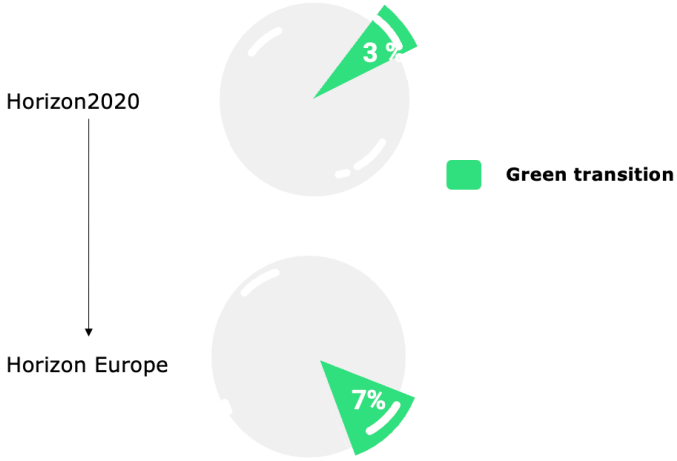
[27] Destination 4 in Cluster 5, dedicated to energy transition in buildings, funds research on energy efficiency renovation strategies for historical buildings, and Destination 2 in Cluster 2, dedicated partly to Cultural heritage preservation and to greener methods for restauration and partly to cultural and creative industries Theses promote sustainability and ensure the preservation of cultural heritage.

[28] See e.g. ARCHE – Alliance for Research on Cultural Heritage in Europe (2022-2025), funded under Horizon Europe. https://www.heritageresearch-hub.eu/arche-home/

transition initiatives so far[29]. This result has to be interpreted against the backdrop that Horizon 2020 invested around EUR 600 m in cultural heritage and creative industries research, highlighting innovation and societal impact and in this project, a total funding of EUR 462 m was captured. Overall, Horizon Europe allocates around EUR 760 m under Cluster 2 to cultural heritage and CCI to foster a resilient, inclusive, and democratic European society[30].

These projects primarily explore the intersection of art, culture, and environmental protection rather than directly contributing to the green transition of the cultural and creative industries. They emphasize the role of artistic and cultural initiatives in raising awareness, fostering sustainable practices, and promoting environmental responsibility through creative expression.

Figure 9: Share of Horizon 2020 and Horizon Europe projects that contribute to the green transition of the CCI



Source: Technopolis Group analysis

An example of Horizon Europe co-funded project in the field of CCI that contributes to the green transition is presented in the box below.

Box 1: Example of a project funded by Horizon Europe that is related to green transition and CCI

Ecocritical Study of Landscape Representations in Contemporary Art (EcoLandscapes)

The project explores the landscape genre as a valuable subject for ecocritical study in art history, emphasising environmental interrelation, sustainability, and justice. While ecocriticism has expanded across the humanities, art history has yet to fully engage in these discussions. The project aims to bridge this gap by analysing contemporary European landscape art (since the 1980s) and the role of new imaging technologies in shaping the genre. It also seeks to develop new theoretical tools to understand shifting perceptions of nature and humanity. The findings will be shared with both academic and general audiences.

Source: Technopolis Group based on https://scanr.enseignementsup-recherche.gouv.fr/project/101023548

[29] The analysis will be updated in the 2025 edition of this analytical report.
[30] See further here: https://research-and-innovation.ec.europa.eu/research-area/social-sciences-and-humanities/cultural-heritage-and-cultural-and-creative-industries-ccis_en

2.2.1.4. Creative Europe programme

Driven by the European Parliament's call for a greener Creative Europe[31] and aligned with the ambitions of the European Green Deal, the Creative Europe programme is actively integrating environmental considerations into its funding mechanisms for the CCI. The 2024 Creative Europe work programme reflects this commitment. It emphasises 'greening' the programme in line with the overall EU target of dedicating 30% of the budget to climate objectives. Building on the recommendations of the Greening the Creative Europe Programme" report[32], this initiative outlines a gradual approach to achieving environmental sustainability within the CCI. The study also resulted in a **Creative Europe Programme Greening Strategy**, as well as a **Creative Europe Monitoring Guide for Programme Greening**[33], that can be used to monitor the Creative Europe successor programmes' progress and contribution towards the European Green Deal objectives in the future[34].

'On the move' is a multiannual programme co-funded by the EU which analyses art and culture open calls on a yearly basis. The results of their research are published in their cultural mobility yearbooks. In 2023 the open calls were analysed within the framework of environment and sustainability[35]. Results showed that **15.5% of calls with a European organiser or destination had a thematic focus on environment and sustainability**. A large part of this activity was again driven by EU programmes and given an extra push by the inclusion of 'greening Creative Europe' as a cross-cutting priority for projects to address. The yearbook (2023) also stresses that digital mobility seems to be a key element in the green transition. However, it also highlights that online activity has its own environmental footprint. The digital transition and the dematerialisation that is associated with it are often highlighted as one of the levers in reaching climate goals, but the material reality of digital technology turns out to be different. Research[36] indicates that digital activities in Europe are projected to account for 40% of an individual's total sustainable greenhouse gas (GHG) budget by 2050. This percentage keeps rapidly accelerating. The ongoing rapid renewal of electronic devices remains the largest source of emissions, while the environmental impact of data usage, network traffic, and online storage is expanding.

With the aim of sharing information on greening relevant to cultural and creative sectors in Europe and beyond, a specific 'greening' section has been created on the **Creatives Unite platform**[37], which is supported by the Creative Europe programme.

2.2.1.5. Other EU initiatives supporting the green transition of CCI

The Single Market programme[38] has been crucial to foster a highly integrated and interconnected economic space that has greatly benefited small and medium-sized enterprises (SMEs).

CCIs are intrinsically linked to the Single Market programme through their ability to transcend borders, foster cross-sector collaboration, and facilitate the free movement of goods, services, and talent. By integrating CCIs into the Single Market

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[31] European Parliament (2020). European Parliament resolution of 15 September 2020 on effective measures to 'green' Erasmus+, Creative Europe and the European Solidarity Corps (2019/2195(INI)). https://www.europarl.europa.eu/doceo/document/TA-9-2020-0211_EN.html

[32] Ecory, 2023

[33] See https://op.europa.eu/en/publication-detail/-/publication/ab9d592c-f52e-11ed-a05c-01aa75ed71a1/language-en

[34] IDEA Consult, imec-SMIT-VUB, KUL-CiTIP, Amann S. and Heinsius J. 2024, Research for CULT Committee – EU culture and creative sectors policy – overview and future perspectives, European Parliament, Policy Department for Structural and Cohesion Policies, Brussels. https://bit.ly/4cnfOFg

[35] Ellingsworth, J., Ben Safia, S., & Mlandu, U. N. (2023). Cultural Mobility Yearbook. In Yohann Floch & Walid Dakhlaoui (Trans.), *On The Move* [Book]. On the Move. https://on-the-move.org/sites/default/files/library/2023-03/OTM_yearbook-2023.pdf

[36] Maillon. (2022). *Where to land: embedding European performing arts in the new Climate Regime*. https://on-the-move.org/sites/default/files/library/2023-01/MAILLON_where-to-land_2023_EN.pdf

[37] https://creativesunite.eu/theme/greening/

[38] https://commission.europa.eu/funding-tenders/find-funding/eu-funding-programmes/single-market-programme_en

framework, the EU harnesses their potential to enhance competitiveness, support SMEs, and drive creativity across Europe.

The programme's support for CCIs SMEs have been instrumental in enhancing their competitiveness – particularly through the **EuroClusters** initiative has facilitated collaboration among European CCIs clusters, allowing SMEs to integrate value chains, share expertise in the specific CCI industries and test new products and ideas. With a budget of around EUR 2.7 m two Euroclusters projects, notably, Friends CCI and Creathrive-EU, have been specifically focused on the CCIs, with a combined total of at least 165 SMEs supported. These initiatives have facilitated collaboration, up-skilling, and green and digital transitions.

In addition, the **WORTH Partnership projects**[39] bring together designers, artisans, and SMEs across Europe to create groundbreaking concepts that embody sustainability and creativity. WORTH II projects contribute to the objectives of the circular economy including green transition, energy efficiency, reducing carbon footprint, sustainable production and consumption. The WORTH Partnership Project is a catalyst for change in sustainability, digital transformation, and craftsmanship. By supporting projects that push the boundaries of creativity and technology, WORTH empowers designers to contribute to a more inclusive, eco-friendly, and innovative future. It promotes groundbreaking solutions that combine cutting-edge materials, sustainable practices, and a respect for traditional craftsmanship in fashion, furniture and home decoration. The WORTH partnership project had a total investment of EUR 7.7 m so far and has supported 388 transnational partnerships involving 887 partners (out of which 857 SMEs), coming from 35 EU /COSME countries. By leveraging these support measures, SMEs have been able to improve their environmental sustainability, enhance their competitiveness, and capitalise on new business opportunities, ultimately contributing to the EU's green transition and growth agenda.

2.2.2. Skills supply and demand underpinning the green transition

This section analyses the demand and supply side of the labour market in terms of green transition skills (green skills relevant for environmental protection, implementation of green technologies, or the circular economy). Regarding demand, it utilises experimental data from Cedefop's Knowledge OVATE database, particularly the Online Job Advertisement tables. To examine the supply of skilled professionals relevant to the green transition, data from LinkedIn has been employed. LinkedIn, being the largest professional networking platform, offers rich information such as profile summaries, job titles, job descriptions, and fields of study, which can aid in identifying professionals with skills pertinent to the green transition. Both analyses have been further enhanced by desk research and interviews.

The analysis of green transition related skills followed the definition of Cedefop, notably "*the knowledge, abilities, values and attitudes needed to live in, develop and support a sustainable and resource-efficient society*" (Cedefop, 2012). Green skills have been defined as skills related to environmental protection, environmental services, resource efficiency, biodiversity, low carbon technologies, renewable energy, the circular economy, waste management, management of food waste, and clean production technologies and business models related skills (the list of keywords that have been used and are possible to track with the algorithm of LinkedIn is included in Appendix B).

2.2.2.1. Supply of skills relevant for the green transition

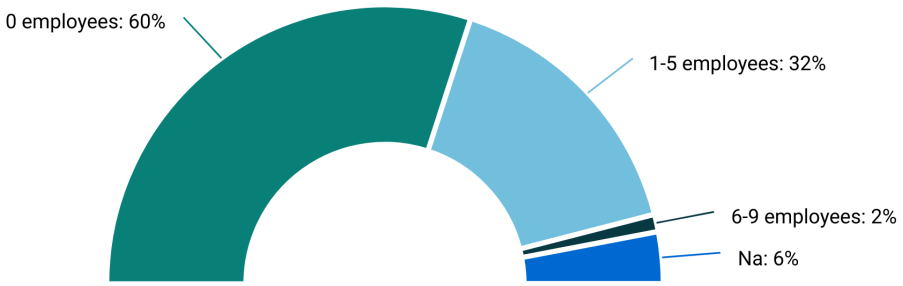
The **Eurobarometer 2024 indicates that organisations in the CCI industrial ecosystem employed in general 1.8 full time employees in green jobs some or all of their time**[40]. Green jobs are roles that contribute to environmental sustainability by

[39] https://worth-partnership.ec.europa.eu/worth-partnership-projects_en
[40] Eurobarometer survey 2024

preserving or restoring the environment for example linked to renewable energy, energy efficiency, waste management, and environmental conservation.

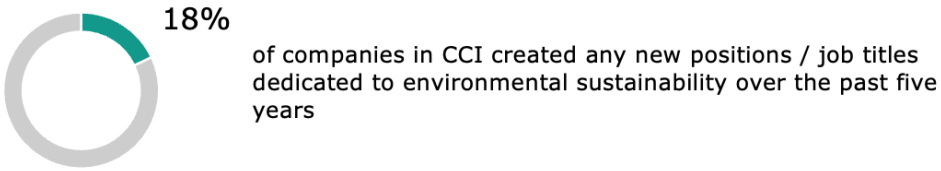
The results also indicate that 60% indicated that they do not employ any professionals in green jobs and 32% of the companies have 1-5 employees only. In addition, the EMI Enterprise Survey 2024 found that **12% of companies in the CCI created any new positions or job titles dedicated to environmental sustainability** over the past five years.

