INTESA SANPAOLO

FEDERCHIMICA ASSOBIOTEC
Associazione nazionale per lo sviluppo delle biotecnologie

SPRING
Italian Circular Bioeconomy Cluster

Bioeconomy in Europe

10th Report

Research Department

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Executive summary

The Bioeconomy in Europe Report is now in its tenth edition: an important milestone, the result of the work and passion of a growing group of people who, over time, have joined the original core of authors, demonstrating a strong interest in the complex system of activities that use and transform renewable biological resources.

According to the FAO Dashboard, there are 21 countries in the world that have adopted a Bioeconomy strategy and 17 that are developing it. Estimates based on EIU data show that the countries that already have their own development plan account for 65.5% of GDP and 32% of the world's population in 2023.

While the interest of policy makers has been increasing over the last decade, there are still some points of attention, particularly with regard to the correct identification of activities that use bio-based raw materials, which would require both an adjustment of the statistical classifications currently in use and a change in regulations to maximise the use of biomass with a view to circularity. A coherent legislative framework appears, in fact, essential to support the efforts of a growing number of companies that are investing in the sustainability of their processes and products.

The analyses contained in the Report confirm, even in the most recent data, the importance of the Bioeconomy in the economic context of Italy and the other main European countries (Chapter 1) and the extraordinary vitality of the firms of the sectors involved in the generation and transformation of biological resources, also thanks to the contribution of innovative start-ups (Chapter 2), which constitute a fundamental asset for successfully tackling the great challenges of green and digital transition. The Report then dwells on the positioning of the Italian agri-food industry from a technological point of view (Chapter 3) and on the use of water resources (Chapter 4). Finally, the Report is focused on the cosmetics sector, one of the most dynamic on the national competitive scene in recent years (Chapter 5, realized with the contribution of Cosmetica Italia, the Federchimica association representing the sector's firms).

The perimeter of our analysis includes, as usual, both upstream sectors of the value chain (such as agriculture, forestry and fishing, the wood and paper industry, the chemical and rubber-plastics industry) and downstream sectors (such as food and beverage, clothing, furniture, pharmaceuticals). Bioenergy, biofuels and the water cycle are also considered in the Bioeconomy definition adopted. Finally, in a logic of closing the circle and circular economy, the bio-based component of waste is also included in the analysis: recycling, treatment and biomass are extremely topical and of great interest, also due to their considerable economic value and relevance for the sustainability of the development model.

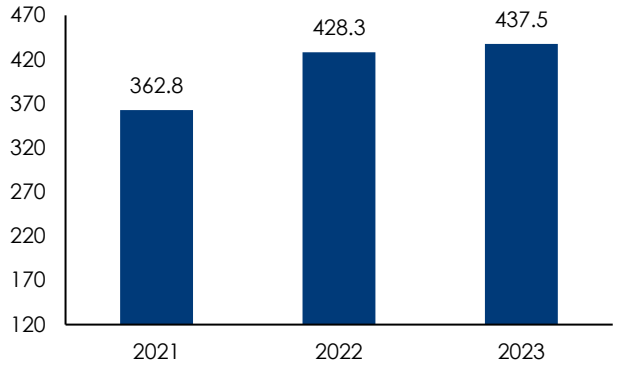
The estimates of the value of the Bioeconomy, contained in **Chapter 1**, were calculated using a similar methodology as in previous years. The lack of detailed data on the value of production referring to 2022 required estimates for both the year 2022 and 2023 for all countries considered.

In 2023, all activities related to the Bioeconomy in Italy generated an estimated output of EUR 437.5 billion (9.3 billion more than in 2022), employing around two million people.

After the acceleration recorded in 2022, when the value of the Bioeconomy's production stood at levels of EUR 428.3 billion, with an increase of 18% compared to 2021 (+ EUR 65.5 billion), also due to the significant increase in producer prices, the sector's growth continued in 2023, but at a slower rate of 2.2%. Employment, on the other hand, was more stable, at levels of around 2 million employed throughout the period considered (2021-23).

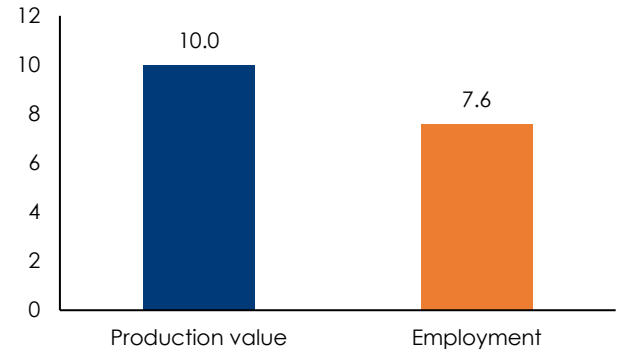
In 2023, the Italian Bioeconomy will weigh 10% in terms of production value and 7.6% in terms of employment, on the total economy of our country.

