Monitoring industrial ecosystems

TOURISM

Analytical report - 2024 edition

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Executive Summary

This report was prepared as part of the **'European Monitor of Industrial Ecosystems'** (EMI) project, with the objective of analysing the green and digital transformation of industrial ecosystems - focusing, in this edition, on the **tourism** ecosystem and its progress over time.

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 the environment and on productivity.

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

Green Transition

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

- In 2024, **21% of companies in the tourism industrial ecosystem have adopted strategies for climate neutrality**.

- Over **70% of tourism companies reduced waste and saved energy, while more than 60% were saving water and materials in 2024.** A much lower share of companies invested directly in green transition technologies: nearly 40% have invested into energy-saving technologies. Advanced materials and waste management technologies were adopted by 18%. At the bottom end of the spectrum are circular industrial business models (6%) and carbon capture technologies (4.4%).

- Tourism companies made most often **reference to responsible sourcing (25% of websites of tourism organisations)**, followed by considerations about a sustainable supply chain and waste reduction.

- However, **progress over time has been slow** both in terms of adoption of environmental measures and sustainability strategies, with the exception of renewable energy adoption, which saw a 6-percentage point increase from 2022 to 2024.

- **24% of the companies surveyed in tourism indicated that they have relied on environmental services such as energy audits** and carbon footprint analysis provided by external companies.

- **3% of companies in the tourism ecosystem had at least one environmental certificate/label referenced** on their website which is close to the results in 2023 and show no progress over this one-year period.

- **Environmental startups in tourism focused on offering rental and sharing services, alternative sustainable tourism** (including online travel agencies with a sustainable concept), and recycling solutions. **Nearly 10% of these startups were able to scale** beyond 51 employees.

- Despite the high share of companies taking action for the environment, there is an **overall low level of investment into environmental technologies**. 26% of tourism companies have opted not to invest in environmental technologies, and of the companies that do invest, nearly half (49%) allocate less than 5% of their annual revenue toward such initiatives. This pattern of investment has shown minimal fluctuation from 2021 to 2024. However, surveyed companies are planning to invest more in the future.

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

- The tourism industrial ecosystem accounted for EUR 14.9 bn in funding from the European Regional Development Fund in 2014-2020. Projects that addressed specifically the **green transition of tourism accounted for over EUR 2.5 bn (16% of ERDF funding dedicated to tourism)**.

- Green transition projects co-funded by the ERDF in tourism cover largely **hotel or infrastructure refurbishment, green space development, biodiversity conservation, and environmental education, promoting sustainability and habitat protection and lowering electricity usage and greenhouse gas emissions, enhance energy efficiency** in businesses, and support the adoption of renewable energy solutions across different industries.

- Throughout the Horizon 2020 programme, over EUR 27 m was allocated to projects related to the green transition of tourism, **amounting to nearly EUR 4 m per year**. In the initial four years of **Horizon Europe, close to EUR 14 m was spent on similar projects, averaging over EUR 4.7 m annually**.

- The **proportion of projects co-funded under the EU's framework programme for research and innovation and related to the green transition has been approx. 20-24%** annually over the period from 2014-2024.

- Organisations in the tourism industrial ecosystem employed in general 2 full time employees in green jobs either partially or fully dedicated to environmentally focused tasks. However, **55% did not employ professionals in green jobs at all and only 16% created a new position related to environmental protection in 2024.**

- There has been a **slow progress in terms of the number of professionals with green transition** related skills. The share of professionals with skills relevant to the green transition reached 2.6% in 2024, showing only a slight increase from 2022. This share was the **highest in museums** (6.4%), followed by 4.7% in **travel arrangements**, and 2.4% and 1.5% in hospitality and restaurants.

- Critical skills gaps in the tourism industrial ecosystem relate to **energy and water efficiency, recycling and waste management, biodiversity conservation and sustainable transport modes.**

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

- **Tourism's environmental impact has seen only limited improvements, with some areas showing deterioration compared to pre-pandemic levels.** This highlights the persistent and multi-dimensional environmental footprint of the tourism ecosystem, encompassing CO2 emissions, resource consumption, pollution, water extraction, and beach litter. Environmental challenges associated with tourism are considerable and difficult to balance with the growth of the sector

- **CO2 and particulate matter emissions based on production account have remained stable over time** (indicating that hotel, restaurants and travel agency services have a stable energy consumption pattern). Additionally, emissions from consumption travel have risen as part of a broader post-pandemic-recovery leading to an increase in CO2 emissions.

- **Material extractions have been increasing** over the entire period of 2016 to 2022, with an average annual growth of 5.53%.

- **Waste production is still a key concern**. Beach waste has been increasing over the years. In particular, the overall median value for plastic items found per 100 m on European beaches was 481 in 2022, compared to 121 in 2013.

- **Land use measured in square kilometres showing a recent surge**. The increase in land use aligns with statistics showing a rise in European hotel construction projects, which saw a significant surge in 2024.

Digital Transition

What is the progress of industrial efforts towards digitalisation?

- **31% of tourism companies have a concrete strategy in place for digital transformation in the tourism industrial ecosystem.**

- The EMI Enterprise survey revealed an **increase in the uptake of digital technologies. The largest increase is seen in cloud technologies and artificial intelligence**, the latter increasing by nearly 15%, and the Internet of Things, which increased by nearly 10%.

- The **adoption rate of AI has doubled** between 2023 and 2024 both in the case of travel agency, tour operator and other reservation services and less so in the case of accommodation and food services.

- In the tourism ecosystem, **46% of businesses that adopted AI did so within the past year.**

- 28% of tourism businesses use **AI in marketing and sales**.

- In terms of startups, **artificial intelligence and software solutions emerged as major technological focus areas.** The former represented 14% in 2020 and 20% in 2023, the latter represented 30% of startups in 2020 and 60% of startups in 2023. Online travel and tourism platforms reached a peak in 2019 in terms of investment before declining. In contrast, investments in artificial intelligence surged in 2022, alongside software technologies. This trend reflects the dynamic shift in digital investments, particularly influenced by the COVID-19 pandemic.

- While online platforms were the dominant technology area developed by digital tech startups in tourism, the share of new companies developing these platforms decreased from 40% in 2015 to 10% in 2023.

- The **vast majority of firms invest less than 5% of revenues across all the technologies**. Only a handful of firms invest more than 30% of their turnover in digital technologies, concentrating on cloud (1.6%) and AI (2.6%).

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

- The European Regional Development Fund (ERDF) plays a vital role in advancing the digital transition within the tourism industrial ecosystem by providing financial support for digitalisation.

- The **ERDF allocated 7% of all tourism co-funded projects (2 378 out of 48 257) to digital technologies,** with the digital transition accounting for 8% of total tourism-related funding (EUR 1.15 bn).

- Advanced digital technologies accounted for **21% of the total ERDF funding dedicated to the digital transition of tourism in the 2014-2020 programming period, with augmented and virtual reality, big data and data analytics, and online platforms being the most commonly supported advanced technologies**.

- During the whole of **Horizon 2020, over EUR 52 m was spent on projects related to the digital transition in tourism**, more than EUR 7 m per year. In the first three years of Horizon Europe, nearly EUR 40 m were spent on digital topics, averaging EUR 13 m per year.

- The share of projects co-funded by Horizon and focused on the digital transition has grown significantly, rising from **43% to 52%.**

- In 2024, **3.2% of professionals registered on LinkedIn and employed within the tourism industrial ecosystem possessed advanced digital skills and 16.8% possessed other more moderate digital skills**, marking an increase from the levels observed in 2022. The most prevalent advanced digital skill remains cloud technologies, followed by artificial intelligence and big data. However, the overall percentages remain modest, and while there has been some increase, it is not substantial.

- The **requirements both for moderate and advanced digital skills listed on online job advertisements within tourism** has been growing steadily over the period from 2021-2023. In 2023, 23% of online job advertisements in the EU27 required moderate digital skills and 17% advanced digital skills.

- Tourism managers are increasingly required to possess broader **digital literacy, the agility to embrace technological opportunities**, and the ability to lead teams in a digitally evolving environment.

- While it is clear that travel and tourism predominantly happens in person, making it an inherently **human-centric experience**, the prevalence of the digital technologies among travellers and growing demand for unique and burdensome travel experience creates an environment for digitally enabled tourism.

What is the impact of digital technologies on competitiveness?

- The tourism industry has become more digital, mobile and personalised affecting the tourism ecosystem across three dimensions: 1) Improving customer experience and personalisation; 2) Boosting operational efficiency and sustainability; 3) Supporting new business models.

- The survey of tourism companies indicates that the adoption of advanced digital technologies increased productivity between 1-15%. **The largest share of respondents witnessed an increase in productivity as a result of cloud computing followed by AI and big data**.

- However, 5% of businesses reported a decrease in productivity attributed to the initial investment costs associated with adopting new technologies or practices. Initial costs include expenditures on **equipment, software, employee training**, and changes to **operational** processes.

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 **'Tourism'**[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 the adoption of green and digital technologies and that move towards sustainable competitiveness. The process is however characterised by complex, multi-level, and dynamic developments. To make transition sustainable, technological change needs to be coupled with new business models, the necessary investments and financial tools, 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 of the report. **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:

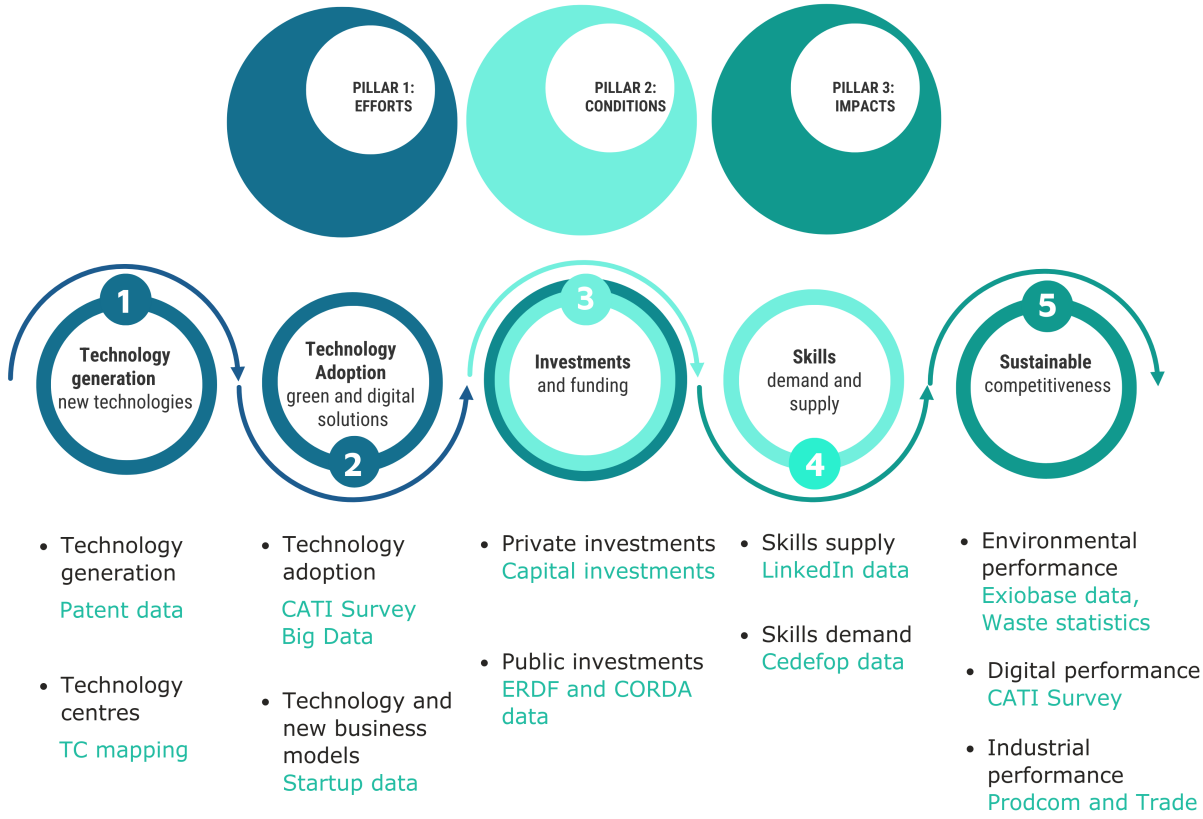
- *Green transition technologies*: advanced materials, biotechnology, clean production technologies, energy saving technologies, recycling technologies, renewable energy.
- *Advanced digital technologies*: advanced manufacturing and robotics, artificial intelligence and big data, augmented and virtual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

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

[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, retail, proximity and social economy, and retail

[3] Tourism is captured by these NACE codes: I Accommodation and food service (100%), N79 Travel agency, tour operator and other reservation service (100%), N82 Office administrative, office support and other business support, R90-R92 Creative, arts and entertainment activities (66%), R93 Sports activities and amusement and recreation (100%), H49 Land transport (45%), H50 Water transport (22%), H51 Air transport (91%).

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



Source: Technopolis Group, IDEA Consult and Fraunhofer ISI

This report contributes to the analysis of the **key pillars put forward in the 'Blueprint for the development of transition pathways'**[4] of the Industrial Forum developed in 2022.

It complements other key reports such as the **Transition Pathway for Tourism**[5], which outlines the strategic plan to lead the tourism sector through green and digital transitions, and **the recent two years stocktaking report**[6]. It also takes into account **the European Tourism Agenda 2030**[7], which is aligned to the former and which provides a comprehensive framework for making tourism in the EU greener, more digital, and more resilient and the **EU Strategy for Sustainable Tourism**[8].

The indicator framework is also complementary to the **EU Tourism Dashboard**[9] that offers interactive visualisations of data and indicators relevant for the European tourism ecosystem. The collected data is also reflected in the EMI Data Dashboard[10]. The dashboard offers an overview of the data collected within the EMI project for several indicators used to measure the progress of the green and digital transitions across the 14 industrial ecosystems on a yearly basis. This dashboard provides a clear and interactive visualisation of data under three dimensions of the twin transition: efforts, enabling framework conditions and impact.

[4] https://ec.europa.eu/docsroom/documents/49407/attachments/1/translations/en/renditions/native
[5] https://single-market-economy.ec.europa.eu/news/transition-pathway-tourism-published-today-2022-02-04_en
[6] https://op.europa.eu/en/publication-detail/-/publication/678c08ab-bc06-11ee-b164-01aa75ed71a1/language-en
[7] https://single-market-economy.ec.europa.eu/news/european-tourism-agenda-2030-commission-welcomes-commitment-eu-countries-make-tourism-greener-more-2022-12-02_en
[8] https://www.europarl.europa.eu/doceo/document/TA-9-2021-0109_EN.html
[9] https://tourism-dashboard.ec.europa.eu/?lng=en&ctx=tourism
[10] See: https://monitor-industrial-ecosystems.ec.europa.eu/data-dashboard

1.2. Scoping the tourism industrial ecosystem

Tourism is a vital industry within the European Union, contributing significantly to economic growth and job creation. As the Transition Pathway described in 2022[11], the tourism industrial ecosystem gathers businesses from a range of sub-industries such as **hospitality services** (food and beverage, accommodation), **tourist information providers** (tourist offices, travel agencies digital platforms, travel technology providers), **tour operators**, **destination managing organisations**, **attractions** (museums, fairs, amusement parks) and **passenger transport** (airlines and airports, trains, buses, car rentals and cruises). It is directly connected to other ecosystems such as Cultural and creative industries (tourism based on cultural heritage, traditions, arts and authentic cultural experiences, sport tourism), Health (access to healthcare while travelling and health tourism), Mobility, transport and automotive, (mobility for travellers and visitors), Proximity and Social economy (local economy), Retail (opportunities for visitors and local residents to create new income), Aerospace (air travel, space data based services), Agri-food (food services), Construction (building and renovating tourism infrastructures) and Digital industries (digital applications)[12].

For the purpose of statistical analysis, following the Annual Single Market Report 2022[13], the tourism ecosystem includes various economic activities, defined by NACE rev.2 classifications and include namely: Accommodation and food service activities (I), Travel agency, tour operator and other reservation service and related activities (N79), Office administrative, office support or other business support activities (N82), Creative, arts and entertainment activities; libraries, archives, museums and other cultural activities; gambling and betting activities (R90-R92) and Sports activities and amusement and recreation activities (R93).

The tourism industrial ecosystem was responsible for 5.6% of the EU value added and provided 20 258 494 jobs in 2022[14]. In 2022, there were 3.5 million businesses in the tourism sector, 99% of which were small, medium, or micro enterprises[15]. Tourism is a vital economic activity in the EU, particularly in certain EU Member States, where it significantly contributes to economic growth, employment, and social development. In 2022, Spain, France, and Italy had the highest concentration of tourism companies in the EU[16]. The tourism ecosystem is diverse and complex, encompassing businesses ranging from large multinationals to small family enterprises across sectors like accommodation, food and beverage, transport, and tour operations, all connected through global value chains.

In 2024, the European tourism industry faced several key challenges despite a strong recovery[17]. Inflationary pressures and high operational costs particularly within the hospitality industry impacted both businesses and consumers. Many EU businesses experienced staffing shortages. Operationally, the industry was still grappling with uneven regional recovery, where some destinations outperforming others, as well as overtourism in popular areas, and varying rates of air traffic recovery.

The latest UN Tourism Confidence Index[18] reveals **optimism for 2025**, with experts predicting better or much better prospects compared to 2024. However, **challenges such as high transport and accommodation costs, volatile oil prices, and geopolitical risks persist.** Tourists are expected to prioritise value for money, while balancing growth and sustainability remains crucial for the industry's future.

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[11] https://single-market-economy.ec.europa.eu/news/transition-pathway-tourism-published-today-2022-02-04_en
[12] European Commission (2022). Transition Pathway for Tourism
[13] Available here: https://ec.europa.eu/docsroom/documents/48877
[14] Eurostat, 2024
[15] European Commission (2024). Tourism Industrial Ecosystem Factsheet https://single-market-economy.ec.europa.eu/document/download/186dd0dc-47c7-4a2f-872f-608a2d56707d_en?filename=Tourism%20Factsheet%20V3.pdf&prefLang=da
[16] Eurostat Structural Business Statistics
[17] ETC (2024). European Tourism: Trends & Prospects Quarterly Report Q2/2024
[18] https://www.unwto.org/news/international-tourism-recovers-pre-pandemic-levels-in-2024

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, **21% of companies in the tourism industrial ecosystem have adopted strategies** for climate neutrality.

- Over **70% of tourism companies reduced waste and saved energy, while more than 60% were saving water and materials in 2024**. A much lower share of companies invested directly in green transition technologies: nearly 40% have invested into energy-saving technologies. Advanced materials and waste management technologies were adopted by 18%. At the bottom end of the spectrum are circular industrial business models (6%) and carbon capture technologies (4.4%).

- Tourism companies made most often **reference to responsible sourcing (25% of websites of tourism organisations),** followed by considerations about a sustainable supply chain and waste reduction.

- However, **progress over time has been slow, with the exception of renewable energy adoption**, which saw a 6-percentage point increase from 2022 to 2024.

- **24% of the companies surveyed in tourism indicated that they have relied on environmental services** such as energy audits and carbon footprint analysis provided by external companies.

- **3% of companies in the tourism ecosystem had at least one environmental certificate/label referenced** on their website which is close to the results in 2023 and show no progress over this one-year period.

- Environmental startups in tourism focused on **offering rental and sharing services, alternative sustainable tourism** (including online travel agencies with a sustainable concept), and **recycling** solutions. Nearly **10% of these startups were able to scale beyond 51 employees**.

- Despite the high share of companies taking action for the environment, there is an **overall low level of investment into environmental technologies**. 26% of tourism companies have opted not to invest in environmental technologies, and of the companies that do invest, nearly half (49%) allocate less than 5% of their annual revenue toward such initiatives. This pattern of investment has shown minimal fluctuation from 2021 to 2024. However, surveyed companies are planning to invest more in the future.

Following the discussion of the main indicators that capture the environmental impact of tourism, this section reports on the progress made by tourism companies taking action towards the green transition. It also analyses how startups and young companies that provide environmental solutions exclusively for tourism contribute to the transformation of the industrial value chain. Moreover, it examines the level of investment by tourism organisations in the green transition including green technologies, renewable energy, and circular economy solutions.

2.1.1. Uptake of environmental technologies and circular business models

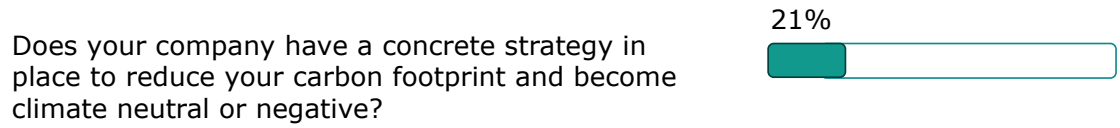
The tourism ecosystem faces a gradual shift from a production model that relies heavily on resources to one that prioritises environmental responsibility. Economic expansion in tourism typically correlates with increased environmental impact, as enhanced tourism

activity involves higher consumption of natural resources and greater pollution[19]. Transitioning to more sustainable practices will demand substantial time, investment, and adjustments to current processes and resource dependencies as this section will also show.

The adoption of technologies and circular business models in tourism has been investigated in detail by the Eurobarometer 2024[20] and has been complemented by the EMI Enterprise Survey[21] with a sample of 605 companies from the tourism ecosystem over the period from July to September 2024. These data sources provide valuable insights into the environmental actions undertaken by companies, the technologies they have adopted, and the challenges they face in implementing sustainable practices. Tourism organisations are adopting various measures that aim at environmental protection as part of their transition towards more sustainable operations, driven by both regulatory pressure and the recognition of the business case for green operations.

In the tourism ecosystem, 21% of companies have implemented a concrete strategy to reduce their carbon footprint and achieve climate neutrality or negativity, according to the results of the Eurobarometer 2024[22]. This reflects a modest level of commitment and indicates a slow progress compared to the 2021 survey results, which found that 24% of companies had such strategies in place that year. In addition, 34% are planning to adopt or purchase new technological solutions to reduce emissions, 25% are planning to develop their own solution (28% in 2021) and 4% are offsetting emissions through carbon credit or similar.

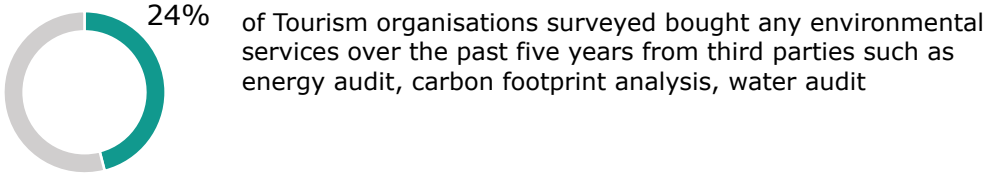
Figure 2: Share of companies in the tourism industrial ecosystem that has adopted strategy to reduce carbon footprint



Source: Eurobarometer 2024, n=640

To further contribute to the green transition, 24% of the companies surveyed in tourism indicated that they have relied on environmental services provided by third-party providers (as illustrated in the Figure below).