Figure 10: Number of full-time employees that work in green jobs some or all of the time in the CCI industrial ecosystem in the EU27 in 2024



Source: Eurobarometer 2024

Figure 11: Share of CCI companies that created new positions or job titles in environmental sustainability over the past five years



Source: EMI Enterprise Survey 2024

To gain insights into the supply of skilled professionals, LinkedIn data has been utilised. As of April 2024, there were 6 574 781 professionals working in any of the cultural and creative industries registered on the platform.

The share of professionals registered on LinkedIn and employed in the CCI industrial ecosystem with skills relevant to the green transition reached 4.49% in 2024, showing a low share but an increase from 2022 (see Figure below). This low share may also be attributed to the tendency of many companies to outsource environmental functions and subcontract external organisations for environmental development initiatives.

Figure 12: Share of professionals in CCI with skills relevant for the green transition in the EU27



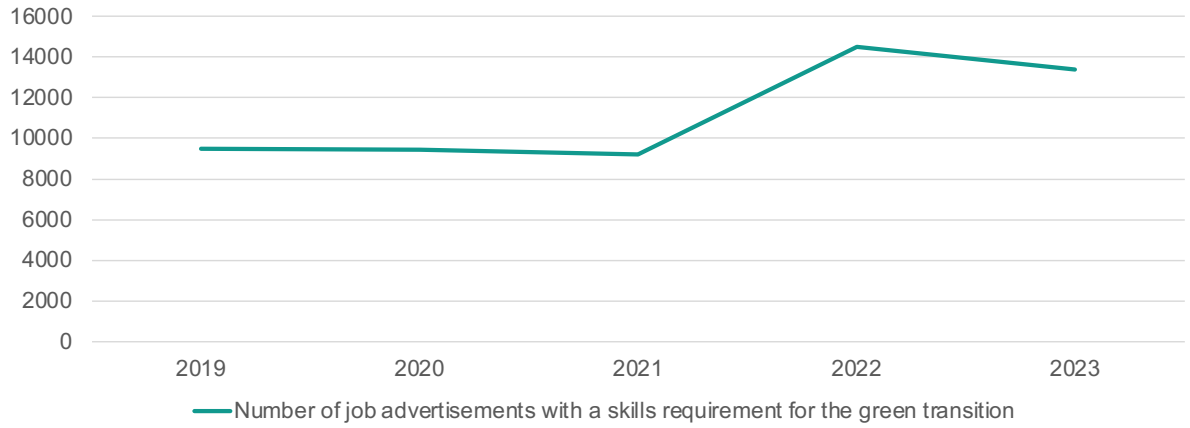
Source: Technopolis Group based on LinkedIn

2.2.2.2. Demand for skills relevant for the green transition

Skills demand has been analysed following the skills intelligence insights of Cedefop, the European Centre for the Development of Vocational Training[41]. This dataset covers the EU27 Member States (plus UK) and is based on the collection and analysis of more than 530 online job advertisement sources (424 distinct websites) which are open-access sites. The dataset provides information on most requested occupations and skills across European countries based on established international classifications, e.g., ISCO-08 for occupations, ESCO for skills, and NACE rev. 2 for sectors.

The share of online job advertisements posted by organisations in the CCI requiring skills related to the green transition in 2023 was around 1%. The total number of job ads referring to green skills was even until 2021 but shows an increase since then. The low requirement for environmental skills in the CCI is due to a combination of factors. These industries, such as art, fashion, film, and music, tend to prioritise creative output and innovation over sustainability, with a traditional focus on technical and cultural expertise rather than environmental concerns. Additionally, many creative sectors face fewer environmental regulations compared to other industries, reducing the urgency to adopt green practices.

Figure 13: Total number of online job advertisements with a requirement for environmental skills



Source: Technopolis Group based on analysis of Cedefop data

[41] https://www.cedefop.europa.eu/en/tools/skills-online-vacancies

2.2.3. Role of cultural and creative industries in increasing demand for environmentally friendly products and services

The CCIs are not consistently included in climate and sustainability policies across Europe. However, research proves that they can play a vital role as partners in Europe's sustainable transformation[42], if they receive adequate support.

Negative impacts on climate and society are often linked to linear production and consumption models, not taking into account e.g. associated waste streams or carbon footprint.

The design sector is recognised as a sector of major importance in the green transition. Ecodesign principles focus on the efficiency, performance, materials, energy, use and disposal of products in order to reduce the environmental impact of each stage of the product life cycle. Ecodesign principles are one of the most applied sustainable interventions in industry in the area of design and is still relevant today[43]. In July 2024, the Ecodesign for Sustainable Products Regulation (ESPR) entered into force. It is the cornerstone of the Commission's approach to more environmentally sustainable and circular products. The ESPR establishes a framework for setting ecodesign requirements on product groups, such as increasement of recycled content, rule on carbon and environmental footprints, digital product passports, green public procurement[44]. The EU Circular Economy Action Plan is another example of a directive which announces initiatives along the entire life cycle of products, and that focuses on the importance of design for developing sustainable products, advancing circular economy practices, fostering responsible consumption, and ensuring that waste is minimised while resources remain within the EU economy for as long as possible[45].

The circular economy is an approach that includes ideas related to ecodesign and design for sustainability. The concept is described as an industrial system that is restorative or regenerative by intention and design. It replaces the 'end-of-life' concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse, and aims for the elimination of waste through the superior design of materials, products, systems and, within this, business models[46]. The concept of producing products with a circular life cycle that doesn't generate waste in the process aligns with the goals of the green transition. Circular economy concerns many more disciplines than design. For the development of circular products, a series of requirements should be followed, some of them are related precisely with the use of design.

The evolution of design for sustainability and ecodesign will be strongly related to the application of AI in circular economy. Machine learning assisted design processes will support rapid prototyping and testing. AI has the potential to enhance the competitiveness of circular business models by enabling pricing and demand prediction, predictive maintenance and smart inventories. Circular infrastructure can also be optimized by improving reserve logistics and supporting to close loops of products and materials[47]. Also, architects play an important role in the green transition of other sectors. Low Energy

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[42] Voices of Culture. (2023). Culture & Creative Sectors & Industries driving Green Transition and facing the Energy Crisis Brainstorming Report. In European Commission, *European Commission Structured Dialogue*. https://ec.europa.eu/assets/eac/culture/docs/voices-of-culture/voices-of-culture-brainstorming-report-green-transition-2023_en.pdf

[43] Bhamra, T., & Hernandez, R. J. (2021). Thirty years of design for sustainability: an evolution of research, policy and practice. *Design Science*, *7*. https://doi.org/10.1017/dsj.2021.2

[44] *Ecodesign for sustainable products Regulation*. (n.d.). European Commission. https://commission.europa.eu/energy-climate-change-environment/standards-tools-and-labels/products-labelling-rules-and-requirements/ecodesign-sustainable-products-regulation_en

[45] *Circular economy action plan*. (n.d.). Environment. https://environment.ec.europa.eu/strategy/circular-economy-action-plan_en

[46] *Circular economy introduction*. (n.d.). https://www.ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview

[47] Ellen MacArthur Foundation. (n.d.). Towards a circular economy: Business Rationale for an accelerated transition. In *Ellen MacArthur Foundation*. https://kidv.nl/media/rapportages/towards_a_circular_economy.pdf?1.2.1

Buildings concepts are frequently used by nearly half of architects (46%)[48]. Fewer architects apply other sustainable development concepts as Nearly Zero Energy Buildings (16%), Circular design (12%) and Plus Energy Buildings (9%).

Beyond designers and architects, a recent analysis in the context of the Horizon-funded project *ekip* illustrates that the CCI at large contribute to the green transition in Europe, through artistic methods (storytelling, role plays) and the unique CCI **skills of (re)imagining, narrating, experiencing, anticipating, and reflecting** on human experiences.[49]

An EU initiative that is particularly relevant for engaging the CCI in the green transition in Europe, is the **New European Bauhaus** (NEB)[50]. Launched in 2020, the NEB is an EU interdisciplinary flagship initiative aiming to bring the EU Green Deal closer to the everyday lives and experiences of EU citizens. The aim of NEB is to inspire citizens and society at large to envision and create a future that is beautiful, sustainable, and inclusive, addressing the pressing challenges of climate change and social inequality. It promotes collaboration across disciplines, encouraging architects, artists, scientists, and citizens to work together and take up different roles in the green transition. Since its launch in 2020, many NEB projects have been funded and implemented, and CCI actors and other stakeholders have been involved. Although the NEB has no specific EU funding programme at its disposal, it mobilises several EU research & innovation funding instruments to support the achievement of the NEB objectives.[51]

[48] Mirza & Nacey Research Ltd, The Architects' Council of Europe, & Schagemann, R. (2022). *The Architectural Profession in Europe 2022*. https://www.ace-cae.eu/fileadmin/user_upload/2022_Sector_Study_EN.pdf
[49] www.ekipengine.eu
[50] https://new-european-bauhaus.europa.eu/index_en
[51] European Commission, New European Bauhaus Progress Report (2022)

2.3. The impact of the industrial ecosystem on the environment

How is the industrial ecosystem's impact on the environment changing?

- The EU's **CCI's emissions totalled 18 million tonnes of CO2 equivalent in 2022** according to Exiobase data's consumption account. CO2 emissions of the CCI have gradually decreased over the period from 2015-2022.

- Most emissions from the CCI sector fall under GHG Scope 3, encompassing indirect emissions throughout the upstream and downstream value chain such as purchased goods and equipment, business travel or operation of data centres.

- **Material extraction has decreased** from 67 thousand megatons to 57.2 thousand megatons over the period from 2016 and 2022 according to consumption-based accounting. The material extraction following production-accounts slightly increased from 400 megatons in 2016 to 500 megatons in 2022.

- **Land use of CCI in the EU decreased** from 20 thousand km2 to 17.4 thousand km2 indicating the increasing importance of virtual space for creative and cultural industries.

- **Streaming services have a negative impact on the environment**. To run these services, infrastructure, namely, data centres, is essential. Currently, these facilities consume approximately 40-45 TWh, accounting for 1.4-1.6% of total EU electricity consumption.

This section summarises the main indicators that capture the environmental impact of the cultural and creative industrial ecosystem. It also reflects on the progress made over time and to what extent targets are being reached.

Cultural and creative industries (CCIs) are generally not known for having substantial negative environmental impacts. However, certain activities within these sectors contribute to sustainability challenges and cause environmental burden, including the energy usage of equipment, museums, theatres, and concerts, as well as the operation of the digital world (eg online news media or streaming) which is often overlooked[52]. As the Shift project highlighted[53], cultural activities, such as art exhibitions, concerts, theatre performances, and film festivals, also contribute to environmental emissions, creating the carbon footprint of the cultural sectors.

This impact arises from several sources, including the construction and maintenance of cultural venues, which require considerable energy consumption. CO2 emissions are also generated from the materials used for construction, the transportation of these materials, and the energy necessary to operate venues. Additionally, the travel involved for artists and audiences, particularly over long distances, adds to the sector's carbon footprint, especially when air travel is involved. Furthermore, the energy consumption during events, including lighting, heating, and cooling, can be substantial, particularly when fossil fuels power these venues. The production of promotional materials, costumes, and props also contributes to the carbon footprint due to the extraction, manufacturing, and transportation of raw materials.

[52] BOP Consulting (2022). Creative Industries and the Climate Emergency: The path to Net Zero

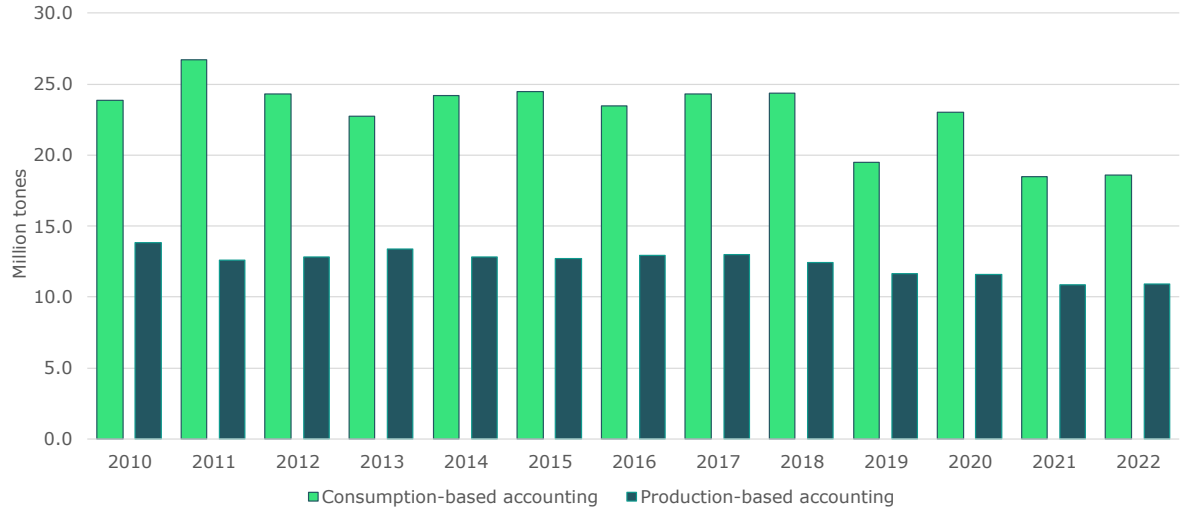
[53] https://theshiftproject.org/article/decarboner-culture-rapport-2021/

Furthermore, the increased use of energy-intensive digital technologies and online services such as streaming and cloud technologies, further impacts the carbon footprint of the CCI. Cloud computing has significant energy consumption and environmental impact. Data centres in the European Union accounted for around 2-4% of total electricity consumption in 2023[54] according to the International Environmental Agency, often relying on fossil fuels and requiring extensive cooling systems. These issues highlight the environmental challenges that some areas of CCIs need to address.