Fig. 1 - The evolution of the Bioeconomy in Italy (billion euros)



Source: Intesa Sanpaolo elaborations on various sources

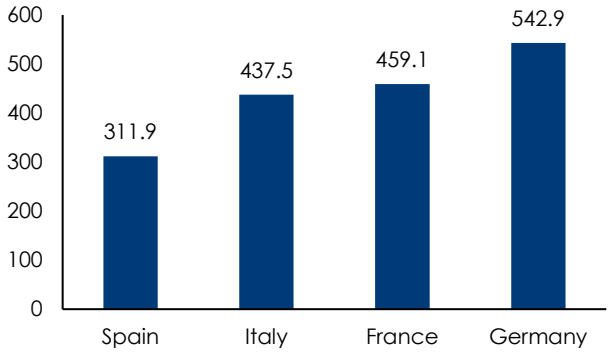
Fig. 2 - The weight of the Bioeconomy in Italy on the total economy (%)



Source: Intesa Sanpaolo elaborations on various sources

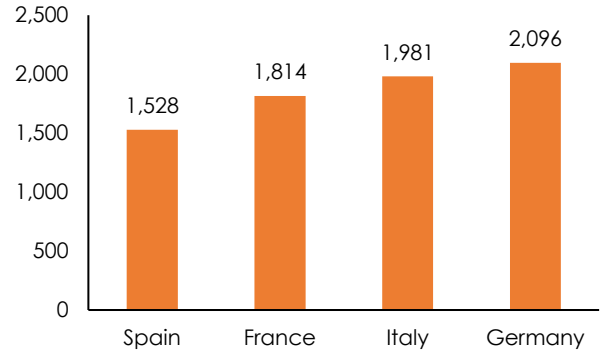
Taking France, Germany, Italy and Spain together, the bioeconomy generated an output of around EUR 1,751 billion in 2023, employing more than 7.4 million people, representing 8.4 per cent and 6 per cent respectively of the four European countries' total figures.

Fig. 3 - Estimated value of Bioeconomy production in 2023 in the main European countries (billion euros)



Source: Intesa Sanpaolo elaborations on various sources

Fig. 4 - Estimated employment in the Bioeconomy in 2023 in the main European countries (thousands employed)

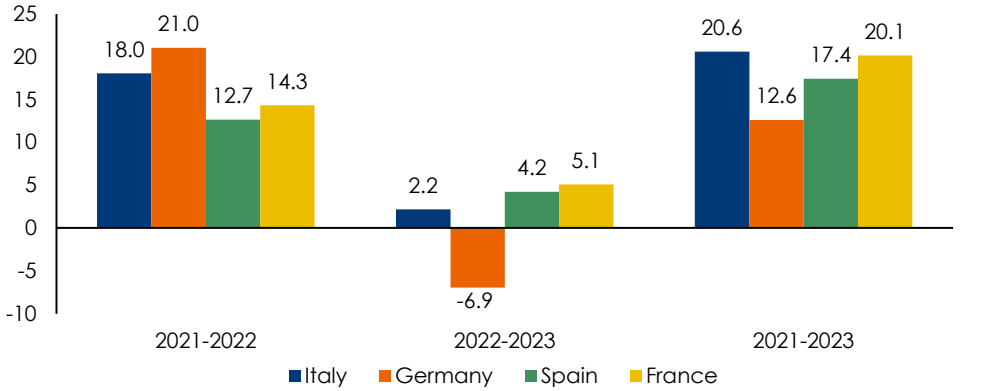


Source: Intesa Sanpaolo elaborations on various sources

Estimates for 2023 confirm what has already emerged in previous editions of the Report. In absolute terms, the importance of the German bioeconomy stands out, ranking first in terms of value of output (EUR 542.9 billion) and number of people employed (around 2.1 million). In terms of output, France ranks second (EUR 459.1 billion), followed by Italy (EUR 437.5 billion) and Spain (EUR 311.9 billion). Italy ranks third in terms of production value and second in terms of employment, with around 2 million employees, followed by France (1.8 million) and Spain (1.5 million). In terms of weight on the total economy, however, Spain and Italy stand out.