Figure 3: Purchasing environmental services



Source: EMI Enterprise Survey 2024, n=605

More specifically, tourism companies in the EU relied on third-party environmental service providers for tasks such as energy audits and carbon footprint analyses. The services are used to meet sustainability goals, comply with environmental regulations. On the one hand, tourism companies use third party services as neutral service provider to enhance company's reputation among eco-conscious travellers For example, hotels, hostels, small accommodations, campsites, holiday parks, conference centres, restaurants and attractions use Green Key certificate that represents a commitment by businesses that their premises adhere to the strict criteria set by the Foundation for Environmental

[19] Trstenjak, A., Tomas Žiković, I. & Žiković, S. Making tourism more sustainable: empirical evidence from EU member countries. *Environ Dev Sustain* (2023). https://doi.org/10.1007/s10668-023-04284-9
[20] https://europa.eu/eurobarometer/surveys/detail/3221
[21] The EMI Enterprise Survey was run as computer-assisted telephone interviewing with companies in all industrial ecosystems from August-September 2024.
[22] This proportion that is similar to that of the economy as a whole, according to the Eurobarometer.

Education[23]. On the other hand, energy audit, carbon footprint analysis or water audit are often complex, requiring specialised expertise, tools, and certifications that are typically not available in-house within most tourism companies.

Companies within the tourism ecosystem have been actively implementing measures to enhance resource efficiency but made limited progress over time. Over 70% are reducing waste and conserving energy, while more than 60% are saving water and materials according to the Eurobarometer 2024. Additionally, 56% to 62% plan to expand these efforts in the next two years. Around 50% of companies are recycling by reusing materials or waste. The adoption of renewable energy has notably increased from 22% in 2021 to 28% in 2024, with 46% planning further progress. These initiatives have led to higher production costs for 39% of firms and reduced costs for 37%.

When comparing values from 2021 to 2024, it can be observed that only limited progress has been made in areas such as waste reduction, recycling, sustainable design, and the adoption of renewable energy.

Table 1: Resource efficiency measures undertake by companies in the tourism ecosystem

Environmental measures	***Share of adoption (2021)***	***Share of adoption (2024)***
Minimising waste	71%	73%
Saving energy	71%	72%
Saving water	63%	61%
Saving materials	63%	61%
Recycling, by reusing material or waste within the company	49%	52%
Switching to greener suppliers of materials	43%	42%
Designing products that are easier to maintain, repair or reuse	30%	33%
Using predominantly renewable energy	22%	28%
Selling your residues and waste to another company	27%	25%

Source: Eurobarometer 2024, n=640

While Table 1 provides clear insights of the objectives of the initiatives undertaken, Table 2 below, provides insights on what exactly is being done, that is, which technologies have been adopted to support the green transition. As indicated below, according to the EMI Enterprise survey **nearly 40% of respondents have invested into energy-saving technologies** in 2024. Advanced materials and waste management technologies are adopted by 18% of respondents. At the bottom end of the spectrum, we find clean production technology (approx. 10%), circular industrial business models (6%) and carbon capture technologies (4.4%).

The comparison between Table 1 and Table 2 reveals a notable difference in the shares reported. The proportion of firms adopting measures in Table 1 is significantly higher than those adopting technologies in Table 2. **This suggests that while many companies are implementing general environmental measures, fewer are investing in more advanced, technology-driven solutions.** This discrepancy may indicate that firms find it easier or less costly to adopt procedural changes than to invest in new technologies or that they may be hesitant due to the higher capital investment and technical expertise required for implementing cutting-edge environmental technologies.

[23] See: https://www.greenkey.global/

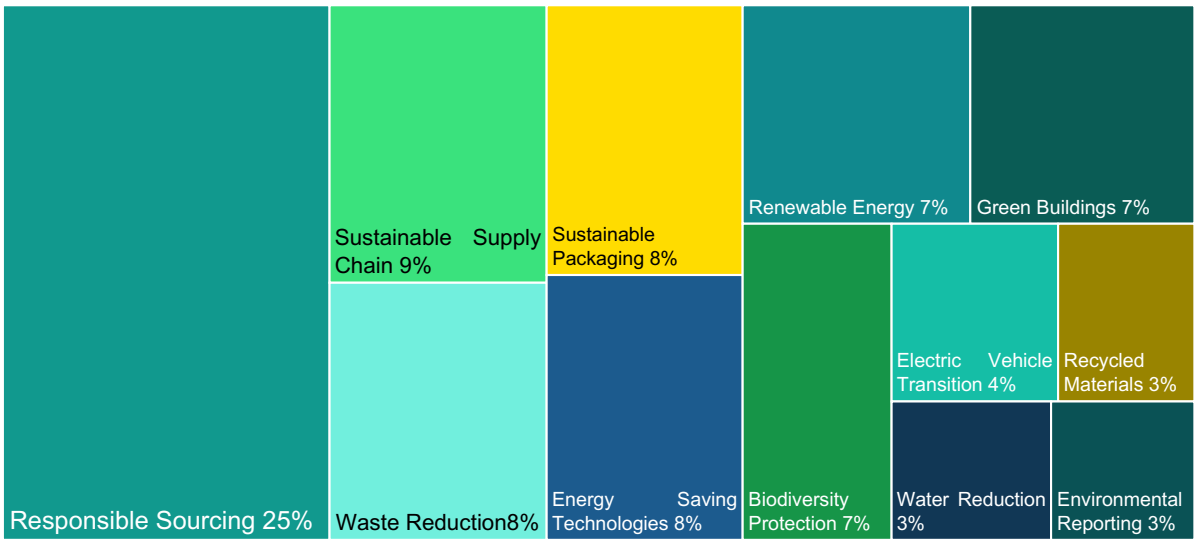
Table 2: Share of companies in the tourism industrial ecosystem that adopted a green transition technology

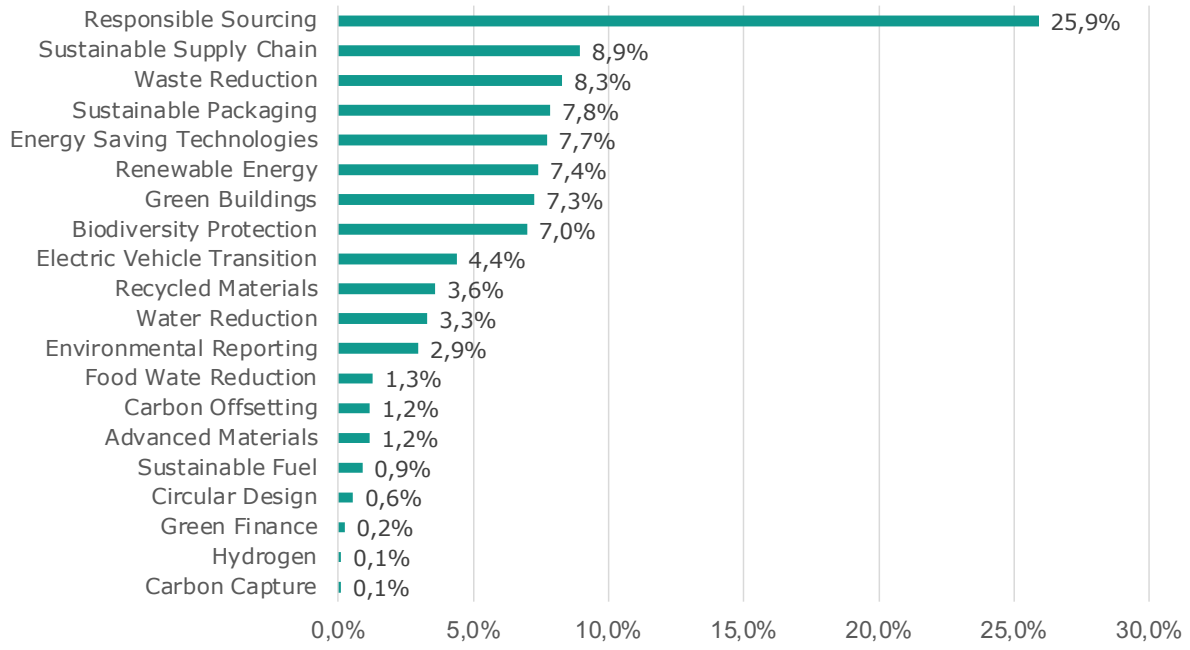
Green Technologies	***Share of adoption (2024)***
Energy-saving technologies	39.89%
Advanced materials	18.03%
Waste management technologies	18%
Clean production technologies	9..4%
Circular industrial business models	6.01%
Carbon capture technologies	4.37%

Source: EMI Enterprise Survey 2024, n=605

By applying text-mining techniques to websites of tourism companies and organisations, more nuanced insights have been gained into the sector's environmental practices. Text-mining—a method for extracting patterns and themes from vast amounts of text data—has allowed for the analysis of company information published on the web (380 465 organisation websites have been scraped) to reveal trends in environmental strategies. The results indicated that the most reference has been made to responsible sourcing (25% of websites of tourism organisations), followed by considerations about a sustainable supply chain and waste reduction. Biodiversity has been referenced only on 7% of the websites which is a low result. Carbon offset programmes appeared on 1.2% of the websites.

Table 3: Share of companies in the tourism industrial ecosystem referencing an environmental measure in 2024





Source: Technopolis Group based on Glass.ai analysis 2024, scraping 380 465 websites

The green transition of companies in the tourism ecosystem (excluding transport) has been analysed similarly to the report in 2023[24] in terms of their use of environmental certifications and secondly their claims of environmental practices.

Environmental certifications/labels are formal recognitions that a company has met specific environmental standards and criteria set by certifying bodies. Examples include certifications like ISO 14001 (Environmental Management), Green Key (for eco-friendly hotels), or EarthCheck (for sustainable tourism). Obtaining such certifications requires a company to adhere to established environmental guidelines and practices.

The results indicate that **3% of companies in the tourism ecosystem** had at least one environmental certificate/label referenced on their website which is close to the results in 2023 and show no progress over this one-year period.

The adoption of these green measures varies across the tourism value chain. Larger companies, such as hotel chains and airlines, are leading the adoption of energy-saving technologies and waste management systems, while SMEs, particularly in rural and ecotourism sectors, focus more on locally sourced products and nature-based tourism services. Startups in the tourism ecosystem are also playing a crucial role, developing new environmental services such as digital platforms for eco-friendly travel planning, waste reduction applications, and solutions that promote the sharing economy to minimise resource use.

Box 1: Company examples adopting environmental technologies

ENAIRE[25] Spain's national air navigation service provider, interviewed as part of this study, is implementing the Fly Quiet initiative[26] to reduce noise pollution affecting communities and biodiversity. It involves designing more efficient flight routes using satellite technology (PBN) to avoid populated areas and systematically analysing the noise impact of each aerial manoeuvre. ENAIRE also assesses the effects on biodiversity, particularly on birds in protected areas, ensuring 100% of its projects are carefully reviewed to minimise noise and environmental impact.

Evaneos[27], a French company, specialises in sustainable, tailor-made travel by connecting travellers directly with local experts. The company has put sustainability at the core of its efforts and business

[24] https://monitor-industrial-ecosystems.ec.europa.eu/industrial-ecosystems/tourism
[25] https://www.enaire.es/home_en
[26] https://www.enaire.es/en_GB/2021_12_23/ndp_enaire-launches-green-sky
[27] https://www.evaneos.de/

model. Evaneos, which was also interviewed as part of the study, is a digital marketplace that brokers between travellers and local agencies, which are required to follow strict environmental and social policies. As part of their commitment to sustainability, they calculate the emissions implied in the travel experiences they sell, with a view to helping reduce them by adjusting their offer. Last but not least, Evaneos has implemented the Better Trips Fund, through which a percentage of their revenues is invested to support environmental projects. Evaneos has committed to cutting emissions by 50% by 2030 and achieving net-zero by 2050, as part of their sustainability efforts, by signing the Glasgow Declaration on Climate Action in Tourism.

In the field of hotels and accommodation, Hotel St. Daniel[28] in Slovenia is one example of an organic hotel built of 100% recycled wood and serving organic food in its restaurant. The hotel is ecological from the wines and ingredients used in the kitchen to washing laundry and running the hotel operations.

Despite the growing adoption of environmental measures, evaluating their effectiveness is challenging because the success of these initiatives depends on external factors within the broader ecosystem. For example, when hotels implement new recycling processes, their effectiveness may be limited without complementary investments from local municipalities in waste management infrastructure. Another example pertains to energy-saving measures that can conflict with regulations aimed at preserving historical heritage. As observed in fieldwork, hotels situated in historic buildings or districts are often subject to cultural heritage regulations, which impose restrictions on interventions like installing solar roof panels. Last but not least, sustainable sourcing, especially for biodegradable materials, remains underdeveloped as supply chains have yet to meet growing demand in the hospitality sector.

According to both the fieldwork carried out as part of this project and the most recent Eurobarometer 2024, there are significant challenges in pursuing environmental resource efficiency. Administrative/legal complexities are the most widely reported challenge (35% of respondents), followed by the complexity of environmental reporting (28%), the costs of environmental initiatives (27%), the difficulty to adapt environmental legislation to the company specificities (27%), the fact that the technical requirements of the legislation are not up to date (27%).

The fieldwork conducted in the framework of this study, involving actors in the hospitality sector as well as startups and cluster organisations in tourism, has confirmed the above challenges and revealed that the shift to green operations mean different things in different segments of the tourism ecosystem. For instance, in the hospitality sector, the challenges faced include the initial high investment costs and the lack of technical know-how in the local labour market, an aspect that is particularly significant for small and medium-sized enterprises (SMEs). Companies emphasised that adopting sustainable practices is necessary for regulatory compliance and that green certifications improve brand reputation and customer loyalty.

Figure 4: Difficulties when trying to set up resource efficiency actions

Source Eurobarometer 2024

[28] https://www.stdaniel.si/en/

2.1.2. Environmental startups supporting the green transition of tourism

Analysing the dynamics of startup creation, growth and investment is essential for understanding the green transition in tourism, as startups signal emerging trends and potential disruptions. Their approaches to sustainability and resource efficiency, provide insights into future industry directions, in relation to business models, market demand and investment priorities. The analysis of Crunchbase[29] and Net Zero Insights[30] identified **2 023 active innovative startups in tourism established after 2015 that indicates a growth compared to a year ago** (when 1 700 startups were registered although with a slightly different methodology). Taking into account business demographics in tourism, which show a 2% growth in the number of enterprises from 2022 to 2023[31] in accommodation and food services, travel agency, tour operator and other reservation services, and cultural activities, this further demonstrates a positive startup environment that supports innovation.

Out of these innovative startups, 158 (8%) focused specifically on improving environmental sustainability. Environmental startups in tourism often connect demand and supply for ecological tourism services in specific niches, foster travel experiences that create links to the local hosts and aim at saving environmental resources. The typology of these environmental startups is similar as found in the EMI tourism report in 2023. Startups are linked to topics such as the **rental and sharing services, alternative sustainable tourism** (including online travel agencies with a sustainable concept), and **recycling solutions**. Sustainable mobility remains also an important topic.

Nearly 10% of the above presented tourism startups focusing on environmental sustainability were able to scale beyond 51 employees, while only 6 were acquired. This demonstrates the significant challenges these companies face in scaling within a competitive market, where growth is often hampered by high operational costs, market saturation, and the need for substantial investment to develop technology-driven services. The limited acquisition rate also underscores the challenges these startups face in securing strategic partnerships or buyouts, which are often crucial for growth and expansion in such a capital-intensive industry.

An example for scaling up is Fairmoove[32] in France that is a digital travel agency that promotes environmentally responsible tourism. It ensures that tourists and local people have a satisfying and sustainable travel experience while minimising the negative effects of travel and tourism on the environment and society.

Other examples include:

- ResQ Club[33], founded in 2015, is a Finnish company that helps reduce food waste by connecting consumers with surplus food from restaurants, cafes, and grocery stores through its app. Users can buy this surplus at discounted prices, supporting sustainability. The company operates in Finland, Sweden, and Estonia, with a mission to bring food waste to zero.
- bstoked[34], a German startup, is a platform dedicated to organising and promoting kitesurfing holidays around the world. It offers unique kitesurfing trips, including kite camps, kite cruises, and beginner or advanced tours, connecting travellers with local hosts. The platform focuses on eco-conscious travel experiences, helping kitesurfers explore global destinations while fostering local tourism economies. With a user-friendly

[29] See: https://www.crunchbase.com/
[30] See: https://netzeroinsights.com/
[31] Eurostat – Enterprise Statistics per size class and NACE rev https://ec.europa.eu/eurostat/databrowser/view/sbs_sc_ovw__custom_16138037/default/table?lang=en
[32] https://www.fairmoove.fr/
[33] https://www.resq-club.com/
[34] https://www.bstoked.net/

booking system and direct contact with local providers, bstoked ensures transparency, sustainability, and adventure for kitesurf enthusiasts.

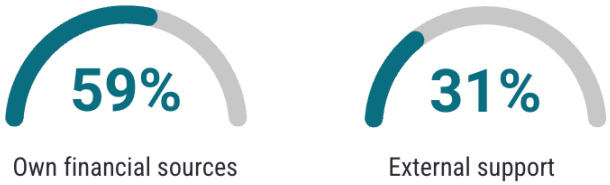
Other startups focus on recycling and waste management (solutions for food waste) and environmentally friendly tourism services. A notable example is Ozarka B.V., based in Amsterdam, which is a circular economy company providing reusable food and drink packaging solutions to restaurants, food vendors, and professional catering companies.

2.1.3. Private investments

The uptake of green technologies as presented above by the analysis of traditional tourism businesses and innovative green tech startups is mirrored by the patterns of investment described below.

Companies in the tourism ecosystem mainly rely on internal financial resources to enhance resource efficiency and offer green products and solutions. The Eurobarometer results show this, with 59% of companies declaring to have used their own financial resources to be more resource efficient.

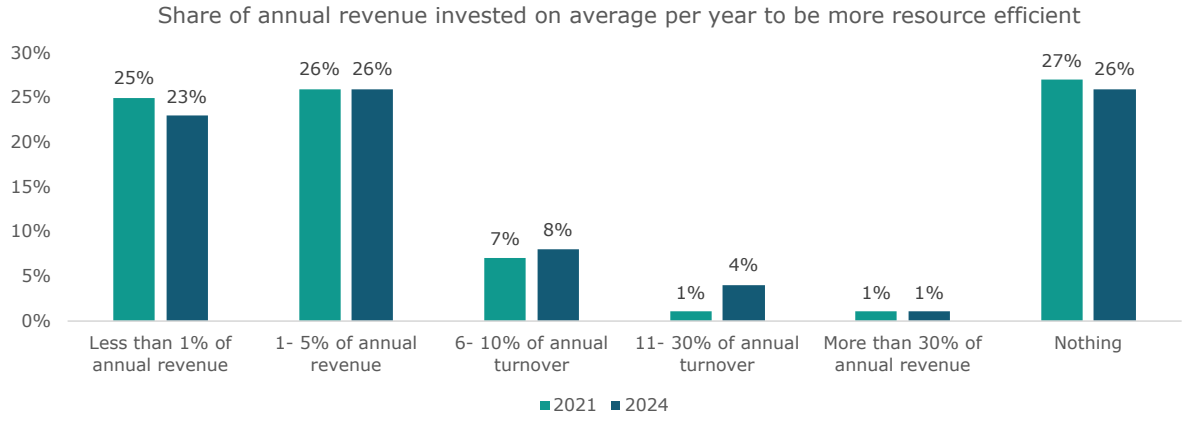
Figure 5: Use of financial resources for resource efficiency and producing green products or services



Source: Eurobarometer survey 2024, n=640

The survey also indicates that as of 2024, **26% of tourism companies have opted not to invest in resource efficiency, and of the companies that do invest, nearly half (49%) allocate less than 5% of their annual revenue toward such initiatives. This pattern of investment has shown minimal fluctuation from 2021 to 2024, suggesting a stable yet low level of commitment to resource efficiency across the industry**. Despite growing awareness of environmental concerns, the limited investment might reflect barriers such as financial constraints, limited access to green technologies, or a lack of strong regulatory incentives that drive resource efficiency within tourism companies.

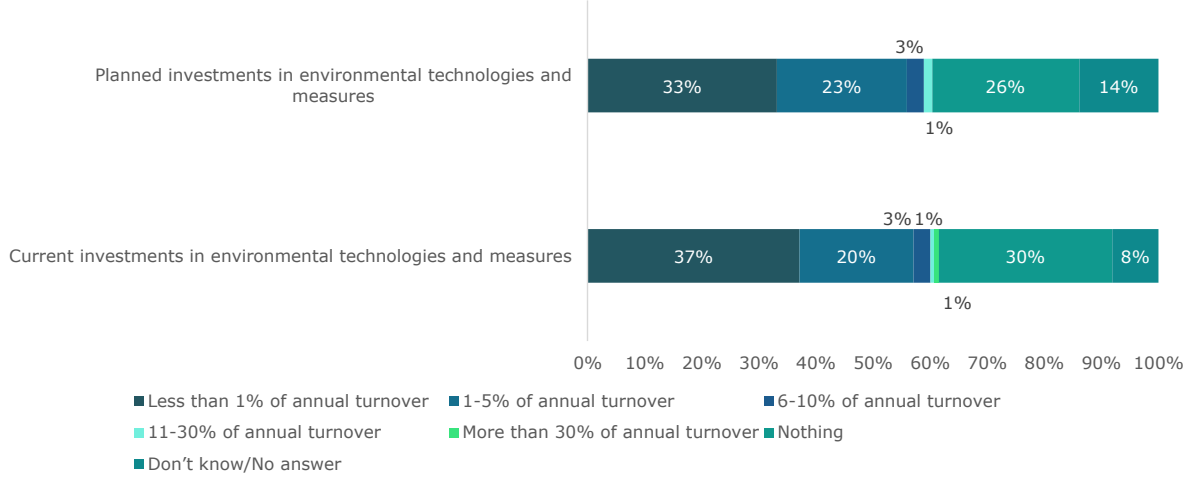
Figure 6: Share of annual revenue invested on average per year to be more resource efficient.