Emissions

The EU's CCI's emissions totalled 18 million tonnes of CO_2 equivalent in 2022 according to Exiobase data. The Figure below reveals that from 2010 to 2022, the **CO2 emissions of the CCI decreased** (from 23.9M to 18.6M tonnes following consumption-based accounting). Following the production-based accounting, Exiobase data shows that the CO2 emissions decreased as well (from 13.9M to 10.9M). In the CCI, the particulate matter emissions following production-based account have remained almost the same since 2016, reaching around (0.002M). Production-based accounting attributes environmental impacts, such as carbon emissions, to the country where production occurs (territorial approach). Consumption-based accounting assigns environmental impacts to the country where goods and services are consumed, regardless of where they were produced (footprint approach).

Figure 14: CO2 emissions of the CCI industrial ecosystem in EU27 (consumption and production accounts)



Source: Technopolis Group based on Exiobase data, calculations in 2024

Figure 15: Examples to illustrate the GHG emissions of CCI activities

Activity	Estimated Average GHG Emissions
Feature film production	Greenhouse gas emissions from the production of around one minute of a series with high production values 1 400 kg CO2-equivalents (CO2e))
Emissions of festivals	Average carbon footprint per person per day 11 kg CO_2e,
One-hour TV show episode	150 tonnes
Music touring	85,000 tonnes
Annual emissions of Spotify streaming service (2021)	353,054 tonnes

Source: Technopolis Group compilation based on https://www.oeko.de/en/blog/study-reveals-major-climate-change-mitigation-potential-in-film-production/, AGF Festival Carbon Footprint report 2023, Ecoprod

The CO2 emissions are created from different activities within the CCI subsectors. The Table below provides several examples and a breakdown of main CO2 emitting activities.

[54] https://www.iea.org/commentaries/what-the-data-centre-and-ai-boom-could-mean-for-the-energy-sector

Table 1: CCI subsectors and most CO2 emitting activities.

CCI subsector	Activity
Advertising	Environmental impact comes from the production process (e.g., shooting) and the printed material. Indirect emissions are generated from the demand that advertising creates for products
Architecture	Due to the nature of the work – typically based in an office and computer-based – most of the emissions connected to architecture are at the Scope 3 level.
Crafts	Overall, relatively small carbon footprint, mostly connected to the value chains of material used, the toxicity of materials used in the production process (e.g., glazes) or the fossil fuels used to power the kilns.
Design	There are no emitting activities. Due to its transversal nature used largely across different sectors, in advertising, electronic goods, fashion and vehicles among others – has the potential to contribute significantly to a more sustainable creative sector.
Film and television industry	Emissions are concentrated on transportation – especially air travel –, onset energy consumption, waste from the production process, and catering supplies. Data shows an average footprint of over 33 metric tonnes per shooting day. Thus, films can generate from 391 metric tonnes up to 1,081 metric tonnes, depending on their length. Nearly 24 per cent of that carbon footprint is generated from air travel and utilities.
Music	Emissions related to the music sector mostly emerge from vinyl manufacturing, music streaming, live touring, venues and festivals. Scope 3 emissions are the most relevant source of emissions, as they encompass audience travel. Streaming services are in a similar situation. For example, 98.9 per cent of Spotify's GHG emissions in 2022 are coming from Scope 3 – further broken down into end use (26.5 per cent), marketing (26 per cent), goods and services (21.5 per cent), business travel (11 per cent) and cloud use (6.7 per cent) (Spotify, 2022).
Video games	Environmental impact arises from the manufacturing of consoles (some of which use materials such as gold or tin and energy use during gaming.

Source: UNCTAD (2024). Creative Economy Outlook 2024.

The examples above illustrate that most emissions from the CCI can be attributed to GHG Scope 3, notably all other indirect emissions that occur within the company's upstream and downstream value chain[55]. To provide further insights, the equity and impact report issued by Spotify in 2024 gives an in-depth look into emissions. In 2023, Spotify's total GHG emissions were 280 355 tonnes of CO2. The scope 3 emissions are further broken down to the categories such as purchased goods and services (86.8% of all scope 3 emissions (this includes marketing, cloud and purchase of goods and services)), business travel (9.3% of all scope 3 emissions).[56] As another example, RTL Germany conducted a study revealing that streaming one hour of content on RTL+ generates approximately 42.7 grams of CO_2 emissions[57].

Resource extraction

According to data from Exiobase (see Figures below), the following observations can be made.

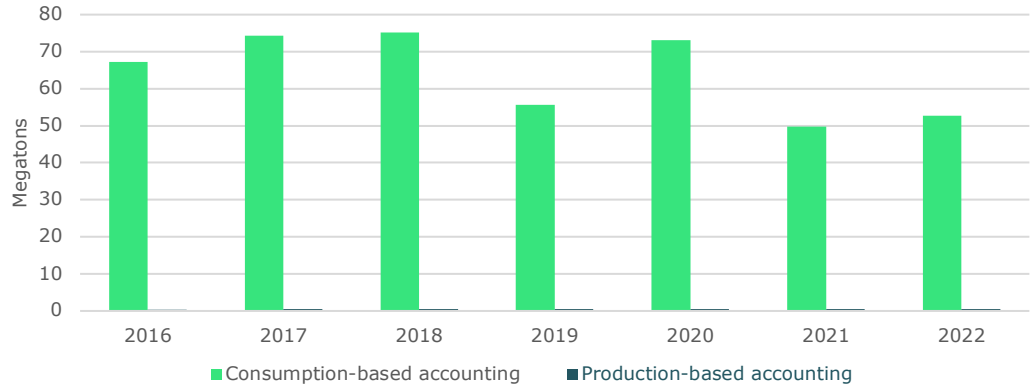
Material extraction of the CCI ecosystem in the EU has decreased from 67 thousand megatons to 57.2 thousand megatons over the period from 2016 and 2022 according to consumption-based accounting. The material extraction following production-accounts slightly increased from 400 megatons in 2016 to 500 megatons in 2022.

[55] The GHG Protocol provides the most widely used framework for businesses' carbon accounting, categorising a company's GHG emissions into three scopes. Scope 1 covers all direct emissions from the company's activities. Scope 2 accounts for indirect emissions from the generation of purchased energy. Scope 3 includes all other indirect emissions that occur within the company's upstream and downstream value chain.

[56] https://www.lifeatspotify.com/reports/Spotify-Equity-Impact-Report-2023.pdf

[57] https://www.cbc-service.de/download/publikationen/Carbon_Footprint_Analysis-of_the_RTL_plus_Video_Streaming_Service.pdf

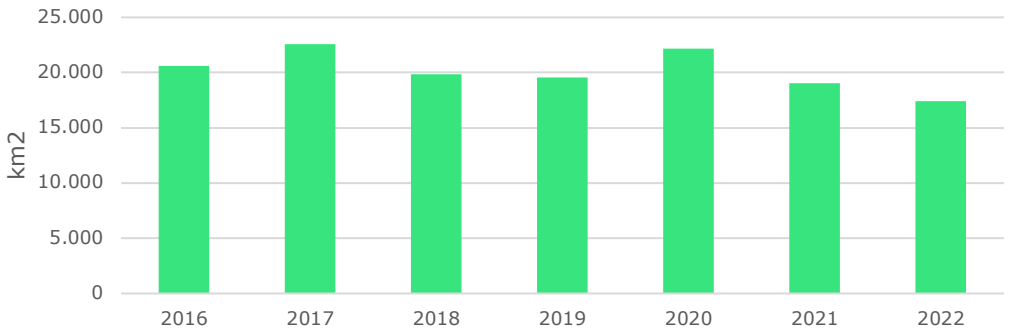
Figure 16: Material extraction by CCI



Source: Technopolis Group based on Exiobase data, calculations in 2024

Land use of CCI in the EU decreased from 20 thousand km2 to 17.4 thousand km2 which might indicate the impact of digitalisation and the increasing importance of virtual space for creative and cultural industries.

Figure 17: Land use in the EU (km2) (consumption-based accounting)

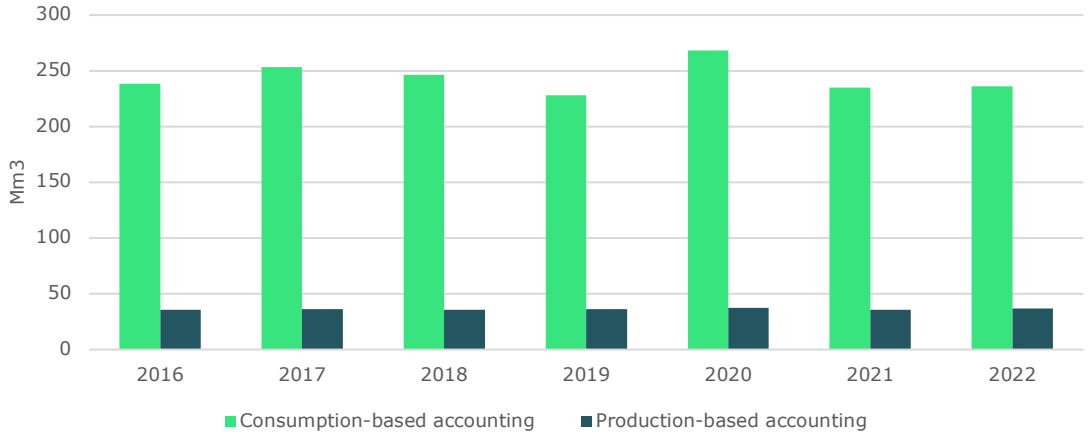


Source: Technopolis Group based on Exiobase data, calculations in 2024

Despite an increase in 2020 of **water consumption by CCI**, the consumption levels in 2022 were almost the same as in 2016. Although water consumption is less of a challenge in the CCI compared to manufacturing industries, certain activities still require water usage. For example, during conservation of cultural heritage sites, artifacts, and artworks can involve techniques requiring water, or printing of books and publishing involves water usage[58].

