INTESA SANPAOLO

SPRING
Italian Circular Bioeconomy Cluster

The Bioeconomy in Europe

11° Report

Research Department

June 2025

Index

The Report was produced by a working group coordinated by the Intesa Sanpaolo Research Department (Laura Campanini, Anita Corona, Serena Fumagalli, Stefania Trenti) in collaboration with the National Cluster for the Circular Bioeconomy SPRING and SRM -Studi e Ricerche per il Mezzogiorno.

Foreword

Catia Bastioli

The global context continues to be extremely complex. The European Union is facing new and significant challenges in the face of geopolitical instability following the conflict in Ukraine and the blockage of the globalisation process: its strong dependence on raw materials and energy has become more marked. This scenario has raised significant questions about the sustainability and viability of the **European Green Deal**. Against this backdrop, manufacturing sectors that have historically been strategic for Europe, such as the automotive and chemical industries, are going through a structural crisis of exceptional magnitude, with a consequent weakening of their ability to invest and attract private capital. The multiple conflicts, of a military and economic nature, affecting the global context and the areas close to European borders, impose a renewed focus on resilience and the enhancement of the specificities of EU territories. In this framework, it is essential to combine sustainability and competitiveness, promoting **a strategic and intelligent use of local production chains.**

Experience in recent years has also shown that the ecological transition must be gradual, leaving room for a plurality of solutions and technologies. As clearly highlighted in the Draghi Report "**The Future of European Competitiveness**"[1] and by the President of the European Commission Ursula Von Der Leyen, Europe must change course and close the innovation gap, strengthen security, reduce dependencies and develop a decarbonisation strategy that stimulates competitiveness instead of weakening it. EU Commission Executive Vice-President Stéphane Séjourné emphasised the urgency to act in the face of increasingly complex global challenges, such as aggressive competition from other economic powers. He explained that it is essential to send a clear signal to markets and investors to strengthen the competitiveness of European industry, reiterating that Europe's industrial agenda will have to be closely linked to environmental and climate ambitions, recalibrating actions to find the best balance between all priorities.[2]

In a profoundly transformed global context, the need to decouple economic growth from the consumption of natural resources and to promote the decarbonisation of the European economy, in order to strengthen its strategic autonomy and competitiveness, is a priority to be tackled with determination and a long-term vision, without losing sight of the present. In this scenario, the Bioeconomy is configured as a strategic driver of the transition, offering a concrete opportunity for innovation, regeneration and sustainable growth. Rooted in local resources and specificities, the Bioeconomy is, by its very nature, interdisciplinary and transversal, capable of integrating different production sectors and technologies, enhancing the potential of territories through connected and resilient supply chains.

In order to build a new balance between economic, environmental and social sustainability, it is crucial to mobilise the full potential of the Bioeconomy: from the regeneration of natural capital and the reduction of carbon emissions to the ability to offer flexible and innovative solutions capable of rethinking production and consumption systems in a sustainable way. It is crucial to avoid counterproductive exclusions and to promote territorial projects capable of activating a process of incremental innovation on the ground that raises aspirations and opportunities. Such an approach can help ensure lasting stability, based on continuous innovation, efficient use of waste and by-products and improved collective wellbeing, while fostering social cohesion and political stability - essential elements for truly sustainable and inclusive development.

The Bioeconomy in Italy already contributes significantly to the overall economy, with an estimated output of **EUR 426.8Bn in 2024**, employing more than two million people. The Italian

[1] Mario Draghi, The future of European competitiveness, September 2024.
[2] Structured Dialogue between ENVI members and Executive Vice-President Stéphane Séjourné, 13 May 2025.

Bioeconomy represents around 10% in terms of production value and 7.7% considering employment.

Thanks in part to the fundamental support of the **Circular Bio-based Europe Joint Undertaking (CBE JU)**, numerous biorefineries, strategic infrastructures for the development of a bio-based and circular economy, have been built in Europe. In Italy, in particular, these plants have been developed on an industrial scale, with total investments in excess of EUR 1Bn, intended for the reconversion and regeneration of disused industrial sites. These biorefineries, which are now fully operational, produce a wide range of bioproducts - including biochemicals, bioplastics, bioherbicides, biolubricants, and biofuels - that are already capable of making a concrete contribution to the decarbonisation of the economy, the prevention of soil and water pollution, and the sustainable transformation of entire production sectors. This is a model of industrial innovation that generates new prospects for an increasingly sustainable, resilient and competitive 'Made in Italy' and 'Made in Europe'. The project has also given rise to a national platform integrating a multiplicity of actors - farmers, composting plants, municipal administrations, commercial brands and environmental organisations - with the common objective of optimising the collection and recycling of organic waste. This platform has allowed our country to be first in Europe for the collection of organic waste (72% of the total against the European average of 26%[3]), anticipating by two years the mandatory separate collection of organic waste. Italy can also boast the **Italian Circular Bioeconomy Cluster SPRING**, which represents over 170 members including universities, SMEs and large companies, together with 14 Italian regions and the Autonomous Province of Trento.

Despite the fact that the USA has started a clear disengagement from the environmental policies of the previous administration[4], bio-based production, strongly linked to agro-food chains and territories, will continue to be a relevant sector. China continues to invest heavily in the transition, reinforcing its leadership in green technologies and the Bioeconomy supply chains[5]. In addition, this country, which has become the global manufacturing hub in many sectors, is also emerging as one in the biochemical and bioplastics sectors, building on a path started in Europe: in addition to its production capacity, it is accelerating the development of its domestic market, also being able to count on the synergy with an impressive multiplicity of technologies in full development phase. The European Commission has invested considerable resources, both in terms of human and financial capital, to promote the development of the Bioeconomy in the Union, starting with the launch of the 2012 European Strategy[6]. In light of the current international scenario and the intensification of investments by Asian countries, particularly China, in bio-based production, it is essential for Europe to fully exploit the strategic opportunities already activated and underway in the key sectors of the Bioeconomy. Losing ground in a strategic sector in which Europe has historically played a driving and leading role would be a loss we cannot afford.

In this perspective, **it is a priority for the European Union to recognise and enhance, also in regulatory terms, the substantial contribution of the Bioeconomy and of bio-based products** to the achievement of the EU's climate and environmental objectives. A full recognition of the strategic role of the Bioeconomy should rest on a few key elements:

- **Appropriate statistical classification**: the introduction of specific NACE sub-codes for the biorefineries of the Circular Bioeconomy is desirable. This would make it possible to distinguish

[3] Zero Waste Europe and BioBased Industries Consortium, Bio-waste generation in the EU: Current capture levels and future potential, 2024.
[4] The White House, Fact Sheet: President Donald J. Trump Rescinds Additional Harmful Biden Executive Actions, 14 March 2024.
[5] National Development and Reform Commission, 14th Five-Year Plan for Bioeconomy Development, 2021.
[6] COM(2012) 60 final

and enhance the specificity of the sector, helping to overcome the regulatory barriers that currently hinder the full utilisation of secondary raw materials.

- **Recognition of the value of bio-based products in decarbonisation:** the role of bio-based materials and products in decarbonisation should be formally recognised and integrated into the European legislative framework. To this end, incentive mechanisms and/or mandatory minimum requirements for bio-based content could be envisaged, in particular for those non-drop-in applications capable of triggering a systemic transformation in production, use and disposal cycles. This approach would contribute to strengthening European strategic autonomy, reducing dependence on fossil resources and capitalising on public and private investments already made in the sector.
- **Protection of natural capital through product legislation:** it is necessary to promote a regulatory framework that supports the development and dissemination of products that do not accumulate in soil, compost and water, that reduce risks in the event of accidental release and that facilitate the sustainable management of organic waste. The evolution of the **Packaging and Packaging Waste Regulation**, for which Member States will have until 12 August 2026 to prepare national regulations, will be crucial in this direction.
- **Sustainable use of biomass:** bio-based production must be accompanied by sustainable use of biomass, in line with the environmental sustainability criteria defined by the Renewable Energy Directive (RED II and RED III).
- **Scalability-oriented** investments in research and innovation: finally, it is crucial to intensify investments in research and innovation, with a specific focus on the industrial scalability of existing technologies. In particular, it is necessary to promote the recovery and valorisation of by-products and co-products along the different stages of production processes, exploiting synergies with the agricultural sector and consolidating the investments already made.

The need for a new **Lead Market Initiative** dedicated to bio-based products seems increasingly evident, with the aim of stimulating demand in a structured manner and strengthening the competitiveness of the European bio-based industry. It is also crucial that these materials are evaluated according to the same environmental, economic and regulatory criteria applied to traditional materials, ensuring a level playing field and full integration into European markets.

With the imminent launch of the **EU Clean Industrial Deal**, we are facing a decisive moment. This is the context for the work of the **EU Bioeconomy** Clusters' **Alliance**, an initiative strongly supported by the SPRING Cluster. To date, **14 clusters from 11 countries have already joined the Alliance**, working in synergy with established networks such as the **Bio-based Industries Consortium**, the **Biosolutions Coalition** and other European organisations.

We are facing a key step: transforming the Bioeconomy from a field of research and innovation into a real European industrial strategy, an essential element for a sustainable and competitive future of the Union. This requires a shared commitment based on **dialogue and cooperation. We must be able to build bridges between different countries and sectors,** in the knowledge that the path towards a circular Bioeconomy will not have systemic and lasting impacts if undertaken alone.

Executive Summary

In an international context marked by increasing geopolitical tensions, Europe is facing new challenges by leveraging its natural heritage and expertise. The Bioeconomy - defined as a set of activities that use biological and renewable raw material as production inputs - represents a remarkable opportunity to enhance competitive and resilient value chains. This can support inclusive and sustainable development, rooted in local specialisations.

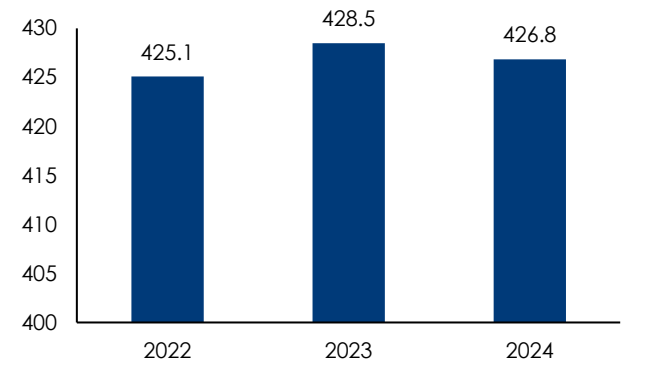
Recognizing the importance of Europe as a unitary space for social and economic development, the Report - now in its 11th edition - broadens its look at other European countries. For the first time, it presents an **estimate of the value of the Bioeconomy in the EU27**, updated to 2024. This allows to highlight the relevance of this meta-sector and its various characteristics based on the climatic, economic and social specificities of the territories.

The estimated production value of the Bioeconomy in the 27 countries of the European Union in 2024 stands at EUR **3,042Bn**, employing over **17 million people**. This **represents 8.7%** of the total EU27 output.

Italy plays a significant role in the European Bioeconomy. The Italian Bioeconomy accounts for 14% of the total output of the EU27 Bioeconomy, a higher percentage than that observed when considering total economic activities (12.4%), thus highlighting Italy's specialisation in the Bioeconomy meta-sector. In 2024, the set of activities related to the **Bioeconomy in Italy** generated an estimated output of EUR **426.8Bn and employed more than two million people**.

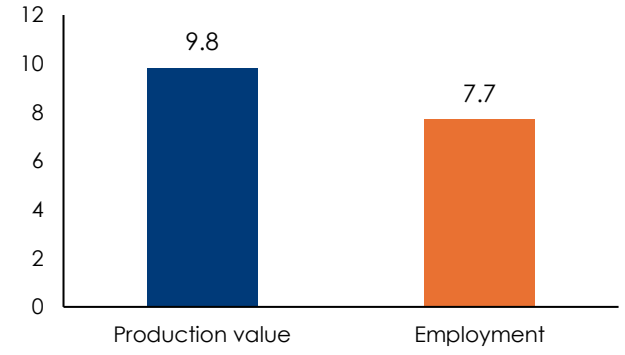
The estimates for 2024, presented in **Chapter 1**, show a slight decrease in the value of the Italian Bioeconomy compared to 2023, equal to -0.4% (at current prices), a synthesis of the return of inflationary tensions and a high heterogeneity in sectoral performance. In fact, **the good results of the agro-food chain**, which represents more than half of the Bioeconomy in Italy, are offset by the decline of some other sectors, such as the Fashion System and the wood and furniture industry in which Italy is specialized. Despite the weak slowdown estimated in 2024**, the weight of the Bioeconomy on the Italian economy as a whole remains significant, representing about 10% in terms of production value and 7.7% considering employment.**

Fig. 1 - The production value of the Bioeconomy in Italy (EUR Bn)



Source: Intesa Sanpaolo elaborations on various sources

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

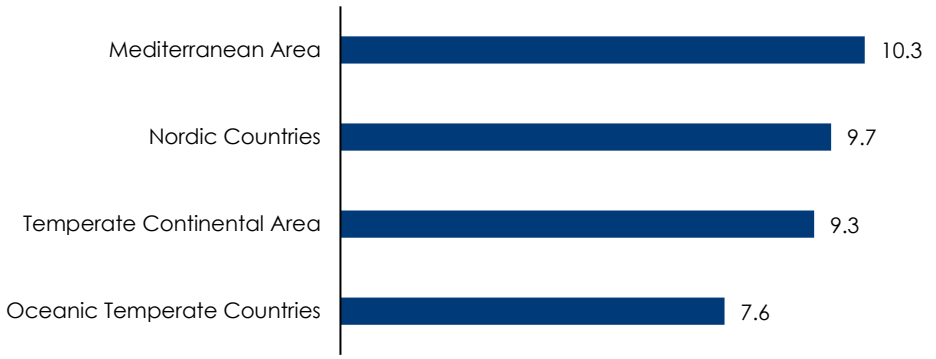


Source: Intesa Sanpaolo elaborations on various sources

Chapter 2 presents an analysis of the Bioeconomy landscape across European countries. This analysis uses classification into climate zones as an interpretive framework - concise yet capable of capturing the specific characteristics of the different geographies. Four clusters have been identified: the Mediterranean Area (Italy, Spain, Greece, Portugal and Croatia), the Temperate Continental area (Austria, Romania, Poland, Czech Republic, Slovenia, Hungary, Bulgaria and

Slovakia), the Temperate Oceanic Area (France, Germany, Belgium and the Netherlands), and the Nordic Area (Latvia, Lithuania, Estonia, Sweden, Finland and Denmark).

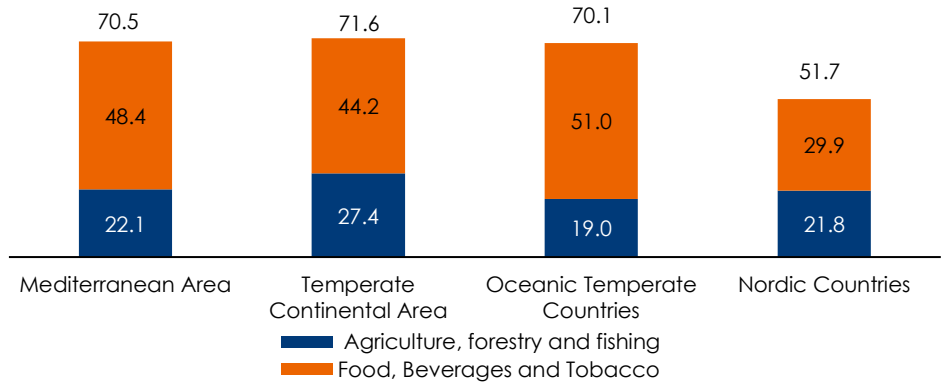
Fig. 3 - The weight of the Bioeconomy output in the different climate clusters (% incidence on the economy's output value, 2024)



Source: Intesa Sanpaolo elaborations on various sources

The estimates, based on Eurostat data and applying the same methodology used to calculate the value of the Bioeconomy in Italy, show a greater relevance of the Bioeconomy in the **Mediterranean and Nordic countries** with a weight on the overall output of **10.3% and 9.7%** respectively.

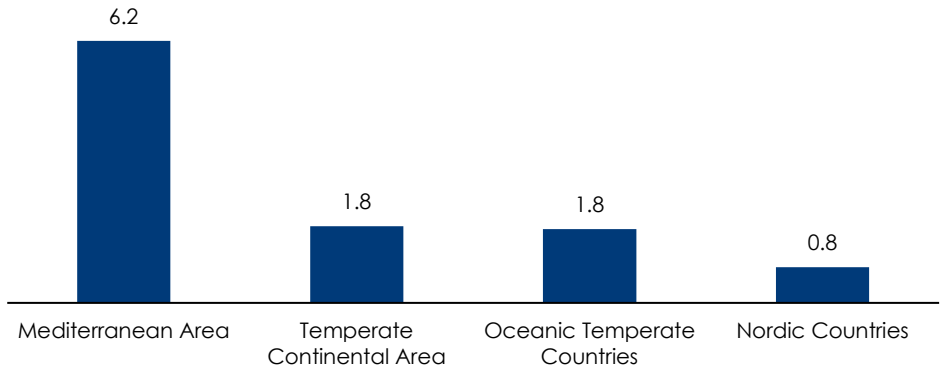
Fig. 4 - The agro-food chain across climate clusters (% incidence on the value of Bioeconomy production, 2024)



Source: Intesa Sanpaolo elaborations on various sources

The sectoral detail shows that in all the areas considered, the agro-food chain represents more than half of the value of the Bioeconomy. In the bio-based Fashion System, the countries of the Mediterranean area, influenced by Italy, stand out, while in the wood and bio-based furniture and paper sectors the Nordic countries emerge.

Fig. 5 - The Bio-based Fashion System across climate clusters (% incidence on the value of production of the Bioeconomy, 2024)

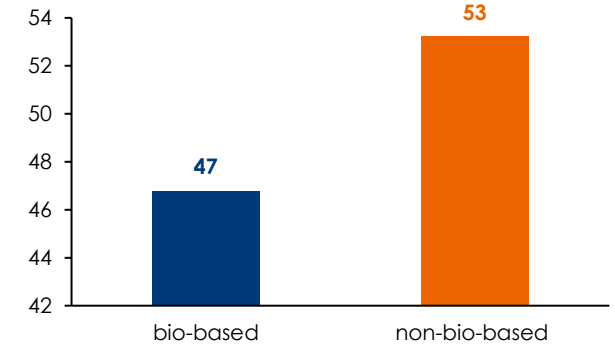


Source: Intesa Sanpaolo elaborations on various sources

The bio-based component of the chemical, rubber and plastic sector has more modest and relatively similar incidences in the different climate zones, from 1.2% of the total Bioeconomy in the Mediterranean to 2.3% in the Nordic countries.

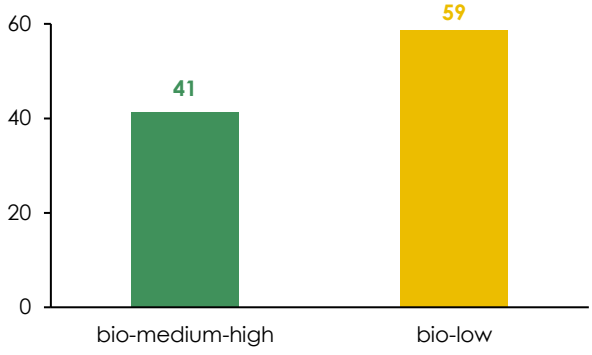
Although its current economic weight remains limited, the bio-based plastics and plastic products segment has a strong development potential, also in light of the recent EU legislation on packaging. It can contribute to emission reductions due to a **lower carbon footprint and improved end-of-life management.** A survey conducted among 171 Intesa Sanpaolo client companies active in the plastic packaging production sector presented in **chapter 3** confirms the role that bio-based products already play in the Italian context**. Indeed, nearly half of the companies interviewed already use inputs of natural origin, and among these, around 40% incorporate bio-based materials in more than 30% of their total inputs.** These are companies with a strong vocation for innovation, which have chosen to use bio-based raw materials driven above all by reasons of competitiveness and market demands.

Fig. 6 - Distribution of the sample by use of bio-based and non-bio-based raw materials (% of respondents)



Source: Intesa Sanpaolo survey of companies in the plastic packaging sector (2024)

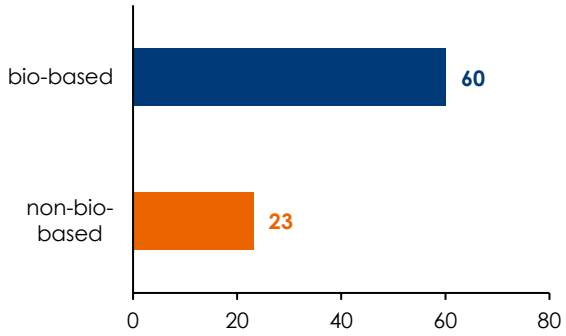
Fig. 7 - Distribution of bio-based companies by intensity class of use of bio-based raw materials (% of respondents)



Note: bio-based raw material use intensity classes: bio-low=1%-30%, bio-medium-high=31%-100%. Source: Intesa Sanpaolo survey of companies in the plastic packaging sector (2024)

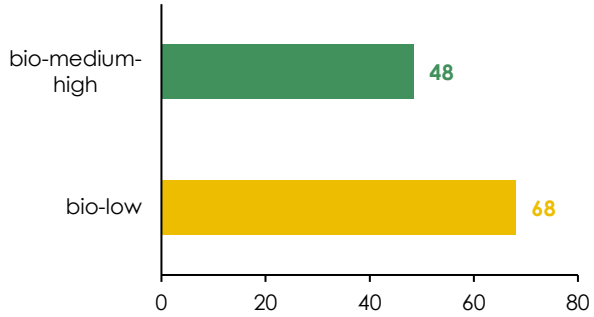
Looking ahead, **23% of companies that currently do not use bio-based raw materials plan to introduce such inputs into their production processes.** Additionally, 68% of companies that use bio-based inputs only marginally report intention to expand their use.

Fig. 8 - Companies that will increase/introduce the use of bio-based raw materials in the next three years (% of respondents)



Note: percentages calculated on total answers, including "don't know". Source: Intesa Sanpaolo survey of companies in the plastic packaging sector (2024)

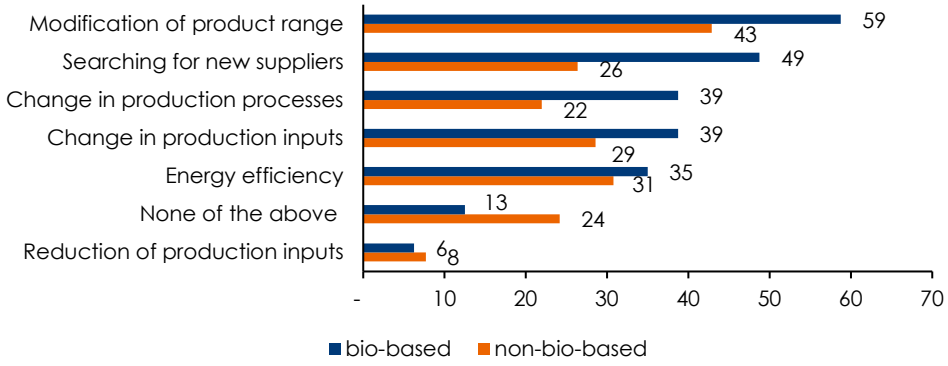
Fig. 9 - Bio-based companies that will increase their use of bio-based raw materials in the next three years (% of respondents)



Note: percentages calculated on total responses, including "don't knows". Intensity classes of use of bio-based raw materials: bio-low=1%-30%, bio-medium-high=31%-100%. Source: Intesa Sanpaolo survey of companies in the plastic packaging sector (2024)

Companies' production and strategic choices are closely linked to the regulatory framework, with **bio-based companies showing greater sensitivity and reactivity** to its evolution. In response to the introduction of new regulations, the main lever activated by companies concerns the modification of the product range, a strategy implemented by 59% of bio-based companies and 43% of non-bio-based firms.

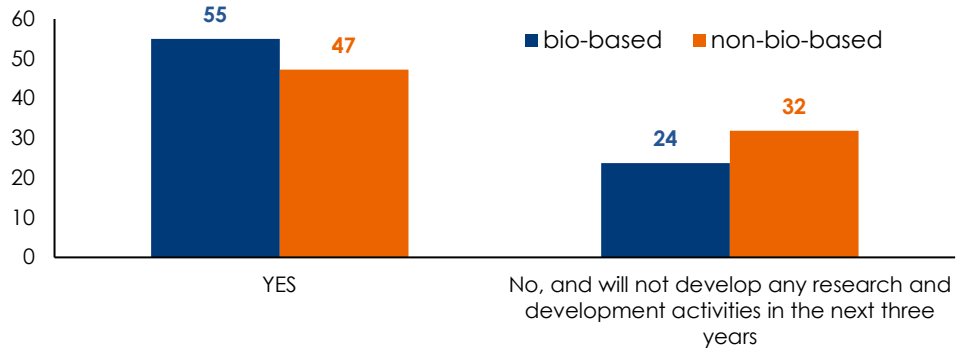
Fig.10 - Strategies adopted following regulatory changes (%; multiple answers possible)



Source: Intesa Sanpaolo survey of companies in the plastic packaging sector (2024)

The vitality of packaging companies also emerges in their focus on innovation, a strategic driver of growth and sustainability. Bio-based companies show a greater attention to this issue: **in fact, more than half of the companies (55%) report carrying out Research and Development activities** -a higher incidence than observed among non-bio-based **companies**.

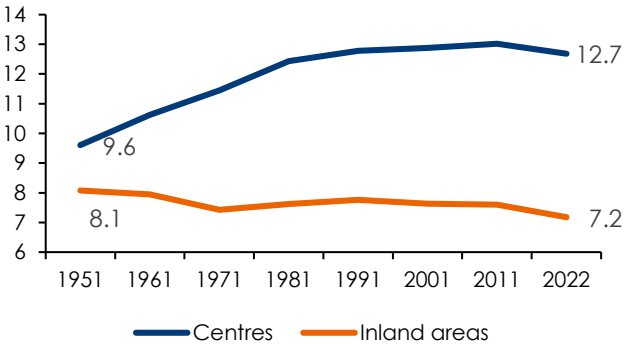
Fig. 11 - Does your company carry out R&D? (%, respondents)



Source: Intesa Sanpaolo survey on companies in the plastic packaging sector (2024)

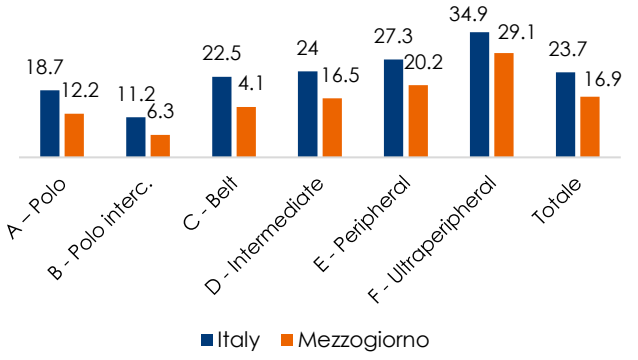
The **Bioeconomy also represents an extraordinary opportunity for inclusive development of Inner Areas** - territories with limited access to essential services, particularly **for Mezzogiorno regions.** These areas, which represent about three-fifths of the national territory, according to the SRM's analysis in **chapter 4**, possess rich ecological and productive capital that makes them naturally suited to lead the transition towards a sustainable Bioeconomy. **Their biodiversity, prevalence of stable crops, diffusion of organic practices, integrated agro-sylvo-pastoral systems, and the relative absence of intensive agriculture configure them as strategic areas for Italy**, not only for production, but as guardians of ecosystem services and sustainable innovation. In order to give **voice to the main actors in the Bioeconomy**, the chapter's conclusions include the main insights from a virtual round table. This dialogue explored both theoretical and institutional aspects of the Circular Bioeconomy model in the context of Inner Areas, as well as concrete cases of project implementation on the territory, with particular attention to the role of wood and forests.

Fig.12 - Population at censuses - Millions of inhabitants per SNAI. Years 1951-2022, Southern Italy



Note: SNAI National Strategy for Inner Areas. Source: SRM elaborations on Istat data

Fig.13 - Share (%) of farms with wooded area by type of territory. Italy and Mezzogiorno



Note: Holdings with woodland/firms with SAT*100. Source: SRM on ISTAT elaborations - VII General Census of Agriculture

Chapter 5 is dedicated to public policies - both Italian and European - that are central to leading lasting and sustainable change. Within the framework of the **Clean Industrial Deal**, the Commission has acknowledged the Bioeconomy as a strategic pillar in building a competitive and sustainable economic and production system. The upcoming **revision of the Bioeconomy Strategy**, expected by the end of 2025, could be a key opportunity to unlock the potential of bio-based materials and reduce dependence on foreign countries. A further building block is **biodiversity-protection**, which is essential for the economy, social and cultural evolution. Bioeconomy sectors, starting with the agro-food sector, are closely intertwined with the health of soil, water, and air. However, despite the growing awareness and policy actions introduced at European and Italian level, biodiversity protection remains a topic that is not widely embraced among Italian companies.

1. The Bioeconomy in Italy in 2024

1.1 Introduction

Laura Campanini
Serena Fumagalli

This chapter presents estimates of the value of production and employment of the Bioeconomy in Italy for the years 2022, 2023 and 2024 and a comparison with the data on the value of the Bioeconomy in the EU27, estimated for the first time in this Report.

In particular, the lack of up-to-date data for 2023 on the value of production per single sector required an estimate for both 2023 and 2024 of the output generated. For employment, on the other hand, Eurostat made 2023 data available and estimates are limited to 2024 only. The revision of the Eurostat statistics used as a basis for our estimates as well as the updating of the bio-based coefficient do not allow a direct comparison of the value of the Bioeconomy with the numbers presented in the previous editions. The updated numbers of the Bioeconomy in 2022 and the new estimates for 2023 and 2024 are therefore presented again.

The perimeter of our analysis includes, as usual, both sectors upstream in the value chain (such as agriculture, forestry and fishing, the wood and paper industry, the chemical and rubber-plastics industry) and sectors downstream in the process (such as food, clothing, furniture, pharmaceuticals). Bioenergy and biofuels and the water cycle are also considered in the definition of the Bioeconomy adopted. Finally, in a logic of closing the circle the bio-based component of waste is also included in the analysis: the recycling and treatment of waste represent, in fact, important sources of biomass that can be used as an alternative productive input to the raw materials traditionally used (typically fossil fuels).

1.2 The estimation methodology

The methodology adopted to calculate the estimation of bio-based activities in this edition of the Report is in continuity with previous editions and has only been revised to take into account information 'gaps', updated statistics and increased data capillarity. The changes concern in particular the estimates for the sectors agriculture, forestry and fishing and waste treatment and collection and the coefficients identifying the bio-based share of the productions of the sectors involved, for which only the values proposed by the Joint Research Centre (JRC) were used. The use of Eurostat statistics made it possible to apply this methodology to the other European countries analysed in Chapter 2.

In this edition of the Report, the lack of detailed data on the value of production to 2023 required estimating both the year 2023 and 2024.

For agriculture, forestry and fishing, the values for 2023 are available in the National Accounts database, while for 2024, unlike in previous editions, the levels were estimated by applying the change in output from data in the Economic Accounts for Agriculture, from Eurostat, a database[7] that collects detailed information on the agricultural system.

The value of the Bioeconomy for the manufacturing sectors (food, fashion system, paper and paper products, wood and furniture, chemicals, plastic rubber and pharmaceuticals) is calculated from the latest data available in the Structural Business Statistics (SBS) database, from Eurostat, updated to 2022. The production value for the years 2023 and 2024 was calculated by applying the rates of change of turnover, available in the Eurostat database with a sufficient level of detail.

