



# Monitoring the twin transition of industrial ecosystems

RETAIL

Analytical report

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# Executive summary

Measuring performance and monitoring change within an industrial ecosystem are vital components that enable policymakers and industry stakeholders to track progress over time and obtain valuable feedback on whether the system is moving in the desired direction. This report is a contribution to the 'European Monitor of Industrial Ecosystems' (EMI) project, initiated by the European Commission's Directorate General for Internal Market, Industry, Entrepreneurship, and SMEs, in partnership with the European Innovation Council and SMEs Executive Agency (EISMEA). Its primary objective is to present the current state and the advancements achieved over time in terms of the green and digital transition of the **Retail Industrial Ecosystem**. From here on, we refer to it as the retail ecosystem.

The retail ecosystem encompasses a wide range of companies, and is made up of various subsectors like clothing, food, electronics, furniture, and more, each with distinct dynamics and that offer their products and services both online and offline. It is defined by NACE categories Wholesale trade, except of motor vehicles and motorcycles (G46), Retail trade, except of motor vehicles and motorcycles (G46) and Postal and courier activities (H53). In the EU, the retail ecosystem holds significant importance due to its substantial size, high employment rates, and substantial value added. It contributes around €1.5 trillion in gross value added and employs nearly 30 million people, making it the largest economic sector. With 5.4 million firms, it exhibits a wide variety of enterprises offering diverse products<sup>1</sup>.

The retail industry is undergoing a significant transformation due to changes in customer preferences, advancements in technology, and increasing pressure to be environmentally sustainable. Key challenges in retail include the shift towards **omnichannel retail, hyper-personalisation, transparency on the origin and production process of the good, sustainability and developing capabilities to harness the potential in advanced digital technologies**.

## Key findings about the green transition

The retail industrial ecosystem's most important environmental impacts are linked to its carbon emissions, plastic packaging, waste, and transportation. Industries that are directly linked to retail and affect the environment include mainly **agri-food and the chemical industries, but also textiles (fashion) and electronics**. Transportation and packaging linked to e-commerce is a further concern for environmental impact. The analysis of Exiobase data suggests also that the most relevant environmental challenges of retail are related to greenhouse gas emissions and biodiversity loss.

Retail was responsible for **3.6% of the total GHG emissions of all industrial ecosystems in 2021**, however, the impact of the broader value chain including the other industries it relies on is much higher. Trends show that greenhouse gas emissions decreased over the period from 2010 to 2021, but particulate matter emissions have grown especially over the latest years. The retail industrial ecosystem has **increasingly contributed to water consumption and to the damage to the natural ecosystem** over the recent years.

With the objective to changing current operational models and switching to environmentally sustainable models, environmental retail startups have been dynamically growing over the past ten years and have created new ways for shopping as the results of startup data show. Environmental startups in retail include a variety of emerging activities, most linked to **online retail platforms facilitating the sharing economy and 'recommerce'** (second-hand operations and selling pre-owned products), moreover also **renting and leasing**. A growing number of retailers position themselves as selling 'green' products. Startups address the challenge of polluting packaging solutions. An interesting

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<sup>1</sup> European Commission (2022). Annual Single Market Report 2022, SWD (2022) 40 final.



new arena of firms is constituted by **digital technology-based startups that enable the reduction of waste and the optimisation of logistics and inventory management.**

In the EU, the number of scaleups in retail has been increasing over time with several unicorns emerging since 2021. This analysis identified **125 scaleups in the retail ecosystem with an environmental sustainability goal that constituted 20% of all retail scaleups.**

Despite the dynamics in emerging environmentally sustainable retail practices, this report found that the green transition of the ecosystem is still in an early stage. According to the business survey conducted within this project about the status in the uptake of digital and green technologies, it was found that **26% of the surveyed SMEs in the retail ecosystem have increased their investments into green technologies and environmental sustainability actions** over the past five years. Remarkably, a substantial 42% of the respondents allocated less than 5% of their overall turnover toward the adoption of eco-friendly technologies and practices.

Energy consumption is a major sustainability issue in the retail industry. Nonetheless, only 14% of small and medium-sized enterprises (SMEs) recognised the use of energy-saving technologies as a way to address this concern. Additionally, **12.1% confirmed using recycled materials, while 10% reported that they had invested in recycling technologies within their company.** Renewable energy technologies have been taken up by 9% of the respondents. Advanced technologies like hydrogen utilisation and carbon capture are among the least adopted by the respondents.

A noteworthy aspect of the survey relates to the circular economy approach, wherein **10.6% of the participants have embraced reselling, reusing, and second-hand operations** as integral components of their strategies. Furthermore, 5.9% of the SMEs demonstrated a commitment to sustainability through the provision of repair and maintenance services. In terms of innovative sustainable practices, the survey highlights a nascent adoption of digital product passports that provide transparent insights into supply chains. However, this practice remains relatively uncommon, with a mere 2.3% of the respondents indicating their usage.

Regarding technological change in retail, Europe's retail ecosystem has seen an increasing share of private equity and venture capital investment since 2010. As found in the analysis of Crunchbase and Net Zero Insights data in this report, **the annual investment into environmentally sustainable solutions in the retail ecosystem has been growing steadily across all funding stages over the period from 2010 to 2022 with a total amount of €2.73 bn.** Close to 45% of the funding rounds involved seed funding that has increased over the last years as well. This evolution over time, with a peak in 2021, indicates that the market values positively green solutions in retail.

The presence of professionals with environmental skills in retail is a further indication of ongoing green transformations. Based on the analysis of LinkedIn data, it is found that **within the registered professionals on LinkedIn and employed in the retail industrial ecosystem, 1.51% claimed having skills relevant for the green transition.** On the demand side based on the analysis of online job advertisements, 1.91% of the job ads within retail demanded green transition related skills.

### **Key findings about the digital transition**

The dynamic shift towards digitalisation has been a defining feature of the retail sector over the past decade. Besides the well-documented trend in e-commerce, the combination of online and physical retail has created a new paradigm affecting the whole value chain, which has given leeway for virtual marketplaces and applications that enhance the virtual shopping experience. To maximise flexibility, and respond fast to market changes, retailers have been moving towards **'headless' or 'composable' commerce platforms.** Different technological software and cloud-based services have emerged to complement the e-commerce ecosystem.

On the other hand, retail has been also **a slow mover in the adoption of other advanced** digital technologies beyond e-commerce. Retail industry players are especially price-sensitive, which is why their investment decisions are primarily driven by the potential to lower expenses and boost profits. While there are several innovations that offer convenience for shoppers, this is not the most important factor for retailers, especially in certain segments like groceries and smaller stores.

The analysis of retail tech startups showed that a growing share has been developing **software and cloud-based technologies for omnichannel supply chain. Big data analytics has become a recent trend** in the retail industry, indicating the importance of harnessing the value in data and accelerate business operations. Artificial Intelligence driven by big data are found among one of the recent common technologies harnessed by tech startups and support retailers achieve cost reductions and efficiency gains in their operations.

In the EU, the number of scaleups in retail has been increasing over time with several unicorns emerging since 2021. **This analysis identified 608 scaleups in the retail ecosystem that represented 2.7% of all retail startups.** In the USA, a higher share, notably 5% of the retail startups managed to scale up.

The results of the business survey conducted in this project showed that a substantial **91% of the respondents affirmed the significance of digitalisation** in shaping their business landscape, with the majority having already incorporated digital technologies.

Encouragingly, **42.6% of the retail SMEs have displayed a proactive stance by increasing their investments in digital technologies** during the past five years.

Intriguing trends emerge when delving into the specifics of digital adoption. Notably, **online platforms (19.6%) and cloud technologies (19.3%) have gained notable prominence** among SMEs in the retail ecosystem. Equally significant, **Internet of Things (IoT) technologies have found traction** within the industry, with a considerable 10.2% of the respondents incorporating them into their operations. In addition, 9.7% of the retail companies surveyed reported using big data analytics, which is often seen as a game-changer for gaining business insights.

A key challenge that has been highlighted during the interviews includes the **integration of new digital solutions with the existing store software.**

**Augmented and virtual reality** has been mentioned by a very low number, notably 3% of the respondents. This indicates that despite the potential in augmented reality to develop personalised retail experiences, the current take-up of these tools is very limited. Robotics and digital twin technologies have been mentioned by a very small share of the respondents, despite the potential of these technologies in warehousing and in operation management.

Interestingly, the digital transformation journey of retailers with regard to advanced digital technologies has been often linked to the digitalisation of other related industries such as electronics, medical equipment and pharmaceuticals, fashion, food.

There is a significant difference between the twin transition strategies of large and small players in the retail ecosystem. While larger players have more financial resources for investments and more opportunities for digitalisation, such as connecting systems and organising the supply chain, smaller players are often more innovative and willing to take risks in certain areas. They see digital and green solutions as key to differentiate themselves.

With regard to investments, the volume of private equity and venture capital funding into digital tech retail startups witnessed a positive evolution over the period from 2010 to 2022, reaching a **total of €42.7 bn in 2022.** Seed and early development type of funding was the most frequent. Investment into online platform has been the most common, followed by software and cloud-based services. Particularly successful have been **e-commerce integrations related to payment, which attracted increasing**

**investments since 2010**, with a clear increase after 2018. Digital tech startups developing AI and big data technologies for retail absorbed 3.2% of the total funding, with a total of €1.3 bn.

Digitally skilled professionals in retail are key building blocks to drive the digital transformation of the industry. Based on the analysis of LinkedIn data, it was found that **15% of professionals employed in retail indicated a moderate digital skill and 2.3% an advanced digital skill** (including cloud, big data, AI, IoT, blockchain, augmented and virtual reality technologies).

In conclusion, the retail industry stands at a pivotal juncture, where it needs to balance the need for sustainability with the demands of the digital era. The survey outcomes underscore a varied landscape in the adoption of both eco-friendly practices and digital technologies within the SMEs comprising the retail ecosystem. As the industry continues to navigate a rapidly evolving landscape, effectively addressing these aspects emerges as an essential determinant of long-term success, environmental responsibility, and competitiveness.



# 1. Introduction

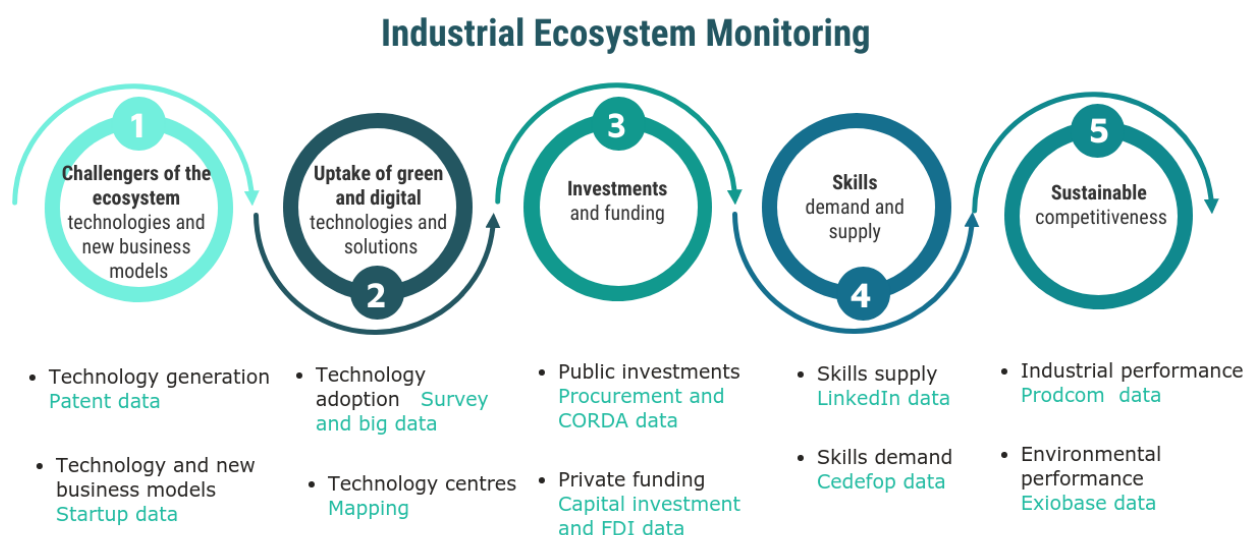
## 1.1 Objectives

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<sup>2</sup> has identified 14 industrial ecosystems<sup>3</sup> – one of them being ‘**Retail**’ – 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 in particular by green and digital technologies and the shift to the circular economy. The process is however characterised by complex, multi-level, and dynamic development. To make transition sustainable, technological change needs to be coupled with new business models, the necessary investments, skills, regulatory framework conditions and behavioural change across the ecosystem.

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).

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



Source: Technopolis Group, IDEA Consult and Fraunhofer ISI

<sup>2</sup> European Commission (2020). A New Industrial Strategy for Europe, COM/2020/102 final and European Commission (2021). Updating the 2020 New Industrial Strategy: Building a stronger Single Market for Europe’s recovery, COM(2021) 350 final

<sup>3</sup> The 14 industrial ecosystems include: construction, digital industries, health, agri-food, renewables, energy intensive industries, transport and automotive, electronics, textile, aerospace and defense, cultural and creative culture industries, tourism, proximity and social economy, and retail

The indicator framework includes a **set of traditional and novel data sources that allow shedding new light on ongoing transformation patterns**. The novelty of the analysis lies in the exploratory and innovative data sources used across the different chapters. Due to its effort to analyse industrial ecosystems using a more or less 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.

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 that have been taken into account in this study are presented in Figure 2.

Figure 2: Main technologies monitored in the project

Green transformation	Digital transformation
Advanced Sustainable Materials	Advanced Manufacturing & Robotics
Biotechnology	Advanced Manufacturing
Energy Saving technologies	Robotics
Clean Production technologies	Artificial Intelligence
Renewable Energy technologies	Augmented and Virtual Reality
Solar Power	Big Data
Wind Power	Cloud technologies
Other (geothermal, hydropower, biomass)	Blockchain
Recycling technologies	Digital Security & Networks/ Cybersecurity
Circular business models	Internet of Things
	Micro- and Nanoelectronics & Photonics
	Online platforms

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'**<sup>4</sup> of the Industrial Forum developed in 2022. It also complements the **transition pathway for a more resilient, digital and green retail ecosystem** initiated by the European Commission<sup>5</sup>.

## 1.2 Definition of the ecosystem

The **retail industrial ecosystem** encompasses all companies (small and large), knowledge providers and other organisations providing products and services for retail (such as suppliers, transportation services, logistics, relevant real estate) as well as consumers. It includes grocery and non-grocery retail, both offline and online, wholesale and online platforms.

When looking into the statistical classification of economic activities, the retail industrial ecosystem encompasses NACE G47(Retail), NACE G46 (wholesale of consumer products) and also of NACE H53 (parcel delivery). The retail ecosystem is traditionally defined using the NACE categories *Wholesale trade, except of motor vehicles and motorcycles* (G46), *Retail trade, except of motor vehicles and motorcycles* (G46) and *Postal and courier activities* (H53). The ecosystem is composed of many subsectors, such as retail of **clothes, textiles, food, consumer electronics, technological equipment, furniture,**

<sup>4</sup> <https://ec.europa.eu/docsroom/documents/49407/attachments/1/translations/en/renditions/native>

<sup>5</sup> [https://single-market-economy.ec.europa.eu/single-market/services/retail/retail-transition-pathway\\_en](https://single-market-economy.ec.europa.eu/single-market/services/retail/retail-transition-pathway_en)

**wholesale** (among many others), which sectors have a very different patterns of dynamics and twin transition. This report captures the retail ecosystem as closely as possible in all indicators and covering the NACE codes G47, G46 and H53.

Retail mainly serves final demand, and therefore occupies an important position in value chains both as a provider to households and as an outlet for upstream sectors (OECD, 2020)<sup>6</sup>. The industrial ecosystem has experienced a gradual change over the last years towards bigger sized companies, with close to 200 000 retail businesses ceased to exist between 2014-2018 (Eurostat) while larger businesses clearly increased their presence as found by the analysis of EuroCommerce<sup>7</sup>.

The retail ecosystem is composed of interconnected actors that interact within a set of framework conditions and market mechanisms. In a broad picture, it can involve an entire chain from production, wholesale, retail, logistics and warehousing, e-commerce platforms, and consumers themselves, all of them interconnected through the sale or re-sale of products and / or services, both online and offline.

Being by far the largest ecosystem, retail virtually serves all ecosystems, due to its presence at the end of the value chain<sup>8</sup>. Some of the other industrial ecosystems that are most closely linked to retail include the proximity economy, agri-food, textile, healthcare (pharma), culture and creative industries, and tourism.

### 1.3 Industry state of play

The retail ecosystem is one of the most important industries in the EU due to its size, the number of employees and its value added. The retail ecosystem is an 'economic heavyweight': it creates a gross value added of approx. €1.5 trillion, the highest among all ecosystems. It is also the biggest employer with almost 30 million people employed<sup>9</sup>. Retail is the sector with the highest number of firms, 5.4 million<sup>10</sup>.

There is a wide typology of retail enterprises, since companies can offer a diverse range of products such as food, drinks, and tobacco; textiles, clothing and foot ware and leather goods; automotive fuel; or computers, peripheral unites and software; among many others.

#### Box 1: Typology of retail enterprises

Due to the size and typology of the retail ecosystem, there are several types of retail enterprise and companies in the ecosystem. The differences among the retailers can be based on their size, the channel they use to sell their goods, on their property structure or on the types of goods they sell. A brief description of the main types of retailers.

*Small independent retailers:* Small independent retailers are businesses that are privately owned and operated by individuals or a small group of owners. They typically have a limited number of stores and cater to a specific niche or local market. These retailers often offer unique products, personalised service, and a distinct shopping experience.

*Large retailers:* large retailers are companies that operate multiple stores or outlets across different locations. They typically have a significant market presence, extensive product offerings, and a strong brand identity.

*Cooperatives:* Cooperatives, also known as co-ops, are businesses owned and operated by a group of individuals or organisations who share a common interest or goal. Members of a cooperative pool their resources, such as capital and labour, to collectively run the business and share in the

<sup>6</sup> OECD (2020). COVID-19 and the retail sector: impact and policy responses. Available at: <https://www.oecd.org/coronavirus/policy-responses/covid-19-and-the-retail-sector-impact-and-policy-responses-371d7599/>

<sup>7</sup> EuroCommerce (2021). The Value of European Retail, a Factbook, May 2021.

<sup>8</sup> European Commission (2022). Annual Single Market Report, SWD (2022) 40 final. Available at: <https://ec.europa.eu/docsroom/documents/48877>

<sup>9</sup> European Commission (2022). Annual Single Market Report 2022, SWD (2022) 40 final. Available at: <https://ec.europa.eu/docsroom/documents/48877>

<sup>10</sup> European Commission (2022). Annual Single Market Report 2022, SWD (2022) 40 final.

profits. Cooperatives can exist in various sectors, including agriculture, retail, housing, and consumer goods.

*Franchisers:* Franchisers are entities that grant the right to individuals or groups (franchisees) to operate a business using their established brand, trademarks, and business model. Franchisees pay fees and royalties to the franchiser in exchange for the right to use their brand and receive ongoing support.

*Online platforms:* Online platforms are digital spaces or websites that facilitate transactions, interactions, or exchanges between buyers and sellers. These platforms enable businesses or individuals to showcase and sell products or services online, often providing a convenient and accessible way for customers to shop.

*Specialty Retailers:* Specialty retailers focus on selling a specific category of products or serving a particular niche market. They often offer a wide range of products within their specialized area, catering to customers with specific interests or needs.

*Department Stores:* Department stores are large retail establishments that offer a wide variety of products across multiple categories, typically organized into separate departments. They provide a one-stop shopping experience, housing various brands and product offerings under one roof.

*Discount Retailers:* Discount retailers, also known as discount stores or value retailers, focus on offering products at lower prices compared to traditional retail stores. They often carry a mix of brand-name and generic products and may emphasize cost-saving strategies such as bulk purchasing or limited store layouts.

*Outlet Stores:* Outlet stores are retail locations that sell discounted or clearance merchandise from a specific brand or retailer. These stores offer products that may be overstocked, discontinued, or from previous seasons at lower prices. Outlet malls are common locations where multiple outlet stores are clustered together.

*Luxury Retailers:* Luxury retailers specialize in high-end, premium products and provide an exclusive shopping experience. They often carry luxury brands and offer personalized service, unique store designs, and a focus on craftsmanship and quality.

In the ecosystem, SMEs are the dominating type of enterprise, representing 99.9% of the retail sector enterprises (ibid) and account for 64.2% of the total number of employees, 59% of the turnover and 59% of the value added in the sector (ibid). Additionally, 55% of the enterprises in the EU retail sector operate with no employees, and only one in 10 companies operate with more than five employees (Eurostat, 2021). Despite the predominance of SMEs in the retail ecosystem, the EU hosts some of the biggest and more relevant retail enterprises worldwide. Among the global top 10 retail companies, five originate in Europe (i.e., Schwarz Group, Aldi, Ahold Delhaize, Carrefour, and Ikea). They are active mainly in the field of discount grocery, grocery, and furniture. Out of the Top 50, EU is well represented: roughly half of the Top 50 global retail companies originate in the EU<sup>11</sup>.

The transformational role of Amazon has been prominent and changed the operational principles of retail. As consequence of the success of online retailers that allow customers to acquire goods from the convenience of their home at any moment of the day and night, and the pressure that it has put on local and physical retailers, more and more companies have also embarked on selling online. Nowadays from small companies to big retailers have launched online channels to allow their customers to buy from anywhere at any time.

While the impact of the COVID-19 pandemic in the retail ecosystem is undeniable, it affected companies differently depending on the goods sold and the channels of distribution<sup>12</sup>. Even before this crisis, the retail sector was already going under a wave of rapid changes. Global e-commerce sales accounted for 19.3% of total retail sales in 2022,

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<sup>11</sup> National Retail Foundation (NRF) (2021) based on Kantar, 2021. Available at: <https://nrf.com/resources/top-retailers/top-50-global-retailers/top-50-global-retailers-2021>

<sup>12</sup> Lashgari, Y.S.; Shahab, S. (2022). The Impact of the COVID-19 Pandemic on Retail in City Centres. *Sustainability*, 14, 11463. <https://doi.org/10.3390/su141811463>

and it is forecasted to grow 8.9% in 2023<sup>13</sup>. While bigger companies are already predominantly online, smaller retailers are little by little increasing their online presence. Likewise, the sustainable transition is increasingly becoming key for retail businesses to respond to consumers' demand as well as to policy requirements.

At the same time, the twin transition is a major challenge for the retail ecosystem and in particular SMEs. These transitions require far-reaching societal change, effecting and engaging all areas of the economy and society. Creating an environment of competitive sustainability is a key principle for Europe's future, that must go hand in hand with the transition to digitalisation. In this regard, tailor-made support measures and regulations are key to generate a strong and competitive SME market as well as to provide SMEs with opportunities to grow and scale up.

The behavioural intentions of digital natives and millennials<sup>14</sup> has a further profound impact on the future of retail with digital commerce becoming the typical way of shopping and paying. Retailers are also confronted new consumer expectations around ease of use, trust, mobility, and personalisation (ibid).