[58] See for example:

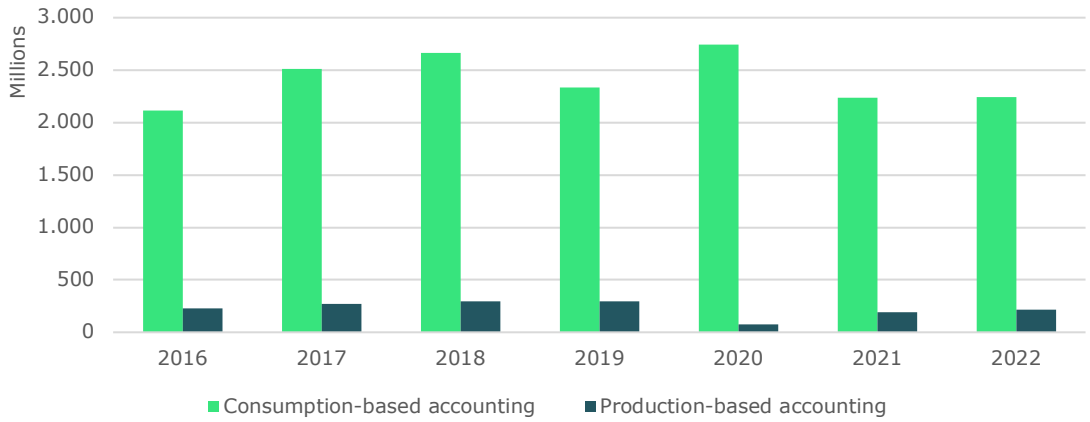
Figure 18: Water consumption in the EU (Mm3)



Source: Technopolis Group based on Exiobase data, calculations in 2024

The **damage to the ecosystem** stayed similar levels in 2016 and 2022 according to both the production- and consumption-based accounting from 2020-2022. Consumption-based accounting, which measures the environmental impact of CCI consumption by EU consumers, has fluctuated over time. Production-based levels increased again over the period from 2020 to 2022 that can be due to the impact of digital consumption of media. Moreover, a recent study found that the global average consumption of web surfing, social media, video and music streaming, and video conferencing **negatively impacts mineral and metal resources use**, leads to **freshwater eutrophication** and higher particulate matter emissions.[59]

*Figure 19: Damage to the ecosystem by 14B ecotoxic emissions (Million * PDF)*



Source: Technopolis Group based on Exiobase data, calculations in 2024

When considering the emissions and resource extraction by specific CCI activities, the **growing interest in streaming services** and its impact on the environment has to be taken into account. The streaming services allow users to watch or listen to content, such as movies, TV shows, music, or podcasts, over the internet. Instead of downloading the content to their device, users can stream it in real-time, which means they can start watching or listening immediately. **To run the streaming services, infrastructure, namely, data centres, is essential. Currently, these facilities consume approximately 40-45 TWh, accounting for 1.4-1.6% of total EU electricity**

[59] Istrate, R., Tulus, V., Grass, R. N., Vanbever, L., Stark, W. J., & Guillén-Gosálbez, G. (2024). The environmental sustainability of digital content consumption. *Nature Communications*, *15*(1), 3724.

consumption[60]. While not all of the electricity consumption is related to streaming services or CCI in general, these data centres consume a significant amount of energy, contributing to the overall electricity consumption in the European Union.

On the other hand, cultural and creative industries are also key drivers of sustainability as showcased in the 2023 EU-funded report Culture & Creative Sectors & Industries driving green transition and facing the energy crisis61. The United Nations suggested in 2020 that the creative economy can contribute to the three dimensions of sustainable development and the achievement of the 2030 Agenda for Sustainable Development, by fostering economic growth and innovation, and eradicating poverty[62]. In particular, artists and designers (but also many CCI professions in general) are agents of change who play a crucial role across global industries[63]. Their creative influence shapes not only the environmental impact of the products we consume but also helps to drive shifts in cultural thinking and social norms. Through their innovative work, they directly affect sustainability practices and inspire broader societal movements toward eco-friendly solutions.

[60] https://joint-research-centre.ec.europa.eu/jrc-news-and-updates/eu-code-conduct-data-centres-towards-more-innovative-sustainable-and-secure-data-centre-facilities-2023-09-05_en

61 https://ec.europa.eu/assets/eac/culture/docs/voices-of-culture/voices-of-culture-brainstorming-report-green-transition-2023_en.pdf

[62] United Nations General Assembly. (2020). International year of creative economy and sustainable development, 2021. https://digitallibrary.un.org/record/3847697?ln=es

[63] https://www.climate-kic.org/news/climate-action-culture-and-creative-industries/

3. Digital transition

3.1. Industrial efforts in transitioning towards digital CCI

What is the progress of industrial efforts towards digitalisation?

- **In 2024, 30% of surveyed companies in the CCI have adopted a concrete strategy for the digital transformation**, however, the aggregate results hide wide differences among the cultural and creative subsectors. While the video games industry is highly digitalised, the performing arts sector remains largely analogue.

- Among advanced digital technologies, the **adoption of cloud technologies, Artificial Intelligence and the Internet of Things have increased the most** as captured by the EMI Enterprise survey in 2024. There is also some increase observed in the use of big data and augmented and virtual reality technologies.

- The **top 3 ranking of CCI subsectors with the highest tech startup activity were news media, design and video games in 2024.**

- **CCI companies invest around 1-5% of their annual turnover in cloud computing in general.** Regarding AI, 17% of the respondents invest less than 1% into artificial intelligence technologies.

- Regarding the impact of AI on jobs, **72% of companies in the CCI ecosystem responded that the adoption of AI had no impact on reducing the number of employees**.

- A **significant portion of CCI businesses (50%) reported using AI systems provided by external service providers**, while only 24% have developed their own AI solutions in-house.

- The use of external service providers calls even more the attention to the role of tech startups in the digital transformation of the CCI.

- The analysis of the technologies in which tech startups are active in highlights the importance of **artificial intelligence and augmented and virtual reality**.

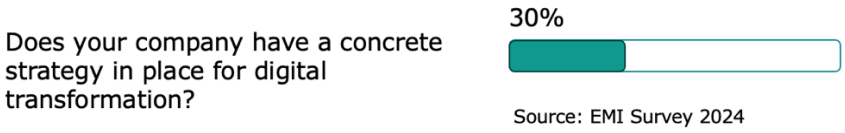
This section analyses the uptake of digital technologies, the evolution of CCI tech startups and private investments. It explores the progress that organisations across the cultural and creative industries have made in integrating digital technologies to enhance operations, streamline processes, and improve customer experiences over the past years.

3.1.1. Uptake of digital technologies

The results of the EMI Enterprise survey 2024 indicate that 30% of surveyed companies in the CCI64 have adopted a concrete strategy for the digital transformation. However, this share conceals subtle differences among the various subsectors within the ecosystem. Many subsectors, such as video games, news media, broadcasting, and music, have already undergone significant digitalisation. In contrast, performing arts and cultural heritage preservation have been less affected.

[64] Regarding the representativeness of the survey please see appendix

Figure 20: Share of companies in the CCI ecosystem that has adopted a strategy for the digital transformation



Source: EMI Survey 2024, n=755

Among advanced digital technologies, **the adoption of cloud technologies, Artificial Intelligence and the Internet of Things** have increased the most as captured by the EMI Enterprise survey in 2024. There is also some increase observed in the use of **big data and augmented and virtual reality technologies**.

Figure 21: Share of adoption of digital technologies by companies in the CCI ecosystem

Digital Technologies	***Share of adoption (2023)***	***Share of adoption (2024)***	
Cloud	20%	45%	
Artificial Intelligence	11%	38%	↑
Internet of Things	10%	21%	↑
Big Data	11%	17%	
Augmented and Virtual Reality	10%	15%	
Edge Computing	6%	7%	
Robotics	8%	5%	
Blockchain	3%	3%	

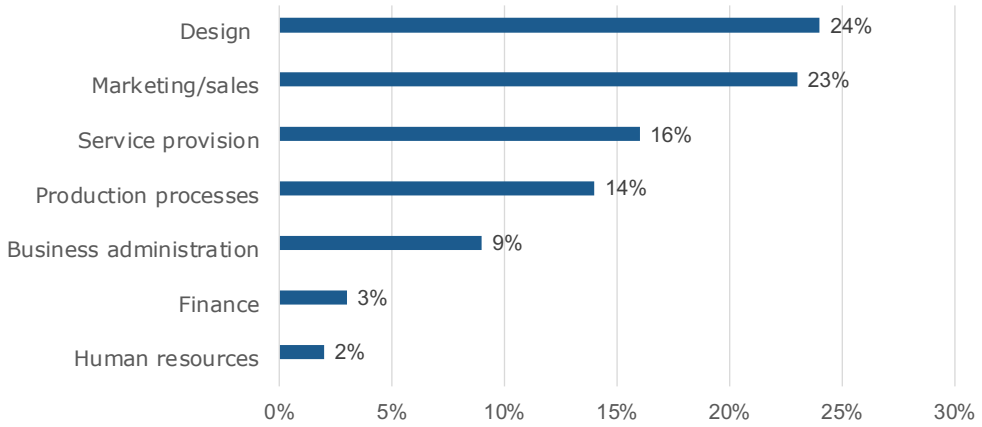
Source: EMI Enterprise Survey 2024. N=755

The CCI ecosystem stands out as one of the industrial ecosystems where organisations have reported some of the longest periods of AI usage, with many businesses indicating more than five years of experiencing with this technology. However, these respondents come mainly from video games, the audiovisual and news media sectors. This prolonged engagement with AI reflects the sector's growing reliance on innovative technologies to enhance productivity and creativity.

A significant portion of CCI businesses (50%) reported using AI systems provided by external service providers, while only 24% have developed their own AI solutions in-house. The reliance on external providers highlights the cultural and creative sectors' need for specialised expertise and ready-to-implement AI tools. Notably, 60% of these businesses rely on AI services from US-based providers, underscoring the dominance of US tech companies in the global AI market.

In terms of applications AI is primarily utilised in design, with 23% of businesses incorporating AI into their design processes. Other common areas of AI usage include marketing and sales, where businesses are leveraging AI to optimise strategies and improve customer engagement. As AI continues to evolve, its integration in the CCI ecosystem is expected to expand, driving further innovation and efficiency across the sector.

Figure 22: Share of CCI companies using AI according to the business operation stage



Source: EMI Enterprise Survey 2024. N=755

Regarding the impact of AI on jobs, 72% of companies in the CCI ecosystem responded that the adoption of AI had no impact on reducing the number of employees. However, 28% indicated that they reduced the number of employees (with 1-2 employees less), which is still significant and indicates relevant trends. According to 22% of respondents, AI had the greatest impact on data analytics related tasks, followed by content creation, automation and quality control.

The type of job profiles that AI impacts the most as indicated by the respondents include:

- Technicians, Sound engineers
- Translators
- Content creators, 3D designers
- Marketing professionals
- Assistants

In the book publishing sector, digital technologies such as ebooks, audiobooks, and AI are transforming traditional models of content delivery. The digitalisation of book publishing is in a profound state of transformation, having established itself as a significant and permanent part of the industry[65]. Digital publishing, particularly ebooks, represented a notable portion of the book market in 2024, and the audiobook sector is experiencing rapid expansion due to its convenience and accessibility. The ebook market of the EU was valued at EUR 4 bn with 97 million ebook readers. The rise of global distribution platforms has enabled publishers and individual authors to sell globally with ease.

In film and TV production, the most impactful advanced digital technologies include artificial intelligence and augmented and virtual reality enabling virtual production. These advancements are enabling the creation of high-quality visual effects, computer generated imagery, and real-time rendering, which optimise production costs while delivering content.

More specifically AI is being integrated into almost all facets of filmmaking and the expectation is that AI will touch every single aspect of production[66]. For example, AI streamlines workflows and reduces friction in the filmmaking process. Artists can use generative AI to explore new storytelling techniques, while AI also helps save time on tasks like creating pitch decks, editing films, and even replacing the need for stock photos.

Museums and galleries are adopting digital platforms to offer virtual tours, augmented exhibits, and digital archives, making art and cultural heritage more accessible to global

[65] EDRLab (2024). The Future of Digital Book Publishing
[66] See here: https://variety.com/2025/film/news/sundance-adobe-the-future-of-ai-filmmaking-1236287306/

audiences. Museums and galleries are using smart sensors to enhance exhibits with augmented reality, providing visitors with additional layers of information and engaging storytelling.

Although considered less digital, cultural heritage preservation is also impacted profoundly by digitalisation. This shift is being driven by the integration of digital tools, which are transforming how cultural heritage is shared and how visitor experiences are accessed by making cultural institutions more engaging and accessible. The change is significant in the following three areas: enhancing accessibility, making cultural experiences more engaging, and fostering collaborative preservation efforts[67]. One of the key initiatives to accelerate the digitalisation of cultural heritage is Europeana[68], a digital platform that provides access to millions of cultural heritage items from museums, libraries, and archives across Europe. Europeana is actively supporting cultural heritage institutions in improving the quality of digital files and accompanying metadata. This initiative aims to make cultural items more accessible and user-friendly by enhancing the information available about each piece.

The music industry has been a front-runner in digitalisation, with streaming services revolutionising content distribution and consumption. Online platforms allow artists to reach global audiences while enabling data-driven insights into listener preferences. Artists and record labels are leveraging digital platforms for fan engagement and marketing.