[7] Economic accounts for agriculture, Output of the agricultural 'industry'.

For the water service and the bio-based waste management service the estimates for 2023 and 2024 were made from the production levels of 2022 available in Structural Business Statistics disaggregated for the two sectors. For the water sector, the value of output in 2023 was calculated by applying the change in output (for 2023) and value added (for 2024) available in National Accounts data for a larger aggregate than the water sector[8]. For the bio-based waste sector, on the other hand, the dynamics of the value of output estimated by Intesa Sanpaolo[9] was used for the Waste Collection and Treatment sector. This methodology differs from the one used previously but allows a more accurate grasp of the specific dynamics of the sector, although it is broader than just the part referring to bio-based waste.

For the energy sector, the production value estimates for 2023 and 2024 were calculated taking into account both the changes in quantity of energy production, using data from the EMBER source[10], and the electricity production prices using the Eurostat database. This made it possible to consider both the change in quantity of energy production and the price component, which already had a significant relevance from the second half of 2021 and even more so in 2022, due to the price increases following the outbreak of the Russian-Ukrainian war, and which saw a gradual decrease in 2023.

Employment data are available for 2022, 2023, while for the 2024 estimate of employment, we used the Eurostat rates of change of the labour force for all sectors of the perimeter, which are available with a level of disaggregation suitable for our analysis.

With reference to the perimeter, in continuity with previous years, some sectors were considered as a whole, since they have a renewable and biological origin of their inputs: the bio-based value of their production corresponds to the total of the production itself. These sectors are agriculture, forestry and fishing, the food, beverage and tobacco industry, the timber industry and the paper industry. The water cycle is also considered in its entirety: the different phases of the integrated service come under the definition of the Bioeconomy that we have adopted.

With regard to the remaining sectors, it was necessary to identify the share of bio-based inputs relative to each specialisation in order to apply it to the estimated output levels and the number of people employed.

The coefficients used in our estimates to quantify the bio-based share in the pharmaceutical, chemical, rubber-plastics, fashion and furniture sectors are those proposed by the Joint Research Center and presented in the BIOECONOMICS Bioeconomy database updated to 2022[11]. These are quotients calculated by JRC scholars from product statistics, selecting, thanks to the contribution of a group of experts, only those with a bio-based nature. The estimates we calculated for the years 2023 and 2024 were made by keeping the coefficient identified in 2022 fixed, as we do not have reliable information to update these coefficients.

Instead, to determine the coefficients for bioenergy, we used the statistics on electricity production by type of source, available in the EMBER database, which allow us to identify the

[8] The change is available for the aggregate that includes: E36, water collection, treatment and supply; E37, sewerage management; E38, waste collection, treatment and disposal activities and materials recovery; E39 remediation activities and other waste management services).

[9] Source: Intesa Sanpaolo-Prometeia Microsectors Scenario - March 2025 edition.

[10] Independent think tank dealing with energy: https://ember-climate.org/

[11] Lasarte López, Jesús; Ronzon, Tévécia; Piotrowski, Stephan; M'barek, Robert; Carus, Michael; Tamošiūnas, Saulius (2022): Jobs and wealth in the EU bioeconomy / JRC - Bioeconomics. European Commission, Joint Research Centre (JRC) [Dataset] PID: http://data.europa.eu/89h/7d7d5481-2d02-4b36-8e79-697b04fa4278 .

share of energy produced from bio-based sources in the total energy generated for all the years analysed.

For the value of biofuel production, we referred to PRODCOM product statistics, selecting the codes referring to the production of this type of fuel. The data are updated to 2023 and were also considered stable for 2024.

As far as the waste management and treatment sector, the coefficient estimating the component of collected bio-based waste in the total waste produced, net of mineral waste, was updated to 2022[12]. This coefficient was applied to the production and employment data for the waste collection, treatment and disposal sector in order to estimate the bio-based component.

Finally, the value of production and the number of people employed in the Bioeconomy for Italy were calculated by adding the estimates for the agriculture, forestry and fishing, food and beverage industry, wood and paper industry and water cycle sectors to the estimates for the remaining sectors, identified by considering only the bio-based component of their production.

Given the significant dynamism observed in prices in recent years, it is important to point out that the estimates refer to current values, which therefore include the effect of inflation.

In the next section we therefore present both the value of the Bioeconomy for 2022, which takes into account the revisions of the time series used and the updating of the coefficients for the bio-based component of certain production specialisations, and an estimate of the production and number of employees in the Bioeconomy-related sectors for 2023 and 2024.

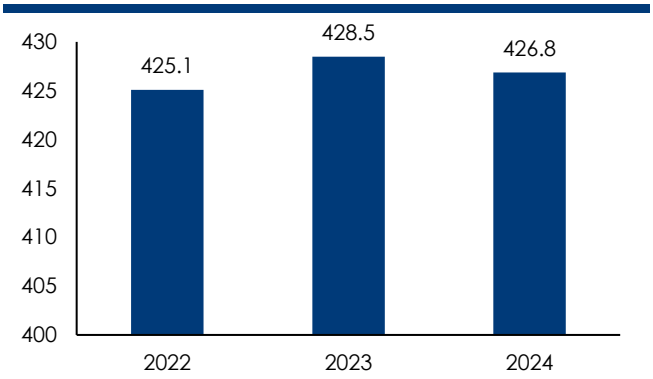
1.3 The Bioeconomy in Italy

In 2024 the set of activities related to the **Bioeconomy in Italy**, defined on the basis of the perimeter indicated in the previous paragraph, generated an estimated output of EUR **426.8Bn and employed more than two million people.** The value of the Bioeconomy is thus estimated to decrease slightly in 2024 compared to 2023 (-0.4%, change in current prices), but this is a synthesis of the highly heterogeneous performance of the sectors that make it up. The good results of the agro-food sector, which accounts for more than half of the Bioeconomy in Italy, are in fact contrasted by the decline of some highly specialised sectors of our production system, such as the fashion system and the wood and furniture sector.

Despite the slight slowdown estimated for 2024, **the weight of the Bioeconomy on the Italian economy remains significant: it represents about 10% in terms of production value and 7.7% considering employment.**

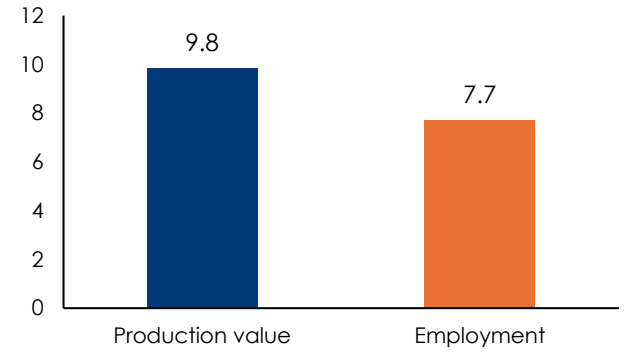
[12] Methodology in line with previous editions of the report, for a more in-depth look at the paragraph "Estimating the bioeconomy component of the waste cycle", 5th Report on the Bioeconomy in Italy and Europe.

Fig. 1.1 - The evolution of the Bioeconomy in Italy (EUR Bn)



Source: Intesa Sanpaolo elaborations on various sources

Fig. 1.2 - The weight of the Bioeconomy in Italy on the total economy, in terms of value of production and employment (%)



Source: Intesa Sanpaolo elaborations on various sources

The agro-food sector, which accounts for about 64% of the value of the Bioeconomy, with an output of over EUR 272Bn (of which about 195Bn generated by the food, beverage and tobacco industry), closed 2024 with an increase in the value of production of 1.3%. According to Istat, the **agricultural sector** showed a 1.4% increase in the volume of goods produced, particularly for crops (1.5%) and livestock (+0.6%) after a 2023 that had been particularly penalised by adverse weather events. The year was particularly favourable for fruit, fresh vegetables and wine. After the rises of the last three years, the trend in production prices, according to Ismea surveys, marked a decisive downturn in 2024, with a -3.7% compared to 2023, while the prices of agricultural products gained 0.9% on the average level of 2023. As regards the processing stage, the production of the **food, beverages and tobacco industry** confirmed the positive trend already observed in 2023, thanks to both the good performance on the domestic market, supported by a moderate rebound in domestic consumption, and the excellent results achieved on foreign markets. Supporting sales abroad were typical Made in Italy products, such as olive oil, wine, cured meats and cheeses, with favourable indications both in traditional European markets and Extra-European ones (United States, Japan, China, Middle East). Also in terms of employment, the agro-food industry is the most relevant sector of the Bioeconomy: more than 1.4 million people will be employed in the sector in 2024 (931,000 in agriculture and 489,000 in the food, beverages and tobacco industry), equal to 46% and 24% respectively of the total national Bioeconomy. The evolution in 2024 is positive for both agricultural employment (+0.5%, up from -1.2% in 2023) and food processing industry employment (+2.1%, up from +1.7% in 2023).

Table 1.1 - The Bioeconomy in Italy

	Value of production – EUR M			Weight %	Employment 2024	
	2022	2023	2024	2024	Thousands	%
Total Bioeconomy	**425,084**	**428,487**	**426,849**	**100.0**	**2.037.8**	**100.0**
Agro-food chain	256,109	268,999	272,569	63.9	1420.6	69.7
Agriculture, forestry and fishing	*74,274*	*75,167*	*77,642*	*18.2*	*931.2*	*45.7*
Food, Beverages and Tobacco	*181,835*	*193,832*	*194,927*	*45.7*	*489.4*	*24.0*
Bio-based Fashion System	47,372	47,998	42,976	10.1	216.3	10.6
Bio-based textiles	*11,543*	*11,006*	*9,805*	*2.3*	*47.9*	*2.4*
Bio-based clothing	*15,442*	*16,555*	*15,328*	*3.6*	*83.8*	*4.1*
Bio-based tanning and leather goods/footwear	*20,387*	*20,437*	*17,842*	*4.2*	*84.5*	*4.1*
Wood and wood products	19,248	16,502	15,475	3.6	110.9	5.4
Paper and paper products	34,697	30,551	29,421	6.9	77.0	3.8
Bio-based chemistry	6,008	5,186	4,993	1.2	9.4	0.5
Bio-based pharmaceuticals	16,297	17,694	18,977	4.4	43.6	2.1
Bio-based rubber and plastics	1,095	1,011	964	0.2	3.6	0.2
Bio-based furniture	13,885	13,539	13,218	3.1	57.5	2.8
Bioenergy	6,151	1,902	2,408	0.6	2.1	0.1
Biofuels	2	2	2	0.0	ND	ND
Water cycle	14,436	14,406	14,744	3.5	52.3	2.6
Biodegradable Waste Management and Recovery	9,787	10,697	11,103	2.6	44.6	2.2

Note: ND = not available. Source: Intesa Sanpaolo elaborations on various sources

2024 was a negative year for the Italian fashion system, conditioned by the slowdown in world trade, the weakness of consumption on the domestic market and the decrease of demand for luxury goods, which affected all sectors of the fashion indusry. In our country, the bio-based share of the production of goods in the fashion system is significant and higher than the EU average, with a weight exceeding 55% for tanning, leather goods and footwear and 40% for the textile-clothing segment. More specifically, the **bio-based fashion system** is expected to have a production value of around EUR 43Bn in 2024, down 10.5% compared to 2023 (EUR -5Bn), a synthesis of a negative trend that has affected all segments and in particular that of tanning/leather goods (-12.7%, EUR -2.6Bn), which has suffered most from the difficulties of companies linked to the large luxury brands. The textile sector also fell in double figures (-10.9%, -EUR 1.2Bn), while the clothing sector contracted by -7.4%. Despite the downsizing, the weight of the fashion supply chain in the total bioeconomy remains high, with a share of 10.1%. With about 216,000 employees, the sector accounts for 11% of employment in the national Bioeconomy.

The slowdown in the **paper and paper products** sector continued in 2024, albeit at a less intense pace than in 2023. While a recovery was observed in the paper segment, the paper products segment continued to decline. Despite some positive signs from the activating sectors (packaging first and foremost), the drop in producer prices contributed to the decline in the value of production, which stood at EUR 29.4Bn in 2024, 3.7% less than in 2023, representing 6.9% of the national Bioeconomy's output. Employment also fell slightly, to around 77,000, or 3.8% of the total.

For the chemicals sector, 2024 was also a year of contraction, albeit smaller than that observed in 2023. Globally, the sector suffered from weak demand in the main customer sectors, automotive and construction, in a scenario characterised by increasing competitive pressure. The weak performance of the Italian chemical industry, that concerns the majority of segments, was also affected by the dynamics of sales prices, which fell during the year. An exception to this was the cosmetics and personal care products sector, which saw an increase in turnover, thanks also to the good dynamics of exports. We estimate for **bio-based chemicals** a drop in the value of output of 3.7%, to levels of around EUR 5Bn, or 1.2% of the national Bioeconomy. The number of employees also fell, although they remain at levels of over 9 thousand, or 0.5% of the total.

The rubber-plastics sector also declined, showing a less intense pace of reduction than in 2023. The slowdown was transversal to the various divisions, but more significant for rubber products. The weak demand for automotive components contributed above all to the sector's performance, which was only partially offset by more dynamic demand from other activating sectors such as food or consumer goods sector. We estimate for the **bio-based plastic rubber** sector a drop in production value of 4.7%, which brings output to levels of EUR 964M, representing 0.4% of the total Bioeconomy. Also in terms of employment, with approximately 3,600 employees, the bio-based plastic rubber sector shows a limited weight of 0.2% of total employment.

If the wood sector is considered as a whole as part of the Bioeconomy, for the furniture industry only a share of the production is bio-based, approximately 50%. The year 2024 was a year of further slowdown for the wood sector (-6.2%), which was affected by the lesser driving force of the construction industry and the slowdown of the demand for inputs destined for the furniture sector, which was less dynamic both on the domestic front, where consumption remained weak, and on foreign markets (-2.4%). In 2024, the **wood supply chain** and the **bio-based furniture** sector thus reached values of EUR 15.5Bn and EUR 13.2Bn respectively, representing around 7% of the value of the Bioeconomy. Overall, the supply chain (wood and bio-based furniture), with approximately 168.4 thousand employees, accounts for 8.3% of the total.

The growth of the Italian pharmaceutical industry continued in 2024, confirming a higher development trend than that of the manufacturing industry, with positive indications for both basic pharmaceuticals and medicines. The value of **bio-based pharmaceutical** production is estimated at around 19Bn, or 4.4% of the Bioeconomy. In terms of employment, the sector employs over 43,000 people, around 2% of the total.

Bioenergy saw a slight recovery in 2024 compared to 2023, but without reaching the peaks seen in 2021-2022. According to EMBER's data, electricity generation considering the different types of sources recorded an increase of about 1% in TWh in 2024, while prices for electricity production, transmission and distribution continued to decrease, after jumping by more than 100% in 2022, falling by more than 12%. The value of **bioenergy** production is thus estimated at EUR 2.4Bn in 2024. Although the weight of the sector is low, in the future the demands of the energy green transition may increasingly involve this sector, which plays an important role among renewable energies in Italy.

In 2024, the total production value of the **water cycle** is just under EUR 15Bn and represents 3.5% of the production value of the Bioeconomy, employing 52 thousand people. Water is an essential commodity for agricultural production, industry and civil (household) use. Demand is characterised by being essentially anti-cyclical while tariff dynamics are regulated. It should be remembered that self-production plays a significant role in the consumption of manufacturing industry and to some extent also in agricultural production. These components are obviously not included in the statistics used in the Report.

The estimation methodology adopted to quantify the **biocompatible** part of the **waste cycle** leads to a production value of EUR 11.1Bn in 2024, which corresponds to 2.6% of the total production value of the Bioeconomy. Compared to 2023, the sector shows a growth of 3.8%, which can be attributed to the positive GDP dynamics (the sector has not yet achieved the desired decoupling between GDP and waste generated, if only to a small extent) and the trend in tariffs. The development of the waste treatment sector is closely linked to EU and national regulations and plant equipment. Through recycling and reuse targets, regulations aim to 'close the circle' of the product life cycle through a greater share of recycling and especially reuse; the adoption of these practices will bring benefits for both the environment and the economy through the ability to extract maximum value from raw materials, waste and waste, favouring energy savings and the reduction of greenhouse gas emissions.

Biodiversity, human activities and the Bioeconomy: a focus on the actions of Italian companies

Laura Campanini
Stefania Trenti

According to the definition of the Rio Convention on Biological Diversity, biodiversity is the variability of all living organisms included in aquatic, terrestrial and marine ecosystems; "this concept includes diversity within species, and between species in ecosystems", and is distinct from the notions of environment and ecosystems.

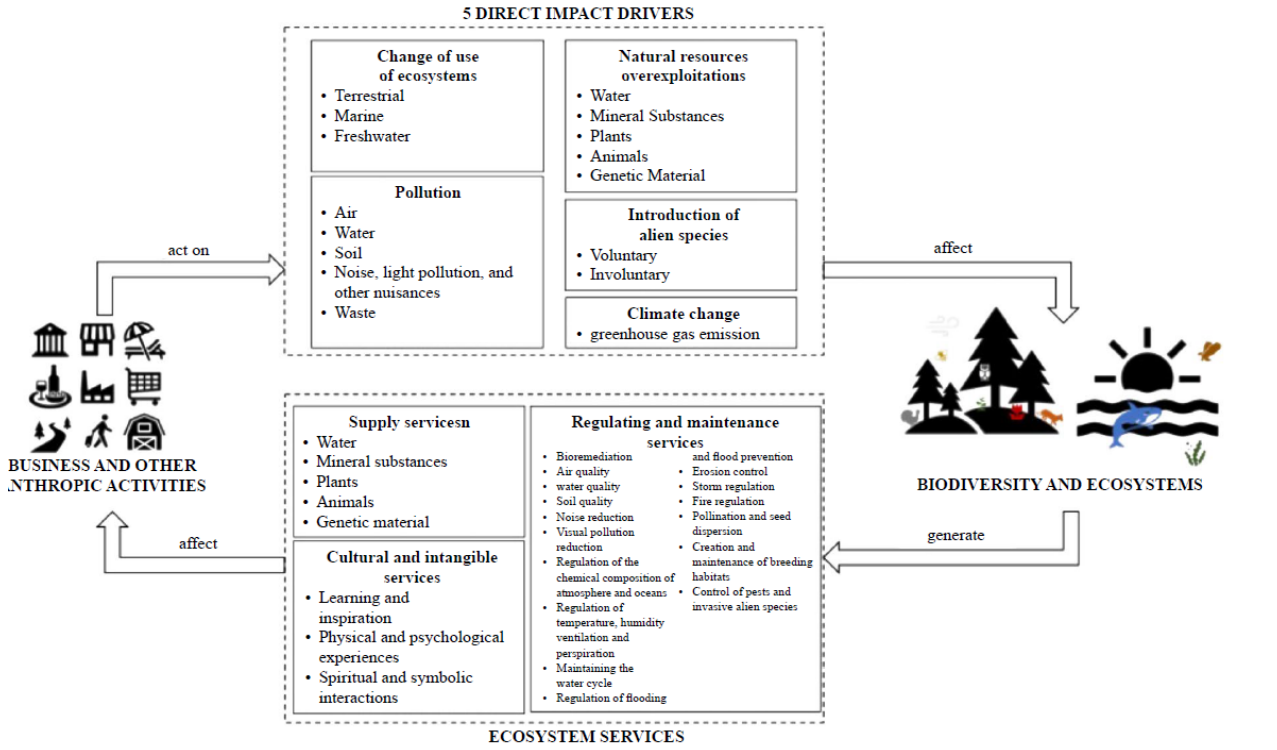
Biodiversity is not just a list of species living in certain environments, the true value of biodiversity lies in the set of interactions that species develop with each other and with the ecosystem. Interactions form the basis of all ecosystems, generate value and are closely linked to our health, food security and quality of life.

Human activities are accelerating the loss of biodiversity, putting species and ecosystems at risk. Habitat destruction, pollution, climate change, and unsustainable use of resources are major risk factors.

The main causes of biodiversity loss can be grouped into five macro-categories:

- changes in land use (deforestation, intensive monocultures, urbanisation);
- direct exploitation: hunting and fishing (intensive fishing can reduce fish populations and alter the balance of marine ecosystems);
- climate change;
- pollution (industries may emit pollutants, in addition to the production of potentially dangerous/damaging waste for ecosystems);
- the presence of invasive exotic species.

Systemic model of corporate impacts dependencies



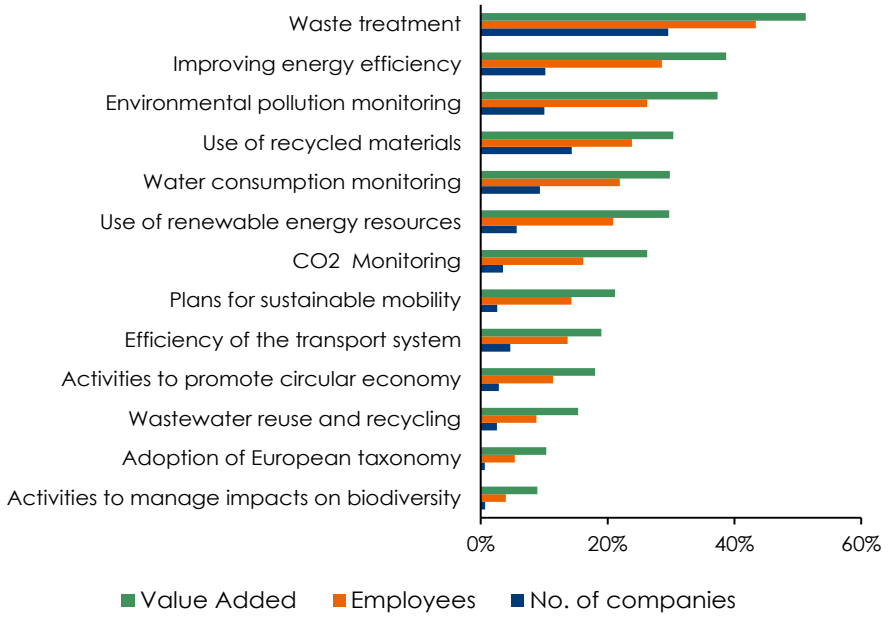
Source: 1st ANNUAL REPORT OF THE NATIONAL BIODIVERSITY FUTURE CENTRE, 2024

At the same time, the loss of biodiversity has important consequences for economic and generally human activities. Economic development is linked to biodiversity as it is based on the use of natural resources. In fact, productive activities use various 'services' that derive from the proper functioning of ecosystems such as raw materials, water, environmental resources, and agricultural land. The creation of value is closely linked to interaction with the ecosystem. The loss of biodiversity undermines the ability of ecosystems to provide adequate services for economic development and represents both a cost and a potential risk. The logic can only be systemic with the creation of real 'dependencies'. The graph, drawn up by the National Biodiversity Forum, describes the main interactions of impacts-dependencies between human activities and biodiversity and provides an overview of the interrelationships and links between different human activities and ecosystems.

Bioeconomy sectors starting with the agro-food sector, are closely connected with soil, water and air health, and depend on the balance of biodiversity. The links with the biodiversity of the agricultural sector, and thus of the food industry, are crucial. The wood, paper and furniture industries are closely linked to forests; the fashion industry uses natural fibers derived from crops and livestock; biomass is used for the production of energy and new chemical-pharmaceutical and plastic products. The water cycle is also an important and fundamental component of the Bioeconomy and is crucial for biodiversity.

The protection of biodiversity, despite the growing awareness and policy actions introduced at European and Italian level, is still a little-known issue among Italian companies. The results, recently published by Istat, concerning the actions taken by national companies on the environmental sustainability activities shows, in fact, those to manage the impacts of biodiversity in last place: only 0.7% of companies with more than three employees, accounting for 3.9% of employees and 8.9% of value added.

Diffusion of sustainability actions in Italian companies 2022 (%)

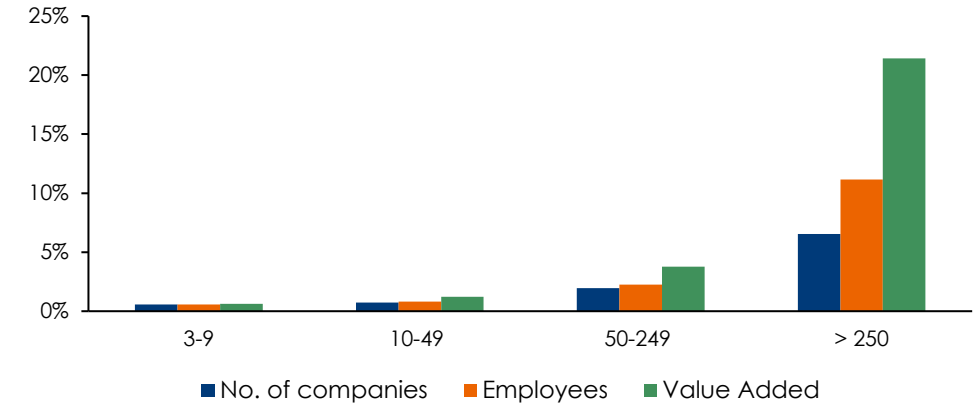


Source: Intesa Sanpaolo elaborations on Istat data

Clearly more widespread are behaviours related to waste treatment or attention to energy issues, both from the point of view of process efficiency and the use of renewable energy sources.

Details by company size show an increasing diffusion according to company size: among large companies, in fact, the share of subjects adopting actions to mitigate their impact on biodiversity rises considerably, reaching about 20% of GDP.

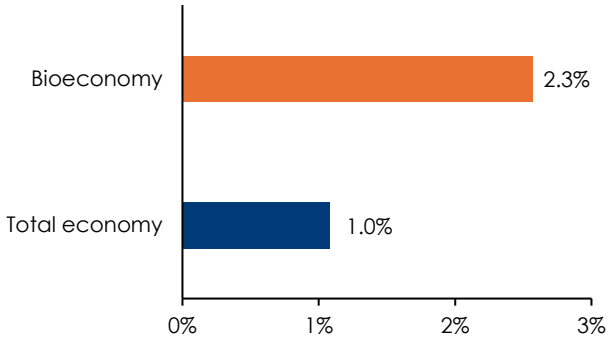
Diffusion of actions to manage biodiversity impacts by company size (%, 2022)



Source: Intesa Sanpaolo elaborations on Istat data

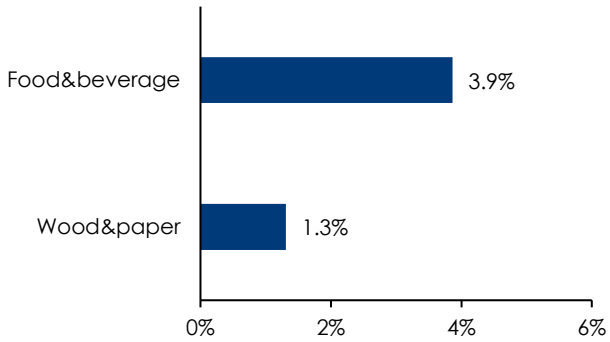
These data are in any case partial: in fact, the survey excludes agricultural companies, potentially those most interested in the biodiversity issue, along with sectors, such as food and beverages or the wood/paper in which actions to reduce their impact are, in fact, more widespread. Overall, redefining the perimeter with the same methodology adopted in other parts of this report, behaviours aimed at preserving or mitigating the impact on biodiversity appear to be more widespread among companies belonging to the Bioeconomy sectors.

Diffusion of actions to manage impacts on biodiversity (% of companies with more than 10 employees, 2022)



Note: Bioeconomy net of agriculture, forestry and fishing. Source: Intesa Sanpaolo elaborations on Istat data

Diffusion of actions to manage biodiversity impacts by sector (% of companies with more than 10 employees, 2022)



Source: Intesa Sanpaolo elaborations on Istat data

1.4 The Italian Bioeconomy in Europe

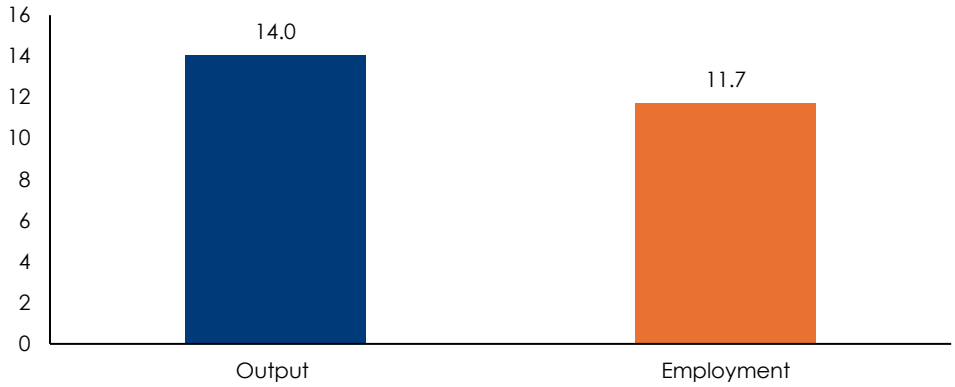
This section presents a comparison between the value of the Italian Bioeconomy and that of the EU27, estimated for the first time in this Report.

Applying the same methodology used to calculate the Italian Bioeconomy to the statistics available for the EU27 aggregate[13], the value of production and the number of people employed in the European Bioeconomy in 2024 were in fact measured. In the next chapter, the results will also be presented both at an aggregate level according to climate zones and for individual countries. This is an original work that aims to broaden the comparison with other countries from the analysis of only the main European economies (France, Germany and Spain) carried out in previous years' editions.

The production value of the Bioeconomy in the 27 countries of the European Union is estimated to be EUR 3,042Bn in 2024, employing over 17 million people. The Bioeconomy thus accounts for 8.7% and 8% respectively of total EU output and employment.

The Italian Bioeconomy accounts for 14% of the total output of the European Bioeconomy, a higher percentage than that observed when considering total economic activities (12.4%), thus highlighting **Italy's specialisation in the Bioeconomy meta-sector. In terms of employment, the weight of the Italian Bioeconomy is 11.7%** of the total, in line with that observed for the total economy. In Italy, the value of production per employee in the Bioeconomy is higher than in Europe, with an average figure of EUR 209,000 per employee compared to 174,000 per employee in the EU-27. Italy's higher output per employee could depend on the different sectoral composition, especially considering the greater importance of the agricultural sector in Europe and the number of people employed in it.

Fig. 1.3 - The weight of the Italian Bioeconomy on the total EU27 Bioeconomy



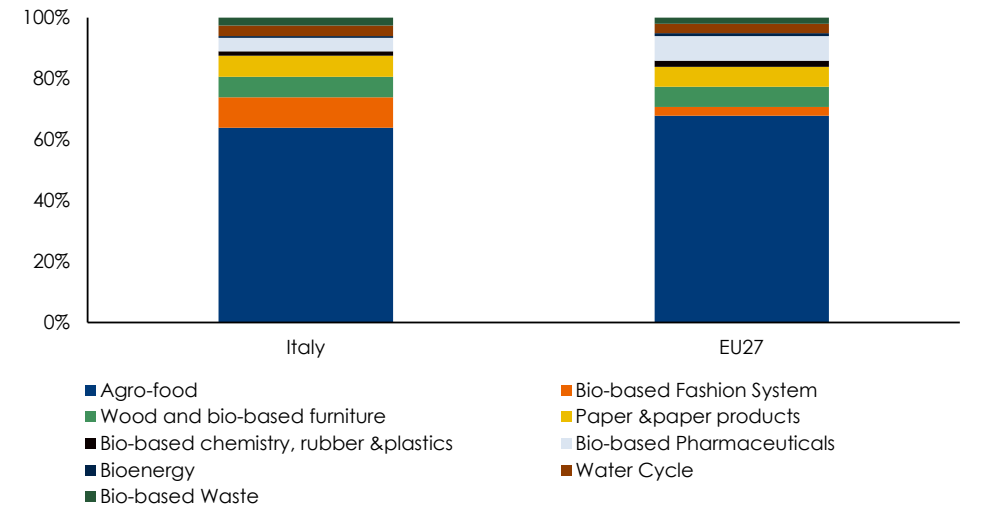
Source: Intesa Sanpaolo elaborations on various sources

A comparison of the Italian sectoral composition with the European one shows similarities, but also some interesting differences. The agro-food sector plays a leading role in both the Bioeconomy of our country and the EU27, with a weight of more than half of the total, both in terms of output value and number of employees. However, it is more relevant in Europe, where the percentage is 68%, compared to 64% in Italy, with more marked differences if we analyse the figure in terms of employees. In this case, the European agro-food sector accounts for 77% of the total number of employees, about 8 percentage points more than in the Italian Bioeconomy. In

[13] Information is available for all the sectors analysed except for pharmaceuticals, whose data at European level are confidential. To overcome this shortcoming and given the relevance of the pharmaceutical industry in the European context, it was decided to use the turnover figure for bio-based pharmaceuticals from the Joint Research Center.