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<sup>13</sup> <https://www.oberlo.com/statistics/ecommerce-share-of-retail-sales>

<sup>14</sup> Akram et al (2021). Impact of Digitalisation on Customers' Well-Being in the Pandemic Period: Challenges and Opportunities for the Retail Industry



## 2. Challengers of the industry status quo: green and digital technological trends

### Key findings

The retail ecosystem is going through a systemic transformation driven by a shift in customer demand, technological change, and environmental sustainability pressures. Key challenges in retail include the shift towards **omnichannel retail, hyper-personalisation, transparency on the origin and production process of the good, sustainability and developing capabilities to harness the potential in advanced technologies** such as big data and Artificial Intelligence.

Both digital tech and environmental retail startups have been dynamically growing over the past ten years and have been challenging the traditional retail industry by providing new ways for shopping as the results of the data analysis conducted in this report shows.

Environmental startups in retail include a variety of emerging activities such as

- online retail platforms facilitating the **sharing economy and 'recommerce'** (second-hand operations and selling pre-owned products), moreover also **renting and leasing**
- retailers of **sustainable products**,
- the development of less polluting **packaging solutions** and
- **digital** technology-based startups that enable the **reduction of waste and the optimisation of logistics and inventory management**.

Besides the well-documented trend in e-commerce, digital transformation is present in many ways:

- digital tech startups developing **software and cloud-based technologies for omnichannel supply chain** have grown more and more and account for 5.7% of the total digital tech retail startup landscape.
- The combination of online and physical retail has created a new paradigm affecting the whole value chain, which gives leeway for **virtual marketplaces** and applications that enhance the **virtual shopping experience**,
- **Big data analytics** has become a recent trend in the retail industry, indicating the importance of harnessing the value in data and accelerate business operations. **Artificial Intelligence driven by big data** are found among one of the recent common technologies harnessed by tech startups and support retailers achieve cost reductions and efficiency gains in their operations.

In the EU, the **number of scaleups in retail** has been increasing over time with several unicorns emerging since 2021. This analysis identified 608 scaleups in the retail ecosystem that represented 2.7% of all retail startups. In the USA, a higher share, notably 5% of the retail startups managed to scale up. Companies with an **environmental sustainability goal constitute 20% of all retail scaleups**.

### 2.1. The changing landscape of the retail ecosystem

Retailers operate in a dynamically changing environment with unstable geopolitical conditions and sharp rises in the cost of living. This draws the attention even more to the need of growing digital capabilities and embracing technologies that help adapting to new market and consumer requirements.

The first wave of digital transformation with the emergence of **e-commerce** has been pivotal and it has become mainstream in the recent years, with more and more retail

enterprises of all sizes and types also selling or offering their products and services online. This has totally disrupted the sector, giving new opportunities to consumer who now can buy from retailers not close to them, but also has forced retailers to digitalise their operations should they want to remain competitive<sup>15</sup>.

Some of the key challenges and transformation forces pushing the retail ecosystem include:

- The retail sector has been disrupted by increasing integration of online and in-store retail, also known as **'omnichannel' retail**. Omnichannel creates a new paradigm for retailers, with massive implications across the value chain, including logistics, warehousing, and the shopping experience online and offline, in cities, shopping centres or beyond.
- The emergence of **advanced digital technologies** (e.g., Internet of Things, robotics, Artificial Intelligence, etc.) is changing the core of retail operations and labour. These technologies are projected to offer unprecedented opportunities for retailers to improve their value, sustainability performance and maximise their efficiency<sup>16</sup>.
- The emergence of big data techniques is placing the consumer at the core of the product development. More and more retailers are providing **hyper-personalised products, services, and customer experience**<sup>17</sup>.
- Demand has increased for **transparent and sustainable products**. Customers are increasingly becoming aware of the product journey and are demanding information about the supply chain journey of the final product<sup>18</sup>. Moreover, a shift in consumption behaviour towards second-hand products, organic food, etc., is also pushing retailers to take advantage of these new green markets and expand their consumer portfolio<sup>19</sup>.
- While **e-commerce and digitalisation** were already increasing before the pandemic, COVID-19 gave a boost to its adaptation. While this is an opportunity to many enterprises since they will reach a bigger base of customers, it is also forcing many retailers to close brick-and-mortar stores<sup>20</sup>.

Traditionally, retailer's online architecture was mainly focused on the store front-end (what the users sees) and on the supply chain of the retailer, including inventory, stock, etc<sup>21</sup>. These early commerce platforms had the benefit of being simple to set up and are normally convenient for small retailers. They provided everything retailers need to create a storefront, connect with inventory, and take and process online payments.

However, to maximise flexibility, respond fast to market changes and achieve 360 omnichannel experiences, retailers looking to achieve the next level of personalisation and customer centred services are moving towards **'headless' or 'composable' commerce platforms**. In essence, this means that the back end and front end of e-commerce sites are decoupled and connected via an Application Programming Interface (APIs)<sup>22</sup>. This modular approach allows retailers to smoothly choose the integrations they want to add to their e-commerce ecosystem, avoiding slow and costly data migrations and adapting their offer to customer demands in a matter of seconds. Basically, they can choose the services

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<sup>15</sup> McKinsey & Company (2022). E-commerce: At the center of profitable growth in consumer goods. Available at: <https://www.mckinsey.com/industries/consumer-packaged-goods/our-insights/e-commerce-at-the-center-of-profitable-growth-in-consumer-goods>

<sup>16</sup> World Economic Forum (2017). Shaping the Future of Retail for Consumer Industries. Available at: <https://www.weforum.org/reports/shaping-the-future-of-retail-for-consumer-industries>

<sup>17</sup> KPMG (2019), Retail trends 2019. Available at: <https://assets.kpmg/content/dam/kpmg/xx/pdf/2019/02/global-retail-trends-2019-web.pdf>

<sup>18</sup> ARUP (2017). The future of retail. Available at: <https://www.arup.com/perspectives/publications/research/section/the-future-of-retail-2017>

<sup>19</sup> Naidoo and Gasparatos (2018). Corporate environmental sustainability in the retail sector: Drivers, strategies and performance measurement. Available at: <https://www.sciencedirect.com/science/article/abs/pii/S0959652618326040>

<sup>20</sup> McKinsey & Company (2021), The future of work after COVID-19. Available at: <https://www.mckinsey.com/featured-insights/future-of-work/the-future-of-work-after-covid-19>

<sup>21</sup> CB Insights (2022). The Technology Driving The Omnichannel Retail Revolution. Available at: <https://www.cbinsights.com/research/report/omnichannel-retail-technology/>

<sup>22</sup> An API is a connection between the frontend and backend, sending information between the two in real time. More information at: <https://www.shopify.com/enterprise/headless-commerce#:~:text=Is%20Shopify%20a%20headless%20CMS,via%20the%20GraphQL%20Storefront%20API.>

that they would like to include in their online sites through the modular design of headless or composable e-commerce sites. This allows for a higher level of customisation.

As a result of this, different technological software and cloud-based services have emerged to complement the e-commerce ecosystem. These technology-based services can be grouped depending on the stages of the consumer buying process:

- *Points of sale (POS) system providers*: which integrate the online shop with payment methods and other functionalities (Shopify, WooCommerce, etc.)
- *Pre-transaction phase* is mainly focused on providing marketing and research tools to facilitate and engage with the customer's journey through the online platform.
- *Transaction stage*: payment platforms fully integrated as a module within the e-commerce ecosystem. There are also innovations related to alternative payment methods offering interest free "buy now, pay later" options.
- *Post transaction phase* (delivery of the purchased goods): Big retailers such as Amazon have re-set the standards of delivery times, putting more pressure on other retailers. Online retailers offering same day delivery and even 10 minutes delivery options are the most common services that have emerged in the last decade.
- *Operational services* related to analytics, inventory and logistics, pricing tools and cybersecurity: As the availability of customer data grows, retailers can improve the accuracy of their sales forecast, optimise their inventory management capabilities, optimise pricing and promotion allocation, etc. Further, advanced analytics are also bringing more and more personalised experiences to the customer, as retailers are increasingly targeting their marketing campaigns.

At the same time, digital e-commerce marketplaces are taking a diversity of models, including:

- Business-to-business (B2B), where the goods or services sold or provided are intended for businesses, and the sellers are businesses themselves; usually, the sellers are selected or curated by the platform owner (e.g., Shopify, BigCommerce, OpenCart, etc.)
- Business-to-consumer (B2C), where goods or services are sold to final consumer. Multi-brand digital native retailers such as Zalando, 'About you' are the main companies within this category. There are also sustainable business models using B2C digital platforms, for example food waste reduction companies that connect customers with restaurants or supermarkets that sell close to expire food at a reduced price.
- Consumer-to-consumer (C2C), where consumers use digital platforms to sell their own products. As an example, second-hand online platforms have become extremely popular in the last decade.

## 2.2. Twin transition driven by innovative startups

Technological trends and in particular the green and digital transition of the retail industrial ecosystem have been analysed via startup<sup>23</sup> data from **Crunchbase and Net Zero Insights**. Startup data allows to monitor the commercialisation trends in retail technologies, e-commerce, and sustainability, but also related mobile payment and digital platform innovations. Crunchbase<sup>24</sup> is a widely trusted source of primary data on venture capital and private equity-backed innovative companies. Net Zero Insights is a specialised database of over 19 000 European startups identified as green innovators. Net Zero

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<sup>23</sup> In this study, startups are defined as 'young, innovative, growth-oriented businesses in search of a sustainable and scalable business model' (NESTA, 2015). Tech startups are technology-based startups. More specifically, digital tech startups do not simply develop or adopt digital technologies but digital is an inherent part of their value proposition (Oestreicher-Singer and Zalmanson, 2012; Griva et al, 2023). Environmental startups are another form of young, innovative business that develop and implement products, technologies and services that contribute to environmental sustainability, for example by reducing greenhouse gas emissions, improving energy efficiency, adopting a circular economy approach or providing a service that is ecological (see in Bergset et Klaus, 2015).

<sup>24</sup> The methodological details are to be found in the conceptual and indicator framework report of the project available here: xxx

Insights is specialised in capturing environmental sustainability-oriented startups, and therefore covers well the innovation that are being developed in the context of the green transition.

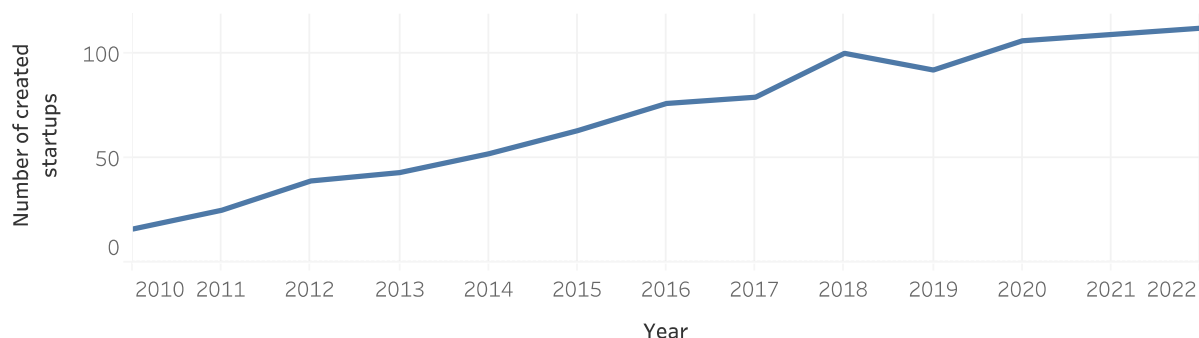
### 2.2.1. Green technologies

There is an increasing consumer demand for environmentally friendly products and services sold in retail<sup>25</sup>. This does not only refer to the products themselves but also to the whole product journey from sourcing, to manufacturing, to distribution and finally to how it is managed at the end of its useful life. This demand is also closely linked to more transparency as highlighted by ARUP in its analysis<sup>26</sup>.

Retail tech startups are transforming the traditional retail industry by providing new ways for shopping. Besides one of the strongest trends of moving the shopping experience online, greening the supply chain has been creating new opportunities as later demonstrated in this analysis. Environmental startups specialised in retail are key building blocks in the transition towards a green economic model. Entrepreneurial activity helps accelerating the diffusion of technologies in industrial ecosystems and startups that provide green retail solutions are one indicator how the industrial ecosystem is transforming itself to reach environmental sustainability objectives.

Monitoring development over time indicates a positive progress **in the number of environmental startups in retail** from 2010 to 2022.

Figure 3: Overview of startups with green technologies and green business models



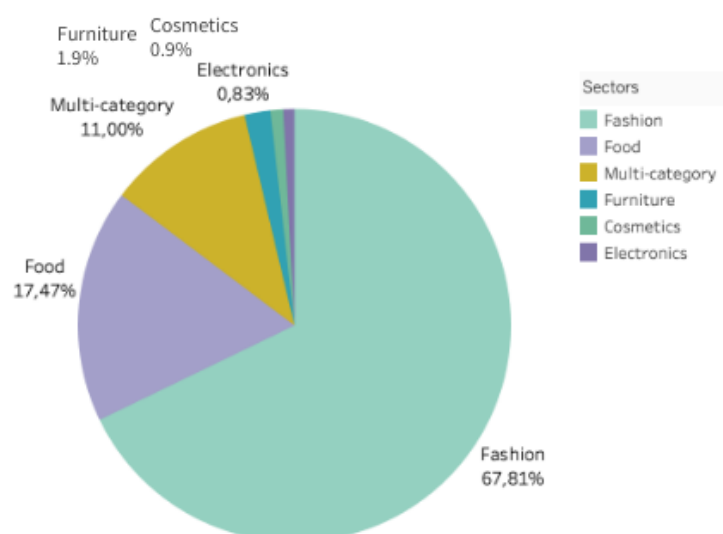
Source: Technopolis Group based on Net Zero Insights data, 2022

The analysis shows that environmental startups in retail are concentrated in certain sub-sectors (see Figure 4). **The fashion industry includes by far the highest number, followed by the food industry, both accounting for 85% of all environmental retail startups. Multi-category retailers are also relevant (8%) and often represent online marketplaces that sell different types of products.** This category also includes startups that rely on digital technologies such as blockchain technologies (ensuring traceability of the supply chain), inventory management software (that helps optimisation and reduction in the use of resources or the creation of waste).

<sup>25</sup> World Economic Forum (2021), The global eco-wakening: how consumers are driving sustainability. Available at: <https://www.weforum.org/agenda/2021/05/eco-wakening-consumers-driving-sustainability/>

<sup>26</sup> ARUP (2017). The future of retail. Available at: <https://www.arup.com/perspectives/publications/research/section/the-future-of-retail-2017>

Figure 4: Distribution of green retail startups based on their retail sector

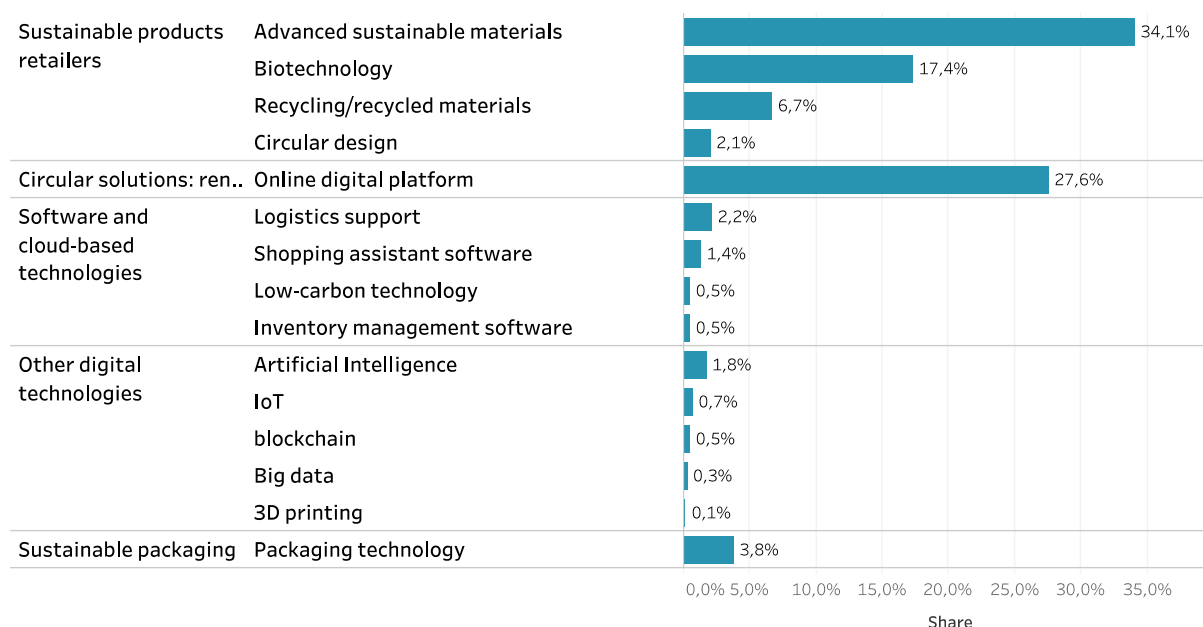


Source: Technopolis Group based on Net Zero Insights data, 2022

### Type of green technologies and service models

Environmental startups in retail include a variety of activities such as online retail platforms that facilitate the sharing economy, **retailers of sustainable products**, the development of less polluting **packaging solutions** and **digital technology-based startups** that enable the reduction of food waste or the optimisation of logistics and inventory management (see Figure 5). As it is illustrated in the Figure below green/environmental technologies that have been the most relevant include advanced materials, biotechnology (embedded in sustainable products that are sold) and online platforms that enable circularity.

Figure 5: Type of environmental startups in retail (founded after 2015)



Source: Technopolis Group based on Net Zero Insights data, 2022



## Sustainable products retailers

Among the environmental startups captured via Net Zero Insights, **60.5% are retail companies selling environmentally sustainable products** (made from bio-based or recycled materials/of origin) and positioning themselves as ecological retail firms. Since most of these green retail startups operate in the fashion industry, many of them source their raw materials from textile factories that supply fabrics certified under voluntary schemes such as GOTS certified Organic Cotton (Tranquillo<sup>27</sup>, Germany). Moreover, 25% of the companies use bio-based materials. As an example, the retailer WilliCroft Store<sup>28</sup> from France produces and sells plant-based cheese products intended to be a sustainable vegan alternative to traditional cheese.

## Sharing economy and the circular economy

Close to 84% of the entrepreneurs developing online platforms are online multi-brand marketplaces, of which 28% are **C2C platforms** that facilitate the exchange or rental of pre-owned clothes (e.g., Vinted<sup>29</sup> from Lithuania and Vestiaire Collective<sup>30</sup> from France). The concept of '**recommerce**' has emerged that revolves around selling pre-owned items through online marketplaces.

The share of online food platforms facilitating the **reduction of food waste** through mobile applications is also relatively high notably 13%. A common example of this application is for instance the Finnish startup Fiksuruoka<sup>31</sup>, an online grocery store selling surplus food that is close to expire at a reduced price.

A growing number of retail startups have embraced **rental and subscription-based models** relevant for the circular economy. Rental of various types of products such as clothes or electronics has been made possible following monthly rental fees that can attract both environmental-conscious and price-sensitive customers. The change to rental is facilitated by retail tech startups that support the creation of an operating system for such new models. For example, Rentle<sup>32</sup> enables retailers to manage orders, payments, deposits, online and offline channels, inventory as well as maintenance and refurbishment operations (belonging also to the category of startups providing IT solutions for green models).

Other types of applications include **B2B online platforms** which connect and deliver food from local producers, facilitating the connection of local farmers to consumers. Agriflux<sup>33</sup>, a French startup founded in 2019, connects and distributes food from local farmers directly to stores and restaurants.

## Sustainable packaging solutions

Some of 12% of the environmental retail startups develop sustainable and recycled packaging solutions. Although startups are often not labelled under the retail NACE codes, they are directly linked to the retail industrial ecosystem, in particular to the inherent needs of online retail. Some examples of the environmental solutions these retail entrepreneurs provide include the following:

- Providers of a sustainable packaging system designed for reusable and returnable packaging service. Repack<sup>34</sup> is a provider of reusable packaging for online e-commerce that also takes care of the reverse logistics of the packaging material.

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<sup>27</sup> [https://www.tranquillo-shop.de/en\\_US/](https://www.tranquillo-shop.de/en_US/)

<sup>28</sup> <https://willicroft.store/collections/cheese>

<sup>29</sup> <https://www.vinted.com>

<sup>30</sup> <https://www.vestiairecollective.com>

<sup>31</sup> <https://www.fiksuruoka.fi>

<sup>32</sup> <https://www.rentle.io/>

<sup>33</sup> <https://www.agriflux.fr>

<sup>34</sup> <https://www.repack.com/>

One of its innovative features is that it can be integrated as a module within e-commerce platforms such as Shopify<sup>35</sup> or Woocommerce<sup>36</sup>.

- Alternatives to Plastic such as reusable containers made of glass or biodegradable materials (e.g., Sulapac<sup>37</sup> from Finland and Miwa<sup>38</sup> from Czech Republic). Landpack<sup>39</sup> designs insulated packaging for shipping temperature-sensitive goods in Germany since 2013 that is biodegradable and made of renewable raw materials.

## IT software solutions and cloud technologies

There is entrepreneurial activity developing green oriented software and cloud-based services (9.5% of the startups of the sample), which are mainly operating as integration of the e-commerce tech architecture. Diverse solutions that facilitate transactions at different stages of the retail ecosystem supply chain include:

- With the objective of raw materials reduction, there are software solutions focused on **efficient inventory management** predicting demand and raw material use (Whywaste<sup>40</sup> from Sweden).
- **Shopping assistance** software has been developed both for costumers and brands with the objective to incentivising sustainable consumption. For example, Renoon<sup>41</sup> is a Dutch startup founded in 2020 that has developed an app where consumers can search for clothes based on their sustainable criteria. Operating for the food sector, Evocco<sup>42</sup> is an Irish startup that has developed a tracker to inform consumers about the environmental impact of food products.
- Online operators focused on **optimising logistics** services with a particular focus on the reduction of emissions, packaging material, management of returns and overstock, etc. Skrym<sup>43</sup> from Sweden is a cloud-based logistics provider that offers modules and API endpoints that can be merged with the retailer online site and that aim at optimising the whole value chain.

Software modules integrated within the e-commerce ecosystem platform to **calculate and monitor of the carbon footprint** and energy consumption of the retailers' value chain. Vaayu<sup>44</sup> measures and monitors emissions using machine learning algorithm. Either through an API or directly connected to the e-commerce platform, Vaayu takes advantage of the interconnectivity among value chain segments to calculate emissions and identify potential emissions saving points.