Source: Eurobarometer survey 2024, n=640

The EMI Enterprise survey 2024 found that **majority of companies either do not invest or invest less than 1% of their annual turnover into environmental technologies and measures. However, it should be noted that the surveyed companies are planning to invest more in the future**. For example, the share of companies planning to invest 1-5% of annual turnover increased from 20 to 23%.

Figure 7: Current and planned investments in environmental technologies and measures.



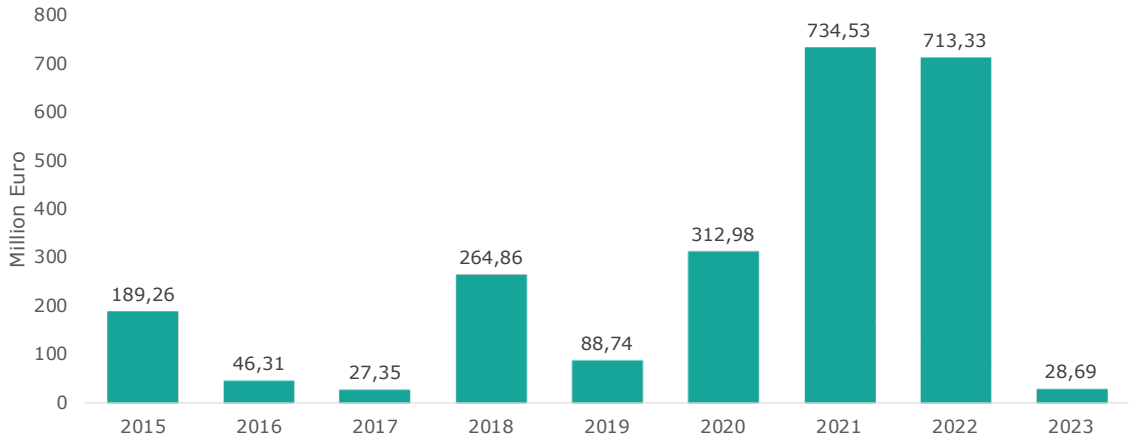
Source: EMI Enterprise survey 2024, n=605

Estimates for venture capital (VC) investment into environmental companies specialised in tourism and tourism startups that have environmental protection as a core activity have been derived from Crunchbase and Net Zero Insights databases. Together, these sources provide insights on VC funding in Europe for tourism and its relationship to the green transition. Companies captured in this analysis include for example Squake[35], which is an industry solution for sustainable travel, offering an end-to-end platform that calculates accurate carbon emissions and provides tangible compensation. Another example is Sea Going Green[36] which is an environmental consultancy that assists tourist companies to go green for sustainability and ocean protection.

Venture capital investment has fluctuated over the last decade, reaching a peak in 2021 (where over EUR 730 m were invested) and falling sharply to less than EUR 29 m in 2023. **Travel startups have historically been underfunded at the global level, receiving only about 1% of total startup funding, despite the sector's significant contribution to global GDP. However, from 2020 to 2022, there was a notable increase in investment, with approx. EUR 25 bn invested globally, driven by changes in traveller preferences and market consolidation**[37].

Figure 8: Venture capital and private equity investments into environmental companies specialised in tourism the EU27

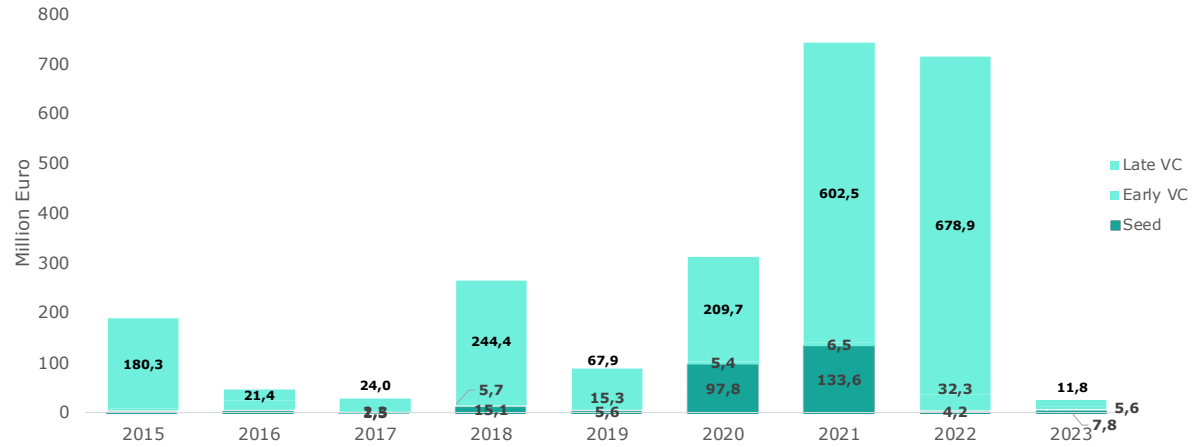
[35] https://www.squake.earth/
[36] https://www.seagoinggreen.org/
[37] McKinsey (2023). Travel startups: disruption from within–or not? *https://www.mckinsey.com/~/media/mckinsey/industries/travel%20logistics%20and%20infrastructure/our%20insights/travel%20startups%20disruption%20from%20within/travel-startups-disruption-from-within-or-not.pdf*



Source: Technopolis Group based on Crunchbase and Net Zero Insights

Despite this global uprise in VC funding, the EU's market fragmentation creates challenges both for scaling and for localised innovation. Investors have therefore favoured more established European startups, making it harder for early-stage companies to secure funding.

Figure 9: VC investment into the green transition of tourism startups



Source: Technopolis Group based on Crunchbase and Net Zero Insights

The VC investment was concentrated on late VC across all years except 2020. Late VC – on average- accounted for nearly 70% of all the investment in the period considered. Seed capital received, on average 14% of the funding over the years, whereas early VC accounts for the remaining 16%.

2.2. Framework conditions supporting the green transition

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

- According to the analysis of the European Regional Development Fund (ERDF) data from the 2014–2020 period, the tourism industrial ecosystem accounted for EUR 14.9 bn in funding in the EU. Projects that addressed specifically the **green transition of tourism accounted for over EUR 2.5 bn (16% of ERDF funding dedicated to tourism)**.

- The largest share of projects related to the green transition in tourism (47%) fall under the thematic objective 3: 'Competitiveness of SMEs'. Green transition projects co-funded by the ERDF in tourism cover largely **hotel or infrastructure refurbishment, green space development, biodiversity conservation, and environmental education, promoting sustainability and habitat protection and lowering electricity usage and greenhouse gas emissions, enhance energy efficiency** in businesses, and support the adoption of renewable energy solutions across different industries.

- Throughout the Horizon 2020 programme, over EUR 27 m was allocated to projects related to the green transition of tourism, **amounting to nearly EUR 4 m per year**. In the initial four years of **Horizon Europe, close to EUR 14 m was spent on similar projects, averaging over EUR 4.7 m annually**.

- The **proportion of projects co-funded under the EU's framework programme for research and innovation and related to the green transition has been approx. 20-24%** annually over the period from 2014-2024.

- Organisations in the tourism industrial ecosystem employed in general 2 full time employees in green jobs either partially or fully dedicated to environmentally focused tasks. However, **55% did not employ professionals in green jobs at all and only 16% created a new position related to environmental protection in 2024.**

- There has been a **slow progress in terms of the number of professionals with green transition** related skills. The share of professionals registered on LinkedIn and employed in the tourism industrial ecosystem with skills relevant to the green transition reached 2.6% in 2024, showing only a slight increase from 2022.

- Looking at the level of sub-industries, the share of professionals with environmental skills has been the **highest in museums** notably 6.4%, followed by 4.7% in **travel arrangements**, and 2.4% and 1.5% in hospitality and restaurants (which employ a higher proportion of less skilled personnel).

- Critical skills gaps in the tourism industrial ecosystem relate to **energy and water efficiency, recycling and waste management, biodiversity conservation and sustainable transport modes.**

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 funding, skills demand and supply and demand-side factors among others that are analysed in the sections below.

2.2.1. Public investments – the role of the European Regional Development Fund

The European Court of Auditors (ECA)[38] provided valuable insights into how public funding, particularly through the European Regional Development Fund (ERDF), supports the green transition in tourism. The report, issued in the aftermath of the COVID-19 pandemic, reflects on the sector's future and highlights long-term sustainability challenges.

The ECA's assessment, based on a sample of ERDF-supported projects, revealed mixed results. While some initiatives were aligned with sustainability goals and regional tourism strategies, others faced issues such as poor planning, limited impact, delays, and cost overruns. The EMI monitoring framework builds on this line of reasoning by categorising

[38] European Court of Auditors (2021). EU Support to tourism. Need for a fresh strategic orientation and a better funding approach available here: https://op.europa.eu/webpub/eca/special-reports/eu-support-in-tourism-27-2021/en/index.html

ERDF projects from the 2014-2020 period and determining whether they contributed to the green or digital transition in tourism.

This analysis spans both regional and national ERDF operational programmes and provides insights into the types of projects currently being pursued. As ERDF funds are aimed at fostering territorial cohesion, with resources spread across the EU and concentrated in less-developed areas, examining these projects offers insights on how territories absorb innovations and adapt them to their unique contexts, contributing to the broader sustainability agenda in tourism.

These insights, are complemented by data on Horizon 2020 and Horizon Europe, which - with the focus on innovative solutions and excellence at the EU level- have funded research and innovation initiatives benefiting the tourism sector across the following areas:

- **Cultural tourism business models,** driving economic growth, job creation, and social inclusion in rural areas.
- **Sustainable tourism**, balancing increased tourism with environmental protection and the preservation of cultural heritage.
- **Digital technologies,** promoting lesser-known destinations, ensuring tourism growth without overburdening local resources.

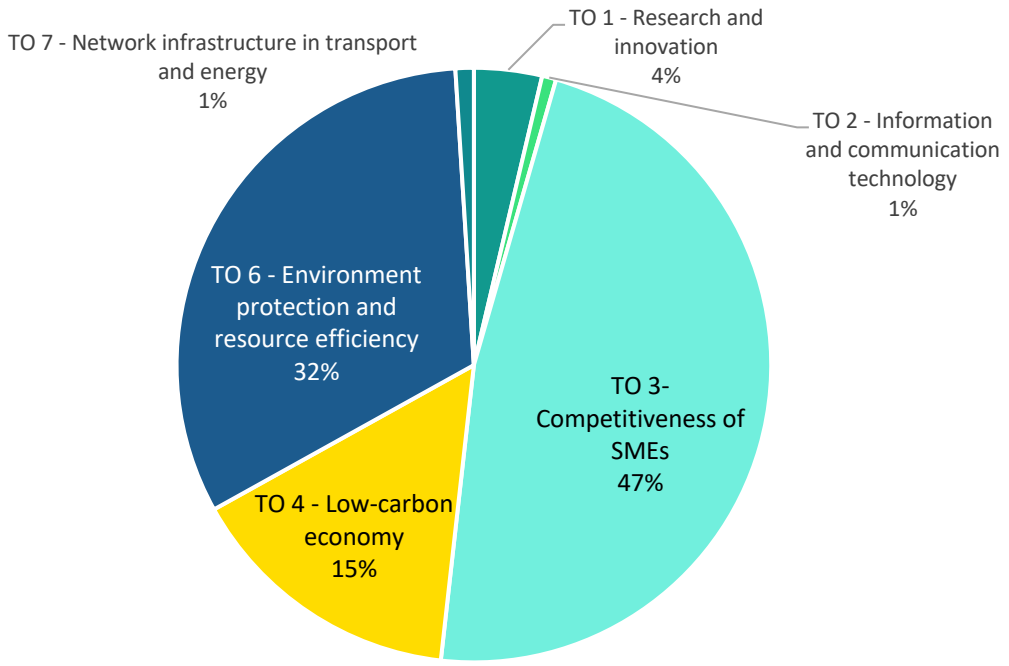
According to the analysis of ERDF data from the period 2014-2020, a total of 50 574 projects fall under the tourism industrial ecosystem. Of these, 8% (4 077) are classified as green projects.[39]

In terms of funding, the tourism ecosystem received EUR 14.9 bn in ERDF support during the 2014–2020 period, with over EUR 2.5 bn (16%) allocated to projects supporting the green transition in tourism.

The largest share of projects related to the green transition in tourism (47%) fall under the so-called thematic objective 3 of the 2014-2020 period namely: 'Competitiveness of SMEs'. Such projects cover largely **hotel or infrastructure refurbishment**. The second largest share belongs to 'Environment Protection and Resource Efficiency' (32%). Projects under this category focus on **green space development, biodiversity conservation, and environmental education**, promoting sustainability and habitat protection. The third largest group falls under the category of 'Low Carbon Economy' (15%). These projects focus on lowering electricity usage and greenhouse gas emissions, enhance **energy efficiency** in businesses, and support the adoption of renewable energy solutions across different industries.

Figure 10: Tourism projects focussed on green transitions in ERDF, organised by Thematic Objectives of Cohesion Policy 2014-2020

[39] In our monitoring framework the same project can be classified as contributing to both the digital and green transition



Source: Technopolis Group based on the Khoesio dataset

Projects related to 'Research and Innovation' (thematic objective 1), which account only for 3.7% of the total, focus **on sustainable tourism, digital environmental monitoring, climate change research, and sustainability standards.** They emphasise innovation and collaboration to reduce carbon footprints and protect ecosystems.[40]

The Table below illustrates various types of projects captured by the EMI monitoring framework as contributing to the green transition in tourism.

Table 4: Typology of projects contributing to the green transition of tourism through ERDF

Energy Efficiency and Renewable Energy Adoption in tourism facilities
Photovoltaic installation on the building of Hotel Irys (Poland)[41] The project's goal is to achieve energy independence for the hotel Iris located in Lublin. This initiative aims to ensure that a significant portion of the required energy will be generated from renewable sources, specifically solar power. Additionally, any excess energy produced will be sold to the grid. The project will involve purchasing fixed assets, installing a photovoltaic power plant with a capacity of at least 10.5 kW, and connecting it to the grid.
Testing new solutions for sustainable tourism
Zero-impact tourism between water and land: modular amphibious dwellings, environmentally sustainable housing for the eap delta and the Venice lagoon (Italy)[42]

[40] The very same projects classified by Policy Objectives, as per the current programming period show that 47% of projects fall under Policy Objective 2 - Greener, Carbon-Free Europe; 52% fall under PO1 - A Smarter Europe and only 1% under Policy Objective 3 - A Connected Europe.
[41] https://kohesio.ec.europa.eu/en/projects/Q6726070
[42] https://kohesio.ec.europa.eu/en/projects/Q2074763

Energy Efficiency and Renewable Energy Adoption in tourism facilities
The project aims to develop an innovative and eco-friendly solution for sustainable tourism by introducing temporary modular housing systems on floating barges, designed for use in natural environments like the Venice Lagoon and the EAP Delta. The concept emphasises harmony with the surrounding environment, utilizing natural materials to minimise ecological impact. These modular structures will seamlessly integrate into the landscape, offering a low-impact, flexible housing solution that adapts to the natural context. The project strives to create a sustainable tourism model that respects and preserves the environment while providing unique, immersive experiences for visitors.

Source: Technopolis Group based on the Kohesio dataset

2.2.2. Public investments – the role of EU Framework Programmes for Research and Innovation

The Commission's key support instrument for research and innovation (R&I) is the Horizon Europe framework programme (2021-2027). The programme has opened several relevant calls, which can support sustainable tourism development: Systemic circular solutions for a sustainable tourism[43], EU Capital and EU Green Pioneer of Smart Tourism[44] Cultural heritage and cultural and creative industries[45], and New European Bauhaus calls[46].

Tourism operators typically are not investing in research and innovation in other related sectors[47], however, specific R&I needs go beyond tourism (e.g., development of sustainable fuels and transport technologies; practices/technologies for efficient use of water resources, low-and zero-energy building technologies). Therefore, in the analysis only projects with a direct link to tourism were selected as a result of the participation of a tourism stakeholder or due to the application of the technology in the tourism industry or because of the industrial ecosystem definition which includes transport (air, water, land).

Throughout the Horizon 2020 programme, over EUR 27 m[48] was allocated to projects related to the green transition of tourism, amounting to nearly EUR 4 m per year. In the initial four years of Horizon Europe, close to EUR 14 m was spent on similar projects, averaging over EUR 4.7 m annually (following fractional counting, notably not allocating the full project amount but only the share dedicated to project beneficiaries from the tourism ecosystem). The Figure below highlights the evolution of projects related to the green transition in tourism, in Horizon2020 and Horizon Europe, the key funding programme for research and innovation of the EU.

In general, while the funding for twin transition in tourism increased under Horizon Europe, the share of funding allocated specifically to green transition decreased compared to Horizon 2020. More specifically, **the analysis reveals that the proportion of projects related to the green transition have decreased, from 24% of tourism projects in Horizon2020 down to 20% in Horizon Europe** (although one has to keep in mind that the Horizon Europe analysis is not yet the full period).

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[43] See: https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/horizon-cl6-2024-circbio-01-4

[44] See: https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/tender-details/1d7f69f1-11e9-44ba-9767-06feb02eab83-CN

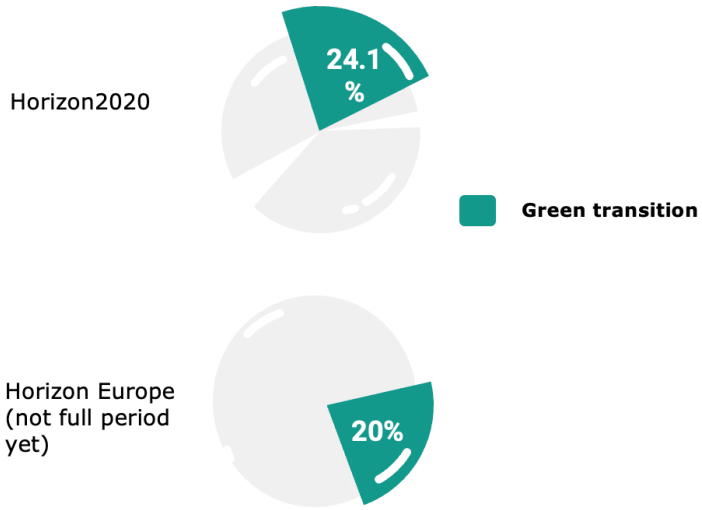
[45] See: https://rea.ec.europa.eu/funding-and-grants/horizon-europe-cluster-2-culture-creativity-and-inclusive-society/european-cultural-heritage-and-cultural-and-creative-industries_en

[46] See: https://new-european-bauhaus.europa.eu/funding/currently-open-and-forthcoming-calls_en

[47] Tourism transition pathway. See: https://single-market-economy.ec.europa.eu/sectors/tourism/eu-tourism-transition/tourism-transition-pathway_en

[48] To ensure a more accurate allocation of project costs and funding, a fractional counting approach has been implemented. This involves assigning the root categories of each project based on their EuroSciVoc taxonomy to each industrial ecosystem based on their defining terms. Each project has been categorised based on its root categories and the fraction of all the relevant categories has been determined. The project funding dedicated to each industrial ecosystem has been calculated based on the fractions relevant for the industry in the case of each project.

Figure 11: EU Horizon2020 and Horizon Europe (latter is not full period only 2022-2024) funding dedicated to the green transition of the tourism industrial ecosystem



Source: Technopolis Group based on CORDIS data

The analysis of CORDIS open data allows to explore the type of projects pursued in these programmes. Horizon projects focus on research and technology-driven solutions, compounded with data-driven approaches, community engagement, and comprehensive frameworks applied in diverse touristic contexts, with a strong link to cultural and creative industries, urban solutions and sports. For example:

- **RescueME Project-Equitable Resilience Solutions for Cultural Landscapes and Communities:** RescueME aims to protect Europe's cultural heritage, which is vital to community identity, well-being, and the economy but is increasingly threatened by climate change and natural hazards.
- **SnowRESolution project:** The ski industry is increasingly impacted by climate change, with shorter seasons due to reduced snowfall and rising temperatures. SnowRESolution by NeveXN offers an innovative solution, producing high-quality snow even when temperatures exceed 0°C without chemical additives.

Although the EU research and innovation framework programmes support relatively few tourism projects, they play a vital role in fostering innovation, as evidenced by the success of green innovation initiatives.

2.2.3. Skills for the green transition of tourism

In the tourism industrial ecosystem, there is an increasing need for professionals who can integrate sustainable practices into their services. Such skills encompass knowledge and abilities related to energy efficiency, water management, the adoption of bioproducts and sustainable tourism services among others[49]. **Despite some progress, substantial skills gaps remain, especially in the practical implementation of environmental initiatives and in sustainability leadership** as highlighted by the interviews conducted for this study. While the sector has increasingly valued skills related to compliance with environmental certifications, there is a pressing need to enhance transversal competencies relevant for the green transition across the workforce to fully align with the EU's sustainability objectives. This shift emphasises the need for professionals who can balance customer service with environmental responsibility.

This section aims to analyse both the demand and supply of environmental skills within the tourism ecosystem. Regarding demand, it utilises experimental data from Cedefop's

[49] See for example: https://nexttourismgeneration.eu/sector-skills-intelligence-monitoring-system/

Knowledge OVATE database[50], particularly the Online Job Advertisement tables. To examine the supply of skilled professionals relevant to the green transition, data from LinkedIn has been utilised. 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 complemented by the findings from the Eurobarometer and the EMI Enterprise Survey and further enhanced by desk research and interviews.

As of April 2024, there were 5 147 796 tourism professionals registered on LinkedIn. When compared to Eurostat statistics on total employment, this suggests that an estimated 31% of professionals employed in tourism are active on LinkedIn, which should be taken into account when interpreting the results presented in the next sections. Tourism industry professionals active on LinkedIn include mostly owners, managers, directors (travel and hospitality managers), but also food servers (as part of restaurants), receptionists, tour guides, marketing and sales specialists, event and conference coordinators. Despite the limitations, the data can shed light on existing green skills and trends in the industry given the lack of other statistical data in this subject.

The CEDEFOP Knowledge OVATE-OJA database analyses online job vacancies across Europe to provide critical insights into labour market trends. It offers a comprehensive overview of skills demand in different sectors, allowing policymakers, researchers, and educators to track and understand evolving needs in the workforce. By collecting and categorising job vacancy data from numerous European countries, OVATE provides detailed information on the qualifications and competencies that employers are seeking. This makes it an invaluable resource for identifying emerging trends in occupations and helping shape decisions in education, vocational training, and employment policy.