Italy, on the other hand, the greater importance of the fashion system stands out, with a weight of 10.1% compared to a modest 2.9% for the EU27, which confirms our strong specialisation in the textile-clothing and leather sectors (both in terms of output and employees). The weight of European bio-pharmaceuticals is higher, especially if we look at the value of production, a figure that reflects the strong specialisation of some European countries, where important multinationals in the sector are located. The wood and bio-based furniture industry, as well as the paper and paper products sector, accounts for about 7% of the Bioeconomy's output, both in Italy and in Europe. Slightly higher in Europe is the weight of bio-based chemicals, rubber and plastics (2% versus 1.4%) and bio-energy (1% versus 0.6%), while it is lower in the water cycle (3.1% versus 3.5%) and bio-based waste (1.9% versus 2.6%).

Fig.1.4 - % composition of the Bioeconomy by sector (production value)



Source: Intesa Sanpaolo elaborations on various sources

2. The Bioeconomy in Europe

2.1 Introduction

Laura Campanini
Serena Fumagalli

In this chapter we focus our analysis on the Bioeconomy in different European countries, widening our view for the first time to almost all European countries (23 countries out of 27)[14]. This is a considerable broadening, since in previous editions the comparison was always conducted on a limited number of countries; in the last editions of the Report, data on France, Germany and Spain were presented.

The analysis focuses on the estimated production value of the Bioeconomy in 2024.

In order to offer a view that is both concise and able to describe the specificities of the different geographical areas, it was decided to first analyse the European countries starting from their belonging to the different climate areas defined in Köppen's mapping and then to give the detail by individual country.

2.2 The estimation methodology and the clusters identified

The methodology adopted to calculate the estimation of Bioeconomy-related activities in the different European countries resembles that used in Chapter 1 for the estimation of the Bioeconomy in Italy.

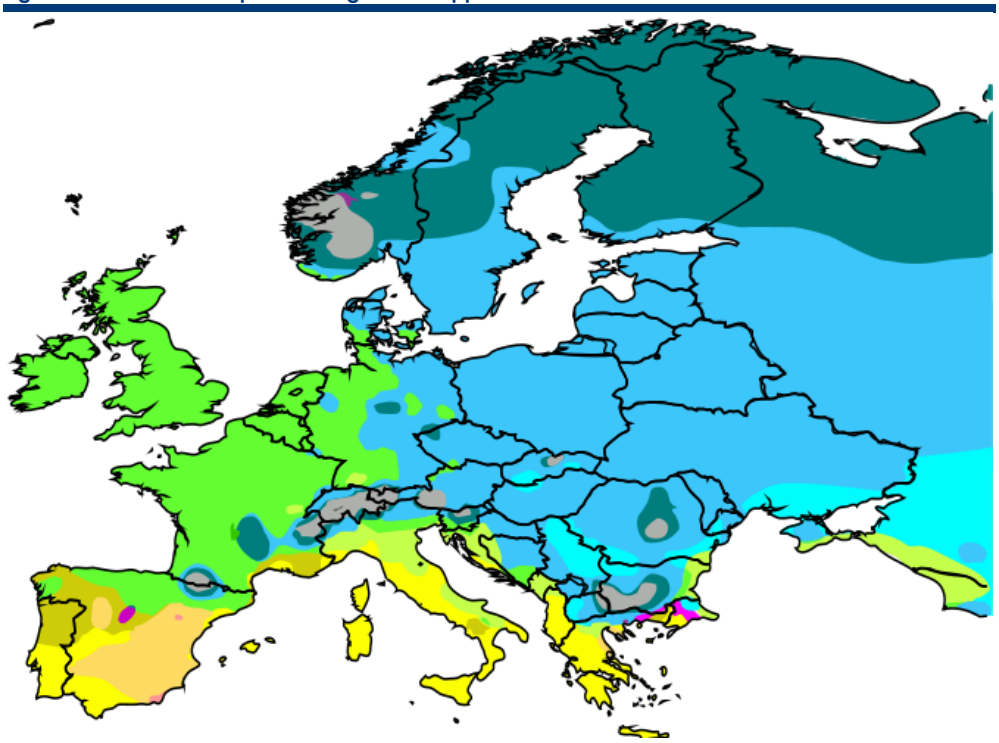
The databases of National Accounts, Agricultural Accounts and Structural Business Statistics, as well as short-term statistics on the evolution of turnover are, in fact, available for the various European countries, at a level of sectoral detail adequate to estimate the sectors included in the Bioeconomy, albeit with some exceptions.

An aggregation of the 23 countries by climatic areas is proposed in the awareness that the Bioeconomy more than other sectors is based on territorial and local specificities characterised by specific climatic aspects. For this purpose, the climate areas defined in the Köppen mapping were used and the individual countries were attributed to a specific area following the criterion of prevalence. The proposed clusters are therefore four:

- **Mediterranean area**: Italy, Spain, Greece, Portugal and Croatia;
- **Temperate Continental area**: Austria, Romania, Poland, Czech Republic, Slovenia, Hungary, Bulgaria and Slovakia;
- **Oceanic Temperate area**: France, Germany, Belgium and the Netherlands;
- **Nordic area**: Latvia, Lithuania, Estonia, Sweden, Finland and Denmark.

[14] Countries that are not analysed were excluded from the calculations due to the lack of up-to-date and sufficiently detailed data at sector level.

Fig. 2.1 - The climate map according to the Köppen classification

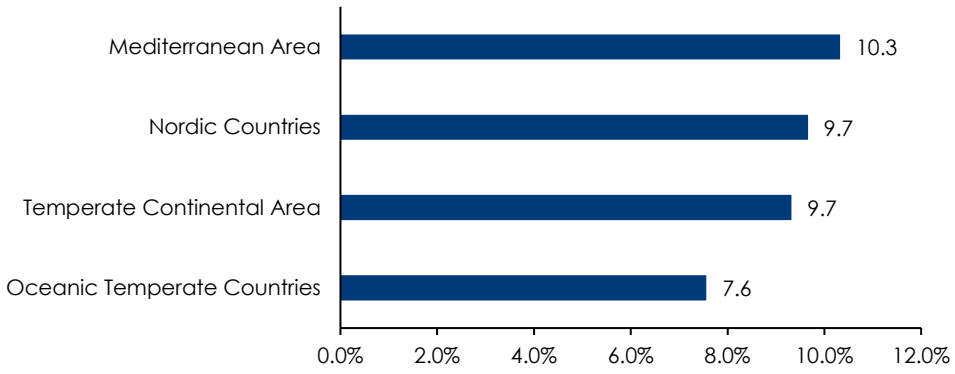


Source: Köppen classification map

2.3 The Bioeconomy in European countries aggregated by climate zones

The incidence of the Bioeconomy on the overall production activities is greatest in the Mediterranean area where, overall, the five countries examined realised an output of EUR 870Bn in the Bioeconomy meta-sector. Next in terms of relevance to the economy is the Nordic area, where activities of interest account for 9.7% of the total and the six countries realised an output of 256Bn. In the Temperate Continental area, the Bioeconomy activities of the eight countries are estimated to be worth EUR 477Bn and account for 9.3% of the total output value. The lowest weight is found in the four Temperate Oceanic Countries despite the fact that this area has the highest cumulative value of bioeconomy production, 1,309Bn, but where the sector's weight in the total economy is 7.6%.

Fig. 2.2 - The weight of the Bioeconomy in 2024 in climate clusters on the total economy, in terms of production value (%)

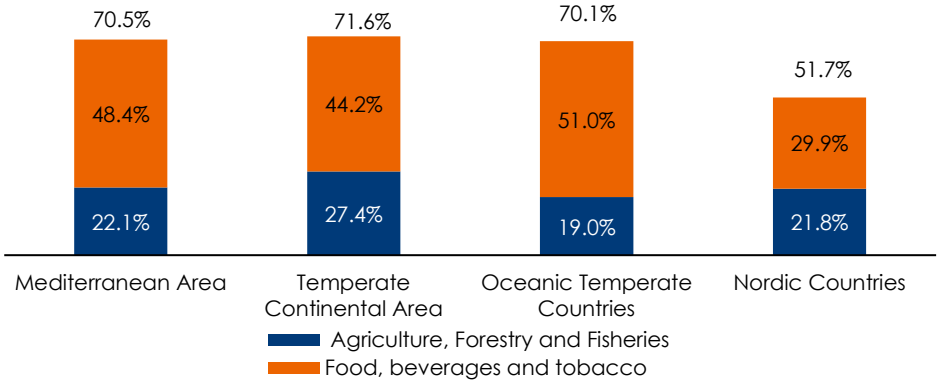


Source: Intesa Sanpaolo elaborations on various sources

The analysis of countries aggregated at the level of climate clusters offers a cross-section of the relevance of the various sectors in the different clusters.

The agro-food industry represents the main sector in all areas but with partly different weights. The importance of this sector in the total Bioeconomy in the Mediterranean, Temperate Continental and Temperate Oceanic Countries is very similar (70.5%, 71.6% and 70.1% respectively), while **for the Nordic countries agro-food accounts for 51.7%** of the total value of production in the Bioeconomy. However, when considering agriculture and the food and beverage industry separately, the specialisations differ even among the countries that show an incidence of more than 70%. In the Mediterranean and Oceanic Countries, the weight of the processing industry is more relevant, while in the Temperate Continental Countries the primary sector has a higher incidence.

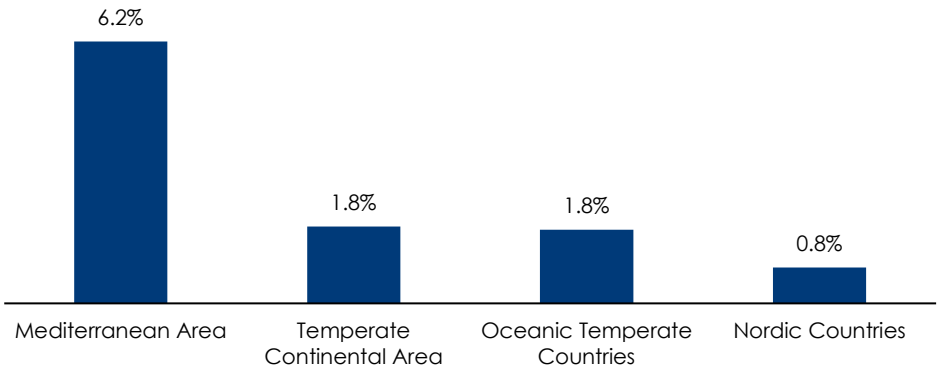
Fig. 2.3 - The agro-food sector in the various climate clusters (percentage on the value of production of the Bioeconomy, 2024)



Source: Intesa Sanpaolo elaborations on various sources

The bio-based fashion system is significant in the Mediterranean countries for which the sector accounts for 6.2% of the Bioeconomy's total production, in the other clusters the weight of this sector is lower and ranges between 0.8 and 1.8%. The figure for the Mediterranean area is influenced by the sector's relevance in Italy.

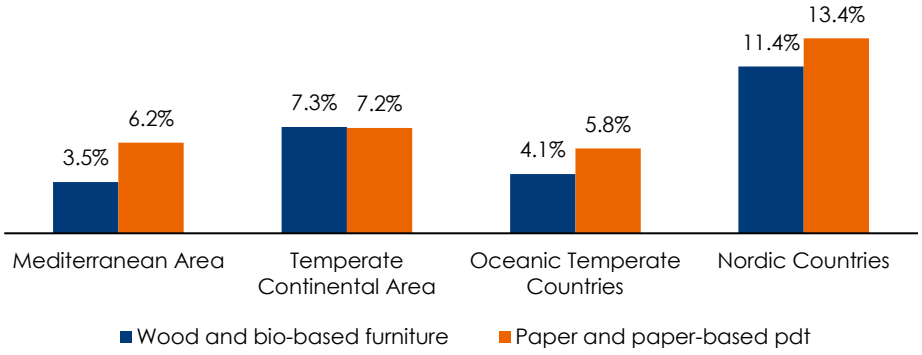
Fig. 2.4 - The bio-based fashion system (Percentage on the value of production of the Bioeconomy, 2024)



Source: Intesa Sanpaolo elaborations on various sources

The Nordic countries are characterised by a high incidence of production in the Wood and bio-based Furniture (13.3%) and **Paper and Paper Products** (13.4%) **sectors**. These industries are also significant in the other clusters but with a lower weight.

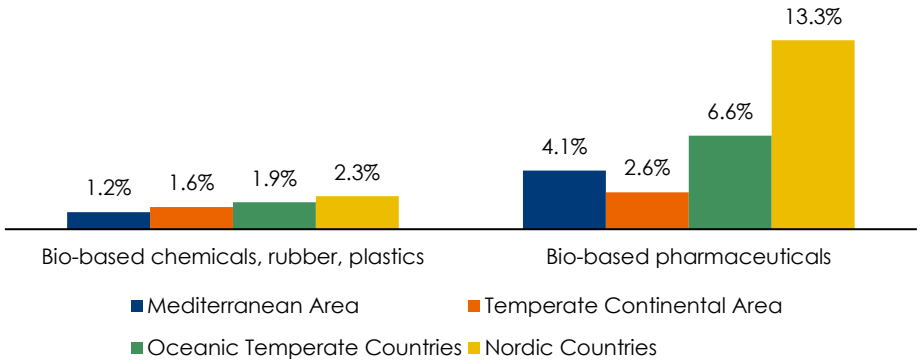
Fig. 2.5 - The Wood and bio-based furniture and Paper and paper products sectors (weight on the value of production of the Bioeconomy, 2024)



Source: Intesa Sanpaolo elaborations on various sources

The bio-based chemical-pharmaceutical sector has a significant weight in the Nordic and Temperate Oceanic countries. The greatest differences concern bio-based pharmaceuticals, which in the Northern countries account for 13.3% of the value of the Bioeconomy, the weight of this sector decreases to 6.6% in the Oceanic Temperate Countries, and to 4.1% in the Mediterranean area and 2.6% in the Continental Temperate Countries. The bio-based chemical industry has a more modest and relatively similar weight in the different climate zones.

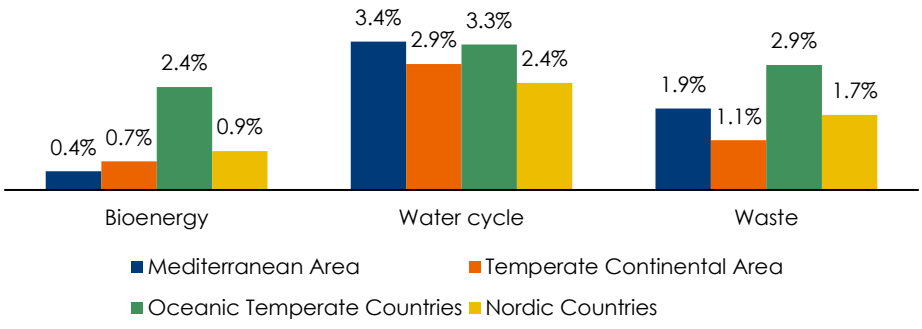
Fig. 2.6 - The Bio-based Chemicals, Plastic Rubber and Pharmaceuticals sectors (weight on the value of production of the Bioeconomy, 2024)



Source: Intesa Sanpaolo elaborations on various sources

For bioenergy, the specialisation of Temperate Oceanic Countries stands out. Bio-based waste management and the water cycle have relatively similar weights in the different climate zones.

Fig. 2.7 - Bioenergy, water cycle and bio-based waste (weight on the value of production of the Bioeconomy, 2024)



Source: Intesa Sanpaolo elaborations on various sources

Bio-based waste in Europe

Laura Campanini

The perimeter of the Bioeconomy adopted in the Report includes bio-based waste, i.e. that part of waste of urban and industrial origin that has a bio-based component and that is collected in a differentiated manner. In quantifying the value of production in the various European countries, specific coefficients have been used relating to the percentage of bio-based waste collected out of the total waste produced, net of mineral waste, in line with the methodology already adopted in the Report in previous editions for a more limited number of European countries.

Bio-based waste represents an important source of biomass that can be used to obtain compost, nutrients, bioenergy; in fact, it is a valuable input for bio-refineries. For these reasons, the collection of such waste is crucial for the sustainability and circularity of economic models.

However, the collection of this waste is still limited in all European countries and this resource is only partly valorised; a not marginal fraction, not being collected by separate sorting, is still disposed of together with undifferentiated waste in landfills (even part of the waste collected separately is not valorised in an appropriate way today).

The greatest delays are evident for municipal organic waste, i.e. waste from separate collection from households and catering and small businesses. An important component of this waste is food waste, a further component derived from the collection of green waste.

A recent study[15] estimates the amount of organic waste produced in the different European countries and the current capacity to collect this waste separately, so that it can be sent to the most appropriate recycling methods. The available biomass is estimated by distinguishing between food and green waste[16].

The results are shown in the table below. At European level, the average per inhabitant of organic waste generated is estimated to be 220 kg. **Overall, the biomass from organic waste (food and green) is just under 100 million tonnes at European level.** In absolute terms, Germany is estimated to have a biomass potential from municipal waste of 18 million tonnes, followed by France with 16 million tonnes and then Italy (10 million tonnes).

[15] Bio-waste generation in the EU: Current capture levels and future potential. Zero Waste Europe, 2024.
[16] For food waste the estimates are in line with the estimates provided by the EU-funded FUSIONS project, which indicate an EU average of 113 ± 12 kg per capita. For bio-waste from green waste, estimates are based on evidence of different green waste generation in different climate zones and territories (cities, suburbs and rural areas).

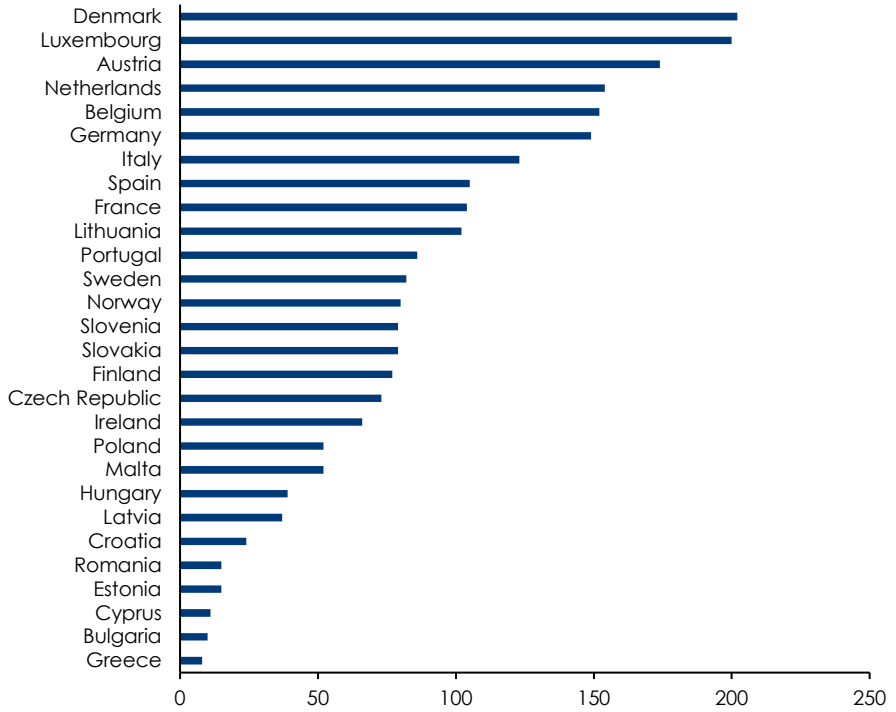
Organic waste potential (food + green, Kg/person/year and tonnes, 2021-2022)

	Kg/person	tonnes
Germany	220	18,291,912
France	238	16,204,488
Italy	176	10,402,420
Poland	247	9,299,530
Spain	187	8,854,298
Romania	271	5,166,043
Netherlands	209	3,669,435
Belgium	239	2,781,491
Portugal	244	2,528,613
Czech Republic	232	2,441,390
Hungary	244	2,362,685
Sweden	226	2,359,538
Austria	257	2,304,038
Bulgaria	199	2,304,038
Greece	192	2,003,391
Denmark	273	1,280,818
Slovakia	235	1,275,355
Finland	227	1,258,190
Ireland	235	1,190,052
Norway	216	1,174,462
Croatia	225	867,429
Lithuania	251	704,533
Slovenia	264	555,571
Latvia	230	431,738
Estonia	213	283,231
Luxembourg	277	178,568
Cyprus	118	107,140
Malta	128	66,428

Source: Zero Waste Europe, 2024

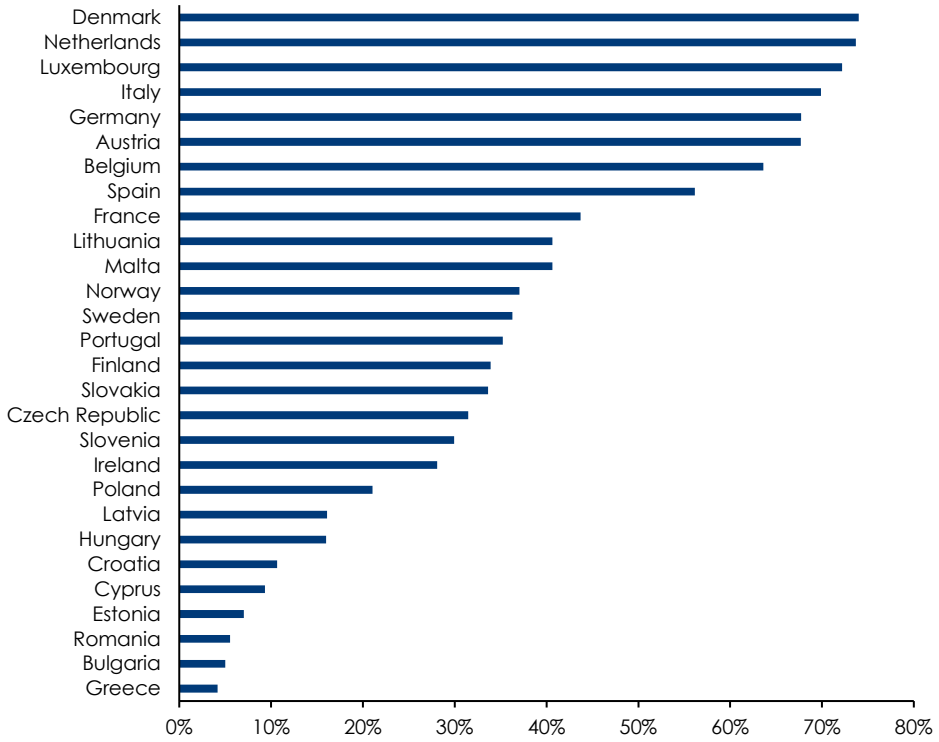
The capacity to collect this biomass separately and to send it for recycling is 47% at the European level, which means that more than half of the biomass is not recycled today. At the level of individual countries, the situation is quite heterogeneous: it ranges from 74% collected in Denmark to the lowest in Greece, where only 8% of organic waste is collected. However, in recent years, from 2018 to 2022, separately collected bio-waste has increased by 46% at European level; this is a good indicator of the outlook, with particularly virtuous countries.

Bio-waste collection (Kg/person/year, 2021-2022)



Source: Zero Waste Europe, 2024

Percentage of separate collection of organic waste (2021-2022)

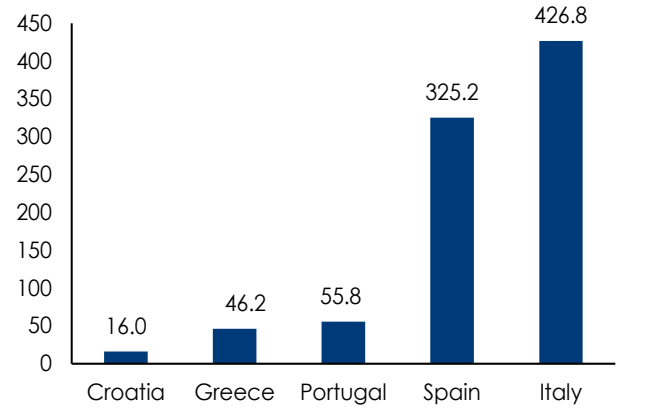


Source: Zero Waste Europe, 2024

2.4 The Bioeconomy in European countries

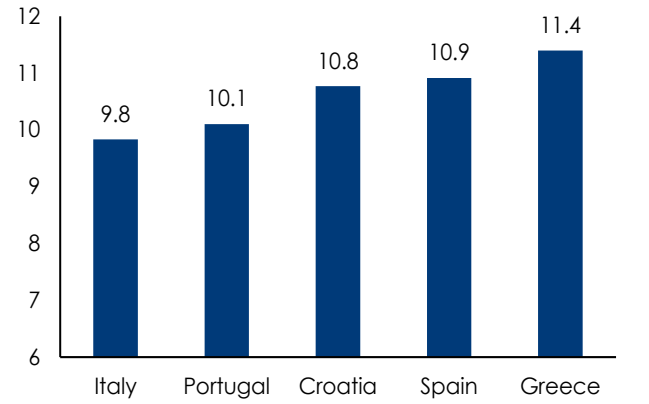
In the **Mediterranean area**, Italy and Spain stand out in terms of the value of the Bioeconomy in absolute terms, with an estimated output for 2024 of EUR 426.8Bn and 325.2Bn. The figures for Portugal, Greece and Croatia are much lower, with outputs of EUR 55.8Bn, 46.2Bn and 16Bn respectively. However, the incidence of the Bioeconomy on national output shows a **similar weight in all the countries analysed**, with values **of around 11% for Spain and Croatia and 10% for Portugal and Italy.** The incidence is higher in **Greece**, with a percentage of **11.4%.**

Fig. 2.8 - The value of the Bioeconomy in 2024 in some Mediterranean countries (EUR Bn)



Source: Intesa Sanpaolo elaborations on various sources

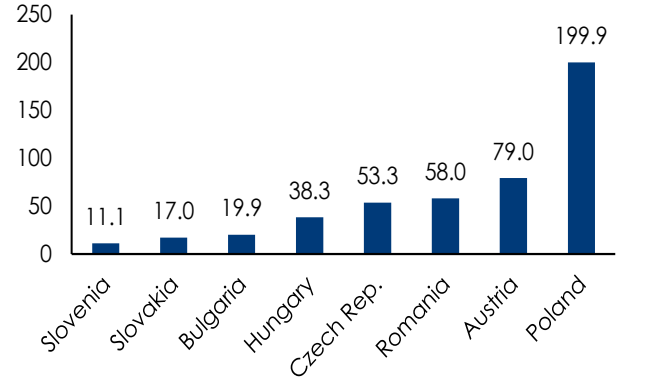
Fig. 2.9 - The weight of the Bioeconomy in 2024 in some Mediterranean countries on the total economy, in terms of production value (%)



Source: Intesa Sanpaolo elaborations on various sources

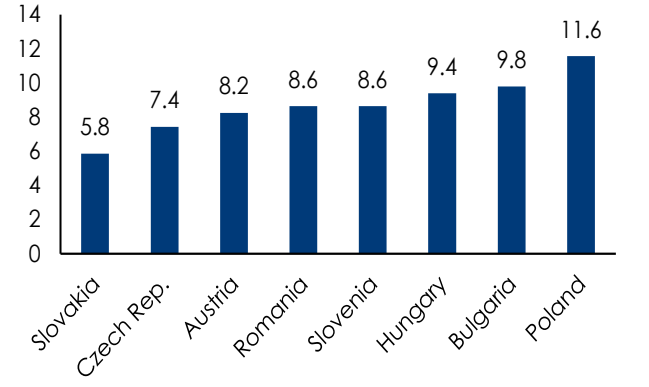
In the **Temperate Continental area, Poland's figure stands out,** with an estimated output value of the Bioeconomy in 2024 of about EUR 200Bn, which represents 11.6% of the total Polish economy. The value of the Bioeconomy for the other countries is lower: for Austria, an output of EUR 79Bn is estimated, followed by Romania (58Bn), the Czech Republic (53.3Bn) and Hungary (38.3Bn). Finally, values below 20Bn are estimated for Bulgaria, Slovakia and Slovenia. In relative terms, however, Bulgaria ranks second, with a weight of 9.8% of the total Bioeconomy, followed by Hungary (9.4%), Slovenia (8.6%), Romania (8.6%) and Austria (8.2%). The Czech Republic (7.4%) and Slovakia (5.8%) account for less of the Bioeconomy's share of total economic activity.

Fig. 2.10 - The value of the Bioeconomy in 2024 in the countries of the Continental Temperate zone (EUR Bn)



Source: Intesa Sanpaolo elaborations on various sources

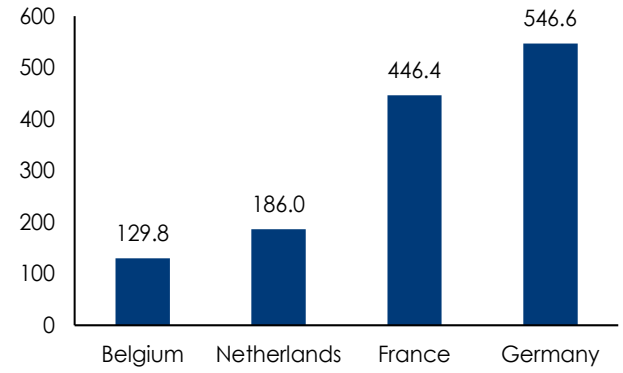
Fig. 2.11 - The weight of the Bioeconomy in 2024 in the countries of the Continental Temperate zone on the total economy, in terms of production value (%)



Source: Intesa Sanpaolo elaborations on various sources

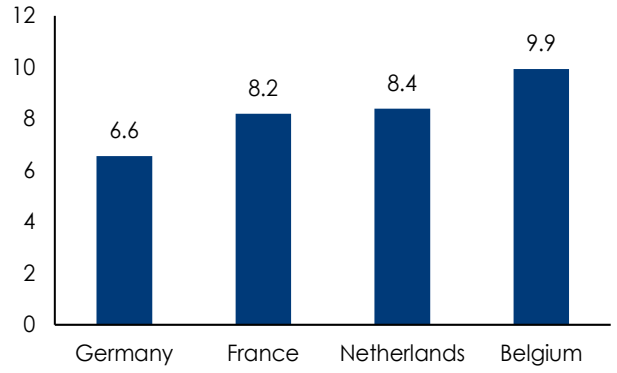
In the **Temperate Oceanic area,** Germany and France rank first in terms of estimated value of the Bioeconomy in 2024, with EUR 546.6Bn and 446.4Bn respectively. In relative terms, however, the weight of the Bioeconomy in Germany is 6.6 %, the lowest incidence observed in this region. In the **Netherlands and Belgium,** the Bioeconomy's value of EUR 186Bn and 129.8Bn respectively, accounts for **8.4% and 9.9%** of the total national economy.