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<sup>35</sup> <https://www.shopify.com>

<sup>36</sup> <https://woocommerce.com>

<sup>37</sup> <https://www.sulapac.com>

<sup>38</sup> <https://www.miwa.eu/>

<sup>39</sup> <https://landpack.de>

<sup>40</sup> <http://www.whywaste.com>

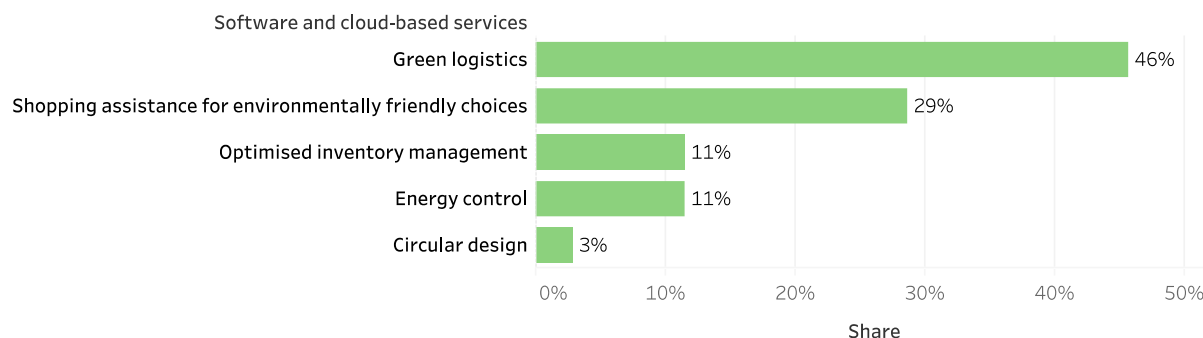
<sup>41</sup> <http://www.renoon.com>

<sup>42</sup> <https://www.evocco.com>

<sup>43</sup> <https://www.skrym.se/>

<sup>44</sup> <https://www.vaayu.tech>

Figure 6: Overview of type of solutions of software and cloud-based services



Source: Technopolis Group based on Net Zero Insights data, 2022

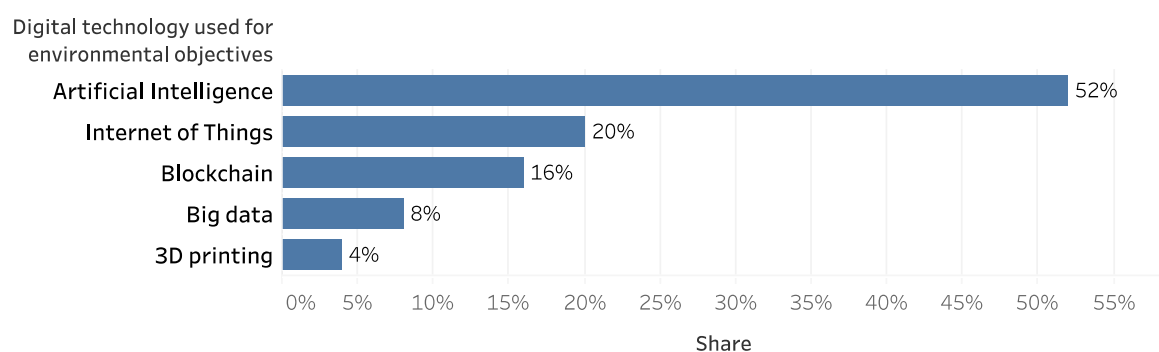
### Advanced digital technologies underpinning the green transition

Green retail solutions powered by advanced digital technologies are provided by 3% of the startups including **Artificial Intelligence, blockchain and the Internet of Things** technologies. Big data and related data analytics play a key role optimising supply chain logistics, for instance warehouse management systems using machine learning can maximise storage capacity and optimise layouts, increasing energy efficiency, cutting down on wasted space, and preventing waste through retailers to procure the right amount of stock<sup>45</sup>.

Blockchain technologies ensure traceability of materials and flow products in complex supply chains where logistics play a key role, such as in the food and fashion industry (Originchain<sup>46</sup> from Ireland). Smart IoT driven solutions that improve warehousing services and retail logistics, which not only have become increasingly important with the raise of e-commerce companies but also to improve performance and save emissions (Ogoship<sup>47</sup>, Finland).

**AI-driven solutions are particularly prominent**, with 50% of them focused on food waste reduction solutions for retailers and wholesalers through demand forecasting (e.g., Circly<sup>48</sup> from Austria; Freshflow<sup>49</sup> from Germany; Snomoln<sup>50</sup> from Sweden), online match making tools for food surplus (e.g., SPRK<sup>51</sup> from Germany). Also powered with AI, there are startups developing software which assist customers in their shopping journey to make more sustainable choices (Faircado<sup>52</sup>, Germany).

Figure 7: Digital technologies applied for environmental objectives among retail tech startups (share in total)



<sup>45</sup> <https://technative.io/3-ways-that-technology-can-make-retail-more-sustainable/>

<sup>46</sup> <http://www.originchain.network>

<sup>47</sup> <http://ogoship.com/>

<sup>48</sup> <https://www.circly.at/>

<sup>49</sup> <https://freshflow.ai/>

<sup>50</sup> <http://www.snomoln.se>

<sup>51</sup> <http://www.sprk.global>

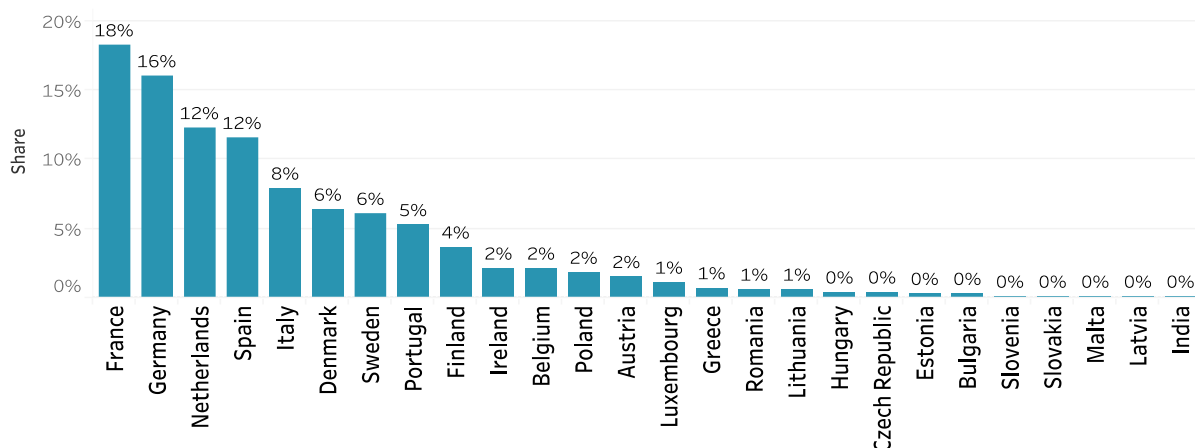
<sup>52</sup> <http://faircado.com/>

Source: Technopolis Group calculations based on Net Zero Insights, 2022

## Country patterns

The geography of the startups included in the sample indicates that there are disparities across Europe (Figure 8). The data points out that France, Germany, the Netherlands, and Spain are clear frontrunners, where 58% of the startups are concentrated. Further larger retail startup ecosystems are also found in Italy, Denmark, Sweden, and Portugal. When looking at which countries have been growing the most in terms of creation of green retail startups, the data indicates that the Portugal grew 300% in 2020, compared to 2015 data, followed by the Netherlands (+140%) and Sweden (+100%).

Figure 8: Geographical distribution of green retail startups across the EU27 countries

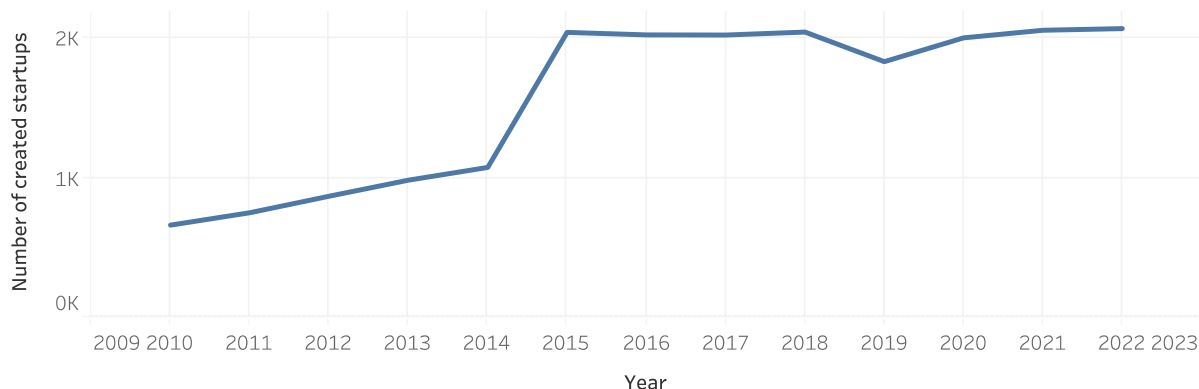


Source: Technopolis Group based on Net Zero Insights data, 2022

## 2.2.2. Digital technologies

Digital transformation trends have been analysed based on Crunchbase<sup>53</sup> data composed of 15 150 companies. The results show that during the period 2010-2015 the number of digital tech startups in retail has been steadily increasing.

Figure 9: Trends over time in creating startups

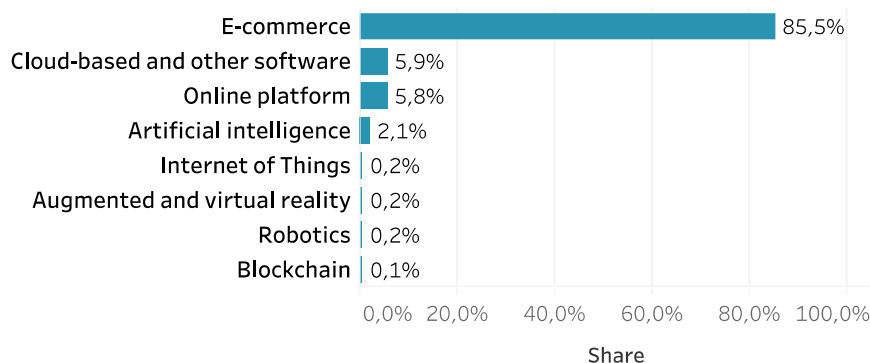


Source: Technopolis Group calculations based on Crunchbase, 2023

<sup>53</sup> Startups have been selected by filtering for 'Retail', 'Retail Technology', 'E-commerce', 'E-commerce Platforms', 'Marketplace', 'Shopping', 'Point of Sale', 'Personalisation', 'Wholesale', 'Warehousing', 'Supply Chain Management' and 'Mobile Payments' categories and by text-mining the business descriptions of companies with a filter for digital technology related startups<sup>53</sup>. This search resulted not only in traditional retail companies but also in a set of digital startups that specifically provide technological services and enable the digital transition of the retail ecosystem.

The startup landscape shows a large share of digital tech retail startups focusing on online retail and **e-commerce**. The number of these type of startups has been steadily growing since 2010. This is in line with the expectation of industry representatives that predicts a further acceleration of e-commerce due to the fact of the rising number of online shoppers<sup>54</sup>.

Figure 10: Share of technologies used among digital retail startups



Source: Technopolis Group calculations based on Crunchbase, 2022

The most frequent applications of online platform are:

- Online marketplaces that offer several brands or services such as the exchange of second-hand clothes (Vinted<sup>55</sup> from Lithuania), repaired electronics (Back Market<sup>56</sup> from France).
- Applications offering delivery services such as same day delivery/last mile delivery. Gorillas<sup>57</sup>, a delivery provider that offers grocery products delivered to consumers within 10 minutes, was founded in 2020 and has already penetrated the market in several European capitals in less than 2 years.
- Online search engines offering price comparison tools for retail products.

As omnichannel supply chain has become the new norm, startups developing **software and cloud-based technologies** that are part of the e-commerce architecture have grown more and more and account for 5.7% of the total digital tech retail startup landscape. These group of startups encompass all companies developing software modules that operate within the e-commerce architecture. Among the services that these startups offer there are:

- E-commerce platform tools that provide retailers with front-end architecture of their online shop. For instance, Vue Storefront<sup>58</sup> is a Polish startup founded in 2017 offering an API-focused and Front-End for eCommerce, which facilitates the omnichannel experience as it can relate to different e-commerce integrations related to payment, CMS, e-commerce platforms, etc.
- Payment modules integrate the payment process within the online site and app. There are innovations developing alternative payment methods such as the French startup JUST<sup>59</sup> that offers a payment module to speed up the checkout process for customers.
- Price monitoring plugins such as Boardfy<sup>60</sup> from Spain, a startup that provides retailer with dashboards monitoring in real-time the prices of their competitors.

<sup>54</sup>Eurostat (2023). E-commerce continues to grow in the EU. Available at: <https://ec.europa.eu/eurostat/web/products-eurostat-news/w/DDN-20230228-2>

<sup>55</sup><http://vinted.com>

<sup>56</sup><https://www.backmarket.com/en-us>

<sup>57</sup><https://gorillas.io/en>

<sup>58</sup><https://www.vuestorefront.io>

<sup>59</sup><https://www.getjust.eu>

<sup>60</sup><https://www.boardfy.com/products-price-intelligence/>



- Software integrations that facilitate delivery services covering the delivery experience for the customer. As an example, the Spanish Singro<sup>61</sup> is an integration that connects the POS of restaurants to all their orders, reservations, and delivery channels.
- Inventory management plugins providing real time overview of the business' warehouse stock. The French startup Stockly<sup>62</sup> has developed a software integration that allows online retailers to keep selling even when they are out of stock, using the inventory of other retailers.
- SaaS driven platforms integrating data from all retail segments in one single software, including in store technology, warehouse, delivery, payment etc.
- Startups developing e-commerce fulfilment solutions for digital native retailers who have not physical facilities, including warehouse, inventory management and delivery (Autofulfil<sup>63</sup> from Ireland).

**Big data analytics has become a recent trend in the retail industry**, indicating the importance of harnessing the value in data and accelerate business operations.

As product volumes rise and delivery times decrease, both triggered by e-commerce consumers demands, **robotics** technologies applied to warehousing and logistics can lead to shorter shipment-processing time and can achieve efficient warehousing operations. As an example, Eiratech Robotics<sup>64</sup> is an Irish startup that has developed a robot which can be used for multiple warehousing purposes such as e-fulfilment, e-grocery, and inventory management. There are different focuses of innovation that enable automation within warehousing activities, for instance the Austrian startup D-ARIA<sup>65</sup> uses drone technology to automatise the collection of stock data within warehouses, while WAKU Robotics<sup>66</sup> has developed pallet shuttle warehouse that enables fully automated storage and picking systems for maximum performance.

Advanced digital technologies are applied throughout all the segments of the retail ecosystem.

- **Artificial Intelligence (AI) driven by big data have given rise to new ways of optimising sales.** Data driven methods provide a deeper understanding of customer behaviour and therefore enhance product development to the next level of personalisation<sup>67</sup>. AI is playing other relevant roles such as in improving online assistance to costumers (e.g., chatbots) or inventory management strategies based on demographic trends and real-time market conditions<sup>68</sup>.

While it is clear that digital technologies allow customers instantaneous access and faster purchase decisions, they are also producing valuable data that can contribute to enhance brand value. In this context, **Artificial Intelligence and big data** techniques are found among the most common technologies (320 startups within the sample) that are helping retailers achieve cost reductions and efficiency gains in their operations.

Because of the increase on the availability of consumer data, the use of analytics and predictive techniques for the interpretation of such data is allowing retailers to provide consumers hyper-personalised marketing based on aspects such as location, individual preferences, decision-making patterns, online behaviours, etc. Further than the obtention of consumer insights, analytics and monitoring activities are also nurturing retailers' business intelligence, helping them for instance to better assess store operations, the impact of specific marketing campaigns and even detailed insights into what drives customers' purchase decisions and what designs are in demand in the market. As an

<sup>61</sup> <https://www.singro.com>

<sup>62</sup> <https://www.stockly.ai/>

<sup>63</sup> <https://www.autofulfil.com>

<sup>64</sup> <http://www.eiratech.com>

<sup>65</sup> <http://www.d-aria.at>

<sup>66</sup> <https://www.waku-robotics.com>

<sup>67</sup> KPMG (2019), Retail trends 2019. Available at: <https://assets.kpmg/content/dam/kpmg/xx/pdf/2019/02/global-retail-trends-2019-web.pdf>

<sup>68</sup> CB Insights, 2021. Retail AI Trends to watch in 2021. Available at: <https://www.cbinsights.com/research/report/enterprise-ai-trends-2021/>

example, the Polish Ecometrixo<sup>69</sup> is an e-commerce analysis tool that offers online retailers with KPIs to monitor the performance of their e-shop.

Also, as part of the personalisation experience, AI-powered chatbots and voice assistants allow online retailers boost their response times to customer inquiries, point them to reviews and even make product and size suggestions (Dialogtrail<sup>70</sup> from Sweden). In line with this, AI-driven applications for perfect size & fit are also present among fashion stores, boosting sales and reducing returns (Fitle<sup>71</sup> based in France).

- **Retail is also increasingly powered by the Internet of Things.** For example, created in 2010, Retailic<sup>72</sup> is a Polish startup that uses sensor based IoT technology to measure, analyse and manage people behaviour in physical environment and improve the results of sales, marketing, and operations of retail companies. Internet of Things (IoT) technologies are becoming important in a range of applications, allowing to personalised experiences in connected stores, delivering cost efficiencies in inventory-management (e.g., radio-frequency identification (RFID)).
- Although less prominently, **augmented, and virtual reality applications** are also used by digital retail startups as a mean to increasingly become part of an **engaging, immersive, and hyper-personalised on-line customers experience**. AR/VR can be used with different purposes, from product visualization at home to virtual shopping experiences, all of them aiming at increasing customer sales and reducing returns. The Finnish startup Sayduck<sup>73</sup> uses 3D technology for consumers to virtually see and fit furniture pieces in their homes, enabling a personalised experience. Augmented and virtual reality is drastically changing the online consumer's shopping journey, for instance by incorporating virtual visualisation of products online, or by allowing customers to scan products in store to check the ingredients and related information on the product. 3D technology can also help to decarbonise supply chains, for instance by developing seasonal samples online, avoiding the production of physical garments prior to launch.

AR/VR can also help retailers reduce their production cost. The Italian startup Future Fashion<sup>74</sup> has developed a solution to help fashion brands to virtualise and customise their collections in 3D, therefore reducing sample costs and increasing customer experience.

- **Blockchain** is a growing technology that is transforming supply networks. It can ensure transparency and traceability not only of the production process but also on the logistics of retail products. As consumers environmental demands increase, supply chain traceability offers retailers the possibility to provide consumers transparency regarding where products come from. Blockchain technologies also find applications within payment transactions, for instance in B2B payments simplifying the transaction process between financial institutions, speeding up the process, and reducing intermediary costs and risk<sup>75</sup>.
- **Robotics and automation technologies** complement and speed up human labour across the warehousing function. Retailers can take advantage of automatized stock management and sorting, allocation of storage space, selection of optimal routes, pick and pack customers' orders for shipping, etc. They are essential for retailers to respond to increasing e-commerce demands (CB Insights, 2021).

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<sup>69</sup> <https://ecometrixo.com/>

<sup>70</sup> <https://www.dialogtrail.com/>

<sup>71</sup> <http://www.fitle.com/>

<sup>72</sup> <http://retailic.com>

<sup>73</sup> <http://www.sayduck.com>

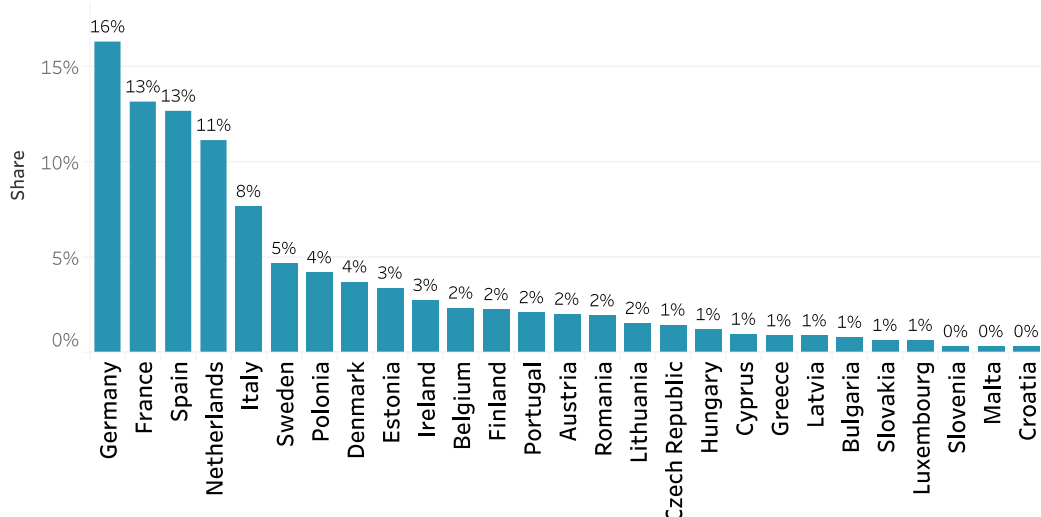
<sup>74</sup> <https://www.futurefashionsolution.com/en/>

<sup>75</sup> Deloitte, 2018. New tech on the block. Planning for blockchain in the Retail and Consumers Packaged Good industries. Available at: <https://www2.deloitte.com/uk/en/pages/consumer-industrial-products/articles/new-tech-on-the-block.html>

## Country patterns

Looking at the location of the analysed startups, 52.6% come from the Netherlands, with 96.8% of the companies being e-commerce retailers (5 500 startups). Spain, Germany, and France follow with lower shares. However, Germany ranks first when it comes to startups developing online platforms, software and cloud-based technologies, AI and big data AR/VR and robotics and automation.

Figure 11: Country distribution of digital tech retail startups



Source: Technopolis Group calculations based on Crunchbase, 2022

### 2.2.3. Scaleups in retail

Young firms that are scaling up are key drivers of innovation and potential disruptions in any industrial ecosystem including retail. They challenge the status quo and push other industrial firms to adapt their production and operation models. This is why they play a key role also in digitalisation and the green transition. As a recent JRC report concluded, the number of scaleup businesses and unicorns in the EU lags behind the US and China<sup>76</sup>. Europe hosts only around 10% of the world scaleups as concluded by recent researchers<sup>77</sup>. In comparison with the USA, scaling up is a challenge in the EU and the number of unicorns is still low even if the number of startups has increased significantly over the past years<sup>78</sup>. There are various definitions for scaleups and unicorns. The OECD defines a scaleup “as a company that has achieved 20% annual growth in headcount or revenue over the past three years”. Other researchers define scaleups according to growth funding and other expansion criteria. The European Scaleup Monitor<sup>79</sup> adopted a definition “as young fast-growing companies 10 years old or younger that have received at least €1 million within the past 10 years”.

Following the above definition, this study identified 608 active scaleups in the retail industrial ecosystem in the EU27 based on Crunchbase data (data retrieved in June 2023). This includes not only general retail, wholesale or retail tech, but new online platforms that offer an alternative to e-commerce. This number represents 2.7% of all retail startups in the database. As a comparison, the number of scaleups in the retail ecosystem was 1 229 in the USA, which is 5% of all US startups.

<sup>76</sup> European Commission JRC (2022). Tackling the Scale-up Gap

<sup>77</sup> Vlerick (2022).

