



Bioeconomy in Europe

5° Report

Research Department

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Executive Summary

In an increasingly complex and unstable global economic scenario, environmental, social and economic sustainability is a fundamental compass to guide the actions of institutions and individual subjects. Use that does not waste the planet's natural resources, which are by definition limited, can be possible only by adopting a systemic effort, which starts from local contexts to reach global dimensions and which makes use of the opportunities offered by the rapid development of the scientific and technological frontier that has characterized the last decades.

Bioeconomy, from this perspective, is a key field of action, proposing an intelligent exploitation of renewable resources of biological origin, directed towards a circular logic that does not cut resources from primary uses, such as food, but maximizes opportunities for re-use through technological innovation and behavioral changes in all the actors involved, from companies to institutions and individual citizens.

The Report on Bioeconomy in Europe, now at its fifth edition, aims to continue monitoring activities related to bioeconomy, with the awareness of the systemic and supply chain nature, of the importance of the downstream closure phases of the cycle, of the contribution of technological innovation and of the important role that public actors can have, particularly in local contexts.

In this edition, the Report refines the definition of bioeconomy (**chapter 1**), including some downstream sectors, previously excluded, such as the bio-based component of clothing, rubber and plastic and furniture. This expansion was made possible thanks to the Bioeconomics database, supplied by the Joint Research Center of the European Commission, which also includes these sectors (with data till 2015) and which confirms the estimates we proposed in the previous editions on the bio-based component of chemistry and textiles.

In our scope, consistently with what was proposed in the previous editions, the activities related to the water cycle and the biocompatible component, estimated by us, of the waste cycle continue to be included, aware of the crucial nature of the circular logic in the bioeconomy.

The estimates, updated to 2017, give us the image of a complex set of sectors, which significantly weighs on the Italian economy and on the economy of the other European countries.

In Italy, in 2017, the set of activities related to bioeconomy generated an output of approximately € 328 billion, employing over two million people. Bioeconomy accounted for 10.1% in terms of production and 7.7% in terms of employment of the total economy of our country. According to these estimates, the value of bioeconomy production in 2017 grew by over 6 billion compared to 2016 (+ 1.9%), thanks to the positive contribution of the majority of the sectors considered and, in particular, of the agriculture and food industry sectors. With regard to employment, on the other hand, there has been a limited increase in the last year (0.2%), conditioned by the negative dynamics, particularly in the agricultural sector.

The estimation method adopted to quantify the part of the biocompatible waste cycle leads to a production value of € 6.8 billion in 2017, increasing by 1.6% compared to 2016 and by 21.8% compared to 2008. The waste cycle activities that do not deal with biocompatible waste and do not value biomass are not included in the estimate made. In terms of impact on the overall bioeconomy, biodegradable waste represents 2.1%.

Italy is characterized by a strong inclination towards recycling and re-using waste: nowadays great attention is paid to the correct management of post-consumer materials with separate waste collection and recycling activities. Closing the circle through efficient and effective waste management allows our country to position itself among the European countries with the highest percentage of recycling on the total amount of waste: in Italy 67% of treated waste is sent to recycling sites, compared to a European average of 55%. With reference to biocompatible waste,

which is part of the bioeconomy, the ability to re-use it is even greater: 91% of biocompatible waste is recycled, compared to a European average of 77%.

Long-term analysis shows an increasing value of bioeconomy production in the last 10 years, both in absolute terms and as a percentage of the total output of the Italian economy: from 8.8% in 2008 to 10.1% in 2017. In particular, there are three sectors whose weight on overall bioeconomy has increased in recent years: the food and beverage industry, services related to the water cycle and waste management.

The European comparison points out, in absolute terms, the role of Germany, with an estimated bioeconomy production value of € 402.8 billion, followed by France with a value of € 357.7 billion. Italy ranks third, with an output of € 328 billion, ahead of Spain (€ 220.6 billion) and the United Kingdom (€ 189.8 billion). In terms of employment, bioeconomy records a number of employees between 1.2 million in the United Kingdom and 2.1 million in Germany. Italy, with just over 2 million employees, ranks second after Germany, ahead of France (1.7 million) and Spain (1.5 million).

In relative terms, the greater importance of bioeconomy in Spain and Italy can be noticed, weighing on total economic activities for 10.3% and 10.1% respectively in terms of production and 7.7% and 8% considering employment.

The logic of the supply chain and of re-use led us to investigate, in particular, the complex world that exploits forest resources, starting from the upstream activities of forestry to move on to the sector of wood (**chapter 2**) and paper (**chapter 3**), and then finally analyze the cycle closure activities (**chapter 4**). The picture is completed with an analysis of the specific development potential of these sectors in the Southern regions (**chapter 5**), where the adoption of specific policies in favor of bioeconomy can make a significant contribution to growth and sustainability.

Forests play a key role in bioeconomy, being at the same time sources of renewable resources with a vast range of uses, and complex ecosystems, able to preserve animal and plant biodiversity, to combat climate change thanks to photosynthesis, to provide a bulwark for hydrogeological instability and to characterize the landscape of entire regions of the earth.

With 11 million hectares occupied by forests (38% of the surface), Italy is the sixth EU country in absolute terms and the first in terms of dynamics: the wooded area has increased by 6.7% in the last quarter of a century, compared to +2.1% in the EU average. Italy is also at the forefront as to forest protection, with 4.7 million hectares of forest recognized as crucial to preserve biodiversity and landscape features, and 8.2 million hectares with soil and water protection. In Italy, the forestry sector directly provides 40,000 jobs and creates an added value of € 1.3 billion.

Among the various uses of forest products, one of the most important is the production of processed timber for the furniture industry and for construction. These processes, mainly intermediate, constitute the **wooden products** industry, divided into the sub-sectors of wood cutting and planing, and other wood, straw and cork products: from beams, to panels for kitchen doors, to wine corks and countless other wooden objects that are part of our daily life.

This industry employs 104,277 workers in Italy, which represent 2.8% of the workers in the manufacturing industry, with a total turnover of € 13.3 billion, with Italy ranking second in the EU28 behind Germany.

Italian production, which has been showing a decline since the economic crisis of 2008, also due to a progressive rationalization process of the extremely fragmented business fabric, is concentrated on carpentry work for the building sector, including doors and windows. Carpentry work for the building industry is also the only sector in which Italy shows a positive trade balance with foreign countries. The lack of protection of forest resources and the need to safeguard them means that Italy, a major furniture manufacturer, should supply itself with wood products mainly

from abroad, making it a top global importer. Our deficit in the wood cutting and planing sector is particularly relevant: for these first processes related to the proximity to exploited forests, we mainly turn to Austria.

The analysis of over 686 thousand purchase transactions by a sample of Italian furniture manufacturing companies across Italy, shows the other side of the coin, regarding national purchases. Italian furniture companies show first of all intensive subcontracting relationships, concentrating 23% of their purchases from other furniture companies. The purchases of metal products follow in importance, while wooden products are only in third place, confirming the fact that the latter are purchased mainly abroad.

As regards average purchasing distances, furniture companies tend on average to be located relatively close to their subcontractors belonging to the wood supply chain, while they have to find products such as metals, plastic, stones and glass in more distant places. The geographical gap between North and South is very important in the furniture industry: wood supplies purchased from companies in Southern Italy are transported for an average distance about 5 times greater than the distance covered by Northern companies.

The **paper** industry has been experiencing a transformation in recent years: the dematerialization of content has led, especially in Anglo-Saxon contexts, to a significant decrease in paper consumption, concentrated in the graphic paper industry: the worldwide production of paper for graphic purposes has increased from 21.4 to 16.1 kilograms per capita. At the same time there has been a global growth in consumption, linked both to the industrialization of emerging countries, with China which has quickly become the leading producer and consumer of paper worldwide, and to the greater use of paper in different contexts with respect to printing and graphics (from packaging to the increase in hygiene and sanitary uses).

Increased environmental awareness and the search for new raw material sources have led to a push towards the use of increasingly certified materials as to their origin and, above all, to a strong surge in recycling, with a decrease of virgin paper pulp in favor of recycled paper. Between 2001 and 2017, the share of pulp from recycled fibers rose from 6% to 33% of the total.

Furthermore, internationalization is expanding, both through foreign direct investments, a traditional form of opening up new markets in this industry, and increasingly through import/export flows, with a growth serving foreign markets even in the closing phase of the cycle and with China being the main importer of recycled paper.

In this context, Europe is carving out a leading role both for the traditional vocation of some Northern European countries, rich in raw materials (Germany, Sweden, Finland) and for the growth of new production platforms such as Poland.

The historical role of Italy is confirmed and strengthened. Despite the lack of raw materials, Italy ranks among the leading European producers, in particular as regards graphic and sanitary paper. As evidenced by the example of the paper district of Lucca, this success depends on the strong specialization of some players that have carved out an important role in the world landscape, focusing on technological innovation and on the partnership with the competitive mechanical industry dedicated to paper.

In the paper and wood supply chains, **waste** is largely recycled to allow material to be reused. Waste is regenerated and reused in order to circulate again on the market or it is recycled to raw material. Both paper and wood lend themselves to being reintroduced into the production process over and over again. Not only does closing the circle reduce the consumption of raw material (trees and cellulose), but it also saves energy and water, reduces emissions and decreases the amount of materials sent to landfills for disposal, thus saving precious resources that would otherwise be destroyed.

In the case of paper, the potential for recycling is exploited and maximized both at European and Italian level. Almost all paper and cardboard waste is recycled. The waste-to-energy process is marginal: only 1% of paper waste is subject to this treatment method at European level.

As regards wood, the scenario is more diversified: there is a group of countries that prioritizes waste-to-energy (Germany, Finland, Sweden, Norway) and another group that recycles more than three-quarters of its treated wood waste (Spain, Italy, Portugal, Austria).

With reference to the treatment of packaging waste only, the objectives set at European level for both paper and wood are not particularly ambitious and have already been largely exceeded by a good number of countries. The paper packaging recycling rate should be at least 75% in 2025 and 85% in 2030.

The figures for 2016 indicate that the paper packaging recycling rate is already at 85% at European level; France recycles 94% of paper packaging, Germany 88.7%. Looking at the figures for 2016, the paper packaging recycling rate is already at 85% at European level; France recycles 94% of paper packaging, while Germany recycles 88.7%. Italy ranks below the European average at 79.7%, however it is already above the target foreseen for 2025. With regard to wood packaging waste, the European target for 2025 is 25%, that for 2030 is 30%, both widely exceeded. The percentage of recycling at European level is in fact equal to 40%. Spain and Italy are the most virtuous countries, with a percentage of recycled wood packaging waste of 67% and 60% respectively.

As to paper recycling, the issue of the spread of separate waste collection and the quality of the collected waste is crucial. There is still a significant gap between some areas of the South and the Central northern areas as regards separate waste collection. Per capita paper and board collection data in the Southern regions is close to 35 kg per inhabitant, while in the remaining areas of the country, the weight of 60 kg is exceeded (54.2 kg is the national average). However, the South has contributed for more than three quarters to the additional national volumes of 2017, although it only accounted for 22.2% of the country's overall stock. Furthermore, the problem of the quality of the collected material arises for paper: the presence of spurious materials makes recycling less sustainable and generates more waste. To guarantee cycle closure, paper waste must have homogenous materials with good intrinsic quality: the product design and planning phase and the packaging phase are very important. It is also necessary to have adequate equipment for the disposal of recycled waste; in the current situation, the sustainability of the entire paper supply chain is linked to the export flows of waste paper, especially of low quality. The introduction by China, which is the main area our paper waste is exported to, of new and strict quality standards on imports is creating significant difficulties to the global paper and board recycling chain.

With reference to wood waste, in Italy separate waste collection stood at 800 thousand tons in 2017, with an increase of 26% compared to 2013. There were however significant regional differences attributable both to different consumption habits and to a different spread of the separate waste collection service. The flow of special waste (factories, trade) is added to the flow of waste collected by separate collection. The total production of special wood waste stood at 3.7 million tons in 2016, representing therefore the predominant part of total wood waste. The main product of the recycling activities are chipboard panels; another product for which recycled wood is used is formwork blocks and wood-concrete floor slabs for green building applications; recycled wood packaging waste can also be used in the production of chemi-mechanical pulps, which are used to produce different qualities of papers and cardboards.

In the broader national scenario, **Southern Italy** plays its part with some sectors linked to the growth of the bioeconomy that have a higher value on the territory than the national average. There is great potential, on the basis of which in the last years we have witnessed the development of some specific supply chains and sectors of excellence, which have already started a re-conversion process not only in terms of production sustainability, but also of industrial reorganization in the light of bioeconomy.

In particular, strong potential can be seen in the agri-food supply chain and in green chemistry with bio-based productions that confirm the achievement of different experiences in Campania (with the pilot plant of GF Biochemicals of Caserta for the production of levulinic acid from biomass, with the biotechnological research center of Novamont di Piana di Monte Verna and the headquarters, at the CNR of Pozzuoli, of the Zoological Station Anton Dohrn); in Puglia (where significant university and startup spin-off projects are underway); in Sardinia (where the joint venture between Novamont and Versalis was established in Porto Torres in 2011 in order to build a biorefinery); in Basilicata (with the ENEA green chemistry research center in Rotondella and with the development of the bioeconomy cluster); in Sicily (with the project for the recovery of the Gela refinery by ENI).

The wood and paper supply chain can represent a further strategic lever: despite their low weight on the national context, these sectors have greater relevance in the Southern regions. Furthermore, there are interesting signs of growing awareness by public and private actors of the potential linked to sustainable production and of greater attention towards the environment.

We need only think, for example, of "Rete 100% Campania", a sort of green district created in Campania with the aim of sharing the strength of individual companies and thus increasing the positive effects across the territory. Starting from waste paper, this network implements a proximity transformation cycle which is able to guarantee that the entire value chain stays in the territory. In order to understand its effects, consider that the processing on site of 100 thousand tons of paper from separate collection has an estimated impact on 300 jobs and over 80 million of added value.

Another positive sign is linked to separate waste collection. Data on the recycling of paper and cardboard in the last years, as already mentioned, indeed show growth rates which are considerably higher for the South than those recorded for the Central Northern regions. According to some estimates for 2018, the Southern regions are growing at a quadruple speed compared to the Central Northern regions (+6.9% against +1.4%).

The wood industry, for its part, although not so representative compared to the entire national sector, shows a business fabric (businesses and employees) for the Southern regions that has a significantly greater impact on the regional economy than that recorded in other areas.

In some Southern areas there are therefore signs of interest and convergence with the remaining areas of the country that are more oriented towards the new paradigm of circular economy. Southern Italy has the full potential to make this paradigm its own: putting it into a system is the fundamental step to recover the existing gap and to face the challenges of innovation and global competition with other national and international economic situations. Adherence to the models of the circular economy and the bioeconomy can therefore potentially accompany the South and help it catch-up with the most advanced economies.

1. Bioeconomy in Italy and in Europe in 2017

1.1 Introduction

Bioeconomy, understood as a system that uses terrestrial and marine biological resources, as well as waste, as an input for food, industrial production and energy, is now a central theme in the EU political debate, which is more and more careful about environmental issues and about the sustainability of production processes. This growing importance requires continuous monitoring and quantification of the phenomenon, in order to make targeted choices about economic policy that are also aware of the changes taking place.

By Laura Campanini and
Serena Fumagalli

In this fifth report, the scope of analysis of the bioeconomy was further refined, including both the bio-based component of the rubber and plastic industries, and the activities downstream of production processes, such as the manufacture of furniture and that of clothing and footwear, thus completing the supply chain, in an increasingly circular logic. This inclusion was possible, as the paragraph dedicated to methodology will better show, following completion of the information in the bioeconomy BIOECONOMICS¹ database produced by the Joint Research Center (JRC) of the European Commission.

The bioeconomy estimate we propose expands the scope with respect to the JRC methodology and also includes, as already defined in previous editions of the Report, the water cycle and the bio-compatible component of the waste cycle.

The adoption of a new definition, as well as the methodological changes for the estimation of some sectors, do not allow a direct comparison of the bioeconomy value with the numbers presented in the previous edition. The possibility of applying the new methodology to the data of the past few years allows an overview of the phenomenon over time, with a long-term picture.

In addition, in this edition we will also quantify the number of employees in addition to the production value, in order to outline a more complete and articulated profile for this complex issue. The analysis will then focus on the main countries: Germany, France, Spain and the United Kingdom, offering an overview of the European bioeconomy.

1.2 A new method

The estimate of the activities related to bioeconomy has been updated to 2017 using the National accounting data to quantify the production value and the number of people employed in the agriculture, forestry and fishing industries, while starting from the available statistics in the Eurostat Structural Business Statistics database to estimate the other sectors included in the scope of bioeconomy.

Some sectors have been considered as a whole, since their inputs have a renewable and biological origin: the bio-based value of their production corresponds to the total of their production. These are the sectors of agriculture, forestry and fishing, the food, beverages and tobacco industries, the wood and paper industries, but also the component linked to tanning in the fashion industry. The water cycle is also considered in its entirety: the different phases of the integrated service are fully included in the definition of bioeconomy we have adopted. The water cycle includes the collection of water from rivers, lakes, wells and rainwater, the treatment (water purification for its distribution, desalination of sea water or subsoil water), the distribution of water to residential and industrial users and the management of the irrigation canals (Ateco 36), the removal of wastewater through the sewage system and the purification process (Ateco 37). Wastewater

¹ <https://datam.jrc.ec.europa.eu/datam/mashup/BIOECONOMICS/index.html>.

treatment makes it possible to minimize the environmental impact and guarantees the reuse and valorization of wastewater and recycled water. The sludge produced during the waste water purification process (civil, industrial and zootechnical) can also be an important source of biomass. From sludge it is possible to obtain compost, energy (biogas and biomethane), individual nutrients (phosphorus in particular) and biocompatible materials (bioplastics).

For these sectors we have information updated to 2017 in terms of production value and employed people for Italy and the other European countries which have been analyzed.

As regards the remaining sectors, it was necessary to identify the bio-based input quota for each specialization, in order to be able to apply it to Eurostat data relating to the output value and the number of employed people, updated to 2017.

The coefficients used in our estimates to quantify the bio-based share in the pharmaceutical, chemical, rubber-plastic, textile-clothing and furniture industries were those proposed by the JRC, for the main European countries, from 2008 to 2015. These quotients were calculated by JRC researchers starting from the statistics on products, by selecting, thanks to the contribution of a group of experts, only those with a bio-based nature² - the same methodology we adopted in the estimates contained in the previous editions of this Report. Moreover, it should be pointed out that the estimates of the JRC experts are substantially the same as those published by us, with regard to the bio-based component of the textile and biochemical sector. The statistics updated to 2015 are available in the aforementioned BIOECONOMICS database. The estimates we calculated for years 2016 and 2017 were made considering the coefficient identified in year 2015.

Although the coefficients are variable between countries and over time, they have some common elements. In Italy, the pharmaceutical sector is the one showing a higher percentage of bio-based production on the total, with a share higher than half of the overall figure, followed by the textile and clothing industry and by the furniture industry with percentages between 40% and 45%. On the other hand, the bio-based shares of the chemical and rubber-plastic sectors are at lower levels, with percentages of 6% and 4% respectively. This ranking can be also observed in the other countries analyzed, with the exception of Germany, where a greater impact of the bio-based share of the furniture industry is observed compared to other sectors.

To determine the coefficients related to bioenergy, the statistics relating to the production of electricity by type of source were taken instead from the Eurostat database, which makes it possible to identify the production of energy from bio-fuels (solid, liquid and gaseous) and renewable waste on the total energy produced³.

As to the value of bio-fuel production we referred to the statistics on PRODCOM products, selecting the product codes referring to the production of this type of fuel. The data is updated to 2017 for all countries except France.

The waste management and treatment sector is not within the scope of the JRC; for the quantification of the component attributable to the bioeconomy supply chain, an original estimation methodology was used, which is detailed in the following paragraph.

The production value and the number of people employed in the bioeconomy industry as a whole for Italy and the main European countries were finally calculated by adding to the data already

² Ronzon T., Piotrowsky S., M'Barker R. Carus M., "A systematic approach to understanding and quantifying the EU's bioeconomy".

³ Eurostat Database: "Production of electricity and derived heat by type of fuel".

available to 2017 for the sectors of agriculture, forestry and fishing, food and beverage industry, paper wood industry, water cycle, the estimates for the remaining sectors, identified considering only the bio-based component of their production.

The estimate of the bioeconomic component of the waste cycle

To estimate the component attributable to the bioeconomy chain of the waste management and treatment system, the management of both solid urban waste and special waste was taken into consideration.

Urban solid waste is waste originating from residential users and from so-called assimilated waste, that is, from factories, small craft and commercial productions generally attributable to public service management. Through assimilation, in fact, the applicable regulations are modified in terms of management methods and related charges.

Special wastes are wastes deriving from industrial and commercial activities; they are entrusted to the responsibility of their producers, based on the Extended Producer Responsibility (EPR) principle, and are managed in the free market, according to criteria of specialization and in compliance with the standards set by legislation. Special waste producers and users (companies, distributors, services) must identify the operator authorized to treat that type of material and enter into a contract that includes waste management, treatment, recovery and, possibly, disposal.

Finally, a specific category that is transversal to the previous two is that of packaging: packaging waste managed for the purpose of material recycling and recovery comes from both separate flows. Legislation identifies the subjects required to guarantee the correct and effective environmental management of packaging in producers and users, while completely exempting consumers from these obligations. Producers and users are given full financial and managerial responsibility for the end-of-life of their products and this entails various obligations depending on the type of packaging and the stage of the waste management chain considered.

The product composition of waste varies greatly. In urban solid waste, organic (wet + green) is the most important component, followed by paper and plastic. Among special waste, a substantial part in terms of volume is represented by construction and demolition waste, followed by the waste of various manufacturing activities. The biocompatible waste considered within the scope of bioeconomy is organic waste of animal and vegetable origin, common sludge and waste deriving from water purification processes, waste paper and cardboard, textile waste and wood waste.

The waste cycle includes the various activities involved in the collection, management and treatment of waste, namely:

- waste collection activities (Ateco 38.1);
- waste treatment and disposal activities (Ateco 38.2);
- materials recovery activities (Ateco 38.3).

As already pointed out, not all the activities connected to the management of the waste cycle can be considered part of bioeconomy: with reference to the collection service, only separate collection can be considered the sine qua non condition to start the recycling, reuse and recovery of waste bio-components. Separate waste collection is the only form of upstream waste management that allows the activation of multiple downstream waste processing stages, stimulating innovation and dynamic competition. Waste collected separately in 90% of cases is recovered, through biological composting and anaerobic digestion treatments (for the organic fraction) and other waste selection and valorization processes (for the dry fraction). The residual

part, amounting to less than a tenth, may undergo mechanical-biological treatments or may also be sent directly to incineration, landfill disposal or export. Among the treatment and disposal activities, the biological treatment, intended as composting and anaerobic digestion of green waste and sludge, and in part biomass waste-to-energy can be included in the definition of bioeconomy. Finally, recovery activities include recovery and preparation for recycling bio-compatible waste. Waste recycling is the priority of all management policies both at national and at EU level. It represents one of the cornerstones of the Circular Economy model that aims to make the economic system sustainable by eliminating waste.

Since statistics do not offer a similar degree of detail, we proceeded to estimate the share of the waste cycle attributable to the bioeconomy chain using the method already proposed in the 3rd Report on Bioeconomy. To this end, an activity input indicator was used relating to the percentage of biodegradable waste collected on the total of that produced net of mineral waste (mainly construction and demolition waste) in the various European countries.

Once the coefficients were identified, the estimates were obtained by applying these quotients to the production data and number of employees updated to 2017.

1.3 Bioeconomy in Italy

In 2017 the set of activities related to bioeconomy in Italy (including both waste management and recovery, and the water cycle) generated an output of approximately € 328 billion, employing over two million people. Bioeconomy accounted for 10.1% in terms of production and 7.7% in terms of employment of the total economy of our country in 2017 - percentages in line with those of 2016.

According to these estimates, the value of bioeconomy production in 2017 grew by over 6 billion compared to 2016 (+1.9%), thanks to the positive contribution of the majority of the sectors considered and, in particular, of the agriculture and food industry sectors. With regard to employment, on the other hand, there has been a limited increase in the last year (0.2%), conditioned by the negative dynamics, particularly in the agricultural sector.