2023 was also a positive year for the Bioeconomy in France (+5.1%) and Spain (+4.2%), observing a further increase after the significant growth already recorded in 2022. In contrast, the German Bioeconomy declined (-6.9%), affected by negative signals in most sectors. Comparing the output levels of the Bioeconomy in 2023 compared to 2021, positive results are observed for all countries, with better indications for Italy, which recorded an increase of 20.6% slightly higher than France (20.1%), followed by Spain (17.4%) and Germany (12.6%).

Fig. 5 - Evolution of the Bioeconomy in Europe (value of production, var. %)



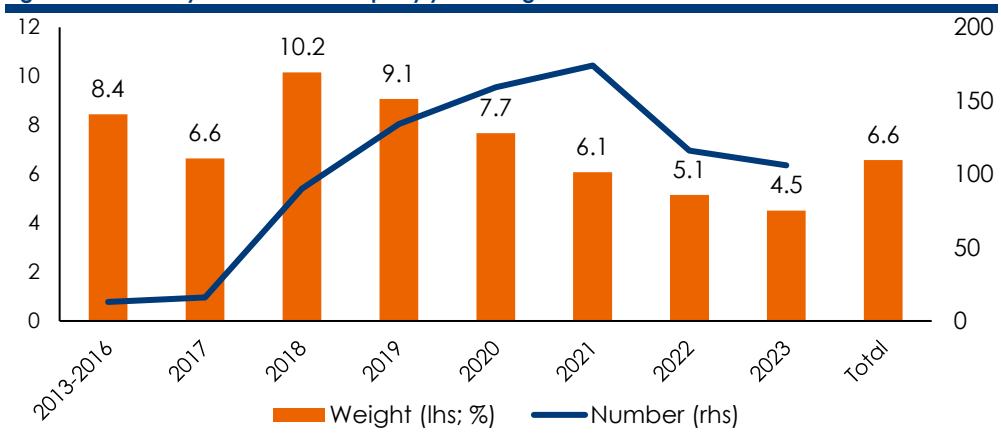
Source: Intesa Sanpaolo elaborations on various sources

The vitality of the Bioeconomy is also evident in terms of innovation, a strategic factor for the growth of companies in general but, in the current context of green transition and development of the circular economy, even more so for Bioeconomy companies, called upon to respond to a growing demand for bio-based products and materials to be used as inputs and original solutions for increasingly environmentally friendly processes.

A key role is played by innovative start-ups, analysed in **Chapter 2**. There are 808 innovative start-ups in the Bioeconomy active as of 31/12/2023, equal to 6.6% of the total of 12,300 companies registered in the innovative start-ups section of the Companies Register. Looking only at innovative start-ups active in the sectors included in the Bioeconomy, the incidence of these rises to 25%. However, this is most likely an underestimate of the actual number of start-ups that can be traced, even indirectly, to the Bioeconomy.

As also emerged in previous surveys of the phenomenon, innovative start-ups in the Bioeconomy are mainly concentrated in the Research and Development sector (R&D; about 45% of the sample) and in the agri-food industry (about 25%), with a good incidence also in the chemical, pharmaceutical, rubber and plastic sectors. These start-ups are localized throughout the country, with more than half of the regions specialising in the sector. Compared to the rest of the start-ups, those in the Bioeconomy show a greater prevalence of medium-to-high capitalisation companies, show a higher diffusion of requirements related to intellectual property and qualified human capital and, in terms of governance, are characterized by a greater prevalence of young people and women. There is also a greater presence of 'energy' start-ups, i.e. companies that develop or market high-tech products in the energy field.