<sup>78</sup> See the analysis of ATI 2021

<sup>79</sup> European ScaleUp Monitor (2021). European scaleups got knocked down, but are up again, Erasmus Centre for Entrepreneurship, available at: <https://www.eur.nl/media/100543>

- Grover<sup>80</sup> is a German scaleup/unicorn that provides an online platform for renting tech products through monthly subscriptions instead of buying them.
- Flink<sup>81</sup> is a developer of an online platform used to offer and deliver multi-category grocery products.
- Back Market<sup>82</sup> is an online marketplace for refurbished electronics.
- Ankorstore<sup>83</sup> is an online B2B marketplace that connects independent shop owners and specialist brands with neighbourhood retailers. Its mission is to reinvent the wholesale market for independents in order to level the playing field for them.

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<sup>80</sup> <https://www.grover.com/de-de>

<sup>81</sup> <https://www.goflink.com/en/>

<sup>82</sup> <https://www.backmarket.nl/>

<sup>83</sup> <https://www.ankorstore.com/>

### 3. Uptake of green and digital technologies and business models

#### Key findings

The retail industry has a huge responsibility in shaping an environmentally friendly consumer behaviour. Following global megatrends, retailers are more and more challenged to shift to sustainable business practices while protecting their competitiveness. The results of the EMI survey conducted with 400 SMEs in retail are the following:

- Only 26% of the respondents have increased their investments into the green transition over the past five years. A large share (42%) invested less than 5% of their turnover into green technologies and related business practices.
- SMEs in the retail industrial ecosystem are most concerned about their energy use and 14% indicate having adopted energy-saving technologies.
- 12.1% confirmed that they use recycled materials and 10% any other recycling technologies.
- The least cited technologies include hydrogen and carbon-capture technologies.
- 10.6% of the respondents adopted resell, reuse and second-hand operation followed by repair and maintenance services.
- Renting, leasing and related service models were taken up by 5.9% of the respondents.
- Digital product passport including transparent supply chains was indicated to be used by 2.3% of the respondents

Regarding the digital transition, the retail industry has been making advancements over the past decade. The survey results indicate that 91% of the respondents said that digitalisation has been important for their business, and they have adopted one form of digital technology.

- 42.6% of retail SMEs had increased their investments dedicated to digital technologies during the past five years.
- The detailed results demonstrate that besides online platforms (used by 19.6%) and cloud technologies (19.3%), retail SMEs adopted Internet of Things technologies the most often (10.2%).
- 9.7% of the surveyed companies from the retail ecosystem manifested that they use big data.

With the objective to monitor the status in the uptake of digital and green technologies, a large-scale business survey has been implemented in the framework of this study. The survey was based on using [Computer Assisted Telephone Interviewing \(CATI\)](#). The final sample included 8 987 companies in all industrial ecosystems and **1 267 interviews for retail in particular**. The mainstage fieldwork was conducted between 15 January and 15th May 2023. A prerequisite for each reach-out and interview was to have a respondent with adequate capacities and knowledge to answer the questionnaire (for more details please see the methodological report of the project). The survey respondents come from a mix of micro-enterprises (less than 10 employees), small enterprises (10-50 employees) and medium-sized enterprises (50-250 employees). In terms of geographical coverage, the survey has a balanced coverage of all EU countries.

The results of other existing surveys have been also taken into account such as the Flash Eurobarometer 498 on SMEs, green markets and resource efficiency, and the ICT-usage in

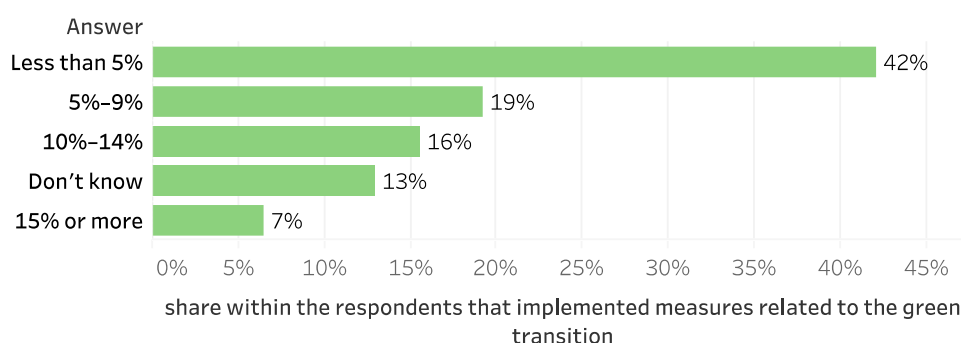


enterprises survey<sup>84</sup>. The different time of the field work for each survey can give some insights about progress even if the questions were not exactly the same. The Flash Eurobarometer 498's field work took place in November-December 2021. The last ICT usage survey results date from 2020.

### 3.1. Green transition of SMEs

Overall, the survey results show that 19% of the surveyed organisations adopted at least one form of technology relevant for the green transition as identified below. Retailers were asked whether they **had increased their investments dedicated to the green transition** and environmental sustainability during the past five years. The results show that only 26% of the respondents answered positively. A further question was related to the percentage in terms of turnover that SMEs had invested in green transformation on average annually. The responses show that a large share (42%) **invested less than 5%** which is a low result, although it is also due to the low capital intensity of green transition measures that retailers can actually implement. The Flash Eurobarometer in 2021 found that **17% of the SMEs surveyed in retail had a concrete strategy in place to reduce their carbon footprint and become climate neutral** or negative, and 22% was planning to prepare one.

Figure 12: Share of turnover invested in green transformation by SMEs in the retail industrial ecosystem on average annually



Source: Technopolis Group and Kapa Research, 2023

The detailed survey results demonstrate that **SMEs in the retail industrial ecosystem are most concerned about their energy use**. Some of 14% indicated having invested in energy-saving technologies. Nonetheless, a larger share has been taking further actions to save energy. The Flash Eurobarometer found that 62% indicated that SMEs implemented any measure in this field. In particular, energy efficiency of logistics centres is in focus.

Another **12.1% confirmed that they adopted the use of recycled materials and 10% stated that they invested in other recycling technologies**. Interestingly, this is quite a low result, although the Flash Eurobarometer in 2021 indicates that 42% of SMEs in retail reused material of waste within the company. The least cited technologies include hydrogen and carbon-capture technologies. The share of those respondents that have not yet adopted green technologies but planning to do so is relatively low.

<sup>84</sup> [https://ec.europa.eu/eurostat/cache/metadata/en/isoc\\_e\\_esms.htm](https://ec.europa.eu/eurostat/cache/metadata/en/isoc_e_esms.htm)

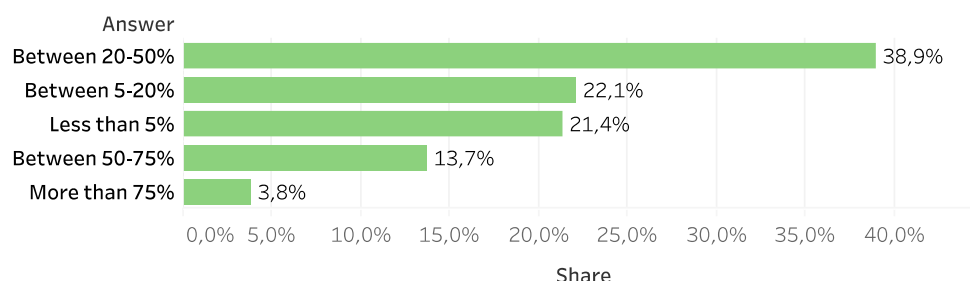
Figure 13: Adoption of green technologies within the retail industrial ecosystem

Green technology	Answer	
	Already using	Planning to adopt
Energy-saving technologies	14,0%	5,2%
Recycled materials	12,1%	3,2%
Recycling technologies	10,7%	3,0%
Renewable energies	9,9%	5,5%
Waste reduction technologies	4,9%	4,0%
Circular design	3,8%	2,0%
Advanced materials including organic, bio-based, biodegradable	3,1%	1,7%
Biotechnology	1,3%	1,7%
Additive manufacturing (3D printing, 3D manufacturing)	1,1%	2,4%
Hydrogen	0,8%	1,4%
Carbon capture technologies	0,8%	1,4%

Source: Technopolis Group and Kapa Research, 2023

**Renewable energy technologies have been taken up by 9% of the respondents** as displayed in the Table above. The results indicate that 38.9% of those that responded positively, cover between 20-50% of their total energy consumption by renewable energy.

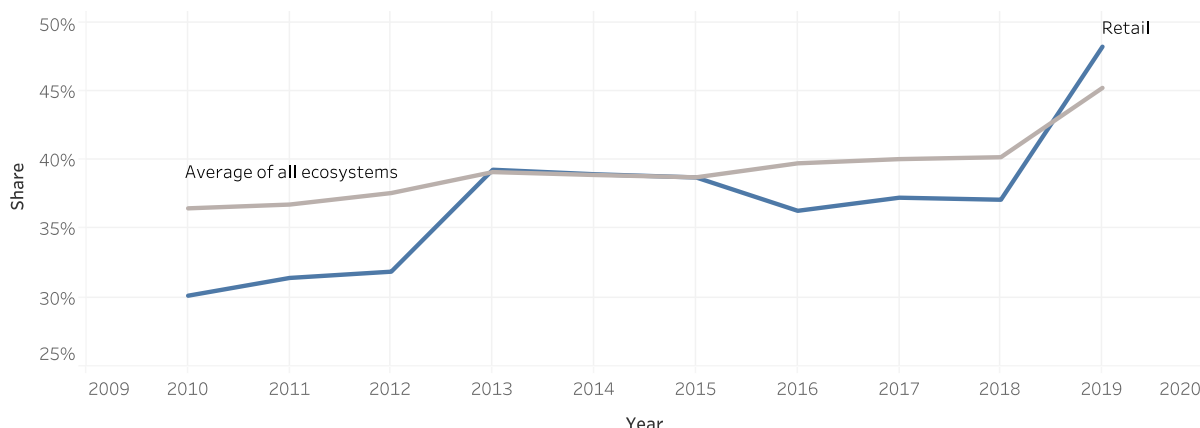
Figure 14: Share of renewable energy use within total energy consumption



Source: Technopolis Group and Kapa Research, 2023

The renewable energy share of the retail industrial ecosystem is also monitored based on statistics from Eurostat. Although the last available year of this statistics is before the pandemic notably 2019, it demonstrates the evolution over time (see Figure 15). The data indicate that 48% of the total energy consumption of the retail industrial ecosystem was covered by renewable energies in 2019.

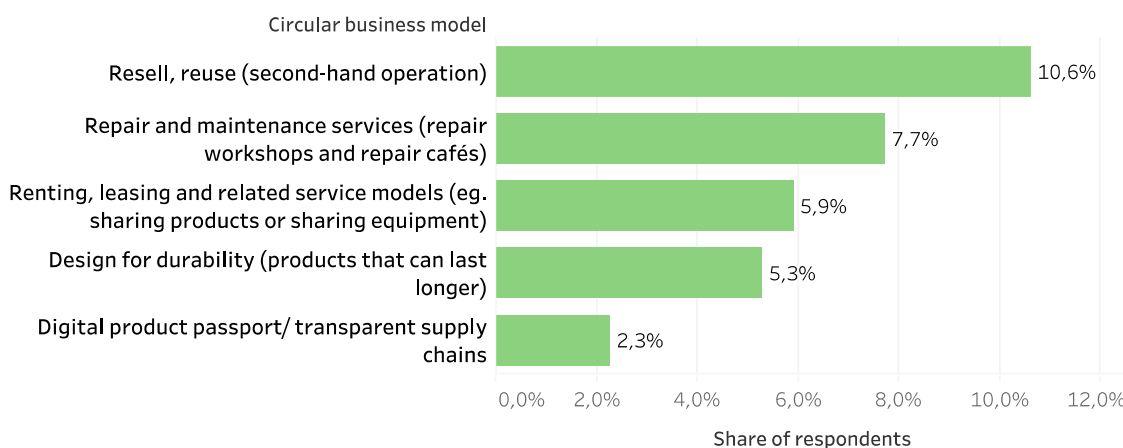
Figure 15: Evolution of the share of terajoules of renewable energy use by the retail industrial ecosystem and the total EU27 IEs (2010 – 2019)



Source: Technopolis Group, 2022, based on Eurostat [ENV\_AC\_PEFASU]

Retail SMEs were surveyed about the **adoption of circular business models** such as repair, renting, leasing or design for durability. The results indicate that the largest share notably 10.6% of the respondents adopted resell, reuse and second-hand operation followed by repair and maintenance services. Renting, leasing and related service models were taken up by 5.9% of the respondents. Actions related to transparent supply chains (towards digital product passports) were taken by 2.3% of the respondents, but even this small share indicates an interest in this tool (some interviewees also indicating a high interest in this topic for their future work). Digital product passports as highlighted in the sustainable products initiative<sup>85</sup> of the European Commission will be the norm for all products with tags identified and linked to data relevant to their circularity and sustainability.

Figure 16: Adoption of green business models and non-technological solutions within the retail industrial ecosystem



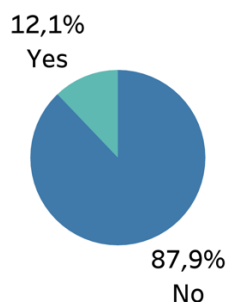
Source: Technopolis Group and Kapa Research, 2023

When asked about the certification on any environmental standards, 12.1% of the respondents indicated that they had been certified (see Figure 17). There are several ISO certifications that can be implemented by retailers. The most common ones are ISO 9001

<sup>85</sup>European Commission (2022). Sustainable Product Initiative. Available at: [https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12567-Sustainable-products-initiative\\_en](https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12567-Sustainable-products-initiative_en)

- Quality Management systems; ISO 14001 – Environmental management, and ISO 45001
- Occupational Health and Safety (Auva Certification, 2022)<sup>86</sup>.

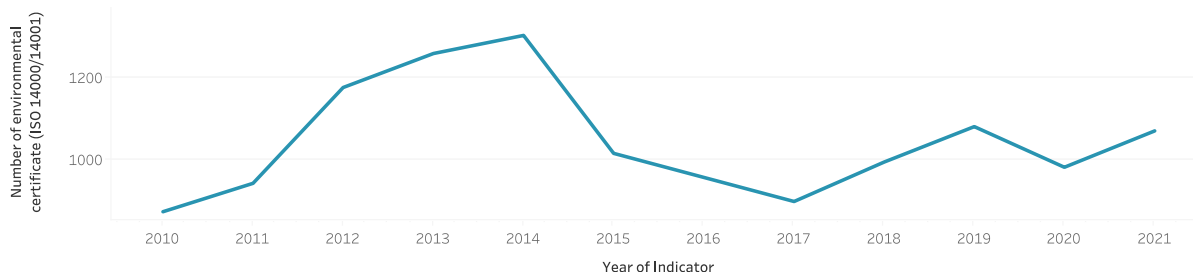
Figure 17: Share of respondents indicating that they have obtained an environmental certificate



Source: Technopolis Group and Kapa Research, 2023

The annual ISO survey indicates that there were **870 certificates issued to retail companies in the EU27 in the year 2010, which number increased to 1 070 certificates issued in 2021**. ISO 14001 is a set of standards that any company can follow to implement an effective environmental management system. By adopting the good practices suggested by the standard, firms can substantially reduce their environmental footprint. The number of environmental certificates issued in the industry indicates the progress towards the application of environmentally friendly business practices and production methods. For the purposes of this report, ISO data were accessed via the ISO survey of certifications to management system standards<sup>87</sup>. As indicated in the Figure below, there has been an irregular progression in the number of retail companies that obtained ISO environmental certificates over time. There was an upward trend between 2010 and 2014, that then decreased until 2017, to then increased again until 2019. In 2020, the number of environmental certificates issued reduced again to then increase again in 2021.

Figure 18: Number of environmental certificates issued in the retail industrial ecosystem



Source: Technopolis Group, 2022, based on ISO

## 3.2. Digital transition of SMEs

The retail industry has been making relatively good advancements on the digital scene over the past decade.

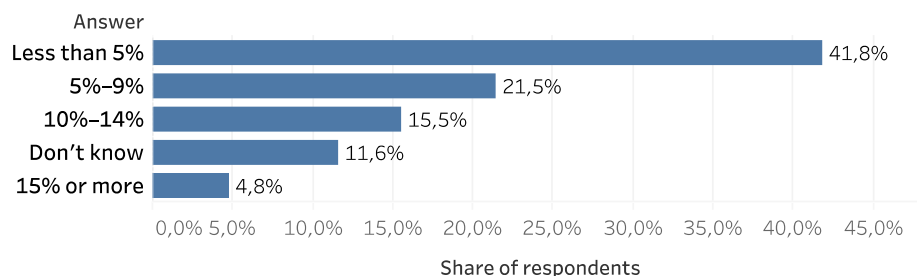
The survey results indicate that 91% of the respondents said that digitalisation has been important for their business, and they have adopted one form of digital technology when including also basic digital technologies such as any IT software.

<sup>86</sup> Auva Certification (2022), Wholesale and retail. Available at: <https://auvacertification.com/sectors/wholesale-and-retail/> (Retrieved on December 16<sup>th</sup>, 2022).

<sup>87</sup> ISO (2022) ISO Survey of certifications to management system standards. Accessed on <https://isotc.iso.org/livelink/livelink?func=ll&objId=18808772&objAction=browse&sort=name&viewType=1>

When asking retail SMEs, whether they had increased their investments dedicated to digital technologies during the past five years, 42.6% responded positively. A further question was related to the percentage in terms of revenue that retailers had invested in digital transformation on average annually. The responses show that **41.8% of the respondents invested less than 5% in revenue** in digital technologies.

Figure 19: Share of revenue/income invested in digital transformation on average annually



Source: Technopolis Group and Kapa Research, 2023

The level of adoption of specific digital technologies relevant for the retail ecosystem is presented in Figure 20. The detailed results demonstrate that besides **online platforms (used by 19.6%)** and **cloud technologies (19.3%)**, **retail SMEs adopted Internet of Things technologies the most often (10.2%)**.

Figure 20: Adoption of digital technologies within the retail industrial ecosystem

Technology	Answer	
	Already using	Planning to adopt
Online platform	19,6%	2,0%
Cloud technologies	19,3%	1,5%
Internet of Things	10,2%	2,7%
Big data	9,7%	3,8%
Artificial Intelligence	6,4%	4,9%
Blockchain	4,6%	0,7%
Augmented and virtual reality	3,3%	3,0%
Robotics	1,9%	1,8%
Digital twin	1,3%	1,2%

Source: Technopolis Group and Kapa Research, 2023

### The adoption of online platforms reflects the dynamic diffusion of e-commerce.

As Eurostat statistics confirms, 16.8% of EU enterprises conducted e-sales using only websites or apps in 2021<sup>88</sup>. The survey on ICT usage and e-commerce in enterprises found that 'accommodation' recorded the highest e-commerce use in 2021 with 31.6 % the highest share of turnover generated from web sales followed by 'Information and communication' (15.5 %) and 'Retail trade' (10.5 %) (ibid).

The use of e-commerce and web portals goes normally hand in hand with the use of cloud computing services. **Cloud technologies** in this project have been defined as the **use of cloud-based software and related cloud platform services**. The adoption rate of

<sup>88</sup>Eurostat (2021). E-commerce statistics. Available at: [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=E-commerce\\_statistics#E-sales\\_record\\_a\\_slight\\_increase\\_over\\_recent\\_years](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=E-commerce_statistics#E-sales_record_a_slight_increase_over_recent_years)

cloud technologies was 19.3% as found by the survey in this project. According to Eurostat statistics<sup>89</sup> 15.9% of the companies belonging to the sector of retail trade, except of motor vehicles and motorcycles bought high cloud-computing services such as CRM (customer relationship management) software and accounting software in 2020. Eurostat statistics<sup>90</sup> also indicate that 33.9% of EU retailers (G47) and 46.9% of wholesalers (G46) had purchased cloud computing services in 2021 when applying a broader definition of the technology.

When zooming into the type of cloud service purchased, we observe that 13.8% of wholesalers have bought ERP software applications, and 15.3% have purchased a CRM software. In the case of retailers, 8.5% have bought ERP and 8.6% CRM.

Upon closer examination of the specific cloud services procured, among wholesalers 13.8% have invested in ERP software applications and 15.3% have acquired CRM software. As for retailers, 8.5% have purchased ERP systems, and 8.6% have bought CRM solutions.

A key challenge that has been highlighted during the interviews includes the **integration of new digital solutions with the existing store software**.

**9.7% of the companies surveyed in the retail ecosystem stated that they use big data and related data analytics solutions.** Similarly, Eurostat<sup>91</sup> data indicates that as of 2020, 13.9% of retail companies and 14.8% of wholesale companies (10 employees or more) have actively engaged in analysing big data, both from internal and external data sources. When comparing the results of the survey conducted in this project and Eurostat statistics, it has to be kept in mind that Eurostat provides data about companies that have more than 10 employees and including large companies as well. The EMI survey focused on the broader retail industrial ecosystem and includes only SMEs of all sizes.

**The importance of Internet of Things technologies** as expressed in some of the interviews is not surprising since the first use cases of IoT appeared in retail more than two decades ago with the use of radio frequency identification (RFID) systems connected to the internet<sup>92</sup>. IoT has been used most to optimise their supply chain, notably to monitor their assets remotely, support traceability and inventory management. With the support of IoT sensors, retailers can track the level of stock in real time and adapt faster according to actual demand. Next to logistics, IoT-based smart devices are used to control lighting and save energy. IoT devices can monitor also the use of heating and cooling.

IoT can also enable **smart labelling of products** and communicate between the shelf and a central computer via WiFi and storing data on the cloud as highlighted by some of the interviews. Smart labels can also help monitoring expiration dates and reduce waste.

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<sup>89</sup> [https://ec.europa.eu/eurostat/databrowser/view/ISOC\\_CICCE\\_USEN2\\_custom\\_7273540/default/table?lang=en](https://ec.europa.eu/eurostat/databrowser/view/ISOC_CICCE_USEN2_custom_7273540/default/table?lang=en)

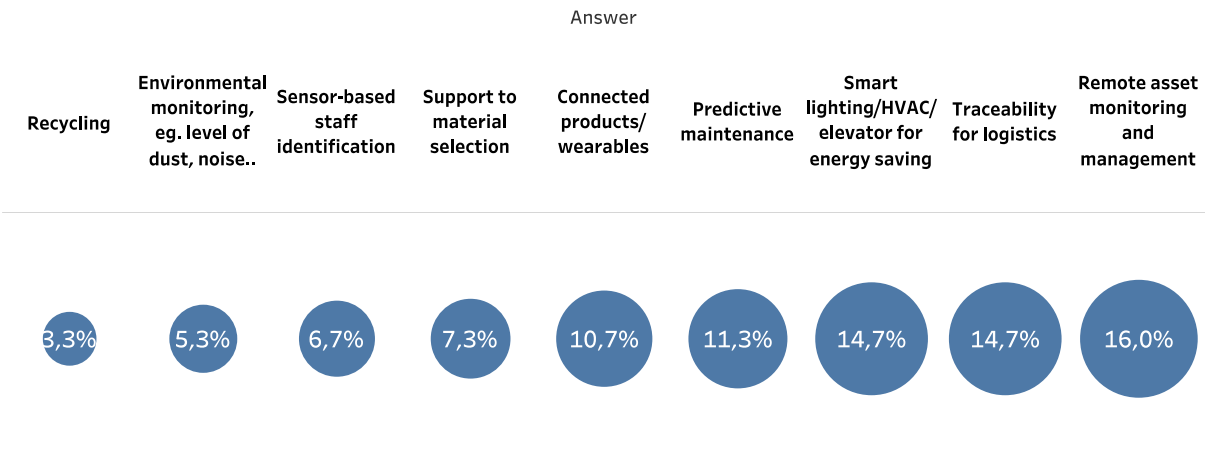
<sup>90</sup> [https://ec.europa.eu/eurostat/databrowser/view/ISOC\\_CICCE\\_USEN2/default/table?lang=en&category=isoc.isoc\\_e.isoc\\_eb](https://ec.europa.eu/eurostat/databrowser/view/ISOC_CICCE_USEN2/default/table?lang=en&category=isoc.isoc_e.isoc_eb)

<sup>91</sup> [https://ec.europa.eu/eurostat/databrowser/view/ISOC\\_EB\\_BDN2/default/table?lang=en&category=isoc.isoc\\_e.isoc\\_eb](https://ec.europa.eu/eurostat/databrowser/view/ISOC_EB_BDN2/default/table?lang=en&category=isoc.isoc_e.isoc_eb)

<sup>92</sup> See for example the analysis in Gregory, J. (2015). The Internet of Things: Revolutionizing the Retail Industry. Accenture.