2017 was a positive year for the Italian economy, with an average GDP growth of 1.5% per year at constant prices, supported by both domestic demand, which accelerated compared to 2016, and by the exchange with foreign countries. These dynamics have had a positive impact on most bioeconomy sectors, although with varying intensity. In fact, if bioeconomy represents a set of activities characterized by a renewable source of input, on the other hand it is extremely varied and heterogeneous, moving with different economic logics specific to each sector.

The primary importance of the food, beverage and tobacco industry is confirmed, representing in terms of production 40.9% of the total, with a value of € 134 billion. The importance of the sector is also observed in terms of employment, equal to 450 thousand, more than a fifth of the overall figure, in second place after agriculture. 2017 was a year of further consolidation for the sector, after the positive performances of 2016, with a 1.2% growth in production value and 1.5% in employment terms, confirming the sector's good state of health.

Tab.1.1 – Bioeconomy in Italy (production value and employment)

	Production value (mln euro)			Employment (thousands)		
	2016	2017	% 2017	2016	2017	%2017
Agriculture, forestry and fishing, of which:	56.273	57.965	17.7	920	912	45.3
Agriculture	52.967	ND		852	ND	
Forestry	1.570	ND		40	ND	
Fishing and aquaculture	1.737	ND		28	ND	
Food, beverages and tobacco industry	132.620	134.204	40.9	443	450	22.4
Wood industry	12.969	13.295	4.1	104	104	5.2
Paper industry	22.329	22.731	6.9	71	72	3.6
Textile industry from natural fibers and tanning, of which:	16.240	16.444	5.0	75	76	3.8
Bio-based textile*	9.160	9.162	2.8	53	53	2.6
Tanning	7.080	7.282	2.2	23	23	1.1
Pharmaceutical bio-based products*	14.076	15.022	4.6	35	36	1.8
Chemical bio-based products*	3.107	3.112	0.9	7	7	0.3
Bio-fuels**	139	169	0.1	ND	ND	
Bioenergy	2.248	2.035	0.6	2	2	0.1
Bio-based rubber-plastic*	1.633	1.689	0.5	7	7	0.3
Bio-based clothing and footwear/leather goods	32.324	32.804	10.0	199	200	10.0
Bio-based clothing*	11.152	11.357	3.5	79	79	3.9
Footwear and leather goods	21.171	21.448	6.5	120	121	6.0
Bio-based furniture*	9.370	9.642	2.9	57	58	2.9
Water cycle	11.845	12.120	3.7	45	46	2.3
Management and recovery of biodegradable waste***	6.692	6.804	2.1	42	43	2.1
Total Bioeconomy	321.863	328.036	100.0	2.008	2.013	100.0
Totale economia	3.145.886	3.232.951		24.826	25.113	
% of Bioeconomy on the total economy	10,2	10,1		7.7	7.7	

Note: (*) Estimated values for 2016 and 2017 by applying the JRC coefficients for 2015 to the 2016 and 2017 statistics of Structural Business Statistics. For the pharmaceutical sector, the National Accounting data were used. (**) The source for bio-fuel statistics is Prodcorn, where employment data are not available. (***) For the estimation of the coefficients see the methodological paragraph. Source: Intesa Sanpaolo calculations based on Eurostat data

The agriculture, forestry and fishing industry ranks second in terms of output, with a production of around 58 billion, and first for employment, with 912 thousand employees, 45.3% of the total. 2017 was a positive year for the evolution of the production value, conditioned also by the price trend. Instead there were less positive signs in terms of employment

The wood and paper industries are considered, as a whole, as sectors related to bioeconomy, contributing with an output of around 13.3 billion the first and 22.7 billion the second in 2017, respectively 4.1% and 6.9% of the total. In both sectors, a growth in production was observed compared to 2016, benefiting from the combined effect of the expansionary trend of the main manufacturing sectors, positive household demand and less unfavorable signals from the construction industry. In terms of employment, a substantial stability was observed in the two-year period 2016 and 2017, with 104 thousand employees employed in the wood industry and 72 thousand in the paper industry. This edition of the Report is dedicated to this important chain that involves the upstream sector of forestry, the downstream sectors of wood (chapter 2) and paper (chapter 3) as well as the final phase of closing the cycle through recycling and reuse (chapter 4).

The fashion system industry has been analyzed as a whole, considering both the phases upstream of the chain (the textile industry and the preparation and tanning of leather) and those downstream of the production processes (clothing and the production of leather goods and footwear), applying, also in this case, the coefficients proposed by the JRC to obtain the bio-based component. The textile industry from natural fibers and tanning represents 5% of bioeconomy in Italy, with a production value of € 16.4 billion in 2017, a slight increase compared to 2016, thanks in particular to the tanning component. Instead, it represents 10% of the total, with an output of € 32.8 billion for the apparel and leather goods sector, also growing compared to 2016. In terms of employment, the bio-based and tanning textile sector employs about 76 thousand workers

(3.8%), while 200 thousand are employed in bio-based clothing and footwear, reflecting the importance of these “Made in Italy” sectors in the Italian industrial landscape.

It is interesting to point out the growing attention that environmental issues are also playing in the Italian fashion industry. Recently, for example, the companies of the Santa Croce tanning district presented an investment plan of around € 80 million, also signed by the Tuscany region, to support the reuse of processing waste in an increasingly circular supply chain logic. These investments will serve on the one hand to double the capacity of the sludge treatment plant of the purifiers, and on the other hand to strengthen and modernize the tanning processing waste treatment plant, so as to recover not only the organic fraction to make fertilizers, as already happens, but also to recover the chromium present in the products to be able to treat even the scraps of finished leather⁴.

The rubber and plastic sector (which also includes part of the manufacture of plastic packaging) is among the other sectors in the intermediate stages of production processes. In particular, the value of the bio-based production of the rubber-plastic industry represents 0.5% of the total bioeconomy, with production levels rising to around € 1.7 billion, and 7 thousand employed people, in line with the data of 2016.

The bio-based production of the rubber-plastic industry is destined to rise in the coming years, also considering some recent regulatory developments at the EU level. In fact, in December 2018 the European directive on the prohibition of disposable plastics was approved starting from 2021 (the final text will have to be approved during 2019), aimed at reducing marine litter and which will also be reflected in some packaging products and packaging, such as plastic bottles. In particular, producers of plastic packaging (bottles) will have to contribute to the costs of waste disposal and cleaning of beaches and seas, and to support awareness campaigns on the polluting value of plastic packaging, as well as aiming at design requirements and eco-design. The agreement reached also foresees a target of 77% separate collection of plastic bottles by 2025 and 90% by 2030. Moreover, in 2030 all bottles, not only those in PET, must be made up of at least 30% from recycled material.

As far as bio-based chemicals are concerned, the production value amounted to € 3.1 billion, employing around 7 thousand workers, similar to that observed for 2016. The sector represents 0.9% of the overall bioeconomy in terms of output and 0.3% in terms of employment.

Bio-fuels have been excluded from the estimate of the bio-based chemistry for which the figure related to the production of PRODCOM5 is available. In 2017 the production of bio-fuels in Italy amounted to € 169 million, slightly up on the total, although it represents only 0.1% of the bioeconomy. The perspectives for the development of bio-fuels are also influenced by the political choices proposed in the national integrated plan for energy and climate, which on the one hand foresees a decrease in the category of first generation bio-fuels, while on the other hand it sets important goals for the development of advanced bio-fuels. These energy policies will also affect bioenergy production, understood as the production of electricity from biomass, calculated considering the generation of energy as solid, liquid and gaseous bio-fuels, and from renewable urban waste. In 2017 the value of bioenergy in Italy amounted to € 2 billion, employing around 2000 people.

According to our estimates, the bio-based pharmaceutical industry generated a production value of over € 15 billion in 2017 and employed over 36,000 people, representing 4.6% and 1.8%

⁴ Source: Il Sole 24 Ore, 4th March 2019, “La concia investe 80 milioni nell’economia circolare” (Tanning invests 80 million in the circular economy). ⁵ The PRODCOM database includes production statistics.

respectively of the total bioeconomy. Our country has become one of the leading manufacturers of drugs in the European Union thanks to the high competence of its human resources, to the vitality of the companies operating in the territory, often foreign multinationals, and to the high quality also of research and development, which also has an impact on the bio-based component of production. According to our estimates, using the coefficients proposed by JRC, over half of the production of pharmaceutical products has a bio-based nature. This is a particularly significant share, as well as higher than that proposed by Farmindustria, which considers a quota that stops at 32% of the total as bio-based⁵.

The furniture industry also falls under the new definition of the bioeconomy; the value of bio-based production in the furniture industry represents € 9.6 billion, employing 58 thousand people. The sector accounts for 2.9% of the total bioeconomy in terms of output and employees. The bio-based share of this production has grown over time, confirming a growing interest in companies in this industry to develop products using biomaterials and innovative materials, in view of a lower environmental impact.

The estimation method adopted to quantify the part of the biocompatible waste cycle leads to a production value of € 6.8 billion in 2017, increasing by 1.6% compared to 2016 and by 21.8% compared to 2008. Waste cycle activities that do not deal with biocompatible waste and do not value biomass are not included in the estimate. In terms of impact on the overall bioeconomy, biodegradable waste represents 2.1%.

With reference to the water cycle, the different phases composing it fall within the scope of the bioeconomy, representing a fundamental input of life itself and of many of the processes included in the standard scope of the bioeconomy. However, nowadays water as a resource is only partially considered and valued in a bioeconomic perspective: the management of waste water largely regards, in fact, mere treatment and subsequent disposal. A "closed cycle", on the other hand, would allow the systematic recycling and reuse of both water and sludge. Recycled water can be used in agricultural activities, in industrial processes, in permitted civil uses in order to reduce the withdrawal of natural surface and underground water resources and improve situations of water stress. The sludge produced during the purification process can be used directly in agriculture through spreading or used for the production of compost, for the extraction of single materials (phosphorus in the first place), for the development of biocompatible materials (bioplastics) and for energy valorization (biogas and biomethane)⁷. However, despite this potential, water recycling and the use of sludge are still low, offering therefore interesting potential for development in a bioeconomic perspective. The estimates carried out on potential reuse are significant: in a world where the demand for fresh water is constantly increasing and where the limited water resources are subject to an increasing pressure caused by excessive extraction, pollution and climate change, neglecting the opportunities coming from better wastewater management is becoming more and more unimaginable.

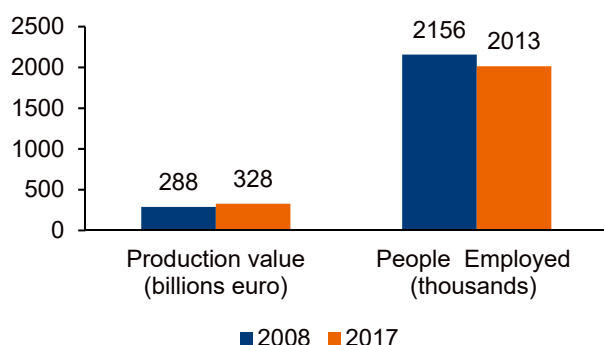
The total production value of the integrated water cycle was just over € 12.1 billion in 2017, up 2.3% compared to 2016.

Long-term analysis shows an increase in the relevance of the bioeconomy in terms of production value compared to 2008, both in absolute terms and as a percentage of the total output of the Italian economy. In 2008, bioeconomy generated a production value of € 288 billion, 8.8% of the total, an impact lower than that observed in 2017 (10.1%). In particular, there are three sectors

⁵ The biopharmaceutical sector in 2017 - Innovation and growth for Italy, Farmindustria -EY. ⁷ See the IV Report for more information on the use of sewage sludge.

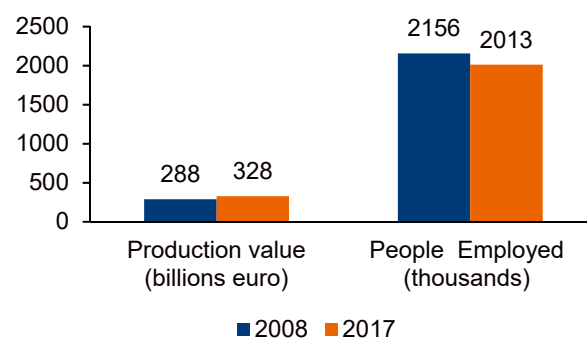
whose weight on overall bioeconomy has increased in recent years: the food and beverage industry, services related to the water cycle and waste management.

Fig.1.1 – Italy: production value and employees



Source: Intesa Sanpaolo calculations based on Eurostat data

Fig. 1.2 - Italy: the weight of the bioeconomy on the total economy



Source: Intesa Sanpaolo calculations based on Eurostat data

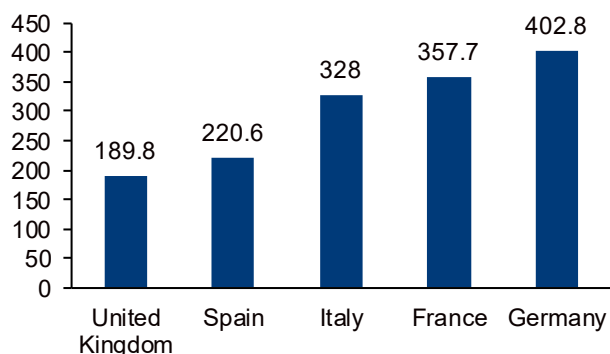
As regards employment, a slight decrease is observed, both in absolute and relative terms. This is the result of a general reduction in the number of people employed in the various sectors pertaining to the world of the bioeconomy, although there is no lack of positive indications for some sectors, including the food and beverage industry.

1.4 Bioeconomy in Europe

In this paragraph we present the data on the value of bioeconomy and on employment in the main European countries, comparing them with the data regarding Italy.

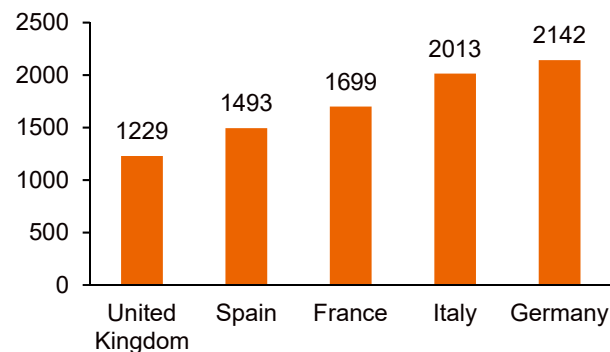
Fig. 1.3 shows the bioeconomy production values in 2017, expressed in billions of euro, in the 5 European countries analyzed. In absolute terms, the weight of Germany is pointed out, with an estimated bioeconomy production value of € 402.8 billion, followed by France with a bioeconomy production value of € 357.7 billion. Italy ranks third, with an output of € 328 billion, ahead of Spain (€ 220.6 billion) and the United Kingdom (€ 189.8 billion). In terms of employment, bioeconomy records a number of employees between 1.2 million in the United Kingdom and 2.1 million in Germany. Italy, with just over 2 million employees, ranks immediately after Germany, ahead of France (1.7 million) and Spain (1.5 million).

Fig. 1.3 – Bioeconomy in Europe in 2017 (production value in billions of euros)



Source: Intesa Sanpaolo calculations based on Eurostat data

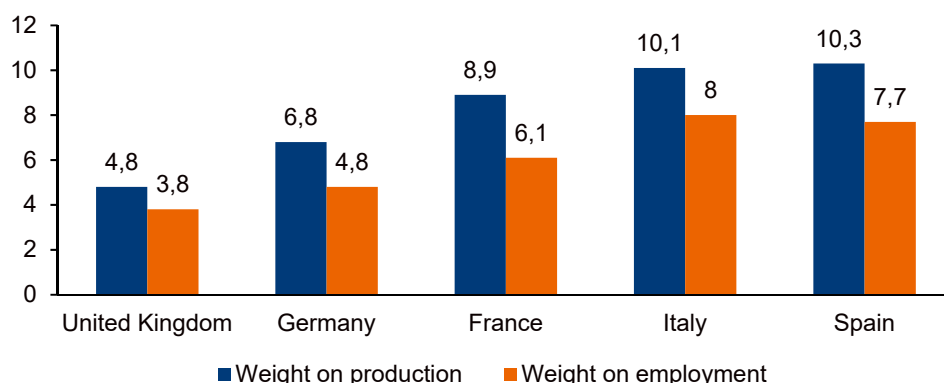
Fig. 1.4 – Bioeconomy in Europe in 2017 (thousands of employees)



Source: Intesa Sanpaolo calculations based on Eurostat data

In relative terms, considering the production value and the number of employees, on the overall data for economic activities (including both the production of goods and services), we note in particular the greater importance of bioeconomy in Spain and Italy, which account for 10.3% and 10.1% of the total respectively in terms of production and 7.7% and 8% if we consider employment.

Fig. 1.5 – The weight of bioeconomy on total production and total employment (2017)



Source: Intesa Sanpaolo calculations based on Eurostat data

From the analysis of the bioeconomy sectors, some common aspects emerge between the countries and some differences linked to the specializations and territorial specificities of each single nation.

The food, beverage and tobacco and agriculture, forestry and fishing industries represent the most significant shares of bioeconomy both in terms of production and employment. The food and beverage industry in particular represents a share of between 40.9% in Italy and 52.3% in France, in terms of production and 22.4% in Italy and 41.6% in Germany for employment.

Our country stands out for the greater importance of the fashion system industry, both upstream in the textile and tanning industry, and downstream, in the clothing and in the footwear and leather goods industry. Overall, in Italy, the bio-based fashion system accounts for 15% of the total bioeconomy in terms of production (13.7% in terms of employment), a value clearly higher than that observed in other European economies, where the share settles at values between 1.8% in the United Kingdom and 3.7% in Spain as regards production value.

Tab. 1.2 – Bioeconomy in Europe, 2017 production (% composition)					
Production value	Germany	Spain	France	Italy	United Kingdom
Total Bioeconomy	100.0	100.0	100.0	100.0	100.0
Agriculture, forestry and fishing	14.9	24.3	24.4	17.7	17.3
Food, beverages and tobacco industry	46.8	51.2	52.3	40.9	45.1
Wood industry	5.9	3.0	3.1	4.1	4.9
Paper industry	9.4	5.9	5.2	6.9	7.1
Textile industry from natural fibers and tanning	0.8	1.1	0.2	5.0	0.8
Pharmaceutical bio-based products	5.6	3.6	3.8	4.6	7.4
Chemical bio-based products	2.0	1.0	1.4	0.9	1.2
Bio-fuels	0.3	0.3	0.0	0.1	0.0
Bioenergy	0.9	0.2	0.2	0.6	0.8
Bio-based rubber-plastic	1.0	0.4	0.4	0.5	0.4
Bio-based clothing and footwear/leather goods	1.3	2.7	2.3	10.0	1.0
Bio-based furniture	2.6	1.0	0.7	2.9	2.1
Water cycle	5.5	4.1	4.1	3.7	9.0
Management and recovery of biodegradable waste	3.0	1.3	1.9	2.1	3.0

Source: Intesa Sanpaolo calculations based on Eurostat data

In Germany the importance of the wood and furniture and paper industry stands out, with a share of bioeconomy of 5.9%, 2.6% and 9.4% respectively. Italy emerges for the data on the furniture industry, which confirms our country's specialization in the wood-furniture system (both in terms of production and employment).

The bio-based drug production sector has a weight between 3.6% in Spain and 7.4% in the United Kingdom, one of the most important if we focus our attention on the most innovative sectors. The sectors of rubber-plastic and bio-based chemistry represent, in fact, only a limited proportion of bioeconomy, between 3% in Germany and 1.4% in Spain.

The water cycle and the management of biodegradable waste have a greater weight in the United Kingdom (9% and 3% respectively), compared to lower values in Spain (4.1% and 1.3%) and Italy (3.7 % and 2.1%).

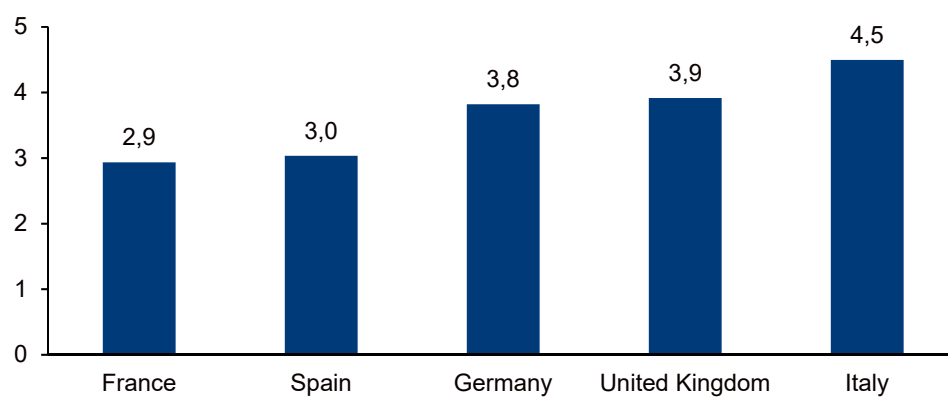
Tab. 1.3 – Bioeconomy in Europe, 2017 employment (% composition)					
	Germany	Spain	France	Italy	United Kingdom
Total Bioeconomy	100.0	100.0	100.0	100.0	100.0
Agriculture, forestry and fishing	28.8	52.0	44.1	45.3	36.3
Food, beverages and tobacco industry	41.6	27.3	36.7	22.4	37.3
Wood industry	6.1	3.5	3.5	5.2	6.0
Paper industry	6.7	3.0	3.8	3.6	4.6
Textile industry from natural fibers and tanning	0.9	1.2	0.7	3.8	1.0
Pharmaceutical bio-based products	2.8	1.7	1.4	1.8	1.9
Chemical bio-based products*	1.0	0.4	0.6	0.3	0.6
Bioenergy	0.4	0.0	0.1	0.1	0.2
Bio-based rubber-plastic	1.0	0.3	0.4	0.3	0.5
Bio-based clothing and footwear/leather goods	1.4	3.6	2.6	10.0	1.4
Bio-based furniture	3.2	1.7	0.9	2.9	3.4
Water cycle	3.7	3.6	3.2	2.3	4.2
Management and recovery of biodegradable waste	2.4	1.9	1.9	2.1	2.6

Note: (*) The occupation relating to the production of bio-fuels is not distinct, but it is part of the production of bio-based chemicals.

Source: Intesa Sanpaolo calculations based on Eurostat data

These results confirm the high production diversification of our economy, which on the one hand is highly specialized in the traditional "Made in Italy" sectors, while on the other hand it shows a good specialization also in other sectors. The index of production diversification (measured as the inverse Herfindahl index) shows higher levels for our country, followed by the United Kingdom and Germany.

Fig. 1.6 – Sector diversification in bioeconomy (inverse Herfindahl index)



Source: Intesa Sanpaolo calculations based on Eurostat data

2. From Tree to Wood to Furniture: the Wood Supply Chain

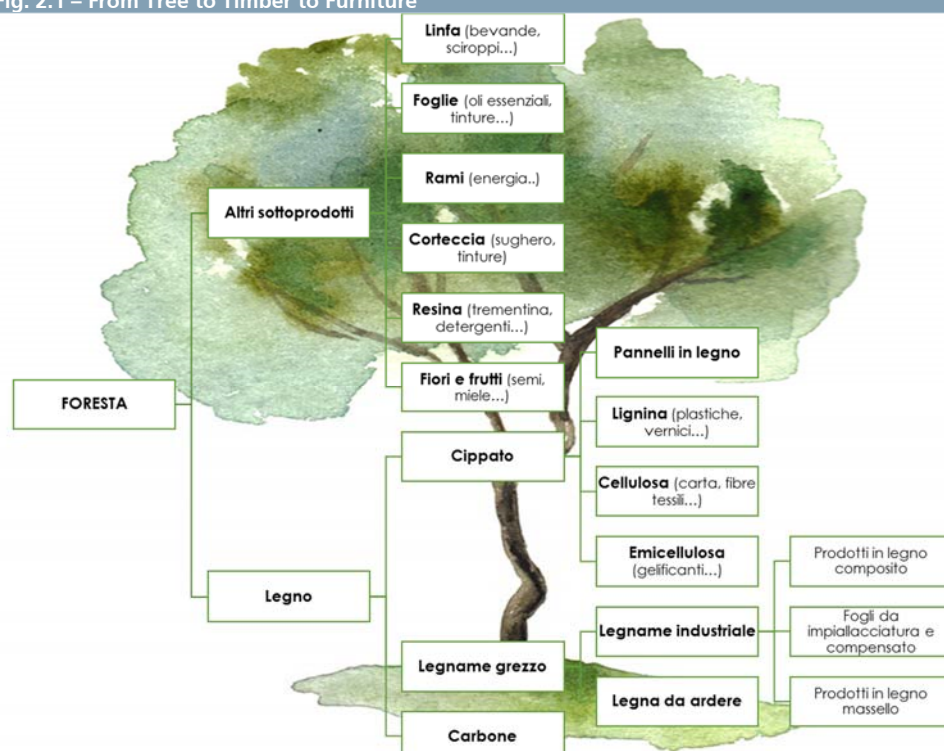
2.1 Introduction

Forests have always performed multiple economic, environmental and cultural functions, directly connected to human wellbeing. They have played a fundamental role throughout human history, starting from prehistoric hunter gatherers, who fed on fruits of the forest and found shelter among trees, to the men of the agricultural revolution and then the industrial revolution, who shaped the earth's landscape over time by increasingly taking open areas away from woods and anthropizing them so that they could better meet evolving human needs. Appropriately managed woodland makes it possible to obtain economic benefits such as timber and other forestry products, which are environmentally friendly by their nature and can be used for numerous purposes. At the same time, it is possible to preserve the indispensable environmental benefits, from protecting animal and vegetal biodiversity to resilience to climate change, to safeguarding water and soil.