Fig. 2.12 - The value of the Bioeconomy in 2024 in the countries of the Temperate Oceanic region (EUR Bn)



Source: Intesa Sanpaolo elaborations on various sources

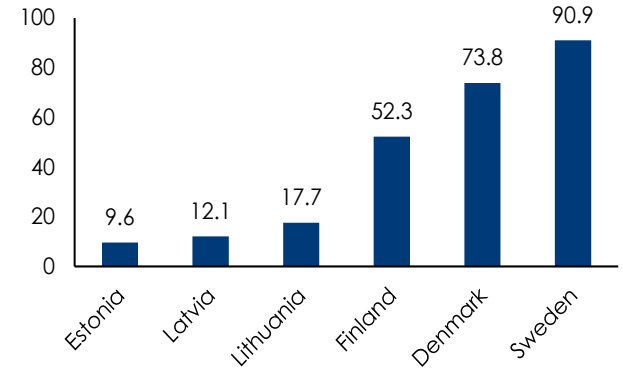
Fig. 2.13 - The weight of the Bioeconomy in 2024 in the Temperate Oceanic area countries on the total economy, in terms of production value (%)



Source: Intesa Sanpaolo elaborations on various sources

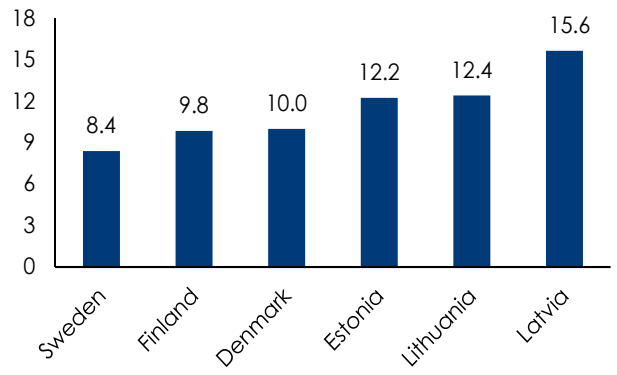
In the **Nordic climatic area** countries, a greater importance of the Bioeconomy, in absolute terms, is observed in the **Scandinavian countries** with values of EUR 90.9Bn for Sweden, EUR 73.8Bn for Denmark and 52.3 for Finland. In the **Baltic** countries, the Bioeconomy is worth less than EUR 20Bn for all three countries: EUR 17.7Bn for Lithuania, EUR 12.1Bn for Latvia and EUR 9.6Bn for Estonia. In relative terms, the picture changes, with **a higher incidence** in Latvia (15.6%), Lithuania (12.4%) and Estonia (12.2%). However, the weight of the Bioeconomy in the other countries of the area remains above 8%, with percentages of 10% for Denmark, 9.8% for Finland and 8.4% for Sweden.

Fig. 2.14 - The value of the Bioeconomy in 2024 in the Nordic countries (EUR Bn)



Source: Intesa Sanpaolo elaborations on various sources

Fig. 2.15 - The weight of the Bioeconomy in 2024 in the Nordic climatic area countries on the total economy, in terms of production value (%)



Source: Intesa Sanpaolo elaborations on various sources

2.5 Conclusions

The extension of the estimates of the value of the Bioeconomy to 23 European countries represents an important step forward in understanding the relevance of this meta-sector in Europe. In consideration also of the new revision of the European Strategy, having updated estimates for the various European countries is a useful tool for making targeted policy choices.

The analysis shows, in fact, how the Bioeconomy, despite the sectoral specificities that distinguish the different geographical areas, has an important weight in the European countries, with percentages of around 10% for the Mediterranean areas and the Nordic countries, and 9% and 8% for areas with temperate climates.

The sectoral detail shows some similarities, but also differences between geographical areas. The agro-food sector represents more than half of the value of the Bioeconomy in all the areas considered, with a greater weight for the processing industry sector. In the bio-based Fashion System, the countries of the Mediterranean area, influenced by Italy, stand out, while in the bio-based wood and furniture and paper sectors the Nordic countries emerge.

3. Plastic packaging: key findings from a dedicated survey, with a special focus on bio-based companies

3.1 Introduction

Laura Campanini
Anita Corona
Serena Fumagalli

The plastic packaging industry includes the production of both semi-finished and finished plastic products, whose primary function is to contain and protect goods, thereby enabling their transportation, storage, presentation and delivery to the end user or consumer.

This sector represents the foremost application of plastics, accounting for 39% of all processed plastics in Italy, a figure that remain consistent with that observed across other European countries[17]. Packaging is typically characterised by a short-term usage[18], often becoming a waste soon after its initial purpose is fulfilled. In addition, if not properly managed, this waste risks ending up in landfills or contributing to the plastic problem pollution in soil and water systems.

For these reasons, the sector has been increasingly affected by stringent EU measures aimed at enhancing the packaging cycle sustainability. The recent European Regulation on packaging and packaging waste (PPWR), which came into force at the beginning of 2025 after two years of intense discussions, sets forth demanding targets for the packaging sector as a whole, with particular emphasis on plastic packaging. The overarching goal is to govern the entire life cycle of packaging - from production to end-of-life management - in order to mitigate adverse negative impacts. The regulation sets out sustainability requirements grounded in circular economy principles, which include design improvements, measures to extend packaging lifespan (e.g. through reuse), and the optimization of end-of-life treatment processes (material and organic recycling). These provisions reflect the European Union's commitment to ambitious decarbonization and sustainability targets.

This chapter presents the results of a survey conducted between February and May 2024, involving 171 Italian companies active in the plastic packaging manufacturing sector that are customers of Intesa Sanpaolo [19].

The survey was carried out to investigate the characteristics and market positioning of Italian plastic packaging companies, as well as the strategic choices adopted also in response to the recent regulatory changes impacting the industry. The data analysis focuses on companies that use bio-based raw materials – either entirely or partly - and are therefore part of the Bioeconomy. The goal is to delineate their profile and identify the distinguishing or shared traits in comparison with other companies operating in the same sector. After a brief overview of the size of the bio-based plastics industry and the important role it can play in promoting a greater sustainability in the packaging sector, the chapter presents findings from a survey conducted among Intesa Sanpaolo's corporate clients. It begins with a description of the key characteristics of the sample, followed by an analysis of the production inputs and products of the surveyed companies. It then explores the impact of regulation on companies' past and future choices. A dedicated sub-section is devoted to the topic of research and development. The final part of the chapter highlights corporate strategies, with particular reference to sustainability issues, and then concludes with the outlook for the sector.

[17] Figure as for 2022; source: Federchimica and Plastics Europe.
[18] The European association of plastics manufacturers, Plastics Europe, reports that the average lifespan of plastic packaging is less than one year, compared to 5 years for products intended for the electronics sector, 15 years for automotive products, and 50 years for plastic items used in the infrastructure and construction sectors (Plastics Europe, The circular economy for plastics. A European analysis, March 2024).
[19] The survey was carried out in cooperation with Intesa Sanpaolo's Corporate Sales & Marketing Department and relationship managers from Banca dei TerritoriDivision.

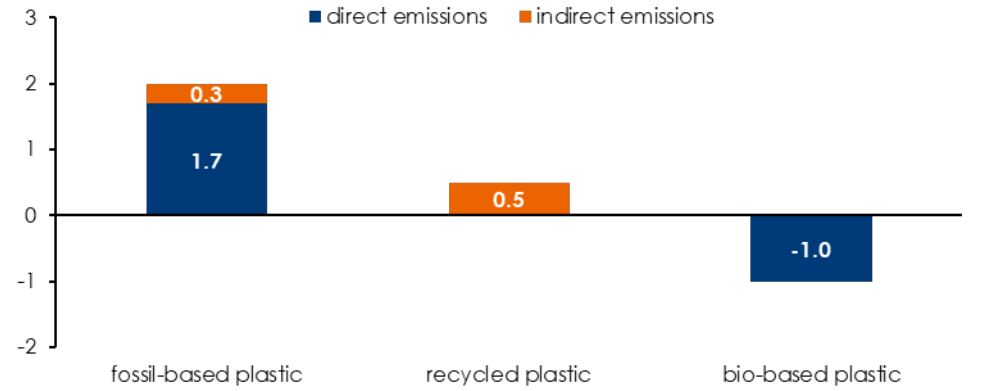
3.2 Bio-based plastics and sustainability

Bio-based plastics account for only a marginal share of total plastics production, just **0.7% of the 414 million tonnes produced worldwide and 1.4% of the 54 million tonnes produced in the European Union in 2023**[20]. Nonetheless, they present prospects for significant growth in the coming years[21]. At European level, Italy is the second largest producer of plastics from biomass, with a 34% market share, behind Germany (41%) and before France (10%)[22].

The main advantages of using of plastics from renewable materials – particularly when compared to those made from virgin fossil sources - include the use of raw materials that can regenerate within a geologically useful timeframe for mankind, a **lower carbon footprint and improved end-of-life management**, especially in the case of bio-based plastics that are also compostable [23].

In terms of greenhouse gas emissions, **biomass-derived plastics** - taking into account the entire production cycle - from raw material extraction to processing and transformation into a manufactured product - have a **negative emission factor of about 1 tonne of CO_2 for every tonne of bio-based plastic produced**. This is due to the absorption of CO_2 from the environment during the biomass growth phase as a result of the chlorophyll photosynthesis process[24]. In comparison, polyethylene produced from fossil sources (among the most common plastics) emits approximately 2 tonnes of CO_2 per tonne produced. This calculation excludes the end-of-life phase of the product, which would result in 3.1 tonnes of additional CO_2 being released into the atmosphere if the plastic is incinerated[25]. In the case of plastics derived from post-consumer plastic recycling (primarly mechanical recycling, while awaiting the full exploitation of opportunities related to chemical recycling), emissions are about 0.5 tonnes of CO_2, as the initial oil extraction and polymerisation phase is bypassed.

Fig. 3.1 - CO_2 emissions from fossil-based plastics, recycled plastics and bio-based plastics (tonnes CO_2 per tonne of plastic produced)



Note: indirect emission data for bio-based plastics are not reported because they are unavailable. Source: ECCO, Plastics in Italy: a vice or a virtue? April 2022

[20] Source: Plastics Europe, the fast Fact 2024.
[21] European Bioplastics estimates that global production of bio-based and/or compostable plastics will more than double between 2024 and 2029.
[22] Source: Plastics Europe, the fast Fact 2024.
[23] Plastics made from renewable sources – just like traditional plastics - can be either biodegradable or non-biodegradable.
[24] The removal of CO_2 from the atmosphere that occurs during biomass growth depends on the type of plants used and the bioplastic produced. Generally speaking, it can be assumed to be about 1.4 tonnes of CO_2 per tonne of plastic, to which about 0.4 tonnes of CO_2 must be added for plastic polymerisation (source: ECCO, Plastics in Italy: a vice or a virtue?, April 2022).
[25] The activities with the highest emission impact are related to the mining phase (0.8 tonnes CO_2 per tonne of plastic produced) and the cracking phase for monomer production (0.8 tonnes CO_2 per tonne of plastic produced).

Plastics: the price of success

Anita Corona

Plastic exhibits a wide range of properties, which make it an extremely versatile material, often irreplaceable in many applications. Among these properties, to name just a few, are light weight, low electrical conductivity, mechanical strength, chemical stability and non-interaction with the material with which it comes into contact, hygienic safety and protection from bacterial contamination, easy processability, transparency, and high cost-effectiveness.

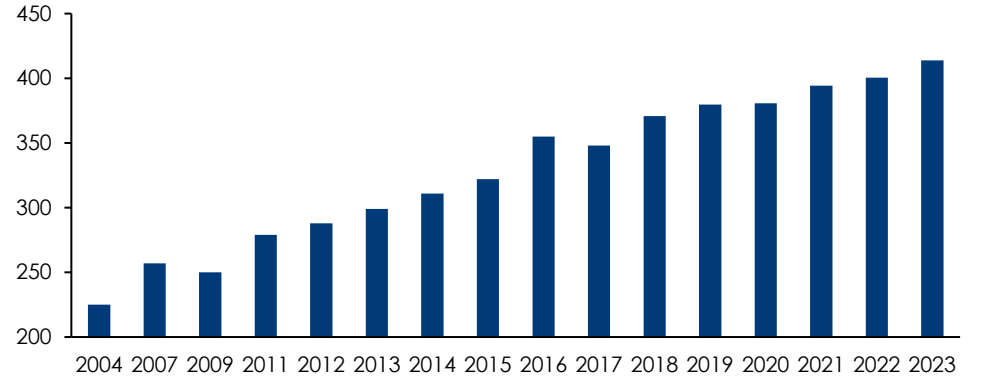
The use of plastics has grown exponentially over the past decades: global production volume has increased from 2 million tonnes in 1950 to 414 million tonnes in 2023. In the last decade alone, the amount has risen by 38%. In a no-policy change scenario, the OECD projections indicate that plastic consumption by volume will triple by 2060, driven by economic and population growth[26].

The price of plastic great success, however, comes with major challenges:

- **High consumption of fossil sources**. 90% of the plastic produced worldwide is from non-circular fossil sources[27] and therefore implies the use of resources that require millions of years to regenerate.
- **Significant implications for climate change**. Fossil-based plastics are currently estimated to account for 2.5% of total CO_2 emissions[28]. The World Economic Forum calculates that - unless more circular models are implemented - plastics production will represent 20% of global oil consumption and be responsible for 15% of global greenhouse gas emissions by 2050.[29]
- **Impacts on ecosystems and human health**. Due to improper end-of-life management, between 8 and 10 million tonnes of plastics are dumped into the oceans every year. Overall, it is estimated that plastic waste accounts for about 80% of the total marine pollution and that by 2050, if no action is taken to reverse the trend, there will be more plastic than fish in the world's oceans[30]. Pollution-related problems have substantial impacts on marine life and ecosystems, also due to the extreme longevity and resistance of non-biodegradable plastics. When not properly managed and dispersed in the environment, these materials are not naturally degraded but rather reduced into increasingly smaller fragments that persist for hundreds of years. Microplastics (smaller than 5 mm) have been found in multiple ecosystems, from ocean depths and polar ice to groundwater and alpine lakes. They have entered the food chain of animals and have been detected in the human body. While extensive data is available on the presence of microplastics in the environment, knowledge about their health impacts remains limited.[31]

[26] Source: OECD, Global plastics outlook. Policy scenarios to 2060, June 2022.
[27] Figure as for 2023; source: Plastics Europe, The fast Facts 2024.
[28] Source: To solve the plastic problem, let's think about how to produce it, Corriere della Sera, 30 May 2023.
[29] World Economic Forum, This is how to ensure sustainable alternatives to plastic, March 2022.
[30] Source: UNESCO.
[31] Source: European Environmental Agency (EEA), Impacts of microplastics on health, March 2025.

Global primary plastic production (millions of tonnes)



Source: Plastics Europe

3.3 Sample description and profile of bio-based companies

Overall, the sample of 171 companies interviewed generated **a EUR 3.2Bn turnover** in Italy in 2023 - about **90% of which relates to plastic packaging**. Their production structure consisted of **210 production sites** and about **8,350 employees.** The sample represents about **16% of national production** and just under 6% in terms of the total number of companies.

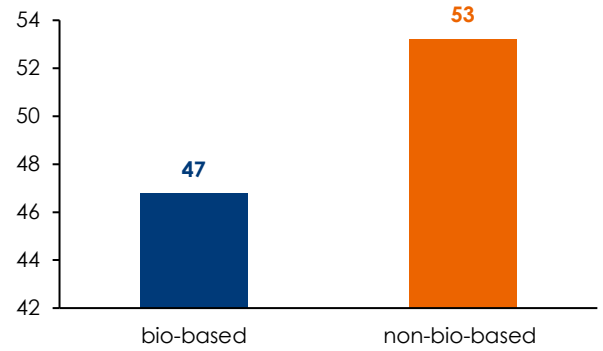
In terms of size, 57% of the sample consists of micro-small enterprises (with a turnover of less than EUR10M) and the remaining 43% of medium-sized enterprises. The sample presents an average turnover per enterprise more than 3 times higher that of the Italian plastic packaging industry[32], which is characterised by a very fragmented production structure, with few large and medium-sized national operators and many small and medium-sized regional operators specialised only in specific types of processing.

The analysis of the survey was carried out by dividing the sample into two clusters: **companies that use bio-based raw materials,** i.e. those **belonging to the Bioeconomy sector** (bio-based companies), **and companies that do not use such raw materials** (non-bio-based). In addition, the bio-based companies were further **subdivided by the intensity of their use of biomass inputs** between companies with significant bio-based inputs use, exceeding 30% of their total raw materials (bio-medium-high companies), and companies for which bio-based inputs account for less than 30% of total raw materials (bio-low companies).

Of the 171 companies analysed, 47% fall within the Bioeconomy cluster, whereas the remaining 53% are non-bio-based companies. Within the Bioeconomy cluster, 59% of the bio-based companies use renewable resources to cover up to 30% of their total raw material inputs. Conversely, 41% of the bio-based companies show a higher intensity of renewable production inputs, exceeding 30%. Within the latter group, a large tail of companies (accounting for just under 20% of the total bio-based cluster) use biomass-based raw materials for over 90% of their total inputs.

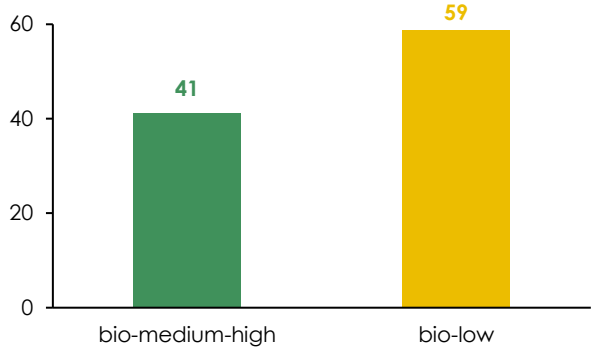
[32] Elaborated by Intesa Sanpaolo on data from the Cerved Report "Plastic Packaging", December 2024.

Fig. 3.2 – Sample distribution of bio-based vs. non-bio-based raw material use (% of respondents)



Source: Intesa Sanpaolo survey on plastic packaging companies (2024)

Fig. 3.3 - Distribution of bio-based companies by intensity class of bio-based raw material use (% of respondents)

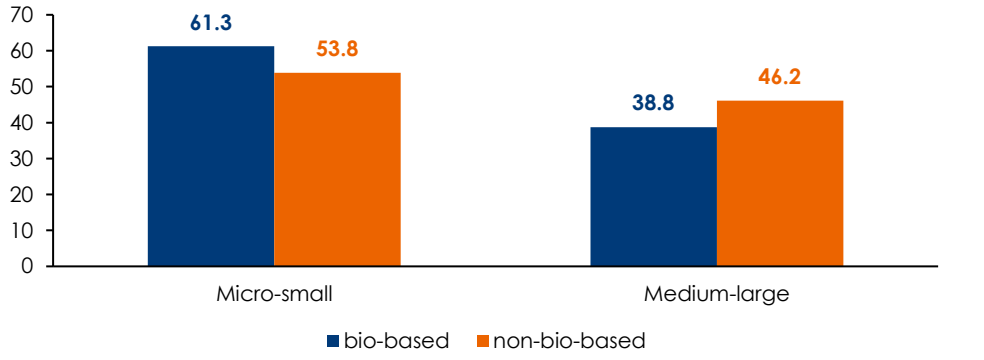


Note: bio-based raw material use intensity classes: bio-low=1%-30%, bio-medium-high=31%-100%. Source: Intesa Sanpaolo survey on plastic packaging companies (2024)

In the bio-based cluster, there is **a higher incidence of micro-small enterprises,** with a numerical differential of 7 percentage points. The greater incidence of smaller companies is also confirmed when comparing the cluster of non-bio-based companies with the two subgroups of companies showing medium-high and low intensity of renewable raw materials.

Within the cluster of biobased companies, 10% of the companies were originally established with biobased characteristics, while the remaining majority shifted towards bio-based modes after their inception.

Fig. 3.4 - Distribution of companies by size (% of respondents)

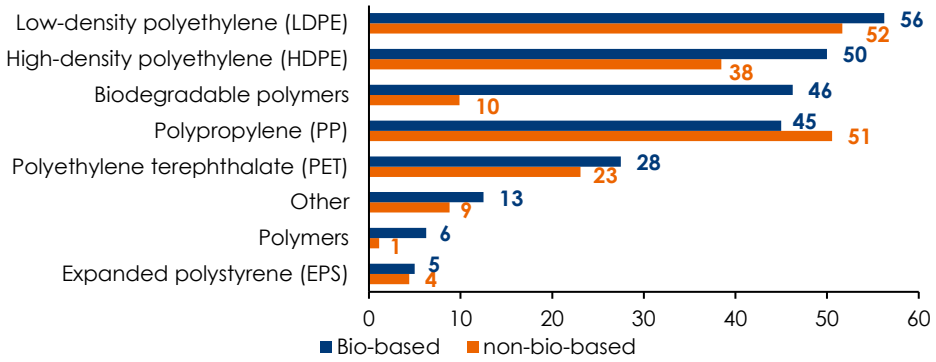


Source: Intesa Sanpaolo survey on plastic packaging companies (2024)

With regard to the types of plastics declared among those predominantly used, the main – albeit unsurprising - difference between the bio-based and non-bio-based clusters is the higher incidence of biodegradable polymers among bio-based companies (46% of the latter declare biodegradable polymers among their main plastics used compared to 10% of non-bio-based companies). This broad category of biodegradable plastics includes materials that are not mechanically recyclable, such as PLA (polylactic acid), starch-based bioplastics, and PHA.

As for bio-based companies, it is interesting to observe a widespread use of mechanically recyclable plastics derived from biomass (also confirmed within the group of companies using renewable resources for more than 80% of their total raw inputs). These include high- and low-density bio-polyethylene, bio-PET, and bio-polypropylene.

Fig. 3.5 - Types of commonly used plastics (% of respondents; multiple answers possible)



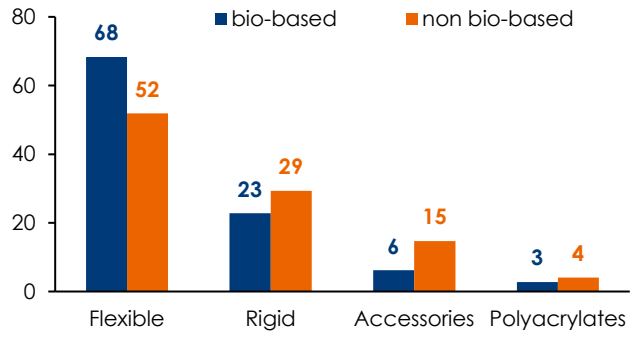
Note: ranking according to bio-based companies. Source: Intesa Sanpaolo survey on plastic packaging companies (2024)

In relation to the type of packaging produced, the sample shows **a 59% incidence of the flexible packaging segment** (which includes sacks, bags and stretch films), compared with an industry average (by volume) of 45% [33].

The incidence of flexible packaging is higher among companies with Bioeconomy characteristics, due, as will be further explored below, to their greater specialisation in the production of plastic carrier bags. At the same time, there is a lower incidence of production related to rigid packaging (which includes beverage bottles, flacons, drums, jerrycans, and similar items) and accessories (a segment comprising caps, closures, spray caps, adhesive tapes, and cushioning materials).

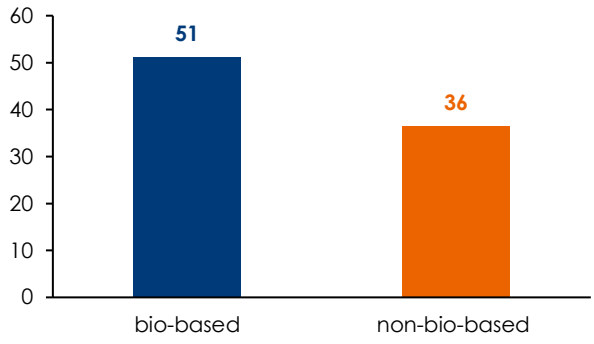
43% of the analyzed sample operates in the primary packaging segment (in direct contact with the packaged product), with a higher incidence among bio-based companies (+15 percentage points more than non-bio-based firms). Within the bio-based cluster, the share of primary packaging is even greater among medium-sized and large companies, with an average incidence of 8 percentage points higher.

Fig. 3.6 - Breakdown of packaging turnover by type of packaging produced (% of respondents)



Source: Intesa Sanpaolo survey on plastic packaging companies (2024)

Fig. 3.7 - Average weight of primary packaging on turnover (% of respondents)



Source: Intesa Sanpaolo survey on plastic packaging companies (2024)

[33] Source: Cerved, based on data from the Italian Packaging Institute.

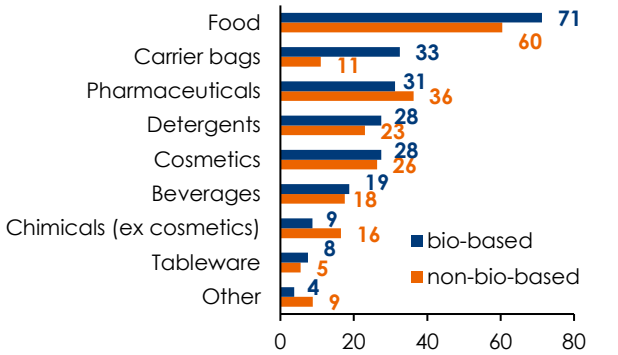
As far as application sectors are concerned, the sample declares to operate on average in 2.16 sectors.

The food sector is the primary application market for the companies in the sample. This is not surprising given that the food sector is the leading consumer of plastic packaging by volume in Italy (54%). A higher incidence is observed among bio-based companies, 71% of which report operating in this sector, a difference of 11 percentage points compared to non-bio-based companies.

Bio-based companies show a significantly greater tendency to serve the plastic carrier bags segment (+22 percentage points), while exhibiting a lower presence in the chemical sector (-8 percentage points).

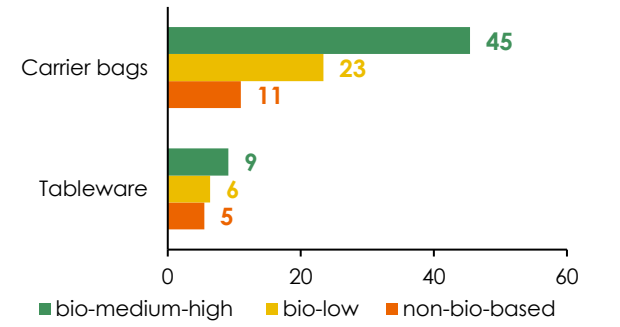
The higher incidence of bio-based companies (especially those with a high use of renewable inputs) in the plastic carrier bags segment can be explained by the introduction in Italy, starting in 2011, of a legal requirement mandating the use of biodegradable bags for transporting goods, alongside the ban on traditional single-use plastic carrier bags. This regulatory shift led to the replacement of polyethylene, the polymer typically used for producing such bags, with biodegradable polymers. As noted in the section on plastic use, this explains the significantly higher incidence of biodegradable plastics among companies with Bioeconomy characteristics. With regard to the other business segment affected by Italian regulations on plastic usage, namely tableware, a positive albeit much smaller gap is observed between bio-based and non-bio-based companies, as well as between those with high versus low use of bio-based inputs. This reflects in particular the market penetration of reusable products, especially since 2023.[34]

Fig. 3.8 - Packaging application sectors (% of respondents; multiple answers possible)



Note: ranking according to bio-based companies. Source: Intesa Sanpaolo survey on plastic packaging companies (2024)

Fig. 3.9 - Distribution of companies active in carrier bags and tableware segments (% of respondents; multiple answers possible)



Note: bio-based raw material use intensity classes: bio-low=1%-30%, bio-medium-high=31%-100%. Source: Intesa Sanpaolo survey on plastic packaging companies (2024)

[34] Since 2022, Italy has implemented the EU Directive 2019/904 on the reduction of the impact of certain plastic products on the environment (known as SUP, Single-Use Plastics Directive). Recognizing the unique characteristics of Italy's compostable plastics treatment system - integrated with organic waste- and in order to protect the national compostable plastics supply chain, the Italian legislation introduced an exemption from the ban on certain products, including tableware. This exemption applies when biodegradable and compostable plastics are used, provided that they contain at least 40% renewable raw materials, increasing to 60% from 01.01.2024, in the case where reusable alternatives are not available.

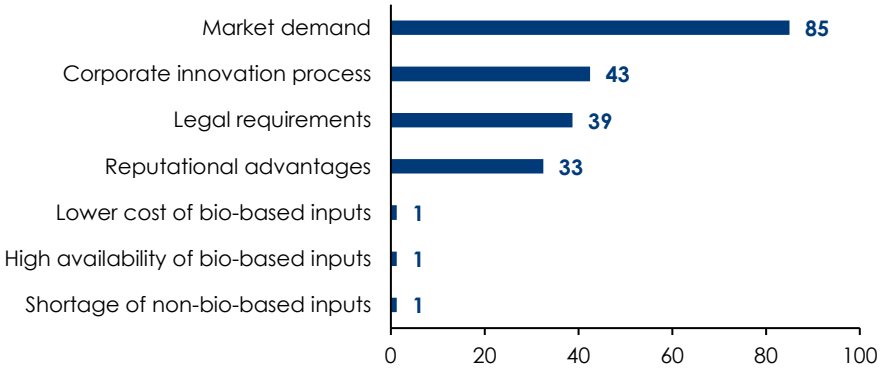
3.4 Production inputs choices: bio-based, recycled, or fossil resources

Part of the questionnaire focused on the use of production inputs, the reasons behind their introduction, and companies' outlook on their future usage.

Regarding the factors that led to the introduction of bio-based production inputs, **the primary motivation - cited by 85% of the bio-based sample - is market demand** (market driven). Less commonly, companies referred to innovation-related reasons - indicated by 43% of the analysed bio-based sample - and the need to comply with regulatory obligations - gmentioned by 39% of the bio-based respondents. Slightly lower, yet still market-driven, is the motivation linked to the reputational advantages of using renewable raw materials (33%).

Therefore, the adoption of bio-based inputs is mainly a market competitiveness strategy for companies, and, secondarily, a choice driven by innovation and compliance with regulatory obligations.

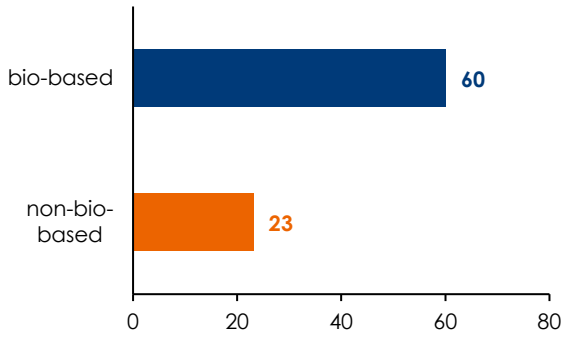
Fig. 3.10 - Factors that determined the introduction of bio-based production inputs (% of respondents; multiple answers possible)



Source: Intesa Sanpaolo survey of companies on plastic packaging companies (2024)

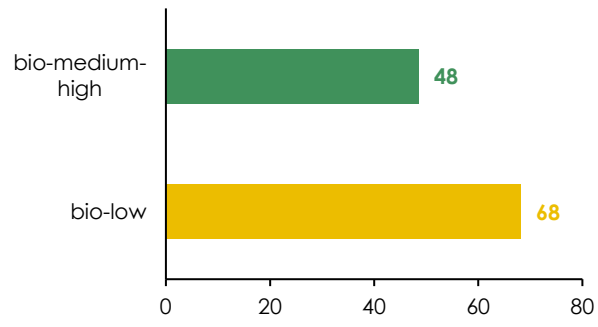
Is the future leaning towards more bio-based solutions? **A significant part of the bio-based cluster (60%, higher than the 23% of the non-bio-based cluster) plans to increase the use of renewable raw materials in the next 3 years.** Within the companies with bio-based characteristics, those with currently low levels of bio-based input utilization aim to increase the percentage of renewable raw materials the most, precisely because their current use is limited, leaving greater room for expansion.