Figure 21: Use cases of Internet of Things among retail SMEs



Source: Technopolis Group and Kapa Research, 2023

**Big data and related data analytics have been adopted by 9.7%** of the retailers. **Artificial Intelligence has an uptake of 6.4%** (which is a result close to the indicator of Eurostat<sup>93</sup>). From the interviews conducted with companies, it is also evident that SMEs in the retail ecosystem that adopt AI are in most cases close to medium-sized retailers and often they are related to specific good such as selling medical products and equipment, or fashion and less groceries.

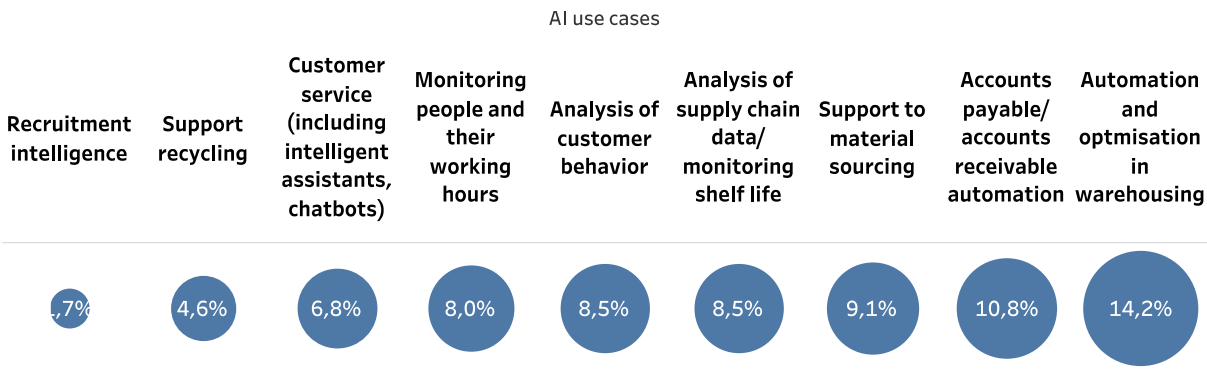
Additional questions of the survey revealed the areas where Artificial Intelligence technologies have been focused on along the industrial value chain. The results indicate that

- AI is used in the automation processes of warehousing and optimising logistics the most often. For example, if the retailer has a central warehouse and several sub-stores, the route of the truck can be optimised in order to deliver the goods in the most efficient way.
- AI is also used in accounting and business operations to provide management with a clear understanding of how a business's finances are being utilised.
- Support to material sourcing shows the use of AI in supply chain management and optimisation of product placements. Some companies in the retail industry use AI-based cameras to scan shelves and suggest replacing products that are overdue.
- The use of retail chatbots is still low (6.8% of those that adopted AI use chatbots) although it holds potential in engaging customers, recommending items and assist a personalised service.

AI has entered e-commerce more quickly than traditional retail because online business is inherently data-driven, as some interviewees have stated. A new trend includes Gen AI that some retailers pointed out testing to become more productive and support communication.

<sup>93</sup> Enterprises using AI technologies by economic activity, EU, 2021

Figure 22: Use cases of AI among retail SMEs

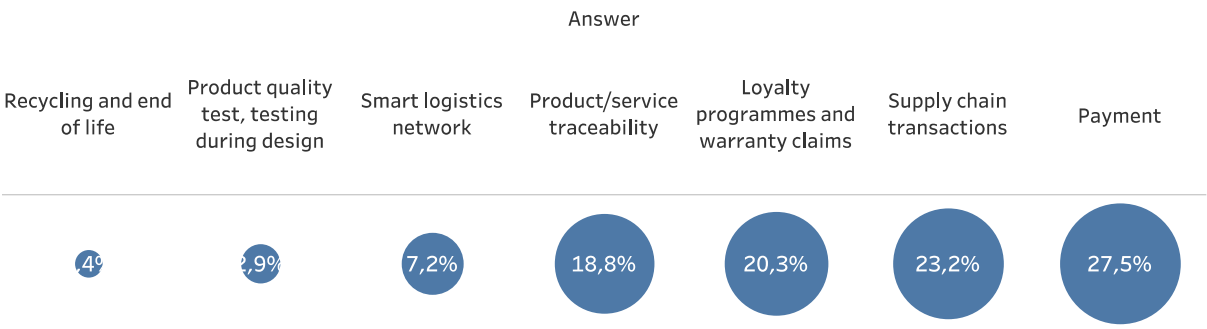


Source: Technopolis Group and Kapa Research, 2023

Blockchain

The main interest in blockchain technologies among retailers come from the potential it offers for transparent supply chains, transactions, and reducing costs, while increasing security at the same time. The survey results indicate that 4.6% of the respondents has already adopted this technology and 27.5% of these makes use of blockchain primarily in payments, followed by supply chain transactions and also loyalty programmes and warranty claims.

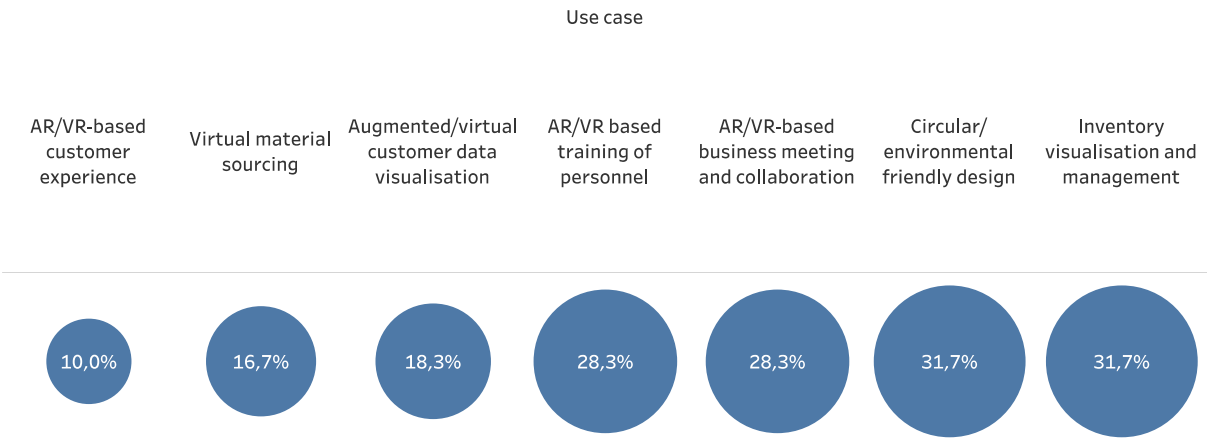
Figure 23: Use cases of blockchain among retail SMEs



Source: Technopolis Group and Kapa Research, 2023

**Augmented and virtual reality has been mentioned by a very low number, notably 3% of the respondents.** This indicates that despite the potential in augmented reality to develop personalised retail experiences, the current take-up of these tools is limited. Among those that have adopted AVR, the most important use case is related to inventory visualisation and management, and interestingly, the use of AVR has been also mentioned in design, more specifically creating circular, environmentally friendly designs.

Figure 24: Use cases of augmented and virtual reality of retail SMEs



Source: Technopolis Group and Kapa Research, 2023

**Robotics and digital twin technologies** have been mentioned by a very small share of the respondents, despite the potential of these technologies in warehousing and in operation management.

Although this business survey was focused on SMEs, it has to be noted that there is a significant difference between the twin transition strategies of large and small players in the retail ecosystem. During the interviews, it was stressed that while larger players have more financial resources for investments and more opportunities for digitalisation, such as connecting systems and organising the supply chain, smaller players are often more innovative and willing to take risks in certain areas. They see digital and green solutions as key to differentiate themselves.

### 3.3. Technology centres supporting technology uptake

Innovation actors are at the core of industrial ecosystems and gathering and sharing information about them in a structured way is crucial to detect gaps, improve collaboration, foster innovation, and strengthen innovation ecosystems. The [Technology Centre Mapping](#) comprises information on technology centres that are key actors in innovation ecosystems due to their technical expertise and their ability to bring together and steer collaboration among various types of actors in their own ecosystems and beyond.

The mapping of technology centres only included 10 technology centres that are active in the retail industrial ecosystem as of March 2023. Four technology centres are located in Spain, two technology centres are located in Finland, while Estonia, Czech Republic, Italy and Ireland host one technology centre. Countries might host additional technology centres active in retail, which are currently not registered to the technology centres mapping.

The following examples serve to illustrate the activities and scope of technology centres active in retail, their links with the broader ecosystem as well as examples of recent activities in which they are involved. They include the following cases: STACC (EE), and CeADAR (IE).

Box 1: Example Technology Centre: STACC (EE)

Name of the Centre	STACC (EE)
Location and scope	
STACC (Software Technology and Applications Competence Center) was founded in 2009 by the University of Tartu, Tallinn University of Technology, Cybernetica AS, Regio AS (now Reach-U AS), Webmedia AS (now Nortal AS), Logica Eesti AS (now CGI Eesti AS) and Quretec OÜ.	

SACC works in the field of data science and machine learning with the objective of developing Artificial Intelligence to help customers find data driven solutions for their business problems. It supports multiple sectors such as retail, tourism, telecommunications, consumer goods, and education, among others.

### Main services and equipment

STACC provides data analytics and IT solutions in different fields:

- **E commerce:** STACC offers recommendations systems to increase the turnover, personalised email campaigns and different machine learning solutions such as supply chain management, demand forecasting and credit scoring.
- **Online media:** the centre provides services to help companies increase their competitiveness in online media with tools like text analytics and machine learning feasibility analysis.
- **Manufacturing:** STACC helps to analyse and optimise the manufacturing process.
- **E-government:** STACC helps processing data volumes and developing innovative solutions in the public sector. Therefore, it has created the so-called X-Road, a software platform that allows Estonian private and public sector institutions to exchange data in a smooth way.
- **Personalised medicine:** The Centre provides services for a preventive, predictive and participatory health system which involves conducting epidemiological studies, developing the necessary software and IT components, and creating safe and well-structured data analytics.
- **Start-ups:** STACC offers start-ups services for conducting applied research, product, or service development, conducting feasibility studies and protection of their intellectual property.

Among its equipment, STACC has an IT Laboratory with computing and database servers, a secured network, and a functional office space in Tartu.

### Recent projects related to the green and digital transition in retail

- **COOP:** STACC built a recommendation system for personalising shopping charts.
- **Rademar:** STACC designed a product-based recommendation algorithm that finds the most suitable alternative for any product.
- **SELVER Hea mote:** STACC developed an offline recommender system for personalised email marketing campaigns.

Source: Technology Centre Mapping, 2023 and STACC, 2023 <https://stacc.ee/ai-solutions/e-commerce/>

#### Box 2: Example Technology Centre: CeADAR (IE)

Name of the Centre	CeADAR (IE)
<b>Location and scope</b>	
<p>CeADAR is a not-for profit Irish centre of innovation and applied Research and Development in Artificial Intelligence, Data Analytics and Machine Learning.</p> <p>It functions as a link between the world of applied research and the commercial deployment of Artificial Intelligence, machine learning and data analytics solutions. In fact, it offers market ready solutions and assistance for companies in searching for funding and investment.</p> <p>CeADAR is composed of two units:</p> <ul style="list-style-type: none"> <li>- CeADAR Business, which undertakes work from companies, from giving them advice on technical strategies to implementing AI and analytics solutions.</li> <li>- CeADAR Lab, where the research is carried out.</li> </ul>	
<b>Main services and equipment</b>	

CeADAR provides the following services:

- **Industry placement services** offer companies an opportunity to have a CeADAR data scientist work in their organisation to help with project deliveries, and their internal data agenda. This is done through the so-called CeADARConnect placement programme.
- Different packages of **technical services** for all types of companies: multinationals, SMEs, or start-ups.
- **Advisory services** for finding funding and investment opportunities.
- **CeADAR tools** for maturity assessment, demonstrators, and assistance for elaborating companies AI roadmap.
- **Research and Development services.**

#### Recent projects related to the green and digital transition in retail

- **IdentityMarch** aims to identify persons of interest in social network contexts. It allows to located users with a particular interest or skillset.

Source: Technology Centre Mapping, 2023 and CeADAR, 2023 <https://ceadar.ie/>

## 4. Investment and funding

### Key findings

The adaptation to omnichannel retail and the shift towards environmentally sustainable retail models need investments both from large and small retailers and wholesalers.

Regarding technological change in retail, Europe's retail ecosystem has seen an increasing share of private equity and venture capital investment since 2010. As found in the analysis of Crunchbase and Net Zero Insights data in this report, the annual investment into environmentally sustainable solutions in the retail ecosystem has been growing steadily across all funding stages **over the period from 2010 to 2022 with a total amount of €2.73 bn**. Close to 45% of the funding rounds involved seed funding that has increased over the last years as well. This evolution over time, with a peak in 2021, indicates that the market values positively green solutions in retail.

The volume of funding into digital tech retail startups witnessed a positive evolution **over the period from 2010 to 2022, reaching a total of €42.7 bn in 2022**. Seed and early development <sup>94</sup> type of funding was the most frequent. Investment into online platform has been the most common, followed by software and cloud-based services. Particularly successful have been e-commerce integrations related to payment, which attracted increasing investments since 2010, with a clear increase after 2018. Digital tech startups developing AI and big data technologies for retail absorbed 3.2% of the total funding, with a total of €1.3 bn.

**Regarding foreign direct investment into retail** and wholesale, in the period from 2015 to 2022, the EU27 had a volume of €14.4 bn intra-EU, €24.4 bn inward and a volume of €21.8 bn outward foreign direct investment into retail.

The volume of financial resources dedicated to back the green and digital transition is key in terms of assessing the progress towards new developments. According to McKinsey modelling<sup>95</sup>, companies across all retail and wholesale subsectors will need to invest an additional 0.8 to 1.6% of their revenue till 2030 on average in order to comply with the twin transition objectives. That equals an industry total of €315 bn if companies set themselves less ambitious targets (in the conservative scenario) or € 600 bn if the sector takes on more commitments (in the ambitious scenario).

Already as a response to the COVID-19 crisis, EU27 companies started to invest in digitalisation, and are expected to continue investing in the longer term. In the case of the retail industrial ecosystem, more than 50% of companies have invested as a response to COVID-19 and almost a 60% are expected to invest in the long term<sup>96</sup>. These investment level positions the ecosystem in the higher-middle part of the table when comparing with the other 13 industrial ecosystems.

In the policy context, the European Commission adopted in May 2023 a retail investment strategy<sup>97</sup> as the basis to boost retail investments through several measures which might include the reduction of administrative burden to improve accessibility of products of services, enhancing protection of retail investors against misleading marketing, etc,

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<sup>95</sup> McKinsey & Company (2022), Climate sustainability in retail: Who will pay? Available at: <https://www.mckinsey.com/industries/retail/our-insights/climate-sustainability-in-retail-who-will-pay>

<sup>96</sup> European Commission (2022), Annual Single Market Report, SWD (2022) 40 final. Available at: <https://ec.europa.eu/docsroom/documents/48877>

<sup>97</sup> European Commission (2023), Retail Investment Strategy. Available at: [https://finance.ec.europa.eu/publications/retail-investment-strategy\\_en](https://finance.ec.europa.eu/publications/retail-investment-strategy_en)

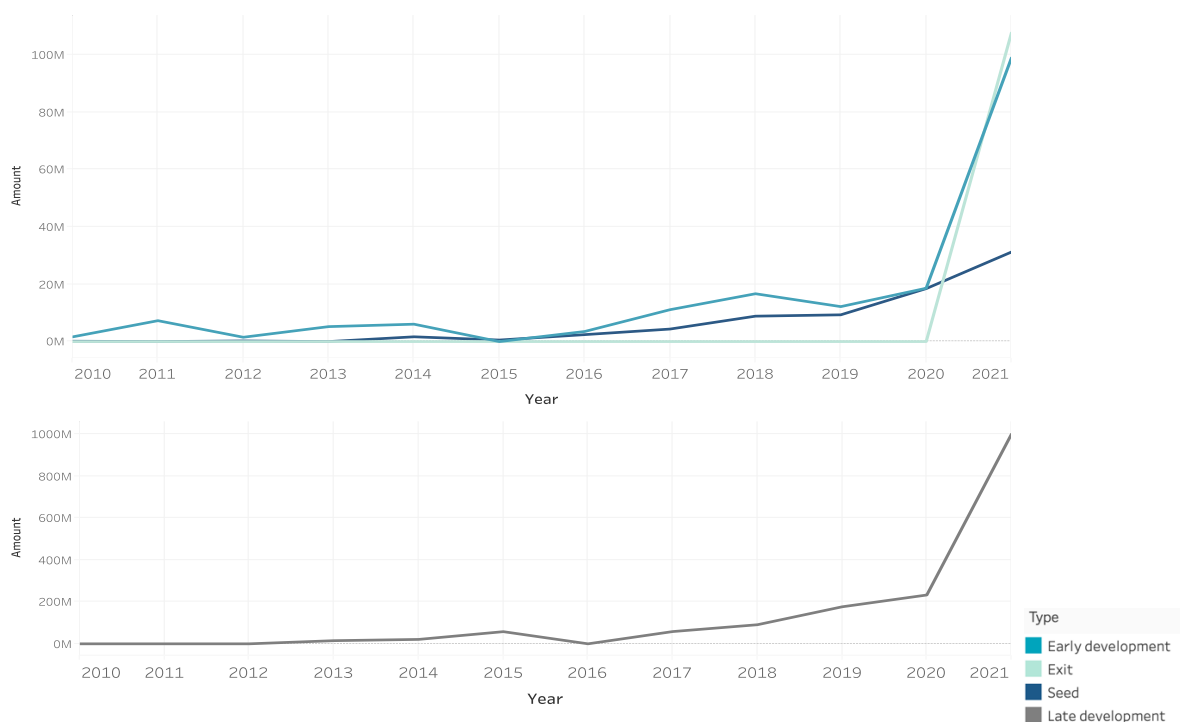


**Europe's retail ecosystem has seen an increasing share of private equity and venture capital investment since 2010.** The analysis of Net Zero Insights and Crunchbase allowed to capture investment information for 299 funding rounds of 105 green retail startups and 2 922 funding rounds of 1 465 digital tech retail companies over the period from 2010-2021). The investment figures presented in this section refer only to the funding rounds where a value has been disclosed.

## 4.1. Green transition related venture capital investment in retail

In line with the increasing number of environmental retail startups, the annual investment into environmentally sustainable solutions in the retail ecosystem has been growing steadily in all funding stages during the period 2010-2022 **with a total amount of €2.73 bn.** Close to 45% of the funding rounds involved seed funding that has increased over the last years as well. This evolution over time, with a peak in 2021, indicates that the market values positively green solutions in the retail ecosystem.

Figure 25: Annual private equity and venture capital investment into green retail startups (2010-2021)

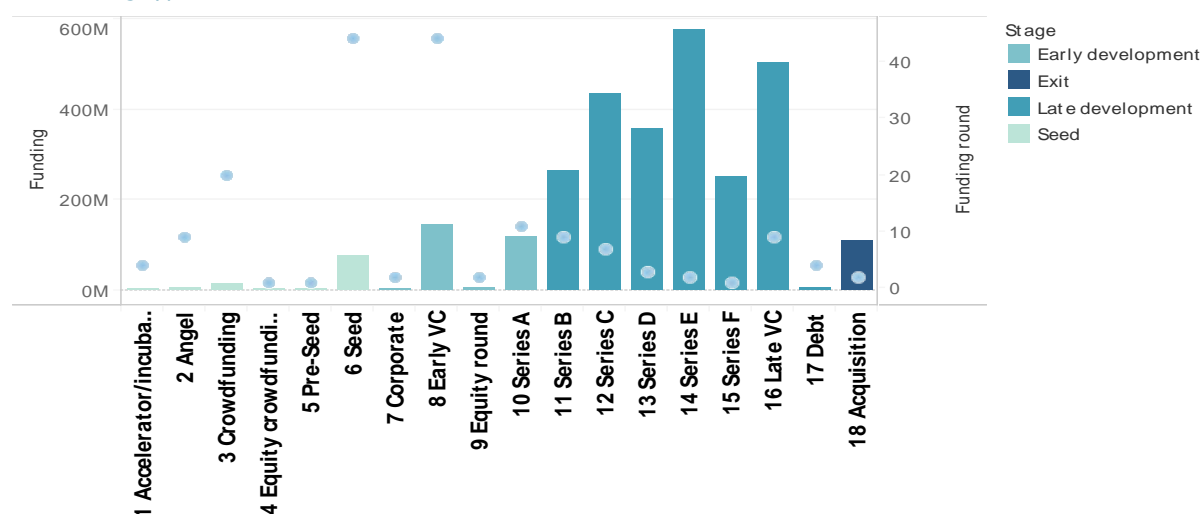


Source: Technopolis Group calculations based on Net Zero Insights, 2022

The analysis of late development funding<sup>98</sup> has been consistently increasing since 2017 and reaching a maximum in 2021 with an increase of 347% compared to 2020. The fact that 97% of the VC has been invested in online digital platforms that foster the sharing economy reflects the market consolidation of these solutions.

<sup>98</sup> For the purpose of this study the following categories have been considered under late development funding: Equity Crowdfunding over 20M, Late VC, Series B, C, D, E, F, G, H and I, and unknown series of VC over 20M.

Figure 26: Total investment into environmental startups in retail over the period from 2010 to 2022 per stage and funding type



Source: Technopolis Group calculations based on Net Zero Insights, 2022

The analysis of private equity and venture capital investment in retail technology indicates that 86% of the funding went into less capital-intensive startups providing an **online platform or marketplace for sharing, renting, and exchanging** over the period from 2010 to 2021. Some of the companies that attracted the highest investment include Back Market<sup>99</sup> an online marketplace for refurbished electronics, the Lithuanian Vinted<sup>100</sup> that allows the exchange of second-hand clothes, and Vestiaire Collective<sup>101</sup>, a luxury second-hand retailer from France.