Lavinia Stoppani

This chapter explores the wood supply chain, analyzing in particular the upstream sectors, which directly benefits from woodland resources, and focusing in particular on Italy and Europe. Following the supply chain, paragraph 2.2 deals with woodland resources and forestry and paragraph 2.3 with the industry of wooden products in Italy and Europe.

Fig. 2.1 – From Tree to Timber to Furniture



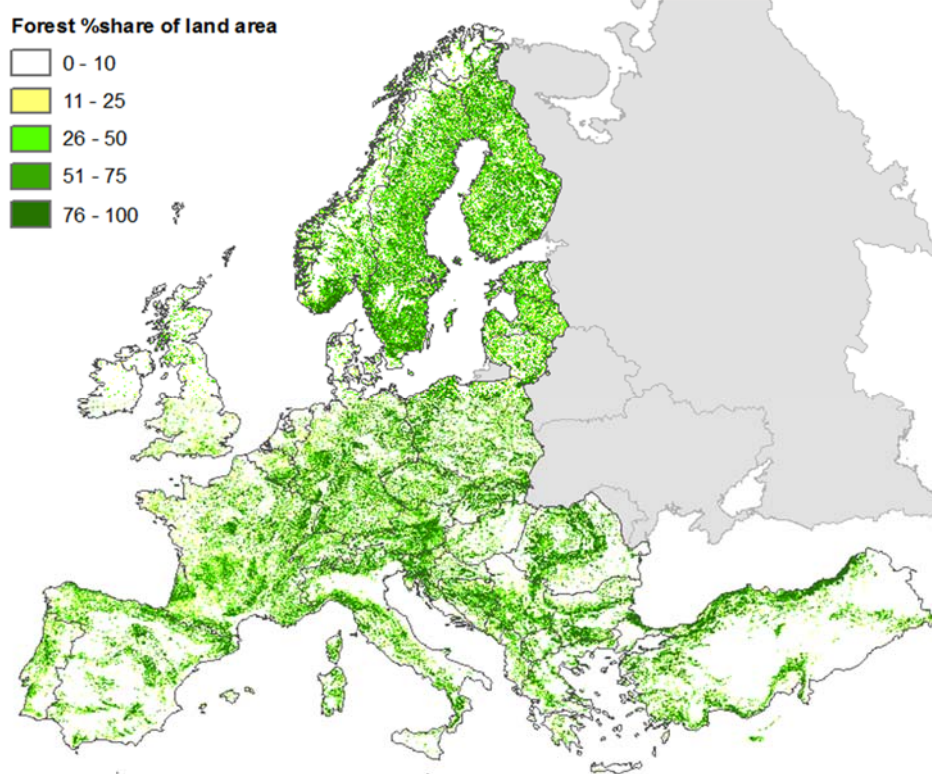
Source: Intesa Sanpaolo

2.2 Forestry in Italy and in Europe

In the EU-28, woodland covers 182 million hectares (FAO, Food and Agriculture Organization of the United Nations, 2015), accounting for 42.8% of the overall surface area (excluding surface waters). The size of forests varies considerably in the different European countries: in Malta, the Netherlands, Ireland and United Kingdom the areas covered by forests are smaller, while in Finland and Sweden forests occupy larger areas (over 70% of their territory is covered by forests). Italy

ranks sixth in the European Union in absolute terms, its woodland covering over 11 million hectares, but its woodland area (37.6% of total surface) is slightly lower than EU average.

Fig. 2.2 – Map of European Areas covered with woodland (% forests over total surface area)

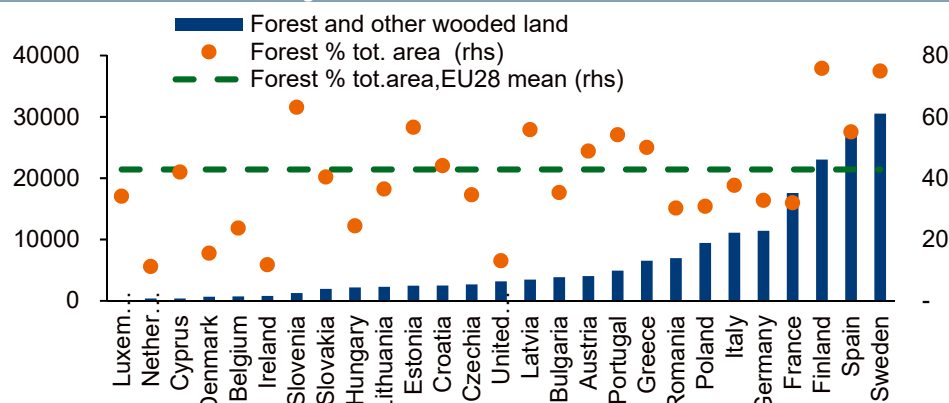


Source: JRC European Commission (Kempeneers et al. 2011⁶)

In a world scenario where areas covered with woods and forests are shrinking, the European Union is an exception, showing a 2.1% increase over the past 25 years (1990-2015). This trend is the result of reforestation programs as well as vegetation spontaneously taking back difficult and poorly productive land following the abandonment of agriculture and sheep farming. Italy is the European country showing the highest rate of woodland growth (+6.7% from 1990 to 2015).

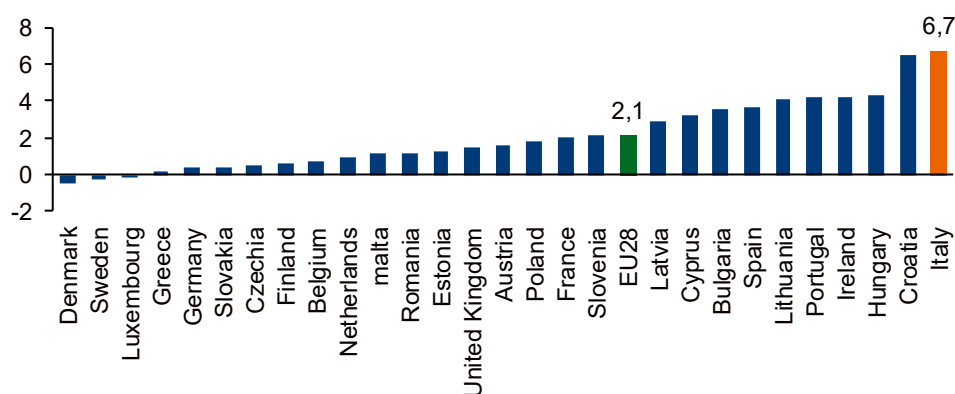
⁶ Kempeneers, P., Sedano, F., Seebach, L., Strobl, P. and San-Miguel-Ayaz, J. (2011). Data fusion of different spatial resolution remote sensing images applied to forest-type mapping. IEEE Transactions on Geoscience and Remote Sensing, vol. 49, no. 12, pp. 4977–4986. DOI: 10.1109/TGRS.2011.2158548

Fig. 2.3 - Surface occupied by forests and woods in European Countries (thousands of hectares and % of total area, not including internal waters, 2015)



Source: Intesa Sanpaolo elaborations on FAO-Eurostat data

Fig. 2.4 - Dynamics of the surface occupied by forests and woods in the EU28 (var. % 1990-2015)

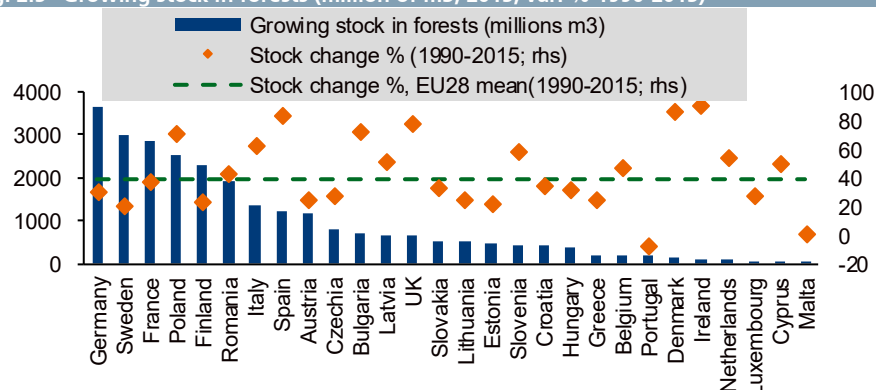


Fonte: elaborazioni Intesa Sanpaolo su dati FAO-Eurostat

When studying forest resources, it is important to measure also the trunk of living trees, besides the wooded land, which is known as "growing stock", and it is generally measured in cubic meters. Studying how it has evolved over time is fundamental to check forest sustainability and it is also used to estimate the amount of carbon stored in living trees⁷. FAO estimates included in the *Global Forest Resources Assessment*, show that Italy is the seventh European economy in terms of wood stock volume and such stock has increased very dynamically (+62%) over the past 25 years, above European average (+38%).

⁷ Photosynthesis allows trees (and all plants) to absorb CO₂ from the atmosphere, release oxygen and keep carbon as a solid element in their biomass.

Fig. 2.5 –Growing stock in forests (million of m3, 2015; var. % 1990-2015)



Source: Intesa Sanpaolo elaborations on Eurostat, FAO. data about Portugal refer to 2010 and the percentage variation has been calculated between 1990 and 2010.

The recent successful results of EU countries in terms of sustainability have obviously a relatively low impact from a global standpoint, considering that the growing wood stock of all EU countries accounts for slightly over 3% of the world stock. As a matter of fact, statistics relating to carbon stored in forests, always according to FAO data, show a 3.7% worldwide decrease from 1990 to 2015 and a further reduction between 2015 and 2016, this being the last year this information is available. Stocked carbon grew during the 25 years surveyed only in North America, Europe (this region includes Russia, which alone represents the third country for carbon stocked in forests) and Oceania, with EU countries showing a decisively faster pace (+68% on average and +60% for Italy).

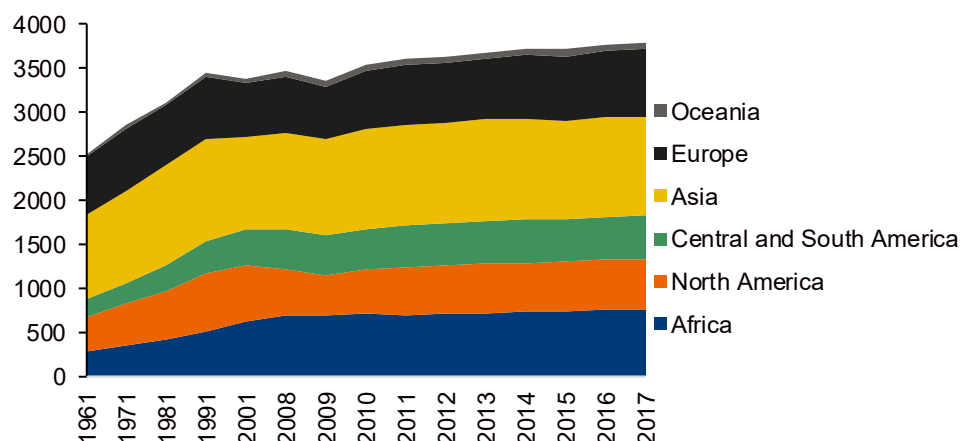
On the other hand, FAO statistics on raw wood production show moderately increasing data on a global level over the past 25 years, following thirty years (1960-1990) of highly dynamic growth.

Tab. 2.1 - The carbon stock stored in forests (millions of tons)

	1990	2015	2016	Var. % 2015-1990	Var. % 2016-2015
World	307.257	296.010	295.719	-3.7	-0.1
Central and South America	116.554	107.640	107.449	-7.6	-0.2
Africa	66.307	59.620	59.400	-10.1	-0.4
Europe	41.872	45.496	45.716	8.7	0.5
Asia	37.724	35.799	35.622	-5.1	-0.5
North America	28.875	31.313	31.364	8.4	0.2
Oceania	15.924	16.143	16.168	1.4	0.2
European Union	6.002	10.089	10.230	68.1	1.4
France	965	1.364	1.387	41.3	1.7
Germany	871	1.189	1.203	36.5	1.1
Sweden	950	1.114	1.117	17.3	0.2
Poland	467	822	833	76.0	1.3
Finland	633	780	780	23.3	0.0
Romania	383	616	661	61.0	7.3
Italy	400	641	651	60.3	1.5
Spain	325	610	619	87.6	1.5
Austria	335	391	392	16.7	0.4

Source: Intesa Sanpaolo elaborations on Eurostat.

Fig. 2.6 – Evolution of global wood production (millions of m3)



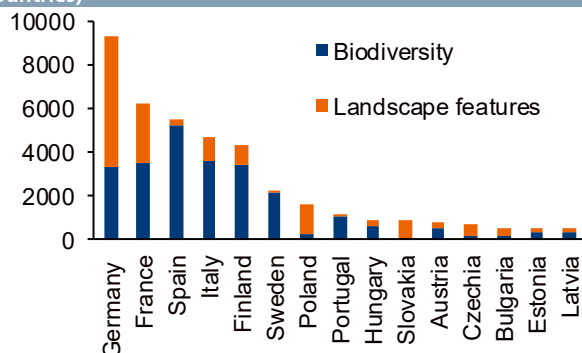
Source: Intesa Sanpaolo elaborations on FAO

Preserving forests so that they can carry on absorbing CO₂ is fundamental in fighting climate change, which, in turn, affects the development of wooded land with hardly predictable effects.

The carbon stock stored in forests, on the other hand, does not disperse when living trees are turned into timber and, then, into wooden products: every piece of furniture (poles, beams, etc.) is in itself a carbon stock; it cannot absorb more carbon but cannot release it in the atmosphere at least throughout its life cycle and beyond, if its end life as a product is managed using a circular economy-based approach (see Chap. 4).

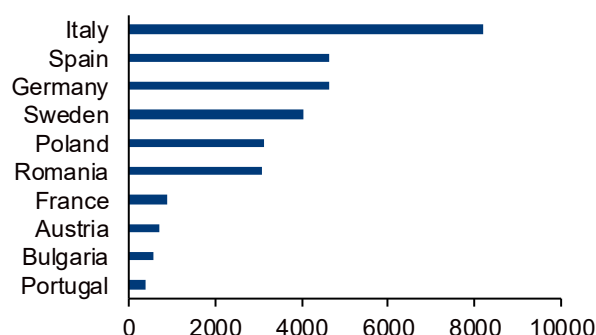
Existing woodland also carries out other key functions for the environment. Forests are a bulwark for protecting biodiversity and play an essential role in contrasting hydrogeological instability. In Italy, 3.6 million hectares of forest are protected to preserve biodiversity, whereas another one million hectares is subject to environmental restrictions. In addition, 8.2 million hectares of Italian forests are defined as forest areas having the task of protecting the soil, water and other ecosystems.

Fig. 2.7 – Natura 2000* protected forest area by type of protection (thousands of hectares, 2015; first 15 of EU28 countries)



Source: Intesa Sanpaolo elaborations on Eurostat *Natura 2000 is a European network of websites aimed to safeguard areas that are vital to a number of protected species or habitats

Fig. 2.8 – Forest surface with the role of protecting soil from water and other ecosystems or infrastructures (thousands of hectares, 2015; first 10 of EU28 countries)

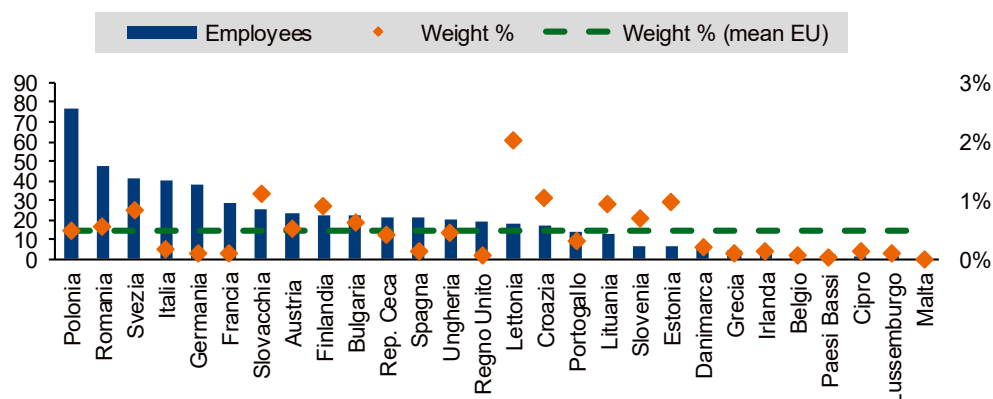


Source: Intesa Sanpaolo elaborations on Eurostat

Italy ranks fourth in Europe in terms of operators working in forestry: 40,000 in 2016, 7.4% of total European personnel in the same industry and 0.2% of total person employed in Italian

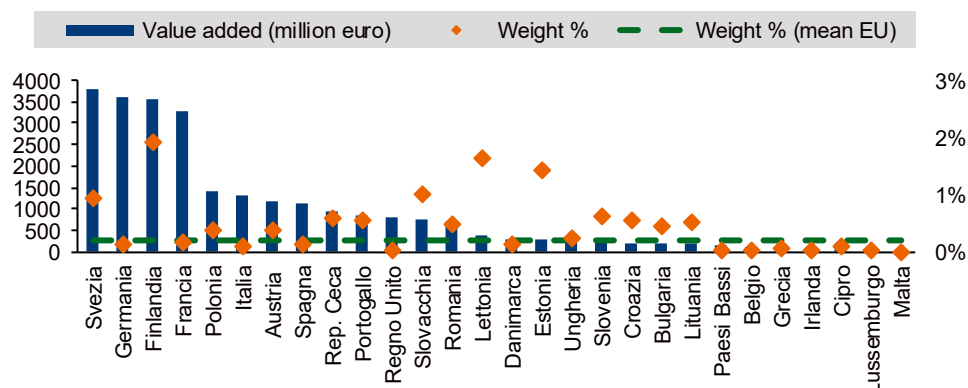
economy. In terms of the value added this sector provides, Italy ranks sixth in Europe (thus confirming that Italian woodland relates more to the environment and landscape and only in second place to timber production) and amounts to € 1.3 billion, corresponding to 0.1% of Italian GDP and 5% of EU-28 forestry added value.

Fig. 2.9 – Employees in forestry (thousands of employees and weight % on the total economy)



Source: Intesa Sanpaolo elaborations on Eurostat (National Account).

Fig. 2.10 – Forestry value added (thousands of euro and % on the total economy)



Source: Intesa Sanpaolo elaborations on Eurostat (National Account).

2.3 The Wood Industry in Italy and in Europe

The wooden product manufacturing industry is downstream of forestry, but upstream of the furniture supply chain. This sector includes all first timber processing steps, from sawmilling and planing, to the production of veneering sheets and wood panels (veneering, multi-ply panels, MDF⁸ and other composites), building material (including doors and windows), pre-assembled parquet flooring, wood containers and finally of other products deriving from the processing of plant products, such as plaiting material, straw and cork (this category includes for instance the production of corks for wine bottles)

⁸ Medium density fiberboard

Tab. 2.2 – The wood industry (2017)

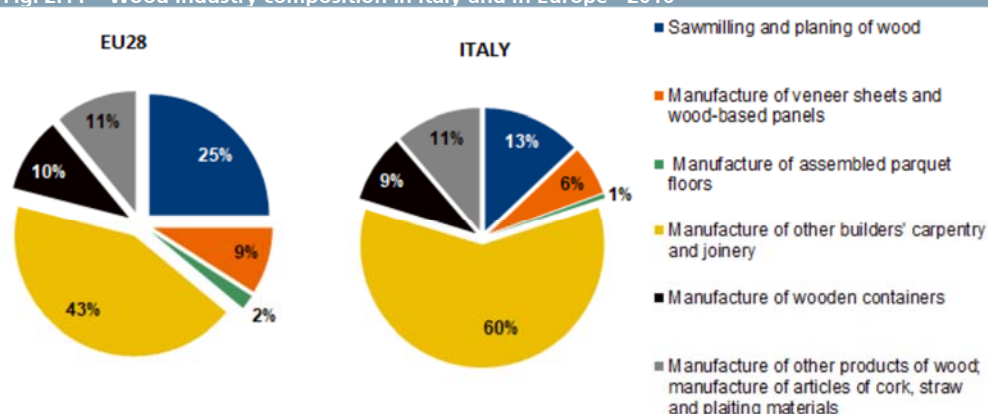
	Enterprises		Persons employed		Turnover	
	N.	%	N.	%	Mln euro	%
EU28	170.568	100.0	970.819	100.0	133.139	100.0
Germany	12.060	7.1	131.651	13.6	25.115	18.9
Poland	17.088	10.0	127.382	13.1	9.003	6.8
Italy*	27.194	15.9	104.277	10.7	13.308	10.0
UK	9.287	5.4	74.030	7.6	10.400	7.8
France**	9.409	5.5	59.215	6.1	12.007	9.0
Czech Rep.	28.928	17.0	54.303	5.6	3.710	2.8
Spain	9.646	5.7	52.319	5.4	6.858	5.2
Romania	4.994	2.9	51.537	5.3	3.038	2.3
Sweden	5.055	3.0	34.015	3.5	9.996	7.5
Austria	2.668	1.6	33.433	3.4	8.738	6.6
Portugal	5.077	3.0	29.075	3.0	3.212	2.4
Latvia	1.981	1.2	24.748	2.5	2.240	1.7
Slovakia	11.760	6.9	23.741	2.4	1.304	1.0
Lithuania	3.466	2.0	21.471	2.2	1.202	0.9
Finland	1.699	1.0	20.101	2.1	6.928	5.2

*as for Italy, the figure about the number of companies refers to 2016 (see Chapter 5: Movimpresa estimates identify 32,142 companies operating in Italy in 2018) ** as for France the number of employees refers to 2016.

Source: Intesa Sanpaolo -elaborations on Eurostat data

In the EU-28, this sector is composed of 170,568 enterprises and employs nearly one million workers (970,819 in 2017), with a total turnover amounting to € 133.1 billion. In terms of weight on the manufacturing sector of EU28, it accounts for 8% of enterprises, 3.2% of persons employed-and 1.7% of turnover. Italy has 104,277 persons employed in this industry and ranks third amongst EU countries (10.7% of total EU-28), second in terms of number of enterprises (15.9% of the total EU-28), with more than 27,000 firms (2016 data), and of turnover - € 13.3 billion - that is 10% of the total turnover of the EU wood industry. In terms of weight on the manufacturing sector, the wood industry is relatively less important in Italy compared to the EU average: it accounts for 7% of manufacturing firms, 2.8% of persons employed and 1.4% of overall turnover.