In news media, media outlets are using automation and data analytics to streamline production and deliver more personalised news and content experiences to their audiences. As found by the analysis of Reuters[69], news organisations are increasingly adopting AI technologies, with 60% of publishers highlighting the importance of back-end automation to support new workflows. Gen AI is transforming newsrooms. In 2025, AI-driven audience-facing features, such as text-to-audio, AI summaries, and multilingual translations, are expected to grow, with 75% of publishers exploring text-to-audio, 70% considering AI summaries, and 65% planning language translations. Over half of the survey respondent participating in the Reuters study are also looking into AI chatbots and search interfaces, signaling a clear trend towards more personalised and interactive content, though not all initiatives will reach full production.

The Internet of Things has been also increasingly influencing news media, with applications such as smart devices that track real-time events for reporting, sensors that collect environmental data, and audience measurement tools that offer insights into how people consume content on connected devices like smart TVs and wearables.

The video games industry has embraced cutting-edge advancements such as cloud gaming and delivers immersive experiences. Game developers use AI for procedural content generation, creating dynamic environments, non-playable characters, and quests that adapt to player behaviour[70].

3.1.2. Tech startups specialised in the CCI

Trends in technology startups have been captured by analysing the Crunchbase[71] data source and complemented by desk research. The analysis based on Crunchbase data explored tech startups activity related to the following sub-sectors in CCI:

- Architecture
- Advertising
- Design
- Gaming, video games
- Film, Film production, Film distribution
- Museums and historical sites

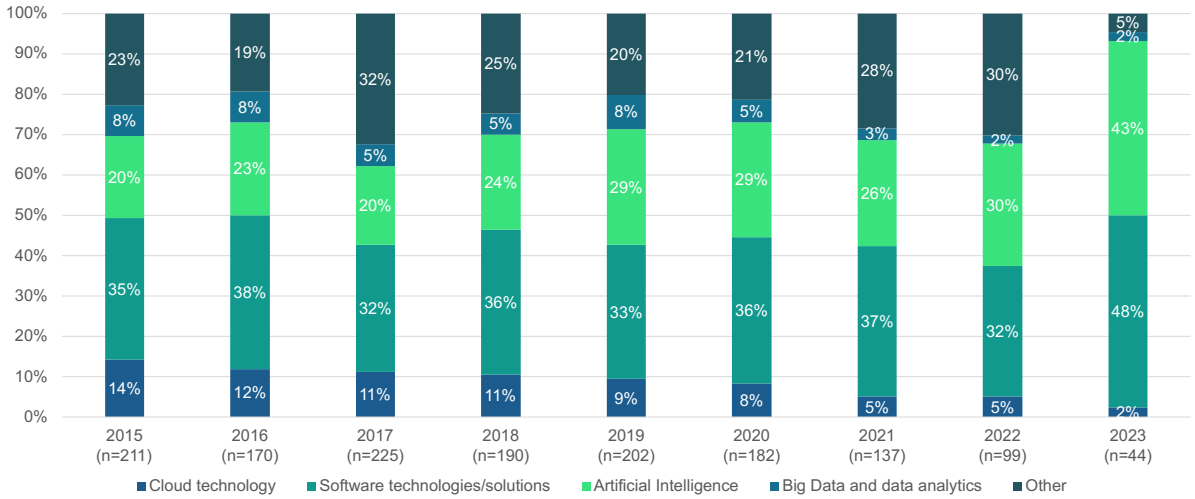
[67] Interreg (2024). How digitalisation transforms tourism, heritage preservation and cultural activities
[68] https://www.europeana.eu/en
[69] https://reutersinstitute.politics.ox.ac.uk/journalism-media-and-technology-trends-and-predictions-2025
[70] https://webosmotic.com/blog/ai-in-game-development/
[71] https://www.crunchbase.com/

- Music
- News, Journalism, News, Printing, Readio
- Publishing, Audiobooks, E-books
- Photography
- Performing arts, Theatre, arts

The top 3 ranking of CCI subsectors with the highest tech startup activity are news media, design and video games. The analysis of the technologies in which tech startups are active in highlights the importance of advanced technologies such as artificial intelligence and augmented/virtual reality, but also immersive content for various subsectors, including advertising, video games, news media, architecture, and design. Technologies such as software solutions are mostly linked to design, video games, news media, platform solutions for advertising, and streaming technology for music.

The number of **CCI-related tech and innovative service startups (including digital technologies) has been growing over time and has further increased during the pandemic period,** except for some industries such as books, museums and performing arts.

Figure 23: Share of startups created, by advanced digital technology between 2015 and 2023.



Source: Technopolis Group, Crunchbase and Net Zero Insights

3.1.3. Industrial investments into digital technologies

The cultural and creative industries (CCIs) are increasingly prioritising digital investments to enhance their operational efficiency, improve audience engagement, and innovate product offerings. These investments span various areas, reflecting the sector's unique characteristics and the evolving demands of consumers.

Figure 24 below indicates the share of respondents who indicated to make investments in advanced digital technologies in the CCI industrial ecosystem based on the EMI Enterprise survey 2024. The results show that most CCI companies invest in cloud computing followed by artificial intelligence. While a larger share of companies invests between 1-5% of their annual turnover in cloud computing, they do less so in the case of other advanced digital technologies. Regarding AI, 17% of the respondents invest less than 1% into artificial intelligence technologies.

Figure 24: Share of CCI businesses investment into digital technologies, in % of annual turnover invested.

Technologies	<1%	1-5%	6-10%	>30%
Cloud Computing	11.27%	12.68%		2.82%
Artificial Intelligence	16.90%	4.23%		
Big Data	7.04%	2.82%	1.41%	
Internet of Things	8.45%		4.23%	
AVR	2.82%	2.82%		

Source: EMI Enterprise survey 2024

The response about planned investments indicate that cultural and creative industries are embracing digital technologies to improve their operations, however, increased investments are planned only in the field of AI while in other fields there is no difference between current and planned efforts. AI offers opportunities for the CCI in four areas of implementation: saving costs and increasing efficiency, making decisions, discovering new audiences and building loyalty, inspiring human creation[72]. Most recently, Generative AI is reshaping the cultural and creative industries by opening new avenues for artistic expression, automating creative workflows, and enabling immersive cultural experiences, while simultaneously prompting critical debates on authorship, intellectual property, and the preservation of cultural authenticity.

Investments in AR/VR overall remain very limited in the CCI. Analysis in the context of the Horizon Europe-funded project *ekip*[73] highlighted several barriers that remain for adopting these technologies in the CCI, such as a lack of inspiring good cases that can support awareness raising of the possibilities, fragmentation on the side of hardware and distribution, and lack of piloting and testing infrastructures. Similarly, with respect to the use of AI, multiple barriers and challenges remain.

In particular, the use of AI and other digital tools brings significant challenges in the area of intellectual property and data management. When AI is used to generate content, the debate about whether authorship can be non-human comes to the fore and the very concept of authorship itself is called into question[74]. AI but also blockchain can significantly enhance how copyright-related data is managed across Europe's creative sectors, improving rights tracking, licensing, remuneration, and interoperability of metadata while addressing sector-specific challenges[75].

There are further key challenges related to AI such as the need for artists to retain their voice and avoid homogenisation of aesthetics due to AI training data[76]. As AI models are trained on existing datasets, they may favour dominant artistic trends while overlooking niche, experimental, or underrepresented styles. This could lead to a loss of diversity in creative expression, with AI-generated content becoming repetitive or derivative. Moreover, artists face challenges in maintaining ownership and control over their work. AI tools often generate content based on vast amounts of training data, which may include copyrighted or culturally significant works.

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[72] European Commission (2022). Study on Opportunities and Challenges of Artificial Intelligence (AI) Technologies for the Cultural and Creative Sectors | Shaping Europe's digital future

[73] EKIP (2024). Policy reports, www.ekipengine.eu

[74] Digital transformation in the cultural and creative sectors and industries. https://www.euskadi.eus/contenidos/noticia/keb_argit_23_eraldaketa_digita/es_def/adjuntos/KEB-OVC_2023_Digital-Transformation.-Executive-Summary.pdf

[75] European Commission (2022). Study on Copyright and New Technologies, https://digital-strategy.ec.europa.eu/en/library/study-copyright-and-new-technologies

[76] https://variety.com/2025/film/news/sundance-adobe-the-future-of-ai-filmmaking-1236287306/

The rise of AI technologies stresses the opportunities of data-driven decisions on the one hand and privacy concerns on the other. The Council conclusions on empowering the cultural and creative sectors through data-driven audience development in 2024 highlighted that leveraging data for audience engagement offers many opportunities but also requires the cultural and creative sectors to anticipate risks and adapt their methods. This includes addressing legal (IP, copyright, privacy), ethical, sustainability, and ecological concerns, while carefully evaluating the impact of AI and other advanced digital technologies[77].

This need is confirmed by several audiovisual creative professionals at Initiatives like TEMS[78], the **Trusted European Media Data Space** are developed to break down data silos while giving individuals control over how their data is used. This EU co-funded project aims to develop and run a large cross-border data space for the media industry. 42 CCI organisations from 12 countries will contribute to develop the data space that enables specific use cases between trusted data holders, data consumers, apps, infrastructure and service providers.

Another data space is the **Data Space for Cultural Heritage**[79] that is an initiative aimed at creating a shared, interoperable digital infrastructure to facilitate access to and collaboration on cultural heritage data across Europe. It enables cultural institutions to share, preserve, and enhance digital collections, fostering innovation and collaboration in the sector.

[77] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:C_202403542
[78] Tems. (2024, June 12). *About - Tems.* https://tems-dataspace.eu/about/
[79] https://pro.europeana.eu/page/the-common-european-data-space-for-cultural-heritage-faqs

3.2. Framework conditions – assessment of the broader ecosystem supporting the digital transition

To what extent do framework conditions such as public financing and skills support the digital transition?

Public funding

- The total number of ERDF projects in the CCI industrial ecosystem that supported the digital transition in 2014-2020 was 1 716. The analysis shows that about **15.7% of the total ERDF funding dedicated to CCI, notably EUR 1.18 bn supported the digital transition**.

- Among ERDF CCI projects contributing to the digital transition, 42% of the funding was allocated to projects related to advanced digital technologies specifically.

- Under Horizon 2020, **43.1% of the EU funding to CCI projects contributed to the digital transition**. Under Horizon Europe a similar share contributes to CCI projects related to the digital transition.

Skills

- The share of professionals registered on LinkedIn and employed in the CCI industrial ecosystem with advanced digital skills reached 8% in 2024, showing a relatively high increase from 2022.

- To effectively develop digital skills in the CCI, adequate resources, structured processes, technical infrastructure, supportive leadership are necessary that fosters digital growth, opportunities for staff to focus on their own digital development and an open space for discussions about digital challenges.

- The **share of online job advertisements requiring skills related to the digital transition in 2023 was high, 44% for moderate digital skills and 39% for advanced digital skills**.

Framework conditions that support the digital transition refer to various structural and institutional elements that create an enabling environment for businesses to embrace the digital transformation. Key components of these framework conditions include public investments, skills demand and supply and demand-side factors among others that are analysed in the sections below.

3.2.1. Public investments

3.2.1.1. European Regional Development Fund

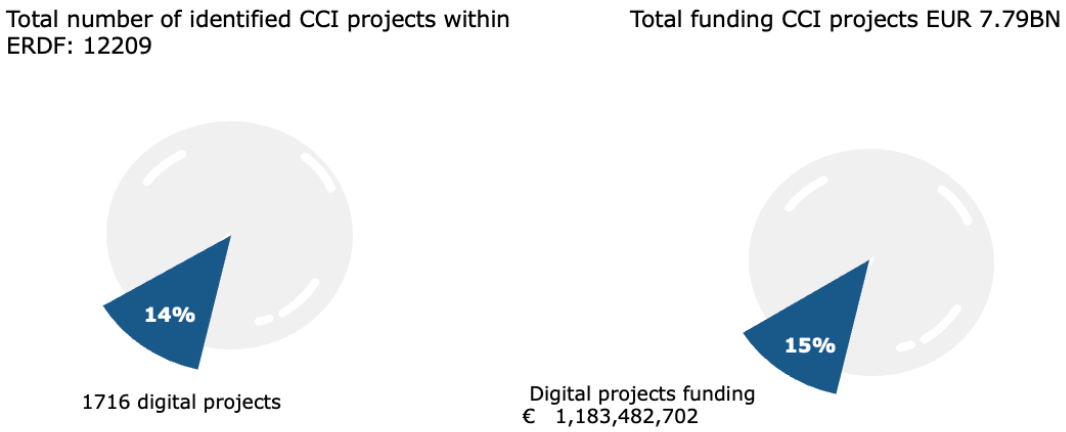
This study examined **public investments supporting the digital transition of the CCI industrial ecosystem** through the European Regional Development Fund (ERDF)[80]. For

[80] The European Regional Development Fund (ERDF) supports projects aimed to strengthen economic, social and territorial cohesion in the European Union. It aims to correct imbalances between regions enabling investments in a smarter, greener, more connected and more social Europe that is closer to its citizens. The ERDF finances programmes in shared responsibility between the European Commission and national and regional authorities in Member States.

this analysis, two data sources have been used and merged, namely the Cohesion Open Data maintained by the European Commission and the Kohesio data[81] [82].