Fig. 6 - Bioeconomy innovative start-ups by year of registration

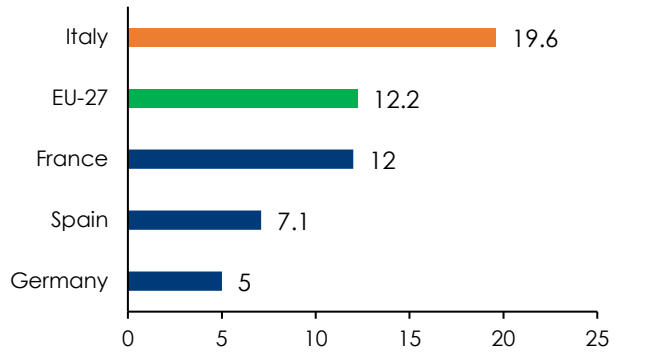


Source: Intesa Sanpaolo elaborations on Chamber of Commerce data

A more detailed analysis, both through the observation of keywords describing the activities of start-ups and through the in-depth analysis of some business cases, offers a snapshot of some of the technological trends that start-ups in the sector are tracking. The development of new materials for the production of cosmetics, as well as the search for different production inputs for the manufacture of bioplastics, are some of the examples. Also in the agri-food sector, the use of alternative raw material sources or the introduction of new technologically advanced production processes aimed at improving environmental sustainability are some of the innovative trends that companies are tracking. There are also several start-ups active in the fashion system, where players use waste materials from other processes or industries, or in green building, where there is a growing focus on improving health and comfort conditions in homes through the use of natural and environmentally sustainable materials. There are also some cases of companies active in civil and industrial waste management and water purification processes, which confirm that innovative activity concerns the entire production cycle.

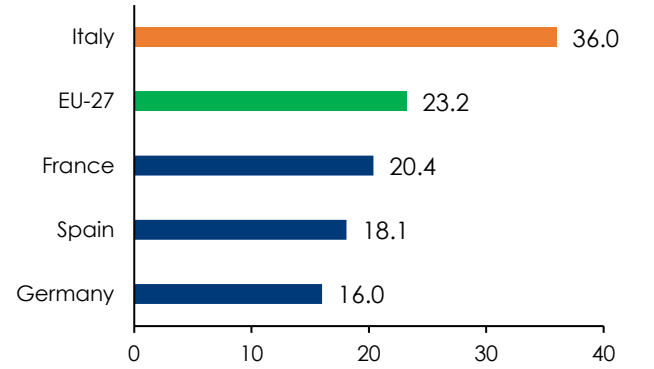
Innovation is also a key factor for the Italian agri-food supply chain, which is strongly characterised by the valorisation of both local tradition and links with the territory, and by an high innovative capacity (**Chapter 3**).

Fig. 7 - Food, drink and tobacco companies that introduced a new product (%, 2020)



Source: Eurostat - CIS 2020

Fig. 8 - Food and beverage enterprises that have introduced a process innovation in the production of goods or the provision of services (%, 2020)



Source: Eurostat - CIS 2020

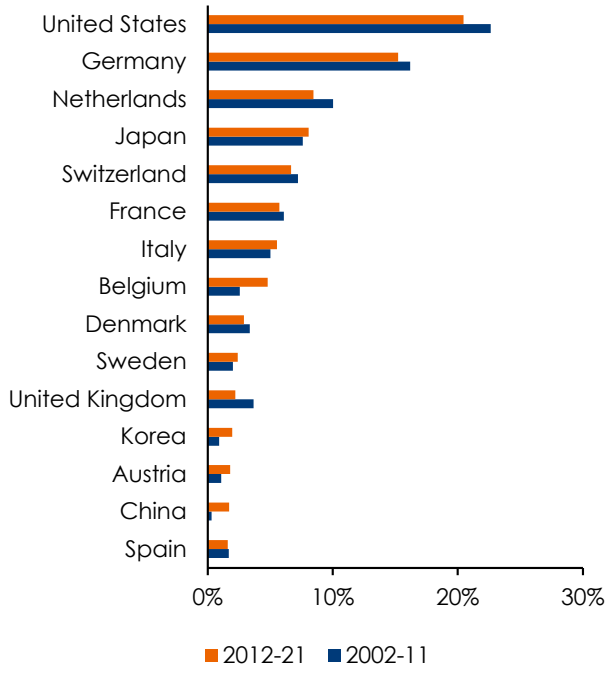
Despite their small average size, Italian food companies, which are significantly smaller than their European competitors, stand out due to their high share of product innovations. Particularly with

regard to innovations for the market, i.e. those not offered by other competitors, the creative capacity of Italian companies stands out. They outperform their European competitors with a share of almost 20%, against an EU-27 average of 12.2% (Germany, France and Spain all fall below the European average). Innovative efforts are sustained by a greater diffusion of subjects carrying out R&D 'in house' (indicated by 34% of Italian companies, against 24% of French and 16% of German companies), especially in a 'continuous' mode (16.9% of Italians, against 13.4% of French and 5.8% of Germans).

Also relevant is the focus on process innovation, which is often fundamental for the introduction of new products: in particular, Italian companies stand out for the introduction of innovations intended to change production methods, where Italy outperforms its main competitors by more than 15 percentage points.