Fig. 2.11 – Wood industry composition in Italy and in Europe - 2016

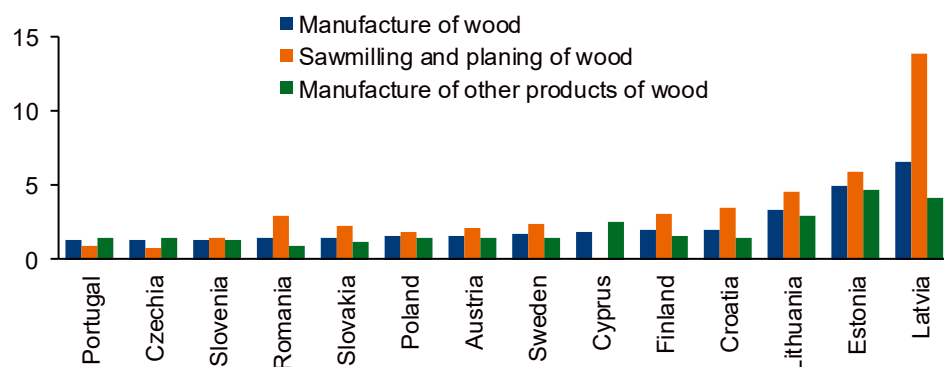


Source: Intesa Sanpaolo elaborations on Eurostat data.

Our country, actually, is not amongst the most specialized EU countries in this sector. The top ranking countries are the Baltic Republics and two EU Scandinavian countries, Finland and Sweden, besides Croatia, Poland and Romania. These countries are characterized by vast forest resources, as described in the previous section, in absolute terms and/or for their woodland-total surface ratio; they are consequently specialized in the first steps of timber processing, sawmilling and planing, which are strictly related to wood being available on site. In terms of turnover,

Sweden and Finland dominate the sector of wood sawmilling and planing, and they come after Germany in the ranking.

Fig. 2.12 – European Countries specialized in wood industry (specialization index *)



Source: Intesa Sanpaolo elaborations on Eurostat data. *for each country I and sector J the index is calculated according to the formula: persons employed ij / persons employed manufacturing i / (persons employed EUj / persons employed manufacturing EU). A country is specialised in sector j if index is greater than 1.

Tab 2.3 – Persons employed in the wood industry by size class (first 5 European countries, %, 2016)

	0-9	10-19	20-49	50-249	250+
Manufacture of wood					
EU28	31.0	12.6	16.8	23.3	16.3
Germany	22.8	14.7	15.6	24.3	22.6
Italy	53.9	18.9	13.0	11.1	3.1
France	29.4	15.3	22.7	22.6	10.0
UK	21.6	13.8	21.9	29.7	13.0
Sweden	17.2	8.7	16.0	29.5	28.5
Sawmilling and planing of wood					
EU28	27.6	13.9	20.2	24.4	13.9
Germany	20.0	13.8	21.5	23.6	21.1
Italy	54.4	24.8	16.3	4.5	0.0
France	37.7	18.5	21.6	13.4	8.9
UK	10.5	8.2	19.4	40.7	21.2
Sweden	11.6	8.1	17.4	36.1	26.8
Manufacture of other products of wood; manufacture of articles of cork, straw and plaiting materials					
EU28	32.0	12.5	15.6	22.9	17.1
Germany	23.4	14.9	14.2	24.5	23.0
Italy	53.8	18.0	12.5	12.0	3.7
France	25.9	13.9	23.1	26.6	10.5
UK	23.0	14.5	22.2	28.3	12.0
Sweden	20.3	9.0	15.2	26.1	29.5

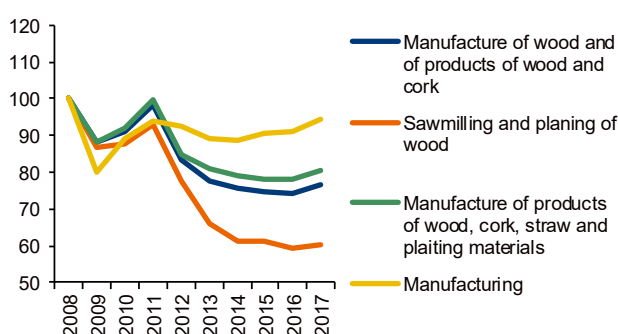
Source: Intesa Sanpaolo elaborations on Eurostat data.

The wood product manufacturing sector is less concentrated in terms of specialization; it interfaces directly with the furniture industry, the building sector and other end consumer-oriented manufacturing sectors, such as packaging and other wooden products. In this area Austria, Poland and Lithuania stand out for being highly specialized and for their overall turnover relating to the production of assembled parquet flooring. Portugal, on the other hand, stands out for other wooden products, such as cork, etc. due to the considerable amount of cork oaks available in the central area of Portugal. The only sector Italy proves to be specialized in on a European level is woodworking and lumber manufacturing for industrial use, which includes the production of windows and doors; it employs 60% of workers in the Italian wood industry (43% in the EU-28).

The wood industry includes sectors showing different features on an industrial level, some are strictly related to the world of handicraft (for instance the workshops of picture framers) while others are more industrial (wood panel manufacturing); it is also characterized by a high number of small-sized enterprises. Based on an EU average, smallest firms (less than 10 persons employed) employ nearly one third of employees in this sector. -In Italy small firms employ more than 50% of workers, in line with our industrial system.

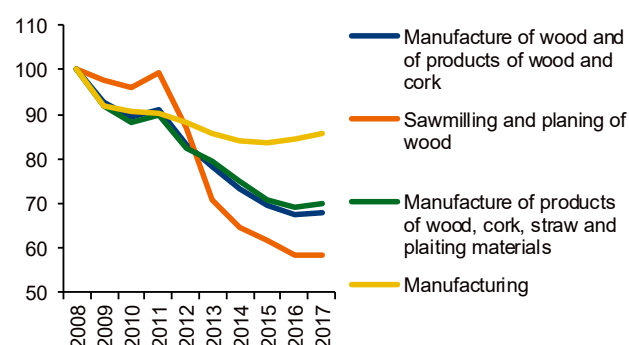
The Italian wood industry still appeared to be poorly dynamic after 10 years from the 2008 economic crisis. In 2017 the turnover of the wood processing sector widely underperformed compared to 2008 figures (-23.5% based on current prices), notwithstanding of a weak recovery that started in 2015. The wood sawmilling and planing work branch, which is relatively less important in the Italian industry, reached 60% of 2008 levels of activities in 2017. The number of employees has decreased even more drastically over the past years, dropping by 32% in the industry, once again more markedly for wood sawmilling and planing.

Fig. 2.13 – Italy: evolution of the turnover of wood industry (2008=100, current prices)



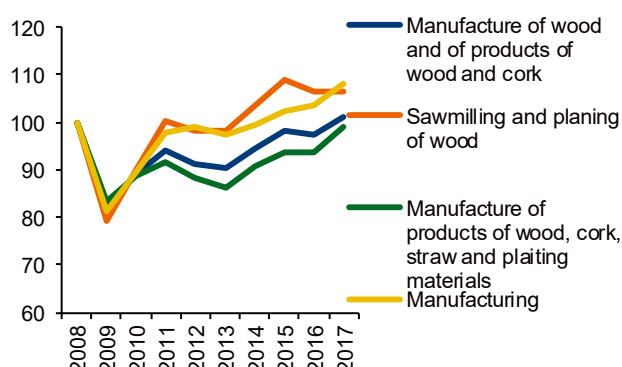
Fonte: elaborazioni e stime Intesa Sanpaolo su dati Eurostat

Fig. 2.14 – Italy: evolution of the employment of wood industry (2008=100)



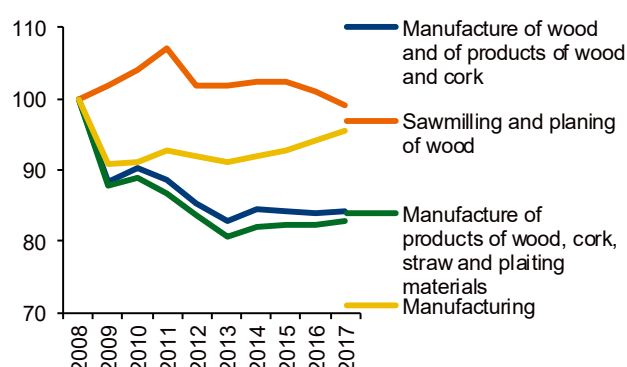
Source Intesa Sanpaolo elaborations on Eurostat data.

Fig. 2.15 – EU28 evolution of the turnover of wood industry (2007=100, current prices)



Source: Intesa Sanpaolo elaborations on Eurostat data.

Fig. 2.16 – EU28: evolution of the employment of wood industry (2008=100)



Source: Intesa Sanpaolo elaborations on Eurostat data.

This sector performed worse than the manufacturing industry in Europe also, even though in this case wooden products dragged the overall results downwards and, in terms of turnover, 2008 levels were substantially achieved in 2017. The employment level, instead, decreased, in particular in the wooden product area: in 2017 the wood industry employed 84% of workers in EU compared to 2008.

Italy is characterized by a flourishing furniture industry (ranking second in the world, after China, in terms of turnover), and it is traditionally a net importer of rough timber and processed wood. FAO forest data referring to 2017 estimate that the Italian share of raw wood produced on a world level is lower than 0.5%, firewood prevailing (84%) over lumber for industrial use. Such share achieves 1% when referred to the production of chips, pellets and wood panels. On the other side, Italy ranks first in the world among importers of firewood (19%, data relating to quantity), fourth for pellets (9.5%), sixth for sawmilling and planing products (3.3%).

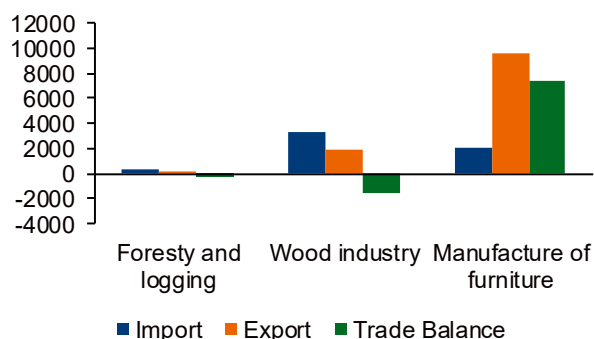
Tab. 2.4 – The main importers of wood and wood products (import in m³, % on total world, 2017)

-Raw wood for industry			Firewood			Chipped wood		
China	55.664.997	42,2%	Italy	1.087.493	19,2%	Japan	21.512.191	32,7%
Germany	8.680.584	6,6%	Germany	537.324	9,5%	China	19.837.748	30,1%
Austria	8.649.038	6,6%	Austria	451.029	8,0%	Turkey	3.347.000	5,1%
Sweden	7.695.283	5,8%	Romania	346.437	6,1%	Finland	2.696.174	4,1%
Canada	6.491.400	4,9%	Slovenia	238.874	4,2%	Canada	2.549.000	3,9%
India	4.898.178	3,7%	France	207.498	3,7%	Sweden	1.962.330	3,0%
Finland	4.830.686	3,7%	Greece	170.828	3,0%	Portugal	1.720.681	2,6%
South Korea	3.715.161	2,8%	Hungary	165.754	2,9%	Poland	1.628.016	2,5%
Belgium	3.636.878	2,8%	Belgium	164.423	2,9%	Taiwan	1.598.921	2,4%
Japan	3.265.702	2,5%	Sweden	157.836	2,8%	South Korea	1.422.000	2,2%
Italy	2.357.077	1,8%	USA	145.683	2,6%	Germany	1.292.911	2,0%
Portugal	2.000.368	1,5%	Norway	113.181	2,0%	Austria	1.279.953	1,9%
Czech Rep.	1.898.137	1,4%	Slovakia	107.126	1,9%	Lithuania	1.032.362	1,6%
Poland	1.703.972	1,3%	Denmark	101.782	1,8%	France	780.738	1,2%
Vietnam	1.504.097	1,1%	United Kingdom	90.346	1,6%	Italy	662.281	1,0%
Sawmilling and planning of wood			Wood panels			Pellet		
China	38.795.628	26,1%	USA	14.248.106	16,8%	United Kingdom	6.885.523	36,4%
USA	27.418.474	18,4%	Germany	5.654.521	6,7%	Denmark	3.089.123	16,4%
United Kingdom	7.580.258	5,1%	Japan	3.952.645	4,7%	South Korea	2.431.165	12,9%
Japan	6.332.585	4,3%	United Kingdom	3.792.044	4,5%	Italy	1.792.547	9,5%
Germany	5.144.183	3,5%	Canada	3.301.798	3,9%	Belgium	1.090.921	5,8%
Italy	4.914.826	3,3%	Poland	3.260.380	3,9%	Japan	442.517	2,3%
Egypt	4.567.879	3,1%	China	2.732.257	3,2%	Austria	403.117	2,1%
Netherlands	3.170.800	2,1%	Italy	2.478.684	2,9%	Germany	391.244	2,1%
France	2.722.306	1,8%	South Korea	2.475.467	2,9%	Sweden	268.948	1,4%
South Korea	2.637.667	1,8%	France	2.335.575	2,8%	France	263.863	1,4%
Vietnam	2.180.011	1,5%	Belgium	1.956.912	2,3%	Netherlands	244.700	1,3%
Uzbekistan	2.175.297	1,5%	Netherlands	1.784.700	2,1%	USA	211.617	1,1%
Austria	1.930.788	1,3%	Vietnam	1.343.391	1,6%	Latvia	195.802	1,0%
Denmark	1.634.000	1,1%	Czech Rep.	1.100.208	1,3%	Lithuania	117.990	0,6%

Source: Intesa Sanpaolo elaborations on FAO data

It is not surprising, therefore, that the trade balance of the two sectors, forestry and wooden products, is negative, when considering domestic statistics, whereas the trade balance of the downstream sector of furniture production is instead positive and high (7.5 billion Euros in 2017).

Fig. 2.17 – Italy: Import, export and trade balance in wood industry (million euros, 2017)

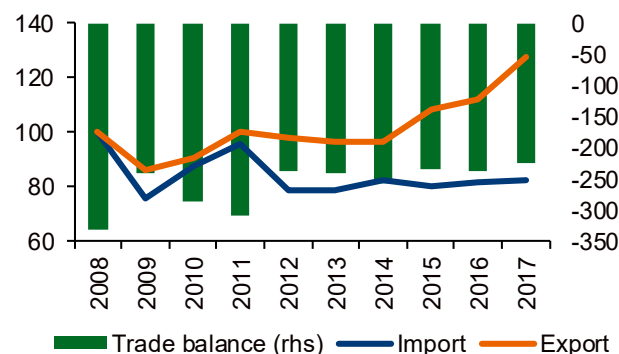


Source: Intesa Sanpaolo elaborations on Istat data

Observing the evolution of import and export flows over the past 10 years (2008-2017), we see that in both upstream sectors, imports in terms of value have gradually shrunk, whereas exports in terms of value have grown, thus resulting in the absolute value of the negative trade balance being reduced over the years. In the furniture industry, instead, imports have increased more than exports, which have however achieved better results in value terms in 2017 compared to 2008, and, consequently, the trade balance has remained more stable.

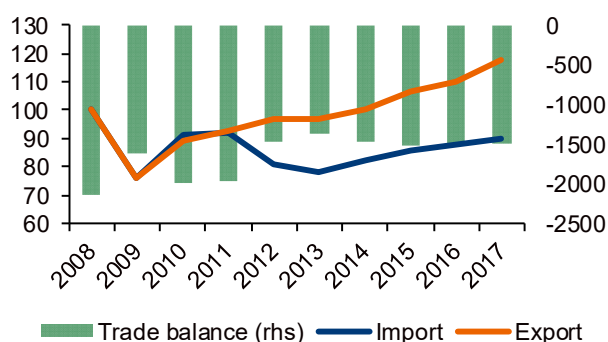
The first sub-item in Italian imports refers to sawmilling and planing products, for which our country shows a remarkable negative trade balance. Wood sheets and panels follow, together with other wooden products and joinery products for construction and rough timber. The only items where Italy shows a positive trade balance are wooden doors and windows, wild growing non wood-forest products and wood frames.

Fig. 2.18 – Italy: evolution of trade in Forestry and logging (2008=100, current prices; million euros)



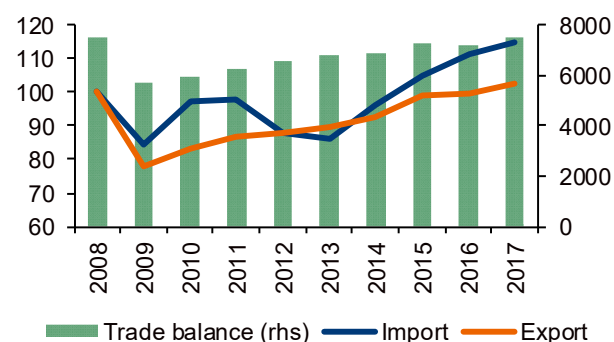
Source: Intesa Sanpaolo elaborations on Istat data

Fig. 2.19 – Italy: evolution of trade in wood industry (2008=100, current prices; million euros)



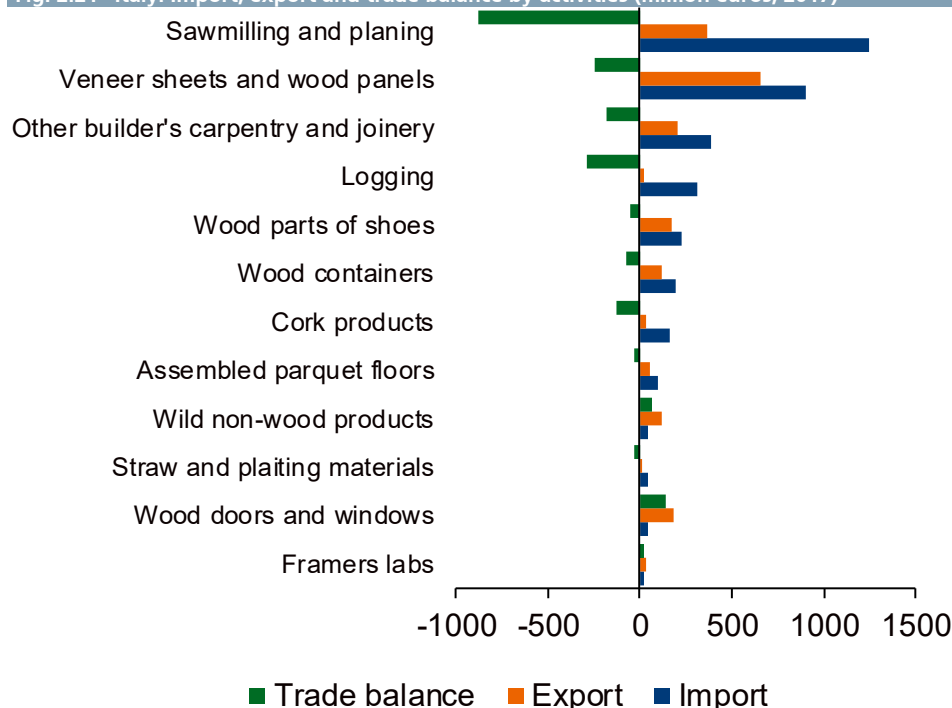
Fonte: elaborazioni Intesa Sanpaolo su dati Istat

Fig. 2.20 – Italy: evolution of trade in furniture industry (2008=100, current prices; million euros)



Fonte: elaborazioni Intesa Sanpaolo su dati Istat

Fig. 2.21 –Italy: Import, export and trade balance by activities (million euros, 2017)



Source: Intesa Sanpaolo elaborations on Istat data

Our main trading partners for forestry products are our neighboring European countries. As for wooden products, we import them from several countries: Austria, first partner, supplies a considerable share of sawmilling and planing products; China ranks fourth and exports to Italy mainly doors and windows and wooden components for shoe production. We import straw items and plaiting materials in particular from Poland, whereas Portugal is our main provider of cork-derived products, with a 59% market share. Furniture import figures show that China is our most important partner, which particularly supplies chairs and seats, furniture parts and accessories (which we also import from Poland in large amounts), and home furniture. The value of furniture imports has increased over the years, from China and, even more, from Poland, France and Romania.

Tab. 2.5 – Italy: first 10 wood industry for import (million euros, 2017)

Forestry and logging		Wood products		Furniture	
Countries	Mln euro	Countries	Mln. euro	Countries	Mln euro
France	63	Austria	895	China	506
Slovenia	60	Germany	301	Poland	255
Austria	37	France	197	Germany	239
Croatia	36	China	175	Romania	229
Bosnia-Herzegovina	30	Poland	162	France	116
Switzerland	23	Romania	134	Spain	57
USA	20	Croatia	124	Slovenia	56
Netherlands	20	Slovenia	112	Turkey	48
Germany	14	Portugal	108	Lithuania	47
Spain	14	Hungary	98	Austria	43

Source: Intesa Sanpaolo elaborations on Istat data

The Furniture Supply Chain

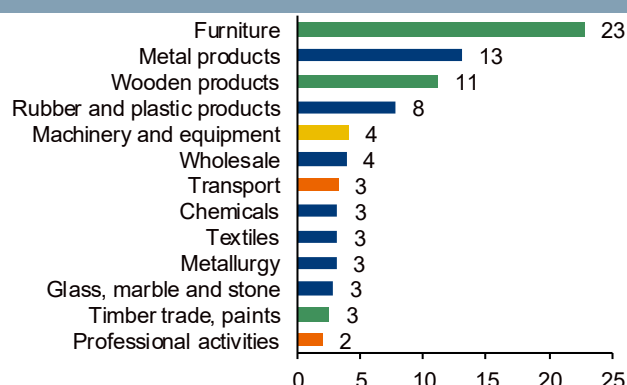
The results presented in this in-depth analysis stem from a single database, which maps the purchases that a sample of Intesa Sanpaolo clients managed through our network covering Italy in 2017. Based on transaction-related data, a picture of the supply network of Italian furniture companies⁹ can be outlined both in geographic and product terms. This analysis, regardless of all its limits¹⁰, allows us to draw an even more complete picture of the supply chain (also including infra-national trade), together with a usual study on customs figures to explore supply through trade flows with countries abroad.

By Sara Giusti and
Lavinia Stoppani

More than 686,000 purchase transactions were analysed overall, worth over € 3 billion and corresponding to approximately 23% of goods and services purchased by the businesses in the sample.

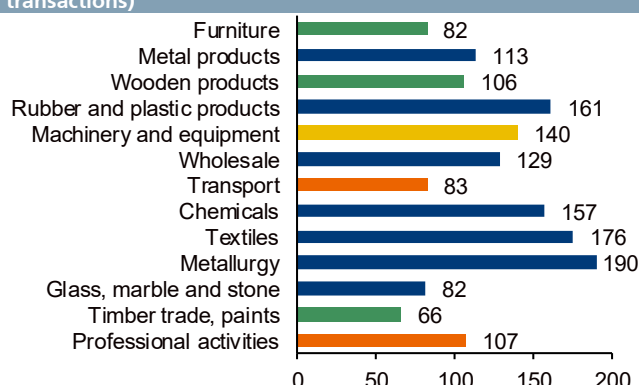
Furniture manufacturers also rank first for transacted sums in the ranking of supplier-based supplies: this confirms that close subcontracting relations exist within the furniture sector. Metal products follow, in terms of total expenditure, whereas wooden products rank only third. In line with the data shown in Chapter 1, estimating that the bio-based component weighs on furniture production for slightly less than half the production value, furniture companies prove to have a varied network of suppliers of raw material: wood, metals, plastics, fabrics and stones.

Fig. 1 – Furniture Supply Chain according to the supplier sector (% on the total transactions)



Source: Intesa Sanpaolo Integrated Database (ISID). Note: colors refer to the following groups: green: wood, subcontracting, whole sale of timber; blue: other raw materials; orange: services; yellow: mechanical equipment.