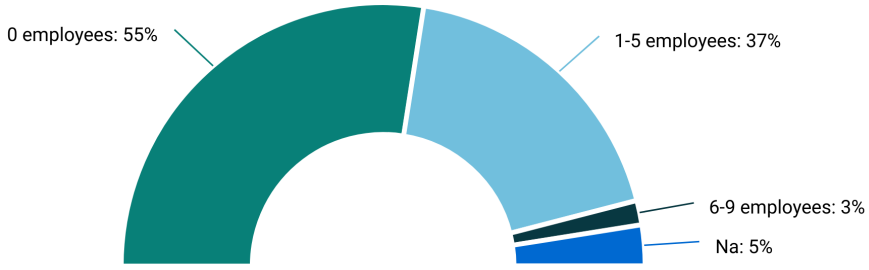
The analysis of green transition related skills followed the definition of Cedefop, notably "*the knowledge, abilities, values and attitudes needed to live in, develop and support a sustainable and resource-efficient society*" (Cedefop, 2012). Green skills have been defined as skills related to environmental 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).

2.2.3.1. Supply of skills relevant for the green transition

The **Eurobarometer 2024 indicates that organisations in the tourism industrial ecosystem employed in general 2 full time employees in green jobs either partially or fully dedicated to environmentally focused tasks**[51][52]. 55% indicated that they do not employ any professionals in green jobs and 37% of the companies have 1-5 employees only. In addition, the EMI Survey 2024 found that a low share notably **16% of companies in tourism created any new positions or job titles dedicated to environmental sustainability** over the past five years.

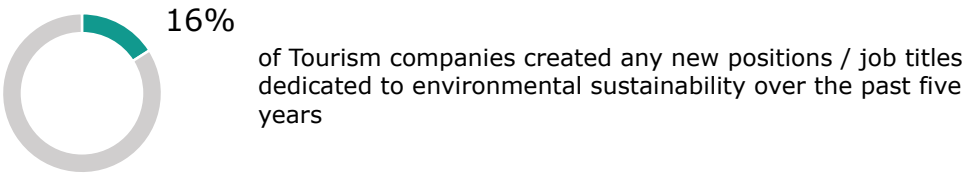
[50] Available online: https://www.cedefop.europa.eu/en/tools/skills-online-vacancies
[51] The exact average is 1.63
[52] Eurobarometer survey 2024

Figure 12: Number of full-time employees that work in green jobs some or all of the time in the tourism industrial ecosystem in the EU27 in 2024



Source: Eurobarometer 2024

Figure 13: Share of tourism companies that created new positions or job titles in environmental sustainability over the past five years



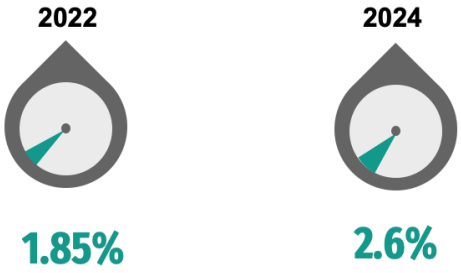
Source: EMI Enterprise Survey 2024

To gain insights into the supply of skilled professionals, LinkedIn data has been utilised. As of April 2024, there were **5 147 796 tourism professionals** registered on the platform. Tourism industry professionals active on LinkedIn include mostly owners, managers, directors (travel and hospitality managers), but also food servers (as part of restaurants), receptionists, tour guides, marketing and sales specialists, event and conference coordinators.

The tourism industry is highly labour-intensive, demanding a mix of organisational, communication, and management skills from its workforce. In recent years, the ecosystem has increasingly required environmental skills, as sustainability becomes more integral to its operations. Employees must now be equipped to manage resources efficiently, reduce environmental impact, and promote sustainable practices in areas such as eco-tourism and green hospitality initiatives. This shift reflects broader trends in the industry, emphasising the need for professionals who can balance customer service with environmental responsibility.

Despite these trends, the share of professionals registered on LinkedIn and employed in the tourism industrial ecosystem with skills relevant to the green transition reached 2.6% in 2024, showing an increase from 2022 (see Figure below). This low share may be attributed to the tendency of tourism companies to outsource environmental functions and subcontract external organisations for environmental development initiatives (as the analysis of startups in the previous sections also demonstrate).

Figure 14: Share of professionals in tourism with skills relevant for the green transition in the EU27

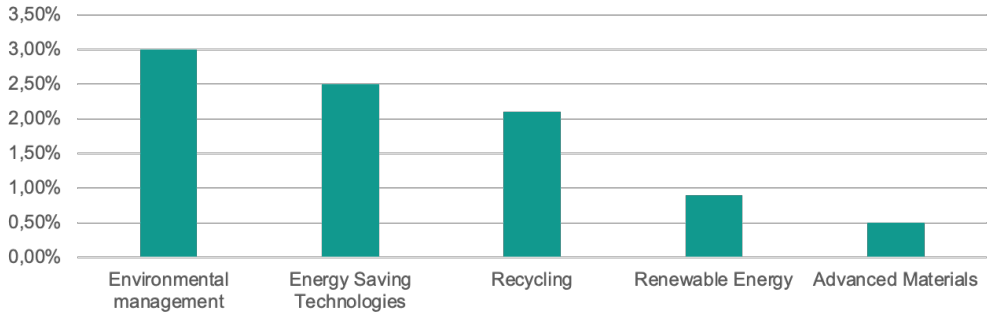


Source: Technopolis Group based on LinkedIn

Looking at the level of sub-industries, **the share of professionals with environmental skills has been the highest in museums notably 6.4%, followed by 4.7% in travel arrangements**, and 2.4% and 1.5% in hospitality and restaurants (which employ a higher proportion of less skilled personnel). This disparity can be attributed to these sub-industries employing a higher proportion of less-skilled personnel, making the integration of specialised environmental skills less prevalent despite the growing importance of sustainability initiatives.

The most relevant green transition skills are related to environmental management such as certifications, standards similarly as in 2023, followed by energy saving technologies and recycling. The slight increase in the number of professionals with such skills indicates a growing recognition of the importance of the green transition in the industry.

Figure 15: Share of professionals with a specific green transition skill within the tourism industrial ecosystem in the EU27 and with a profile on LinkedIn



Source: Technopolis Group based on LinkedIn, data download September 2024

2.2.3.2. Demand for skills relevant for the green transition

Critical skills gaps in the tourism industrial ecosystem relate to energy and water efficiency, recycling and waste management, biodiversity conservation and sustainable transport modes as highlighted by interviews and where further skill development is necessary[53]. These skills are crucial for fostering sustainable tourism practices and aligning the industry with international climate goals, such as those outlined in the Paris Agreement. Addressing these gaps requires the implementation of more structured **Environmental Management Systems (EMS)** and dedicated training programmes within tourism and hospitality to bridge the divide between current skills and those needed for future sustainability efforts.

Understanding the skills within the supply chain is equally important as in the hospitality sector the required skills extend beyond those directly related to tourism. For instance, suppliers of equipment related to energy efficiency must also possess the

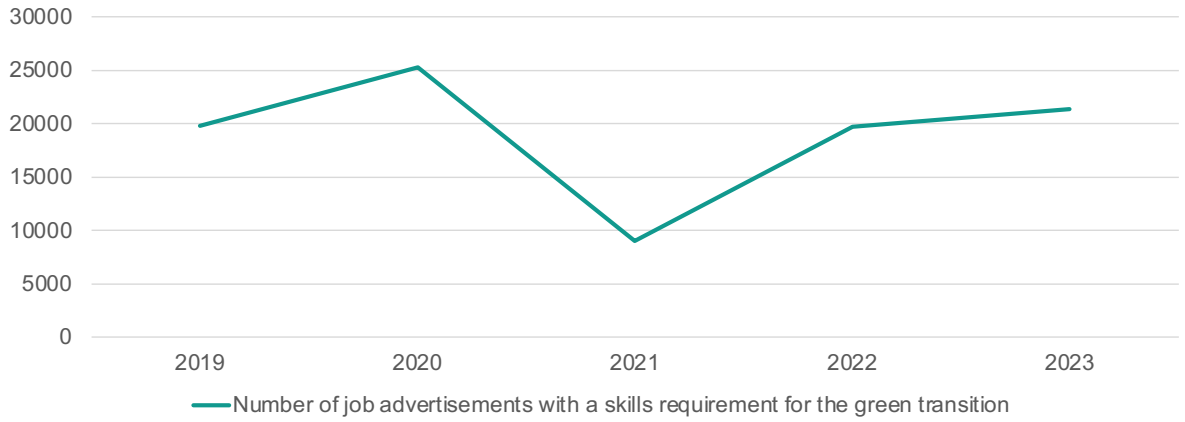
[53] See also Carlisle, S., Ivanov, S., Dijkmans, C., & Marco-Lajara, B. (2022). Environmental skills gaps in tourism and hospitality organisations: Evidence from Europe. Tourism, 70(3), 411-431. https://doi.org/10.37741/t.70.3.6

technical expertise to properly maintain and service such equipment. Availability of such skills may vary across geographical areas.

Specific to the tourism industrial ecosystem[54], there were more than 10 million unique online job advertisements from companies between 2019-2023 in the EU27[55]. These job advertisements have been text-mined and the required skills analysed from the perspective of the green transition. Green skills are most importantly related to environmental protection, environmental services, environmental sustainability, environmental standards, renewable energy, the circular economy, recycling and biodiversity.

In 2023, approximately 1-2% of online job advertisements in the EU27 required skills related to the green transition, amounting to a total of 21 343 job postings. While there was a decline in such advertisements between 2020 and 2021, the numbers have been steadily rising since, reflecting a positive trend and growing demand for environmental skills. This upward trajectory aligns with findings from the 2023 EMI report, which also highlighted the consistent increase in the share of online job advertisement in total seeking green transition competencies.

Figure 16: Share of online job advertisements with a requirement for environmental skills in the tourism ecosystem in the EU27



Source: Technopolis Group elaboration from CEDEFOP OVATE-OJA database

The Net Zero Roadmap for Travel & Tourism report highlighted several areas where skills and expertise are needed to support the transition to net-zero emissions.

- **Carbon Measurement and Reporting**: There is a significant demand for professionals who can accurately measure and categorise emissions, especially Scope 3 emissions. This includes understanding how to conduct carbon inventories, calculate baselines, and use tools like carbon calculators.
- **Decarbonisation Strategy Development**: There is a need for skills in developing and implementing effective net-zero strategies. This includes identifying relevant decarbonisation levers and understanding the impact of different reduction initiatives.
- **Sustainable Procurement and Sourcing**: There is a need for expertise in sustainable sourcing and procurement practices to reduce emissions through supply chains. This includes understanding circular procurement and choosing low-carbon materials
- **Understanding of Sustainable practices:** The report highlights the importance of businesses becoming more sustainable, and that sustainability training is needed to reach that goal.

[54] In the case of the retail industrial ecosystem the dataset was filtered for the NACE industries as defined in the Annual Single Market Report.
[55] As captured in the Cedefop SkillsOvate database

- **Certification Standards**: There is a need for professionals with expertise in sustainability certifications. Businesses in the travel and tourism sector can benefit from employees with a solid understanding of the various certification programs such as EarthCheck, Green Key and Hotel Sustainability Basics.
- **Understanding of emerging technologies**: Businesses need professionals that can understand the emerging technologies, and the need to evaluate their potential.
- **Capacity Building and Training**: There is a need for professionals to develop and deliver sustainability training programmes for employees across the value chain.
- **Awareness Raising**: The industry needs experts who can raise awareness about climate change and sustainable practices among businesses, customers and stakeholders.

2.2.4. Demand-side drivers: growing environmental tourism services, but not the primary choice driver

The shift towards environmentally friendly practices in tourism is largely driven by a growing consumer awareness of environmental sustainability, as well as a desire to experience travel in ways that are more connected to nature and local cultures. For instance, many travellers now show a preference for consuming local products, using ecological modes of transport, and staying in accommodations that prioritise sustainable practices. However, these consumption patterns are still in transition, and several barriers hinder a more widespread adoption of green and circular consumption as highlighted by the interviews.

Studies[56] confirm that there is a noticeable shift in traveller preferences towards immersive, enriching experiences, including activities like hiking, cycling, wellness retreats, and culinary tours, rather than traditional sightseeing. This is accompanied by a growing demand for eco-conscious travel, with tourists favouring destinations that promote responsible tourism, environmental conservation, and local community welfare. This extends to transportation choices, with more travellers opting for eco-friendly options like trains and bicycles, benefiting destinations with well-developed sustainable infrastructure. Interestingly, the notion of regenerative tourism is emerging, which emphasises rebuilding and restoring ecosystems, rather than merely minimising harm. It involves a broader focus on revitalising local communities and economies while reducing environmental impact. This trend aims to counter resource depletion and foster long-term sustainability.

Limited academic research[57] on sustainable consumption patterns in EU countries indicates that EU tourists are increasingly aware of sustainability and exhibit growing interest in green tourism. Environmental attitudes, knowledge, subjective norms, and emotional and conditional values significantly influence the green purchase intentions of both groups, also within tourism.[58]

First, EU citizens are most willing to take are consuming locally sourced products on holiday (55%), reducing waste while on holiday (48%), traveling outside of the tourist high season (42%) and travelling to less visited destinations (41%).[59]

Secondly, some EU tourists also seek eco-certifications and green services, reflecting their consciousness about environmental issues. According to Flash Eurobarometer 499 survey, 11% of EU citizens base their destination on the sustainability certification of

[56] Tihinen, M., & Salvador, M. (2024). Boosting the uptake of digitalisation, innovation, and new technologies in tourism through transnational cooperation and capacity building. Lapland University of Applied Sciences, NEST - Tourism Innovation Center, 1-37.
[57] See Vilkaite-Vaitone, N. and Tamulien (2024). Vilkaite-Vaitone, N., & Tamuliene, V. (2024). Unveiling the untapped potential of green consumption in tourism. Sustainability, 16, 230. https://doi.org/10.3390/su16010230
[58] Nekmahmud et al. (2022)
[59] Flash Eurobarometer 499 Attitudes of Europeans towards tourism Report 2021. See: https://mint.gov.hr/UserDocsImages/2022_sustainable/220429_EU_attitudes_eurobarometar.pdf

accommodation and attractions.[60] Importance of consumption eco-certifications is also more prevalent among tourists from countries like the Germany, Cyprus and France, where awareness of green tourism is high. For example, Flash Eurobarometer 499 survey found that the share of respondents who take into account the sustainability certification of accommodation and attractions while choosing a destination to visit is 22% in Germany, 17% in Cyprus and 16% in Luxembourg[61].

As a response, tourist accommodation establishments have shown increasing interest in the EU Ecolabel which is a 'best of class' type of label which can be awarded to tourist accommodation services with excellent environmental performance[62]. More specifically, 138 new licences (+30%) between March 2022 and September 2023 have been issued, raising the total number of EU Ecolabel tourist accommodation services to 620.

Despite the above, safety and affordability remain critical factors in driving consumers' choices. Indeed, the fieldwork indicates that, in terms of hotel stays, price is still the major element in driving choices, however, commitment to sustainability may be more relevant to the loyalty of the client. One of the main challenges is the **cost** associated with more sustainable options. While eco-consciousness is rising, many consumers are not willing to pay the premium prices that often accompany eco-friendly travel and services. Another barrier lies in the limited availability of ecological services in some regions. While urban centres and well-known tourist destinations might offer eco-certified accommodations and sustainable mobility options, such offerings are often sparse in rural or remote areas, making it difficult for travellers to maintain environmentally friendly practices throughout their journeys.

Last but not least, the significant demand for air travel, indicates that environmental concerns of tourists are overall of limited significance when it comes to CO2 emissions.

2.3. The impact of the industrial ecosystem on the environment

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

- **Tourism's environmental impact has seen only limited improvements, with some areas showing deterioration compared to pre-pandemic levels.** This highlights the persistent and multi-dimensional environmental footprint of the tourism ecosystem, encompassing CO2 emissions, resource consumption, pollution, water extraction, and beach litter. Environmental challenges associated with tourism are considerable and difficult to balance with the growth of the sector

- **CO2 and particulate matter emissions based on production account have remained stable over time** (indicating that hotel, restaurants and travel agency services have a stable energy consumption pattern). Additionally, emissions from consumption travel have risen as part of a broader post-pandemic-recovery leading to an increase in CO2 emissions.

- **Material extractions have been increasing** over the entire period of 2016 to 2022, with an average annual growth of 5.53%.

[60] Flash Eurobarometer 499 Attitudes of Europeans towards tourism Report 2021. See: https://mint.gov.hr/UserDocsImages/2022_sustainable/220429_EU_attitudes_eurobarometar.pdf
[61] Flash Eurobarometer 499 Attitudes of Europeans towards tourism Report 2021. See: https://mint.gov.hr/UserDocsImages/2022_sustainable/220429_EU_attitudes_eurobarometar.pdf
[62] European Commission: Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs, Transition pathway for tourism – Taking stock of progress by 2023, Publications Office of the European Union, 2024, https://data.europa.eu/doi/10.2873/775069

- **Waste production is still a key concern**. Beach waste has been increasing over the years. In particular, the overall median value for plastic items found per 100 m on European beaches was 481 in 2022, compared to 121 in 2013.

- **Land use measured in square kilometres showing a recent surge**. The increase in land use aligns with statistics showing a rise in European hotel construction projects, which saw a significant surge in 2024.

This section summarises the main indicators that capture the environmental impact of the tourism industrial ecosystem. It also reflects on the progress made over time and to what extent targets are being reached. It reports on impacts, through primary and secondary sources of data that examine the progress made over time including data on: 1) GHG emissions, 2) Particulate matter emissions, 3) Material extraction and 4) Water and land usage. The data is based on the Exiobase[63] database, which provides input-output tables, estimating emissions and resource extractions by industry.

International tourism has reached close to pre-pandemic levels in 2024, with Europe recovering 99% of their pre-pandemic arrivals[64]. The ease of travel within Europe, particularly with Romania and Bulgaria joining the Schengen area, the influx of visitors for events like the Paris Olympics, the rise of new destinations and popularity of established hotspots[65] have contributed to the increase in tourism. However, **this boost has also brought environmental costs, as more travel has led to higher greenhouse gas emissions from flights, trains, and road transportation.**

Environmental challenges associated with tourism are considerable and difficult to balance with the growth of the sector[66]. The carbon footprint of tourism is notable, largely due to the energy-intensive nature of transportation and accommodation, contributing significantly to global CO2 emissions and exacerbating climate change. Mass tourism poses additional challenges, including overcrowding, resource depletion, and environmental degradation, which can significantly impact the sustainability of popular tourist destinations. These effects are particularly severe in the EU, where local ecosystems and communities are under considerable pressure from high tourist volumes. Moreover, a comprehensive review of the academic literature[67] has highlighted that tourism in Europe significantly contributes to greenhouse gas emissions, particularly through transport activities like long-haul flights. The review also underscores that European tourism is highly vulnerable to climate risks such as rising temperatures, sea level rise, and extreme weather events.

The pressure on natural resources is also substantial, with high demands for water and energy leading to potential resource depletion, especially in regions already facing scarcity. Moreover, increased waste in areas lacking robust waste management systems is also an increasing concern. Plastic pollution, particularly in coastal and marine environments is accumulating in bodies of water, threatening marine life and ecosystems. Indeed, the UN Tourism (2024)[68] report on 'The Integration of Biodiversity in National Tourism Policies', has highlighted that tourism has a significant impact on biodiversity, leading to both direct and indirect ecological consequences. Direct impacts include habitat destruction from infrastructure development (such as hotels, roads, and airports) and pollution from waste and sewage. Indirect impacts involve the disruption of

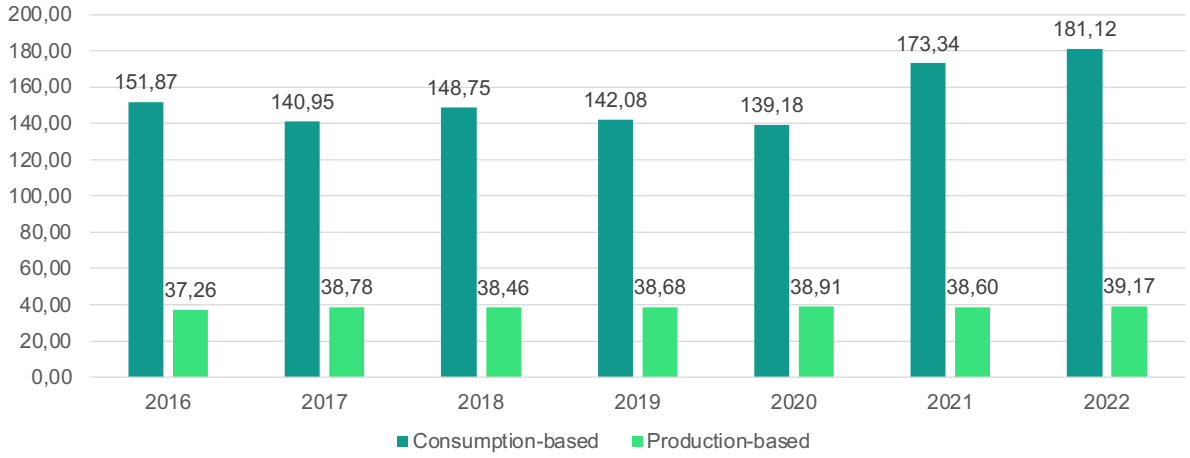
[63] https://www.exiobase.eu/
[64] https://www.unwto.org/news/international-tourist-arrivals-hit-96-of-pre-pandemic-levels-through-july-2024
[65] See also: https://etc-corporate.org/news/european-tourism-reaches-new-highs-in-2024-as-travellers-plans-diversify/#:~:text=Europe's%20tourism%20industry%20continued%20its,%2C%20Italy%2C%20and%20the%20Netherlands.
[66] OECD (2024). Tourism Trends and Policies 2024. OECD Publishing, WEF, 2024; Steiger et al 2023; the UNWTO 2024 and the Transition Pathway for Tourism report
[67] *Steiger, R., Demiroglu, O. C., Pons, M., & Salim, E. (2023). Climate and carbon risk of tourism in Europe. Journal of Sustainable Tourism. https://doi.org/10.1080/09669582.2022.2163653*
[68] UN World Tourism Organization (2024). The integration of biodiversity in national tourism policies. UN Tourism, Madrid. *https://doi.org/10.18111/9789284424900*

local ecosystems through the introduction of invasive species, disturbance of wildlife, and the overuse of natural resources. The environmental impacts of tourism extend beyond the natural environment to affect local communities. The increased demand for resources, coupled with pollution and inadequate waste management, can lead to a decline in the quality of life for residents, as reflected in recent anti-tourism movements recorded in the press[69].