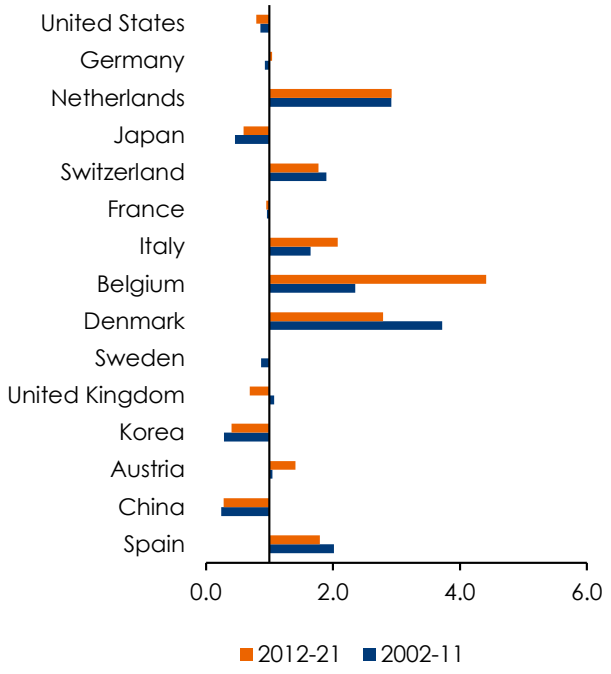
The focus on production processes also emerges from an analysis of patent activity dedicated to the agro-food sector, where Italy ranks seventh in the world in terms of patents, with a share and degree of specialisation that has clearly strengthened in recent years.

Fig. 9- Shares in world food technology patents (%)



Source: Intesa Sanpaolo on OECD data

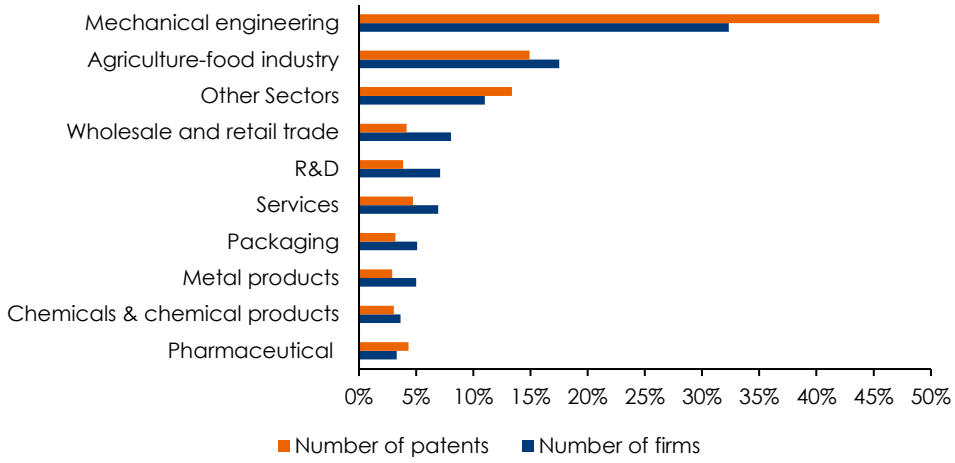
Fig. 10 - RTA - Revealed Technological Advantage in food technology (index)



Source: Intesa Sanpaolo on OECD data

The detailed analysis of the patent portfolio in technologies dedicated to the food sector shows the presence of a diversified innovation system, both in terms of sector and size, with a good level of cooperation between different actors (companies, universities, Italian and foreign research centres) that generates a high share of co-patents. In addition to companies active in the agri-food sector, a decisive role is played by those in the mechanical sector, which represent the main source of food-related patent applications (45% of patent applications and 32% of assignees). In addition, the activity of pharmaceutical companies, which are engaged in nutraceuticals, and chemical and other materials (rubber, paper, glass), with patent activity mainly directed to packaging and process improvement, also stands out.