Companies developing IT software and providing cloud-based services have been involved in 23 funding rounds since 2018. Software platforms focusing on logistics and energy efficiency are the most popular among investors, absorbing 99% of the total funding within this technology group. The French company Sweep<sup>102</sup>, a SaaS based platform that tracks carbon emissions along the business value chain, has quickly moved from seed funding in 2021, to venture capital through Series A and B in 2022. Material Exchange<sup>103</sup> is a Polish startup which provides a digital sourcing platform for textile suppliers and buyers. Founded in 2017, the company received series A funding in 2022.

Startups developing or using digital technologies to address environmental challenges has attracted significant investment as well. AI-driven startups have participated in 7 funding rounds, with the German company FitAnalytics<sup>104</sup> being acquired in 2021.

Since 2019, entrepreneurs developing sustainable solutions for packaging have received funding from 20 funding rounds.

<sup>99</sup> <https://www.backmarket.com/>

<sup>100</sup> <https://www.vinted.be/>

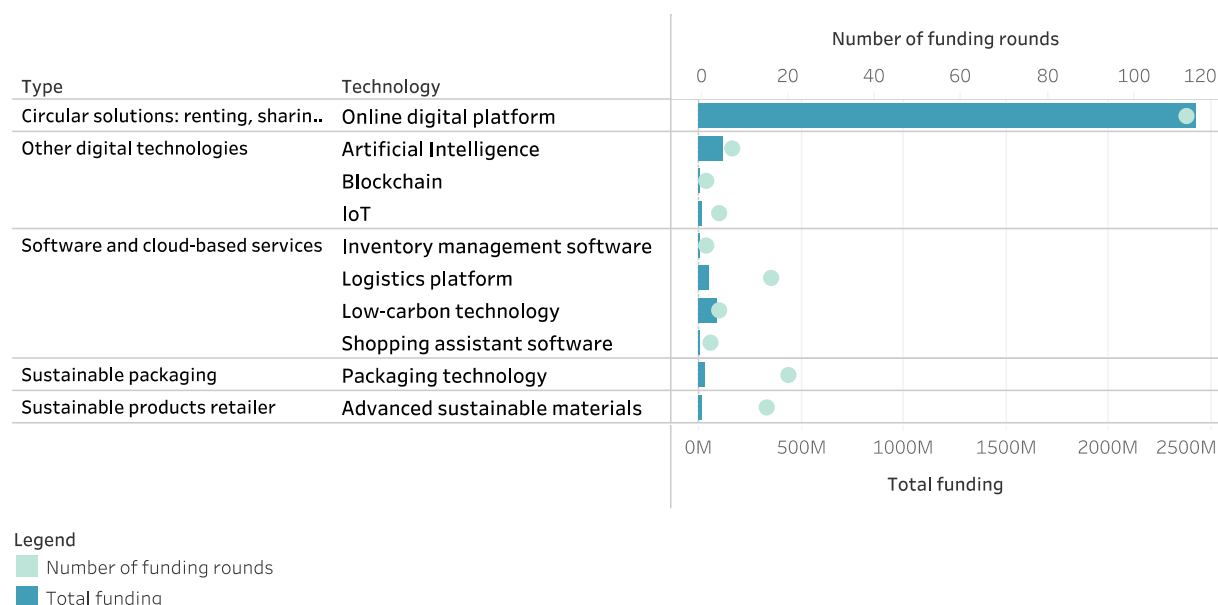
<sup>101</sup> <https://fr.vestiairecollective.com/>

<sup>102</sup> <http://www.sweep.net>

<sup>103</sup> <http://www.renoon.com>

<sup>104</sup> <https://www.fitanalytics.com/>

Figure 27: Total funding received by type of technology/solution that green retail startups offer (in EUR)

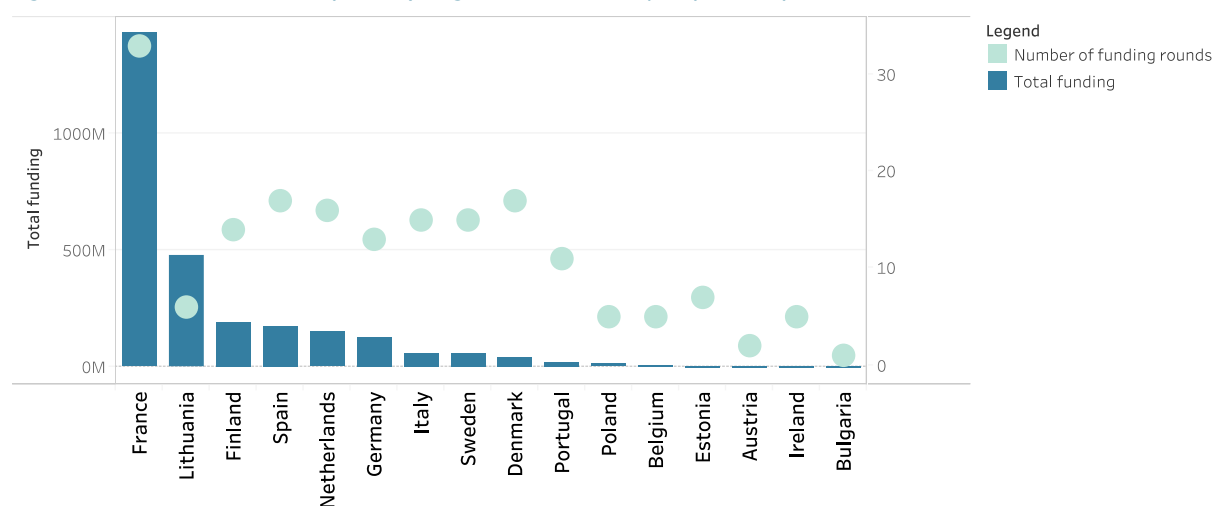


Source: Technopolis Group calculations based on Net Zero Insights, 2022

## Country patterns

The geography of environmental retail startups in terms of the highest volume of venture capital and private equity investment indicates that 50% of the funding is concentrated in French startups, of which around 67% comes from the online marketplace Back Market. Lithuania located startups follow, absorbing 16% of the funding, which is entirely concentrated into the online platform called Vinted, an online fashion second-hand marketplace enabling people to sell old clothes.

Figure 28: Total investments (in EUR) in green retail startups by country, 2014 -2021



Source: Technopolis Group calculations based on Net Zero Insights, 2022

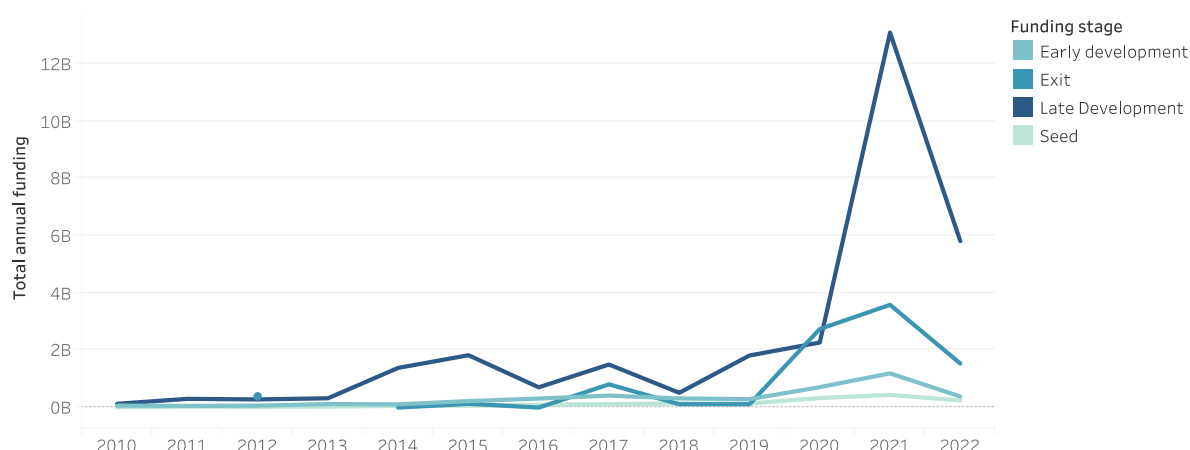
## 4.2. Venture capital investment in digital tech retail

The funding of digital tech retail startups data indicates a positive evolution in the annual funding over the period from 2010 to 2022, reaching a total of €42.7 bn in 2022. Seed and early development type of funding is the most frequent in terms of number of rounds (86.5% in total), although the share of the total funding has fluctuated between 3% (2012)

and 13% (2018) in the case of seed funding<sup>105</sup>, and between 7% (2014) and 29% (2018) for rounds within early development<sup>106</sup> funding.

Late-stage funding<sup>107</sup> has naturally the highest share within the total funding amount as depicted in Figure 29. Funding at this stage increased by 450% in 2021 compared to 2020 data, with 34 funding rounds each valued in more than €93 m. Also in 2021, particularly relevant are three late VC rounds of €1 bn to the startups Klarna (payment platform), Gorillas (delivery services) and Groves (online marketplace). As of 2017, data indicates several exit operations reaching approx. €1.4 bn (\$1.5 bn) in total in 2022<sup>108</sup>.

Figure 29: Annual funding of digital tech retail startups since 2010



Source: Technopolis Group calculations based on Crunchbase, 2022

Investment into online platform has been the most common, reaching €22.5 bn for the period 2014-2022. Startup offering delivery services such as same day delivery account for 58% of the funding directed to online platforms and 32% of the total funding. As an example, Delivery Hero, a Swedish startup founded in 2011, offers same-day delivery of local businesses and went through 19 funding rounds and had its IPO in 2017. Online marketplaces such as the second-hand French electronics seller Back Market are also attractive to investors, capturing 25% of the total funding.

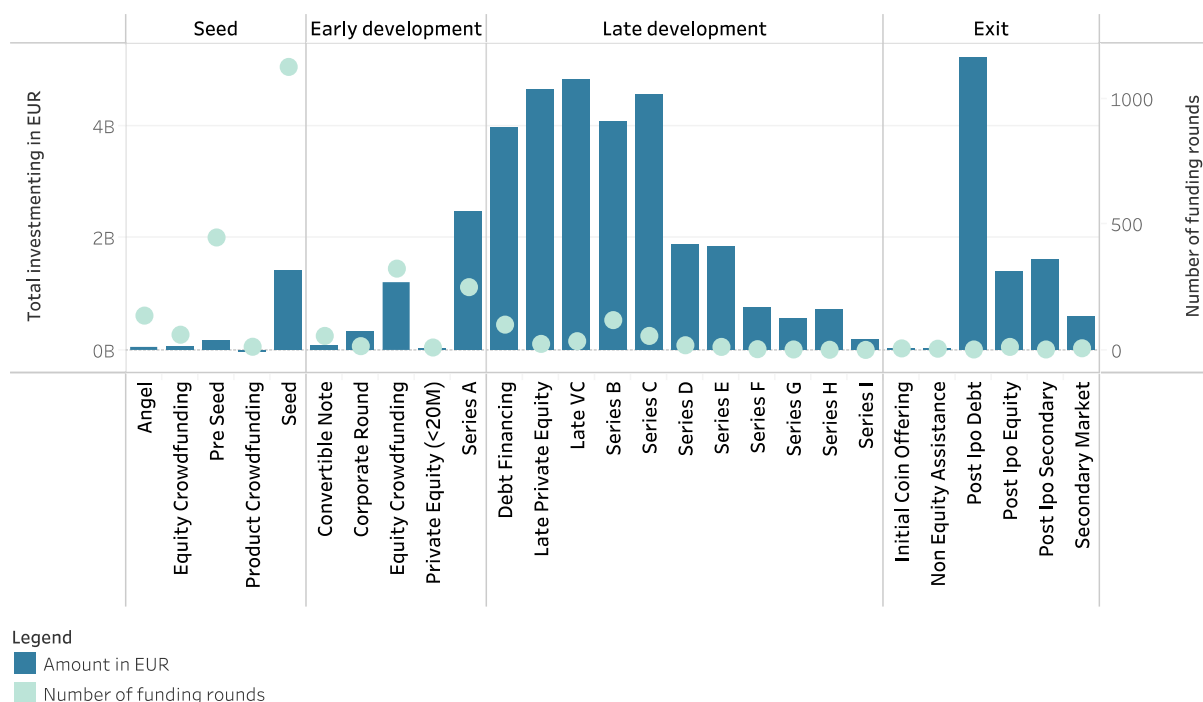
<sup>105</sup> For the purpose of this study the following categories have been considered seed type of funding: Angel, Crowdfunding, Initial Coin Offering, Pre-Seed, Seed

<sup>106</sup> For the purpose of this study the following categories have been considered early development type of funding: Series A, Private equity (<20M), Convertible Note, Corporate Round and Early VC rounds (<20M).

<sup>107</sup> For the purpose of this study the following categories have been considered late type of funding: Debt Financing, Late Private Equity, Late VC, Series B, Series C, Series D, Series E, Series F, Series G, Series H and Series I

<sup>108</sup> Two Post-IPO Equity operations for the delivery services startup Delivery Hero.

Figure 30: Total amount by stage and type of funding for digital retail companies during the period 2010 – 2022



Source: Technopolis Group calculations based on Crunchbase, 2022

Software and cloud-based services have received 27% of the total funding, a total of €11.16 bn. Particularly successful have been e-commerce integrations related to payment, which have been raising more and more funding since 2010, with a clear increase after 2018. Examples include the Swedish payment solution Klarna, that has raised a total of €4.2 bn in funding during 18 funding rounds, the latest in 2022 from a late VC round. Klarna<sup>109</sup> can be integrated as a payment alternative within e-commerce checkout portals and offers costumers 'buy now, pay later' solutions with interest-free financing. Mollie<sup>110</sup> (The Netherlands, 2004) is a payment module for e-commerce platforms that integrates different payment methods online such as MasterCard, VISA, Klarna, and that even allows the retailer to create their own payment method. In 2021, it went through a Series C round where it gathered €614 m (\$665 m). Offering a supply chain management platform, RELEX<sup>111</sup> based in Finland gathered €753.8 m (\$804 m) in five funding rounds.

Digital tech retailers have attracted €4.96 bn (\$5.3 bn), accounting for 12.2% of the total funding. Digital tech startups developing AI and big data technologies for retail absorb 3.2% of the total funding, with a total of €1.3 bn (\$1.39 bn). Within this technology group, startups developing business intelligence tools have been particularly successful, gathering €861.65 m (\$919 m) in total. As an example, the Irish marketing analytics provider Wayflyer<sup>112</sup> has undertaken a total of 6 rounds and gathered €833.5 m (\$889 m).

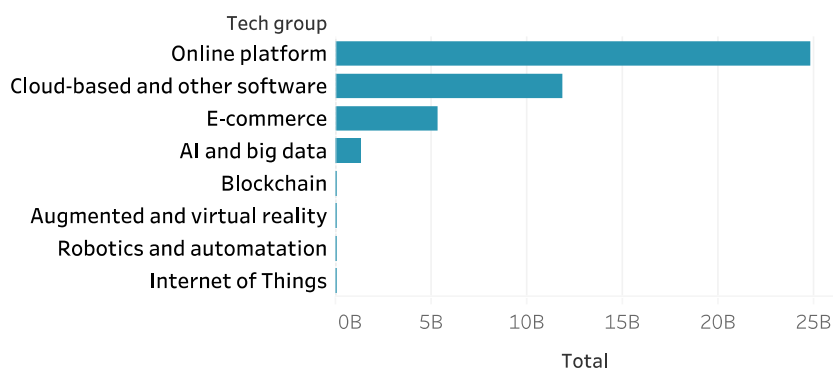
<sup>109</sup> <http://www.klarna.com>

<sup>110</sup> <https://www.mollie.com>

<sup>111</sup> <https://www.relexsolutions.com/platform/>

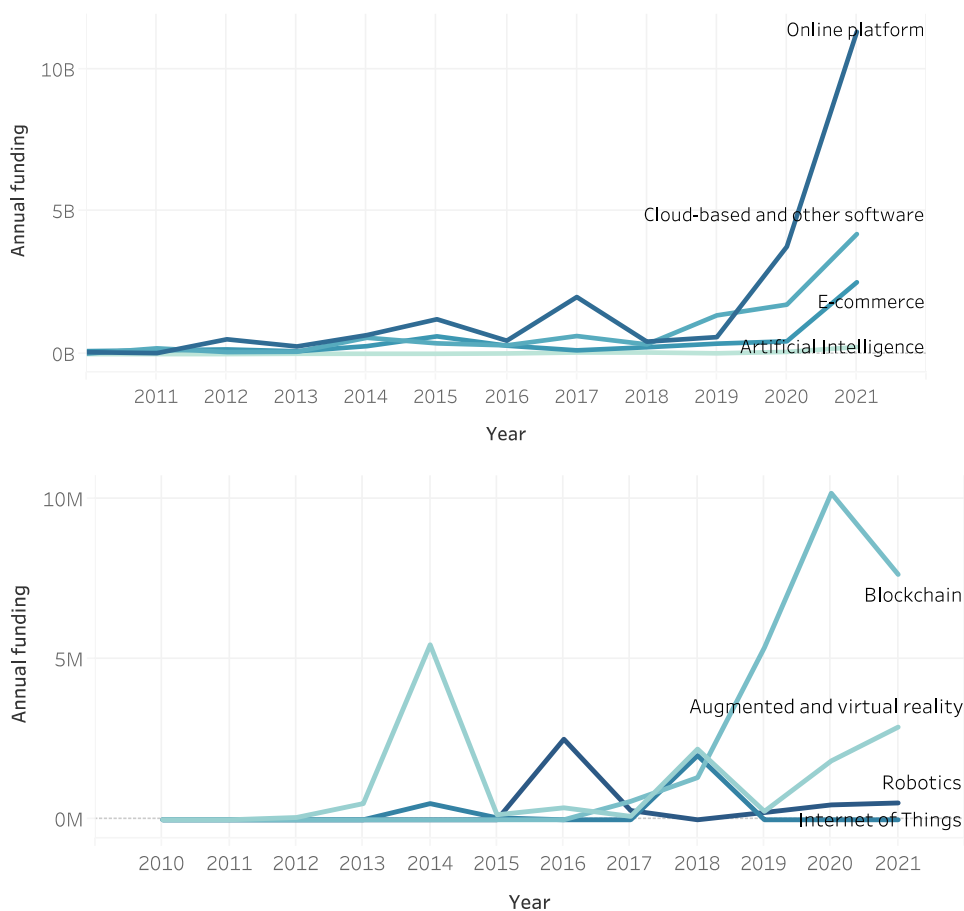
<sup>112</sup> <https://www.wayflyer.com/>

Figure 31: Total investments in digital tech retail startups by tech, 2014 -2022



Source: Technopolis Group calculations based on Crunchbase, 2022

Figure 32: Annual private equity and VC investments into digital retail tech companies since 2010



Source: Technopolis Group calculations based on Crunchbase, 2022

The geography of private equity and VC funding in digital retail tech shows that the most active country of origin in terms of VC activity is Germany<sup>113</sup>, with a total of €20.62 bn (\$22 bn.) France and Sweden follow, with a total €5.53 bn (\$5,9bn) each.

### 4.3. Intra EU and extra EU foreign direct investment in retail

<sup>113</sup> The startup Delivery Hero accounts for 44.5% of the total funding absorbed by German startups



Regarding foreign direct investments (FDI), wholesale and retail were the 4<sup>th</sup> sector with the highest number of FDI transactions in 2021 after Manufacturing, ICT, and financial services (European Commission, 2022)<sup>114</sup>.

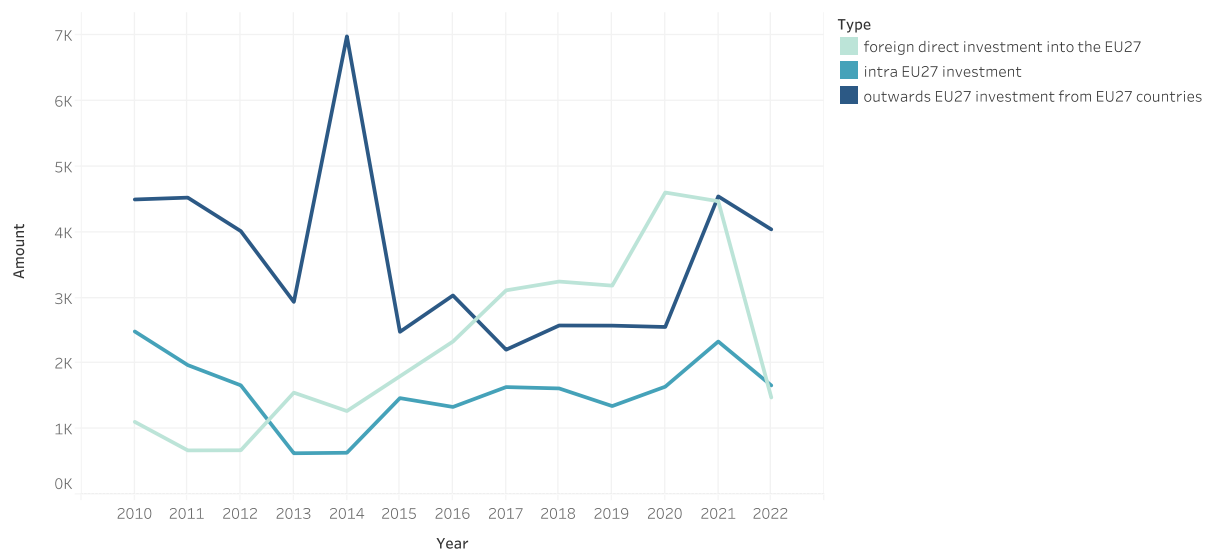
FDI intelligence<sup>115</sup> tracks cross-border greenfield investment both intra EU, extra EU and of course globally, covering the retail industrial ecosystem among other industries. It provides real-time monitoring of investment projects, capital investment and job creation with powerful tools to track and profile companies that are active investors in the field. The data source tracks projects that are expected to create new jobs.

The figure below shows the development over the years (2010 – 2022) of FDI in the EU27 in the retail sector. Despite some peaks between 2010-2018, the investment volumes after 12 years are very similar to the 2010 numbers, with a 6% decrease in 2021 compared to 2010 data.

In the period from 2015 to 2022, the EU27 had a volume of **€14.4 bn intra-EU, €24.4 bn inward and a volume of €21.8 bn outward foreign direct** investment into retail.

There has been a steady increase in foreign direct investment projects into the EU27 from non-EU countries, indicating that Europe's retail sector is a clear 'destination' for foreign investors. In terms of the geography of the investments, Germany (26%), France (17%) and Spain (15.4%) have been clearly successful destination countries for foreign investors, with a total of €16.12 bn (\$17.2 bn).

Figure 33: Trends in FDI investment in the EU27 as a source and destination in the retail sector



Source: Technopolis Group based on fDi intelligence, 2022

<sup>114</sup> European Commission (2022), Second Annual Report on the screening of foreign direct investments into the Union, COM (2022) 433 final. Available at: [https://ec.europa.eu/transparency/documents-register/detail?ref=COM\(2022\)433&lang=en](https://ec.europa.eu/transparency/documents-register/detail?ref=COM(2022)433&lang=en)

<sup>115</sup> <https://www.fdiintelligence.com/>

## 5. Skills demand and supply

### Key findings

The importance of developing digital and environmental sustainability skills among retailers have been highlighted by the skills partnership for the retail ecosystem<sup>116</sup>. To achieve the green and digital transformation the ecosystem will need a talented and skilled workforce, and the recently created partnership on retail will play a key role in that.