Fig. 3.11 - Companies that will increase/introduce the use of bio-based raw materials in the next three years (% respondents)



Note: percentages calculated on total number of responses, including "don't know" answers. Source: Intesa Sanpaolo survey on plastic packaging companies (2024)

Fig. 3.12 - Bio-based companies that will increase their use of bio-based raw materials in the next three years (% of respondents)

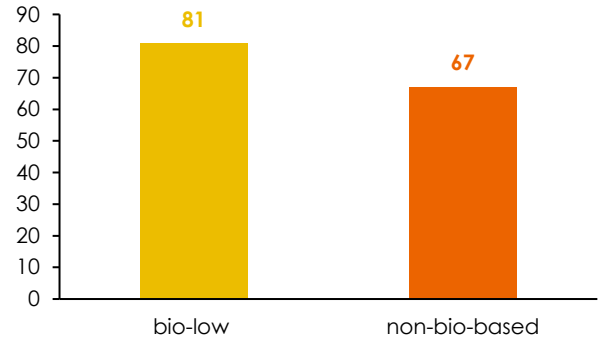


Note: percentages calculated on total number of responses, including "don't know" answers. Bio-based raw material use intensity classes: bio-low=1%-30%, bio-medium-high=31%-100%. Source: Intesa Sanpaolo survey on plastic packaging companies (2024)

Turning to the use of secondary raw materials (from post-consumer waste recycling), we compared bio-based companies with low levels of renewable raw material use to non-bio-based companies. We did not take into account bio-based companies with a high intensity of renewable raw material utilization, as their focus on bio-based raw inputs results in lower use of secondary raw materials.

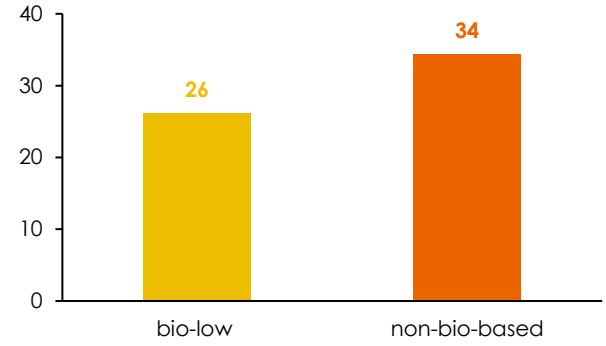
Interestingly, the sample reveals that **within the bio-based cluster with low renewable material intensity, the share of companies using secondary recycled materials is higher than in the non-bio-based cluster**. Non-bio-based companies, however, show a higher average incidence of secondary raw materials relative to their total production inputs.

Fig. 3.13 - Use of secondary raw materials (% of respondents)



Note: bio-based raw material use intensity classes: bio-low=1%-30%, bio-medium-high=31%-100%. Source: Intesa Sanpaolo survey on plastic packaging companies (2024)

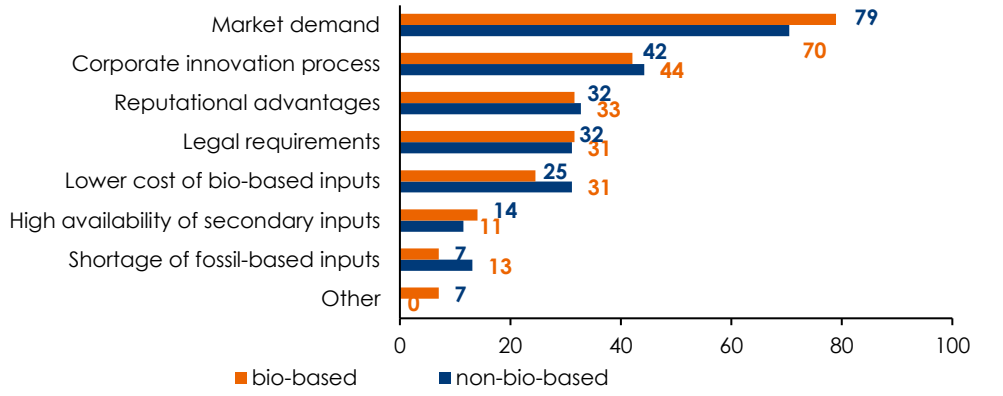
Fig. 3.14 - Average incidence of secondary raw materials on total raw materials used (% of respondents)



Note: bio-based raw material use intensity classes: bio- low=1%-30%, bio-medium-high=31%-100%. Source: Intesa Sanpaolo survey on plastic packaging companies (2024)

Returning to the full sample and examining the underlying motivation for the introduction of secondary raw materials, it is interesting that there are no major differences between the bio-based and non-bio-based clusters and that the ranking of motivations appears the same. Market demand is the main driver for 70-80% of the companies, followed by innovation and reputational advantages. Regulatory obligations also play an important role, cited by about 30% of respondents in both clusters. Additionally, about one third of the respondents mention the lower cost of second raw materials

Fig. 3.15 - Factors that determined the introduction of secondary raw materials among production inputs (% of respondents)

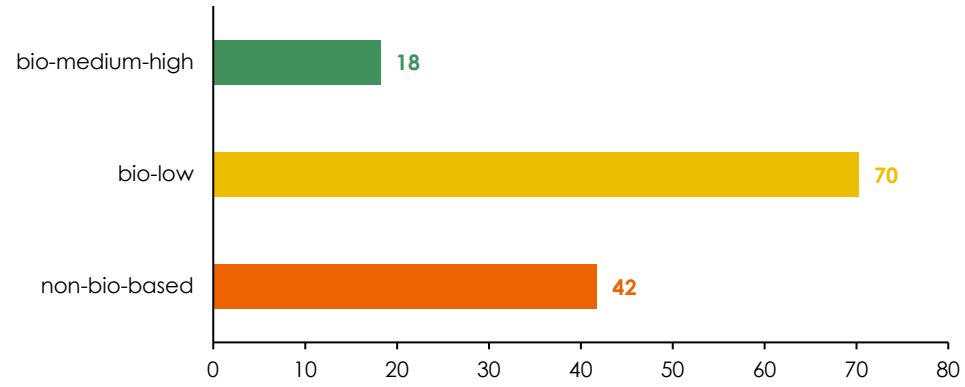


Source: Intesa Sanpaolo survey on the plastic packaging companies (2024)

49% of the surveyed bio-based companies plan to increase their use of secondary raw materials in the next 3 years, compared to a lower percentage (42%) among non-bio-based companies.

Notably, among bio-based companies with a low intensity of renewable raw material use, a significantly larger share of companies declare their intention to boost the use of secondary raw materials over the next three years than do non-bio-based companies.

Fig. 3.16- Enterprises that will increase/introduce the use of secondary raw materials in the next three years (% of respondents)

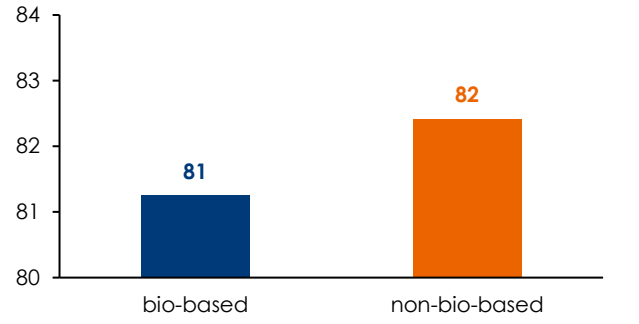


Note: bio-based raw material usage intensity classes: bio-low=1%-30%, bio-medium-high=31%-100%. Source: Intesa Sanpaolo survey on plastic packaging companies (2024)

As regards the use of virgin fossil raw materials, **the number of companies using these inputs is almost identical in the two clusters analysed, although the average weight of fossil raw materials on the total production inputs used is significantly lower for bio-based companies.**

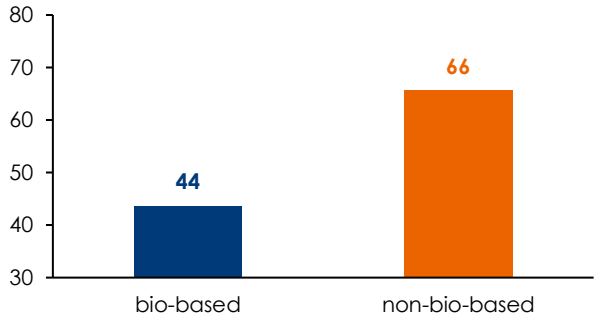
Analysing the use of virgin fossil raw materials by intensity of renewable raw materials, the average weight of virgin fossil raw materials on total production inputs decreases as the intensity of bio-based raw material use increases. Bio-based companies using bio-based raw materials for more than 45% of their input mix do not employ any fossil raw material and show an average virgin fossil input share below15%. On the other hand, biobased companies with a low renewable input intensity employ virgin fossil raw materials extensively (100%) and exhibit an average virgin fossil raw material share only slightly lower than that of non-bio-based companies (the latter cluster also includes many companies that prevalently use secondary raw materials).

Fig. 3.17 - Use of virgin fossil raw materials (% of respondents)



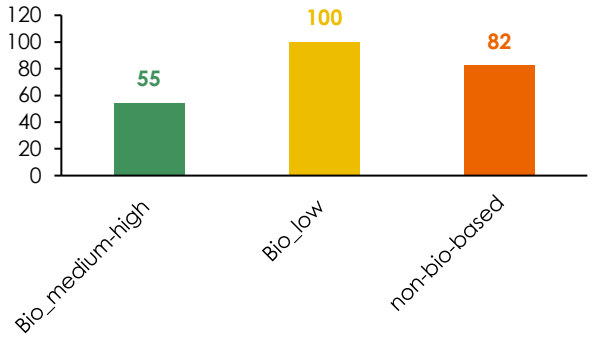
Source: Intesa Sanpaolo survey of companies on plastic packaging companies (2024)

Fig. 3.18 - Incidence of virgin fossil raw materials on total raw materials used (% of respondents)



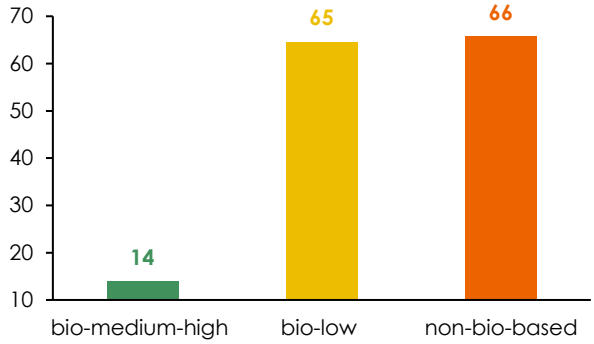
Source: Intesa Sanpaolo survey on plastic packaging companies (2024)

Fig. 3.19 - Use of virgin fossil raw materials (% of respondents)



Note: bio-based raw material use intensity classes: bio-low=1%-30%, bio-medium-high=31%-100%. Source: Intesa Sanpaolo survey on plastic packaging companies (2024)

Fig. 3.20 - Average share of fossil-based inputs in total raw materials used (% of respondents)

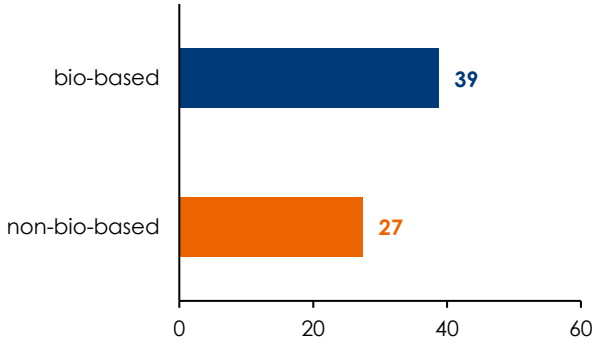


Note: bio-based raw material use intensity classes: bio-low=1%-30%, bio-medium-high=31%-100%. Source: Intesa Sanpaolo survey on plastic packaging companies (2024)

Future perspectives on the use of fossil-based raw materials

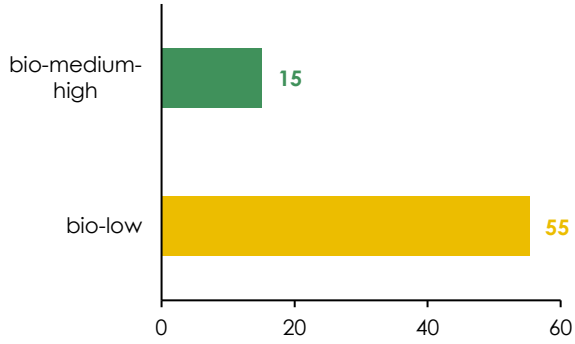
Regarding future prospects for the use of virgin fossil raw materials over the next three years, the share of bio-based companies declaring a decrease is higher (39%) than that of non-bio-based (27%). The figure is mainly "driven" by bio-based companies with low renewable raw material intensity, given their still high declared average use of fossil raw materials (64%).

Fig. 3.21 - Companies that will decrease their use of virgin fossil raw materials (% of respondents)



Note: percentages calculated on total answers, including "don't know". Source: Intesa Sanpaolo survey on plastic packaging companies (2024)

Fig. 3.22 - Bio-based companies that will decrease their use of virgin fossil raw materials in the next three years (% of respondents)



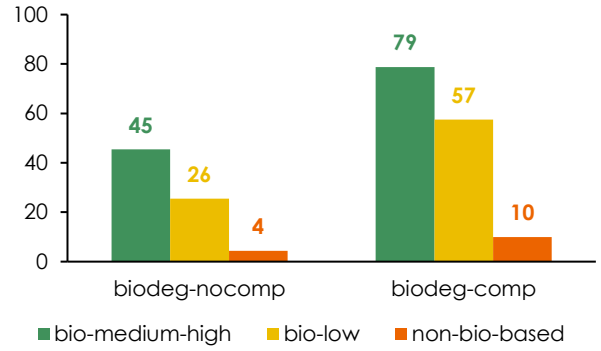
Note: percentages calculated on total responses, including "don't knows".Bio-based raw material use intensity classes : bio-low=1%-30%, bio-medium-high=31%-100%. Source: Intesa Sanpaolo survey on plastic packaging companies (2024)

3.5 The focus on product types

A specific section of the questionnaire focused on key end-of-life characteristics for plastic packaging, biodegradability and compostability, as well as two features expressly considered by the European legislator, recyclability and reusability.

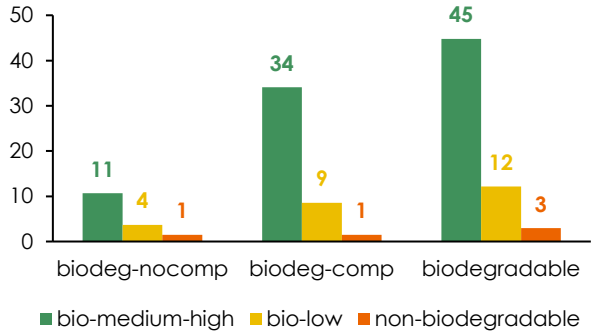
Clustering the sample into bio-based and non-bio-based companies shows that **most biodegradable packaging is plant-derived or bio-based**. In the examined sample, both the share of companies producing biodegradable packaging, primarily compostable but also non-compostable, and its average turnover weight increase significantly when moving from non-bio-based to bio-based companies, and from bio-based companies with low renewable inputs to those with a significant share of renewable inputs.

Fig. 3.23 - Share of companies with bio-based, compostable and non-bio-based production (% of respondents)



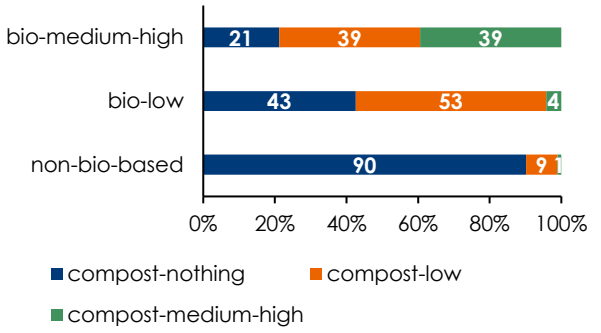
Note: bio-based raw material use intensity classes: bio-low=1%-30%, bio-medium-high=31%-100%. Source: Intesa Sanpaolo survey on plastic packaging companies (2024)

Fig. 3.24 - Average weight of biodegradable, compostable and non-compostable productions on turnover (% of respondents)



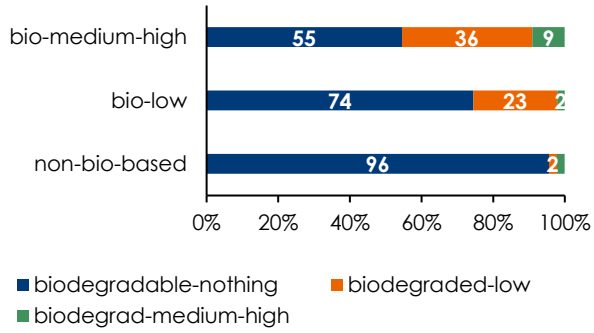
Note: bio-based raw material use intensity classes: bio-low=1%-30%, bio-medium-high=31%-100%. Source: Intesa Sanpaolo survey on plastic packaging companies (2024)

Fig. 3.25 - Distribution of companies by compostability classes (% of respondents)



Note: bio-based raw material use intensity classes: bio-low=1%-30%, bio-medium-high=31%-100%. Classes of incidence of compostable products on total turnover: nil: 0%, low: %-20%, medium-high: 31%-100%. Source: Intesa Sanpaolo survey on plastic packaging companies (2024)

Fig. 3.26 - Distribution of companies by biodegradability and non-compostability classes (%of respondents)



Note: bio-based raw material use intensity classes: bio-low=1%-30%, bio-medium-high=31%-100%. Classes of incidence of non-compostable biodegradable products on total turnover: nil: 0%, low: %-20%, medium-high: 31%-100%. Source: Intesa Sanpaolo survey on plastic packaging companies (2024)

Biodegradable and compostable plastic

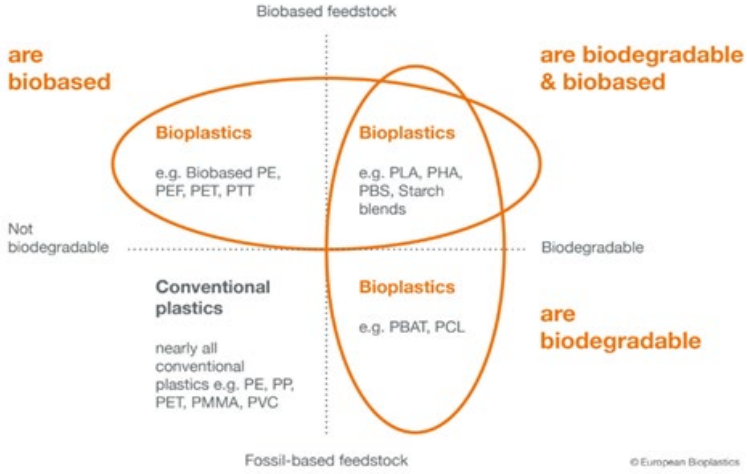
Anita Corona

Regarding the end-of-life of plastics, a main distinction concerns biodegradability versus non-biodegradability and, within biodegradable plastics, a further differantiation lies between compostability and non-compostability.

Although most compostable and biodegradable plastics available on the market today are bio-based, it should be pointed out that the categories of biodegradability and compostability do not strictly coincide with that of plastics derived from renewable sources. In fact, these properties are primarily determined by the molecular structure of the polymer rather than the raw materials used, whether bio-based or fossil-derived. For example, biodegradable and compostable plastics, such as PLA and PHA originate from plant sources. In contrast, certain bio-based plastics such as bio-PET, bio-polyethylene, bio-polypropylene are not biodegradable. Some fossil biodegradable plastics, including polybutylene adipate terephthalate (Pbat), polycaprolactone (Pcl) and polybutylene succinate (Pbs) are biodegradable. Additionally, plastic products may include blends of bio-based and fossil-based components, further blurring the lines between origin and end-of-life behaviour.

Biodegradable plastics, in general, are materials that, through the action of microorganisms such as fungi and bacteria, break down into their basic chemical elements (carbon dioxide and water). The biodegradation processes depend on environmental conditions, the specific polymer composition, and the respective degradation timeframe. Soil biodegradability is regarded as an added value because, in the event of dispersion in the environment, it does not present the problem related to the persistent longevity of plastics and the release of microplastics. Even more critical is the characteristic of compostability, a property that goes beyond biodegradability. In fact, compostability implies the possibility for the plastic material to be treated alongside the wet fraction n industrial composting plants, exploiting its biodegradability properties in the presence of oxygen, to produce compost. This humus-rich substance nourishes soils and serves as a vital tool for combating desertification and erosion. Furthermore, compost reduces the need forthe use of chemical fertilisers[35] and helps capture carbon in the soil (carbon sink).

Scheme proposed by European Bioplastics to define different types of plastics (fossil-based, bio-based, biodegradable)



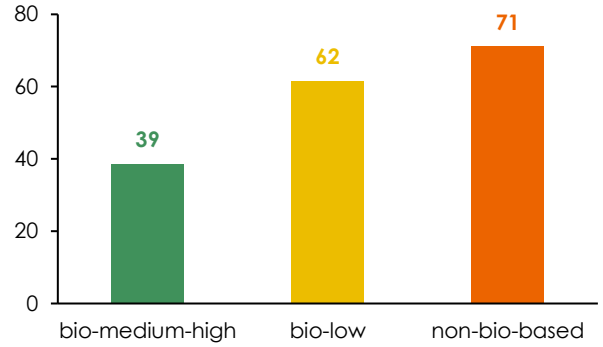
Source: European Bioplastics

In evaluating the recyclability of products, **a lower average weight of recyclable products on turnover** emerges **for bio-based companies, particularly for those with a high reliance on renewable raw materials**. This stems from their greater use of biodegradable plastics, which fall outside conventional recycling streams, as well as their higher prevalence of compostable products that follow a different end-of-life pathway

However, when considering the combined share of recyclable products and compostable products (recyclable via organic waste management), the overall average weight among the categories of enterprises (non-bio-based, bio-based with high and low use of bio-based inputs) is almost similar, at around 70%.

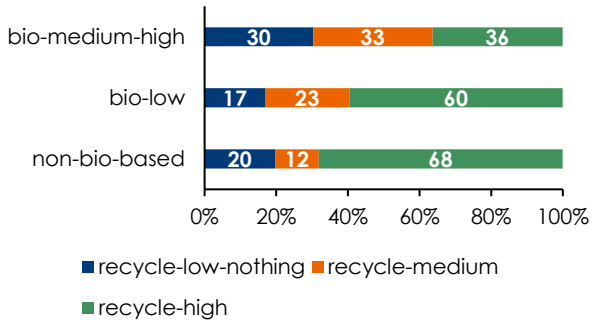
[35] A compostable material is certainly biodegradable, but the reverse is not true. According to the applicable regulations, for a material to be considered industrially compostable, it must degrade by 90 per cent within six months and disintegrate into fragments of less than two millimetres by 90 per cent of mass within three months. In addition, there must be no negative ecotoxicity effects on plants, as well as low levels of heavy metals and other chemical-physical parameters affecting the pH level and the concentration of nitrogen, phosphorous, magnesium and potassium.

Fig. 3.27 - Average weight of recyclable products on turnover (% of respondents)



Note: bio-based raw material use intensity classes: bio- low=1%-30%, bio-medium-high=31%-100%. Source: Intesa Sanpaolo survey on plastic packaging companies (2024)

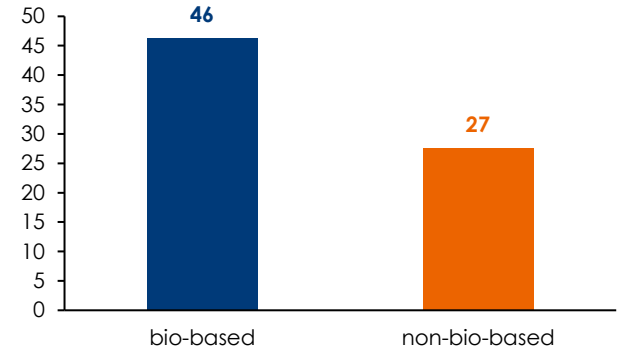
Fig. 3.28 -Distribution of companies by recyclability classes (% of respondents)



Note: bio-based raw material use intensity classes: bio- low=1%-30%, bio-medium-high=31%-100%. Source: Intesa Sanpaolo survey on plastic packaging companies (2024)

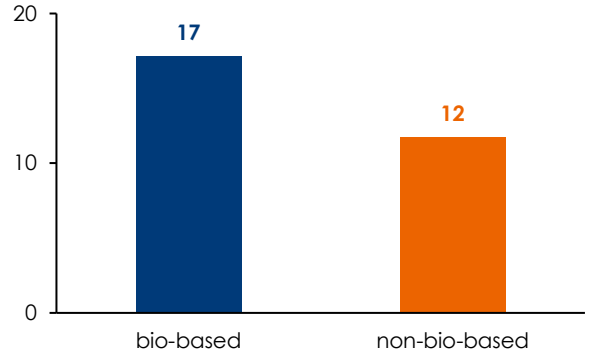
The incidence of reusable product manufacturing remains generally low across the full sample, reflecting the limited levels of reusability within the Italian system. However, a higher incidence is observed among bio-based companies, both in terms of the number of companies producing reusable goods and the average weight of reusable products relative to total turnover.

Fig. 3.29 - Incidence of companies with reusable products (% of respondents)



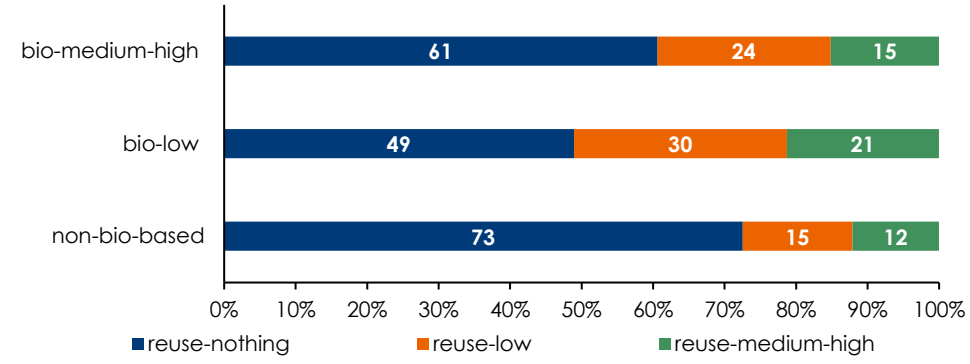
Source: Intesa Sanpaolo survey on plastic packaging companies (2024)

Fig. 3.30 - Average weight of reusable products on turnover (% of respondents)



Source: Intesa Sanpaolo survey on plastic packaging companies(2024)

Fig. 3.31 - Distribution of companies by reusability classes (% of respondents)



Note: bio-based raw material use intensity classes: bio- low=1%-30%, bio-medium-high=31%-100%. Classes of incidence of reusable products: none: 0%, low: 1%-30%, medium-high: 31%-100%.
Source: Intesa Sanpaolo survey on plastic packaging companies (2024)

3.6 The impact of regulations on business decisions

A part of the questionnaire explored the impact of sector-specific regulations on company decision-making, acknowledging that both current and forthcoming policies will be relevant in shaping business strategies. In the section describing the sample it was already highlighted how for certain applications (plastic carrier bags and tableware segments) **regulatory frameworks influenced the production and strategic choices of companies.** In particular, it was asked to highlight the strategies pursued in the past in the face of legislative and regulatory changes and those that are expected to be implemented following the approval of the European Packaging Regulation.

In the past, as in the future, **the main lever activated by companies concerns the modification of the product range, a strategy implemented by 50% of companies in the past and 54% in the future.**

This is followed, by recurrence, by the search for new suppliers and the modification of production inputs.

The lever of energy efficiency was relevant for the regulatory changes already in place, while it appears less frequent among companies' responses to the introduction of the new regulation.

The clustering of the sample into bio-based and non-bio-based companies highlights the notably greater pro-activity of bio-based companies (particularly those with a substantial reliance on bio-based inputs) in implementing all available strategic actions. This is also summarised by the indicator relating to companies that report no response to the evolving regulatory environment: 24% of non-bio-based companies, compared to only 13% among bio-based firms. The proportions remain identical with regard to the strategies that companies anticipate adopting in light of the newly approved regulation.

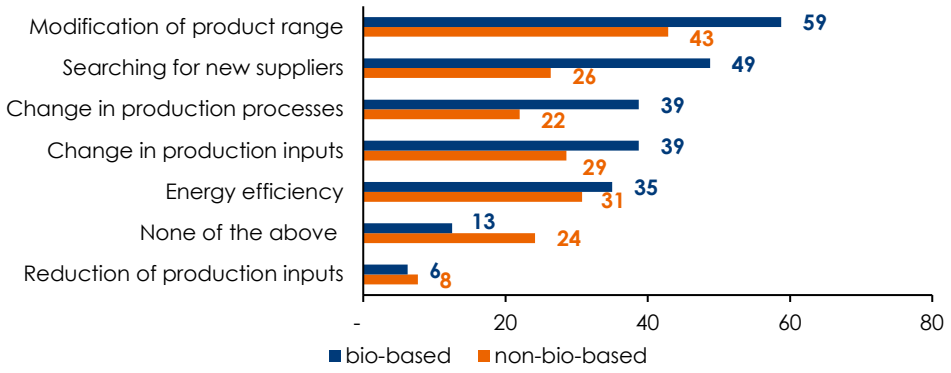
Changing their product range was considered important by 59% of bio-based companies, compared to 43% of non-bio-based companies. In anticipation of the implementation of the European Regulation, the share of non-bio-based companies intending to adjust their product offering increases (49%), yet the gap compared to bio-based companies remains significant (60%). This finding highlights the commitment of bio-based companies, despite their low incidence of recyclable products (see previous section), to enhance this aspect of their manufactured products. **The search for new suppliers was the response to regulatory changes adopted by 49% of the bio-based companies and is expected to remain a key lever (43%)**. By contrast, non-bio-based companies used this strategy only in 26% of cases in the past and just 24% consider it relevant in light of the newly approved regulation.

At the same time, the modification of production inputs was pursued by 39% of bio-based companies and 29% of non-bio-based companies; in perspective, the proportion of firms responding to new challenges with this strategy will remain at similar levels.

Another strategy more strongly pursued by bio-based companies concerns the change in production processes (39%, compared to 22% of non-bio-based companies) with the disparity projected to persist.

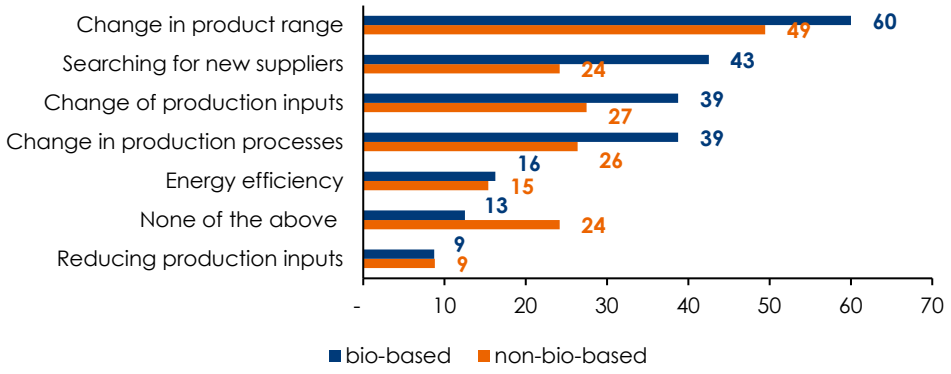
With respect to some strategic levers, no significant differences are evident between the two groups: energy efficiency measures and the reduction of production inputs were undertaken with equal frequency.