There have been only limited improvements in tourism's environmental impact over the past 5 years as the results of the analysis from Exiobase[70] indicates, with some areas showing deterioration compared to pre-pandemic levels. This confirms the persistent and multi-dimensional impact of the tourism ecosystem on the environment, spanning across CO2 emissions, resource consumption, pollution, water extraction, and beach litter. The graph below shows the level of CO2 emissions of EU27 in megatons in tourism. It presents both the production account, which evaluates impacts based on where products are manufactured (in this case, within the EU27), and the consumption account, which attributes the environmental impacts of products to where and by whom they are ultimately consumed, regardless of the production location. This includes impacts from the consumption of products and services within the EU, including those that are imported. The picture indicates that the bulk of CO2 emissions comes from consumption, rather than production of tourism. This is because the Exiobase dataset accounts for the impact of EU tourists across the world, in other words, the emissions of EU tourists far exceed those produced by the tourism ecosystem in the EU itself.

CO2 and particulate matter emissions have remained stable over time (indicating that hotel, restaurants and travel agency services have a stable energy consumption pattern). Additionally, emissions from travel have risen as part of a broader post-pandemic-recovery, leading to an increase in CO2 emissions. These trends are coherent with data from the International Energy Agency, which points out that aviation emissions (which correlate with CO2 emissions in tourism) rose in 2022 to reach nearly 80% of their pre-pandemic peak in 2019, as any improved energy efficiency of fuels has not compensated the increased demands[71].

Figure 17: CO2 emissions of EU27 in megatons in the tourism industrial ecosystem (both consumption and production-based account)



Source: Technopolis Group calculations based on Exiobase

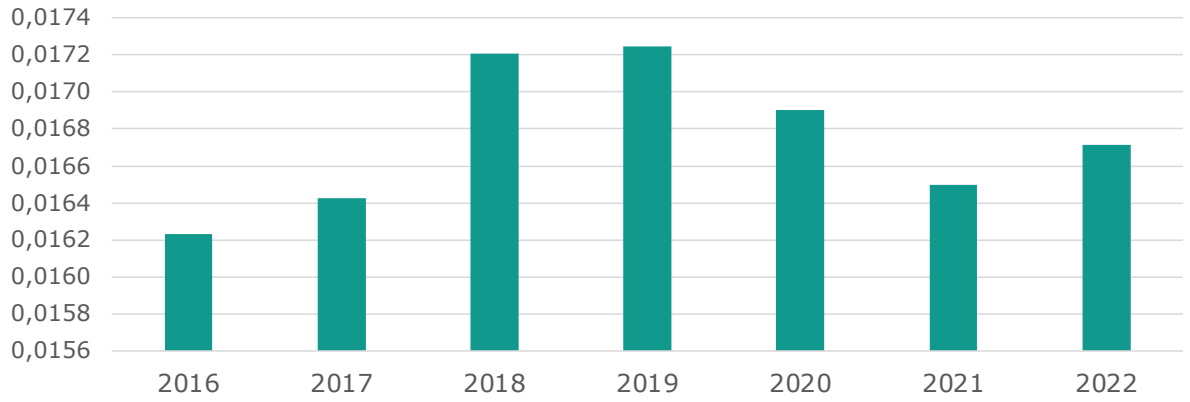
In 2022, direct emissions from aviation accounted for 3.8% to 4% of total EU GHG emissions. Additionally, aviation generates 13.9% of transport emissions, making it the second biggest source of greenhouse gas emissions in the transport sector, after road

[69] See for instance: https://www.euronews.com/travel/2024/07/06/malaga-for-living-not-surviving-locals-protest-tourism-amid-rising-rents-and-gentrificatio
[70] https://www.exiobase.eu/
[71] See: https://www.iea.org/energy-system/transport/aviation

transport[72]. Consequently, the CO2 airlines CO2 emissions in tourism ecosystem require additional focus. The overall climate impact from aviation is a combination of both its CO2 and non-CO2 emissions (e.g. NOX, PM, SOX, water vapour and subsequent formation of contrail-cirrus clouds).[73]

Aircraft engine emissions (mainly NOX and particulate matter) impact air quality around airports. Exposure to NO2 and ultrafine particles levels from aviation could be significant in residential areas in the vicinity of airports. The figure below provides an overview of the particulate matter emissions of EU27 in megatons.

Figure 18: Particulate matter emissions of EU27 in megatons in tourism (Production Account)

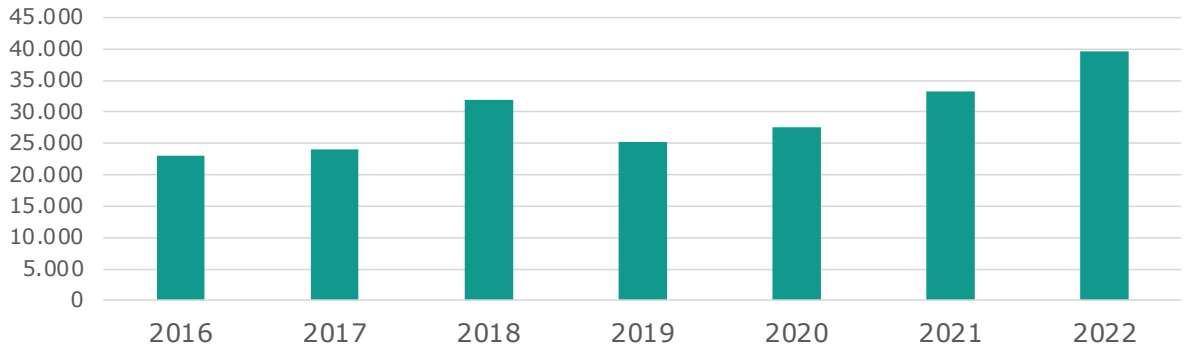


Source: Technopolis Group calculations based on Exiobase

Following rapid emission decline from 2019 to 2021, emissions increased again in 2022 as indicated by Exiobase data. This increase is due to increased growing number of flights, which have not yet reached the 2019 level. The growing particulate matter emissions are also combined with an increase in other non-CO2 emissions. For example, NOX emissions have grown faster than CO2 emissions since 2005 and are expected to continue to do so without further improvement in engine technology[74].

The graph below provides insights into material extractions in tourism. **Material extractions have been increasing over the entire period of 2016 to 2022, with an average annual growth of 5.53%.** Despite a slowdown during the pandemic and the consequent disruption of value chains brought by global instability and the energy crisis, material extraction reached its highest level in 2022 with 39.5 megatons.

Figure 19: Material extractions (used and unused) in kilotons (Production Account)

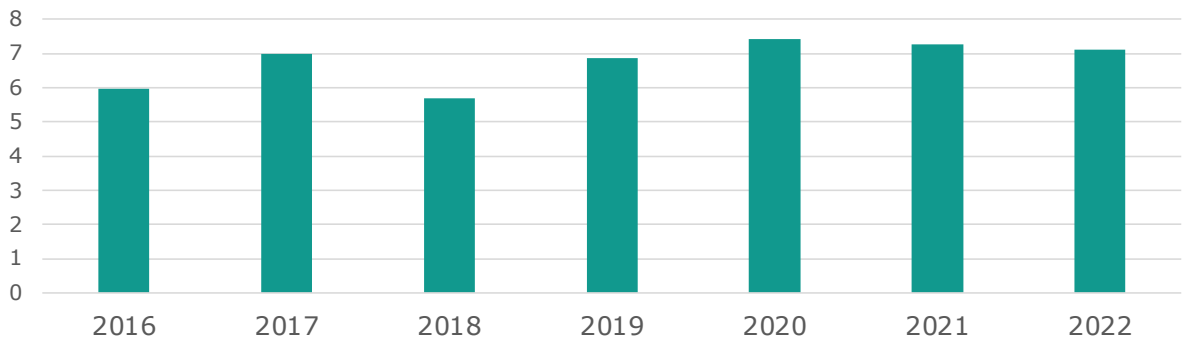


Source: Technopolis Group calculations based on Exiobase

[72] See: https://climate.ec.europa.eu/eu-action/transport/reducing-emissions-aviation_en
[73] See: https://www.easa.europa.eu/sites/default/files/eaer-downloads/EASA_EAER_2025_Book_v5.pdf
[74] https://www.easa.europa.eu/en/domains/environment/eaer/overview-aviation-sector

Water extraction and pollution are also significant negative externalities of the tourism ecosystem. The graph below provides information on water extraction measured in million cubic meters. The indicator refers to water sourced from surface or groundwater resources incorporated into a good, used for a service, or returned to another source after the good or service has been produced, or returned at a different time. The graph shows a stable trend with water extraction fluctuating around 6.8 million cubic meters.

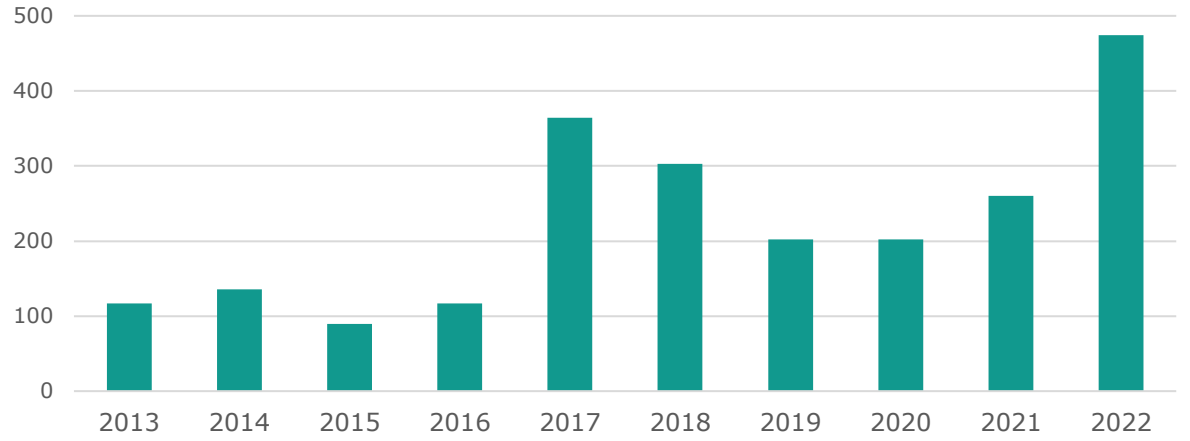
Figure 20: Water Extraction in million cubic litres



Source: Technopolis Group based on Exiobase

In addition, **waste production is still a key concern. Beach waste has been increasing over the years. In particular, the overall median value for plastic items found per 100 m on European beaches was 481 in 2022, compared to 121 in 2013.**

Figure 21: Median litter items/100m found on European beaches in the period 2013-2022



Source: European Environment Agency[75]

A full picture of marine pollution can be found in the 2024 Marine Litter Watch Report [76]. Litter is piling up in all aquatic systems, particularly on sea beaches, being their last stop on the journey. With at least 11 million tonnes of plastic ending up in global oceans every year, plastics make up the bulk of marine debris along beaches. Marine litter refers to waste that has been improperly managed and subsequently discarded into the sea, rivers, on land, or beaches, eventually making its way to the sea via rivers, sewage systems,

[75] https://www.eea.europa.eu/en/circularity/sectoral-modules/plastics/litter-found-on-european-beaches?activeTab=658e2886-cfbf-4c2f-a603-061e1627a515

[76] Šubelj, G., Veiga, J. M., Aydın, E.B., & Aydın, M. (2024). Marine Litter Watch – Europe's Beach Litter Assessment (ETC BE Report 2024/1). European Topic Centre on Biodiversity and Ecosystems. Retrieved from: https://www.eionet.europa.eu/etcs/etc-be/products/etc-be-products/marine-litter-watch-2013-europe2019s-beach-litter-assessment

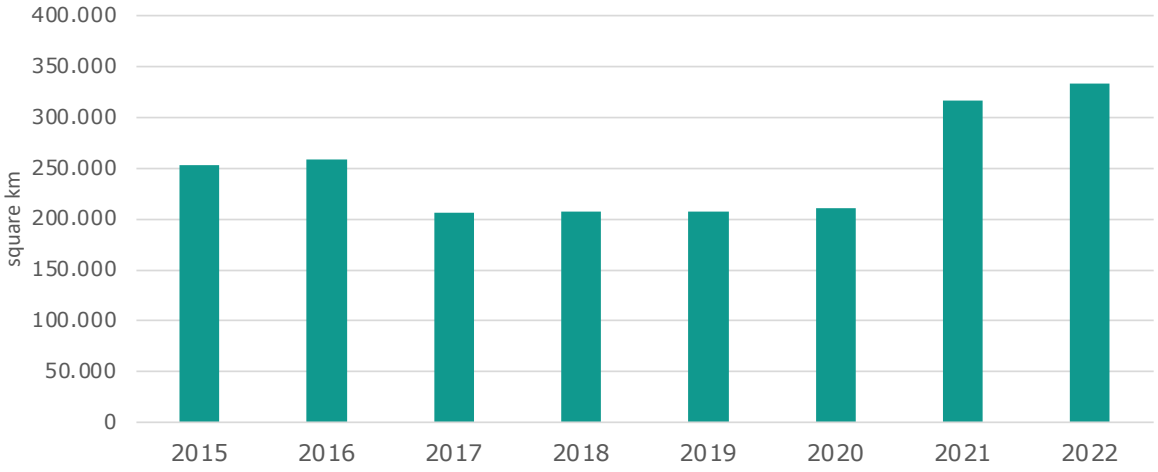
stormwater runoff, or winds. According to Marine Litter Watch, the top five items in European beaches (as a % of all items) are:

- Cigarette butts and filters (23.4%)
- Plastic pieces and fragments (between 2.5 cm and 50 cm of length) (9.5%)
- Polystyrene pieces (between 2.5 cm and 50 cm of length) (5.3%)
- Other identifiable plastic/polystyrene items (4.6%)
- Plastic caps/lids for drinks (3.9%)

In particular, although there are fluctuations over time in marine and beach litter, it is clear that European beaches are not reaching the Good Environmental Status (GES)[77]. The Marine Litter Watch highlights that Mediterranean Sea and the Black Sea exhibit higher levels of beach litter compared to the North-east Atlantic Ocean and the Baltic Sea, due to the higher tourism flow. As tourism is the most important source of beach litter amounting to 81.7% share[78], leading countries in coastal tourism (Spain, Greece, Italy and France) [79] demonstrate higher beach litter levels.

Tourism development heavily relies on the availability, quality, quantity, and specific characteristics of land. It impacts all primary drivers of biodiversity loss, including land and sea use changes that lead to habitat degradation, direct species exploitation, climate change acceleration, pollution, and the spread of invasive alien species[80]. The graph below provides information on **land use measured in square kilometres showing a recent surge.** The increase in land use aligns with statistics showing a rise in European hotel construction projects, which saw a significant surge in 2024[81].

Figure 22: Land use in square kilometres of the tourism industrial ecosystem (consumption account)



Source: Technopolis Group based on Exiobase

[77] For a definition of GES see here: https://environment.ec.europa.eu/topics/marine-environment_en
[78] Zalewska, T., Maciak, J., & Grajewska, A. (2021). Spatial and seasonal variability of beach litter along the southern coast of the Baltic Sea in 2015–2019-Recommendations for the environmental status assessment and measures. Science of the Total Environment, 774, 145716.
[79] Fernández-Macho, J., González, P., & Virto, J. (2024). How specialized are coastal tourism destinations in Europe?. Journal of Destination Marketing & Management, 31, 100856.
[80] Sorakunnas, E., Räikkönen, J., Konu, H., Grénman, M., & Tyrväinen, L. (2024). Biodiversity, leadership, and resilience in a national sustainable tourism program. *Scandinavian Journal of Hospitality and Tourism*, 1–19. https://doi.org/10.1080/15022250.2024.2332308
[81] https://lodgingeconometrics.com/forty-five-percent-of-the-hotel-projects-in-europes-total-pipeline-are-under-construction-at-the-end-of-q1-2024/

The trends presented above are mirrored by the increasing concern with overtourism, with its severe environmental consequences, especially in rural and coastal areas[82]. These impacts include water and air pollution, soil erosion, and wildlife disturbance in fragile ecosystems, particularly where visitor numbers are concentrated in small areas. Additionally, overtourism can degrade local infrastructure such as roads and waste management systems. Destinations like coastal and island regions are particularly vulnerable due to their limited capacity to absorb large numbers of tourists.

Despite its environmental impacts, well-managed tourism can contribute positively to sustainability by serving as a link between economic growth and environmental conservation. Properly implemented sustainable practices in tourism can help protect natural resources, support local economies, and promote cultural preservation, aligning growth objectives with environmental and social goals[83].

[82] Strasdas, W., Lund-Durlacher, D., Wolf-Gorny, L., Schuh, B., Badouix, M., Gaugitsch, R., Gorny, H., Münch, A., Weber, F., Priskin, J., Wyss, M., Brkanovic, S., Eggli, F., Kinga, H., & Rončák, M. (2022). Unbalanced tourism growth at destination level – Root causes, impacts, existing solutions, and good practices. European Commission. https://doi.org/10.2826/782120

[83] https://leadersinternational.org/results-insights/how-can-tourism-contribute-to-sustainable-development/

3. Digital transition

3.1. Industrial efforts towards digitalisation

What is the progress of industrial efforts towards digitalisation?

- **31% of tourism companies have a concrete strategy in place for digital transformation in the tourism industrial ecosystem.**

- The EMI Enterprise survey revealed an **increase in the uptake of digital technologies. The largest increase is seen in cloud technologies and artificial intelligence**, the latter increasing by nearly 15%, and the Internet of Things, which increased by nearly 10%.

- The **adoption rate of AI has doubled** between 2023 and 2024 both in the case of travel agency, tour operator and other reservation services and less so in the case of accommodation and food services.

- In the tourism ecosystem, **46% of businesses that adopted AI did so within the past year.**

- 28% of tourism businesses use **AI in marketing and sales**.

- In terms of startups, **artificial intelligence and software solutions emerged as major technological focus areas.** The former represented 14% in 2020 and 20% in 2023, the latter represented 30% of startups in 2020 and 60% of startups in 2023. Online travel and tourism platforms reached a peak in 2019 in terms of investment before declining. In contrast, investments in artificial intelligence surged in 2022, alongside software technologies. This trend reflects the dynamic shift in digital investments, particularly influenced by the COVID-19 pandemic.

- While online platforms were the dominant technology area developed by digital tech startups in tourism, the share of new companies developing these platforms decreased from 40% in 2015 to 10% in 2023.

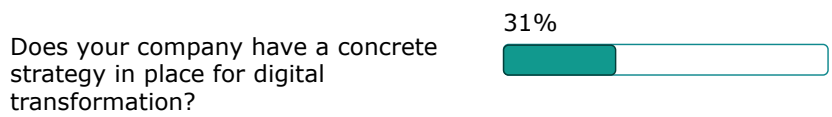
- The **vast majority of firms invest less than 5% of revenues across all the technologies**. Only a handful of firms invest more than 30% of their turnover in digital technologies, concentrating on cloud (1.6%) and AI (2.6%).

This section analyses the uptake of digital technologies, the evolution of tourism tech startups and private investments in the tourism industrial ecosystem. It explores the progress tourism companies 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 adoption of digital technologies has been explored through the CATI survey conducted as part of this project, as previously discussed in the section on the green transition. According to the survey results, **31% of companies have a concrete strategy in place for digital transformation in the tourism industrial ecosystem**.

Figure 23: Digital transformation strategy



Source: EMI Enterprise Survey 2024

The Table below provides an overview of advanced digital technology adoption rate by tourism companies.

Table 5: Share of companies in the tourism industrial ecosystem that indicated to having adopted advanced digital technologies

Digital Technologies	*Share of adoption (2023)*	*Share of adoption (2024)*	
Cloud	**25.24%**	**37.07%**	↑
Artificial Intelligence	8.01%	**22.95%**	↑
Internet of Things	9.81%	**19.67%**	↑
Big Data	13.60%	11.48%	
Augmented and Virtual Reality	3.59%	7.65%	↑
Blockchain	1.79%	6.01%	↑
Robotics	1.79%	2.73%	
Edge Computing		2.37%	

Source: EMI Survey 2024

The EMI Enterprise Survey revealed an increase in the uptake of all digital technologies except big data, which decreased from 13.6% in 2023 to 11.5% in 2024, although big data is increasingly recognised as being intrinsically connected to artificial intelligence.

The largest increase is seen in cloud technologies and artificial intelligence, the latter increasing by nearly 15%, and the Internet of Things, which increased by nearly 10%. More specifically:

- **Cloud technologies**: Tourism enterprises have been increasingly realising the potential of cloud computing and storage for their business. Cloud is one the main cost-efficient technology enabling digital transformation of the companies. The proliferation of cloud service providers has also contributed to the increasing adoption of these technologies across multiple industries. As measured by Eurostat in its indicator called Use of cloud computing services, by economic activity. This data shows that the adoption of cloud services has increased over the period increased from a share of 16.4% in 2018 to a share of 32.1% in 2023 in the case of accommodation and food services[84]. It should be noted, however, that the use of cloud computing based on Eurostat statistics was mostly for e-mail, office software and storage of files[85].
- **Artificial Intelligence**: the survey results indicate that **22% of tourism organisations adopted AI in 2024**. The related indicator in Eurostat that measures the use of AI by enterprises by economic activity found that 6% of enterprises in accommodation and food service activities (10 persons or more) adopted at least one Artificial Intelligence technologies in 2024. The same Eurostat indicator was 24% in the case of travel agency, tour operator and other reservation service and related activities. **In both cases, adoption rates have doubled since 2023.** One potential explanation for the increase in the use of AI in tourism is related to the surge in the use of generative AI (e.g. ChatGPT).
- **Internet of Things**: The integration of IoT in the tourism sector can enhance tourist experiences, improve destination management, and create a channel for efficient information exchange. Consequently, the adoption of the IoT in the ecosystem is

[84]See:https://ec.europa.eu/eurostat/databrowser/view/isoc_cicce_usen2/default/table?lang=en&category=isoc.isoc_e.isoc_eb
[85]See: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Cloud_computing_-_statistics_on_the_use_by_enterprises

growing. IoT has been used most often for the purposes of monitoring tourist flows, followed by the use of IoT based products for energy saving[86].

As a general rule, the actual uptake of these new digital technical solutions depends very much on the segment of the value chain, the types of actors in the tourism ecosystem and their size. While large actors can navigate the digital transition, SMEs with smaller operations struggle to take advantage of this opportunity to the same extent. Interviews with experts in the hotel business specifically highlighted that the ability to benefit from digitalisation varies depending on the size of the actors. Small hotel businesses have more limitations to implement strong digital transformation and scale the benefits.