Based on the analysis of LinkedIn data, it is found that within the registered professionals on LinkedIn and employed in the retail industrial ecosystem, **1.51% claimed having skills relevant for the green transition. In the case of moderate digital skills, this share is 15% that is still low compared to the importance of such skills. Advanced digital skills are possessed by 2.3% of professionals in retail.**

On the demand side based on the analysis of online job advertisements, there were 4 389 887 unique vacancy ads in retail between 2019-2022 in the EU27. The share of online job advertisements that required any form of moderate digital skills (excluding basic IT office skills) was 34% over the period from 2019-2022, while this percentage was 17.09% for advanced digital skills. Requirements related to the green transition appear less often on the advertisements notably in 1.91% of the cases.

Figure 34: Share of online job advertisements in the retail industrial ecosystem requiring a skill relevant for the green and digital transition



Source: Technopolis Group calculations based on Cedefop data, 2023

Digital skills that have been searched for the most include computer programming and database management, while green skills are related to sustainable transportation and waste management.

This section analyses the skills challenge in the **retail industrial ecosystem**. Skills indicators have been constructed based on data sourced from the LinkedIn and the skills intelligence insights from Cedefop<sup>117</sup>. To harvest data from LinkedIn, keywords capturing skills by each technology in focus have been refined. The analysis captured the level of supply in terms of professionals with specific digital or green transition related skills employed in the retail industrial ecosystem.

Retail and wholesale have a very strong social component that needs to be kept in mind when analysing skills development. The sector is composed of 5.4 million business, most of them SMEs, and employs around 30 million workers only in Europe<sup>118</sup>.

<sup>116</sup> European Commission (2022). Pact for Skills – Skills Partnership for the Retail ecosystem. Available at: [https://pact-for-skills.ec.europa.eu/about/industrial-ecosystems-and-partnerships/retail\\_en](https://pact-for-skills.ec.europa.eu/about/industrial-ecosystems-and-partnerships/retail_en)

<sup>117</sup> <https://www.cedefop.europa.eu/en/tools/skills-online-vacancies>

<sup>118</sup> European Commission (2022), Annual Single Market Report.

In order to overcome these challenges, and in the context of the Pact for Skills initiative<sup>119</sup>, since 2022 the European Commission facilitates together with social partners, a **Skills Partnership in the retail ecosystem**<sup>120</sup>. The main objective of the Skills Partnership for the retail and wholesale ecosystem is to enhance the competitiveness and resilience of the sector by investing in the skill sets of its employees.

The partnership has five more concrete objectives:

- Promoting a culture of lifelong learning for all
- Building a strong skills partnership with relevant stakeholders
- Monitoring skills supply/demand and anticipating skills needs
- Working against discrimination and towards equal opportunities for all
- Raising awareness & attractiveness of the retail and wholesale sector

As concluded, there is a need of upskilling in the retail sector, most notably linked to the use of digital technologies since it will allow to retain at least part of the already existing workforce. In addition, educating the workforce on green transition related skills is also important such as in the field of carbon footprint reduction. Other relevant skills include e-commerce, data science, digital content creation, green technology, and tracking sustainability challenges.

### 5.1.1. Professionals with green and digital transition skills in retail

LinkedIn had 3 124 821 professionals registered as being employed in retail and wholesale in May 2023. For the skills analysis of the retail industrial ecosystem, the number of professionals working in the industry (retail and wholesale) has been captured with the relevant occupations. The following definitions are applied:

**Green transition related skills** follow the definition of Cedefop and mean “*the knowledge, abilities, values and attitudes needed to live in, develop and support a sustainable and resource-efficient society*” (Cedefop, 2012). In this study, 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).

**Moderate digital skills** include the monitoring of basic and other digital skills. Cedefop distinguishes “*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 and are possible to track with the algorithm of 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 retail and across the EU. An analysis of representativeness is provided in Appendix B and in the related methodological report.

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<sup>119</sup> European Commission (nd), Pact for Skills. Available at: <https://ec.europa.eu/social/main.jsp?catId=1517&langId=en>

<sup>120</sup> Eurocommerce et al (2022), Contribution 29 November 2022- Pact for Skills – Skills Partnership for the Retail Ecosystem.

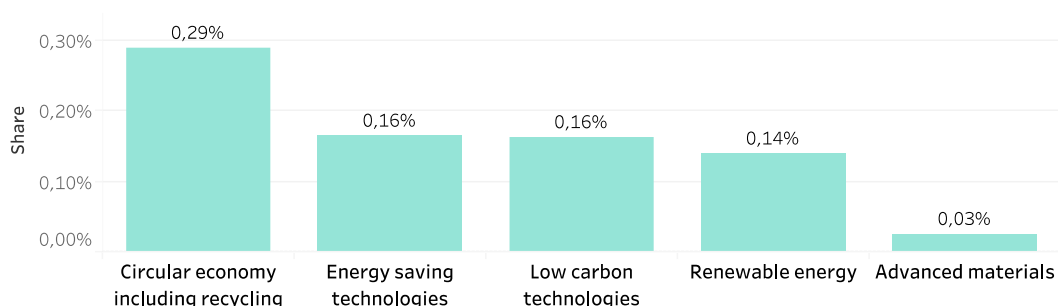
Based on the analysis of LinkedIn data, the figures below provide a picture of the supply of professionals with digital and green transition related skills in retail. **Within the registered professionals on LinkedIn and employed in the retail industrial ecosystem, only 1.51% claimed having skills relevant for the green transformation.**

**In the case of moderate digital skills, this share is 15%** that is still low compared to the importance of such skills. **Advanced digital skills are possessed by 2.3% of professionals in retail.**

The low level of available advanced digital skills has been highlighted by the Skills Partnership for the Retail Ecosystem<sup>121</sup>. One of the main gaps identified is the lack of data scientists that could help shape the future of the sector and the impacts that are already taking place.

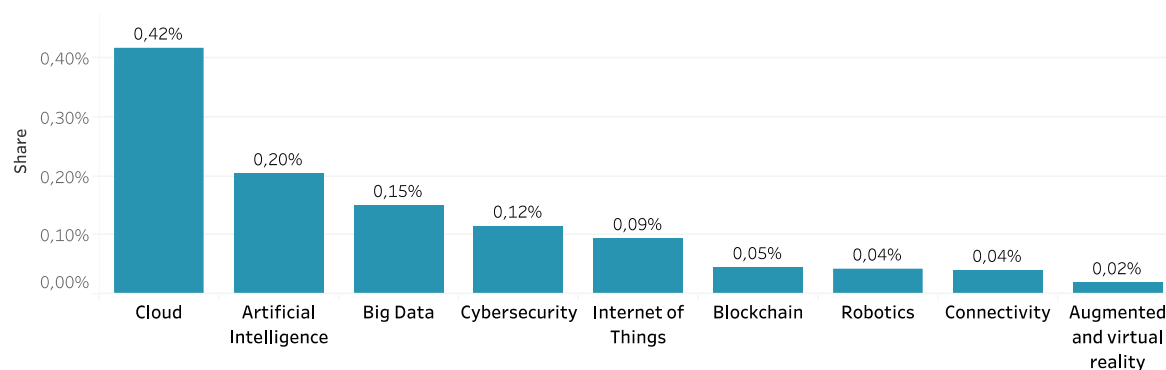
Among the more specific green transition skills, circular economy has the highest share almost doubling the next three: energy saving technologies, low carbon, and renewable energy. Among the digital skills, cloud related skills are the most common ones, doubling the next most common skill, Artificial Intelligence.

Figure 35: Share of professionals with green skills



Source: Technopolis Group calculations, 2023

Figure 36: Share of professionals with digital skills

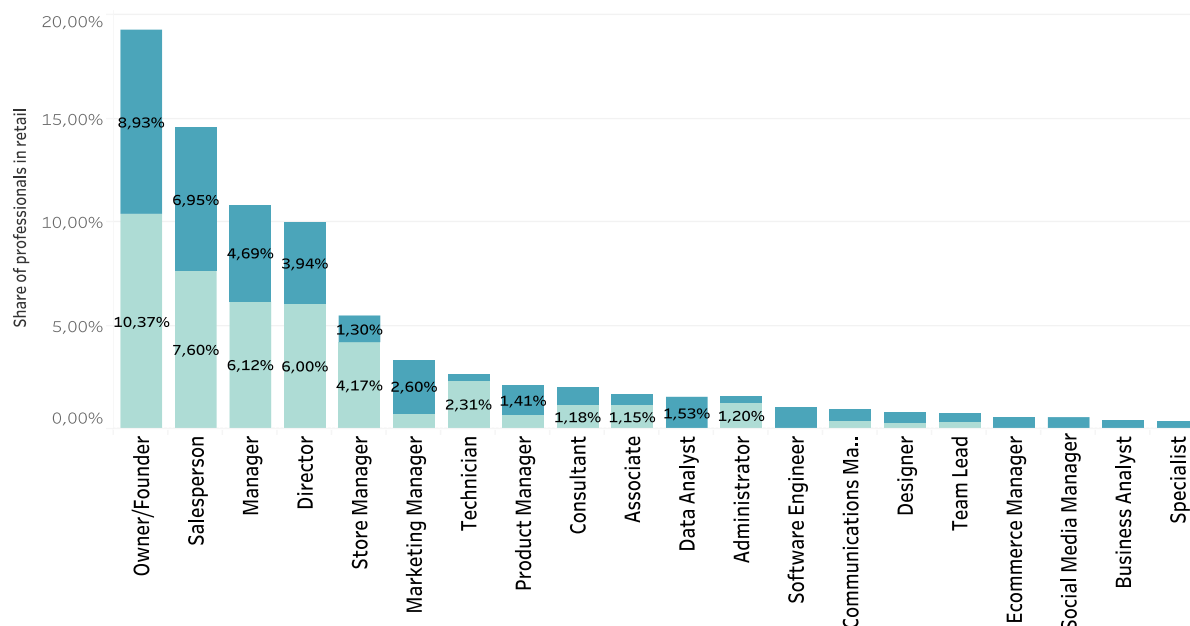


Source: Technopolis Group calculations, 2023

When looking at the type of profiles within the retail enterprises that have relevant skills, we can see that *owner* is the most common type of profile (3.2%), followed by salesperson (2.8%) and founders (2.7%).

<sup>121</sup> European Commission, 2022. European skills: Launch of a large-scale partnership on skills in retail, see: <https://ec.europa.eu/social/main.jsp?langId=en&catId=89&furtherNews=yes&newsId=10475>

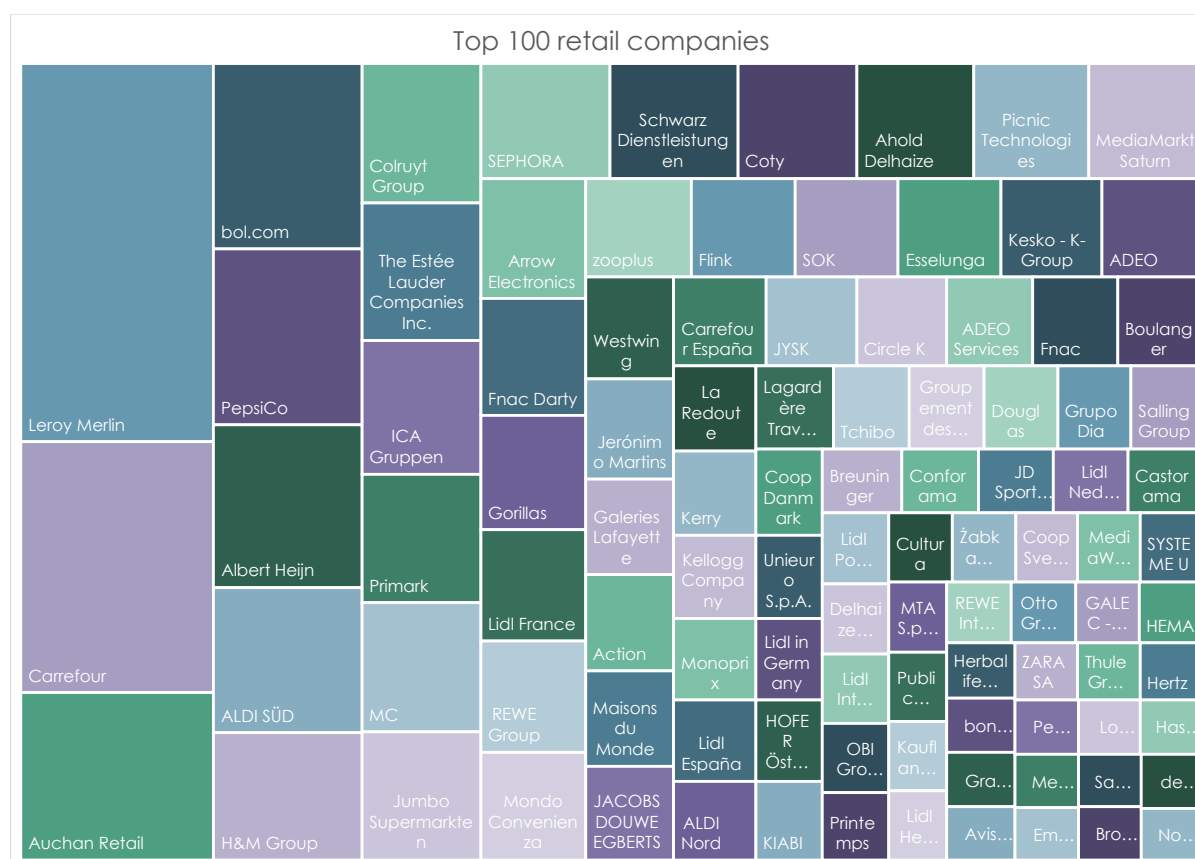
Figure 37: Most common jobs with relevant skills



Source: Technopolis Group calculations, 2022

The analysis also shows the 100 companies that employ the highest share of professionals with digital and green transition related skills. Key retail companies with digitally and green skilled employee profiles include major retail brands such as Leroy Merlin, Carrefour, Auchan Retail or bol.com.

Figure 38: Top 100 retail companies with the highest number of professionals with skills relevant for the twin transition



Source: Technopolis Group calculations, 2022

## Soft skills

Without neglecting the importance of green and digital skills, soft skills play a key role in the retail ecosystem. As part of their day-to-day tasks, retail workers are directly interacting with the customers, hence the importance of also equipping retail workers with soft skills such as customer service, communication, advisory services etc., are also of the utmost importance for the retail workers.

The need for more skills related with customer centricity and interpersonal awareness was also identified by the social partners working on the skills partnership for the retail ecosystem<sup>122</sup>. Social and emotional skills are also becoming more and more important, and there is expected to be an increase of 32% in the number of hours worked in this area between 2016 and 2030 as found by McKinsey<sup>123</sup>.

During the last year there has been a positive uptake on digital and green transition skills in the retail sector. Considering overall measurements, the twin transition skills increased in a 18%, the digital skills a 14% and the green skills a 12.10%.

### 5.1.2. Skills demand

Skills demand in the retail industrial ecosystem has been analysed following the skills intelligence insights of Cedefop, the European Centre for the Development of Vocational Training<sup>124</sup>. This dataset covers the EU27 Member States (plus UK) and is based on the collection and analysis of more than 530 online job advertisement sources (424 distinct websites) which are open-access sites. The dataset provides information on most requested occupations and skills across European countries based on established international classifications, e.g., ISCO-08 for occupations, ESCO for skills, and NACE rev. 2 for sectors.

Specific to the retail industrial ecosystem<sup>125</sup>, there were **4 389 887 unique job advertisements** from companies between 2019-2022 in the EU27. These job advertisements have been text-mined and the required skills analysed from the perspective of the green and digital transitions. The green pre-defined skills are from ESCO v1.1 and the digital are predefined from ESCO v1.1.1 which is currently being updated.

The European multilingual classification of Skills, Competences, Qualifications and Occupations (ESCO) is used as follows:

- **Green transition related skills** (ESCO v1.1.) are those knowledge and skills which reduce the negative impact of human activity on the environment. The labelling of skills and knowledge concepts as green follows a methodology based on a 3-step process, which combines human labelling and validation, and the use of machine learning algorithms.
- **Moderate and Advanced Digital skills** (ESCO v1.1.1 which is currently being updated) are competences which involve the confident, critical and responsible use of, and engagement with, digital technologies for learning, at work, and for participation in society. The labelling of skills and knowledge concepts follows a 5-steps methodology, which combines human labelling and validation with the use of machine learning algorithms.

The share of online job advertisements that required any form of **moderate digital skills (excluding basic IT office skills)** was **8.32%** over the period from 2019-2022, while this percentage was **4% for advanced digital skills**. Requirements related to the **green**

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<sup>122</sup> Eurocommerce et al (2022), Contribution 29 November 2022- Pact for Skills – Skills Partnership for the Retail Ecosystem.

<sup>123</sup> McKinsey & Company (2020), Closing the skills gap in retail with people analytics.

<sup>124</sup> <https://www.cedefop.europa.eu/en/tools/skills-online-vacancies>

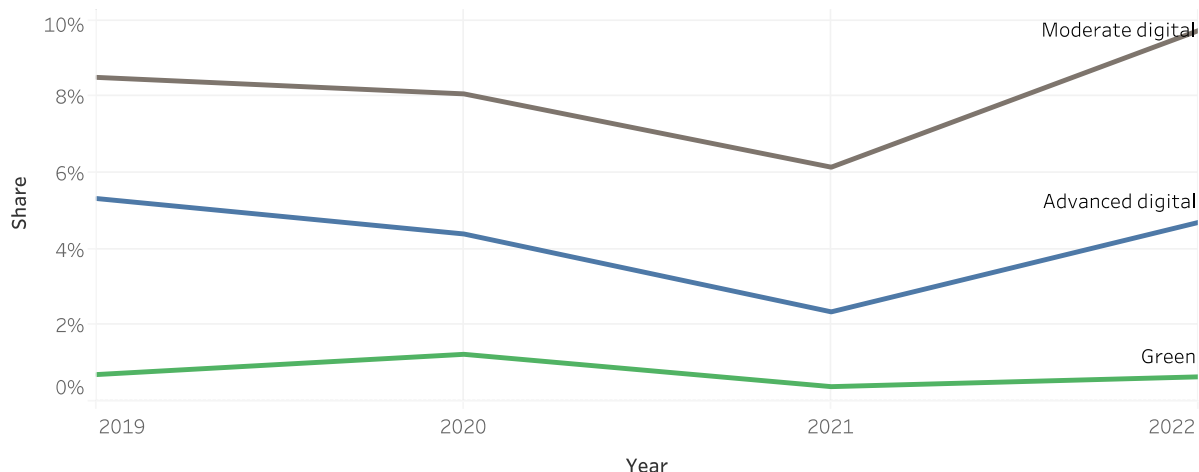
<sup>125</sup> In the case of the retail industrial ecosystem the dataset was filtered for the NACE industries as defined in the Annual Single Market Report.



**transition** appear less often on the advertisements notably in a very small share **0.7%** of the cases.

It is interesting to observe that while the absolute number of job ads with digital or green skills requirement increased over time, the share within the total number of retail job ads experienced a drop in 2020 and in particular in 2021 but bounced back strongly in 2022.

*Figure 39: Share of online job advertisements that demand digital and green transition related skills in the retail industrial ecosystem within the total number of retail job ads*



*Source: Technopolis Group calculations based on Cedefop data, 2023*

The more sought after advanced digital skills include the following:

- Online analytical processing
- Database management
- Computer programming
- SAP
- Cloud computing

The more sought-after green transition related skills are in line with what has been highlighted in the analysis of the survey (retail SMEs putting a high emphasis on energy efficiency):

- corporate social responsibility
- energy efficiency
- solar energy

## 6. Sustainable competitiveness: the green performance of the ecosystem

### Key findings






The environmental impact of the retail industrial ecosystem is linked to the retailing operation itself, and secondly it stems from the material sourcing and production of the retailed goods<sup>126</sup>. The most important negative impacts are linked to **carbon emissions, plastic packaging, waste and transportation**. Industries that are directly linked to retail and cause critical environmental burden include mainly agri-food and the chemical and pharmaceutical industries, but also textiles and fashion, and electronics. Transportation and packaging linked to e-commerce is a further concern for environmental impact.

The analysis of Exiobase data suggests that the most relevant environmental challenges of retail are related to **greenhouse gas emissions and biodiversity loss**. Retail was responsible for **3.6% of the total GHG emissions of all industrial ecosystems in 2020** as found in this analysis based on Exiobase data, however, the impact of the broader value chain including the other industries it relies on is much higher. Trends show that greenhouse gas emissions decreased over the period from 2010 to 2021, but particulate matter emissions have grown especially over the latest years, which is for concern.

The retail industrial ecosystem has **increasingly contributed to water consumption and to the damage to the natural ecosystem over the past years**.

Trends and change over time in environmental impacts are indicated in the Figure below.

Figure 40: The performance of the retail ecosystem on environmental indicators over time

Environmental impact		Change from 2010 to 2021 (CAGR)
GHG emissions		-0.6%
Material use		-0.6%
Land use		+1.9%
Water use		+2.5%
Biodiversity loss/ Damage to the environmental ecosystem		+2.6%

Source: Technopolis Group, 2022, based on Exiobase data

Throughout the retail supply chain, starting from the production and ending in the consumption, waste is created. The main waste streams of retail include packaging, food waste, and electronic waste, but also hazardous waste such as from chemical or pharmaceutical products.

<sup>126</sup> Naidoo M, Gasparatos A (2018). Corporate environmental sustainability in the retail sector: Drivers, strategies and performance measurement, Journal of Cleaner Production, Volume 203, 2018, Pages 125-142, ISSN 0959-6526

Retailers have a responsibility in trading goods that are environmentally sustainable as the key intermediary between producers, manufacturers, and final consumers. Their environmental impact is closely linked to the carbon footprint of their supply chain.

The European Environmental Bureau has drawn the attention to the fact that as consumer goods are increasingly sold online, e-commerce gives a leeway for products with environmental and safety concerns<sup>127</sup>. Issues also arise around greenwashing and false claims as pointed out by a study of the European Parliament<sup>128</sup>. Moreover, it was found that online e-commerce platforms contain an increasing number of solicitations of consumers' attention that influences decisions that might be against responsible consumer behaviour<sup>129</sup>.

Transportation linked to e-commerce is a further concern for environmental impact. As a recent study of the World Economic Forum concluded *"demand for urban last-mile delivery is expected to grow 78% by 2030, leading to 36% more delivery vehicles in 100 cities around the world"*<sup>130</sup>.

In this context and with the aim to measure trends in environmental impacts of industrial ecosystems, this report draws upon the data sources of Eurostat and Exiobase. The green transition impacts are sourced from Eurostat and Exiobase 3.8<sup>131</sup>. Whilst Eurostat represent the official statistics, Exiobase is a legitimate source of information referred to for example by the European Environmental Agency<sup>132</sup>, the EC/JRC community<sup>133</sup>, Eurostat<sup>134</sup>, and by the European Commission to propose the regulation on carbon border adjustment mechanisms<sup>135</sup>.