Fig.3.32 - Strategies adopted in response to regulatory developments up to now (% of respondents; multiple answers possible)



Source: Intesa Sanpaolo survey on plastic packaging companies (2024)

Fig. 3.33 - Strategies adopted in response to the proposed Packaging and Packaging Waste Regulation (PPWD, % of respondents; multiple answers possible)



Source: Intesa Sanpaolo survey on plastic packaging companies (2024)

The new regulatory environment for plastics: the PPWR Regulation

Laura Campanini
Anita Corona

The new PPWR (Packaging and Packaging Waste Regulation), published in February 2025, **redefines the entire packaging life cycle** (from design to collection and post-consumer waste management), across all material types. It harmonises legislation throughout the EU and introduces targeted measures specifically addressing the plastic packaging supply chain.

Given the ambitious targets and the substantial changes introduced, **implementation will be gradual**. The regulation will begin applyingin August 2026, with a core set of provisions (subject to delegated acts by the European Commission to define specific criteria) phased in progressively until 2030-2040.

The PPWR pursues three overarching goals: reducing the generation of packaging waste, promoting sustainability across the packaging supply chain, and fostering the efficiency of waste management system within the EU Member States. For the first time, in addition to recycling targets, Member States are required to reduce packaging waste per capita (in volume, by 5% by 2030, 10% by 2035 and 15% by 2040 compared to 2018 levels).

In order to **curb waste generation across all material types**, the Regulation mandates that producers or importers design packaging to minimize weight and volume by 2030. Specific provisions address the maximum empty space in transport, e-commerce, and grouped

packaging. In addition, the Regulation introduces **specific reuse targets**: 40% for transport packaging by 2030 (rising to 70%by 2040), 10% for grouped packaging (25% by 20240) and 10% for beverages (40% by 2040), excluding wine, milk and other highly perishable products. The latter rule is one of the most complex to implement in our country, as it requires the establishment of a national system for the collection and regeneration of packaging and, in the case of beverages, deposit and return mechanisms. However, exemptions may be granted to Member States that demonstrate strong performance in meeting material-specific recycling targets. The regulation also intervenes on packaging demand by promoting a shift in consumer lifestyle, **encouraging bulk product sales** and **the use by end consumers of their own reusable packaging**. Finally, to reduce packaging waste, from 2030 it will be prohibited to **place on the market certain single-use plastic packaging**[36].Packaging made from compostable materials may be exempted from this ban, subject to mandatory use and decisions at member state level. **Packaging sustainability** is also pursued through **restrictions on the presence of substances of concern**[37]**.** Another key measure to increase packaging sustainability is the **mandatory recyclability requirement**. From 2030, packaging must meet **high quality recyclability standards**, ensuring that the resulting secondary raw materials are of sufficient quality to substitute primary materials and that components can be easily sorted, without compromising the recoverability of other materials. By 2027, the Commission will establish packaging design criteria and recyclability performance classes, which will serve as the basis to adjust producers' financial contributions under the extended producer responsibility scheme. From 2030, only packaging with a recyclability rate of more than 70% (a threshold that will increase to 80% in 2038) will be allowed on the market. Beginning in 2035, a 'large-scale' recyclability requirement will be introduced, requiring an assessment of the actual recycling rate for each packaging category by the different national collection and recycling systems.

To foster the development of a European market for secondary raw materials, **minimum recycled content** targets for plastic packaging parts are introduced from 2030. These targets will be calculated as an average per production plant and per year and will increase in 2040[38]. The Regulation also provides for the possibility of setting mandatory minimum requirements for green public procurement.

Concerning **bio-based plastics**, the PPWR foresees a dedicated study to be conducted by February 2028. Based on its findings, the European **Commission may propose legislation to set targets aimed at increasing the use of renewable raw materials** and allowing the use of biomass-based materials in specific applications.

[36] This measure has attracted significant criticism from the plastics processing industry. It primarily affects packaging used for unprocessed fresh fruit and vegetables under 1.5 kg, single-serving micro-packaging used in the hotel and catering sector, grouped packaging and ultra-light bags (made of material thinner than 15 microns).

[37] Defined under Regulation 2024/1781 on Ecodesign for Sustainable Products (ESPR). Specific limits are established for lead, cadmium, mercury, and hexavalent chromium and, as of August 2026, for perfluoroalkyl substances (PFAS). PFAS – often referred as 'permanent chemicals'- are a large family of synthetic chemical compounds that are widely used for their resistance to heat, water, and oil. However, due to their non-biodegradable nature, PFAS accumulate in organisms and the environment, posing well-documented damage to human health.

[38] The targets introduced vary according to the primary polymer type and the intended use -specifically, whether the packaging comes into contact with food, beverages, and sanitary products. The targets range from 10% to 35% in 2030, rising to between 25% and 65% in 2040. The Regulation extends a requirement, which as of today, applies only to single-use PET beverage bottles under the SUP (single-use plastic) directive. At present, the recognition of chemical recycling will play a crucial role in meeting the minimum recycled content thresholds for non-PET packaging intended for direct contact with food, beverages or healthcare products. In contrast, PET packaging (primarily used for beverages) is already characterized by a widespread and advanced use of secondary raw materials; with recycled content levels reaching even up to 100 %. A noteworthy provision allows Member States to incentivize producers by modulating extended producer responsibility fees based on the percentage of recycled content used in the packaging.

With regard to **compostable packaging -** a category that represents a very important sector within the Bioeconomy -, the Regulation stipulates that from February 2028, certain packaging formats, including tea bags, coffee pods, and adhesive labels on fruit and vegetables must be compostable throughout the EU. The Regulation also introduces the option for Member States to impose compostability requirements for certain specific applications (light and ultra-light bags and plastic beverage capsules). Moreover, Member States may introduce mandatory compostability for additional packaging formats not explicitly listed, including that in the ban above (e.g. packaging for fruit and vegetables, foodservice for the HO.RE.CA sector, containers for condiments, sauces, etc.) before the Regulation's date of application of 12 August 2026. Importantly, compostable packaging is exempt from the minimum recycled content requirements.

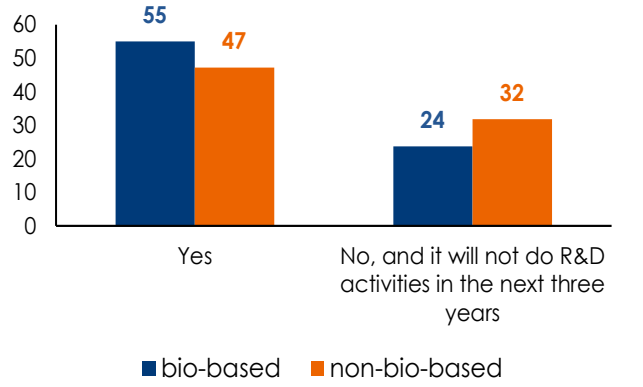
3.7 Research, Development and Innovation

Research and Development plays a pivotal role in driving innovation and enhancing the competitiveness of companies.

For bio-based companies, a greater attention to this issue seems to emerge: **more than half of the companies (55%) report engaging in R&D activites, a figure higher than that observed among non-bio-based companies (47%).** Conversely, a larger share of non-bio-based companies report no plans to pursue R&D in the next three years, confirming a lower sensitivity to this strategy.

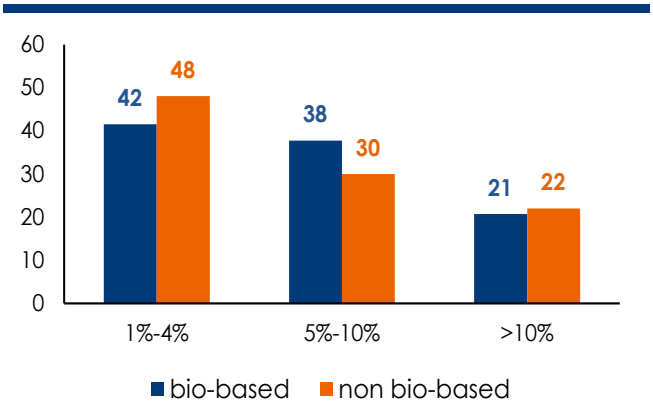
Among the companies that do R&D, the majority, both among bio-based and non-bio-based companies, allocate between 1% and 4% of their turnover to these activities, while around 20% of companies indicate investments of more than 10%.

Fig. 3.34 - Your company carries out R&D activities (% of respondents)



Source: Intesa Sanpaolo survey on plastic packaging companies (2024)

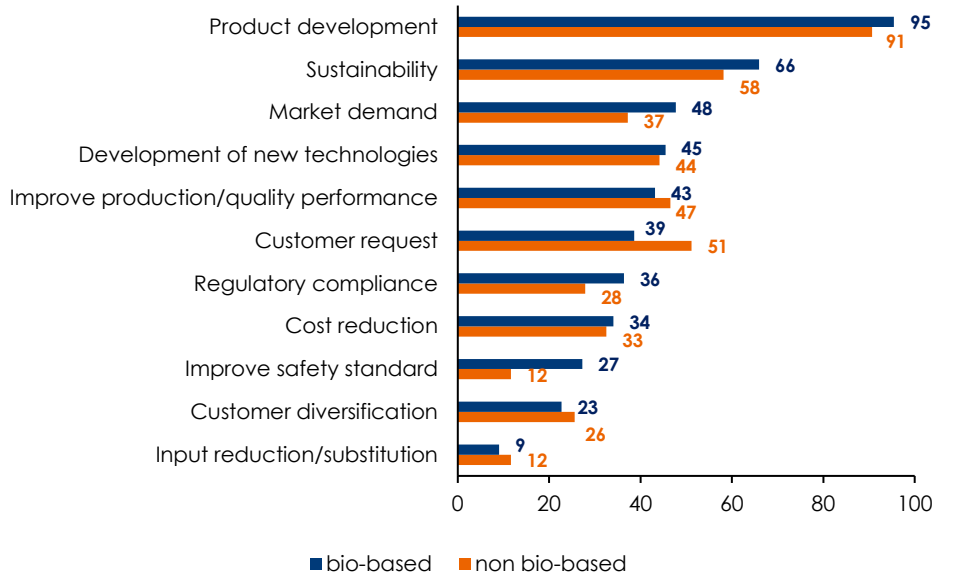
Fig. 3.35 - R&D as a percentage of turnover



Source: Intesa Sanpaolo survey on plastic packaging companies (2024)

The main purpose of R&D is product development, cited by 90% of the companies, regardless of their bio-based nature. Sustainability, encompassing a multitude of different activities, ranks as the second most common R&D objective. For bio-based companies, meeting market demand (48%), followed by the development of new technologies (45%), also emerges as a key motivation for R&D expenditure. In contrast, non-bio-based companies emphasize customer demand as the principal driver for research (51%), followed by the pursuit of quality and/or performance improvements (47%).

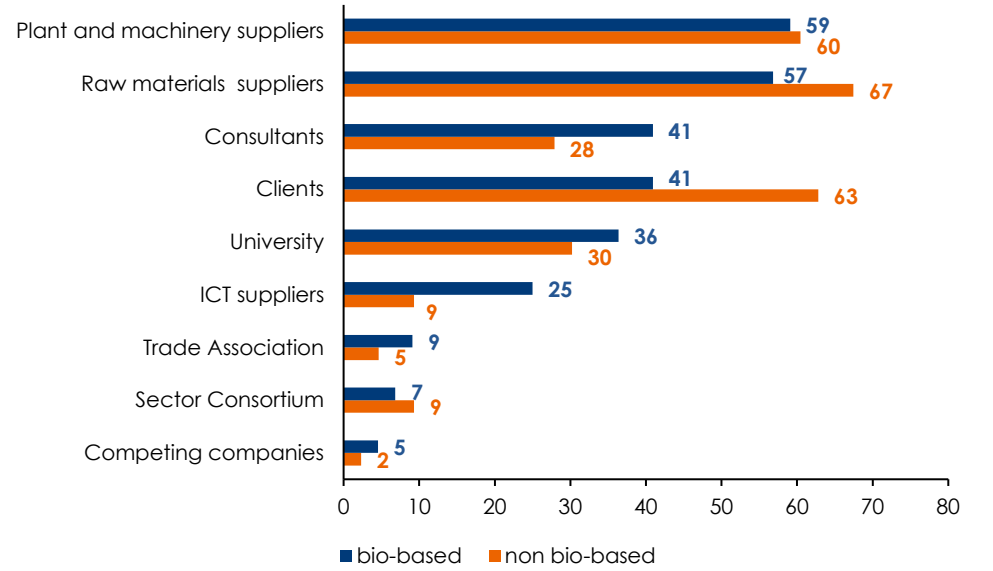
Fig. 3.36 - Purposes of R&D (% of respondents)



Note: ranking by decreasing order of responses from bio-based companies. Source: Intesa Sanpaolo survey on plastic packaging companies (2024)

The most pronounced difference between bio-based and non-bio-based concerns the goal of improving safety standards, indicated by more than a quarter of the bio-based companies, compared to just 12% among non-bio-based firms. This disparity could stem from the introduction of new products requiring strict safety compliance, as well as denote a greater sensitivity to the issue of safety in the face of growing attention to the problem of the potential presence of toxic substances in plastics. Regulatory compliance is cited by 36% of bio-based companies, a higher share than that of non-bio-based (28%). This reinforces the earlier observation of greater proactivity of bio-based companies highlighted in the previous section. Another important aspect to investigate with regard to innovation processes within companies is identification of the main partners in this journey. More than half of the bio-based companies recognize suppliers - both of equipment and raw materials- as their main partners in the innovation process, followed by customers and consultants. For non-bio-based companies, the role of suppliers of raw materials stands out, closely followed by that of customers with over 63% indicating their relevance. It is also noteworthy that for bio-based companies the relevance of collaborations with universities is greater than for non-bio-based ones.

Fig. 3.37 - Partners in R&D (% of respondents)

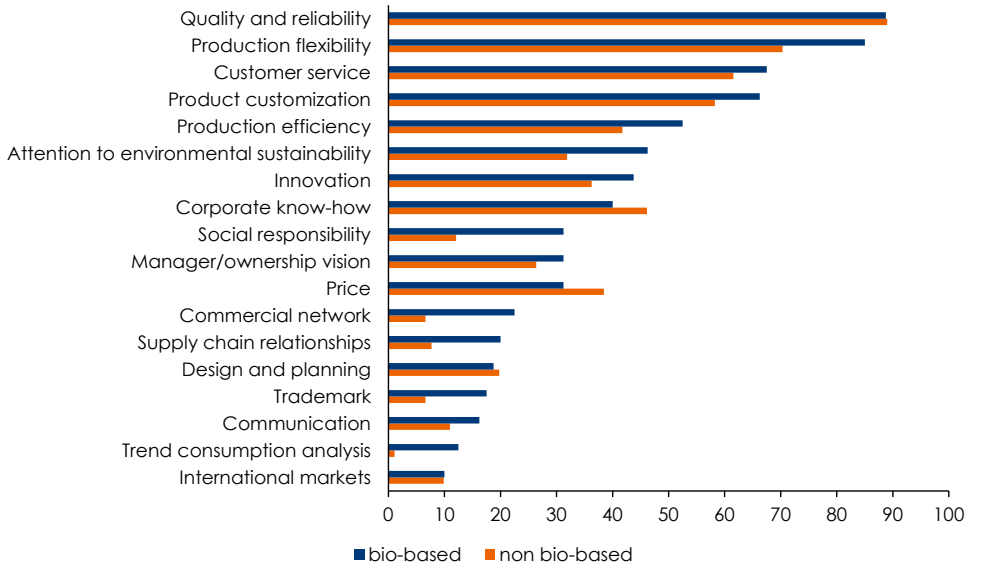


Note: ranking according to the decreasing order of answers of bio-based companies. Source: Intesa Sanpaolo survey on plastic packaging companies (2024)

3.8 Corporate strategies, environmental sustainability, and prospects

Among the main strengths recognised by both bio-based and non-bio-based companies, **product quality and reliability** stand out, **indicated by over 88%** respondents **as the** defining feature **of their** business. These are followed by production flexibility, customer service, and product customisation, each mentioned by more than half of the interviewed firms, regardless of their bio-based nature. The most notable differences between bio-based and non-bio-based companies emerge in social responsibility, which is indicated as a strenght by more than 30% of bio-based players, compared to 12% of other players. A significant gap also emerges in the perceived importance of supply chain relations, considered relevant by one fifth of bio-based companies but only 7% of non-bio-based ones, as well as the presence of a commercial network capable of supporting the business. On the contrary, non-bio-based companies are distinguished by a higher share of respondents that consider price competitiveness and greater corporate know-how to be relevant.

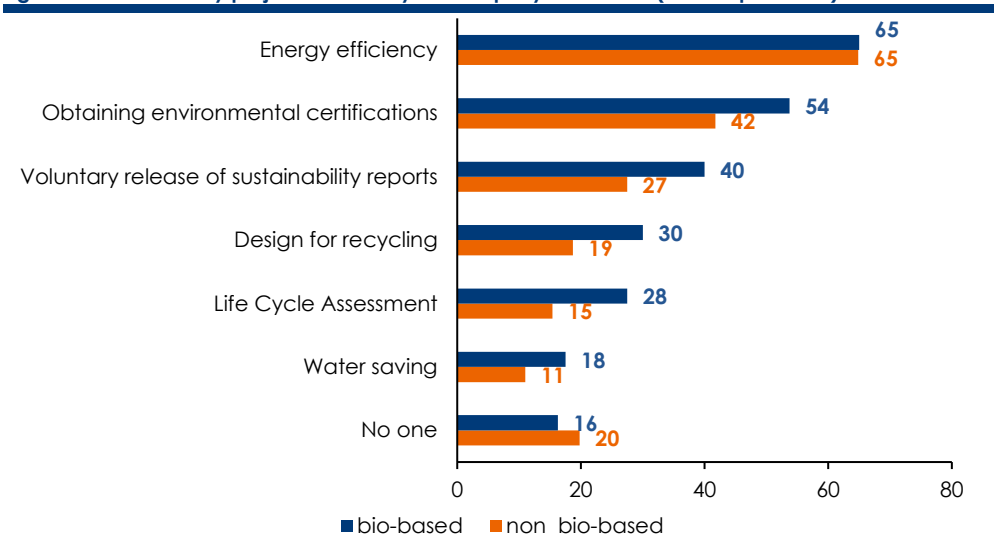
Fig. 3.38- The main strengths of the company (% of respondents)



Note: ranking based on the decreasing order of answers of bio-based companies. Source: Intesa Sanpaolo survey on plastic packaging companies (2024)

An important divergence also emerges between the two sample clusters regarding attention to environmental sustainability, which is considered a key strength by more than 46% of bio-based companies, against 32% of the others. A closer examination of sustainability-related activities and of the specific projects in which the company is involved reveals compelling insights. More than 60 % of the sample, regardless of classification as bio-based or non-bio-based companies, indicate **energy efficiency in production processes** as **their main sustainability project. This result is not surprising considering the increase in energy commodity prices observed since 2022**, which has pushed companies, particularly in Italy compared to key European competitors, to look for alternative solutions to contain the increase in costs, especially energy costs. Notably, across all categories of sustainability projects, the share of bio-based companies involved is higher than that of non-bio-based firms. More than half of the bio-based companies show involvement in obtaining environmental certifications, 40% voluntarily prepare sustainability reports, and 30% are active in design for recycling. These percentages are higher than those recorded for non-bio-based companies, which stand at 42%, 27%, and 19% respectively. For the latter, the proportion of those indicating that they are not involved in any project related to environmental sustainability is higher at 20%.

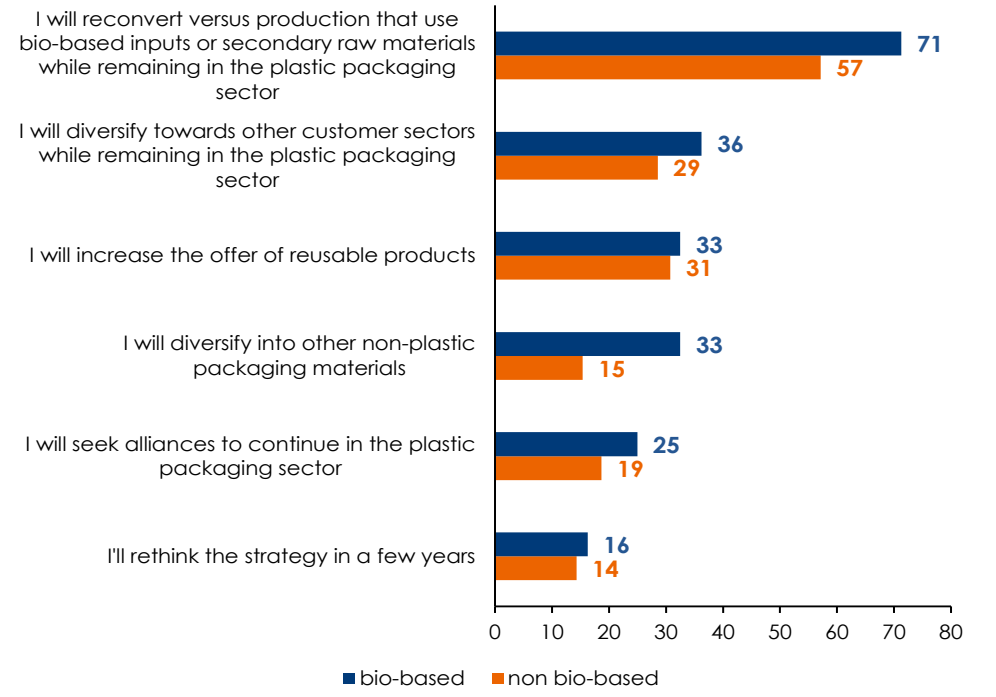
Fig. 3.39 - Sustainability projects in which your company is involved (% of respondents)



Note: ranking according to decreasing order of answers of bio-based companies. Source: Intesa Sanpaolo survey on plastic packaging companies (2024)

Finally, in light of the transformation taking place in the sector, companies were asked to identify their main strategies. In first place, for both types of companies analysed, emerged the reconversion/enhancement of production processes to incorporate bio-based inputs or secondary raw materials, without leaving the plastic packaging supply chain. This is followed by diversification towards other customer segments, still within the plastic packaging supply chain, and an expansion in the offering of reusable products. In general, a greater proactivity of bio-based companies emerges.

Fig. 3.40 - In light of the ongoing transformation of the sector, both from a regulatory point of view and from the point of view of the evolution of the competitive scenario, please tell us which main strategies do you foresee for the future? (%)



Note ranking according to decreasing order of answers of bio-based companies. Only main answers indicated at least 14% of respondents). Source: Intesa Sanpaolo survey on plastic packaging companies (2024)

3.9 Conclusions

The survey has highlighted pivotal dynamics and strategic choices among companies operating in a sector deeply intertwined with sustainability and shaped by the regulatory pressures. The clustering of the sample based on the use and intensity of bio-based raw materials in their production processes reveals notable differences in some cases. An initial finding concerns the motivation behind the introduction of bio-based inputs. This appears to be primarily driven by the pursuit of market competitiveness, and, secondarily, by innovation and regulatory compliance. To a large extent, the bio-based companies analysed have transitioned from tradition fossil raw materials (only 10% were originally already founded with bio-based characteristics). Looking ahead, the adoption of bio-based inputs is set to increase: 23% of the companies that currently do not use bio-based raw materials intend to introduce such inputs into their production processes, while as many as 68% of the companies that use bio-based inputs in a marginal way state that they intend to expand their use of such resources. Companies that use biobased inputs with low intensity also tend to use secondary raw materials more in their production processes than non-bio-based companies. Furthermore, almost half of the surveyed low-intensity bio-based companies plan to increase the use of renewable inputs in the short to medium term, compared to a lower percentage among non-bio-based companies.

The production and strategic choices of companies are closely influenced by the regulatory framework, with bio-based companies appearing to be more sensitive and responsive to the introduction of new regulations. In general, the main lever activated by companies concerns the modification of their product range, a strategy implemented by 50% of the sampled firms in the past and projected to rise to 54% in the future. This strategy is notably more prevalent among bio-based companies (59%) than among non-bio-based companies (43%). The dynamism of packaging companies - regardless of the input type - is also reflected in their innovation efforts, which is a strategic factor for the growth of companies in general and is increasingly critical in the context of green transition and the development of a circular economy. In fact, more than half of the companies in the sample state that they do Research and Development. The incidence is higher for bio-based companies (55%) that respond to a growing demand for sustainable products and materials. The motivations behind the research and development activities differ: bio-based companies aim primarily to meet market demands (48%), followed by the development of new technologies (45%). For non-bio-based companies, instead, it is customer demand that drives the company to do research (51.2%), followed by the need to improve quality and/or performance (46.5%). The most pronounced difference between bio-based and non-bio-based is observed for the objective of improving safety standards, a finding that could perhaps be linked to the introduction of new products. With reference to strengths, product quality and reliability appear to be a common distinguishing feature for packaging companies. However, an important gap emerges between the two sample clusters in terms of attention to environmental sustainability and social responsibility- strategic levers that are particularly emphasized by bio-based companies.

In perspective, reconversion and upgrading of production processes to incorporate bio-based inputs or secondary raw materials appears to be the main response of companies to cope with the ongoing transformations.

4. From marginality to sustainable centrality: the potential of Inland Areas in the perspective of the Bioeconomy

4.1 Introduction

SRM - Studi e Ricerche per il Mezzogiorno:

Salvio Capasso
Agnese Casolaro
Autilia Cozzolino

The aim of this chapter is to analyse the attractiveness of the country's Inner Areas and, in particular, of the Mezzogiorno in relation to the potential of the Bioeconomy.

Everywhere in the world, there are marginal territories (rural, hilly, mountainous areas defined as Inland Areas) far from large urban centres, preserving unique heritage in terms of nature, culture, and traditions. These areas, often neglected in development processes, represent precious resources for building alternative, more sustainable growth models rooted in local contexts.

In Italy, the Inner Areas make up about three-fifths of the national territory, distributed from North to South. They are characterised by considerable natural, landscape, and cultural wealth, their distance from large urban agglomerations and service centres, and development potential centred on a combination of innovation and tradition. The Bioeconomy represents, without a doubt, a sector through which it is possible to enhance the attractiveness of the Inner Areas, offering a concrete development perspective while overcoming the essential deficits (education, health, and mobility) that characterise them.

This relationship is crucial since **the development of the Bioeconomy can reverse declining infrastructural, demographic, and economic trends affecting these territories, facilitating lasting and sustainable socio-economic growth mechanisms**.

Therefore, the connection between the potential of the Bioeconomy and that of the Inner Areas is emphasised. It is a reciprocal relationship since enhancing Inner Areas through territory management can favour the adequate use of renewable biological resources to produce goods, services, and energy, promoting sustainable economic growth consistent with the environmental and energy transitions towards which the EU is heading.

Within this framework, the Bioeconomy represents a transformative paradigm. Based on efficient and regenerative use of biological resources, it offers a growth model aligned with the vocations of Inner Areas: agriculture, forests, biodiversity, crafts, and local supply chains. In particular, the Circular Bioeconomy is geared towards closing production cycles, reducing waste, valorising surpluses, and creating added value through sustainable use of natural resources.

In the remainder of this paper, attention will focus on the characteristics of Inner Areas and their potential within a bioeconomic context. The first paragraph outlines the socio-economic characteristics of the territory, focusing on demographic and entrepreneurial components as a synthesis of its unexpressed potential. This is followed by an analysis of the specific potential (already expressed) of Inner Areas in contributing to the Bioeconomy, highlighting their main production and biodiversity factors[39]. Given this framework, the last paragraph presents, through the reflections of stakeholders and experts, policy guidelines and evaluations regarding the strategic link between Inner Areas and Bioeconomy development, with examples of concrete initiatives aimed at valorising specific resources in these territories.

[39] The data reported for the first two paragraphs, where not otherwise specified, were elaborated by the Istat working group composed of Agata Maria Madia Carucci, Daniela Fusco, Paola Giordano, Maria Antonietta Liguori and Donato Summa for the SRM Tourism & Territory Report 2025.

4.2 Depopulation and resilience: Inland Areas between demographic decline and potential for socio-economic growth

The Italian Inner Areas, according to the definition provided by the National Strategy for Inner Areas (SNAI), represent territories with less accessibility to essential services - education, health, mobility - but at the same time rich in local environmental, cultural and productive resources[40]. Far from the large centres, they are therefore configured as privileged laboratories for experimenting sustainable development models based on territorial capital.

The SNAI classification shows a clear articulation of Italian municipalities according to 'peripherality'. Out of 7,903 municipalities, only 182 (2.3%) are defined as service poles, with more than 20.3 million inhabitants (34.5%), while **the Peripheral and Ultraperipheral areas - the heart of the Inner Areas - count a total of 1,906 municipalities (24.1%), with a population of 5.3 million and a territorial extension of more than 101,000 km².** To these are added the Intermediate and Belt areas, which contribute to forming a heterogeneous territorial mosaic but share structural conditions of fragility and potential.

In the Mezzogiorno, the peripheral vocation of municipalities is even more evident. Considering the core component, it accounts for 39% of the municipalities, 17% of the population and 42.3% of the area's surface area, values that are higher than the national average (24.1%, 9%, 33.7% respectively). The Mezzogiorno also plays a significant role, since well over half of the Peripheral and Ultraperipheral municipalities and their surface area are in this geographical area.