The total number of **ERDF projects in the CCI industrial ecosystem that supported the digital transition** in 2014-2020 was **1 716.** The analysis shows that **about 15.7% of the funding dedicated to the CCI, notably EUR 1.18 bn supported the digital transition** (see Figure below).

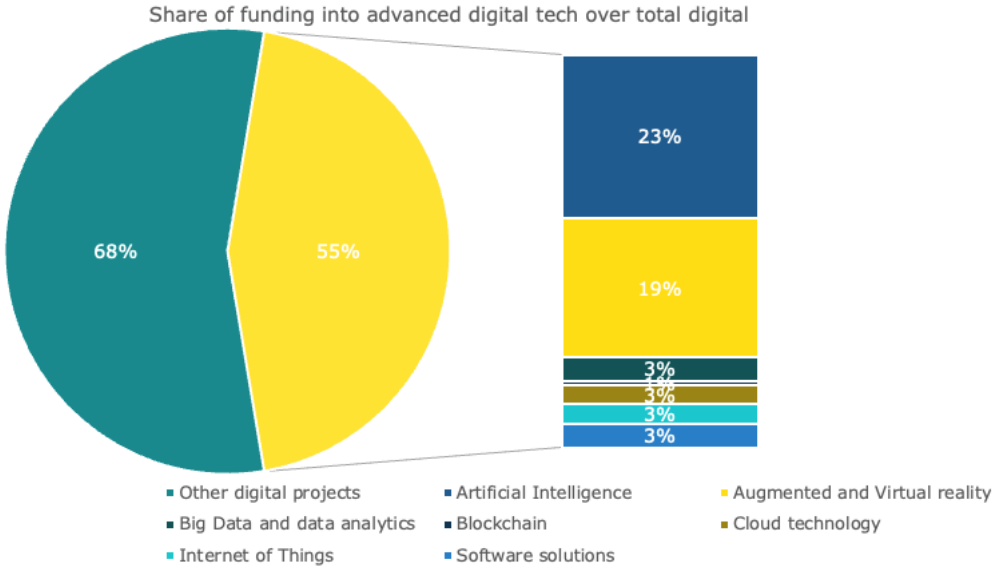
Figure 25: Share of number and total funding of CCI projects co-financed by the ERDF



Source: Technopolis Group based on Kohesio data

Among ERDF CCI projects contributing to the digital transition, 42% of the funding was allocated to projects related to advanced digital technologies[83] (see Figure below). 41% of these projects funding was related to Artificial Intelligence (23%) and Augmented and Virtual reality (19%). Examples of ERDF CCI project supporting the digital transition are presented in the Box below.

Figure 26: ERDF funding per advanced digital technology



Source: Technopolis Group based on Kohesio

[81] For more information on the data sources and the approach, see the methodological report.
[82] Based on the codes of economic activity and additional LLM based searches in the project descriptions.
[83] As identified for the purpose of this project, e.g., projects related to IoT, AI, Cloud, Blockchain, advanced manufacturing etc.

Box 2: Examples of projects supported by the ERDF and dedicated to the digital transformation of CCI

Examples of ERDF CCI projects supporting the digital transition

Germany developed a project titled '**AIDesign'** from 2019 to 2021, funded by the EU with a budget of EUR 115 950. The project aims to expand the possibilities of untrained users to create aesthetically valuable digital works by using artificial intelligence in an application-oriented manner to support the design process. Furthermore, the technology can relieve professional designers from tedious and repetitive work to facilitate the actual creative work.

Research project from Romania titled '**Research of applications of augmented reality and virtual reality in the field of architecture and interior design',** funding by the EU with a budget of EUR 1 m**.** The general objective of this project is to increase the competitiveness of the beneficiary company, by developing four innovative applications in the field of virtual and augmented reality capable of competing with applications on national and international markets.

Source: Technopolis Group based on Kohesio

3.2.1.2. The Recovery and Resilience Facility

Besides the ERDF, the **Recovery and Resilience Facility (RRF)** also contributes to the digital transition of the CCI industrial ecosystem[84]. The overview of the total expenditures by Member States were presented above in Section 2.2.1.

In terms of specific focus on digital transition, various national Recovery and Resilience Plans (RRPs) contain measures to support the digital transition of the cultural sector. The measures include support to the digitisation of the cultural and media sectors and the production and distribution of digital content (in Belgium, Finland, Latvia). Also, investments are planned for digitisation of cultural heritage and major cultural services (in Bulgaria, Estonia, Lithuania, Portugal, Czechia), to improve the accessibility to culture. Attention is also given to capacity building of cultural actors and operators by providing them with digital skills, supporting the digital transition (in Czechia and Italy). More detailed examples are provided in the table below.

Figure 27: Examples of RRF investments in digital transition of the CCI

Spain	
	The Spanish recovery and resilience plan includes an ambitious programme for the promotion, modernisation and digitalisation of the cultural services as well as the audio-visual sector. The plan foresees making the ecosystem accessible, attractive and future proof through the digitalisation of cultural services (digitising some collections from museums and libraries, digital access to public archives).
Belgium	
	With a strong digital focus, the Belgian Recovery and Resilience Plan includes measures to support the cultural and media sectors and equip them with tools for the digitalisation of audio-visual and audio works.

[84] The COVID-19 crisis had significant impact on the CCI. The halt of cultural activities, the closure of museums, libraries, archives, galleries and heritage sites, the cancellation of events, festivals and tours, as well as art, design and fashion fairs and trade shows, led to significant losses of revenues across the EU, with a 70% drop in box-office sales in 2020 for cinema operators, 76% drop in attendance at music venues, and up to 75-80% losses for museums in popular touristic regions. In addition, televisions suffered a drop in advertising revenues of 20%, while news publishers reported up to 80% loss during the lockdowns in the same year. Only the video games industry reported a significant increase in turnover for major EU players in 2020.

	Furthermore, the Plan will support the creation of 100% digital events, such as music and exhibitions, with the aim of enabling artists and cultural partners to gain access to new markets and of increasing access to culture for people and groups located remotely or facing mobility challenges.

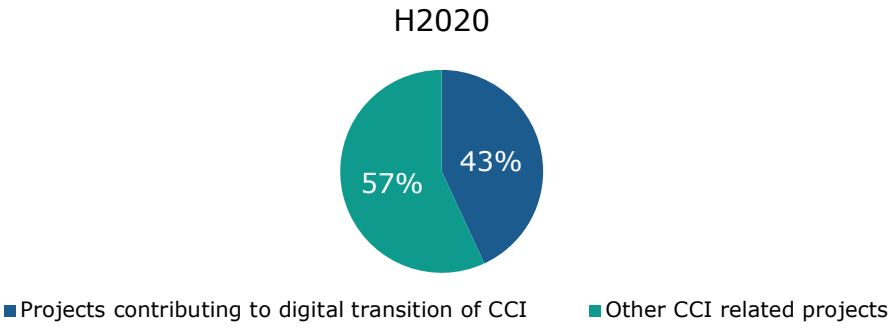
Source: Technopolis Group based on RRF thematic analysis of CCI available at https://ec.europa.eu/economy_finance/recovery-and-resilience-scoreboard/index.html

3.2.1.3. The EU Framework Programmes for Research and Innovation

In this study, funding data from the EU Framework Programmes for Research and Innovation, in particular from Horizon 2020 (2014-2020) and Horizon Europe (2021-2027) was further analysed as in the case of the green transition.

Under Horizon 2020, **43.1% of the EU funding to CCI projects contributed to the digital transition**. Under Horizon Europe, a similar share contributes to CCI projects related to the digital transition to date (keeping in mind that Horizon Europe is still ongoing and further projects will start).

Figure 28: Share of Horizon 2020 and Horizon Europe (only period from 2022-2024) CCI projects that contribute to the digital transition



Source: Technopolis Group based on CORDIS

The **Cultural Heritage Cloud[85] is a European Union initiative for a digital infrastructure** that will connect cultural heritage institutions and professionals across the EU. It will develop specific digital collaborative tools for the sector while removing barriers for smaller and remote institutions. Launched under Cluster 2: Culture, Creativity and Inclusive Society, the initiative has been allocated around €110 million from Horizon Europe for the years 2023 to 2025

Some examples of projects funded under Horizon 2020 and Horizon Europe supporting the digital transition of CCI are described in the Box below.

Box 4: Examples of projects

Example of Horizon 2020 and Horizon Europe projects in the CCI supporting the digital transition

The project Communities and Artistic Participation in Hybrid Environment (CAPHE), funded under Horizon Europe aims to investigate the possibility of an enhanced model of interaction and somatic participation between artists and communities, coming from different cultural backgrounds, both traditional and virtual ones in hybrid environment. The project aims to develop the concept of virtual reality participation, building the integrated framework for VR-mediated consensus and community in a form of an

[85] https://research-and-innovation.ec.europa.eu/research-area/social-sciences-and-humanities/cultural-heritage-and-cultural-and-creative-industries-ccis/cultural-heritage-cloud_en

aesthetic dialogue, geared toward layering and investigating aesthetic experiences through VR technology. Additionally, workshops, trainings, field research and interviews will be carried during the whole project in the virtual space. This will be realised with use of modes of telepresence, Augmented Reality (AR) and Virtual Reality (VR) technologies such as the AltspaceVR platform. The EU contribution for this project is EUR 1.5 m.

The "POPULate AsymmeTric mobile gamEs" project funded under Horizon 2020 was an Innovation Action in the field of mobile games. The project focused on innovation, by combining a multi-devices approach to game design with a state-of-the-art crowd simulation technology. The objective was to develop a prototype involving crowds for asymmetric games using both wearable and mobile devices as controllers and using TV as the main display. The EU contributions for this project were EUR 230 000.

Source: authors based on CORDIS

3.2.2. Skills underpinning the digital transition

In order to analyse trends in the skills of professionals working in the CCI industrial ecosystem, data from LinkedIn has been used as in the case of the green transition. More specifically, digital skills have been defined as below:

Moderate digital skills have been defined following Cedefop[86] notably including "*five types of skills under the digital skills umbrella such as information processing (e.g. using a search engine and storing information and data); communication (including teleconferencing and application sharing); content creation (such as producing text and tables, and multimedia content); security (e.g. using a password and encrypting files); and, problem solving (e.g. finding IT assistance and using software tools to solve problems)"*. (The list of keywords that have been used to track LinkedIn is included in Appendix B).

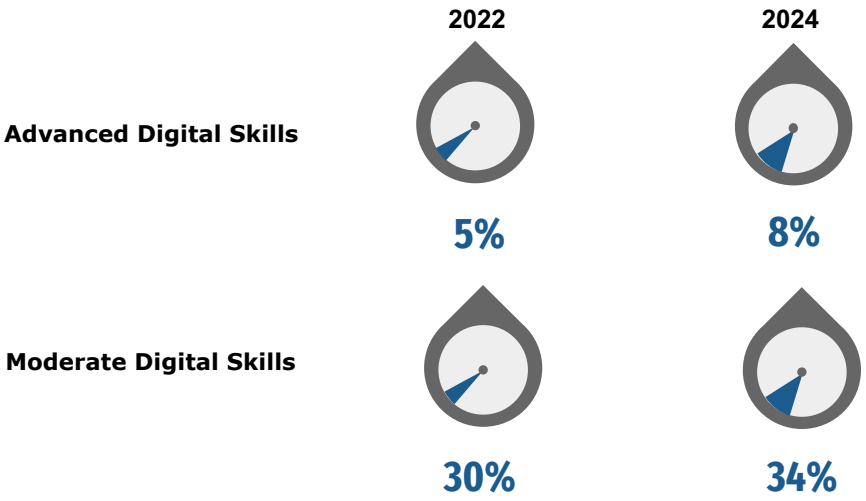
Advanced digital skills have been defined as a specific group of digital skills in the context of the main digital technologies captured in this project notably in artificial intelligence, cloud computing, connectivity, robotics, Internet of Things, augmented and virtual reality and blockchain (the list of keywords that have been used and are possible to track with the algorithm of LinkedIn is included in Appendix B). LinkedIn data have to be interpreted in the light of its representativeness for CCI and across the EU. An analysis of representativeness is provided in Appendix B and in the related methodological report.