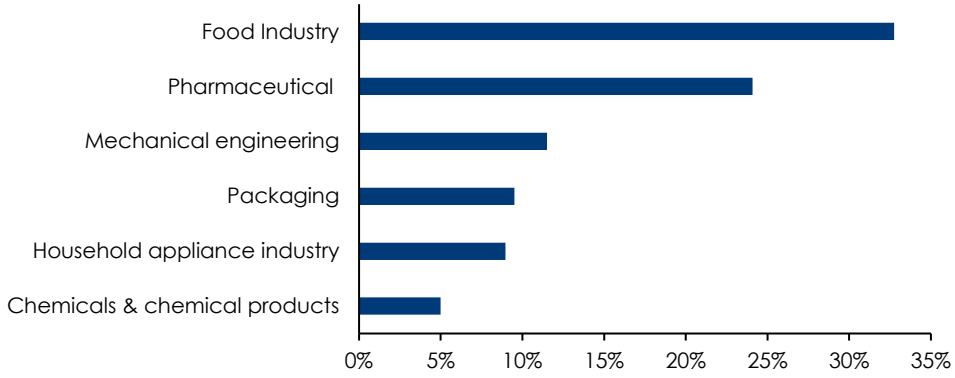
Fig. 11 - Sectoral composition of enterprises and patent applications in agri-food technologies



Source: Intesa Sanpaolo elaborations on ISID

The breadth of sectors involved in food-related patenting confirms the relevance of issues related to safety, quality and productivity that, together with sustainability, drive innovation in food industry.

Fig. 12 - Sectors in which Italian food companies patent (%)



Source: Intesa Sanpaolo elaborations on ISID

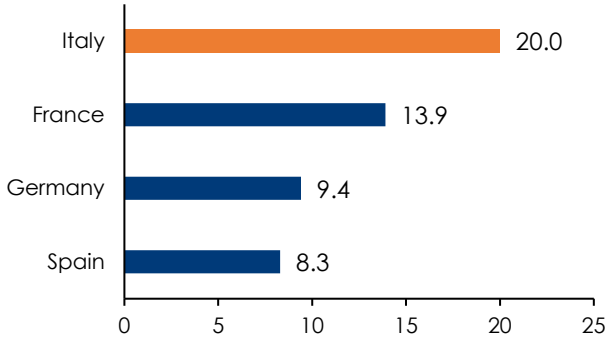
The patenting activity of food and beverage companies, a sample of 386 entities that submitted patent applications to the European Patent Office (EPO), also illustrates the breadth of topics and the variety of innovative paths underway in the sector. Indeed, the importance of processes is confirmed, often supporting the introduction of new products or even the entry into new businesses, such as espresso machines for companies in the coffee industry. Interest in the border area between food and health is also high. Pharmaceuticals is, in fact, in second place among the sectors/areas of technology in which Italian agri-food companies are patenting, immediately after food products. Companies also pay attention to the issue of packaging, to ensure better shelf life, transportability and sustainability.

The protagonists of these changes are not only the large food multinationals with Italian capital, which are strongly committed to research and innovation, but also agricultural companies, small enterprises and start-ups, which complete the panorama of the Italian food innovation system.

One of the most promising directions is certainly, as already mentioned, the search for new compounds intended to improve health: the case of Melinda, one of Italy's leading fruit and vegetable consortia, is emblematic in this sense. Melinda's research is particularly oriented towards the circular exploitation of by-products derived from apple processing, both fresh and processed, with applications in the cosmetic, nutraceutical, biomaterials and clinical sectors, both human and veterinary.

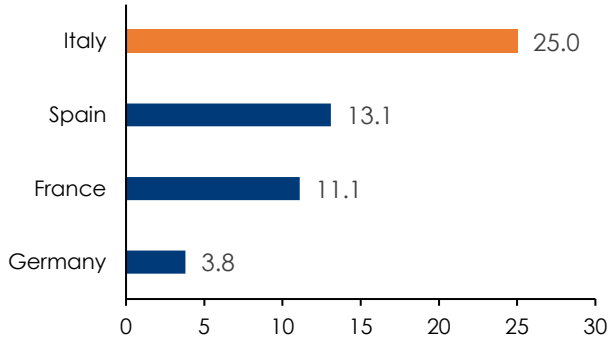
The recovery and valorisation of waste are also at the heart of the activities of Coffeefrom, a start-up company engaged in the development of thermoplastic materials derived from coffee grounds, destined for the creation of new products (packaging, cups, etc.), confirming both the importance of innovation in the agri-food supply chain and the role of technology in supporting greater sustainability.

Fig. 13 - Reduction in material use or water consumption (% of companies for which process innovation is of high importance; 2020)



Source: Eurostat - CIS 2020

Fig. 14 - Substitution of polluting or hazardous materials (% of companies for which process innovation is of high importance; 2020)



Source: Eurostat - CIS 2020

Sustainability plays an increasingly important role in guiding innovative efforts to improve processes. Compared to their German, French and Spanish competitors, Italian companies give more importance to reducing material and water consumption (20% of respondents), but also to recovering waste and water (around 21%), replacing polluting or hazardous materials (25%) and reducing air, water, soil or noise pollution (20.8%).