Fig. 2 – Furniture manufacturers: average distances to reach suppliers (distance in Km weighted based on the value of transactions)



Source: Intesa Sanpaolo Integrated Database (ISID). Note: sectors arranged based on the value of total transactions

The analysis of average distances to reach suppliers (distance in Km between client and supplier, weighted based on the value of the transaction), allows us to identify patterns in client-supplier distances: furniture companies are located on average closer to their suppliers of wood and furniture and more distant from their suppliers of other raw materials and mechanical equipment. They find basic services such as transportation at a closer distance, whereas they purchase more

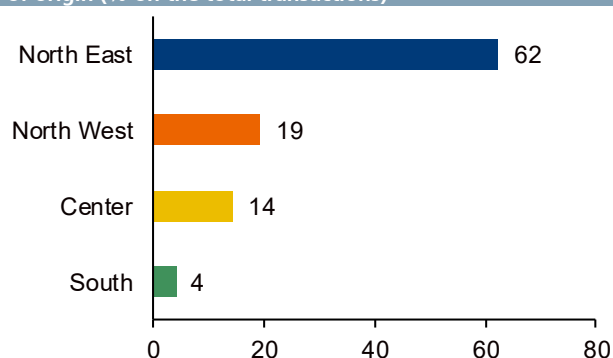
⁹ Companies belonging to Ateco 31. We have chosen to focus on purchases made by those businesses rather than by companies processing wooden products to trace the wood supply chain up to its main end market, a very large market in Italy, where the furniture industry plays a relevant economic role.

¹⁰ The data below need to be read also keeping in mind that when the sample of transactions was selected, some relevant distortion might have been caused to the analysis. It is necessary to consider in the first place that transactions carried out abroad were excluded: they may be more or less important depending on the sector and the supply chain being analyzed. Furthermore, when picking only transactions carried out through the Intesa Sanpaolo network, the sample was once more arbitrarily restricted, even though this distortion was mitigated since Intesa Sanpaolo operates all over Italy and in all industries.

sophisticated ones, such as professional services (including management consulting) from more distant suppliers.

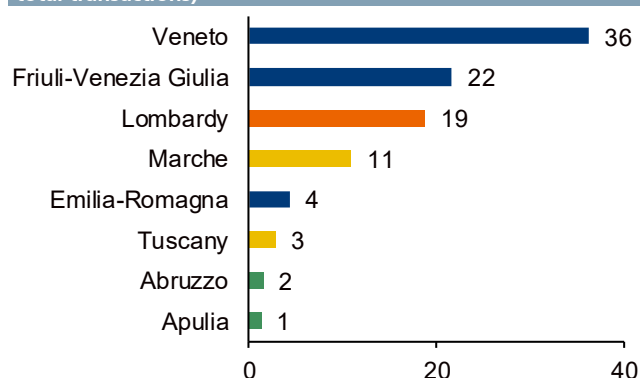
Let us focus on purchases from suppliers working in the wood supply chain, that is to say furniture and wooden product manufacturers and lumber wholesalers: we can observe that 62% of transactions are carried out with suppliers located in North East Italy, mainly in Veneto and Friuli-Venezia Giulia. Companies from the North West (nearly all located in Lombardy) and Central Italy follow, in particular from Marche. Only 4% of transactions are made with suppliers based in Southern Italy.

Fig. 3 – Wood supply chain* according to the geographical area of origin (% on the total transactions)



Source: Intesa Sanpaolo Integrated Database (ISID) * Transactions with suppliers from the furniture and wooden product industry and those with suppliers from the timber trade are included.

Fig. 4 – Main wood products supplying regions * (% on the total transactions)

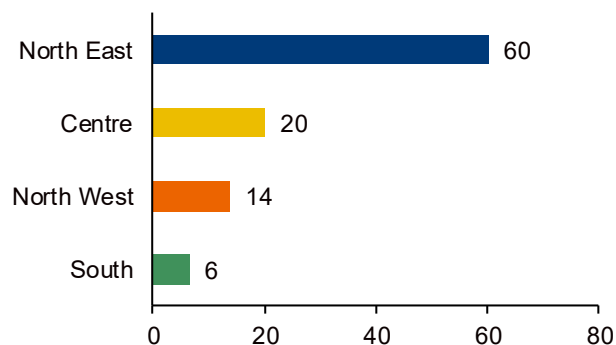


Source: Intesa Sanpaolo Integrated Database (ISID) * Transactions with suppliers from the furniture and wooden product industry and those with suppliers from the timber trade are included.

An opposite analysis calculates the percentage of transactions from companies operating in the wood supply chain based on where the headquarters of client companies are located. 60% of transactions come from companies located in North East Italy, once more from mainly Veneto and Friuli-Venezia Giulia. Client companies based in Central Italy follow, and Marche plays a priority role, where 15% of total transactions originate. Lombardy is the most important region in North West Italy also in terms of client localization, and 13% of total purchases originate from this region. Regions in Southern Italy are placed at the bottom of the ranking, with 6% of transactions, in particular Abruzzo, Apulia and Campania.

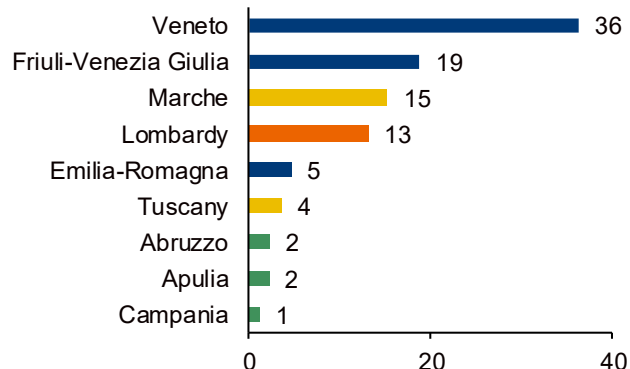
When analysing the average distance for purchases (of products from the wood supply chain) based on the region where transactions originate, it is not surprising to find out that the average distances for supply are markedly shorter in Northeast Italy and Lombardy, where it is possible to buy raw materials mainly from other companies located in the same geographic area. As we consider the regions of Central Italy, we can observe that client-supplier relationships are characterized by longer distances to cover, over 100 Km on average both in Marche and Tuscany. Southern companies are located more distant from their suppliers, the average distance exceeds 250 Km in Apulia and Campania.

Fig. 5 - Wood supplies according to geographical area of destination (% of the total transactions)



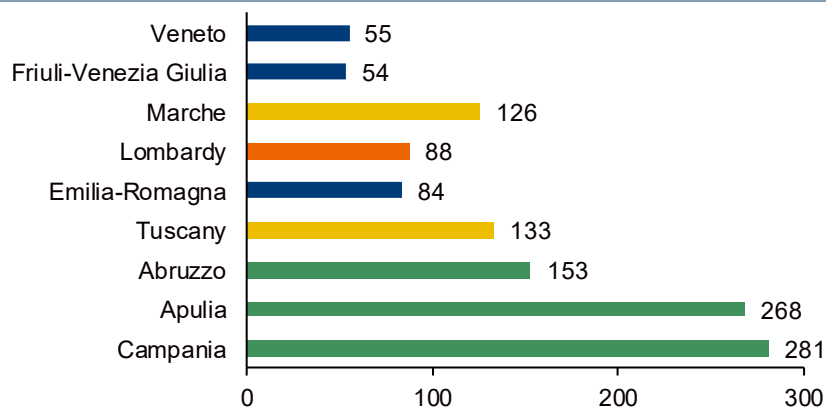
Source: Intesa Sanpaolo Integrated Database (ISID). * Including transactions with suppliers from the furniture and wood industry and with suppliers working in the timber trade

Fig. 6 - The main regions of the purchasing companies of the wood sector (% of the total transactions)



Source: Intesa Sanpaolo Integrated Database (ISID). * Including transactions with suppliers from the furniture and wood industry and with suppliers working in the timber trade

Fig. 7 - Average distances performed by wood supplies * by main purchasing regions (distance in Km weighted based on the value of transactions)



Source: Intesa Sanpaolo Integrated Database (ISID). * Including transactions with suppliers from the furniture and wood industry and with suppliers working in the timber trade.

3. The Paper Industry between Digital Transformation and Environment

3.1 Introduction

Paper represented a key factor in economic and social development, especially when it started being mass-produced: it made it possible to disseminate information and knowledge among large groups of population that had been previously excluded from any sort of culture. After being an essential support for exchanging and storing information for many centuries, in recent times paper has been gradually losing this role, since information has been dematerialized and digitalized. However, it has been used in new or rediscovered ways, from packaging to disposable medical devices, because its sources are renewable and its products can be recycled: highly important features in circular bio-economy.

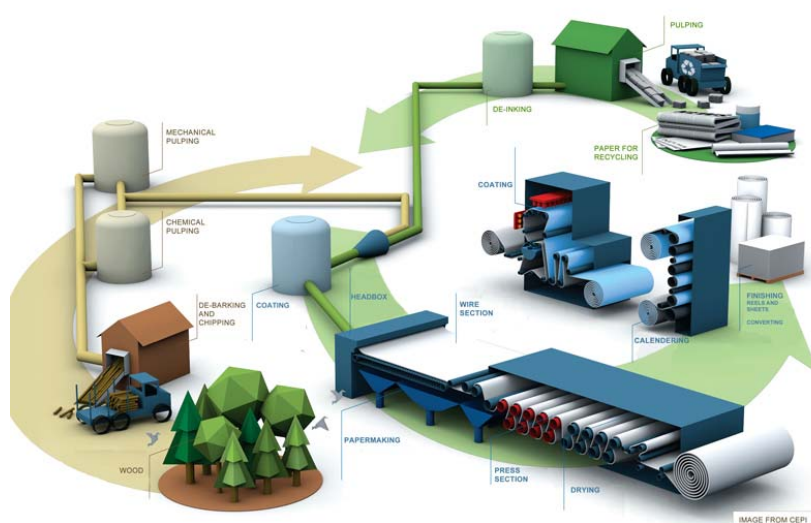
By Stefania Trenti

This chapter analyses the paper industry: in the first section, it reports the outcomes of a FAO database on international production and consumption. In the following section, it outlines an overview on employment in European countries, using Eurostat data that are organized based on Ateco classification of economic activities.

3.2 The paper industry: an international outlook

The paper industry developed in the Western world in relatively recent times. The paper manufacturing process was invented in China in the 2nd century B.C.: it consisted in transforming fibrous substances of different origins into moist pulp first and then in sheets. It spread very slowly, first in the other Asian Countries (Korea and Japan) and, later on, in the Middle East where, however, papyrus was still the main material used for writing. During the Arab domination, some attempts to produce paper were reported in Spain as well as in Sicily (the region the first XII-century European document written on paper came from). However, it was not until the year 1200 that the first paper mill was built and, according to the legend, it was set up near the city of Bologna by Polese da Fabriano, his hometown, where later on a paper manufacturing district developed and became the most important one in Christian Europe for a few centuries.

Fig. 3.1 – The paper production process



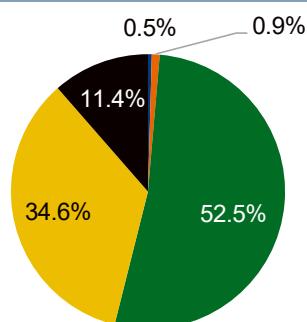
Fonte: Confederation of Paper Industry

The invention of printing increased the demand for paper enormously and encouraged the growing industrialization of manufacturing processes, which received a considerable boost

between the XVIII and XIX centuries, when mechanical and chemical methods were introduced in many European countries (Netherlands, France, United Kingdom and Germany). In particular, in the second half of the XIX century, paper manufacturing processes based on wood biomass were developed to make the most of the large woodland available in northern regions, and they still are the most widely spread ones (paper had been previously made by using rags or different fibers such as flax and hemp, which were more common in Mediterranean climatic areas).

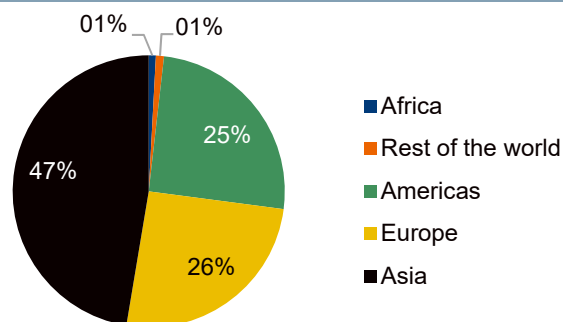
According to FAO data, world paper production in 2017 amounted to slightly more than 412 million tons, and Asian countries play an important part in it: they have been growing very fast and they alone cover nearly half of global production, followed by Europe and Americas, whose weight has been decreasing considerably.

Fig. 3.2 – World production of paper and paperboard in 1961
(% of data in metric tons)



Source: FAO

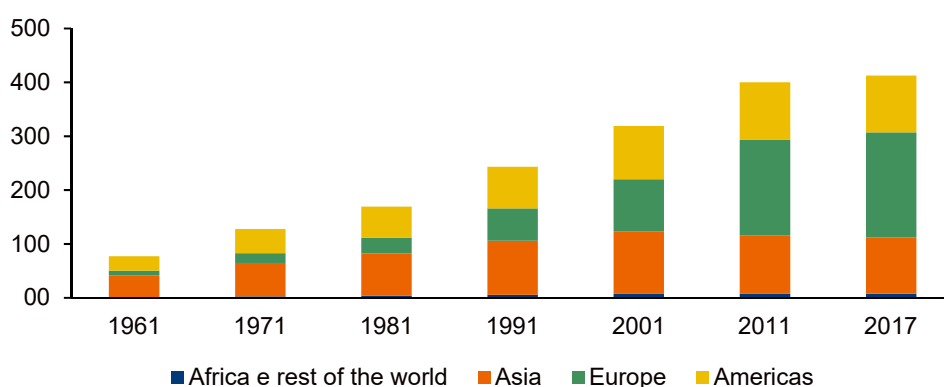
Fig. 3.3 – World production of paper and paperboard in 2017
(% of data in metric tons)



Source: FAO

The reduced weight of the American continent and the simultaneous growth of Asian countries are certainly related to the considerable shift of the focal point of global paper manufacturing towards Asia, where China has been growing as a global industrial power.

Fig.3.4 World production of paper and paper products by area (millions metric tons)



Source: FAO

In 2017, with 115 million tons, China was actually the first ranking manufacturer of paper and cardboard, with a 28% share, whereas the United States ranked second among world producers,

with 17.4% (Tab.3.1). The world ranking shows that other emerging countries (India, Brazil and Indonesia) play an increasingly important role and, at the same time, the quota of many other advanced countries has decreased. In particular, the marked reduction of the Japanese and Canadian production appears evident.

Tab.3.1. - World production of paper and paper products by country (millions of metric tons and %)				
	2001	2017	2001	2017
World	318.9	412.6	100.0	100.0
China	36.5	115.4	11.5	28.0
USA	81.2	71.8	25.5	17.4
Japan	30.7	26.5	9.6	6.4
Germany	17.9	22.9	5.6	5.6
India	4.3	15.0	1.3	3.6
Korea	9.3	11.1	2.9	2.7
Brazil	7.4	10.5	2.3	2.5
Indonesia	7.0	10.5	2.2	2.5
Finland	12.5	10.3	3.9	2.5
Sweden	10.5	10.3	3.3	2.5
Canada	19.8	9.9	6.2	2.4
Italy	8.9	9.1	2.8	2.2
Russian Federation	5.6	8.6	1.8	2.1
France	9.6	8.0	3.0	1.9
Spain	5.1	6.2	1.6	1.5

Source: FAO

Apart from the growth of emerging countries, which has also been occurring in other manufacturing industries, it should also be pointed out that the changes in the production ranking also reflect the different evolution of paper consumption in the different areas of the world.

Per capita consumption was estimated by using FAO data on production, import and export¹¹ and the data actually show a drop over the past years, mainly concentrated in America and Europe, where consumption still proves to be clearly higher than in other parts of the world. Consumption in Asia is still half the consumption in advanced countries, even though it has been growing considerably.

Tab. 3.2 – Per capita apparent consumption of paper and paperboard (kg per inhabitant)							
	1961	1971	1981	1991	2001	2011	2017
Africa	2.8	4.6	5.9	6.1	5.9	6.6	6.3
Americas	93.3	115.1	119.7	129.7	137.6	111.6	103.2
Asia	5.5	9.2	12.2	20.5	28.2	44.8	46.2
Europe	41.2	64.5	76.2	95.6	115.0	117.8	110.5
World	25.1	34.0	37.2	45.0	51.7	56.9	54.6

Source: FAO and World Bank

The data referring to individual countries confirm that paper and cardboard consumption considerably decreased in the US, from over 310 Kg per capita/year in 2001 to 213 Kg per capita in 2017. The drop is marked also in the UK, France and Japan. On the opposite hand, Germany is the only country among the oldest industrialized ones to show an increase in consumption per capita between 2001 and 2017.

¹¹ Data concerning apparent consumption must be considered as estimates close to real consumption data.

Tab. 3.3 – Paper and paperboard consumption in top consuming countries

	Millions of tons	Per capita Kg.	
	2017	2001	2017
World	410.9	51.7	54.6
China	114.2	32.9	82.4
USA	69.3	310.3	212.9
Japan	26.2	243.3	206.4
Germany	20.4	225.2	246.1
India	17.6	4.5	13.2
Italy	10.8	192.8	177.6
Mexico	9.3	51.6	72.3
Korea	9.2	159.8	178.6
Brazil	9.1	39.5	43.5
France	8.8	178.1	131.2
UK	8.7	201.3	131.3
Indonesia	6.8	22.9	25.9
Spain	6.7	158.9	144.9
Russian Federation	6.7	25.8	46.6
Poland	6.4	65.8	168.3

Source: FAO and World Bank

A detailed analysis of the different types of usage (according to the distinction provided by FAO data) is a good illustration of what occurred in the industry: between 2001 and 2017 there was a drop in the world production of paper for graphic use, concentrated in the sector of paper for magazines and newspapers, against an increase in nearly all product categories, especially, in packaging and paper for hygiene and sanitary use.

Tab. 3.4 – World production of paper and paper board (millions of tons and per capita kg.)

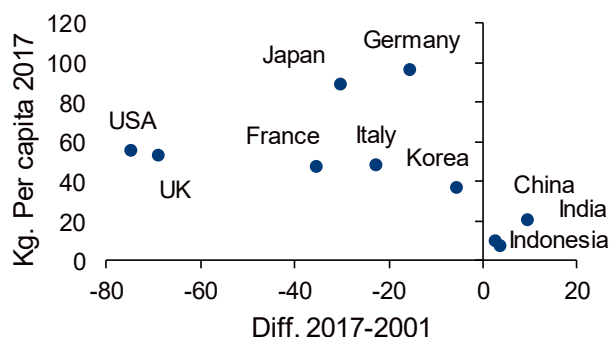
	Millions of tons		Per-capita Kg.	
	2001	2017	2001	2017
Total paper and paperboard	318.9	412.6	51.4	54.8
Paper for graphic use, among which:	132.8	121.3	21.4	16.1
<i>Paper for newspapers</i>	38.2	22.2	6.2	2.9
<i>Other paper for press and writing</i>	94.6	99.1	15.2	13.2
Paper for Hygiene and sanitary use	21.7	34.5	3.5	4.6
Paper and cardboard for packaging	148.9	240.4	24.0	31.9
Other paper	15.6	16.4	2.5	2.2

Source: FAO and World Bank

This trend stems from the process of dematerialization, that is to say the transfer of contents from paper documents to digital supports, which proves to be particularly advanced in Anglo-Saxon countries (Fig. 3.5 and 3.6).

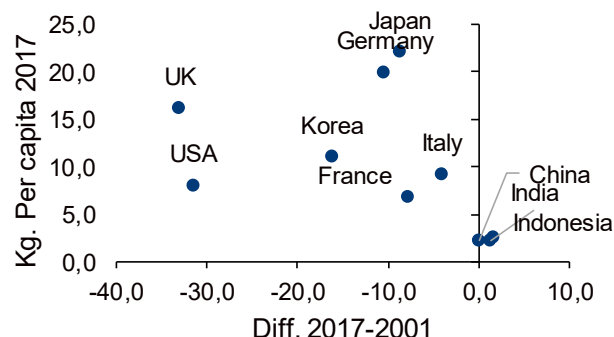
In the US and UK, the usage of paper for graphic works collapsed between 2001 and 2017. In the other advanced countries, which are the main consumers of paper for graphic purposes, this trend has also been recorded, though resulting in less critical outcomes. In emerging countries, the total amount of paper for graphic purposes has slightly grown, though it has been less evident for newspapers and magazines. However, consumption per capita is still very limited. Supposedly, these countries tend to increasingly use digital modes to spread information (from newspapers and magazines to administration or business communications), basically “skipping” paper and favouring other types of media.

Fig.3.5 – Graphic paper consumption: top 10 countries (per capita 2017 and 2001-17 difference)



Source: FAO and World Bank

Fig.3.6 – Newspaper and magazine paper consumption: top 10 countries (per capita 2017 and 2001-17 difference)

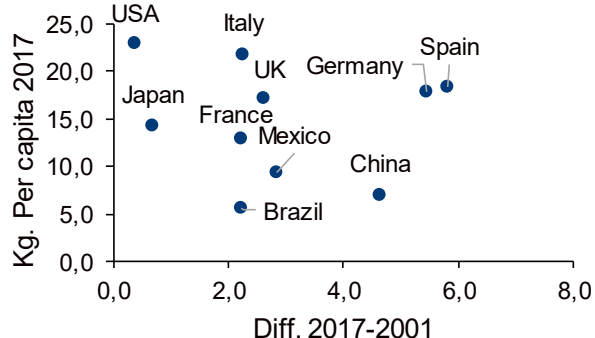


Source: FAO and World Bank

On the other extreme, different usages of paper seem to be spreading, as previously noticed for world total consumption. As for hygiene and sanitary use, the growth has occurred in all countries, Italy being one of the main consumers both in absolute terms and per capita consumption, and ranking second, right after the US.

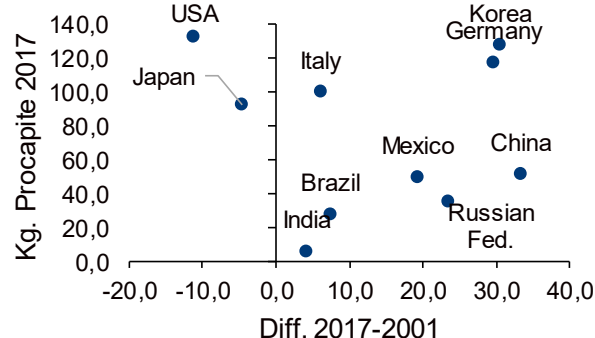
Paper used for packaging also proves to be growing. A decline in consumption per capita took place only in the USA and Japan among the main consumer countries between 2001 and 2017, though levels are still very high. On the opposite hand, a remarkable increase was recorded in Germany and Korea, which already showed very high consumption data in terms of use per capita. The usage of paper and packaging cardboard was strong and slightly growing during the surveyed period also in Italy, a country that has a strong manufacturing tradition and is considerably oriented to export.

Fig.3.7 – Hygiene and sanitary use paper consumption: top 10 countries (per capita 2017 and 2001-17 difference)



Source: FAO and World Bank

Fig.3.8 – Packagin paper consumption: top 10 countries (per capita 2017 and 2001-17 difference)

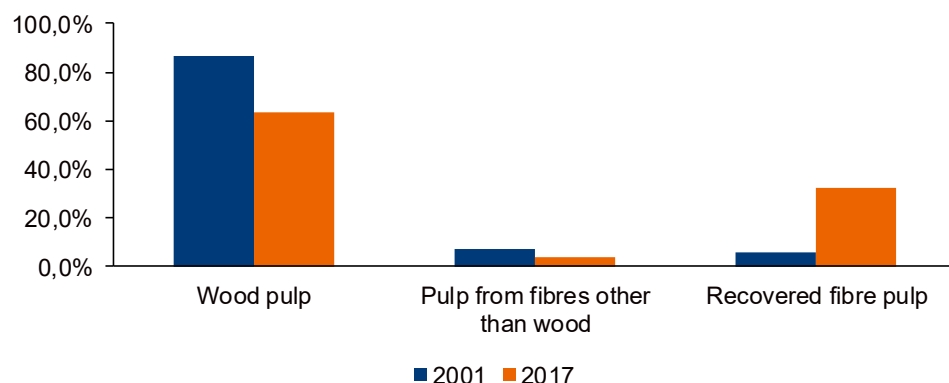


Source: FAO and World Bank

The changes in paper use (including the drop in consumption for some types of paper), as well as growing environmental awareness have also brought some variations in either the upstream phases of paper pulp production and in the downstream phases of material collection and recycling, which will be analysed more in depth in Chapter 4 of this Report.

As for the upstream phase, of note is the increasing use of pulp to be recycled that, according to estimates provided by FAO, reached approximately 30% of the total amount of paper pulp produced worldwide in 2017, and a simultaneous reduction of the quota made from wood (that however is still prevailing) and from other fibres (clearly lower).