3.2.2.1. Supply of skills in the industry relevant for the digital transition

The share of professionals registered on LinkedIn and employed in the CCI industrial ecosystem with advanced digital skills reached 8% in 2024, showing a relatively high increase from 2022 (see Figure below). This rise signals the growing importance of digital expertise in the CCI, as industries like film, music, fashion, and publishing increasingly rely on technology to innovate and maintain competitiveness. Moderate digital skills were indicated on 34% of LinkedIn profiles of professionals working in the CCI as suggested by the data analysis. This trend reflects broader shifts in the industry towards digital transformation, and the importance of related skills.

[86] https://www.cedefop.europa.eu/en/data-insights/digital-skills-challenges-and-opportunities

Figure 29: Share of professionals in CCI with skills relevant for the digital transition in the EU27



Source: Technopolis Group based on LinkedIn

Recent research (2022) on the digitalisation in small and medium-sized museums, based on data from 256 museum practitioners (from which 80.42% of the respondents are active in EU-based organisations)[87], indicates that there is a lag in digitalisation in the museum sector, compared to other sectors. Often, digitalisation in museums is driven by the development of audience-oriented tools and technologies such as 3D elements, virtual reality, augmented reality and online exhibitions instead of digital solutions that support museums[88].

To effectively develop and apply digital skills and literacy for museum teams, certain organisational foundations are essential. These include adequate resources, structured processes, technical infrastructure, supportive leadership that foster an internal culture that encourages digital growth, opportunities for staff to focus on their own digital development and an open space for discussions about digital challenges.

In addition, 80% of survey respondents of the 'Museum Booster' report indicated that their budget is not sufficient to develop their digital ambitions, including supporting staff in developing their digital skills and literacy. Given the limited resources available to small and medium-sized museums, more creative and cost-effective strategies may be necessary to support museum staff in digital upskilling. Professional networks, publicly available resources and partnerships within funded projects are already vital to building digital skills in smaller museums.

Box: Country example from Ireland

The recent study of Creative Ireland Digital notably the 'Creative Industries Roadmap 2024–26[89]' pinpointed specific areas within the creative industries experiencing significant skills shortages. These shortages reflect the rapid pace of technological advancement and the evolving demands of the industry. **Both the animation and gaming industries in Ireland face shortages of skilled 2D and 3D animators.** This shortage is particularly concerning given the high-growth potential of these sectors. These skills gaps emphasise the urgent need for upskilling and training initiatives to equip creative professionals with the digital skills required to meet industry demands. The impact of emerging technologies

[87] Carabelea, A.-M.; Liebl, V.; Tykhonova, O.; Gimeno Grauwinkel, C.; Hannesschläger, V. (2022), DOORS Needs Assessment Report

[88] Museum booster. (2021). *Museum Innovation Barometer*. https://cultureactioneurope.org/wp-content/uploads/2021/08/Museum-Innovation-Barometer-2021.pdf

[89] https://www.creativeireland.gov.ie/app/uploads/2024/01/CI_Creative_Industries_Roadmap_23_Screen_AW-3.pdf

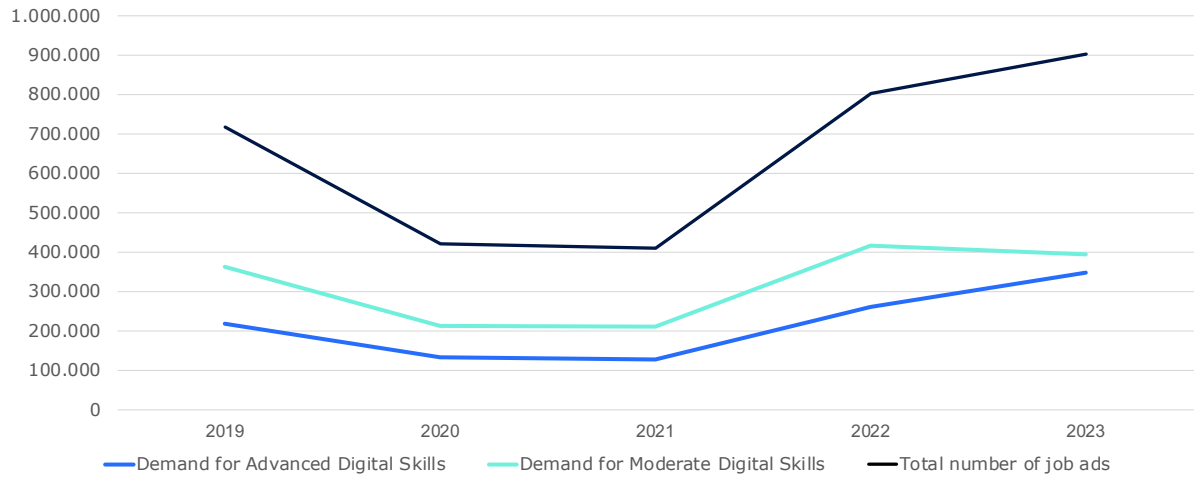
on the creative industries has been also highlighted, creating new opportunities and requiring professionals to adapt and acquire new skills. **Immersive technologies are experiencing rapid growth, creating demand for individuals skilled in content creation and development for these platforms.** While specific skills related to AI are not explicitly mentioned, it is implied that creative professionals will need to develop an understanding of AI's capabilities and applications within their respective fields. The sources acknowledge the emergence of new platforms and distribution channels, requiring creative professionals to adapt their skills and strategies. This includes understanding the nuances of different platforms, content formats, and audience engagement strategies.

3.2.2.2. Demand for skills relevant for the digital transition

Skills demand has been analysed following the skills intelligence insights of Cedefop, the European Centre for the Development of Vocational Training[90].

The share of online job advertisements requiring skills related to the digital transition in 2023 was quite high, 44% for moderate digital skills and 39% for advanced digital skills. The total number of job ads referring to digital skills shows a sharp increase since 2021 and demonstrates the strong demand for digitally skilled professionals.

Figure 30: Share of online job advertisements with a requirement for digital skills



Source: Technopolis Group based on analysis of Cedefop data

The digital transition within the CCI and the increasing adoption of digital technologies raises demand for new related skills, such as digital ethics competences. This can guide CCI professionals and organisations in making ethical decisions within the digital landscape. The application of digital technologies can have consequences related to intellectual property rights, inclusion of vulnerable audiences and user data. In this context, **the Bureau of European Design Associations (BEDA) recently developed the Digital Ethics Compass**[91], a tool that guides design professionals and companies to embed ethical considerations into the core of the digital development process. Also, the European Network of Cultural Centres has taken initiatives to raise awareness about the importance of digital ethics for cultural centres. In 2023, they published a paper 'On Digital Ethics for Cultural Organisations'[92].

[90] https://www.cedefop.europa.eu/en/tools/skills-online-vacancies
[91] The Digital Ethics Compass – BEDA
[92] https://encc.eu/articles/on-digital-ethics-for-cultural-organisations

3.2.3. Consumer demand for digital services

The strong consumer demand for digital media, particularly in the audiovisual and news sectors have been highlighted in the European Media Industry Outlook[93]. While traditional media such as television and print remain prevalent, consumers are increasingly shifting their consumption online, driven by the convenience and accessibility of digital platforms. This trend is particularly pronounced among younger generations who show a clear preference for digital news sources and online streaming services.

As the media industry outlook found, television remains the dominant medium for films and series, with 71% of EU consumers watching via traditional channels monthly. However, subscription video-on-demand (SVoD) services are rapidly gaining ground, used by 60% of consumers assessed in a related consumer survey. Ease of use, content variety, high quality, and trusted brands are key factors driving consumer adoption of SVoD services. Regarding news consumption, television remains the primary source, followed by online platforms, radio, social media, and print. Digital platforms are experiencing the fastest growth in news consumption, facilitated by increased internet penetration and an evolving online news landscape.

Younger audiences demonstrate a distinct preference for online and virtual spaces for both entertainment and news, signifying a shift away from legacy media. This poses a challenge for traditional media outlets to adapt and remain relevant to younger demographics. The US 'Culture Next Report'[94] by Spotify analysed several prominent trends shaping Gen Z's relationship with culture and content and how these trends influence their interactions with the broader cultural landscape. The findings suggest that Gen Z wants genuine connection, which may stem from their constant immersion in the digital world. While social media often amplifies feelings of loneliness, they are increasingly turning to platforms to build connections through shared musical tastes and engaging podcast conversations. Their passion for live events such as concerts, listening parties, and podcast recordings highlights their desire for shared experiences and in-person connections.

Literature highlights the increasing demand from specific consumer groups for digital museum and virtual experiences[95]. The potential of virtual reality to enhance museum experiences, making them more accessible and engaging for a wider audience has been highlighted. The concept of virtual museums, or digital twins, is presented as a way to reach individuals who may not be able to physically visit a museum due to location, disability, or financial constraints.

However, for example, in the case of books, EU residents continued to favour printed books over digital alternatives in 2023 when shopping online as shown by Eurostat statistics[96]. Around 13.4% had purchased printed books online, a slight increase from 2022 (12.7%) but still below 2021 levels (14.5%). While e-book purchases increased from 6.6% in 2022, they remained steady compared to 2021. A recent study by RISE[97] also shown that a significant proportion of respondents across the surveyed countries reported having read and purchased books in the past 12 months. Across the vast majority of the surveyed countries, paper books remain the preferred format for purchasing.

[93] https://digital-strategy.ec.europa.eu/en/library/european-media-industry-outlook
[94] https://becauseofmarketing.com/spotify-culture-report-2024/
[95] Song Z and Evans L (2024). The museum of digital things: extended reality and museum practices. Front. Virtual Real. 5:1396280. doi: 10.3389/frvir.2024.1396280
[96] https://ec.europa.eu/eurostat/web/products-eurostat-news/w/ddn-20240423-2
[97] EIBF and RISE Bookselling (2024). Study on Consumer Behavior: Book-Buying Trends, Reading Habits, and Customer Needs

3.3. Impact of digital technologies on industrial competitiveness

What is the impact of digital technologies on competitiveness?

- The EMI Enterprise survey conducted with CCI companies indicates that the adoption of advanced digital technologies increased productivity around 10% overall.

- However, the adoption of digital technologies does not necessarily lead to a reduction in production costs. As a result, this industrial ecosystem experiences fewer economic gains compared to other industries that benefit more significantly from digital advancements.

- The largest share of respondents reported an increase in productivity due to the adoption of Artificial Intelligence (AI), making it the most impactful among advanced digital technologies. On the other hand, 6% of the respondents also indicated challenges in terms of implementation and reach a return on investment.

- Interestingly, 6% of respondents indicated a decrease in productivity as a result of adopting AI. This suggests that while AI holds significant promise, some tools currently available on the market may not yet be fully optimised for the specific needs of the CCI sector.

- A new digital technology emerging in the space of CCI and increasing productivity is edge computing. Edge computing is transforming for example the news media, audiovisual and music industries by processing data closer to its source, reducing latency, and enhancing responsiveness.

This section aims to provide some insights into the extent to which companies perceive digital technologies as enhancing their competitiveness.

Cultural and creative industries encompass both physical and digital products and services. The majority of growth within these industries today is driven by digital content, online platforms, and technological innovations. As a result, the impact of digitalisation is both significant and self-evident. This shift reflects broader trends in consumer behaviour and the evolution of digital experiences particularly in media, entertainment, and creative services[98].

The rise of online platforms and digital distribution channels has made it easier in particular in the media sectors to reach new and global audiences. Streaming services, e-commerce platforms, cultural websites and social media networks have democratised access to cultural content, breaking down geographic barriers and enabling even small creators and cultural and creative organisations to find an audience. On the other hand, digitalisation has also created opportunities for misinformation and disinformation, particularly in the news media sector, which is increasingly challenged by low trust and an uncertain business environment.[99].