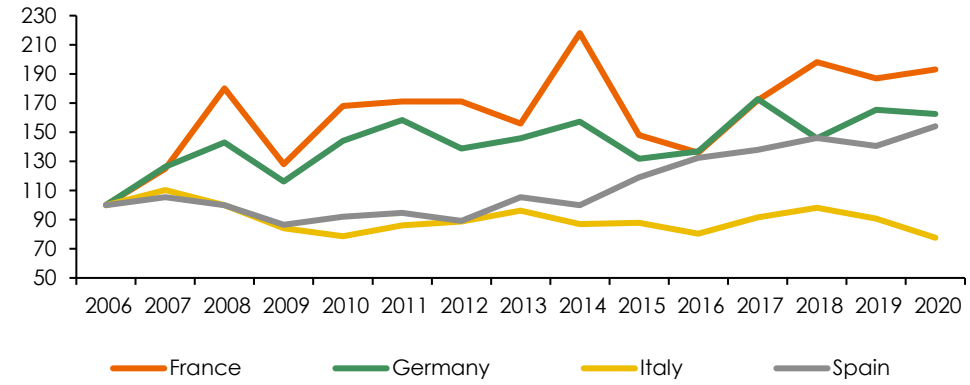
The agri-food sector is becoming increasingly aware of both the relevance of water resources and the critical issues and risks associated with their scarcity for its supply. Climate change is modifying and reducing water availability and the impact can be extremely relevant in a supply chain where water is an important production input. Consumption efficiency and the spread of resource reuse practices are central to the sustainability of the industry. **Chapter 4** presents an overall overview of water consumption in the agro-food supply chain and some reflections on a more conscious use of the resource in this supply chain.

In Italy, unlike in other European countries, the agricultural sector is a large user of water (it absorbs 60% of total consumption) and has a high propensity for irrigation: 20.2% of the utilisable agricultural area (UAA) is irrigated and about 64% of the 484,000 farms with irrigable land actually irrigated their fields in 2020. The sector is therefore one of the first to be affected by water shortages.

Between 2006 and 2020, in Italy there is a decrease in the Aquastat indicator on the efficiency of irrigation water consumption, while in other countries efficiency increases. France is among the countries with the greatest improvements, with the value of production per cubic metre of water

consumed almost doubling over the 15 years considered. In Spain, the indicator increases by 54% cumulatively over the years.

Fig. 15 - Irrigation water use efficiency in Europe (2000=100)



Note: estimated data. Source: Aquastat

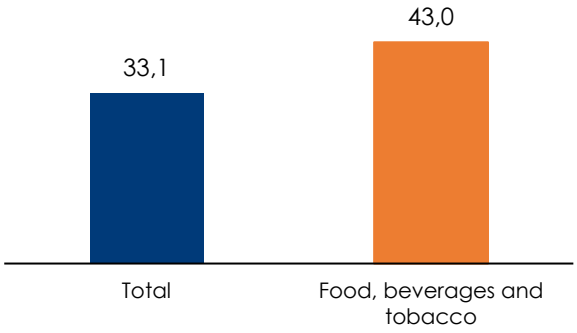
Despite the aggregate figures, progress towards water efficiency has been made in some areas and on some Italian farms; it is now a matter of ensuring the gradual conversion of irrigation systems towards less water-consuming and more efficient methods on a large scale. The adoption of innovative technologies can play a key role.

The reuse of water in Italy is still limited: in 2021 the percentage of purified wastewater reused is 4% at national level, against a potential of 21% (source: ARERA). To ensure a greater diffusion of reuse practices, it is urgent to act on several fronts: first of all, it is necessary to adapt plants and networks and adopt Regulation 741 of 2020, which defines common standards at European level for irrigation reuse.

The food, drink and tobacco industry accounts for 10% of the water consumption in the manufacturing sector: 3.3 liters of water are required per euro of production. Water is used both as a primary input in the production process and for cooling machinery or washing inputs and equipment. The Tagliacarne, Unioncamere, Cluster Spring survey conducted on a sample of 2,000 companies belonging to the Bioeconomy, finds that the food, beverage and tobacco sector is among those where attention to water use is greatest: 43% of food companies have in fact adopted actions to limit water withdrawal and consumption, compared to an average of 33%.