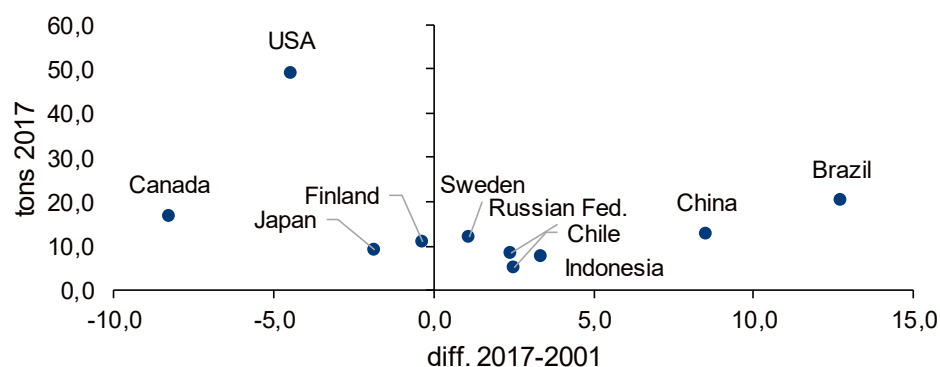
Fig. 3.9 – World pulp production by type of pulp (% on total pulp production)



Source: FAO

The production of wood-made paper pulp strongly declined in some countries between 2001 and 2017, particularly in US and above all in Canada (in the latter, this occurred at the same time as the collapse of paper and cardboard production). Production in Japan and Finland also decreased whereas it grew slightly in Sweden, though this country has lost its fourth position in the ranking. The production of wood-made paper pulp grew significantly in all emerging countries, Brazil playing a major role and becoming the second ranking world producer, right after the United States which are still the top world producer by far.

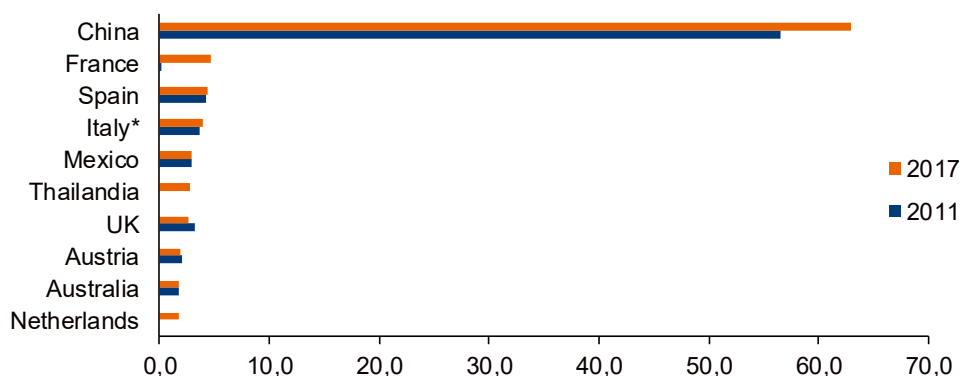
Fig.3.10 – Wood pulp production by country (tons, 2017 and 2001-2017 difference)



Source: FAO

The analysis of paper pulp from recycled materials shows that China plays a major role and covers 66%, equal to 63 tons, of the world production of paper pulp from recycled materials. A group of European countries follow – France, Spain and Italy – that are strongly focused on the upstream recovery phase (as described more in detail in Chapter 4).

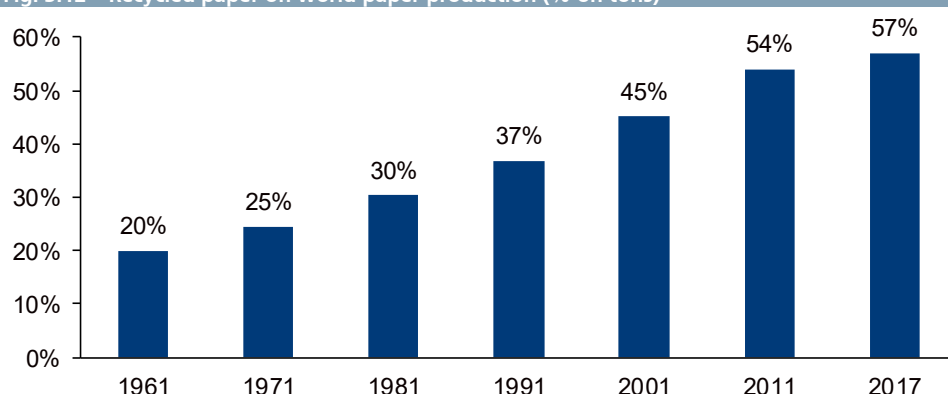
Fig.3.11 – Recovered fibre pulp production by country (tons)



* 2012 and not 2011 Source: FAO

As for the closing of the downstream cycle, related to paper waste collection and treatment, Chapter 4 includes a comprehensive analysis of the European Union and, specifically, Italy. It is however necessary to highlight that collected paper worldwide (key source for producing paper pulp from recycled materials) appears to be strongly growing based on FAO¹² data with respect to world production (proxy for consumption): tons of paper to be recycled amounted to 20% in the 60s and grew to 57% in 2017, reaching 235 million tons¹³.

Fig. 3.12 – Recycled paper on world paper production (% on tons)



Source: FAO

3.3 Paper Industry in Europe

In the EU-28, the industry of paper and paper products employs approximately 660,000 operators in 2017, in a little shy of 20,000 businesses, with a turnover amounting to over € 200 billion. These figures correspond to 2.1% and 2.5% respectively of employees and turnover of the manufacturing industry in the EU-28.

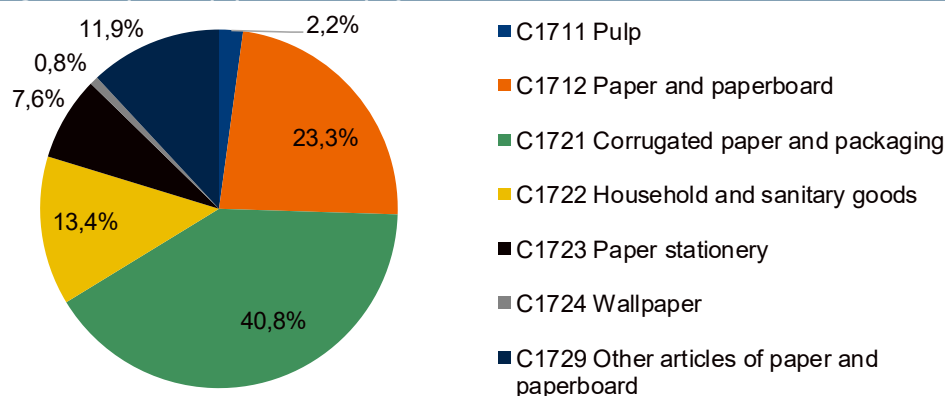
Approximately 25% of employees work in upstream phases (production of paper pulp 2.2% and paper 23.3%), which are highly capital-intensive, whereas the remaining 75% are employed in the downstream phases of paper product manufacturing, which are more labour-intensive. In particular, the production of paper and corrugated cardboard plays an important role among the

¹² FAO data on recycled paper and relating to European countries appear to be partially different from Eurostat data used in chapter 5

¹³ Paper pulp made from recycled materials was approximately 35% in 2011, growing up to 40% in 2017.

downstream sectors, corrugated cardboard alone covers about 41% of the European employees in the industry.

Fig.3.13 – Paper and paperboard employment in EU28 (% , 2016)



Source: Eurostat

In the overall industry, Italy is the second-ranking producer, right after Germany, with 72,000 employees and € 23 billion turnover.

Table 3.5 – Paper and paper products in Europe (2017)

	N.	Firms	Person employed		Turnover	
		%	N.	%	Thousands €	%
EU28	19.562	100.0%	660.000	100.0%	200.000	100.0%
Germany	1.678	8.6%	142.702	21.6%	41.650	20.8%
Italy*	3.763	19.2%	72.378	11.0%	23.099	11.5%
France**	1.343	6.9%	64.655	9.8%	21.657	10.8%
Poland	2.864	14.6%	60.641	9.2%	9.792	4.9%
UK	1.406	7.2%	56.903	8.6%	15.701	7.9%
Spain	1.661	8.5%	45.034	6.8%	13.385	6.7%
Sweden	387	2.0%	33.687	5.1%	14.807	7.4%
Finland	181	0.9%	22.246	3.4%	22.856	11.4%
Czechia	986	5.0%	21.190	3.2%	3.199	1.6%
Netherlands	359	1.8%	16.977	2.6%	7.679	3.8%

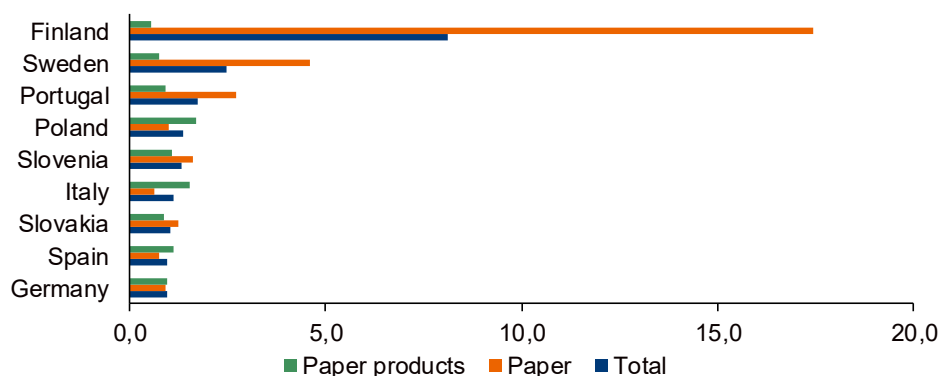
* Italy: number of firms refer to 2016. ** France: person employed refer to 2016. Countries are ordered by number of person employed Source: Eurostat

In the upstream paper processing phases (identified by Ateco code 17.1), the need for wooden raw material as well as the intensive use of water in the production process have historically favoured the development of this sector in Northern European countries (Finland, Sweden), in Continental Europe (Germany in the first place) and also in North America (Canada and United States).

The downstream production of paper products and cardboard (Ateco code 17.2), instead, proves to be closer to users (companies and consumers) and therefore spread across many countries.

In the EU-28, 10 producers are specialized in the paper and paper product industry (Pic. 3.14). Finland, Sweden, Portugal (in particular because of the cultivation of eucalyptus) and Slovakia turn out to be specialized in upstream paper processing procedures, and Scandinavian countries are particularly highly specialized in this connection. Slovenia and Poland combine their specialization in upstream phases with the important role they play in the downstream processing of paper products. Italy, Spain and Germany, on the opposite hand, are exclusively specialized in the downstream segments of paper product manufacturing.

Fig.3.14 Paper and paper products specialisation index (2016)



Source: Eurostat

Table 3.6 shows detailed data about employment in the sectors the paper industry is divided into for the different countries. Northern countries clearly dominate in the paper pulp production (over one third is concentrated in Sweden) and Germany plays a major role, dominating all other production fields except stationery paper goods (envelopes, printing and writing paper, notebooks, writing pads, etc.) where Italy ranks first with a remarkable amount of employees.

The production process includes considerable economies of scale, where energy costs are significantly high and, consequently, the industry structure has become concentrated, where large-sized companies prevail, especially in the upstream field of paper pulp and paper.

In the downstream sector of paper products, instead, small-sized businesses prevail and they often operate on a local scale and/or in specific product niches, in particular in the stationery paper goods, whereas larger companies stand out in the production of paper and cardboard packaging and paper for domestic use.

Italy is no exception and follows this trend, yet small-sized firms play a major role in this industry as well as in others: in our country, employment rate in companies having fewer than 50 employees amounts to 46% of the total for paper products and to 15.6% in the case of paper manufacturers, this lower share being due to the advantages of large-sized companies operating in the upstream phases, but clearly higher compared to the data recorded for the other main European players in this industry.

Tab. 3.6 - Paper and paper products by segment (person employed 2016)

Country	17.11	Pulp	Country	17.12	Paper and paperboard
EU28	14.068	100.0	EU28	151.406	100.0
Sweden	5.138	36.5	Germany	38.159	25.2
Germany	1.804	12.8	Sweden	19.498	12.9
Spain	1.162	8.3	Finland	17.700	11.7
France	1.113	7.9	France	14.041	9.3
Finland	972	6.9	Italy	11.828	7.8
Portugal	683	4.9	Spain	8.009	5.3
Poland	454	3.2	Poland	7.456	4.9
Norway	109	n.s.	Romania	2.263	1.5
Croatia	96	0.7	Norway	1.863	n.s.
Italy	79	0.6	Portugal	1.295	0.9
Country	17.21	Corrugated paper and packaging	Country	17.22	Household and sanitary goods
EU28	264.688	100.0	EU28	87.271	100.0
Germany	56.821	21.5	Germany	24.007	27.5
France	29.660	11.2	Italy	9.196	10.5
Poland	29.077	11.0	Poland	8.346	9.6
Italy	24.028	9.1	France	7.235	8.3
Spain	21.695	8.2	Spain	4.841	5.5
Czechia	8.733	3.3	Sweden	3.404	3.9
Hungary	8.574	3.2	Czechia	2.338	2.7
Romania	7.904	3.0	Hungary	2.205	2.5
Netherlands	7.832	3.0	Greece	2.172	2.5
Portugal	5.850	2.2	Bulgaria	2.046	2.3
Country	17.23	Paper stationery	Country	17.24	Wallpaper
EU28	49.108	100.0	EU28	5.047	100.0
Italy	18.365	37.4	Germany	2.021	40.0
Germany	6.277	12.8	Italy	556	11.0
Poland	4.525	9.2	Belgium	340	6.7
France	4.124	8.4	Sweden	263	5.2
Spain	1.983	4.0	France	179	3.5
Hungary	1.246	2.5	Poland	176	3.5
Romania	966	2.0	Spain	62	1.2
Portugal	792	1.6	Bulgaria	53	1.1
Greece	614	1.3	Hungary	9	0.2
Bulgaria	503	1.0	Norway	7	n.s.
Country	17.29	Other articles of paper and paperboard			
UE28	77.483	100.0			
Germania	14.932	19.3			
Francia	8.302	10.7			
Polonia	8.047	10.4			
Italia	7.170	9.3			
Spagna	5.387	7.0			
Rep.Ceca	3.884	5.0			
Paesi Bassi	2.792	3.6			
Austria	2.596	3.4			
Ungheria	1.878	2.4			
Danimarca	1.508	1.9			

Source: Eurostat

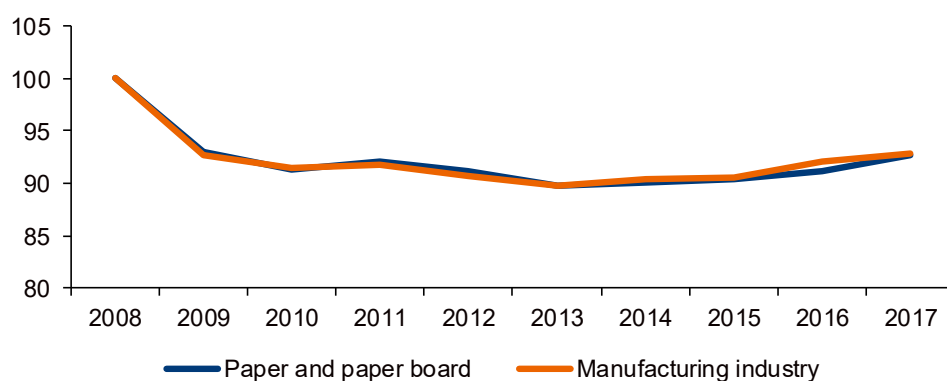
Tab. 3.7 Person employed in the paper and paper products industry by employment size class (% , 2016)

Paper and paper products	0-9	10-19	20-49	50-249	>250	Totale
Germany	1.7	2.0	5.8	33.5	57.0	100
Italy	11.5	12.5	16.8	30.4	28.8	100
France	3.8	5.5	12.8	38.6	39.4	100
Poland	10.6	3.6	9.8	38.8	37.2	100
UK	3.9	4.4	11.6	36.1	44.1	100
Spain	7.4	7.9	16.0	38.5	30.2	100
Paper	0-9	10-19	20-49	50-249	>250	Totale
Germany	1.2	1.0	2.1	26.8	68.9	100
Sweden	0.4	0.7	2.1	10.3	86.5	100
Finland	0.3	0.4	0.8	10.2	88.4	100
France	1.0	0.9	3.4	35.3	59.4	100
Italy	2.0	2.7	10.8	22.6	61.8	100
Spain	3.4	2.3	8.2	35.8	50.3	100
Paper products	0-9	10-19	20-49	50-249	>250	Totale
Germany	1.9	2.3	7.3	36.1	52.4	100
Italy	13.4	14.5	18.0	32.0	22.1	100
Poland	11.6	3.9	10.6	41.1	32.8	100
France	4.6	6.9	15.7	39.6	33.2	100
Spain	8.5	9.4	18.1	39.2	24.8	100
Netherlands	3.2	4.0	10.2	58.5	24.1	100

Fonte: elaborazioni Intesa Sanpaolo su dati Eurostat

Apart from the structure-related aspects described in the previous paragraph, the paper industry in Europe has witnessed some relevant changes over the last years that can be related to the evolution towards dematerialization, as described in the previous paragraph, on the one side, and to the growing use of paper made from recycled materials, on the other.

Fig. 3.15 – Paper and paper products and manufacturing industry employment (2008=100)



Source: Eurostat

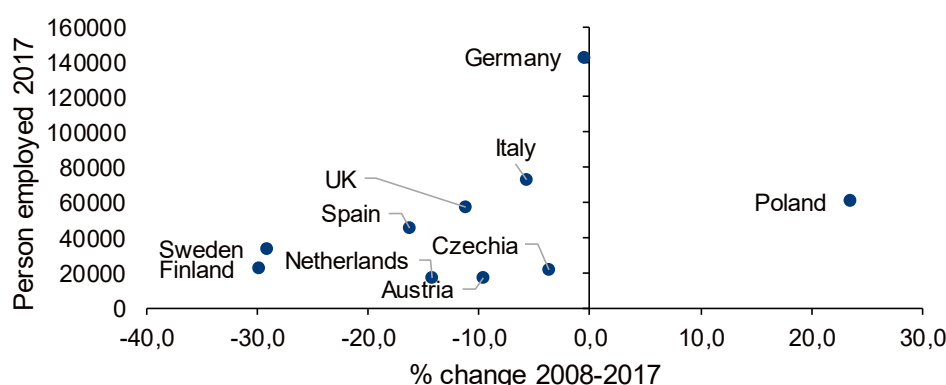
In the EU-27¹⁴ overall, the rate of operators in the paper industry collapsed in 2009 (similarly to what occurred in all manufacturing industries) and recovered later on, though the employment rate was lower than in 2008 by approximately 7%.

This trend basically corresponds to what has taken place in the manufacturing industry in general, and shows some relevant differences among sectors as well as among different countries.

¹⁴ The EU-27 aggregate for years following 2014 has been calculated by extracting data referring to Croatia.

In particular, if we consider the main players, the positive trend in employment in Poland stands out; this country ranks third in Europe due to 23.5% growth between 2008 and 2017, equal to 11,500 employees.

Fig.3.16 – Person employed in the paper and paper products industry (level and 2008-17 % change)

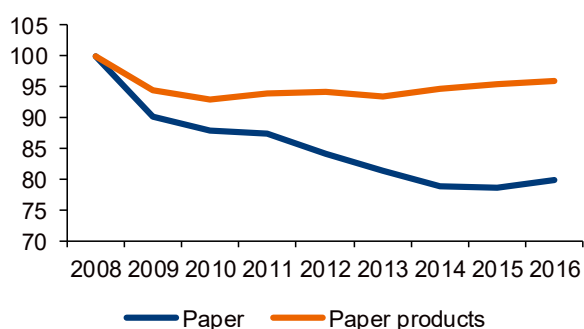


Source: Eurostat

The employment in this industry instead strongly decreased in Scandinavian countries, showing negative variations of approximately 30% and employee numbers dropping by over 13,000 units in Sweden and 9,500 in Finland.

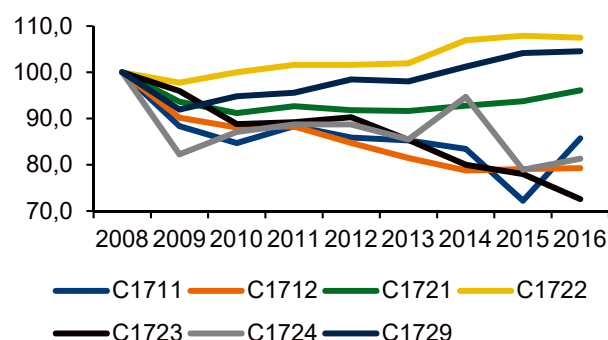
The sizeable reduction of employees in Northern Europe countries mirrors the contraction occurred between 2008 and 2016 (last year disaggregated data are available for), in the upstream segments of pulp and paper production, where the number of employees decreased by approximately 20%, and reduction was more evident in the case of actual paper production.

Fig. 3.17 – Evolution of person employed in the paper and paper products industry (2008=100)



Source: Eurostat

Fig. 3.18 – Evolution of person employed in the paper and paper products industry by segment (2008=100).



Source: Eurostat

A decline in employment between 2008 and 2016 can also be reported relating to some downstream sectors: in the EU-27 scenario, the 30% collapse in employees in stationery paper products should be highlighted (Ateco code 17.23) as well as the 18% reduction in wall paper (Ateco code 17.24). On the other hand, of note is the rise in employees (7.5% in 2008-2016) in the field of paper products for domestic and sanitary use (Ateco code 17.22), favored by the growing use of disposable paper products.

The analysis of the main players (detailed data available relating to 2008 and 2016) shows that the remarkable increase in Poland is spread among all types of production, except stationery paper

goods (17.23), which is a field showing a drop in all main countries. Decrease in Sweden is particularly high in the sector of packaging products (17.21, with a marked reduction of 8,800 employees) and paper (17.12, with a negative difference amounting to 4,500 workers); again in the field of paper, there has been a remarkable drop in Finland (- 8,200 workers) and in the Netherlands (- 4,600 workers). The growth in employees working in the field of hygiene paper products, recorded in the EU-27, instead, mainly derives from the improvement recorded in Germany (5,300 additional employees between 2008 and 2016), in a widely positive scenario, with the exception of Spain, where the employment rate in the industry declined in all sectors.

Tab. 3.8 – Person employed in the paper and paper products industry by segment (difference 2008-2016)

	C1711	C1712	C1721	C1722	C1723	C1724	C1729
	Pulp	Paper and paperboard	Corrugated paper and packaging	Household and sanitary goods	Paper stationery	Wallpaper	Other articles of paper and paperboard
Germany	-153	-1289	799	5398	-2456	-611	-1163
Italy	-267	-2774	-1346	620	-1256	40	-564
Poland	186	1101	4187	535	-1893	2	4857
Spain	-653	-3686	-1310	-1085	-2769	-25	-1110
Sweden	286	-4516	-8825	-404	-312	17	220
Finland	-681	-8258	-604	150	0	0	-30
Netherlands	-81	-4676	-520	48	0	0	-794
Romania	-1	-1045	760	-273	-423	6	-164
Hungary	-126	-687	2982	66	-353	-15	-44
Portugal	-865	-440	593	-96	-422	0	40

Source: Eurostat

As far as Italy is concerned, a downswing is worth emphasizing in the employment rate in the paper processing sector (-2,700 operators), packaging (-1,300 operators) and stationery paper products (-1,200), where our country seems however to perform better than other competitors because it is highly specialized and a top producer. Italy also achieves positive results in terms of employment in the field of hygiene and sanitary paper products, where it holds an excellent competitive position (see also the in-depth analysis of the Paper Manufacturing District in Lucca).