Pressure to environments refer to trade-embodied resources utilisation, and trade-embodied impacts. Resources utilisation is captured with four main dimensions are considered for cross-industry comparisons: embodied land use, embodied water consumption, embodied materials consumption, and energy mix supplied to the industrial activity. In terms of impacts, there are various dimensions monitored: air emissions (incl. GHG), waste generation, water consumption and damage to the ecosystem.

The following table shows the summary of green performance indicators at EU level and its change from 2010 to 2021. Overall, the analysis suggest that the most relevant environmental challenges of retail are related to greenhouse gas emissions and biodiversity loss. Water consumption shows a steady increase that needs to be considered.

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<sup>127</sup> <https://eeb.org/online-sales-of-unsustainable-products-will-dodge-eu-environmental-rules-warn-ngos-and-industry/>

<sup>128</sup> [https://www.europarl.europa.eu/RegData/etudes/STUD/2022/734013/IPOL\\_STU\(2022\)734013\\_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/STUD/2022/734013/IPOL_STU(2022)734013_EN.pdf)

<sup>129</sup> European Commission (2022). Behavioural study on unfair commercial practices in the digital environment: dark patterns and manipulative personalization, by Francisco Lupiáñez-Villanueva, Alba Boluda, Francesco Bogliacino, Giovanni Liva, Lucie Lechardoy, Teresa Rodríguez de las Heras Ballell

<sup>130</sup> World Economic Forum (2020), The future of the last-mile ecosystem. Available at: [https://www3.weforum.org/docs/WEF\\_Future\\_of\\_the\\_last\\_mile\\_ecosystem.pdf](https://www3.weforum.org/docs/WEF_Future_of_the_last_mile_ecosystem.pdf)

<sup>131</sup> Exiobase is a time series of environmentally extended multi-regional input-output (EE MRIO) tables. Its coverage is by country and industry from 1995 to 2021 and has EU and extra rest of the world coverage. Source: Stadler, Konstantin, Wood, Richard, Bulavskaya, Tatyana, Södersten, Carl-Johan, Simas, Moana, Schmidt, Sarah, Usubiaga, Arkaitz, Acosta-Fernández, José, Kuenen, Jeroen, Bruckner, Martin, Giljum, Stefan, Lutter, Stephan, Merciai, Stefano, Schmidt, Jannick H, Theurl, Michaela C, Plutzar, Christoph, Kastner, Thomas, Eisenmenger, Nina, Erb, Karl-Heinz, ... Tukker, Arnold. (2021). EXIOBASE 3 (3.8.2) [Data set]. Zenodo. <https://doi.org/10.5281/zenodo.5589597>

<sup>132</sup> EEA 2022. Visit 12/10/2022. <https://www.eea.europa.eu/data-and-maps/data/external/exiobase>

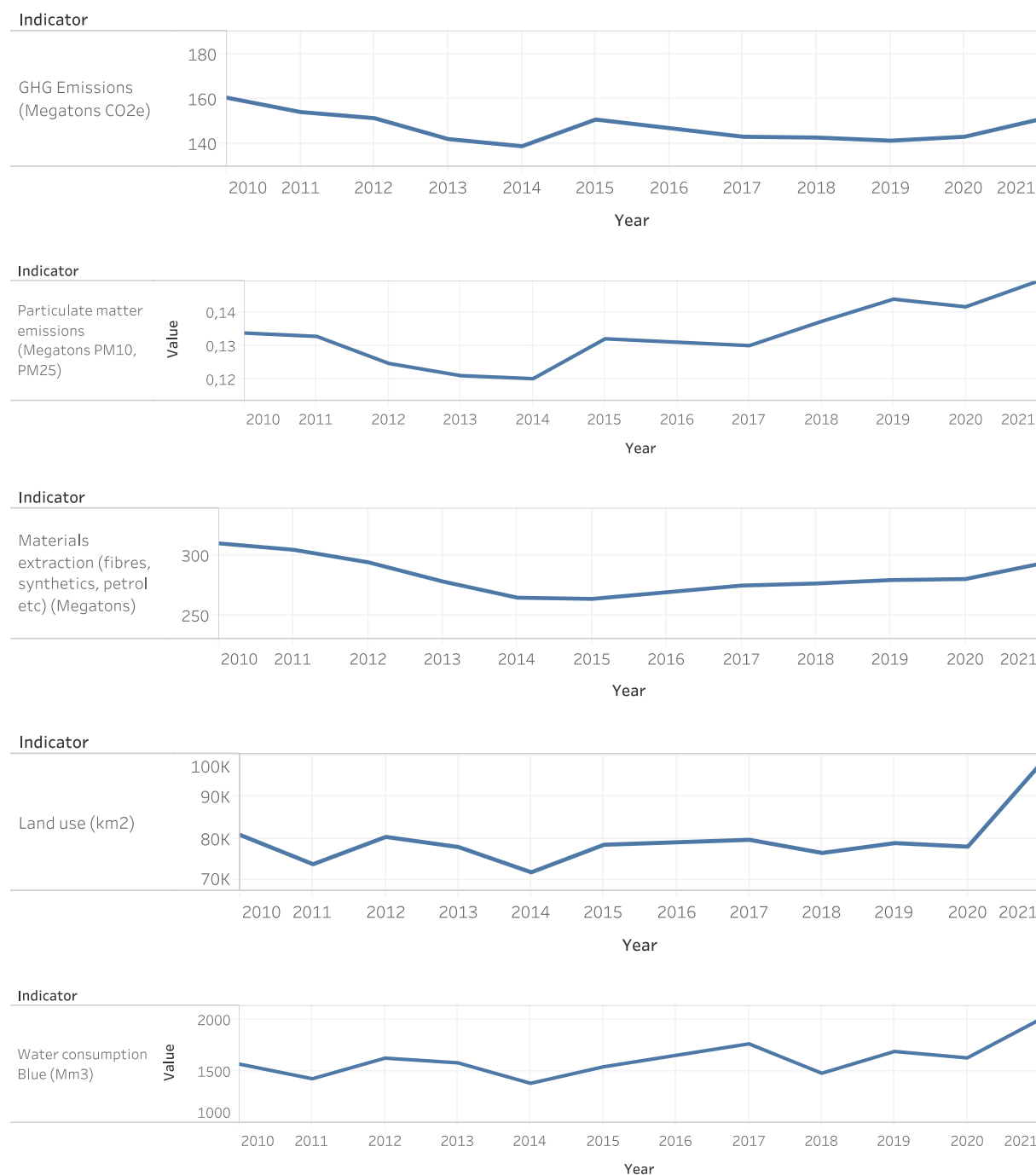
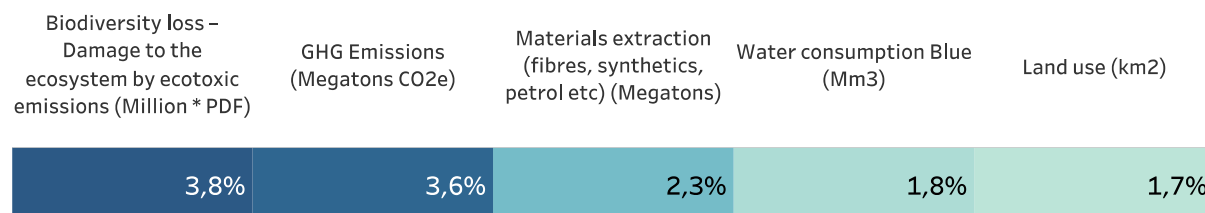
<sup>133</sup> Beylot, A., Secchi, M., Cerutti, A., Merciai, S., Schmidt, J. and Sala, S., 2019. Assessing the environmental impacts of EU consumption at macro-scale. Journal of cleaner production, 216, pp.382-393. <https://doi.org/10.1016/j.jclepro.2019.01.134>

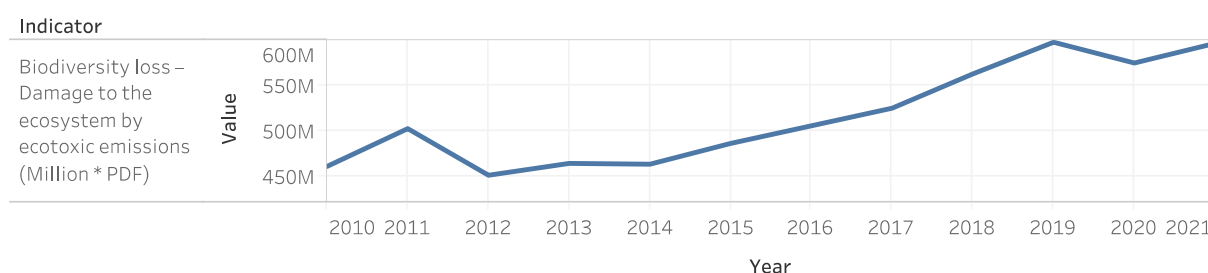
<sup>134</sup> Remond-Tiedrez, I. and Rueda-Cantuche, J.M. eds., 2019. EU Inter-country Supply, Use and Input-output Tables: Full International and Global Accounts for Research in Input-output Analysis (FIGARO). Luxembourg: Publications Office of the European Union.

<sup>135</sup> EC (2021) REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL. Establishing a carbon border adjustment mechanism. COM (2021) 564 final.

**Table 1: Indicators to capture the green transition of the retail industry based on consumption accounts, Exiobase, 2022**

Share of Retail environmental impact in total all industries





Source: Technopolis Group, 2022, based on Exiobase data

## Emissions

Exiobase data provides information on the greenhouse gas and particulate matter emissions of the retail ecosystem. At the level of industrial ecosystems, **retail was responsible for 3.6% of the total greenhouse gas emissions of all fourteen ecosystems monitored, however, the broader value chain including the industries that retail relies on has a much higher GHG share.** Emissions mainly stem from the production of agricultural-based and energy intensive products, and their factory operations, transportation of goods, and electricity used by retailers for store operation.

In the case of CO<sub>2</sub> emissions, there was a downward trend from 2011 to 2014 that was abruptly cut in 2015, when the emissions increased almost to the 2011 level. After that the emissions started to decrease again. Within retail, transport and hence e-commerce is responsible for a large share of CO<sub>2</sub> emissions.

In the case of the particulate matter emissions, the emissions decreased from 2011 to 2014, but after that they have constantly increased until 2022, except for minor decreases in 2015, 2016 and 2017. Overall, the local emissions increased from 0.133 to 0.149 megatons of PM<sub>10</sub> and PM<sub>25</sub> over the period from 2010 to 2021.

Logistics and transportation of goods are one of the areas in which e-commerce has caused the greatest transformation<sup>136</sup>. The main concern in this context is the increased CO<sub>2</sub> emissions resulting from returned goods, the rise in freight traffic to remote locations, and the emphasis on fast delivery in e-commerce business models. For example, e-commerce involves a greater share of returns (25-40% globally) compared to traditional retail (8%)<sup>137</sup>. It has been estimated that the return of a non-food product purchased online causes the emission of 112 grams of CO<sub>2</sub> per product compared to 68 grams of CO<sub>2</sub> for products purchased in physical stores<sup>138</sup>. One of the important process contributing to the environmental burden of e-commerce is electricity consumption in logistics centres<sup>139</sup>.

## Resource consumption, material extraction and water consumption

Similar to emissions, the extraction of natural resources is linked primarily to the products sold via retail and affected by the raw materials used, but also the packaging solutions applied.

Regarding the resource consumption such as material extracted of the retail ecosystem, there has been an irregular progression over the last years. While from 2011 to 2014, there was a remarkable reduction on the consumption of resources, from 300 to 260; the trend was reversed between 2015 and 2022, when the resource consumption steadily increased to reach the same values as in 2011. The relatively high use of materials is linked

<sup>136</sup> Collini, L, Hausemer, P., et al. (2022). E-commerce and the EU Green Deal – Analysis of the environmental footprint of online sales in the context of the circular economy. Available at: [https://www.europarl.europa.eu/RegData/etudes/STUD/2022/734013/IPOL\\_STU\(2022\)734013\\_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/STUD/2022/734013/IPOL_STU(2022)734013_EN.pdf)

<sup>137</sup> Ibid.

<sup>138</sup> Ibid.

<sup>139</sup> Matušík, J.; Kočí, V. A Comparative Life Cycle Assessment of Electronic Retail of Household Products. Sustainability 2020, 12, 4604. <https://doi.org/10.3390/su12114604>

to products and packaging. The increase in eCommerce is also responsible for materials extraction, for instance, packaging materials, equipment related materials of increased number of sorting centres, increase number of fleets for last mile distribution, fuel consumption etc. All these transformations and the need for next day deliveries lead to increased need for materials consumption for the development of the equipment of the full distribution network.

While there has been some decrease in the use of water in concrete years (i.e., 2014, 2018, 2020, and 2022), the overall trend is upward. Water consumption increased from 1400 Mm<sup>3</sup> to almost 3000 Mm<sup>3</sup> in 2020. This can be still a concern even if the overall contribution of retail to industrial water consumption is relatively low. As it was found, the use of retail water accounts approx. 19% of public water globally supplied<sup>140</sup>.

## Land use

The land use of the retail sector had remained stable between 2011 and 2020. In 2021, the use increased considerably from 75k to 95k of square kilometres. The increased land use during the COVID-19 pandemic is linked to a significant rise in e-commerce activity and due to the increased number of home deliveries<sup>141</sup>. There was a slight decrease in 2022, likely due to the impact of COVID-19 again. This decrease corresponds to a 12% decline in e-commerce revenue from 2021 to 2022<sup>142</sup>. However, the amount of land being used has remained around 90 000 square kilometres.

## Biodiversity loss

The retail sector has a clear impact on biodiversity loss. Since 2011, there has been an increase in the harm caused to the ecosystem due to ecotoxic emissions. Although there was a slight decrease in 2012, possibly due to the 2012 European debt crisis, and in 2020, due to the lockdown measures implemented because of the COVID-19 pandemic and the subsequent slowdown in retail trade, the overall trend has been consistently upward. The number of incidents has risen from 14 000 to just over 16 000.

## Waste

Waste in the retail ecosystem is a significant challenge, just like in many other industries. Waste is generated throughout the entire retail supply chain, from production to consumption. The retail ecosystem produces waste through the sale of goods and services to customers. The main types of waste in retail are packaging waste, food waste, electronic waste (e-waste), and hazardous waste from chemical or pharmaceutical products.

According to Eurostat data, 177.9 kg per inhabitant packaging waste was generated in the EU in 2020. The main types of packaging waste were paper and cardboard (32.7 million tonnes in 2020), followed by plastic and glass<sup>143</sup>.

Another main contributor is food waste. In the EU27, nearly 59 million tonnes of food waste, an average of 131 kg per inhabitant, are generated every year. This creates a loss of €132 bn<sup>144</sup>.

In addition to the economic impact, there is also an environmental impact. Food waste accounts for 252 million tonnes of CO<sub>2</sub> equivalents or about 16% of the total greenhouse gas emissions from the EU food system. If food waste were a Member State, it would be the fifth largest emitter of GHG emissions. All in all, around 10% of all food supplied to

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<sup>140</sup> Ferreira, A., Pinheiro, M.D., de Brito, J. *et al.* Water Intensity Indicators in the Global Retail Sector. *Water Resour Manage* 37, 219–234 (2023). <https://doi.org/10.1007/s11269-022-03363-2>

<sup>141</sup> Statista (2023) Statista Market Insights. Accessed <https://www-statista-com.liuc.idm.oclc.org/outlook/digital-markets>

<sup>142</sup> Idem.

<sup>143</sup> [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Packaging\\_waste\\_statistics](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Packaging_waste_statistics)

<sup>144</sup> European Commission (2023), Frequently asked questions: reducing food waste in the EU. Available at: [https://ec.europa.eu/commission/presscorner/detail/en/qanda\\_23\\_3566](https://ec.europa.eu/commission/presscorner/detail/en/qanda_23_3566)

retail, restaurants, food services (e.g., school and corporate canteens, hospitals, etc.) and households is wasted<sup>145</sup>.

Food waste is generated at every stage of the supply chain. However, the amount of waste from retail is less compared to the waste produced in other stages of the supply chain<sup>146</sup>. According to the first EU-wide monitoring of food waste using a common EU methodology, Eurostat estimated that 53% of food waste in the EU comes from households, 7% from wholesale and retail, and 9% from restaurants and food services. Other sectors that contribute to food waste in the EU include primary production (11%) and food processing and manufacturing (20%)<sup>147</sup>.

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<sup>145</sup> Ibid.

<sup>146</sup> Cicatiello, C. et al (2017), The dark side of retail food waste: Evidences from in-store data, *Resources, Conservation and Recycling*, Volume 125, 2017, Pages 273-281, ISSN 0921-3449, <https://doi.org/10.1016/j.resconrec.2017.06.010>.

<sup>147</sup> European Commission (2023), Frequently asked questions: reducing food waste in the EU.



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# Appendix B: Methodological notes

## Startup data and venture capital data analysis

### Crunchbase and Net Zero Insights

Codes used include: Retail, Retail Technology, E-commerce, E-commerce Platforms, Marketplace, Shopping, Point of Sale, Wholesale, Warehousing and Mobile Payments (including retail and customer within their description) and additional search in the business descriptions.

### Survey

The table below presents the overview of the sub-sectors included in the sampling frame, with corresponding sections according to the NACE industrial classification. The survey encompassed the entire retail ecosystem.

Table 2: Survey sampling

NACE		Sample size of the survey
<b>G47</b>	Retail trade, except of motor vehicles and motorcycles	667
<b>G46</b>	Wholesale trade, except of motor vehicles and motorcycles	600

Source: Technopolis Group and Kapa Research, 2023

## Foreign direct investment data analysis

Table 3: Concordance between NACE and FDI Intelligence data

FDI tags used
Food & beverage Stores, General merchandise stores, Miscellaneous store retailers, Nonstore retailers, Warehousing & storage, Wholesale Trade (Consumer Goods), Wholesale Trade (Food & Tobacco)

Source: Technopolis Group

## LinkedIn data analysis

Table 4: Concordance between NACE and LinkedIn

NACE		LinkedIn categories used
<b>G47</b>	Retail trade, except of motor vehicles and motorcycles	Retail
<b>G46</b>	Wholesale trade, except of motor vehicles and motorcycles	Wholesale

Source: Technopolis Group based on LinkedIn

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

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

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

To perform a representativeness analysis of LinkedIn, the available industry-specific dataset has been compared to Eurostat figures regarding the active population. Nevertheless, there are several limitations in conducting a robust representativeness analysis since the two datasets have different origins, classification systems and hence there are mismatches in the definition of some categories<sup>148</sup>. There are 149 industries

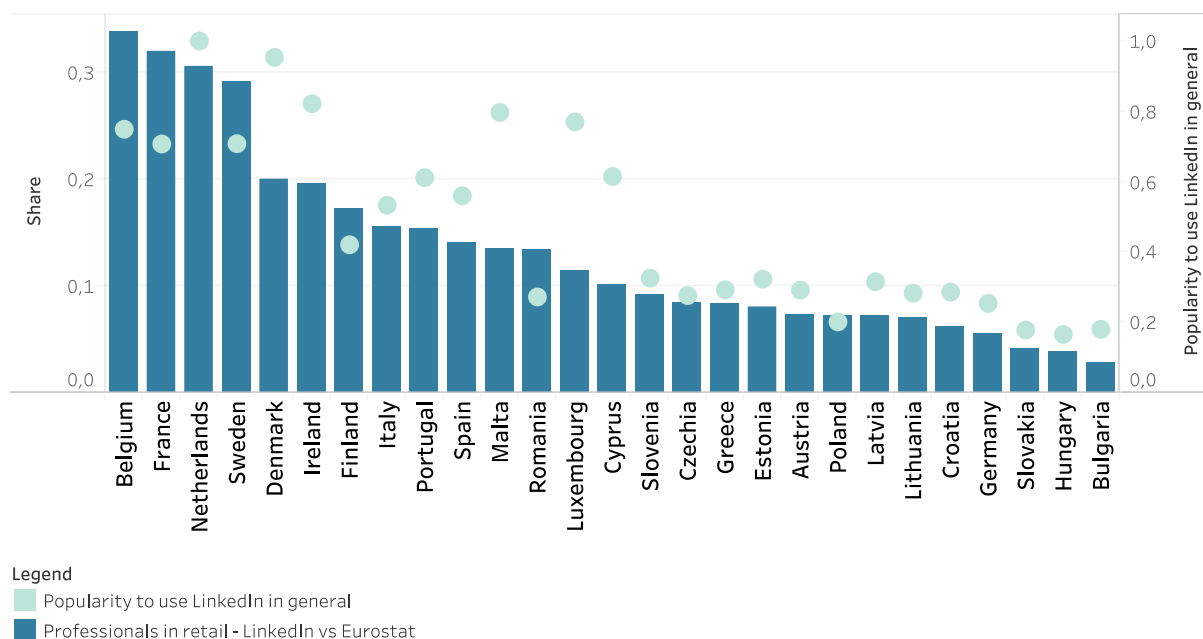
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<sup>148</sup> See more in detail ATI Methodological report: <https://ati.ec.europa.eu/reports/eu-reports/advanced-technologies-industry-methodological-report>

available on the LinkedIn platform and categories are allocated according to the individual choice of the user or the affiliation to a company registered on LinkedIn as a company profile.

Regarding the country profiles, there is an important heterogeneity in the national use of LinkedIn among EU Member States. The largest users are Netherlands, Denmark, and Ireland where LinkedIn is the most popular, with more than 75% of the active population registered. In other EU countries, the number of LinkedIn users is marginal such as in Hungary, Slovakia, Bulgaria, and Poland that display the lowest use of LinkedIn, with less than 20% of the population registered on the platform.

Figure 41: Representativeness: professionals working in retail and on LinkedIn in the share of persons employed in retail according to Eurostat



Source: Technopolis Group calculations based on LinkedIn vs Eurostat - annual enterprise statistics for special aggregates of activities (NACE Rev. 2)

Keeping the above in mind, overall, it can be estimated that approximately 30% of retail industry professionals have a profile on LinkedIn. Countries where a highest share of retail professionals are present in LinkedIn are Belgium, France, and the Netherlands (see figure above). As it was the case in the overall users of LinkedIn, Slovakia, Hungary and Bulgaria have the lowest rates of retail professionals present in LinkedIn.

## Environmental certificates

ISO annual surveys report the number of companies/organisations with environmental certificates. Environmental certificates were the ISO 14000, which was updated requiring more stringent standards and practices in the year 2015. The new standard was then named ISO 14000/2015. Holders of the ISO 14000, starting from the year 2015, had to be re-certified to gain the new ISO14000/2015 certificate. New sustainability and environmental practices had to be put in place; with organisational change and financial requirements implied. Accreditation bodies had also to adopt new verification procedures, with their corresponding time lag. This may explain the drop in number of certified companies/organisations from 2015 to 2017.

## Exiobase

Exiobase is a time series of environmentally extended multi-regional input-output (EE MRIO) tables. Its coverage is by country and industry from 1995 to 2021 and has EU and extra rest of the world coverage. Source: Stadler, Konstantin, Wood, Richard, Bulavskaya, Tatyana, Södersten, Carl-Johan, Simas, Moana, Schmidt, Sarah, Usubiaga, Arkaitz,

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