The adoption of big data has been challenged by several factors in the tourism industry:[87]

- **Limited interoperability of tourism datasets**: datasets particularly relevant for the operators (depending on the use case and the purpose of data collection): accommodation availability and demand; travelling opportunities and demand; environmental and social impact of tourism; and offer and market trends cannot be easily connected and shared.
- **Limited access to data due to large number of data operators**: Currently, tourism bookings and search-related data are mostly controlled by multi-national platforms, giving no or limited access to the businesses that provide these tourism services (nor for public authorities). Data sets can also be catalogued both by private operators and by public authorities at national, regional and local levels creating a diverse, rich, and multilingual landscape, and bookings are managed both through platforms (large and small) and independently by providers.

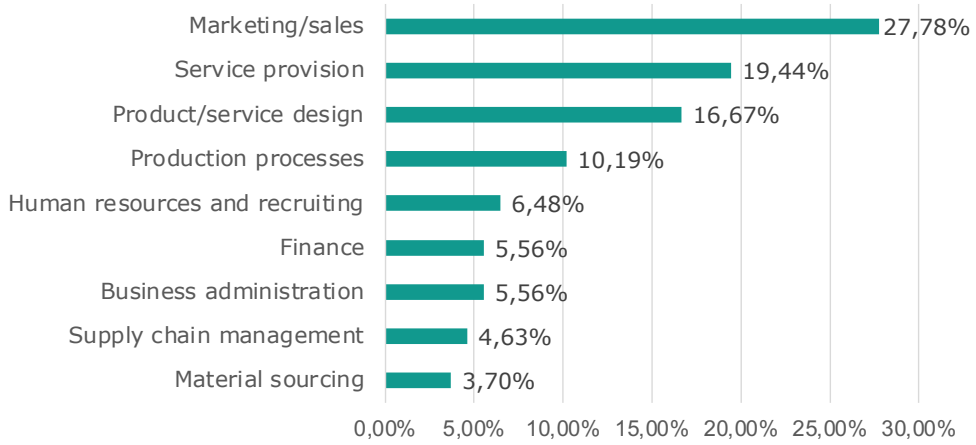
As **making better and innovative use of data is a key factor to boost competitiveness and innovation in tourism services**, increasing the uptake of big data technologies is essential. To address this, the European Commission is working to launch data space for tourism. The data space would provide connections between relevant local and national data ecosystems and initiatives at EU level, exploitation of available data for better interconnection, exchange of information and reuse[88].

Use of Artificial Intelligence in tourism

Given the rapid emergence of AI in the tourism industry over the past few years, it is crucial to explore how firms are adapting to and leveraging this transformative technology. Our survey indicates that in the tourism ecosystem, 46% of businesses that adopted AI did so **within the past year**. Moreover, only **18% of tourism businesses develop AI systems in house** and a third (33%) of tourism businesses that use AI **rely on US service providers**. Last but not least, 28% of tourism businesses use AI in **marketing and sales**. The findings confirm that AI is currently used largely for the efficiency gains that it provides.

[86] Ordóñez, M. D., Gómez, A., Ruiz, M., Ortells, J. M., Niemi-Hugaerts, H., Juiz, C., ... & Butler, T. A. (2022). IoT technologies and applications in tourism and travel industries. In Internet of Things–The call of the edge (pp. 341-360). River publishers.
[87] See: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52023XC0726(01)
[88] See: https://hadea.ec.europa.eu/calls-proposals/data-space-tourism_en

Figure 24: Share of companies using AI according to the business operation stage



Source EMI Enterprise Survey 2024, n=133

27% of tourism businesses reported that AI had the most significant impact on their marketing processes. This includes AI-driven tools that help create promotional content, assist with marketing materials, and enable more targeted campaigns. AI's capabilities in analysing customer data, personalising recommendations, and automating social media content have proven particularly beneficial for companies looking to optimise their marketing strategies and engage audiences more effectively. These technologies support tourism companies by enhancing customer outreach and providing insights that drive more efficient marketing decisions. As also found in the recent report of the World Tourism Organisation[89] (2025), AI algorithms analyse vast amounts of data to provide personalised recommendations for destinations, accommodations, activities, and attractions, enhancing the user experience and increasing customer satisfaction. Chatbots and virtual assistants offer instant responses to customer inquiries, assist with bookings, and provide support throughout the travel journey, improving customer service and reducing operational costs. Hotels are also increasingly implementing voice-activated AI devices to provide guests with hands-free control over room features and services.

19% of the respondents that adopted AI are using it to automate business processes and 18% to analyse data. Use cases of AI by hotels and travel agencies focus predominantly on analysing market trends and forecasting customer behaviour. In addition, AI-based personalisation and recommendations (including virtual agents and chatbots) have also been pointed out.

The EMI Enterprise survey of tourism businesses found that 71% of companies that implemented AI technologies reported an increase in productivity. The estimated boost in productivity was between 5-10%, reflecting the potential of AI to streamline operations, enhance customer engagement, and optimise resource management in the tourism sector. However, despite these improvements, it is essential to recognise that initial implementation costs can pose a challenge, potentially slowing the speed of return on investment for some businesses.

The majority of respondents (73%) said that they have not laid off any employees as a result of the use of AI systems. However, the types of job profiles that AI impacts the most and might also threaten include:

- Marketing professionals
- Sales agents
- Employees in customer service
- Purchasing.

[89] World Tourism Organization and Saxion University of Applied Sciences (2025). Artificial Intelligence Adoption in Tourism, UN Tourism, Madrid, DOI: https://doi.org/10.18111/9789284426065.

3.1.2. Tourism tech startups

The European tourism industry has witnessed a rapid rise in digital technology startups, which are revolutionising how tourism services are designed and delivered. These startups leverage cutting-edge technologies such as artificial intelligence (AI), augmented and virtual reality (AR/VR), blockchain, and big data analytics to enhance customer experiences, streamline operations, and promote sustainable travel. From the 2 023 innovative tourism startups, 1 554 were digital tech startups using or developing an advanced digital technology and advancing the tourism industry.

Several innovative startups are re-shaping the industry or form strategic alliances with traditional industry players enhancing the digital transformation in tourism. The Table below provides some examples, across core tourism business segments.

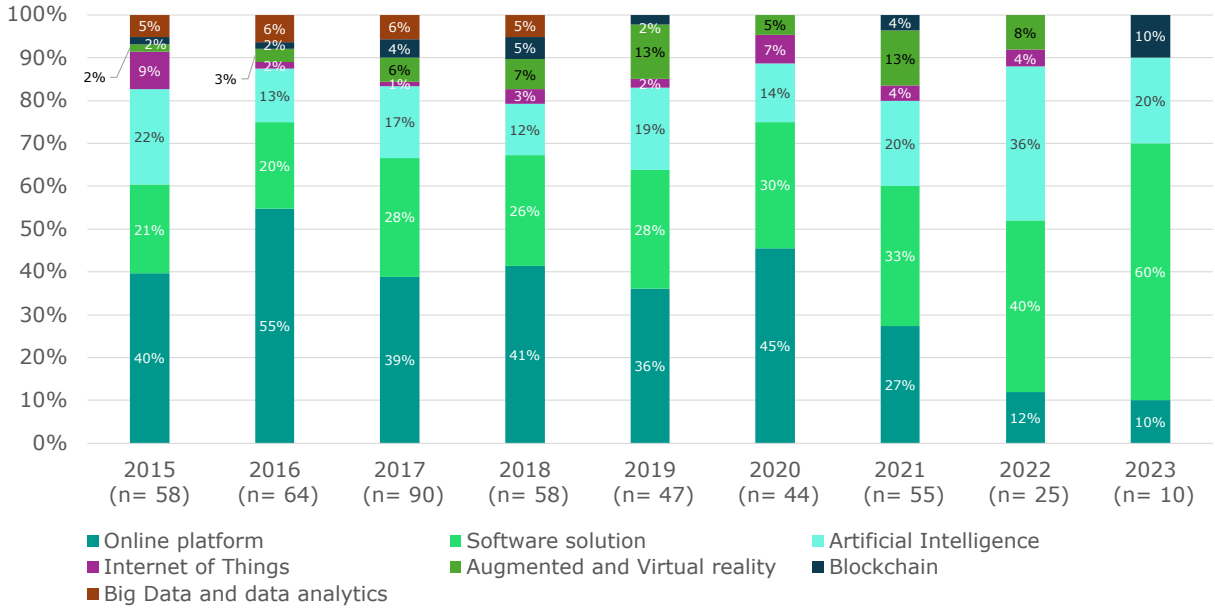
Table 6: European startups leveraging the digital transition for new tourism models

Planning & Booking	***GetYourGuide (Berlin, Germany)*** *focuses on making travel experiences more accessible through its booking platform. By integrating AI and mobile capabilities, it enables users to discover and book personalised, curated activities with ease. GetYourGuide has establishedg itself as a major player in Europe.*
Ticketing & Access:	***Tiqets (Amsterdam, Netherlands)*** *specializes in simplifying access to cultural attractions with its real-time mobile ticketing system. By offering instant tickets to museums and attractions, Tiqets aims to reduce wait times and improve accessibility to cultural experiences.*
Experience*:*	***Questo (Bucharest, Romania)*** *offers a unique way for travelers to explore cities through its interactive, gamified app. By blending augmented reality (AR) with city exploration, Questo encourages deeper engagement with local culture, transforming sightseeing into an entertaining and educational experience.*
Traveling / Transportation*:*	***GreenGo (Paris, France)*** *is an eco-conscious travel booking platform offering sustainable accommodation and transportation options. By promoting eco-friendly travel alternatives, GreenGo supports the growing demand for responsible tourism, helping local communities while contributing to the preservation of the environment.*
Accommodation*:*	***Lodgify (Barcelona, Spain)*** *is an all-in-one SaaS solution that helps vacation rental owners and property managers to manage and market their accommodation business. It is a rental marketing software that simplifies vacation rental marketing. The software allows both vacation rental owners and property managers to create their own mobile-friendly website.*

Source: Technopolis Group based on Crunchbase

The graph below provides insights into the technological focus of digital tech startups specialised in the tourism industrial ecosystem. Online platforms dominated technology adoption until 2020, when other software and data analytics solutions began taking the lead in terms of share. **Artificial intelligence (AI) and software solutions emerged as major technological focus areas.** The former represented 14% in 2020 and 20% in 2023, the latter represented 30% of start-ups in 2020 and 60% of start-ups in 2023**.** This shift can be attributed to businesses prioritising more customised and flexible digital tools, which software solutions offer, along with the increasing reliance on AI for automation, data analysis, and enhanced decision-making. AI's ability to optimise processes and drive innovation has made it an attractive option and impacting even the use of online platforms in tourism.

Figure 25: Evolution of digital tech startups driving the digital transition of the tourism industry



Source: Technopolis Group based on Crunchbase and Net Zero Insights

While online platforms were the dominant technology area developed by digital tech startups in tourism, the share of new companies developing these platforms decreased from 40% in 2015 to 10% in 2023. On the one hand, this change can be attributed to the **impact of Covid-19 and uncertainty regarding the future** of tourism. On the other hand, **startups in areas like augmented reality, virtual reality, and blockchain may find more opportunities to grow compared to those entering the online platform space, which is already dominated by established players such as Booking.com, Airbnb, and Expedia.** Unless these startups offer something highly innovative and disruptive, they are likely to struggle against the market leaders. However, in emerging fields like blockchain and augmented/virtual reality, where no dominant players have yet emerged, there is a more favourable environment for new entrants to succeed.

Additionally, there are significant challenges in applying AI within the tourism sector, particularly due to the lack of accessible, comprehensive data required to train AI algorithms effectively. While there are ongoing efforts in this direction, legislative barriers regarding data use pose a major obstacle to entrepreneurship. Without reforms to make high-quality data more accessible, it will remain difficult to develop effective AI platforms and big data solutions in tourism.

3.1.3. Private investments

The uptake of digital technologies as presented above by the analysis of traditional tourism businesses and innovative tech startups is mirrored by the patterns of investment described in the Table below.

The results of EMI Enterprise Survey 2024 indicate that the vast majority of firms invest less than 5% of revenues across all the technologies. Only a handful of firms invest more than 30% of their turnover in digital technologies, concentrating on cloud (1.6%) and AI (2.6%).

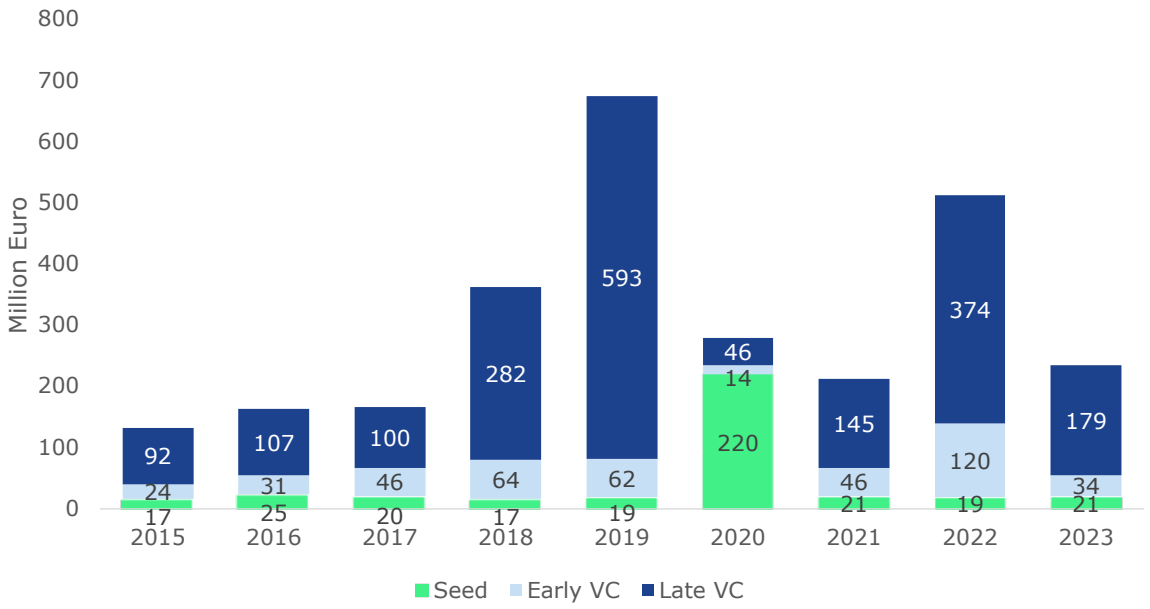
Table 7: Firms' investment in digital technologies

	Cloud	IoT	Big Data	Artificial Intelligence	AVR	Blockchain
Less than 1% of annual turnover	36,51%	30,00%	36,84%	52,63%	45,45%	50,00%
1-5% of annual turnover	34,92%	33,33%	47,37%	18,42%	18,18%	25,00%
6-10% of annual turnover	4,76%	3,33%	5,26%	0,00%		
11-30% of annual turnover	4,76%	6,67%		0,00%		
More than 30% of annual turnover	1,59%			2,63%		

Source: EMI Enterprise Survey 2024

The Crunchbase dataset allows to explore trends related to venture capital investment into tourism tech companies. The Figure below shows how VC investment into digital tourism companies has been distributed over the years. Between 2015 and 2023, nearly EUR 2.7 bn in venture capital were invested in tourism digital startups. Nearly 70% of these funds go to late VC. An interesting outlier is 2020, when seed capital represented nearly 79% of the total. The analysis is in line with the analysis of McKinsey (2023), which highlights how the pandemic accelerated investment in travel startups, with over EUR 25 bn raised between 2020 and 2022 globally. The analysis emphasises that investment is concentrated on mature companies, particularly in hospitality and business travel, with a few category leaders dominating funding.

Figure 26: Disaggregation of the investment stages of the investment into digital tourism young companies



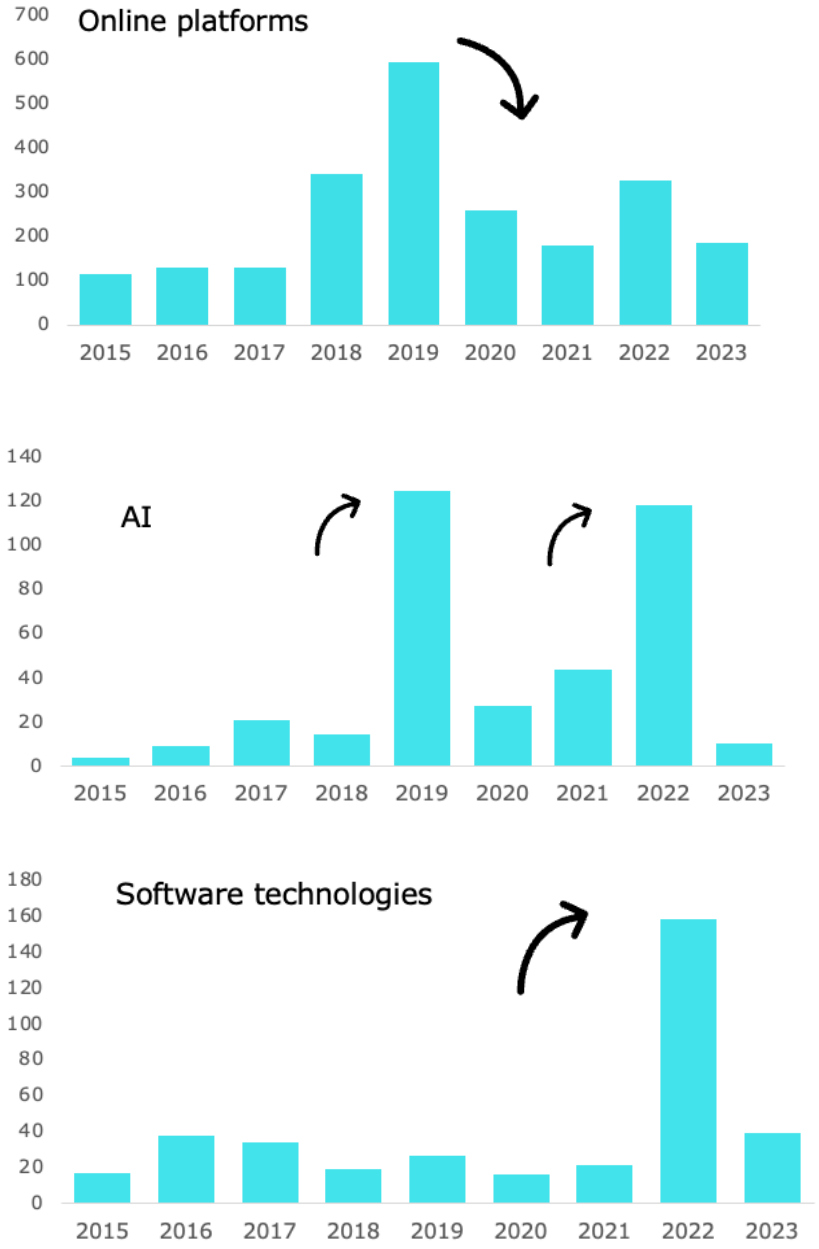
Source: Technopolis Group based on Crunchbase and Net Zero Insights

A very interesting picture emerges from the graphs below, which explore VC investment by specific technologies. The data indicates that investments in online platforms reached their highest point in 2019 before declining. In contrast, investments in artificial intelligence surged again in 2022, alongside the rise of software technologies. This trend reflects the dynamic shift in digital investments, particularly influenced by the COVID-19 pandemic. During 2020 and 2021, there was a significant drop in investment across all

types of technologies as businesses faced disruptions. However, by 2022, there was a sharp recovery, with AI and software technologies driving innovation and efficiency, demonstrating the resilience of tech-driven industries during post-pandemic recovery.

The graph is consistent with the evolution of AI. Before the pandemic, AI in tourism primarily focused on enhancing customer service, personalisation, and operational efficiency through chatbots, recommendation engines, and dynamic pricing systems. Post-pandemic, AI expanded to meet health and safety demands, such as contactless services and digital health passports, while predictive analytics helped businesses adapt to changing travel behaviours, offering more advanced personalisation, virtual tourism, and increased automation in areas like hotel operations and customer service[90].

Figure 27: VC investment in digital tourism company by type of technology in m EUR



Source Technopolis Group based on Crunchbase and Net Zero Insights

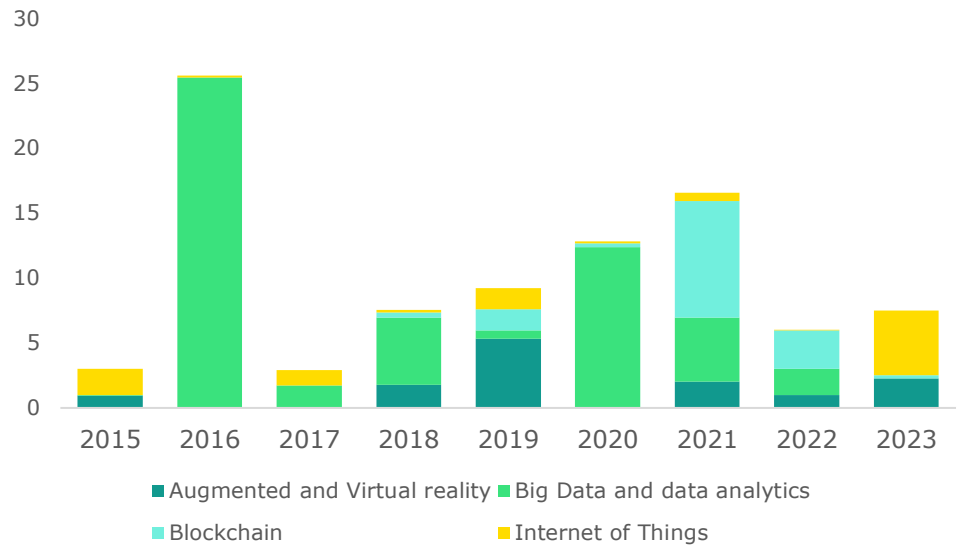
[90] See, for instance, Kontogianni et al. 2022; World Economic Forum, 2023

The graph below offers additional breakdowns of digital VC in tourism. It shows an increasing interest in blockchain technology, with a peak in 2021. Blockchain offers solutions to some of the industry's long-standing challenges, such as transparency, trust, payment efficiency, and data security.

Examples of startups in this area, include **X-Plora,** a platform for physical and virtual tours that bets on XR (AR/VR), Gamification and Blockchain to improve visitor experience; or **LockTrip**, a decentralised hotel book and vacation rental marketplace which also uses block-chains among others.

A significant trend in 2023, is the increased VC investment in IoT. The latter is playing a key role in various tourism-related sectors, including hospitality, transportation, attractions, and destination management. Examples of EU start-ups applying IoT to tourism, include the Portuguese **HiJiffy**[91], which centralises, automates, and measures all hotel customer service activities, or **Roomonitor**[92], which develops IoT solutions to control noise and parties in short term rentals.