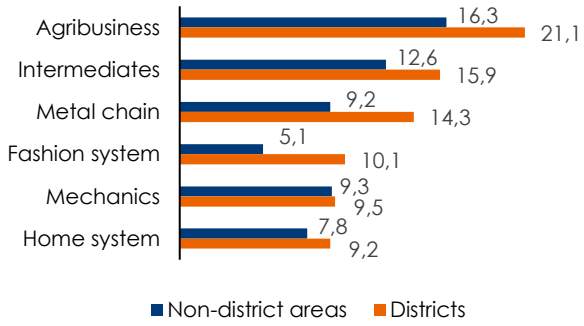
Within the Italian industrial districts, there appears to be greater awareness of water recycling and reuse than in non-district areas: according to the results of Intesa Sanpaolo's periodic survey of its commercial network, in the agri-food districts there are over 21% of managers who indicate that their client companies have taken steps to recycle and reuse water (while the percentage is just over 16% for non-district agri-food companies).

Fig. 16 - Enterprises that have introduced actions to reduce water use in the production process (% of total)



Source: Intesa Sanpaolo elaborations on data from Indagine Tagliacarne, Unioncamere, Cluster Spring 2023

Fig.17 - Recycling and/or reuse of water (% of operators who indicated green strategy per sector, net of don't know)



Source: Intesa Sanpaolo survey, November-December 2023 edition

The cosmetics sector represents excellence in Italy and is highly competitive in international markets, thanks to quality, innovation and know-how. In recent years, in a complex and uncertain context, it has continued to grow and gain market share. These are unexpected results that have also been achieved thanks to a greater commitment to environmental sustainability, with an increasing focus on the natural connotation of products and the low environmental impact of production processes. It is estimated, in fact, that in 2023 a quarter of production will involve cosmetics with a natural and/or sustainable connotation, of which about 10% will use bio-based inputs.

Tab. 1 - Details and trends in the natural and sustainable cosmetics market (million euros; % change)

	2021	2022	2023	Var.% 2022-21	Var.% 2023-22	Weight % 2023	Weight % 2021
Total	**2,654**	**2,893**	**3,113**	**9.0**	**7.6**	**100**	**100**
Natural/organic connotation	1,159	1,215	1,301	4.8	7.1	42	44
Sustainable/green	1,494	1,678	1,812	12.3	8.0	58	56

Source: elaborations by Centro Studi of Cosmetica Italia

This progress has also been possible thanks to the structure of the sector, which can count on strategic supply chain relations of proximity for both production inputs (mainly chemicals, agro-food) and packaging (primarily paper, plastic, glass, ceramics). Also in the future, the presence of local and stable supply chains may represent an advantage for cosmetics companies that want to pursue their path towards more bio-based production and more sustainable production processes. Therefore, the bio-based future of the sector strongly depends on the ability to virtuously involve upstream companies in the ongoing green transition.

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Intesa Sanpaolo Research Department - Head Gregorio De Felice	
Industry & Local Economies Research	
Stefania Trenti (Manager)	stefania.trenti@intesasanpaolo.com
Ezio Guzzetti	ezio.guzzetti@intesasanpaolo.com
Industry Research	
Ilaria Sangalli (Head of Sector Economists Coordination)	ilaria.sangalli@intesasanpaolo.com
Letizia Borgomeo	letizia.borgomeo@intesasanpaolo.com
Anita Corona (Rome office)	anita.corona@intesasanpaolo.com
Enza De Vita	enza.devita@intesasanpaolo.com
Luigi Marcadella (Padua branch)	luigi.marcadella@intesasanpaolo.com
Paola Negro (Turin office)	paola.negro@intesasanpaolo.com
Enrica Spiga	enrica.spiga@intesasanpaolo.com
Anna Cristina Visconti	anna.visconti@intesasanpaolo.com
Regional Research	
Giovanni Foresti (Head)	giovanni.foresti@intesasanpaolo.com
Romina Galleri (Turin office)	romina.galleri@intesasanpaolo.com
Sara Giusti (Florence office)	sara.giusti@intesasanpaolo.com
Anna Maria Moressa (Padua branch)	anna.moressa@intesasanpaolo.com
Massimiliano Rossetti (Ancona office)	massimiliano.rossetti@intesasanpaolo.com
Carla Saruis	carla.saruis@intesasanpaolo.com
Rosa Maria Vitulano (Rome office)	rosa.vitulano@intesasanpaolo.com
Innovation and high technology	
Serena Fumagalli (Responsible)	serena.fumagalli@intesasanpaolo.com
Local Public Finance	
Laura Campanini (Head)	laura.campanini@intesasanpaolo.com