Table 4.1 - Distribution of municipalities, population and surface area by SNAI, absolute values and percentages. Year 2022, Italy and Southern Italy

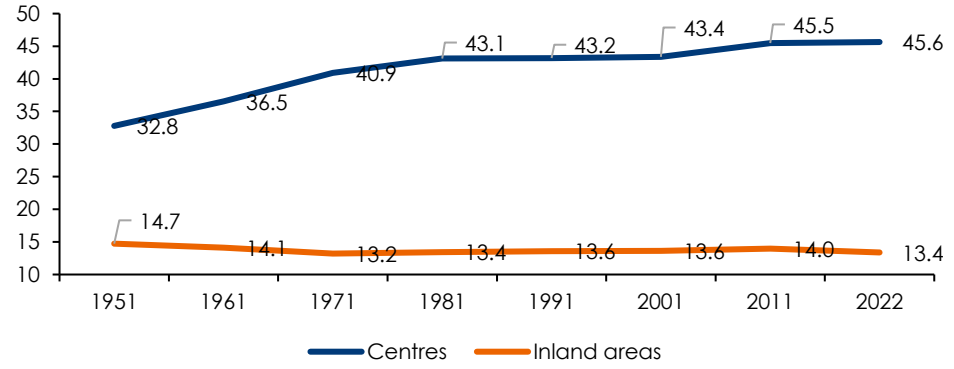
SNAI classification	Italy					
	Municipalities		Population		Surface area	
	abs. val.	%	abs. val.	%	abs. val.	%
Poles	182	2.3	20,332,587	34.5	24,455	8.1
Inter-municipal poles	59	0.7	1,573,209	2.7	3,728	1.2
Belt	3,828	48.4	23,734,444	40.2	96,344	31.9
Intermediaries	1,928	24.4	8,030,611	13.6	75,838	25.1
Peripheral	1,524	19.3	4,615,206	7.8	79,394	26.3
Ultra-peripheral	382	4.8	711,144	1.2	22,310	7.4
Total	**7,903**	**100**	**58,997,201**	**100**	**302,068**	**100**
	Mezzogiorno					
	Municipalities		Population		Surface area	
	abs. val	%	abs. val.	%	abs. val,	%
Poles	50	2.0	5,465,928	27.5	8,181	6.6
Inter-municipal poles	17	0.7	619,723	3.1	2,448	2.0
Belt	766	30.0	6,596,363	33.2	26,699	21.6
Intermediates	732	28.7	3,811,336	19.2	34,121	27.6
Peripheral	757	29.7	2,892,008	14.6	39,421	31.9
Ultra-peripheral	229	9.0	471,473	2.4	12,860	10.4
Total	**2,551**	**100**	**19,856,831**	**100**	**123,730**	**100**

Source: SRM on Istat elaborations - Permanent Population Census

Demographic dynamics show a consolidated trend of depopulation. Between 1951 and 2022, the Inner Areas lost 1.4 million residents, while urban centres recorded a strong increase. Similarly, in the Mezzogiorno, the loss amounted to about 1 million inhabitants. [41]

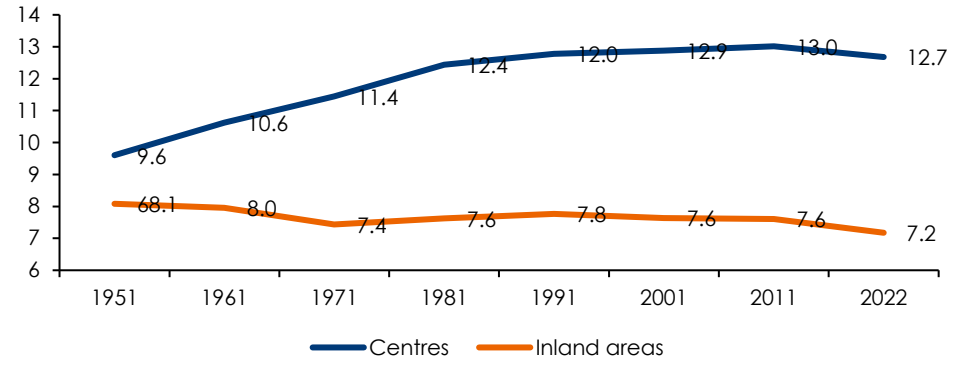
[40] For further information see https://www.agenziacoesione.gov.it/strategia-nazionale-aree-interne/
[41] Istat (2023), Permanent Census of Population and Housing.

Fig, 4.1 - Population at censuses - Millions of inhabitants per SNAI, Years 1951-2022, Italy



Source: SRM on Istat elaborations - Permanent Population Census

Fig, 4.2 - Population at censuses - Millions of inhabitants per SNAI, Years 1951-2022, Southern Italy



Source: SRM on ISTAT elaborations - Permanent population census

At the same time, **population ageing is advancing: the average age in the country's Inner Areas is 46.9 years, with an old age index of 207.1, both values higher than those recorded for urban centres**. In the Mezzogiorno, the average age in the Inner Areas is 46.3 years against 45 in the Centres and the old-age index is 199.3 against 169.5.

Table 4.2 - Average age and old-age index* for Centres and Inner Areas, Year 2022, Italy and Southern Italy

	Average age		Old age index	
	Italy	Mezzogiorno	Italy	Mezzogiorno
Centres	46.2	45.0	189.2	169.5
Inner Areas	46.9	46.3	207.1	199.3
Total	**46.4**	**45.5**	**193.1**	**179.8**

* over 65 for every 100 young people aged 0-14, Source: SRM on Istat elaborations - Permanent population census

These data, in any case, should not be read exclusively in a critical light. On the contrary, **the** very **condition of marginality can represent a field of experimentation for new trajectories of sustainable development, marked by resilience, social innovation, valorisation of local resources and participatory governance**. The Inner Areas can become the protagonists of a new paradigm of territorial citizenship. The structural criticalities of the productive fabric remain, however, a challenge.

According to ISTAT's Frame SBS Territorial survey, **the average added value per employee in the Italian Inner Areas is EUR 43,587, compared to 54,503 in the Centres**, and annual wages are about EUR 3,700 lower. In the Mezzogiorno, the added value per employee in the Inner Areas stops at EUR 34,219, with average annual wages of EUR 19,380, well below the national average. **The average size of enterprises is also smaller**: 2.7 employees per unit in the Southern Inner Areas, compared to 3.1 in the Centres and Inner Areas considered at the national level.

Table 4.3 - Structural and economic indicators of local units by Centres and Inner Areas, Year 2022, Italy and Southern Italy

Indicators	Italy		Mezzogiorno	
	Centres	Inner Areas	Centres	Inner Areas
Value added per employee	54,503	43,587	39,153	34,219
Average salary per employee	27,321	23,552	20,772	19,380
Average number of employees	3.7	3.1	3.1	2.7

Source: SRM on Istat elaborations - Frame SBS Territorial

However, this micro-dimension **can become a strength if oriented towards quality production and network models**. Sustainable agriculture, renewable energy, handicrafts and bio-industries can represent development levers if accompanied by appropriate policies. Enterprises with a low environmental impact, oriented towards the valorisation of local resources - agricultural, forestry, handicrafts, energy - can find precisely in the southern Inner Areas the physical and cultural space for a relaunch based on quality and social innovation.

In this framework, **the integration between bioeconomy and territorial governance is also important** and assumes a strategic value also in the context of the ecological transition promoted at a European level. The Green Deal and the National Recovery and Resilience Plan offer important tools for strengthening investments in the country's most fragile areas, provided they are oriented in a manner consistent with territorial specificities.

What is needed, therefore, is a territorial vision of sustainable development that combines inclusion, innovation and cohesion and, in this sense, the Inner Areas can become symbolic places of the right transition, if we bet on the ability of local communities to become protagonists of economic and environmental regeneration.

Ultimately, Italy's Inland Areas - and particularly those of the Mezzogiorno - are not simply fragile territories, but contexts rich in resources, experience and skills. The Bioeconomy, if integrated with territorial policies and targeted investments, can represent the keystone for a new development paradigm, based on resilience, cohesion and valorisation of natural and human capital. In this sense, the Inland Areas can become the protagonists of a sustainable territorial citizenship project, which restores a future to territories that have been considered marginal for too long.

4.3 Inland Areas and the Mezzogiorno in the Italian agro-livestock system: biodiversity, structural analysis and prospects for the Bioeconomy

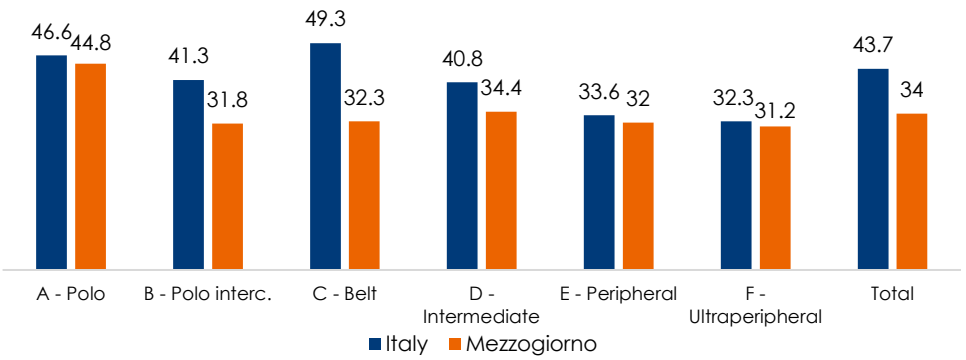
Italian agriculture develops within a highly heterogeneous territorial context, the result of the historical overlapping of very diverse environmental, climatic and socioeconomic conditions. Within this framework, **the Inland Areas are configured as territories with a marked specificity, often characterised by a less intensive agriculture, but more closely connected to the landscape, local traditions and biodiversity**. It is precisely biodiversity, understood in both ecological and cultivation terms, that represents a strategic asset to be valorised in the path towards the Bioeconomy, especially in the southern regions, where the natural component is particularly rich and still largely preserved.

The valorisation of short agro-food supply chains, sustainable forest management, the promotion of the circular economy, the recovery of artisanal knowledge and the use of biomasses represent strategic guidelines for the relaunch of inland areas. The presence of natural parks, UNESCO sites and protected areas also enhances their tourist attractiveness, integrating bioeconomy and sustainable tourism.

Another area of great importance is multifunctional agriculture. **The farms in the Inland Areas, often family-run, preserve traditional practices and local knowledge that can be systemised within bio-based supply chains, integrating production, processing, ecosystem services and rural tourism**. Agricultural enterprises located in the Inland Areas show, therefore, a growing propensity for productive diversification, in line with the principles of the Bioeconomy.

Thus, if we want to draw a picture of the state of the art of the Inner Areas, it is interesting to see how they, compared to other territories, are distinguished first of all by a **larger extension of cultivated areas, with a greater variety of crops that reflects a vocation for productive diversification**. However, these areas also have a lower incidence of certified production, such as DOC and DOCG denominations. At the national level, the share of farms oriented towards such production stands at 46.6% in the urban poles and 49.3% in the metropolitan belts, while it drops to 40.8% in the Intermediate Areas, 33.6% in the Peripheral Areas and 32.3% in the Outermost Areas.

Fig, 4.3 - Share of farms with DOC and DOCG wines by type of territory, Italy and Southern Italy

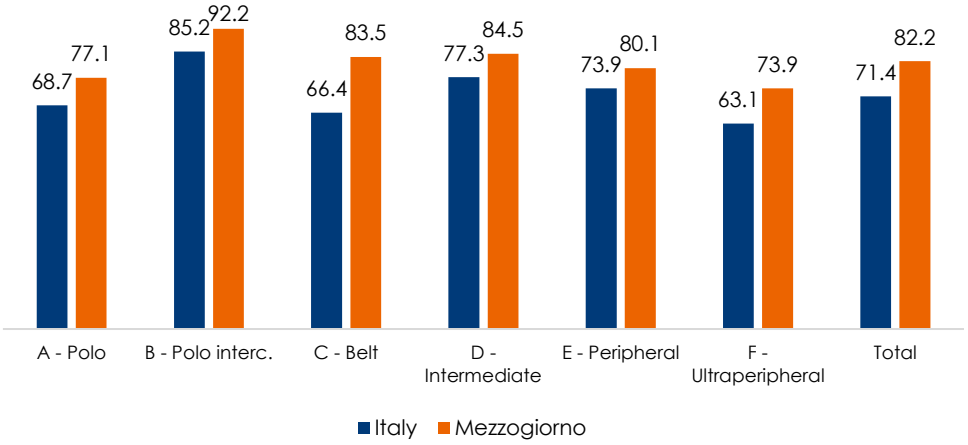


Note: Holdings with DOC and DOCG wines/Farms with vineyards*100, Source: SRM on Istat- VII General Census of Agriculture elaborations

This data highlights a structural difficulty linked to poor accessibility, inadequate infrastructure and less integration in value chains. This dynamic is also reflected in the South of Italy, where the percentage of certified wineries stops at 34%, signalling not only an organisational fragility but also a potential area of intervention for enhancement policies.

On the contrary, **Southern Italy stands out for an extraordinary diffusion of holdings with permanent crops, such as vineyards, olive groves and orchards**, which represent an average of 82.2%, with a peak of 84.5% in the Intermediate Areas and a high holding even in the Outermost Areas (73.9%), compared to a national average of 71.4%, In the national Inner Areas, the share of permanent crops is 77.3% for the Intermediate Areas, 73.9% for the Peripheral Areas and 63.1% for the Outermost Areas, suggesting that the pressure of isolation and orographic complexity can limit even these traditionally stable forms of cultivation. Nevertheless, in the Mezzogiorno, even the most remote areas maintain values above the national average, a sign of a deep-rooted agricultural vocation and a functional balance with the territory.

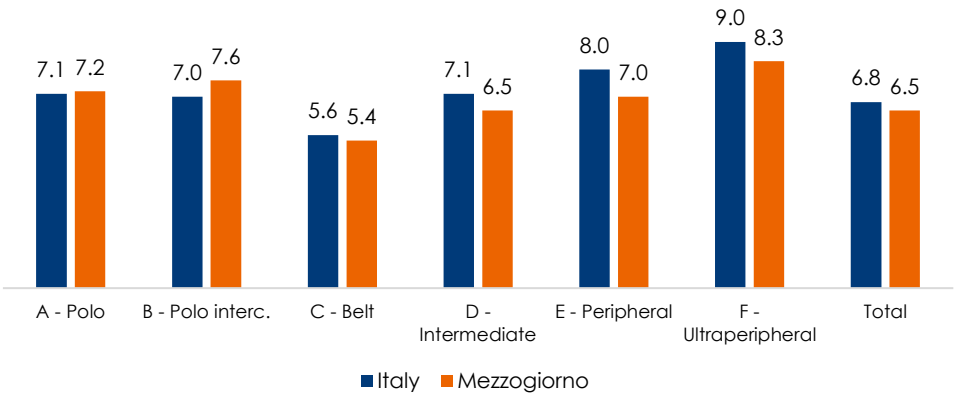
Fig, 4.4 - Share (%) of farms with permanent crops by type of territory, Italy and Southern Italy



Note: Holdings with permanent crops/Farms with UAA*100, Source: SRM on ISTAT elaborations - 7th General Census of Agriculture

Another distinguishing feature of the Inner Areas concerns **the spread of organic farming**, which is an increasingly popular choice as one moves towards the more marginal areas. While the national average of farms with this type of production stands at 6.8%, in the Inner Areas it reaches 7.1% in the Intermediate Areas, 8% in the Peripheral Areas and 9% in the Outermost Areas. In the Mezzogiorno, the trend is confirmed: the average figure is 6.5% but rises to 7% in the Peripheral areas and 8.3% in the Ultraperipheral areas. **This diffusion signals a greater compatibility of these territories with low environmental impact production models, in line with the principles of agroecology, thanks also to the lower anthropic pressure and the absence of large-scale intensive agriculture**.

Fig, 4.5 - Share (%) of farms with organic farming by type of territory, Italy and Southern Italy

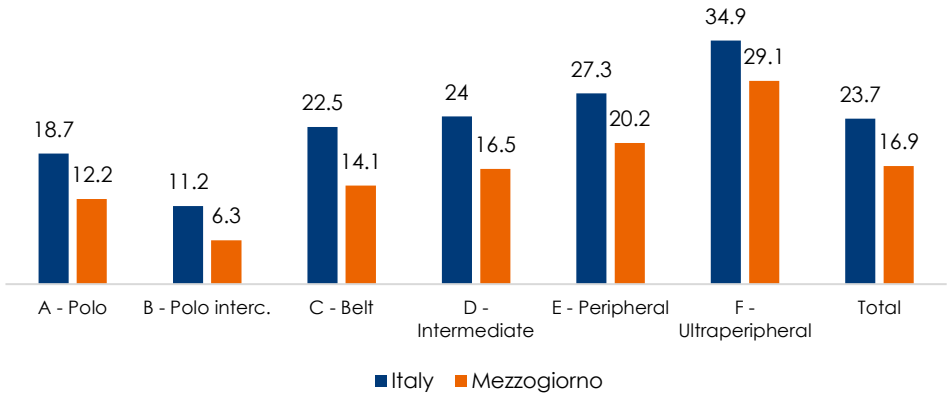


Source: holdings practising organic agriculture/Farms with UAA*100, Source: SRM on Istat elaborations - VII General Census of Agriculture

Another fundamental element for understanding the strategic function of the Internal Areas - and particularly those in the South - in the framework of the Bioeconomy is the presence of **wooded areas**. Compared to a national average of 23.7% of farms with wooded areas, **in the Inner Areas values increase with increasing marginality**: 24% in the Intermediate Areas, 27.3% in the Peripheral Areas and 34.9% in the Outermost Areas. The Mezzogiorno, although with slightly lower values (16.9% on average), follows the same dynamic: 16.5% in the Intermediate Areas, 20.2% in the Peripheral Areas, and 29.1% in the Outermost Areas. **The progressive growth of holdings with forest areas in the most remote areas reinforces the idea that these territories can**

become nerve centres for the development of the forest bioeconomy and the sustainable management of ecosystem services.

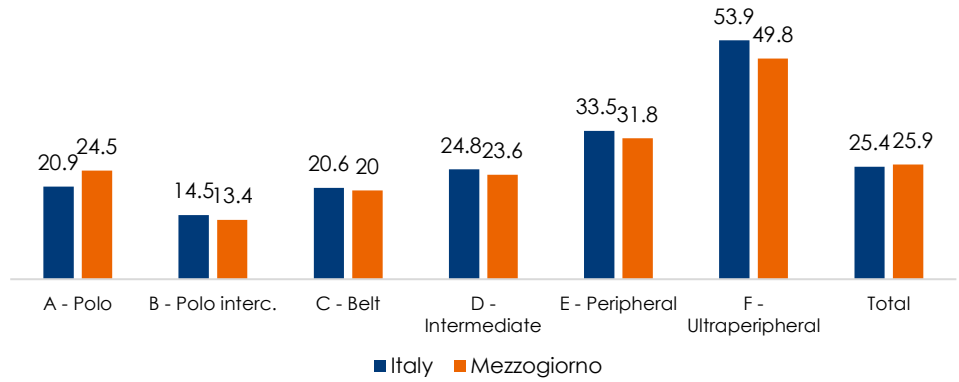
Fig, 4.6 - Share (%) of agricultural holdings with wooded area by type of territory, Italy and Southern Italy



Note: Holdings with woodland/Farms with SAT*100, Source: SRM on Istat processing - VII General Census of Agriculture

Even more pronounced is the relevance of meadows and pastures, present in 25.4% of Italian farms, but in much higher percentages in the Inner Areas: from 24.8% in the Intermediate Areas to 33.5% in the Peripheral Areas and 53.9% in the Outermost Areas. In the Mezzogiorno an average of 25.9% is found, but it rises to 49.8% in the Outermost Areas, highlighting the central role of extensive livestock farming and pastoral activities. **These practices not only guarantee income and employment in fragile contexts, but also contribute decisively to landscape conservation, the prevention of hydrogeological instability and the maintenance of traditional ecosystems such as mountain grasslands, elements closely linked to agricultural biodiversity.**

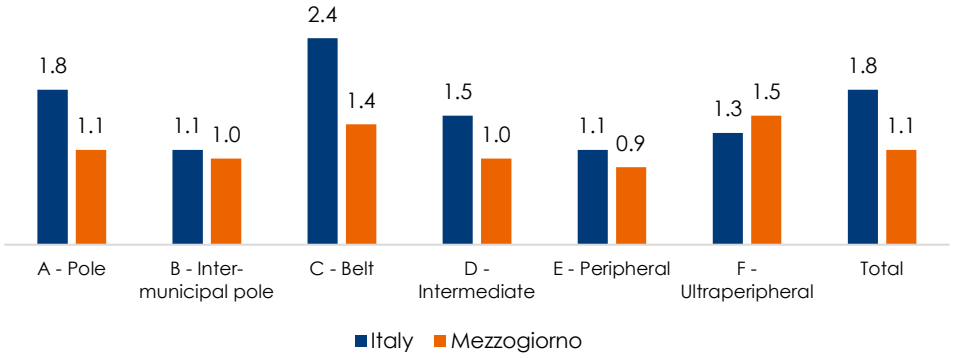
Fig, 4.7 - Share (%) of farms with meadows and pastures by type of territory, Italy and Southern Italy



Note: Holdings with meadows and pastures/Farms with UAA*100, Source: SRM on ISTAT elaborations - VII General Census of Agriculture

Timber arboriculture, although marginal overall (1.8% of national farms), shows constant values in the Inland Areas (between 1.1% and 1.5%) which indicate a productive base on which to build new supply chains linked to the forest Bioeconomy. **The Mezzogiorno, with its vast forest heritage and growing attention to sustainable management, can find in this sector a new opportunity for territorial development.**

Fig, 4.8 - Share (%) of farms with wood arboriculture by type of territory, Italy and Southern Italy



Note: Farms with wood arboriculture/Farms with UAA*100, Source: SRM based on Istat processing - 7th General Census of Agriculture

Overall, the data paint a clear picture: **Italy's Inland Areas, and in particular those in the South, possess an ecological and productive capital that makes them naturally suited to supporting the transition towards the Bioeconomy**. Their richness in biodiversity, the prevalence of stable crops, the spread of organic practices, the presence of integrated agro-sylvo-pastoral systems and the relative absence of intensive agriculture configure these territories as strategic areas for Italy, not only in productive terms, but above all as custodians of ecosystem services and sustainable innovation.

To trigger lasting change, a quality leap in public policies is needed. Multi-level governance, capable of activating investment, accompanying businesses and strengthening local skills, is fundamental, Training, mutualism and cooperation must be at the heart of strategies to bring out the leading role of communities.[42]

The challenge for the future is to recognise and support this vocation through targeted public policies capable of overcoming the welfare logic and investing in tangible and intangible infrastructures, access to credit, the promotion of widespread innovation and the strengthening of local skills. In particular, biodiversity (both natural and agricultural) must be recognised as a fundamental input of the Bioeconomy, transforming itself from a landscape element to a regenerative development lever. Only in this way can the Inland Areas be valorised as central players in the sustainable transformation of the country and the Mezzogiorno can fully express its endogenous potential in an inclusive and lasting way.

4.4 Directions from the territory: strategies, models and concrete actions

In this concluding paragraph, we would like to give voice to the main actors in the development of the Bioeconomy, understood in a logic of economic and social interaction with the country's Inner Areas. These actors include the university and research world, trade associations and institutions, It is only through an integrated reading of the needs and potential of these areas, declined in a socio-economic development perspective, that it is possible to effectively respond to the challenges emerging from the territories, The circular bio-economy may represent one of the most promising answers to these needs.

To this end, a virtual round table was set up, made possible thanks to the expertise and organisational contribution of Luigi Iavarone, board member of the Spring Cluster, who, in the context of his institutional role of connecting and supporting the Bioeconomy supply chain and

[42] For more details see: OECD (2020), Rural Well-being: Geography of Opportunities.

promoting synergies between research, enterprises and territories, considered it fundamental to explore the biunivocal relationship between Inner Areas and the circular Bioeconomy.

The round table aims to highlight, on the one hand, some theoretical and institutional aspects of the Circular Bioeconomy model applied to the territorial context of the Inland Areas, and on the other, concrete cases of implementation of projects in the territory, with particular attention to the role of wood and forests. To conclude the various speeches, a very interesting and relevant reflection by Anci President Gaetano Manfredi.

***

The first contribution is that of Prof. **Marialuisa Saviano** Director Pharmanomics Interdepartmental Research Center of the University of Salerno; as well as President of the Italian Association for Sustainability Science (IASS), who highlights **the need to recognise the Circular Bioeconomy as a new paradigm for the development of Inland Areas and therefore a real institutional, organisational and economic challenge.**

According to Prof. Saviano, looking at the Circular Bioeconomy as a new development paradigm for Inland Areas requires sharing certain premises of strategic governance of the territory. In its most general meaning, the concept of paradigm, which in the scientific sphere recalls the founding thought of Khun (1969), represents a reference model for action that implies a commonality of vision and guiding values, necessary for the alignment of key players throughout the process that goes from the definition of strategies to the evaluation of the results concretely achieved. Political-institutional governance, in its various articulations, does not fail to produce plans and programmes of high strategic value. However, these plans and programmes often do not fully achieve their objectives in the implementation phase. It is therefore necessary to verify the convergence of strategies defined at different levels or in different areas but concerning the same territories of action.

The first strategic reference for Inland Areas is certainly the SNAI, as a territorial strategy aimed at improving the quality of services to citizens and the opportunities for economic development of inland territories at risk of marginalisation. The SNAI focuses on a few key areas of action and adopts an integrated governance approach, envisaging co-planning between institutional levels and the involvement of local communities. Despite the strategy's value, the facts show that the action is not fully effective as evidenced by the data (see supra), with respect to the problem of depopulation. Moreover, there is a lack of homogeneity of impacts at territorial level. Therefore, the vicious circle of decline of the Inner Areas is not, in fact, yet reversed. There are inevitably many reasons for this, which can also be traced back to the heaviness of bureaucracy, and an ex post deterministic analysis is complex.

From an ex-ante analysis perspective, the possibility that the Bioeconomy represents a new economic paradigm for the Inner Areas, with particular reference to the Mezzogiorno, requires a convergence check of the Italian Strategy for the Bioeconomy (BIT) with the SNAI. Compared to the SNAI, the BIT's priority lines of action focus on methods rather than on sectors of intervention. In a perspective of sought-after paradigmatic convergence, this aspect is relevant. Specifically, the ITB proposes, first of all, to **move from 'sectors' to 'systems', thus focusing on the need for a systemic approach to reconnect environment, society and economy in a development model that is fully sustainable**. Furthermore, the BIT affirms the need to create "value from local biodiversity and circularity", thus implicitly recognising the possible limits of a Bioeconomy that is not also designed to ensure circularity, as also expressed by the shift from economy to sustainable economy. Emblematic and significant is, finally, the shift from idea to reality, which underlines the necessity but also the criticality of moving from strategic intentions to facts, drawing attention to the concrete ways in which action is realised, which largely determine its potential for success.

The BIT has recently turned its attention to territories, demonstrating an awareness of the limits of the sectoral perspective, which has already been overcome in thinking of the Bioeconomy as a meta-sector. This evolution significantly enhances **the possibility of the Bioeconomy becoming a reference economic development paradigm for the Inner Areas strategy**. The BIT's territorial turn creates, in fact, the conditions for a territorial integration in the SNAI, On the other hand, the SNAI finds in the circular and inclusive Bioeconomy a concrete answer for the economic but also social regeneration of the Inner Areas. The element of inclusion, to be understood in a broad way, represents a not insignificant aspect for the strategy's effectiveness: it is the local communities, in the final analysis, that are the key to seizing the opportunities offered by an Inland Area strategy centred on the circular Bioeconomy model. Indeed, it is the local communities that are the fundamental link in the reconnection between environment, economy and society at the heart of the 2030 Agenda.

SNAI and BIT, therefore, appropriately harmonised by a wise and authentically convergence-oriented governance, which knows how to adopt appropriate policies of elicitation from the territories so that the local factors of instability and imbalance - which prevent the exploitation of the development opportunities offered by the Inner Areas - can be complementary at the territorial level and strengthen the convergence with the National Strategy for Sustainable Development (SNSvS) at the country system level. The Inner Areas, in fact, similarly to the Protected Areas, are characterised by an almost unique territorial condition in the scenario of the global commitment to sustainability: in contrast to what happens in the developed economies of urban centres, which need to recover an ecosystemic balance at an environmental and social level, the Inner Areas, as pointed out, are places naturally suited to sustainability that enjoy a certain environmental balance, however at risk, but need to recover an ecosystemic balance at an economic and social level. This is, of course, a paradox in the development of the Italian Country System. If, therefore, we need to talk about convergence, it is precisely from the territories that we need to start with a concerted strategy to reduce distances and gaps, relativising the very concepts of centre and periphery. If this strategy were to work, there would be a much larger natural, social and economic, as well as cultural, capital in which to invest for a systemically sustainable development of the territories of Italy as a whole.

Circular bioeconomy and Inner Areas have a common denominator, which is represented by one of the main raw materials available in these territories, useful to promote a balanced and sustainable functioning of the processes inherent in this production model: wood.

***

In this regard, the point of view of Prof. **Piergiuseppe Morone**, Vice-Rector for Research at Unitelma Sapienza and Vice-Chair of the Scientific Committee of the CBE-JU and Director of the School of Sustainability Studies and Circular Economy (SUSTAIN), is interesting.

Prof. Morone emphasises that despite the undoubted potential of forestry as a means of combating climate change and as a key resource in the bioeconomy, **a unanimously agreed definition of a forest-based bioeconomy is still lacking**. In the same way, an organic and all-encompassing regulation on forest exploitation is lacking at EU level. However, the immense potential of forests in the context of actions and policies to combat climate change, as well as the ability of forest products to better meet (compared to non-renewable materials) the increasingly pressing demands for sustainability, have attracted growing interest at a national, European and international level, which has resulted in the proliferation of regulations, strategies and action plans for forestry.

In addition to international and European sources, forests are the subject of careful regulation and discipline at the domestic level, given the importance of Italy's forestry heritage, which covers a surface area of approximately 36.7% of the national territory.

Due to its richness and considerable potential, the Italian forest heritage enjoys careful and timely legal protection, both at central and regional level. In addition, a National Forestry Strategy was drawn up in 2022, valid for 20 years, with the aim of providing the country with resilient forests that can actively combat climate change, encourage the conscious and sustainable use of natural resources and preserve Italy's forest heritage in the collective interest and for the benefit of future generations.

Italian forests can, in fact, play a fundamental role in the decarbonisation efforts undertaken by our country to align with the climate neutrality targets by 2050 set by the EU, as well as playing a key role in the efforts to combat climate change and mitigate its effects, given their considerable carbon storage potential and their central role in the production of renewable energy.

Forests, which are mainly present in Italy's inland areas, also contribute to the protection of biodiversity and certainly play a key role in regulating water flow, combating hydrogeological instability and soil erosion phenomena. Forests can also have great potential in the redevelopment processes of abandoned areas and degraded environments, contributing to the enhancement of otherwise marginal areas of the territory: in fact, inland areas rich in vegetation can offer alternative dimensions to urbanised and densely populated areas, laying the foundations for more sustainable forms of development and growth models more rooted in local contexts.

In conclusion, the forest heritage represents a valuable resource in the context of the Bioeconomy, identifying a fundamental space for action to combat the effects of climate change, to achieve the objectives of decarbonisation and climate neutrality (by 2050 as envisaged by the European Green Deal), as well as to contribute actively to countering extreme weather events by mitigating the effects of the current climate crisis.

***

Wood is therefore a primary source of fundamental importance for positively activating production dynamics in the circular bioeconomy. In this regard, it is interesting to highlight the contribution of the President of Assolegno of FederlegnoArredo**, Claudio Giust**, who not only highlights the **link between local structural wood and the regeneration of inland areas in the Circular Bioeconomy**, but also provides a concrete example of good practice in the area, as in the case of the introduction of the Wood Bonus for post-earthquake reconstruction in Central Italy.

The Circular Bio-Economy, one of the two pillars of the new European Clean Deal, represents, in fact, a model of sustainable development that enhances the territory's renewable resources. In this framework, domestically sourced structural timber emerges as a strategic element: a renewable, low-impact material, capable of storing carbon and replacing emission-intensive materials. Italy's inland areas - often rich in forests but marked by depopulation and economic marginality - can find in the revival of short timber supply chains a lever of resilience and territorial regeneration. Using local wood in construction is not only an ecological choice, but also a way to root added value in the territory, creating employment and strengthening the local socio-economic fabric.

The use of domestic timber in construction brings numerous environmental, economic and social benefits. From an environmental perspective, building with wood contributes to climate

mitigation: every cubic metre of wood used in place of concrete or steel avoids CO_2 emissions and, at the same time, retains carbon in structures for decades, In addition, sustainable forest management - in line with the European Forestry Strategy 2030 - promotes the protection of biodiversity and the prevention of hydrogeological risks, while also ensuring the maintenance of valuable ecosystem services (such as regulating the water cycle and protecting the soil). On the economic and social level, activating short wood supply chains in inland areas means triggering new local business and employment opportunities: from certified forestry to sawmills and green building companies, an industry is created that counteracts the flight of young people and the abandonment of Apennine and Alpine villages.

A concrete example of this strategy comes from post-earthquake Central Italy. After the 2016 earthquake, the Symbola Foundation and FederlegnoArredo promoted the use of wood in reconstruction, a commitment that resulted in 2025 in a commissarial ordinance introducing a 'Wood Bonus': an additional contribution of 10%[43] for those who rebuild their homes demolished after the earthquake with wood construction technologies[44]. This innovative measure - which improves both thermal performance and anti-seismic safety thanks to the intrinsic qualities of wood - is part of the Apennine crater, which is the largest construction site in Europe now dedicated to timber building[45]. Significantly, this enhances the most abundant local resource in those mountainous areas, activating a virtuous chain combining forest management, the wood industry and housing reconstruction. The initiative not only accelerates the rebirth of the affected villages, but demonstrates on a local scale how wood can act as a driver of sustainable development and community cohesion in inland areas.