Figure 28: VC investment by technology in m EUR



Source Technopolis Group based on Crunchbase and Net Zero Insights

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?

- The European Regional Development Fund (ERDF) plays a vital role in advancing the digital transition within the tourism industrial ecosystem by providing financial support for digitalisation.

- The **ERDF allocated 7% of all tourism co-funded projects (2 378 out of 48 257) to digital technologies,** with the digital transition accounting for 8% of total tourism-related funding (EUR 1.15 bn).

- Advanced digital technologies accounted for **21% of the total ERDF funding dedicated to the digital transition of tourism in the 2014-2020 programming period, with**

[91] https://www.hijiffy.com/
[92] https://roomonitor.com/en/

augmented and virtual reality, big data and data analytics, and online platforms being the most commonly supported advanced technologies.

- During the whole of **Horizon 2020, over EUR 52 m was spent on projects related to the digital transition in tourism**, more than EUR 7 m per year. In the first three years of Horizon Europe, nearly EUR 40 m were spent on digital topics, averaging EUR 13 m per year.

- The share of projects co-funded by Horizon and focused on the digital transition has grown significantly, rising from **43% to 52%.**

- In 2024, **3.2% of professionals registered on LinkedIn and employed within the tourism industrial ecosystem possessed advanced digital skills and 16.8% possessed other more moderate digital skills**, marking an increase from the levels observed in 2022. The most prevalent advanced digital skill remains cloud technologies, followed by artificial intelligence and big data. However, the overall percentages remain modest, and while there has been some increase, it is not substantial.

- The **requirements both for moderate and advanced digital skills listed on online job advertisements within tourism** has been growing steadily over the period from 2021-2023. In 2023, 23% of online job advertisements in the EU27 required moderate digital skills and 17% advanced digital skills.

- Tourism managers are increasingly required to possess broader **digital literacy, the agility to embrace technological opportunities**, and the ability to lead teams in a digitally evolving environment.

- While it is clear that travel and tourism predominantly happens in person, making it an inherently **human-centric experience**, the prevalence of the digital technologies among travellers and growing demand for unique and burdensome travel experience creates an environment for digitally enabled tourism.

3.2.1. Public investments via the European Regional Development Fund

ERDF support to the digital transition in tourism: strong focus on SME competitiveness **The European Regional Development Fund (ERDF)[93] plays a crucial role in supporting the digital transition of the tourism industrial ecosystem by providing financial resources to regions within the European Union to promote digitalisation**. The ERDF has a particular focus on less-developed regions with the objective of reducing regional disparities. In this section, we investigate to what extent the ERDF has been used to foster the digital transition in tourism.

The analysis of ERDF data has been based on in-depth data mining of the Kohesio database, described in more detail in section 2.3. The results indicate that 7% of all tourism ERDF projects (2 378 out of 48 257), cover the digital transition, accounting for 8% of the funding (EUR 1.15 bn, out EUR 14.07 bn).

The graph below groups the projects by their thematic objective (TO), following the classification used in the programming period 2014-2020. The most common TO for digital tourism projects is Competitiveness of SMEs (TO 3), accounting for 56.7% of projects (1 348). The results confirm that the digital transition is largely driven by the need to achieve efficiency gains and hence competitiveness. Indeed, under this Thematic Objective, projects focus on website development, social media marketing, and customer management platforms, with a view to enhance brand loyalty and efficiency.

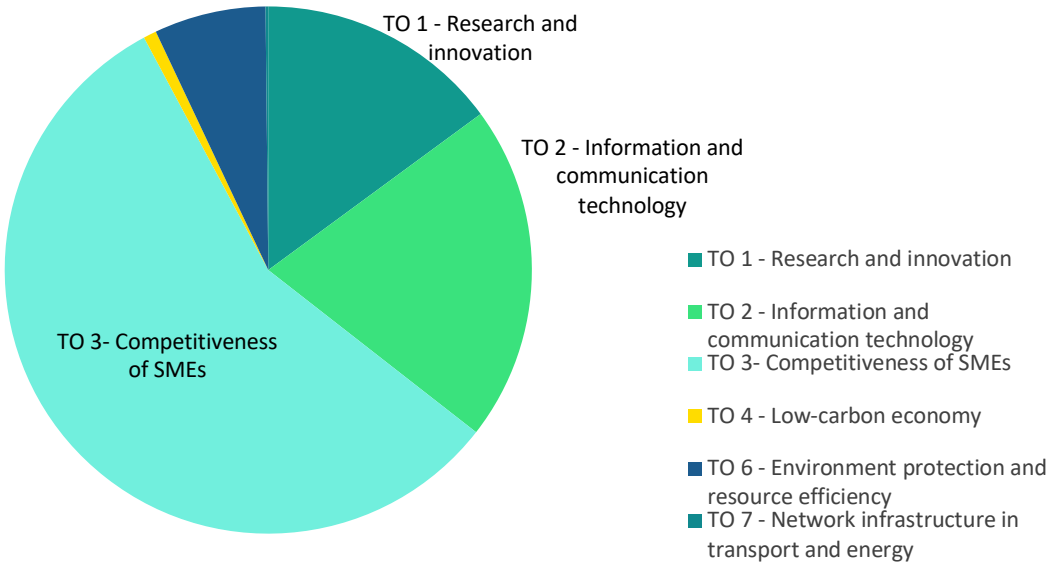
[93] https://ec.europa.eu/regional_policy/funding/erdf_en

The second most common thematic objective is Information and Communication Technology (TO 2) with 20.6% (491), in which projects focus on promoting cultural heritage through **digital innovation**, including augmented reality, virtual tours, and interactive content for historical sites. They emphasise **digitisation of archives and cultural resources**, improving **tourism experience** through smart technology and personalised digital guides and enhancing public services through IoT.

Research and Innovation (TO 1) has the third largest share of projects, with 14.9% of the total (355). Under this TO, projects focus on the development of platforms, mobile apps, and data analysis tools. They aim to enhance booking processes, improve tourist flow prediction, and optimise tourism services using artificial intelligence and big data. Other initiatives include the digitisation of cultural and tourism experiences and explore sustainability in tourism.

The remaining projects are focused on Environment Protection and Resource Efficiency (TO 6) at 6.9%, Low-Carbon Economy (TO 4) at 0.8%, and Network Infrastructure in Transport and Energy (TO 7), which has the smallest share at 0.2%.

Figure 29: ERDF Tourism projects contributing to the Green transition by thematic objective (2014-2020)



Source Technopolis group based on Kohesio data

The Table below provides examples of different types of projects funded under ERDF and classified as supporting the digital transition in tourism.

Table 8: ERDF projects supporting the digital transition of the tourism industrial ecosystem

ERDF projects - examples
Tourism and Hospitality Digital Transformation: Efficiency gains
On-line reservation and geoinformation system of eABM[94] (Czech Republic) The project involves the development of a three-tier sales and information system, branded as "navig.me," designed to operate in a client-server mode. It will be available as a cloud-based web service or as an installation package for Windows, Linux, and iOS operating systems, as well as for mobile platforms including Apple iOS, Android, and Windows Mobile. The system is a comprehensive solution for booking and selling tickets, offering unique features, providing a seamless and efficient user experience across multiple devices and platforms.

[94] https://kohesio.ec.europa.eu/en/projects/Q19703

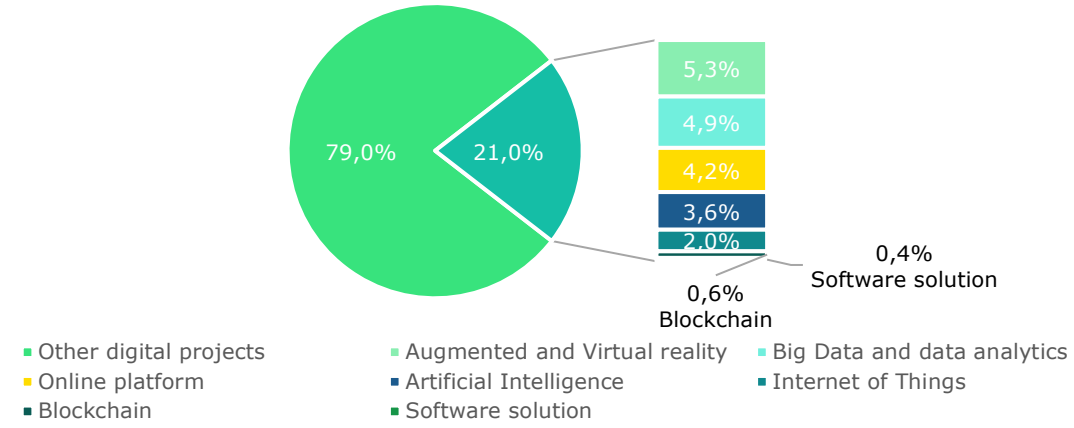
ERDF projects - examples
Tourism Data Management
New digital travel agency (Finland)[95] This project aims to enhance the operations of Ikalisten Travel Office's new digital travel agency by developing real-time booking capabilities during trips and delivering personalised customer experiences. It focuses on increasing digital interaction with customers and managing customer sentiment to create added value for the entire tourism value chain. The project's development efforts are centred on advanced data management to optimise customer engagement and service efficiency.
Cultural Heritage and Digital Education
Closer to culture. Digitisation of representative collections of the National Museum in Krakow for e-culture and e-education (Poland)[96] The project aims to digitise and promote the valuable collections of the National Museum in Krakow (MNK) to enhance Polish cultural heritage visibility both in Poland and internationally. Key objectives include: 1. Preserving objects for digitisation. 2. Developing IT infrastructure for data storage, sharing, and processing. 3. Digitizing representative objects from the Museum's collections. 4. Enhancing the database with new functionalities and metadata. 5. Translating selected metadata into English. 6. Creating a digital platform to showcase the Museum's digitised content. 7. Implementing targeted promotion strategies to reach diverse audiences.
Smart cities and public services
Promote the offer of services based on cultural heritage, associated with the digitisation of the same and its application to the tourism sector (Spain). The project aims to create a platform that enhances municipal management by improving the collection, maintenance, and sharing of geographic information related to the city. This platform will support the storage, processing, access, and distribution of spatial data, with a focus on protected assets, tourism sites, and local services, ensuring interoperability standards.

Source Technopolis group based on Kohesio data

As indicated in the graph below, Advanced Digital Technologies account for 21% of the total ERDF funding on the digital transition of tourism, with augmented virtual reality, big data and data analytics and online platforms, representing the most common advanced technologies.

Figure 30: Share of projects of advanced digital technologies over total digital

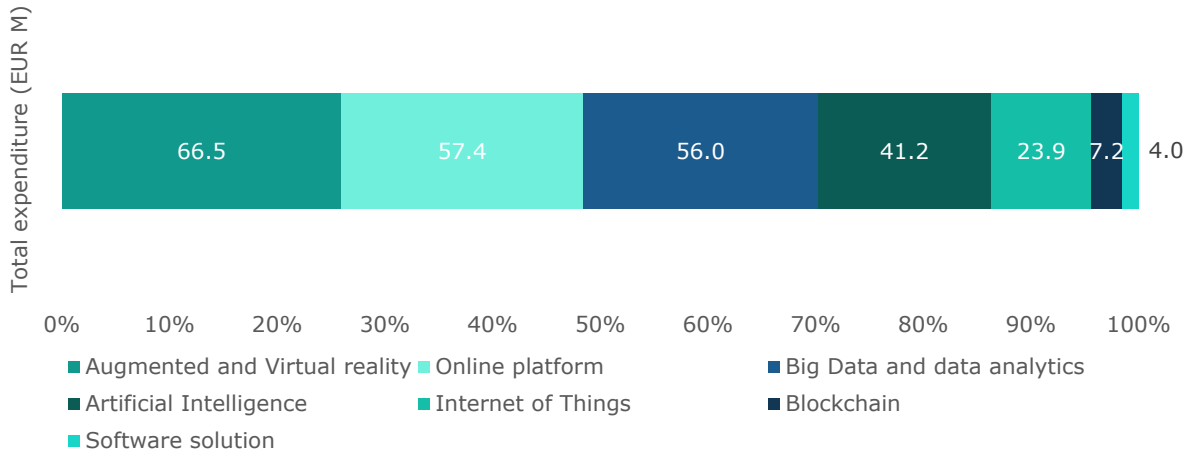
[95] https://kohesio.ec.europa.eu/en/projects/Q3756463
[96] https://kohesio.ec.europa.eu/en/projects/Q87007



Source Technopolis based on Kohesio data

Augmented virtual reality accounts for EUR 66.5 m of expenditure, followed by online platforms with EUR 57.4 m and big data and data analytics with EUR 56 m.

Figure 31: Total Eligible Expenditures in ERDF projects in m EUR



Source Technopolis based on Kohesio data

The Table below provides examples of projects in advanced areas funded through ERDF.

Table 9: Examples of ERDF projects by technology

Advanced Technology	Project
Blockchain	Deployment of blockchain-based settlement system to promote tourism sector consumption in the aftermath of the COVID-19 pandemic (Lithuania)[97] The project explores the feasibility of a blockchain-based payment system to boost tourism post-COVID-19. It examines how blockchain has improved transaction efficiency and assesses the readiness of tourism providers and users to adopt cryptocurrency payments. A prototype virtual currency payment system will be developed and tested in a tourism company.

[97] https://kohesio.ec.europa.eu/en/projects/Q3812633

Advanced Technology	Project
Big data & data analytics	Tools for the Promotion of Tourism Experience[98] (Greece) The project seeks to develop tools that provide personalised tourist recommendations using big data from sources like social media and user history, while ensuring privacy. It uses hypergraphs and dynamic collaborative filtering for optimisation. Mobile apps will offer multilingual interaction, with deep neural networks handling language challenges.
Augmented virtual reality	Archipelag mites[99] (Poland) The project, led by a consortium of four companies from Lublin Voivodeship, aims to create an innovative tourist product, "Archipelag Roztocze," in Eastern Poland, centred on the region's natural and historical heritage. The main attraction is the educational and entertainment park "Archipelag Roztocze," utilizing advanced ICT technologies like augmented reality, virtual reality, 360-degree mapping, and human interactive interfaces (HII). The project features networked elements, including joint investment, unified branding, common promotion, and a shared sales system.
Internet of Things	Smart City Vranov nad Topľou[100] (Slovakia) The "Smart City Vranov nad Topľou" project aims to improve eGovernment services by implementing IoT technology and ICT platforms for smart city management. It focuses on data collection and analysis in areas like traffic, land planning, nature and landscape protection, environmental quality, and public information access. By introducing 84 IoT sensors, the project will provide real-time data on traffic, parking, weather, and environmental conditions, enhancing decision-making, particularly in managing urban development and protecting natural landscapes.
Artificial intelligence	Artificial Intelligence (AI) in Tourism: Development of a system of personalised recommendations for products and services to guests in the hotel sector (Croatia)[101] The "Artificial Intelligence for Tourism" project aims to develop a personalised recommendation system for products and services in the hotel sector, introducing an innovative solution for the tourism industry. This AI and machine learning-based system will enable hotels to offer guests tailored content autonomously and in real-time, transforming them from simple accommodation providers into personalised experience curators. To bring this product to the global market, emerging company Acquafint d.o.o. will invest in equipment, employ software engineers and data scientists, and conduct presentations for potential customers.

Source: Kohesio database

3.2.2. Public investments via the EU framework programmes for research and innovation

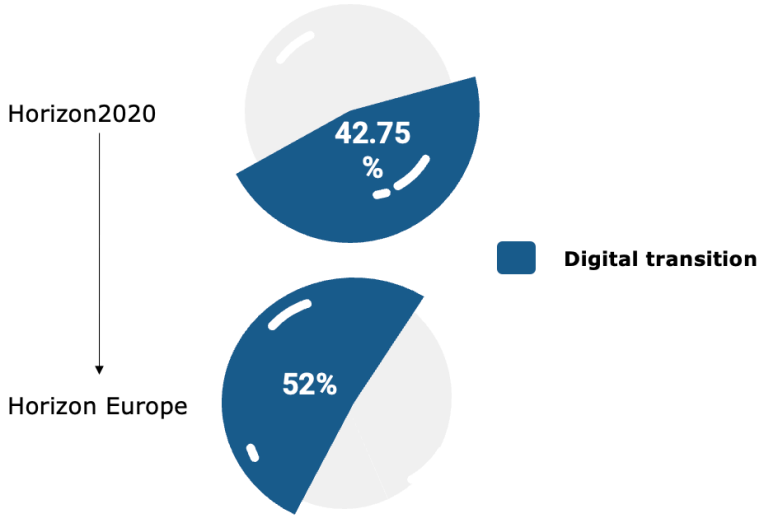
The Figure below highlights the evolution of projects related to the digital transition in tourism in the programmes Horizon 2020 and Horizon Europe. The proportion of tourism related digital transition projects has increased from 43% to 52%.

In terms of spending, during the whole of **Horizon 2020, over EUR 52 m was spent on projects related to the digital transition in tourism**, more than EUR 7 m per year. In

[98] https://kohesio.ec.europa.eu/en/projects/Q2777263
[99] https://kohesio.ec.europa.eu/en/projects/Q87940
[100] https://kohesio.ec.europa.eu/en/projects/Q3107904
[101] https://kohesio.ec.europa.eu/en/projects/Q2732247

the **first three years of Horizon Europe, nearly EUR 40 m were spent on digital topics**, averaging EUR 13 m per year.

Figure 32: EU Horizon2020 and Horizon Europe Funding dedicated to the digital transition of the tourism industrial ecosystem



Source: Technopolis Group based on CORDA

Horizon Europe funding instruments provide support for these areas under following calls:

- Climate-neutral and smart cities mission[102];
- Climate, energy and mobility cluster[103];
- Food, bioeconomy, natural resources, agriculture and environment cluster[104];
- Culture, creativity and inclusive society cluster[105]

The Table below provides several examples of Horizon Europe funded projects focused on digital transition of tourism.

Box: Examples of Horizon Europe funded projects

Project
Aware Systems for Smart Interactive muSeums and arT[1]
The project will support the commercial validation of new contextually aware chatbots in the tourism sector. Exploiting novel contextually aware chatbots in the tourism sector could offer immediate and impactful benefits, as tourists often require real-time, context-specific information and assistance, which these advanced chatbots can effectively provide. Additionally, the chatbots could pave the way for the "future museum", a museum that could become like a thematic park in which visitors could really appreciate the value of on-site visits vs. virtual visits by, for example, generating an emotional link with the original piece of art.
Unobtrusive Technologies for Secure and Seamless Border Crossing for Travel Facilitation[2]

[102] See: https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/eu-missions-horizon-europe/climate-neutral-and-smart-cities_en
[103] See: https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/cluster-5-climate-energy-and-mobility_en
[104] See: https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/cluster-6-food-bioeconomy-natural-resources-agriculture-and-environment_en
[105] See: https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/cluster-2-culture-creativity-and-inclusive-society_en

The EU-funded ODYSSEUS project aims to develop digital solutions enabling citizens to seamlessly cross borders without stopping. Different technologies, i.e. AI and advanced scanning tools (based on X-rays or unmanned aerial vehicles) will also eliminate the friction for border authorities, enabling them to remotely validate identities and check vehicles, luggage or cargos.

Source: Technopolis Group based on CORDA

3.2.3. Skills supply and demand underpinning the digital transition

The **Pact for Skills** highlights the crucial need for **digital skills** in the tourism sector, especially as the industry adopts more digital tools for customer engagement and service delivery. It stresses the importance of helping SMEs upskill in areas such as digital literacy and e-commerce to remain competitive, as well as the crucial role of life-long learning in the industry. In order to analyse trends in the skills of professionals working in the tourism 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:

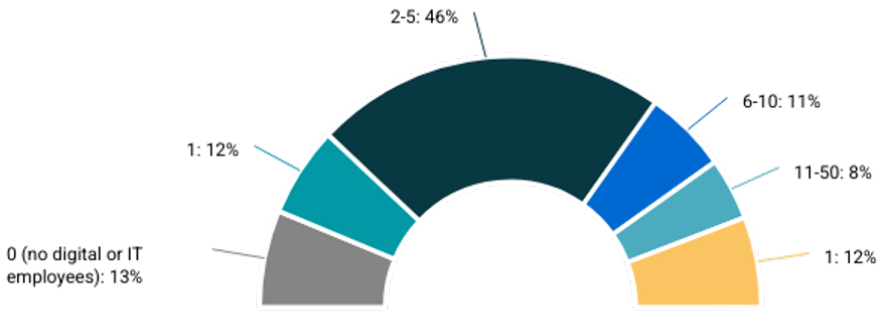
Moderate digital skills have been defined following Cedefop[106] notably including "*five types of skills under the digital skills umbrella such as information processing (e.g. using a search engine and storing information and data); communication (including teleconferencing and application sharing); 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 tourism and across the EU. An analysis of representativeness is provided in Appendix B and in the related methodological report.

3.2.3.1. Supply of skills relevant for the digital transition

In 2024, **13% of tourism companies had one full-time employee in roles directly related to the digital transition, while 50% of respondents reported employing between 2-5 people in digital roles**, according to the results of the EMI Enterprise Survey. These findings reflect the gradual integration of digital technologies across the tourism sector, as companies increasingly recognise the need for specialised skills to navigate the digital transformation.

Figure 33: Share of full-time employees working in jobs relevant for the digital transition

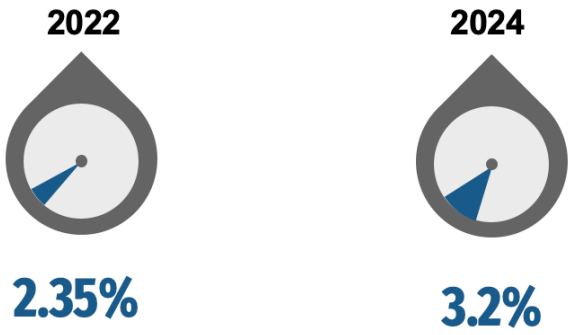


Source: EMI Enterprise Survey 2024

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

In 2024, 3.2% of professionals registered on LinkedIn and employed within the tourism industrial ecosystem possessed advanced digital skills and 16.8% possessed other more moderate digital skills, marking an increase from the levels observed in 2022 (see Figure below). This trend reflects a growing emphasis on digital transformation in the ecosystem in particular in the area of travel services, but also the broader trend towards businesses increasingly adopting advanced technologies to enhance operational efficiency and improve customer experiences.