3.4 Internationalization of the Paper Industry

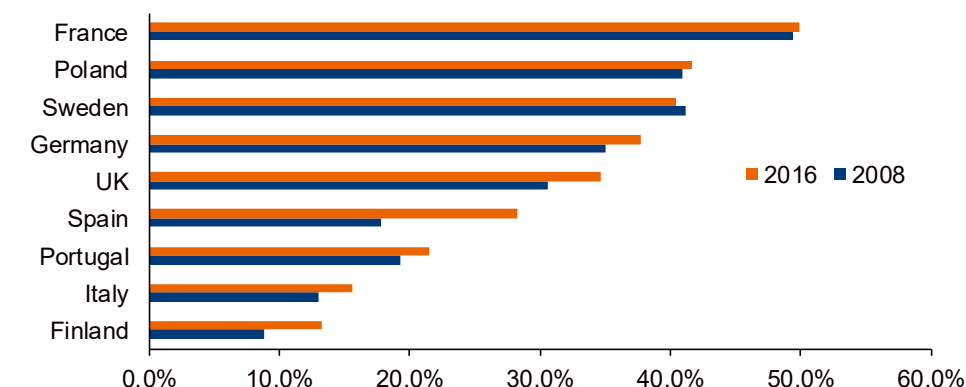
As previously described, the paper industry is strongly characterized by companies working on a local level, in particular for downstream processing phases, also because transporting this material is not cost-effective.

Internationalization is being developed particularly through large-sized companies that set up production sites abroad to supply local markets.

Eurostat data on incoming Foreign Direct Investments (FDI), relating specifically to the industry of paper and paper products in the European countries show that production has been strongly internationalized, in particular in France, where half of employees in the paper industry worked in foreign subsidiaries in 2016 and in Poland (42%), where the paper industry has gone through a period of remarkable development over the past years. High employment rates can be observed in foreign-owned multinational enterprises also in Sweden (40% in 2016) and in Germany (38% approximately).

The Italian rate appears to be starkly lower (16%), which further confirms that our country is relatively closed, also in other industries, and, at the same time, it highlights that this type of manufacturing is significantly rooted in our country.

Fig. 3.19 – Inward foreign direct investments in the paper and paper products industry (% of person employed in foreign controlled firms on total employment)

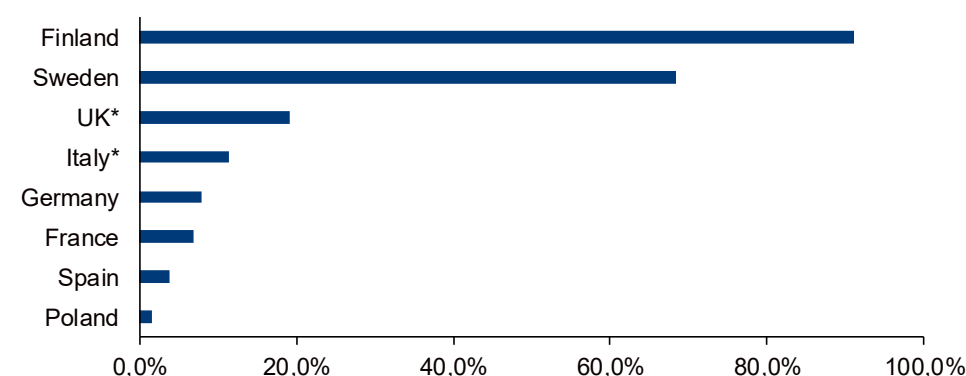


Source: Eurostat

Data relating to outward Foreign Direct Investments specifically in the paper industry, instead, are available only for a few countries: the analysis of the aggregate data including paper and print industries (Ateco code from 16 to 18) confirm however the international trend also for outward investments, in particular in Finland and Sweden.

Italy is strongly oriented to internationalization, slightly more than Germany and France (where the overall level of internationalization of the whole manufacturing industry is clearly higher than in our country). Italian companies actually have been setting up production sites abroad over the years, to strengthen their capability to serve markets (see some examples in the in-depth analysis on the Paper Manufacturing District located in Lucca).

Fig. 3.20 – Person employed in outward foreign controlled firms on total national employment (% , 2016)

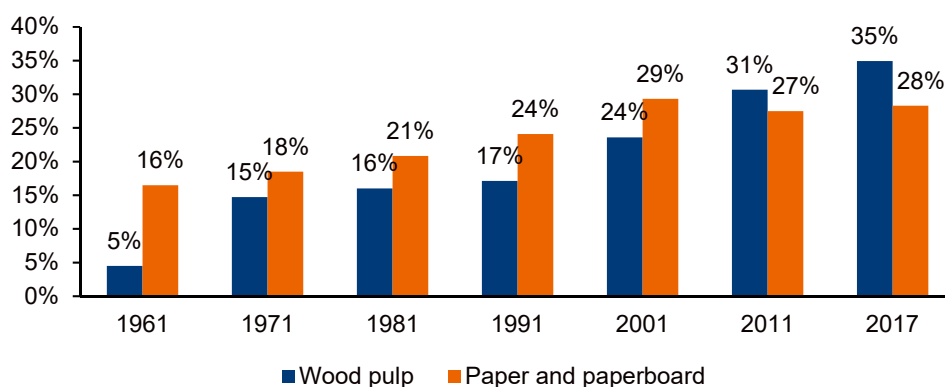


Source: Eurostat

Besides creating production sites in foreign countries, the paper industry has also seen trade becoming increasingly international over the past years.

Quantity data from the FAO database show that worldwide export shares of total production reached 35% for wood pulp (production concentrated in a few countries) and 28% for paper and cardboard in 2017.

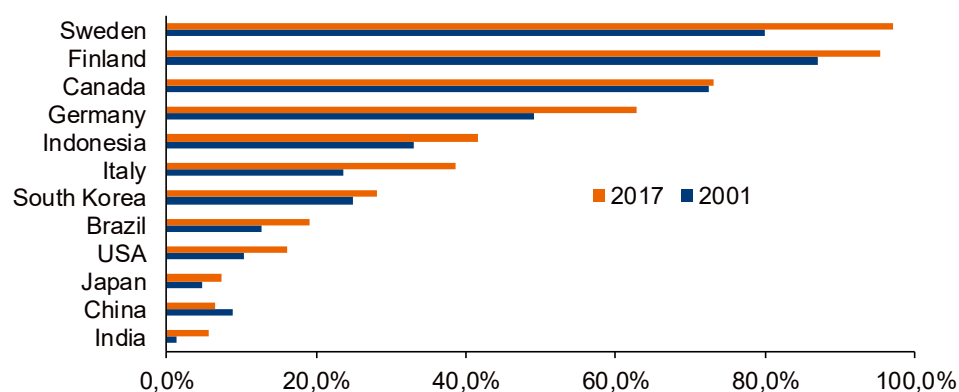
Fig. 3.21 - Export share on total world production (% on tons)



Source:FAO

The analysis of the main paper and cardboard manufacturers highlights that European countries have become more oriented to export than others, which is already more evident with respect to other sectors. In the case of new emerging manufacturing countries, such as China and India, the marked growth in paper and cardboard production recorded over the past years seems to be mainly aimed at meeting the increased domestic needs stemming from the intense industrialization process. Brazil and Indonesia are an exception in this connection, since they have shown to be considerably more oriented to export, thus taking the share of exports of national products to high levels.

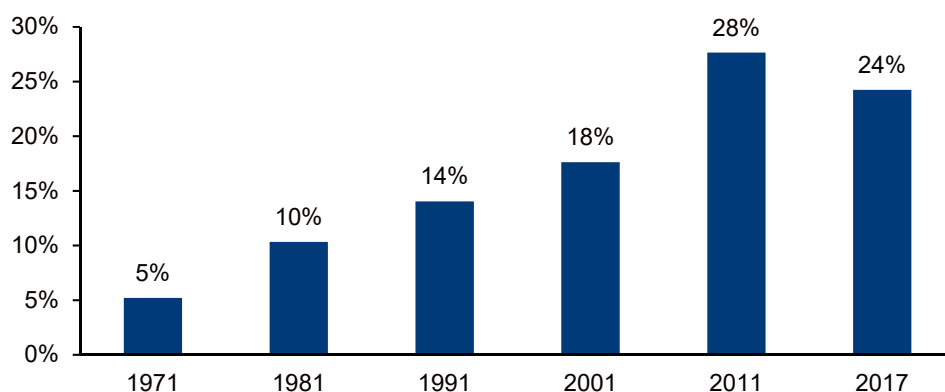
Fig.3.22 – Export share in the paper industry by country (export on production % on tons)



Source:FAO

The level of internationalization that recycled paper has achieved is also impressive: the worldwide share of export of recycled paper on total recovered paper reached almost 30% in 2011, then settling at around 24%, always according to FAO database. In other words, approximately one ton out of four of recycled paper worldwide is marketed on foreign markets.

Fig. 3.23 – Export share in the recycled paper segment (% on tons)



Source: FAO

3.5 Conclusions

The paper industry has gone through a transformation phase over the past years: dematerialization of contents has brought about a considerable drop in paper consumption, most of all in the sector of graphic paper, in particular in Anglo-Saxon countries. There has been at the same time a growth in paper consumption worldwide, deriving both from the industrialization of emerging countries and the increased use of paper for purposes other than printing and graphics (from packaging to the greater use of paper for domestic and sanitary purposes).

Increased environmental awareness and the search for new raw material sources have boosted the use of inputs having a more and more certified origin and, above all, the strong growth of paper recycling, where virgin wood pulp loses ground to the pulp deriving from paper recycling among the sources (see Chapter 4 for in-depth studies).

Internationalization has also expanded, both through Foreign Direct Investments, a traditional way to open new markets in this industry, and through import and export flows, with a growing trend to supply foreign markets also in the closing phase of the cycle.

In this scenario, Europe has carved out an important position because of the traditional role played by some countries in Northern Europe which are rich in raw materials (Germany, Sweden, Finland), and also for the development of new production platforms, such as Poland.

This confirms and strengthens the traditional part played by Italy: even though it lacks raw materials, it ranks among the top European producers, especially for graphic paper and paper for hygiene and sanitary purposes. As the case of the Lucca Paper Manufacturing District highlights, these achievements depend on the strong specialization of some players that have cut out an important position in the worldwide paper industry by focusing on technological innovation and on the partnership with a competitive mechanical sector dealing with paper.

The challenges facing this industry relate to the ability to operate in increasingly complex scenarios requiring a growing capability to innovate and guarantee increasing sustainability. Some key themes for growth and develop concern:

- controlling and managing high energy consumption;
- automatizing control, process and maintenance systems to minimize inefficiency in production set-ups;
- systems for recycling waste from paper mills.

The challenging targets when contrasting climate change have involved the European paper industry with Roadmap 2050 on the modes to achieve them. Paper mills are also part of this process, which will require the use of new technologies, combined with access to energy with more competitive costs than current ones. Natural gas will continue playing a key role, as it is presently the best solution in terms of emission reduction because of the use of high efficiency cogeneration, but it will be possible to integrate energy needs by using renewable sources embedded in the paper production process. This topic was debated and discussed also during the latest edition of MIAC (Mostra Internazionale dell'Industria Cartaria, International Paper Industry Exhibition) aimed at identifying energy efficiency measures and supporting the role of renewable energy sources in reducing direct and indirect emissions.¹⁵ The tissue industry, one of the most important specializations in our country, is on the forefront in developing innovations that have an impact on several production-related aspects, such as reducing time-to-market, increasing flexibility, and improving product quality and efficient source use.

Cardboard box and packaging manufacturing factories are also showing a growing trend to more sustainable production that is aware of its impact on the environment: this trend has been identified in the yearly survey carried out by Associazione Italiana Scatolifici (Associazione CIS)¹⁶. According to data collected in March 2018, the percentage of companies holding the FSC Forest Stewardship Council or PEFC Program of Endorsement of Forest Certifications is clearly growing, involving more than one third of members (36%; +15% than in 2017). The number of ISO 14001 certified companies is also increasing (12%, compared to 8% in 2017). In addition to this, also from the viewpoint of continuing to make investments with this goal, one company out of three stated that it was planning to add further environmental protection certifications during 2018.

Care for the environment and for the raw materials used as well as the considerable potential of circular economy characterize the paper industry in Italy, featuring competitive and specialized operators that have the ability to innovate: this makes it a key player in the bio-economy of our country.

Paper District of Lucca

The area encompassing the eastern part of the province of Lucca and the neighboring province of Pistoia is characterized by a high specialization in paper product manufacturing¹⁷: the areas of Media Valle and Garfagnana, crossed by the river Serchio, and the Southern area featuring a broad plain, the Piana Lucchese (alluvial plain extending to Valdinievole) shows an extensive number of paper and paper product manufacturers (Fig. 1-3).

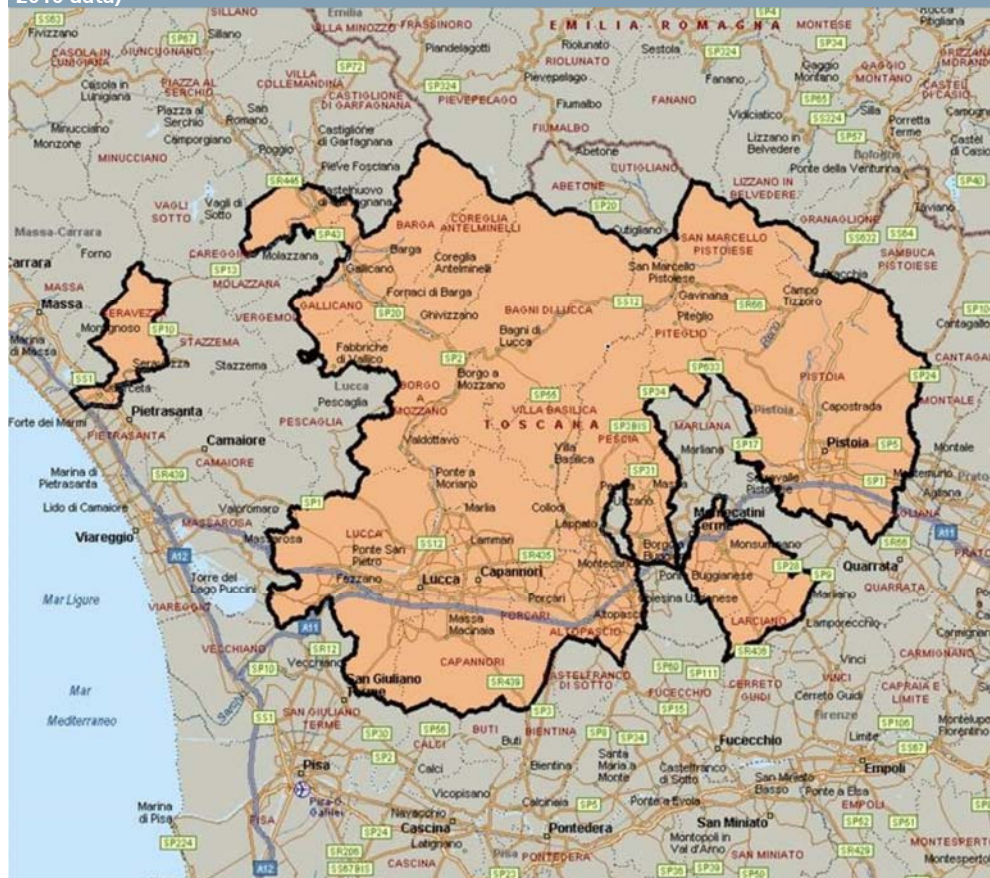
By Sara Giusti

¹⁵ The Cartiera dell'Adda Paper Mill was presented as an example during the Exhibition: it first installed a cogeneration system, which could not meet the total need for steam, then it also installed a new biomass system that uses materials to be disposed of, coming from the clean-up of woods and city green areas, thus generating a virtuous circle in the area.

¹⁶ CIS Association represents companies operating in Italy that process and transform corrugated cardboard into packaging for any type of market as their main business; it includes about a hundred companies operating in this industry in Italy and employing approximately 2,000 workers.

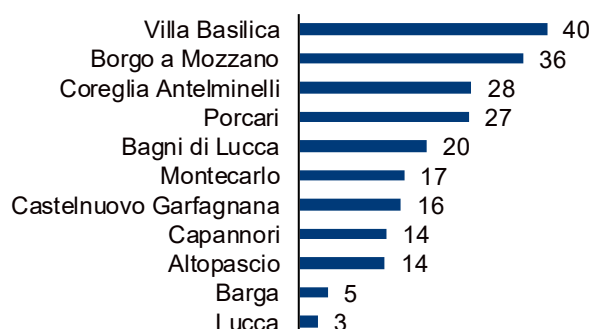
¹⁷ The assessment of the specialization level is based on an index comparing at local level (province, municipality) the incidence of operators for the selected Ateco activity on the total manufacturing, and the same calculation at national level. An index exceeding 1 means that the area is specialized. The formula is the following: (Persons employed Ateco X/Persons employed Manufacturing)Municipality/(Persons employed Ateco X/Persons employed Manufacturing)IT.

Fig. 1 – Major highly specialized municipalities in paper products (specialization index based on 2016 data)



Note: municipalities have been highlighted with a specialization index in Ateco 17 "Manufacturing of paper and paper products" higher than 1. Source: Intesa Sanpaolo processing based on Istat data

Fig. 2 – Municipalities in the province of Lucca with the highest specialization in paper production: specialization index (2016)



Note: municipalities with at least 30 persons employed in 2016. Source: Intesa Sanpaolo estimates based on Istat data

Fig. 3 – Municipalities in the province of Pistoia with the highest specialization in paper production: specialization index (2016)

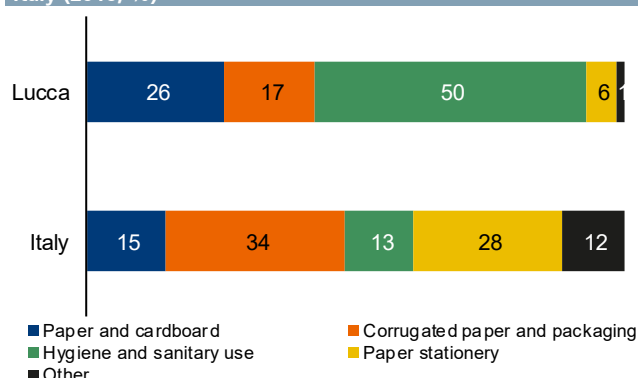


Note: municipalities with at least 30 persons employed in 2016. Source: Intesa Sanpaolo estimates based on Istat data

The province of Lucca stands out for the highest number of employees in this sector: in 2016 of the over 71,500 employees working in the industry all over Italy, 9.1% were in this area (6,511 employees) with over 150 local units. From the viewpoint of specialization in the different sectors, the province of Lucca is characterized by a stronger concentration of operators in paper and

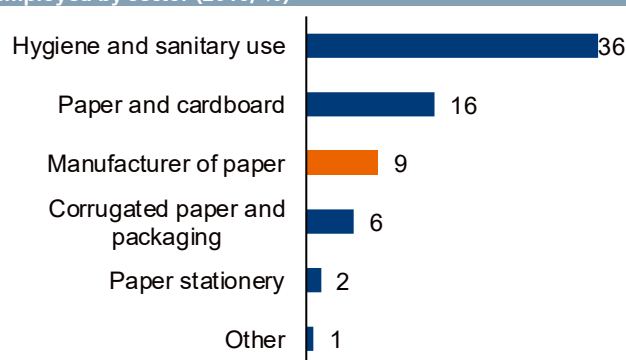
cardboard manufacturing (Ateco 17.12) and products for hygiene and sanitary purposes (Ateco 17.22) which together account for over three quarters of the labor force of the industry (Fig. 4). The province of Lucca has a relevant weight in the most specialized sectors on a national level: in the sector of tissue for hygiene and sanitary purposes, more than one employee out of 3 operates in this area (36%), whereas for paper and cardboard production, 16% of employees in Italy work in Lucca (Fig. 5).

Fig. 4 – Persons employed by sector: composition of Lucca and Italy (2016; %)



Note: "Other" includes manufacture of pulp (17.11), other article of paper and cardboard (17.29) and manufacture of wallpaper (17.24). Source: Intesa Sanpaolo estimates based on Istat data

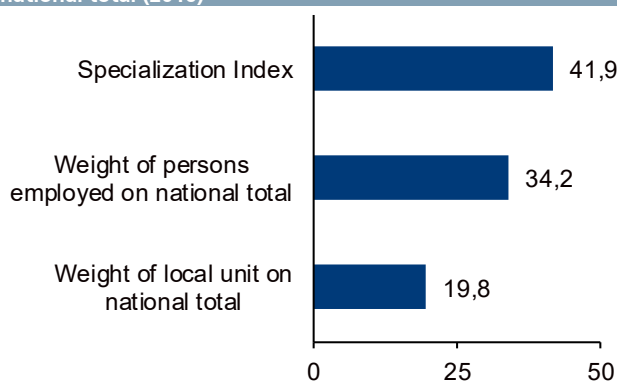
Fig. 5 – The weight of the district of Lucca in term of persons employed by sector (2016; %)



Source: Intesa Sanpaolo estimates based on Istat data

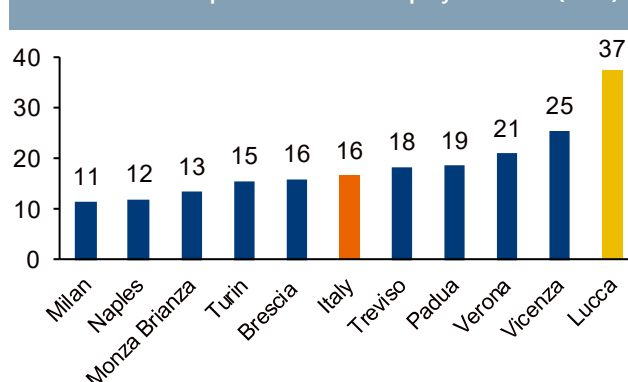
These statistics allow for a better definition of the types of processing that are performed: the district is particularly characterized by the segment of paper for sanitary use (tissue paper). It produces 900,000 tons per year, representing approximately 80% of domestic production and 17% of European production, whereas 1 million tons of paper for corrugating machines covers up to 40% of corrugated cardboard domestic production and 5% of the related European production.

Fig. 6 – Machinery for paper industry in the district of Lucca: specialization index, weight of local units and operators on the national total (2016)



Source: Intesa Sanpaolo estimates based on Istat data

Fig. 7 – The paper processing sector supply chain: operators per local units in the top 10 districts for employment rate (2016)



Note: the ratio is calculated by employees and local units of the Ateco code 17 "manufacturing of paper and paper products" and Ateco 28.95 "manufacturing of machinery for paper and cardboard production" Source: Intesa Sanpaolo estimates based on Istat data

The integrated production chain is another characteristic of this district, especially for the supply of machinery and equipment: 79 local units operate in the province of Lucca, specialized in manufacturing machinery for the paper and cardboard industry and employing approximately 2,300 workers. In relation to the Italian data, one mechanical firm in the paper industry out of 5 is based in Lucca and more than one employee out of 3 works in this area with a specialization

index equal to 42 (Fig. 6). These figures emphasize another aspect that relates to the average size of local manufacturing units, which is higher than that of the main Italian provinces in this sector. The average number of operators per unit is 37, more than double compared to the Italian average of 16 (Fig. 7).

This district is also going through an important internationalization process, which is being implemented in two ways: on the one side, district-based companies show a strong tendency to enter foreign markets by exporting their products and by being strategically present in foreign countries, delocalizing production and marketing to other countries; on the other, the local industry has attracted investments from important foreign organizations that have gradually based their operations in the Lucca plain. About Foreign Direct Investments, ten district-based companies hold shares in 40 companies in foreign countries (controlling interest, minority and equal shareholding), where France is the first destination (6 investments), followed by the United States, Germany (both with 5 investments) and China, Brazil, Spain and Hungary (with 3 investments each). This trend must also be assessed by considering the high incidence of transportation costs which affect the export of large volume, low unit-value products. One of the latest investments was made by the Sofidel group that set up a plant in Circleville (Ohio), investing approximately 500 million euro: it is a newly-built facility that the Lucca-based (100% Italian owned) company built about 2 years ago aiming at a 4.0 type of plant to manufacture toilet paper and kitchen paper, and hiring 300 people. It is important to emphasize how the integration of machinery and technology in the plant meets the logics of supply chain and proximity: the main suppliers for this important investment were locally based firms such as Fabio Perini and ACelli, located in the Tuscany district. In addition to strengthening Sofidel's visibility and recognition, this collaboration will also enable the mechanical companies in the paper industry to gain greater reliability in the eyes of US producers willing to upgrade their plants. This project is part of a broader process aiming at positioning the Sofidel group among the top three US producers of tissue paper products specialized in private label products, also by setting up other plants that are being built in Oklahoma (360 million-dollar investment) and possibly taking over businesses in the North West of the United States¹⁸.