The EMI Enterprise survey conducted with CCI companies indicates that the adoption of advanced digital technologies increased productivity around 10% overall. However, the adoption of digital technologies does not necessarily lead to a reduction in production costs. As a result, this industrial ecosystem experiences fewer economic gains compared to other industries that benefit more significantly from digital advancements. Unlike capital-intensive industries, where cost reduction is a key driver of efficiency, this sector is more reliant on human creativity, talent, and intellectual input. As a result, financial gains from digitalisation are less pronounced, as value creation is rooted

[98] Klein et al (2021). Cultural and creative industries as boost for innovation and sustainable development of companies in cross innovation process, Procedia Computer Science Volume 192, 2021, Pages 4218-4226
[99] Newman N (2024). Overview and key findings of the 2024 Digital News Report

in artistic, cultural, and knowledge-based contributions rather than purely economic efficiencies. The largest share of respondents reported an increase in productivity due to the adoption of Artificial Intelligence (AI), making it the most impactful among advanced digital technologies, closely followed by cloud computing (see Table below). This highlights the transformative potential of AI in the CCI. Cloud computing, on the other hand, has been pivotal in enabling seamless collaboration and efficient data management, which are particularly relevant for businesses.

Interestingly, 6% of respondents indicated a decrease in productivity as a result of adopting AI. **This suggests that while AI holds significant promise, some tools currently available on the market may not yet be fully optimised for the specific needs of the CCI sector.** Factors such as steep learning curves, inadequate customisation, and the high costs of implementation could contribute to these challenges. Additionally, misalignment between the capabilities of certain AI tools and cultural attitudes may hinder their effectiveness, leading to mixed outcomes. Certain AI tools may not fully align with the values, working methods, and creative processes of cultural and creative sectors, which often prioritise artistic expression, authenticity, and human intuition such as in performing art or visual arts.

The Internet of Things is playing a transformative role especially in the field of architecture, reshaping how buildings are designed, constructed, and managed and including an interconnected network of devices embedded with sensors, software, and other technologies.

A new digital technology emerging in the space of CCI is edge computing. Edge computing is transforming for example the news media, audiovisual and music industries by processing data closer to its source, reducing latency, and enhancing responsiveness. This innovation allows for faster data handling and seamless user experiences, paving the way for new creative possibilities. Edge computing in music enables real-time, device-centric data processing, reducing reliance on cloud services and improving efficiency. It enhances music composition, performance sharing, and crowdsensing while minimising data transmission time and energy consumption. By leveraging an edge-cloud computing model, the system optimises computational efficiency, reduces cloud traffic, and supports seamless music collaboration.

Edge computing is reshaping how content is created and consumed[100]. It supports real-time, high-definition, and immersive experiences across various domains, including digital art, video editing and interactive gaming. By leveraging edge computing, artists, designers, developers, and gamers can overcome traditional constraints, explore innovative workflows, and deliver interactive, engaging content.

Table 2: The impact on productivity of advanced digital technologies as expressed by the share of respondents

[100] See for example https://digital-strategy.ec.europa.eu/en/policies/edge-observatory and http://rlist.net/blog/edge-computing-in-creative-space-shaping-the-future-1697829600

	Increased	No change	Decreased
Artificial Intelligence	77%	23%	6.12%
Cloud computing	68%	30%	2%
Big Data	50%	47%	3%
AVR	33%	67%	
IoT	50%	50%	
Edge computing	50%	50%	
Blockchain	na	na	

Source: EMI Enterprise Survey 2024

Appendix A: References

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Appendix B: Methodological notes

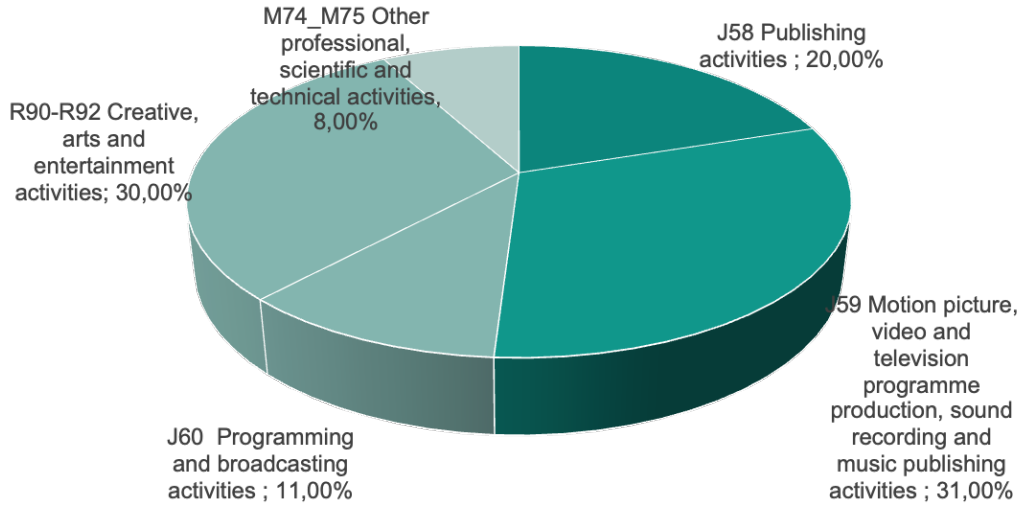
Startup data and venture capital data analysis

Crunchbase and Net Zero Insights/ Tags used in the analysis:

- *Architecture*
- *Advertising*
- *Gaming, video games*
- *Music, Independent music, music label, music streaming,*
- *Internet radio*
- *News, Journalism, News, Printing*
- *Publishing, Audiobooks, E-books*
- *Photography*
- *Performing arts, Theatre, arts*
- *Design*
- *Film, Film production, Film distribution, TV, TV production,*
- *Museums and historical sites*

Survey 2024 sample

Figure 31: Survey sample distribution in the case of CCI



Source: EMI Enterprise Survey 2024

LinkedIn data analysis

Table 3: Concordance between NACE and LinkedIn

Source: Technopolis Group based on LinkedIn

Green skills – keywords used: Cleantech, Sustainability, Sustainable Development, Sustainable Business, Energy Efficiency, Clean Energy Technologies, Renewable Energy, Wind Energy, Biomass, Biomass Conversion, Solar Energy, Solar Power, Urban Forestry, Forest Ecology, Sustainable Communities, Organic Farming, Organic Gardening, Urban Agriculture, Organic Food, Waste Management, Waste Reduction, Recycling, Water Treatment, Water Resource Management, Water Purification, Green Marketing, Green Printing, Environmental Biotechnology, Environmental Science, Environmental Engineering, Environmental Management Systems, Environmental Protection, Wastewater Treatment, Ecology, Circular Economy, Zero Waste, Waste to Energy, Plastics Recycling, E-Waste, Carbon Reduction Strategies, Carbon Footprinting, Carbon Neutral, Energy Retrofits, Biodiversity, Biodiversity Conservation, Nature Conservation, Advanced Materials, Nanomaterials, Biomaterials, Reuse, Separation Process, Sorting, Equipment Repair, Natural Resource Management,

Sustainability Reporting, Green Development, Sustainable Cities, Energy Conservation, Energy Management, Environmental Awareness, Environmental Impact Assessment, Environmental Compliance, Leadership in Energy and Environmental Design (LEED), Environmental Policy, Green Technology, Sustainable Design, Sustainable Architecture, Environmental Consulting, Maintenance and Repair, Solar PV, Solar Cells, Wind Turbines, Wind Turbine Design, Carbon Capture, Low Carbon Technologies, Low Carbon, Renewable Fuels, Renewable Energy Systems, Renewable Resources, Integrated Water Resources Management, Natural Resources, Biodiesel, Bioplastics, Waste Treatment, Waste Water Treatment Plants, Electric Vehicles, Hybrid Electric Vehicles, Multi-modal Transportation, Energy Efficiency Consulting, Recycled Water, Adaptive Reuse, Ecodesign, Life Cycle Assessment, Energy Optimisation, Alternative Fuels, Green Building, Green Infrastructure, Green Purchasing, Biodegradable Products, ISO 14001, EMAS, Environmental Standards

Digital skills – keywords used: data analytics, online platforms, digital payment, online ticketing, Cybersecurity, Intrusion Detection, Malware Detection, Cloud Security, Cybercrime Investigation, Cyber Threat Intelligence (CTI), Cryptography, DLP, Malware Analysis, IDP; Vulnerability Assessment, Certified Information Security Manager (CISM), Computer Forensics, Cloud Infrastructure, Cloud Services, Google Cloud Platform (GCP), SAP Cloud Platform, SAP HANA, Everything as a Service (XaaS), Software as a Service (SaaS), Platform as a Service (PAAS), Infrastructure as a Service (IaaS), Private Clouds, Hybrid Cloud, Cloud Computing, Edge Computing, High Performance Computing (HPC), Serverless Computing, Robotics, Robot, Robotic Surgery, Human-robot Interaction, Drones, Connected Devices, Internet of Things (IoT), Robotic Process Automation (RPA), Wireless Sensor Networks, Embedded Systems, Cyber-Physical Systems, Smart Cities, Artificial Intelligence (AI), Biometrics, Cognitive Computing, Computer Vision, Deep Learning, Machine Learning, Natural Language Processing (NLP), Natural Language Understanding, Natural Language Generation, Reinforcement Learning, Speech Recognition, Supervised Learning, Unsupervised Learning, Big Data Analytics, Hadoop, Real-time Data, Yarn, Teradata Data Warehouse, Blockchain, Ethereum, Bitcoin, Cryptocurrency, Crypto, Distributed Ledger Technology (DLT), Hyperledger, Augmented Reality (AR), Virtual Reality (VR), Mixed Reality, Computer-Generated Imagery (CGI), Connectivity, M2M, 5G, SD-WAN, Home Automation, Flexible Manufacturing Systems (FMS), Smart Manufacturing, Smart Materials, Quantum Computing, Smart Devices, Intelligent Systems, Big Data, Computer-Aided Design (CAD), Computer Science, MATLAB, C (Programming Language), Python (Programming Language), Digital Strategy, Digital Printing, Digital Marketing, Online Journalism, Revit, Building Information Modeling (BIM), JavaCard, R (Programming Language), Digital Imaging, Digital Media, C++, Collaborative Robotics, Industrial Robotics, Medical Robotics, Mobile Robotics, AutoCAD, Automation, Autodesk 3ds Max, Lumion, Data Analysis, Data Mining, 5G Core, Integrated Security Systems, Cloud Applications, Cloud Computing IaaS, Cryptocurrency Mining, CryptoAPI, Automated Machine Learning (AutoML), Machine Learning Algorithms, Virtual Reality Development, Virtual Data Rooms, Intelligence Systems, Robot Programming, Predictive Analytics, Data Lakes, Blockchain Analysis, Digital Publishing, Enterprise Software, Software Development, SAS (Software), SAP Products, SAP ERP, Online Payment, Online Payment Solutions; Online Travel, Online Marketing, Online Business Management, Online Advertising, Online Gaming, Web Services, Mobile Applications, Mobile Marketing, Java Database Connectivity (JDBC), Data Warehousing, Statistical Data Analysis, Data Modeling, Databases; Electronic Data Capture (EDC), Data Centres, Oracle Database, SAP Solution Architecture Data Entry, Data Management, Data Mapping, Web Applications, GIS Applications, Oracle Applications, Visual Basic for Applications (VBA), Computer Hardware, Computer Maintenance, Computer Network Operations, Computer Networking, Computer Graphics, Online Communications, Social Media Marketing, Digital Direct Marketing, Digital Illustration, Digital Video, Digital Photography, Xero, GPS Applications, GPS Devices, GPS Tracking, GPS Navigation, Microsoft Power Apps, Social Networking Apps, Google Apps Script, Social Media, E-Commerce, Data Intelligence, Online Platforms, Mobile Payments

Exiobase

Exiobase is a time series of environmentally extended multi-regional input-output (EE MRIO) tables. Its coverage is by country and industry from 1995 to 2021 and has EU and extra rest of the world coverage. Source: Stadler, Konstantin, Wood, Richard, Bulavskaya, Tatyana, Södersten, Carl-Johan, Simas, Moana, Schmidt, Sarah, Usubiaga, Arkaitz, Acosta-Fernández, José, Kuenen, Jeroen, Bruckner, Martin, Giljum, Stefan, Lutter, Stephan, Merciai, Stefano, Schmidt, Jannick H, Theurl, Michaela C, Plutzar, Christoph, Kastner, Thomas, Eisenmenger, Nina, Erb, Karl-Heinz, … Tukker, Arnold. (2021). EXIOBASE 3 (3.8.2) [Data set]. Zenodo. https://doi.org/10.5281/zenodo.5589597

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