More generally, strengthening the national forest-wood sector has enormous industrial and employment potential. As of today, timber extraction from Italian forests is about 35% of the annual increase in forests[46] - one of the lowest values in Europe - which indicates an available raw material that can be better utilised without compromising ecological sustainability. [47] Investing in short supply chains linked to territories means consolidating this growth, promoting innovation and local know-how, and creating stable jobs in mountain and rural districts. This vision is fully in line with European policies - from the Green Deal to the New European Bauhaus - that encourage the use of natural materials and clean technologies for circular and quality construction. In parallel, the increasing focus on the valorisation of the ecosystem services provided by forests (CO_2 absorption, air quality, landscape) indicates a willingness to recognise and reward the multifunctional role of the forest. In conclusion, increasing the use of local structural wood, within the framework of the circular bio-economy, not only reduces the ecological footprint of the building sector, but also represents a strategy of sustainable territorial

[43]Source: Post-earthquake reconstruction, 10% bonus for timber buildings. https://www.rinnovabili.it/green-building/building/ricostruzione-post-sisma-bonus-del-10-per-gli-edifici-in-legno/

[44] Source: Timber buildings for the 2016 Earthquake Crater: signed the ordinance for the Wood Bonus. https://symbola.net/approfondimento/edilizia-in-legno-per-il-cratere-del-sisma-2016-firmata-lordinanza-per-il-bonus-legno/

[45] Ibid.

[46] Source: Agrarian Sciences: Forests, Silviculture and Forest Production in Italy. https://www.agrariansciences.it/2022/07/boschi-selvicoltura-e-produzioni.html#:~:text=Il%20tasso%20di%20prelievo%20di,Gasparini%20e%20Tabacchi%2C%202011

[47] Source: FederlegnoArredo. 8th Wood Building Report. https://www.federlegnoarredo.it/it/press/comunicati/archivio/report-edilizia-in-legno-italia-si-conferma-terzo-produttore-dopo-germania-e-svezia-fatturato-2022-a-2-3-miliardi#:~:text=legno%3a%20italia%20si%20conferma%20terzo,fatturato%202022%20a%202%2c3%20miliardi.

development capable of revitalising Italy's inland areas, combining climate objectives, nature conservation and the wellbeing of communities.[48]

***

In the series of contributions, the commitment of research and universities to support the growth of this new development model, which the circular bioeconomy can foster in inland and mountainous areas, cannot be overlooked. This is the case of the inter-university network agreement LabNetMEd Legno coordinated by Prof. **Beatrice Faggiano** Associate Professor of Construction Technology at the Department of Structures for Engineering and Architecture of the University of Naples Federico II.

Prof. Faggiano emphasises how topical and relevant the issue of depopulation in rural and mountainous areas is. The instruments implemented so far, for example in Italy following the recent earthquakes that largely involved small towns in inland areas, are economic incentives for reconstruction or settlement, decentralisation of industrial activities, or smart working. These have not so far yielded the desired results. The new approach to be implemented is based on the valorisation of local resources, with a focus on the bioeconomy, the circular economy and sustainability in general. Among the resources that can support the energy and environmental transition underway and thus the gradual reduction in the use of fossil fuels in the production of goods is the plant world par excellence. With reference to the environmental theme, it is useful to remember that forests represent one of the main natural means for capturing CO_2 and the consequent storage of carbon specifically in wood mass. In this context, sustainable forest management plays a significant role with the development of local forest-wood production systems, which, by taking root in rural and mountainous areas and relying on the raw materials located there, enhances them, with the effect of boosting the economy and contributing to the repopulation of inland areas.

The LabNetMed-Legno inter-university network agreement aims to respond to these needs, with a particular focus on southern Italy. The network was established on 7 April 2025. It involves 10 universities (University of Naples Federico II, University of Campania L. Vanvitelli, University of Campania L. Vanvitelli, University of Sannio, University of Molise, University of Salento, University of Basilicata, University of Calabria, Mediterranean University of Reggio Calabria, University of Palermo, University of Enna Kore) and 15 Departments, operating in the fields of forestry sciences, technology, architecture and wood engineering. LabNetMed-Legno is intended as a form of collaboration between the university laboratories, set up in a network, to implement and promote study, research, training activities as well as processes both for the sustainable management of the forest resource (GFS) and industrial processes, for the development of the forest-wood supply chain, which strengthens, reinforces and develops the specific local skills, putting them into a system, with consequent strong repercussions in economic, employment and environmental terms, enhancing the wood resource, in particular in the construction sector, and the territory.

Interest is particularly focused on wood species from the short supply chain in the southern Apennines, both broad-leaved (chestnut, beech, turkey oak, downy oak, poplar, alder, hornbeam, willow, etc,) and coniferous (larch pine), which are little used today, except for the energy market, exploring the possibility of obtaining wood-based products from them, which would make them profitable in the industrial sector. This would also respond to the need to limit the amount of wood imported from abroad by utilising the area's abundant resources. For the wood of these wood species, it is above all necessary to recognise the potential for use in structural applications, for which it is necessary to develop processes aimed at the correct and

[48] Source: European Forest Strategy 2030: the regulatory framework and the role of PEFC Italy - PEFC Italy.

specific qualification of the various productions. To this end, LabNetMed-Wood aims to create the greatest possible synergy between private and public forest owners and the companies involved in first and second processing, right up to the actual construction companies, which intend to build complex products with local wood structures. Each of these steps in the supply chain requires specific planning procedures and quality controls, in accordance with the standards and rules of proper operation, first and foremost, a certified GFS.

LabNetMed-Legno therefore intends to propose itself as a scientific reference body for institutions, researchers, and operators who, in various capacities and at various levels of institutional responsibility, have an interest in investigating the proposed topics.

***

The conclusion of this virtual round table is entrusted, as mentioned, to the contribution of Anci President **Gaetano Manfredi**, who emphasises how the Inland Areas and the Circular Bioeconomy in fact represent a strategic nexus for territorial revitalisation.

The Inland Areas of our country represent, according to the President, an inestimable heritage of biodiversity, culture and traditions, but are often marked by a persistent demographic decline. Depopulation is not just a question of numbers; it erodes the social fabric, impoverishes skills and risks condemning these territories to increasing marginality. However, it is precisely in this apparent fragility that an unexplored potential for socioeconomic growth is concealed, with opportunities that can be triggered by a strategic vision that integrates the enhancement of local specificities with the principles of the circular bioeconomy. In this sense, the Mezzogiorno, with its wealth of natural resources and its peculiar structural analysis, is configured as a privileged laboratory for testing this strategic nexus.

The National Strategy for Inner Areas and ANCI's ambitious counter-exodus agenda represent a fundamental change of step. The objective is no longer to plug the demographic haemorrhage, but to reverse the course, implementing active attraction policies, with a special focus on young people, bearers of innovation and new skills. A direction that is well aligned with the measures launched under the PNRR, which offer a historic opportunity to translate this vision into concrete actions. Thanks to the synergy between ANCI and its regional branches, actions are being implemented that aim at holistic regeneration: not only the physical restoration of buildings and infrastructure, but a parallel economic and social rebirth.

It is crucial to understand that material regeneration alone is not enough; existing human and natural capital must be enhanced, triggering processes of social cohesion and creating tangible economic opportunities for residents and those who choose to return to or settle in these areas.

In this context, **the Circular Bioeconomy emerges as a paradigm capable of combining environmental protection with economic development**. The Inland Areas, with their agricultural and forestry vocation and wealth of biomass, can become the protagonists of innovative and sustainable supply chains. The transformation of agricultural and forestry waste into energy, bioplastics or new materials, the valorisation of typical productions through processes with a low environmental impact, the promotion of rural and experiential tourism linked to biodiversity: these are just some of the directions in which the circular bio-economy can generate added value and new job opportunities, combating depopulation and strengthening the resilience of these communities.

An indispensable element for the success of this strategy, according to the President, is the public-private partnership. In a context of limited public resources, the collaboration between institutions and private initiative, conducted in a structural and not sporadic manner, is an essential

multiplicative lever, in which the role of the private sector is not limited to a mere financial contribution, but extends to business creation, employment provision and the generation of a dynamic micro-economy rooted in the specific territorial features.

Culture, in its many forms - from food and wine heritage to traditional crafts, from artistic expressions to historical re-enactments - is a further pillar for the revitalisation of the Inner Areas. These identity elements, deeply linked to the soul of the places, can become the fulcrum of new entrepreneurial activities, micro-businesses capable of enhancing the territory's excellence and offering concrete employment prospects, encouraging young people to invest their future in these areas.

A limitation to be overcome, of which we are well aware, is represented by the sustainability of administrative processes: the management of public-private partnerships can in fact present a complexity that small municipalities often struggle to govern. It is therefore essential to provide adequate technical and administrative support, simplifying procedures and guaranteeing the transparency and effectiveness of interventions.

Another essential element is territorial cooperation so that inland areas are not seen as isolated and unreachable entities, but as vital nodes within a broader territorial process, including infrastructural planning (from educational services to health services and services for the elderly) and the creation of synergies between different local realities. Only through a systemic approach will it be possible to transform individual interventions into a structural and lasting development flywheel.

The real challenge lies, therefore, in the ability to transform isolated projects into true territorial systems, capable of combining innovative development, based on the principles of the circular bioeconomy and the enhancement of local heritage, with the preservation of the unique identity of places and people. What in short is encapsulated in the binomial 'think globally, act locally'. This is the only way we will be able to witness a genuine re-blooming of inland areas, a re-blooming that is not a nostalgic return to the past, but a conscious projection towards a more balanced, sustainable future that is deeply rooted in the richness and diversity of our extraordinary country.

5. The Bioeconomy in the global geopolitical scenario

5.1 Introduction

Cluster Spring

To counter the growing tensions in the global geopolitical context, we need an industrial policy with challenging but gradual objectives, capable of relaunching the economy by focusing on strategic sectors such as the circular Bioeconomy, characterised by high added value and deep-rooted territorial supply chains, capable of combining sustainability, innovation and local development.

The Bioeconomy is strategic for the relaunch of European competitiveness and was also included in the Clean Industrial Deal (CID) officially presented by the European Commission on 26 February. Among the actions foreseen in the Circularity Pillar, there is in particular the revision of the ***Bioeconomy Strategy*** **(Q4 2025)**, to **promote the potential of *bio-based* materials** and reduce foreign dependence.

In this regard, in view of the **revision of the Bioeconomy Strategy**, the National Coordination Group on the Bioeconomy, established within the Presidency of the Council of Ministers, has been actively working on **the definition of a shared position to respond to the consultation promoted by the European Commission.**

Among the main points put to the attention of Brussels were

- fully recognising the **contribution of the Bioeconomy and bio-based products to decarbonisation,** with demand support measures such as incentives or obligations for renewable content in products;
- promoting **biodegradable and compostable products**, which do not accumulate in the soil and which facilitate the collection and processing of organic waste, with the development of appropriate infrastructure;
- ensuring **the sustainable use of biomass** for the Bioeconomy, with criteria consistent with those of the Renewable Energy Directive (RED). In this sense, it is crucial to strengthen the relationship between primary producers of biomass and the bio-based industry;
- support **the industrialisation of existing technologies**, particularly in the recovery of by-products, in synergy with the agricultural sector and by stimulating investment;
- encourage the total or partial reindustrialisation **of brownfield sites**;
- strengthening **the competitiveness of supply chains** by exploiting synergies between rural, mountain, coastal, wetland, industrial and urban areas;
- **specific NACE codes** for Bioeconomy activities currently classified under the same codes as traditional activities, to enhance the sector and facilitate the use of secondary raw materials.

The Bioeconomy must be placed at the centre of the transition process towards a more sustainable economic model. For this reason, the continuous and careful monitoring of all **the dossiers that the European Commission** has opened, related to the Clean Industrial Deal and the revision of the Bioeconomy Strategy, is fundamental, including:

- the Biotech Act;
- the Net Zero Industry Act;
- the Industrial Decarbonisation Accelerator Act;
- the Circular Economy Act;
- the Life Science Strategy;

- the EU Innovation Act;
- the Vision for Agriculture and Food;
- the Ecodesign Regulation for Sustainable Products (ESPR);
- the revision of the ETS (Emission Trading System) Directive;
- the evolution of legislation on Carbon Removal and Carbon Farming;
- the Communication on Sustainable Carbon Cycles.

Also fundamental is the evolution of the **Packaging and Packaging Waste Regulation**, which already provides for mandatory compostability for certain applications and allows Member States to introduce in national regulations the obligation to use additional compostable packaging. In particular, with the exception of some specific packaging, Member States must have already introduced the compostability obligation before the implementation date of the Regulation, i.e. by 12 August 2026 (see box in chapter. 3).

As mentioned, 2025 is the year of the new European Bioeconomy Strategy. Announced by the European Commission with the Communication 'Building the Future with Nature. Boosting Biotechnology and Biomanufacturing in the EU' of 20 March 2024, it aims to mark a significant step forward in exploiting the opportunities offered by this meta-sector to support European businesses and promote the achievement of the EU's environmental, climate and competitiveness goals.

5.2 The new Bioeconomy Strategy

The new Bioeconomy Strategy **aims to promote innovation and maintain European leadership**. It will propose actions to unlock the potential of Bioeconomy innovations so that they can reach the market, generating green jobs and growth.

The Strategy will also focus on **strengthening circularity and sustainability**, while contributing to the decarbonisation of the EU economy. It will set the framework conditions for start-ups, entrepreneurs and new business models in the Bioeconomy to flourish.

To fully exploit the potential of the European Bioeconomy, the future Strategy will need to ensure a legislative framework that safeguards European competitiveness in the international market by removing current regulatory barriers that create disproportionate burdens and hinder the development and growth of innovative European technology solutions in the Bioeconomy. It will be crucial for **the Strategy to focus on strengthening the industrial dimension of the Bioeconomy**; this should primarily concern the development of regulations and instruments that put this strategic sector at the centre and allow for a full development of its market. Support for research should also be aimed at supporting the industrialisation of existing and future technologies.

In addition to increasing its competitiveness, the European bioeconomy should also seek **new models of fair and equitable international cooperation**, implementing win-win strategies with countries that have abundant biomass but lack technological innovation. The implementation of technologies in countries where biomass is produced could generate value and jobs in those regions, while providing intermediate products to EU bio-based industries.

European companies have already invested in the Bioeconomy sector with the aim of decarbonising products and services; therefore, **it is important to fully exploit the potential of this know-how and to protect existing and planned investments** by taking measures to support the development of this sector and the market for biomass-based products and energy, and not to undermine the European leadership achieved in this field.

To this end, the Strategy should also facilitate the **total or partial reconversion of traditional** and non-productive/competitive **industrial** plants into Bioeconomy plants to meet the specific needs of innovative biobased production chains (for the production of bio-based products, biochemicals and biofuels, including chemical and liquefied gases), also in synergy with the agro-food sector, urban ecosystems and waste and residue management.

This could also be done through public sector support, in synergy with other EU policies, for the conversion of plants and the promotion of research and innovation in cutting-edge technologies that meet high standards of sustainability and productivity. It is also crucial to map marginal land and brownfield sites in Europe in order to promote their conversion into new biorefineries.

These investments can strengthen the EU's competitiveness and resilience by creating new jobs, revitalising the local economy through the integration of local supply chains, promoting the rehabilitation of polluted areas and reducing land and landscape degradation. In this context, it is important to provide public support to move from the laboratory to the pilot and demonstration phase and to mobilise private investment in Europe through better access to finance and capital.

The Strategy should recognise the contribution to decarbonisation of sustainable products, materials, chemicals and energy from biomass and other biological and renewable carbon sources and take measures to reduce the price gap between these products and conventional fossil-based products.

In order to improve the contribution of the above-mentioned biomass-derived products to the decarbonisation of the economy and the reduction of climate-changing emissions, it will therefore be necessary to identify instruments to accelerate the substitution of fossil raw materials and stimulate the demand and market uptake of these products. Measures such as tax leverage, financial incentives and minimum environmental criteria in GPP (Green Public Procurement), introduction of bio-based content requirements for specific applications, such as carbon 14 content targets for biodegradable and compostable plastics.

Furthermore, the Strategy should promote quality standards and additional measures to support market demand.

For example, **the use of biodegradable and compostable bio-based plastics should be supported** for all those contexts in which such products provide solutions that meet technical needs while mitigating environmental issues related to the use of non-biodegradable products in an open (i.e. agricultural plastics) or controlled environment (i.e. products that improve wet waste management, such as applications in contact with organic matter).

Other bio-based products that should be promoted with the aim of protecting ecosystems are **bio-based and biodegradable plant protection solutions**, which minimise the risks associated with the dispersion of products in the ecosystem and reduce the use of certain molecules with a high environmental impact, biolubricants for machinery operating in ecologically sensitive areas, as they rapidly biodegrade in the event of accidental dispersion into the environment, and biodegradable ingredients for the cosmetics and detergents sectors, which can biodegrade without contaminating sewage sludge and water.

Furthermore, in line with the EU's ambitious decarbonisation targets, it is essential to promote **sustainable alternatives also in the energy sector, supporting the use of biofuels and biomethane**. As mentioned above, another essential measure to stimulate market demand is to promote the uptake of sustainable bio-based products both in industrial processing value chains and in final consumption, in order to reduce the price gap with conventional fossil-based products.

Therefore, the Strategy should consider fiscal and financial incentives (e.g. tax remodelling, tax credits and reduced VAT) both to encourage companies to use biomass-based raw materials and to incentivise end consumers to purchase biomass-based products (chemicals, materials and biofuels used in pure form). A good example in this direction is the ETD, which aims to differentiate the excise duties of energy sources and carriers according to their environmental impact. Finally, in order to promote the activities of the Bioeconomy and increase the demand for biomass products, it is essential to introduce dedicated NACE sub-codes for the production of biomass products, which are currently still classified under the same codes as traditional sectors.

Dedicated statistical codes are essential to create the necessary 'enabling environment' and lay the foundations for a reliable monitoring system of the environmental, social and economic impact of the bioeconomy. This is also crucial to define targeted fiscal and administrative actions that enable this sector to realise its full potential. Indeed, the lack of dedicated codes is, on the one hand, a limitation to the recognition of the environmental and social value of Bioeconomy products and, on the other hand, prevents an adequate valorisation of this sector within the framework of EU policies.

The identification of specific sub-codes within the international trade classifications should also provide simplified methods for the recognition of Bioeconomy products at customs offices.

The Bioeconomy in the new NACE rev. 2.1 and ATECO 2025 classification

Stefania Trenti

As of 1 January 2025, the new European (NACE rev. 2.1, 4-digit detail) and Italian (ATECO 2025, 6-digit detail) classifications of production activities came into force and will be adopted gradually.

The new classification makes an overall revision and also contains some novelties with regard to activities related to the Bioeconomy.

As far as the agro-food chain is concerned, the changes are marginal and go in the direction of capturing the relevance of new activities and new production methods. New codes have been introduced at the ATECO 2025 level, detailing the cultivation methods for vegetables (with the distinction of greenhouse cultivation in soil and above ground), insect breeding, soil maintenance activities to keep it in good condition, and phytosanitary treatments (previously classified under support activities), the cultivation and processing of seaweed, fishing support activities, the distinction between fresh and preserved for the production of flour, the production of food supplements and, finally, the production of mineral water (as distinct from other non-alcoholic beverages). Even in the textiles, clothing and leather chain, which is only partially included in the Bioeconomy, the revisions are not significant and are mainly related to the change in the tree structure in clothing with the lesser importance given to fur (which goes from a 3-digit code to a 4-digit sub-code).

More significant, also with a view to circularity and the bio-economy, are the changes in the wood-paper chain. New codes have been introduced relating to the finishing of wood and wood products, greater importance has been given to the production of wooden doors and windows and, above all, a new code identifying the **production of solid fuels from plant biomass** has been introduced. Equally important in the context of the Bioeconomy was the introduction of an ad hoc code for the **production of liquid biofuels** within the framework of chemical activities. On the other hand, the request to introduce a specific code for bio-based chemistry activities was not accepted.

Lastly, the creation of a code identifying the production of electricity from renewable sources (which also includes that from biomass) and the revision of the list of waste-related activities, with a more precise distinction of recovery and disposal activities, should be noted.

5.3 Increasing the efficient and circular use of biological resources

Circular economy, resource efficiency and the Bioeconomy are closely interconnected. To fully exploit the potential of the circular economy, EU policies aimed at supporting the development of the Bioeconomy should consider the following aspects

- **promote industrial symbiosis** in the Bioeconomy, strengthening synergies between local economic actors to improve environmental and economic efficiency, transforming the residues of one actor into a resource for another, thus valorising by-products and waste as raw materials and recovering energy
- with regard to organic residues, stimulate the development of industrial bio-economic solutions for **the valorisation of organic waste and by-products** from the agro-food sectors, as well as from bio-based industries and municipal organic waste management, and their integration into the production process;
- harnessing the full benefits of municipal organic waste, sewage sludge and wastewater through an **integrated multi-product biorefinery** approach for the production of chemicals, materials and energy, and the valorisation of additional products resulting from the process, such as clean water, fertilisers, nutrients and critical materials such as nitrogen, phosphorus and potassium
- support **the use of bio-based compostable plastics and materials** and promote efficient systems for the collection and treatment of municipal organic waste also to contribute to the production of quality compost for use in agriculture;
- improve the competitiveness of entire value chains, taking into account synergies between rural, mountain, coastal, wetland, industrial and urban areas, thus overcoming competition for resources. The agriculture, food, forestry, wetland, fisheries, wastewater and waste management sectors are involved both upstream and downstream. First, as suppliers of biological resources, and then as recipients of technologically advanced, low-impact, bio-based and eco-designed products. These products, like sustainable packaging, are necessary to preserve and increase the shelf life of food and agricultural products, making local supply chains more sustainable and protecting the health of consumers and workers.

In order to further support circularity and maximise industrial symbiosis for the Bioeconomy sector, the valorisation of all residues from Bioeconomy activities as feedstock for the production of sustainable biofuels should be improved, e.g. by supplementing the list of feedstocks for the production of advanced biofuels and biogas in Annex IX, Part A, of the Renewable Energy Directive (RED) to additional residues that can be considered.

Protecting biodiversity

Laura Campanini

The World Economic Forum (WEF) ranks the loss of biodiversity and the collapse of ecosystems as the second most serious risk that businesses and society in general will face in the long term (10 years). Environmental risks - such as extreme weather events, biodiversity loss and pollution - are priorities, according to experts consulted by the WEF. The document states: 'Environmental risks dominate the long-term horizon, with extreme weather events, biodiversity loss and ecosystem collapse, critical changes in Earth systems and natural resource scarcity topping the list of major risks for the next ten years'.

The growing awareness of the relevance and essentiality of biodiversity to ensure a sustainable future has led to the spread and entrenchment of actions aimed at its protection. The protection of biodiversity is not only a moral and environmental duty, but also a fundamental requirement for the economy and social and cultural evolution.

The United Nations Conference in Rio de Janeiro in 1992 with the Convention on Biological Diversity (CBD) was the beginning of a journey in which countries committed themselves to the protection of biodiversity. The implementation of the CBD was entrusted to the Conference of

the Parties (COP), which has been meeting periodically since then (in 2024 it reached its sixteenth edition), with the aim of assessing progress in the implementation of the Convention and defining programmes and courses of action.

At the European level, the main interventions are the Birds Directive and the Habitats Directive (both from 1992), which gave rise to the Natura 2000 Network, consisting of Special Areas of Conservation (SACs) and Special Protection Areas (SPAs). The Natura 2000 Network is the main instrument of the European Union's policy for the conservation of biodiversity, created both to ensure the long-term maintenance of threatened or rare natural habitats and species of flora and fauna at EU level and to ensure the achievement of the objectives set out in the 1992 Convention on Biological Diversity. The Biodiversity Strategy 2030, approved by the European Parliament in 2021[49], aims to strengthen and expand this network, stipulating that by 2030 the European network of protected areas should cover 30 per cent of the land and sea area. In line with these objectives, the Nature Restoration Law, passed in 2024, intends to restore at least 20 per cent of land and marine areas by 2030 and to restore all degraded ecosystems by 2050. In addition, it envisages actions to mitigate the causes of biodiversity degradation such as the abatement of pesticide use and activities to support key ecosystem services such as pollination.

In Italy, the regulatory framework for the protection of land and biodiversity is developed on different levels of governance. The first laws enacted were related to the ratification and implementation of international conventions until the 1991 Framework Law on Protected Areas, which 'defines the fundamental principles for the establishment and management of protected natural areas'.

In 2022, with the amendment of Article 9, the Constitutional Reform introduces among the fundamental principles of our Constitutional Charter 'the protection of the environment, biodiversity and ecosystems, also in the interest of future generations'.

5.4 Ensuring a competitive and sustainable supply of biomass

The Bioeconomy relies on synergies between industry, agriculture and the land, synergies that give rise to new business models.

To this end, it is important to promote the development of **integrated bioeconomy supply chains involving different actors (agriculture, processing, biorefineries**).

In particular, multifunctional and multi-product biorefineries and other bio-economic processes fuelled by renewable raw materials from sustainable biomass (e.g. agro-forestry biomass, intermediate crops, crops grown on heavily degraded land, organic waste and by-products from the agro-food, livestock, forestry, marine and maritime sectors), represent an effective solution to revitalise soil productivity and regenerate fragile territories.

These activities can constitute a source of diversification and an additional element of profitability for all local actors in the supply chain (including those in the primary sector), thus contributing to the regeneration of territories and combating their degradation, abandonment and desertification.

Biofuels and biogas from biomass will contribute to achieving the objectives of both the RED III directive and the REFuel EU Aviation and Fuel EU Maritime regulations relating to the aviation and maritime sectors, while the use of biomass to produce bio-based products, such as plastics and chemicals derived from biomass, is also a key part of the solution to address some of the environmental challenges related to the supply of fossil raw materials. While sustainability criteria

[49] EU Biodiversity Strategy for 2030 - 'Bringing nature back into our lives', approved by the European Parliament on 9 June 2021.

are clearly defined for renewable fuels, those for bio-based feedstocks for plastics and chemicals should be defined using the criteria in Article 29 (2-7) of the RED, related to land use and biodiversity, as a starting point, and secured through independent third-party audits. Given the complexity of supply and production pathways in the plastics value chain, a systemic and complementary approach will be required.

Ensuring wide availability and accessibility of bio-based raw materials should be a key priority for EU and national policy makers, taking into account current EU targets on renewables, the specific needs of each sector, as well as existing and potential synergies.

Integrated approaches that optimise the efficient and holistic use of biomass, promoting synergies rather than competition between sectors, while supporting the conversion of traditional refineries and industrial sites that are no longer competitive into biorefineries for chemicals, polymers and energy products are therefore essential. This approach, together with the promotion of local growth and job creation linked to vertically integrated initiatives in the agricultural and raw materials sectors, is in line with the European objectives set out in the Green Deal, i.e. the realisation of a truly just transition for the hard-to-burn sectors.

The use of biomass as a raw material should therefore focus on the integration of all supply chains, including waste and by-products, by strengthening the current legislative framework on the certification of raw materials. The stronger the connections between products, the lower the environmental impact and the greater the sustainability of the solution.

Important Information

The economists drafting this report state that the opinions, forecasts, and estimates contained herein are the result of independent and subjective evaluation of the data and information obtained and no part of their compensation has been, is, or will be directly or indirectly linked to the views expressed.

This report has been produced by Intesa Sanpaolo S.p.A. The information contained herein has been obtained from sources that Intesa Sanpaolo S.p.A. believes to be reliable, but it is not necessarily complete and its accuracy can in no way be guaranteed. This report has been prepared solely for information and illustrative purposes and is not intended in any way as an offer to enter into a contract or solicit the purchase or sale of any financial product. This report may only be reproduced in whole or in part citing the name Intesa Sanpaolo S.p.A.

This report is not meant as a substitute for the personal judgment of the parties to whom it is addressed. Intesa Sanpaolo S.p.A., its subsidiaries, and/or any other party affiliated with it may act upon or make use of any of the foregoing material and/or any of the information upon which it is based prior to its publication and release to its customers.

Disclosure of potential conflicts of interest

Intesa Sanpaolo S.p.A. and the other companies belonging to the Intesa Sanpaolo Banking Group (jointly also the "Intesa Sanpaolo Banking Group") have adopted written guidelines "Organisational, management and control model" pursuant to Legislative Decree 8 June, 2001 no. 231 (available at the Intesa Sanpaolo website, webpage https://group.intesasanpaolo.com/en/governance/leg-decree-231-2001), providing for practices and procedures, in accordance with applicable regulations by the competent Italian authorities and best international practice, including those known as Information Barriers, to restrict the flow of information, namely inside and/or confidential information, to prevent the misuse of such information and to prevent any conflicts of interest arising from the many activities of the Intesa Sanpaolo Banking Group which may adversely affect the interests of the customer in accordance with current regulations.

In particular, the measures taken to manage the conflicts of interest between the Intesa Sanpaolo Banking Group and issuers of financial instruments, including companies belonging to their group, in the production of reports by Intesa Sanpaolo S.p.A.'s economists, are available in the "Rules for Research " and in the extract of the "Corporate model on the management of inside information and conflicts of interest" published on the website of Intesa Sanpaolo S.p.A., webpage https://group.intesasanpaolo.com/en/research/RegulatoryDisclosures. This documentation is available to the recipient of this report upon making a written request to the Compliance Department, Conflicts of Interest, Inside Information and Personal Transactions, Intesa Sanpaolo S.p.A., Via Hoepli, 10 – 20121 Milan – Italy.

Furthermore, in accordance with the aforesaid regulations, the disclosures of the Intesa Sanpaolo Banking Group's interests and conflicts of interest are available through webpage https://group.intesasanpaolo.com/en/research/RegulatoryDisclosures/archive-of-intesa-sanpaolo-group-s-conflicts-of-interest. The conflicts of interest published on the internet site are updated to at least the day before the publishing date of this report. We highlight that disclosures are also available to the recipient of this report upon making a written request to Intesa Sanpaolo S.p.A. – Industry & Local Economies Research, Via Romagnosi, 5 - 20121 Milan - Italy.

Intesa Sanpaolo - Head of Research Department Gregorio De Felice	
Head of Industry & Local Economies Research	
Stefania Trenti (Head)	stefania.trenti@intesasanpaolo.com
Ezio Guzzetti	ezio.guzzetti@intesasanpaolo.com
Industry Research	
Ilaria Sangalli (Head)	ilaria.sangalli@intesasanpaolo.com
Letizia Borgomeo	letizia.borgomeo@intesasanpaolo.com
Anita Corona (Rome)	anita.corona@intesasanpaolo.com
Enza De Vita	enza.devita@intesasanpaolo.com
Luigi Marcadella (Padua)	luigi.marcadella@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)	romina.galleri@intesasanpaolo.com
Sara Giusti (Florence)	sara.giusti@intesasanpaolo.com
Anna Maria Moressa (Padua)	anna.moressa@intesasanpaolo.com
Massimiliano Rossetti (Ancona)	massimiliano.rossetti@intesasanpaolo.com
Carla Saruis	carla.saruis@intesasanpaolo.com
Rosa Maria Vitulano (Rome)	rosa.vitulano@intesasanpaolo.com
Innovation & High-Tech Industry	
Serena Fumagalli (Head)	serena.fumagalli@intesasanpaolo.com
Local Public Finance Research	
Laura Campanini (Head)	laura.campanini@intesasanpaolo.com