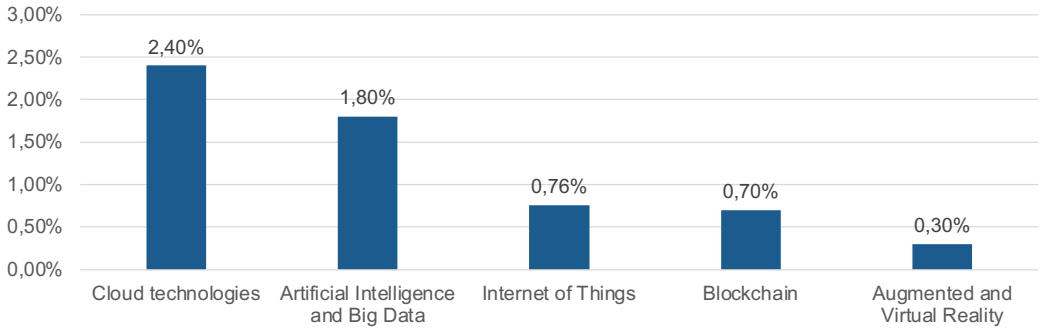
Figure 34: Share of professionals in the tourism ecosystem with skills relevant for the digital transition in the EU27



Source: Technopolis Group based on LinkedIn

The most prevalent advanced digital skill remains cloud technologies, followed by artificial intelligence and big data. However, the overall percentages remain modest, and while there has been some increase, it is not substantial. This reflects that the industry is not yet fully prepared to address the AI challenge, as highlighted by the ongoing transformations and efforts discussed in Chapter 2.

Figure 35: Share of professionals with a specific digital skill within the tourism industrial ecosystem in the EU27 and with a profile on LinkedIn

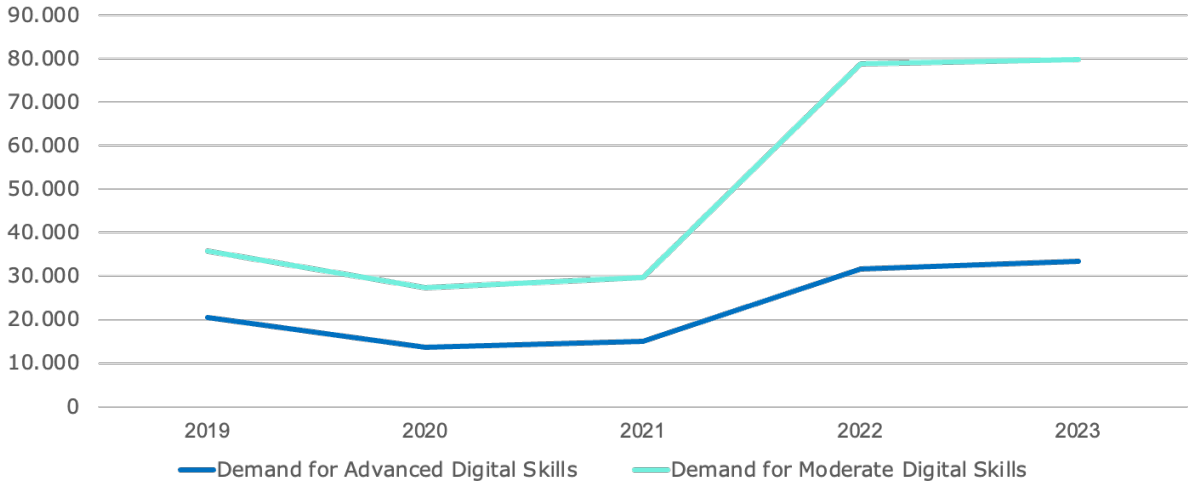


Source: Technopolis Group based on LinkedIn, data download September 2024

3.2.3.2. Skills demand relevant for the digital transition

The requirements both for moderate and advanced digital skills listed on online job advertisements within tourism has been growing steadily over the period from 2021-2023, as shown by the data from Cedefop Skillsovate. In 2023, 23% of online job advertisements in the EU27 required moderate digital skills and 17% advanced digital skills.

Figure 36: Online job advertisements with a requirement for digital skills in the tourism ecosystem in the EU27



Source: Technopolis Group elaboration from CEDEFOP OVATE-OJA database

As highlighted by the OECD (2021)[107] the growing shift towards digitalisation introduces significant challenges, particularly in addressing skill shortages and gaps, which can slow the full adoption of digital tools. This issue is especially pronounced for SMEs, which often have more limited digital capabilities compared to larger firms. SMEs in rural areas face compounded difficulties, with less access to high-quality digital infrastructure and fewer opportunities for training programmes to develop digital proficiency. As digitalisation continues to evolve, these barriers risk exacerbating inequalities in technology adoption across different regions and business sizes within the ecosystem. There is a growing need for digital fluency, especially in management roles. McKinsey & Company (2023)[108] and PANTOUR (2024)[109] stress that the skills gap is characterised by the growing demand for a workforce proficient in digital tools like automation, AI, and data analytics, while many employees lack the necessary training to adapt to these changes.

In line with the above, Carlisle et al. (2024) emphasise the critical role of AI, robotics, augmented and virtual reality in shaping the future of tourism. However, they also specify that **more immediate needs, such as online marketing and social media skills, are essential for day-to-day operations, particularly for SMEs**. The review also highlights that digital literacy is indispensable for maintaining competitiveness in an increasingly globalised market.

Tourism managers are increasingly required to possess broader digital literacy, the agility to embrace technological opportunities, and the ability to lead teams in a digitally evolving environment, as highlighted by interviews. This presents a significant challenge for many, as the skills required to manage digitalised tourism businesses often do not align with the current managerial education and vocational training available. Key challenges for managers in the digital transition of tourism include the need to develop management and leadership skills that are not only relevant to tourism but also applicable across various sectors.

The Pact for Skills in Tourism highlights significant gaps in digital skills within the tourism industry[110]. It stresses the need for upskilling in areas such as IT

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[107] *OECD (2021). Preparing the tourism workforce for the digital future. OECD Tourism Papers, 2021/02. OECD Publishing, Paris. https://doi.org/10.1787/9258d999-en*

[108] McKinsey & Company (2023c). The future of tourism: bridging the labor gap, enhancing customer experience. McKinsey Insights. Retrieved from: https://www.mckinsey.com/industries/travel-logistics-and-infrastructure/our-insights/future-of-tourism-bridging-the-labor-gap-enhancing-customer-experience

[109] PANTOUR Project. (2024). European skills survey report: addressing skills gaps in tourism. Erasmus+ PANTOUR Project, European Union.

[110] See EU Pact for Skills – Skills Partnership for the Tourism Ecosystem December 2021 https://ec.europa.eu/social/BlobServlet?docId=25214&langId=en

tools, digital service quality, and digital business intelligence, which are increasingly important due to the industry's reliance on digitalisation. The post-pandemic recovery has intensified these gaps, especially as new technologies and customer expectations evolve. Immediate action through public-private partnerships is critical to reskill both the current and lost workforce, focusing on the digital transition for long-term competitiveness.

Table 10: Managerial skills for the digital transition in tourism

Executive/Strategic Management	Human Resource Management	Operational/Line Management
• **Championing digitalisation/ Digital leadership** • **Development of a digitalisation strategy** • **Development/ promotion of a value-based digitalisation culture**	• Development of more flexible work organisation/working time models • Identifying individual competence and related needs of employees • Implementing support measures and incentivising adaptation	• Reorganisation of workflows/work processes • Targeted allocation of tasks and functional areas based on strengths • Clear communication of change requirements to teams/individuals • Supporting work in flatter organisational hierarchies • Supporting space for team/individual creativity

Source: OECD (2021) Preparing the tourism workforce for the digital future.

While future managers entering the workforce through higher education are expected to have a stronger foundation in digital skills, the tourism sector will face competition from other industries for these skilled recruits. Therefore, tourism businesses need to offer attractive career paths and competitive terms to retain these future leaders[111].

Even if digital skills in the tourism sector have advanced considerably, **there are still obstacles**, particularly in ensuring digital inclusivity and adapting to the fast-paced technological changes. To bridge these gaps, collaboration between governments, industry stakeholders, and educational institutions is crucial for maintaining competitiveness in the digital era.

Box 1: Measuring the digital skills gap in tourism: emerging initiatives

The limited robust quantitative evidence available on digital skills gap in tourism has prompted significant EU wide initiatives to quantify and qualify such phenomenon. In particular the Next Tourism Generation (NTG) Sector Skills Intelligence Monitoring System[112] provides insights into current and future skills needs within the tourism sector. The system, currently under development, monitors trends in **digital, green, and social skills** and supports workforce development by identifying skill gaps. The system helps tourism businesses, educators, and policymakers make informed decisions regarding training and skill-building initiatives. It emphasises collaboration across the industry to meet evolving market demands, contributing to a more sustainable and competitive tourism sector.

3.2.4. Consumer demand for digital tourism services

Travel and tourism generated global GDP is predicted to grow on average, at 5.8 percent a year between 2022 and 2032, outpacing the growth of the overall economy at an expected 2.7 percent a year[113]. As use of technologies including the 'Internet of Things, artificial intelligence, augmented and virtual reality, and blockchain technology resulted in

[111] OECD (2021) Preparing the tourism workforce for the digital future. Available online: https://www.oecd.org/en/publications/preparing-the-tourism-workforce-for-the-digital-future_9258d999-en.html
[112] https://nexttourismgeneration.eu/sector-skills-intelligence-monitoring-system/
[113] See: https://www.mckinsey.com/industries/travel-logistics-and-infrastructure/our-insights/future-of-tourism-bridging-the-labor-gap-enhancing-customer-experience

a more attractive, socially and environmentally sustainable tourism, demand for digitalisation is expected to continue changing travel experience.[114] While it is clear that travel & tourism predominantly happens in person, making it an inherently human-centric experience, the prevalence of the digital technologies among travellers and growing demand for unique and burdensome travel experience creates an environment for digitally enabled tourism.

More specifically, tourists today increasingly seek various types of digital services to enhance their travel experience. These services span across planning, convenience, engagement, and personalisation. Consumers increasingly demand **automated booking systems**, **real-time support**, and **personalised recommendations**. These trends, accelerated by the pandemic, point toward a **digital-centric future in tourism** where AI and automation help address labour shortages while maintaining the essential human touch that elevates guest experiences[115] [116].

Tourists are increasingly reliant on mobile applications throughout their travel experience, from planning and booking to on-site navigation and reviews. Travel mobile apps have revolutionised the tourism industry by simplifying bookings, improving communication, and offering personalised experiences. Key features like secure payments, integrated travel services, and the ability to share and access reviews on social media further influence tourist decisions, enhancing engagement and satisfaction. Younger generations, due to their familiarity with digital technologies, are more closely engaged in this behaviour[117].

Apps such as Airbnb and HotelTonight allow travellers to easily book accommodations and find deals. Travel apps benefit users by reducing paperwork, providing convenience, and integrating features like geolocation, currency conversion, and payment gateways.[118] Destinations using these innovations are able to offer more personalised, seamless, and immersive experiences, ultimately increasing their appeal in a competitive market.[119] According to Lopez Cordoba[120] the use of digital platforms reduces frictions like geographic distance, language, and borders in tourism flows.

Tourists increasingly desire immersive experiences that go beyond traditional sightseeing. They are seeking deeper engagement, personalised interactions, and the ability to explore destinations in innovative ways. Brands are leveraging this trend by crafting ads that promote experience-focused trips, with companies like Expedia and Airbnb leading the charge. According to the **American Express Travel 2022 Global Travel Trends Report**, **70%** of consumers are most interested in **cultural immersion** and participating in tours when it comes to experiential travel. Additionally, **43%** of travellers express interest in attending **entertainment events** during their trips, while **38%** are drawn to **cultural events**. This highlights a significant preference for travel experiences that offer cultural and entertainment-based activities.[121]

According to a 2021 report on favourite travel apps and websites in the USA, the top five most positively viewed platforms are:

1. **Google Maps**, with a popularity score of **79%**.
2. **Google Earth**, receiving **60%** approval from users.

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[114] See: https://www.unwto.org/digital-transformation
[115] Dang, T.D. & Nguyen, M.T. (2023). Systematic review and research agenda for the tourism and hospitality sector: Co-creation of customer value in the digital age. Future Business Journal, 9(94), 1-16. https://doi.org/10.1186/s43093-023-00274-5
[116] McKinsey & Company (2023c). The future of tourism: bridging the labor gap, enhancing customer experience. McKinsey Insights. Retrieved from: https://www.mckinsey.com/industries/travel-logistics-and-infrastructure/our-insights/future-of-tourism-bridging-the-labor-gap-enhancing-customer-experience
[117] *Nyagaka, C. (2024), Impact of mobile booking applications on consumer behavior in the hospitality industry. Journal of Modern Hospitality 3(2), 26 – 38.* https://doi.org/10.47941/jmh.1958
[118] https://markovate.com/blog/travel-mobile-app-for-tourism-industry/
[119] https://nortal.com/insights/immersive-travel-how-digital-technology-is-transforming-tourism/
[120] Lopez Cordova, JE, Digital Platforms and the Demand for International Tourism Services (February 13, 2020). World Bank Policy Research Working Paper No. 9147, Available at SSRN: https://ssrn.com/abstract=3537945
[121] https://research.mountain.com/insights/consumers-are-seeking-out-experiential-travel/

3. **Expedia**, favoured by **50%** of respondents.
4. **Tripadvisor**, with a popularity score of **49%**.
5. **Google Drive App**, also rated at **49%**.

These platforms were recognised for their usefulness and reliability in travel planning and management.

An important trend to monitor is the rise of immersive experience through virtual reality. As reported by EMB (2024)[122] VR applications in tourism increased by 30%, thus emphasising its growing popularity. Gartner forecasts that by 2025, half of global travel agencies will leverage VR to showcase destinations. Additionally, SEMrush data shows a 40% rise in searches for VR travel experiences over the past year, reflecting heightened consumer interest. Virtual experiences also promote **sustainable travel** by offering alternatives that reduce environmental impact, making VR a compelling tool for both the travel industry and eco-conscious travellers.

It is clear that understanding consumer behaviour is critical to support the tourism ecosystem in the unfolding digital transition. By systematically gathering insights on tourist preferences, behaviours, and expectations, the tourism industry can develop more targeted and effective offerings.

3.3. Impact of digital technologies on industrial competitiveness

What is the impact of digital technologies on competitiveness?

- The tourism industry has become more digital, mobile and personalised affecting the tourism ecosystem across three dimensions: 1) Improving customer experience and personalisation; 2) Boosting operational efficiency and sustainability; 3) Supporting new business models.

- The survey of tourism companies indicates that the adoption of advanced digital technologies increased productivity between 1-15%. **The largest share of respondents witnessed an increase in productivity as a result of cloud computing followed by AI and big data**.

- However, 5% of businesses reported a decrease in productivity attributed to the initial investment costs associated with adopting new technologies or practices. Initial costs include expenditures on **equipment, software, employee training**, and changes to **operational** processes.

This section analyses the extent to which companies perceive digital technologies as enhancing their competitiveness, both for their business and the industry. It also explores the reasons why investing in digital technologies is worthwhile and identifies which ones are particularly advantageous for the tourism sector.

In recent years, digitalisation has been a key driver of economic transformation in the EU and globally, fostering innovation across value chains, reshaping how products are manufactured, how services are delivered, and altering the way we work and consume. Moreover, the Digital Decade Communication sets the target of more than 90% of SMEs reaching at least a basic level of digital intensity by 2030[123]. In 2021, only 56% of SMEs have reached the target, which includes elements such as fast internet connection, a minimum share of e-commerce or web sales in turnover, use of social media, etc.

[122] https://blog.emb.global/vr-tourism-is-revolutionizing-travel-experiences/
[123] Europe's Digital Decade: digital targets for 2030. Retrieved from: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/europe-fit-digital-age/europes-digital-decade-digital-targets-2030_en

These changes have been particularly significant in the tourism ecosystem as they have not only encompassed the introduction of digital technologies into tourism operations but led to a fundamental change in the relationship between businesses and consumers. It should be noted that tourism companies adopt digital and advanced digital technologies. While both categories of technologies foster digital transformation, their adoption, benefits and limitation differ.

Figure 37: Definitions of basic and advanced digital technologies

Basic digital technologies	Advanced digital technologies
These are foundational tools and platforms that enable tourism companies to establish an online presence and improve their operational efficiency. Some examples include e-commerce platforms (e.g., websites and online marketplaces that facilitate online transactions), social media (e.g. use of platforms like Facebook, Instagram, and Twitter for marketing and customer engagement), Point of Sale (POS) systems, Customer Relationship Management (CRM) systems.	Advanced technologies involve cutting-edge innovations that offer more sophisticated solutions for optimising operations, enhancing customer experiences, and gaining a competitive advantage in the digital marketplace. Examples include Artificial Intelligence (AI) and Machine Learning (ML), Internet of Things (IoT), Big Data and Advanced Analytics, Augmented Reality (AR) and Virtual Reality (VR), Blockchain, etc.

Source: Technopolis Group

Digital technology has transformed the tourism industry in several ways: it eases travel planning, allows the optimisation of operations, improves the travel experience and increases safety for example by using digital traveller identity. The emergence of the internet has enabled the development of a tourism market where travellers and tourists are more informed and autonomous and use digital information to make travel decisions[3]. The tourism industry has become more digital, mobile and personalised[124] affecting the tourism eco-system across three dimensions:

1. Improving Customer Experience and Personalisation

- **Digital platforms** and **mobile applications** allow tourists to plan, compare, and book travel services easily. Startups leveraging **AI** and **Big Data** are offering increasingly personalised services, which improve customer satisfaction by analysing customer behaviour and enhancing travel recommendations.
- **Augmented Reality (AR)** and **Virtual Reality (VR)** are helping tourism businesses offer more interactive and immersive experiences. AR can provide additional information about landmarks, while VR allows potential visitors to virtually explore destinations, making the booking process more informed and engaging. The **Metaverse**, is also promising to impact tourism services, along the same lines. [125]
- **Artificial Intelligence (AI)** is also playing a critical role in **personalising the travel experience** by offering tailored recommendations based on customer preferences. This helps to streamline bookings and improve customer satisfaction.

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[124] *McKinsey & Company (2023). The future of tourism: bridging the labor gap, enhancing customer experience. McKinsey Insights. Retrieved from: https://www.mckinsey.com/industries/travel-logistics-and-infrastructure/our-insights/future-of-tourism-bridging-the-labor-gap-enhancing-customer-experience;*
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[125] See for instance here: https://www.mckinsey.com/industries/travel-logistics-and-infrastructure/our-insights/tourism-in-the-metaverse-can-travel-go-virtual

2. Boosting Operational Efficiency and Sustainability

- The **Internet of Things (IoT)** is improving operational efficiency by enabling smart systems in hotels, allowing guests to control room features like lighting and temperature via smartphones. This enhances customer comfort and helps businesses use resources more efficiently. IoT is also playing a role in supporting sustainability by reducing energy consumption and adding predictive maintenance, where systems automatically monitor and manage resources.
- **Big Data** and **AI** are enabling tourism businesses to **forecast demand**, **plan resources**, and **manage tourist flows**, particularly at popular destinations. Cloud technologies further support efficient operations by providing quick access to critical data and insights.

3. Supporting New Business Models

- **Blockchain technology** is being explored to secure transactions and manage data, which can help improve booking security and payment processes in the tourism sector.
- The rise of **digital twins**—**virtual replicas of hotels** or tourist destinations—offers customers the ability to explore accommodations virtually before booking, thus improving transparency and helping with decision-making.
- The tourism industry has seen a steady increase in digital startups, particularly those offering **big data** and **AI-powered solutions** to offer **personalised services** and leverage the **sharing economy**, which are reshaping how tourism services are delivered.

The survey of tourism companies indicates that the adoption of advanced digital technologies increased productivity between 1-15%. The largest share of respondents witnessed an increase in productivity as a result of cloud computing followed by AI and big data (see Table below). However, 5% of businesses reported a decrease in productivity attributed to the initial investment costs associated with adopting new technologies or practices. This decline in productivity can often occur during the transition phase when organisations implement significant changes. The initial costs may include expenditures on equipment, software, employee training, and changes to operational processes.

Table 11: The impact of advanced digital technologies on productivity in tourism

	Increased	No change	Decreased
Cloud computing	73%	26%	
Artificial Intelligence	72%	21%	5%
Big Data	70%	25%	5%
IoT	62%	37%	
AVR	41%	58%	
Blockchain	14%	85%	

Source: EMI Enterprise Survey 2024, n=

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Appendix B: Methodological notes

Startup data and venture capital data analysis

Selected fields from Crunchbase and Net Zero Insights:

Table 12: Concordance between NACE and Crunchbase/N0

NACE		Crunchbase and Net Zero Insights
I	Accommodation and food service activities	Hotel, Travel Accommodations, Hospitality, Vacation Rental, Restaurants
N79	Travel agency, tour operator and other reservation service and related activities	Travel arrangement and reservation services Travel Agency, Adventure Travel, Business Travel, Hospitality, Tour Operator,
R93	Sports activities and amusement and recreation activities	Sports, Amusement Park
N82	Office administrative, office support and other business support activities	*Not applicable*
R90-R92	Creative, arts and entertainment activities; libraries, archives, museums and other cultural activities; gambling and betting activities	Museums and Historical Sites, Parks, Resorts, Casino
H49-H50-H51	Land-, water-, air transport	Public Transportation, Railroad, Marine Transportation, Air Transportation

Source: Technopolis Group and Kapa Research, 2023

Survey

CORDIS data analysis

Codes used:

NACE_rev2	Description
H49	Land transport and transport via pipelines
H50	Water transport
H51	Air transport
I	Accommodation and food service activities
N79	Travel agency, tour operator and other reservation service and related activities
N82	Office administrative, office support and other business support activities
R90-R92	Creative, arts and entertainment activities; libraries, archives, museums and other cultural activities; gambling and betting activities
R93	Sports activities and amusement and recreation activities

Keywords used: vacation, hospitality, air transport & tourism, restaurants, wheelchair access*, disabled guest*, culture, transport & tourism, tourism

LinkedIn data analysis

Table 13: Concordance between NACE and LinkedIn

	NACE	LinkedIn industry categories
I	Accommodation and food service activities	Hospitality, Restaurants,
N79	Travel agency, tour operator and other reservation service and related activities	Leisure, Travel & Tourism
R93	Sports activities and amusement and recreation activities	Recreational Facilities & Services, Sports
N82	Office administrative, office support and other business support activities	na
R90-R92	Creative, arts and entertainment activities; libraries, archives, museums and other cultural activities; gambling and betting activities	Museums & Institutions Gambling & Casinos
H49-H50-H51	Land-, water-, air transport	Airlines/Aviation

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, Ecotourism, Nature tourism

Digital skills – keywords used: data analytics, tourism flow management, 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 Centers, 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

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