The foreign companies that invested in the Lucca district generated a turnover of approximately 1.4 billion in 2017, with over 2,880 employees, which increased respectively by 8.8% and 69 units in the 2015-2017 period. They mainly carried out takeovers, yet two greenfield investments were made by DS Smith in Porcari (named DS Smith Paper Italy) and Körber AG in Lucca (named Engraving Solutions Srl). The DS Smith plant in Porcari has been recently enlarged and its technological equipment has been upgraded aiming to start the production of a new generation of 100% recycled packaging paper, having a grammage 30% lower than other paper available on the market, but offering the same strength. According to the company's statements, the paper produced using the new system makes it possible to create cardboard boxes with the same characteristics of those produced before but with an amount of fibers by square meter reduced by 30%, energy by 12%, water by 20% and CO₂ emissions by 58%¹⁹ (Tab.1).

¹⁸ Source: Il Sole 24 Ore, 24th October 2018

¹⁹ Source: il Sole 24 Ore, 5th July 2017.

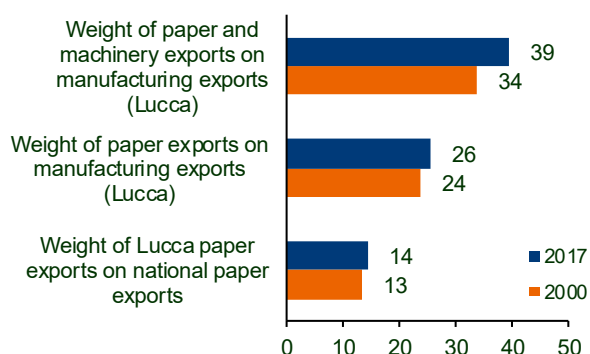
Tab. 1 – Direct foreign investment in the area: main companies with a foreign control (2017)

Name	Group	Country	IDE Year	Turnover 2017 (mln €)	Turnover 2015 (mln €)	Turnover var. %	Operators 2017	Operators 2015	Var. operators
Essity Italia S.p.A.	Essity AB	Sweden	2001	493	482	+2.3	841	825	+16
Fabio Perini S.p.A.	Körber AG	Germany	1993	214	165	+29.6	615	598	+17
DS Smith Paper Italia Srl	DS Smith PLC	UK	2013	175	174	+0.5	193	193	0
Wepa Italia Srl	Pamplona Capital Management LLP	UK	2008	170	167	+1.6	506	489	+17
Fosber S.p.A.	Dong Fang Precision Science	China	2013	112	93	+20.8	269	272	-3
Toscana Ondulati	DS Smith PLC	UK	1996	92	84	+9.0	232	224	+8
Paper Converting Machine Italia S.p.A.	Barry-Wehmiller Group INC	USA	1999	53	38	+38.0	112	111	+1
M.T.C. Macchine	Körber AG	Germany	2017	22	19	+18.6	59	53	+6
Trasformazione Carta S.p.A.	Groupe Paredes S.A.	France	2004	13	12	+15.2	19	20	-1
Panadaye Mapedo S.p.A.	Körber AG	Germany	2002	5	6	-4.9	17	15	+2
Engraving Solutions Srl	M. Torres Diseños Industriales S.A.	Spain	2017	5	5	-6.0	20	14	+6
Total				1.353	1.244	+8.8	2.883	2.814	+69

Note: companies are listed in descending order based on 2017 turnover; only companies where shareholding is equal to control are listed.
Source: Intesa Sanpaolo estimates based on Reprint-ICE data

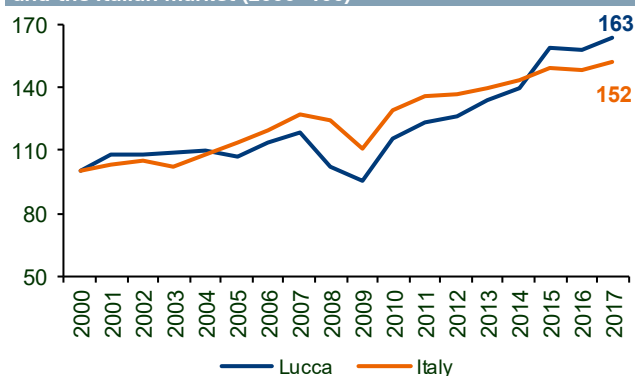
The companies located in this district have increasingly strengthened their capability to sell their products abroad over the past years: the export rate of the district (manufacture of paper and machinery for paper production) amounts to 39% of sales in the Lucca manufacturing industry to foreign countries and increased by 5% with respect to 2000. When comparing this data with national figures, the Lucca paper industry also shows it has increased its impact on the Italian export in this sector, rising from 13% in 2000 to 14% in 2017 (Fig. 8). Such increased weight on the export of Italian paper products is clear when analyzing the trend of exports: exports in the province of Lucca have grown overall by 63% compared to 2000, whereas total Italian exports have increased by 52%, with a 10% higher gap (Fig. 9).

Fig. 8 – Weight of the district exports on the Lucca manufacturing sector and on the national paper sector (%)



Source: Intesa Sanpaolo estimates based on Istat data

Fig. 9 – Exports trend of paper products for the district of Lucca and the Italian market (2000=100)

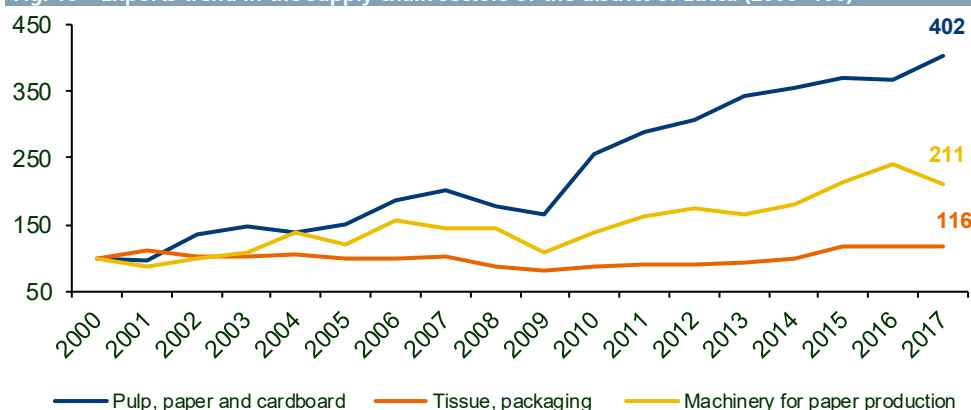


Source: Intesa Sanpaolo estimates based on Istat data

When analyzing the components of the Lucca district in detail, we can see that sales of paper products to foreign countries have significantly improved, more than tripling compared to 2000 (from 97 million to 393 million), whereas tissue and packaging products have remained quite stable, even though they had already reached 500 million in 2000. It is important to emphasize that the paper mill equipment sector has recorded a strong development compared to 2000 since

sales to foreign countries have more than doubled (+111%, from 249 million to 525 million) and they currently amount to 35% of the district export (Fig. 10).

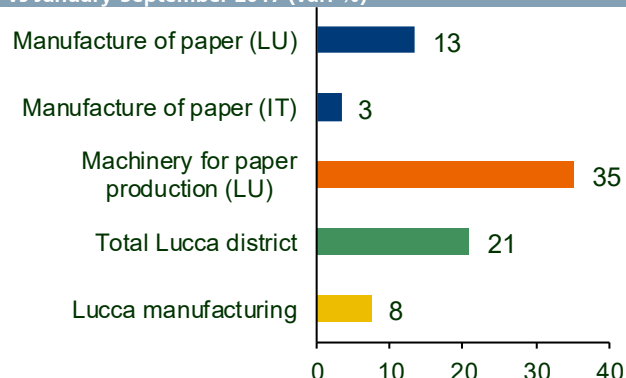
Fig. 10 – Exports trend in the supply chain sectors of the district of Lucca (2000=100)



Source: Intesa Sanpaolo estimates based on Istat data

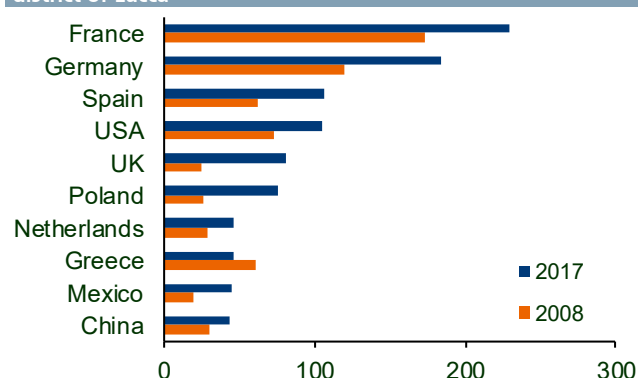
Exports of the entire Lucca district showed a positive trend in 2018 too, due to an overall 21% growth between the first nine months of 2018 and the corresponding period in 2017. This trend was supported by the good performance of foreign sales of machinery for paper production which achieved a 35% growth rate; the paper product component has also grown individually by 13%, 10% more than the sector on a national level and better than the result achieved by the manufacturing sector, +8% (if we exclude the sectors of paper industry and machinery for paper production, the export of the province would have been essentially stable: -0.5%) (Fig. 11). If we set up the analysis by comparing the period before the crisis, there is a general growth in exports in all markets with respect to 2008: in 2017 exports reached approximately € 1.5 billion, exceeding the 2008 result by over 500 million, which amounted to € 967 million. If we focus on target countries, a generalized growth can be reported in all markets, except only Greece where there was an approximately 24% drop, related to the tissue and packaging segments. The first reference market is still France with € 229 million, even though the most marked growth in absolute value occurred in Germany, with an increase of over 64 million (Fig. 12).

Fig. 11 – Exports trend in the period January-September 2018 vs January-September 2017 (var. %)



Source: Intesa Sanpaolo estimates based on Istat data

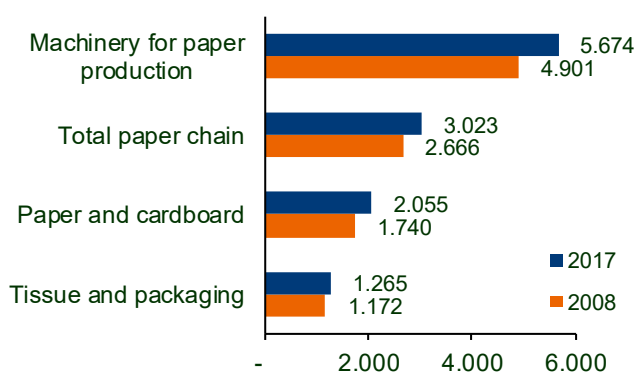
Fig. 12 - Main destination countries for the exports in the district of Lucca



Source: Intesa Sanpaolo estimates based on Istat data

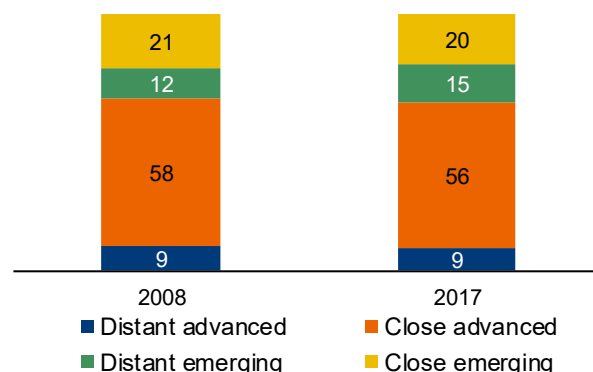
A further in-depth analysis of the foreign trade of products of the Lucca paper district concerns the average shipping distance²⁰: over the past 10 years the distance covered by the products shipped from the district have increased by over 350 kilometers, rising from 2,666 kilometers to 3,023 kilometers. The shipping of paper industry equipment covers the longest distances with over 5,600 kilometers in 2017 (+773 kilometers; +16%), whereas the segment of tissue and packaging products is characterized by a smaller operating range in sales to foreign countries, with 1,265 kilometers in 2017 (+93 kilometers; +8%) (Fig. 13). The outcome of this analysis can be interpreted in the light of the evolution of the weight of exports to emerging countries (and distinguishing close emerging countries from distant ones) as well as the importance of close and distant advanced countries. It is interesting to notice how the increase of average distances of exports is connected to the growing weight of sales to distant emerging countries, which have increased their weight on total sales by 3%, growing from 12% to 15%, in counter-trend with respect to the incidence of close advanced countries (from 58% to 56%; -2%) and close emerging countries (from 21% to 20%; -1%). The weight of sales to distant advanced countries has remained stable, which continue to account for 9% of exports with growth mainly in exports to North America (+49%) (Fig. 14). This analysis allows for a more detailed reading of the flow of exports and points out that managing foreign markets has become progressively more complex since they are located in increasingly distant areas and that exporting companies need to develop better structured organizations.

Fig. 13 - Average distance of exports in the Lucca paper chain sectors (Km)



Source: Intesa Sanpaolo estimates based on Istat data

Fig. 14 – The composition of exports by destination country (%)



Source: Intesa Sanpaolo estimates based on Istat data

The district identified by Intesa Sanpaolo's monitoring activity is based on the selection of 98 companies²¹ operating in the sector of paper products and machinery for paper industry; in 2017 these businesses achieved € 4.3 billion turnover and employed 8,669 operators²² (Tab. 2). The analysis presented below aims at monitoring the performance of the district companies in terms of operating results and financial position, focusing on size class²³ and the different strategies implemented (certifications, trademarks, patents).

²⁰ Distance used corresponds to kilometers between Florence and the capital of the country products are shipped to.

²¹ Source: Intesa Sanpaolo Integrated Database (ISID). The surveyed companies have financial statements available for the last three years. 2015-2017, 2015 turnover threshold higher than 400,000 Euros, 2016 and 2017 turnover higher than 150,000 Euros

²² Source: Inps.

²³ The turnover classes considered are: micro-sized enterprises with 2015 turnover lower than 2 million Euros; small-sized ones with 2015 turnover ranging from 2 to 10 million Euros; medium-sized ones with 2015 ranging from 10 and 50 million Euros; large-sized ones with 2015 turnover higher than 50 million Euros.

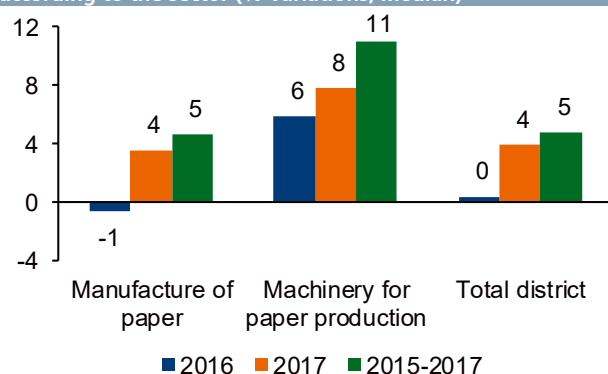
Tab. 2 – Composition and main results on financial position of the paper sector in the district of Lucca according to the company size

	Number of enterprises		Turnover 2017		Employees (2018; Inps)		EBITDA Margin (median)		Net equity on total assets (median)	
	Number	Comp %	Mln euro	Comp. %	Number	Comp. %	2017	Absolute var. 2017-2015	2017	Absolute var. 2017-2015
Total, of which	98	100.0	4,327	100.0	8,669	100.0	5.9	-0.9	23.9	0.1
Turnover classes										
Micro	19	19.4	25.2	0.6	170	2.0	5.8	-1.4	12,5	-0.2
Small	32	32.7	185.0	4.3	506	5.8	5.1	-0.1	18,1	1.5
Medium	31	31.6	721.5	16.7	1.585	18.3	7.2	-0.5	26,9	-6.5
Large	16	16.3	3,395.3	78.5	6.408	73.9	5.8	-0.2	38,4	-0.7
Specialization sector										
Paper	73	74.5	3,573.6	82.6	6.549	75.5	5.1	-1.1	23,3	+0.9
Machinery	25	25.5	753.5	17.4	2.120	24.5	9.4	-1.7	29,7	+0.5

Source: Intesa Sanpaolo estimates based on ISID (Intesa Sanpaolo Integrated Database), Inps data

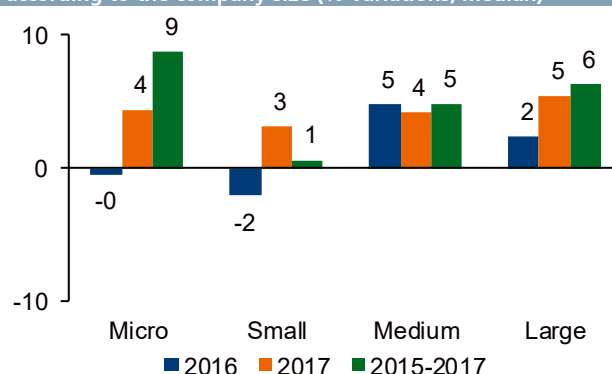
Overall district turnover grew by 11.7% between 2015 and 2017, an increase of over € 450 million. Over the last three years, both the paper product sector and the mechanical equipment sector have recorded a positive variation in their average turnover, which is more marked for mechanical equipment (11%) than for paper products (+5%, in line with total district turnover; Fig. 15). From the size class standpoint, small-sized companies stood out in the 2015-2017 period due to a stronger median growth (micro-sized businesses, growing by 9%) as well as large-sized companies with a 6% variation (Fig. 16).

Fig. 15 – Turnover development of the district enterprises according to the sector (% variations; median)



Source: Intesa Sanpaolo Integrated Database

Fig. 16 – Turnover development of the district enterprises according to the company size (% variations; median)

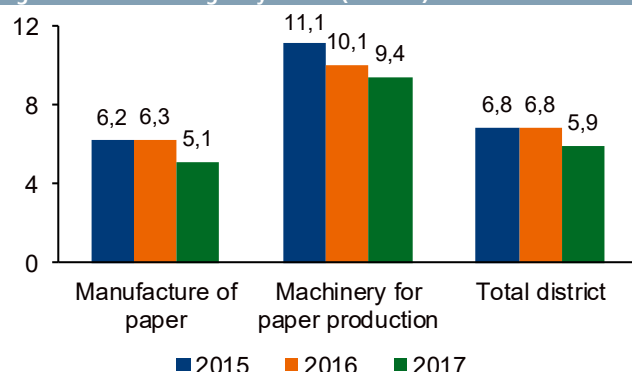


Source: Intesa Sanpaolo Integrated Database

In terms of margins, calculated as the ratio between the gross operating margins and turnover, the mechanical equipment sector obtains the highest returns (9.4% in 2017) although it shows the strongest decrease compared to 2015 (-1.7 %). It probably achieves higher margins because of its higher added-value services and products offered; overall the district keeps median margins amounting to 7.4%²⁴ (Fig. 17), only slightly lower than those of the total of districts. If we analyze the unit margins by size class, medium-sized enterprises show the highest result in 2017 and are the closest to the median of the surveyed districts, whereas micro-sized enterprises suffered the strongest drop between 2015 and 2017 (-1.4 %) (Fig. 18).

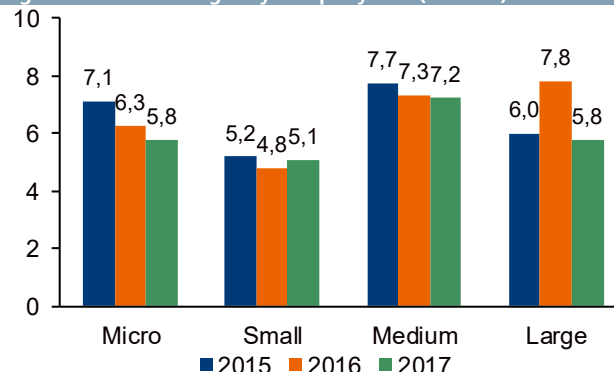
²⁴ See Annual Report n. 11 "Economy and Finance in Industrial Districts"; Intesa Sanpaolo Research Department

Fig. 17 – EBITDA margin by sector (median)



Source: Intesa Sanpaolo Integrated Database

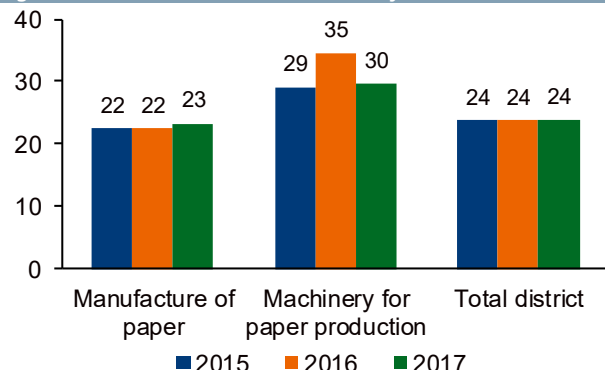
Fig. 18 – EBITDA margin by company size (median)



Source: Intesa Sanpaolo Integrated Database

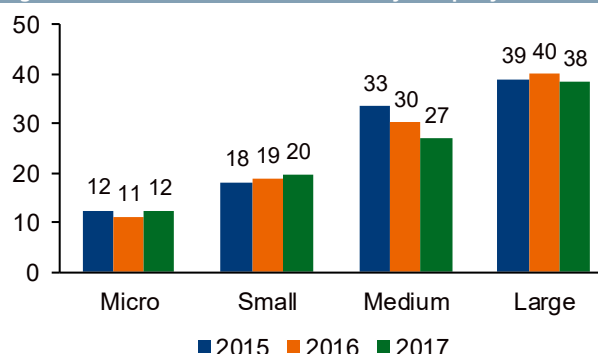
The analysis of capital strength, expressed as the ratio between net assets and total liabilities, highlights that the overall result of the district has been essentially stable over the past three years, approximately 24%, whereas the mechanical equipment sector showed a higher incidence of assets (29.7% in 2017), even though the paper product sector improved the most due to a growth of about 1% compared to 2015 (Fig. 19). With regard to size, the evident growth of the capitalization level is not unexpected and is obviously connected to the growing company size, up to 38% for larger enterprises; in this context, the company category that suffered most is medium-sized businesses, dropping by 6 % compared to 2015 results (Fig. 20).

Fig. 19 – Net assets on total liabilities by sector (median)



Source: Intesa Sanpaolo Integrated Database

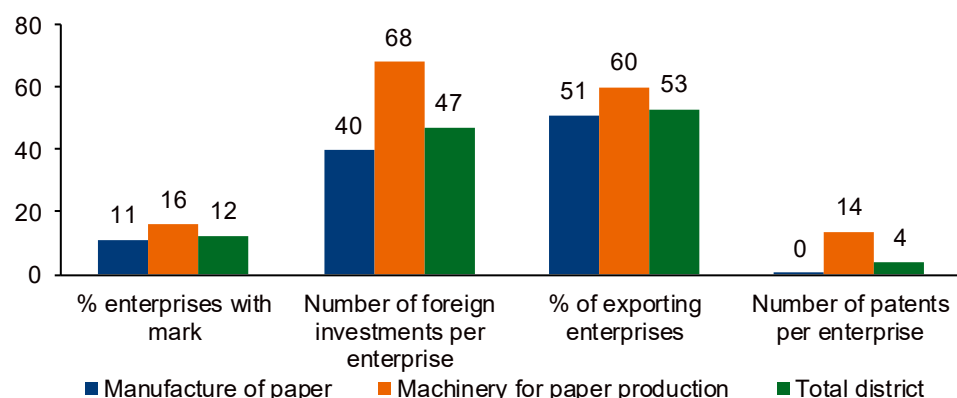
Fig. 20 – Net assets on total liabilities by company size (median)



Source: Intesa Sanpaolo Integrated Database

When analyzing the strategies adopted by the company of the district, the role of foreign markets appears as increasingly important and pivotal: this tendency to compete and enter international markets is emphasized by the percentage of exporting businesses, corresponding to more than half of the district enterprises (53%), as well as by their capability to operate in reference markets with their subsidiaries, corresponding again to about half of the district enterprises (47%) and even more for mechanical equipment manufacturers (68%). Technological evolution and the spreading of strategies focusing on trademarks and patents are particularly significant: most paper product companies develop marketing policies aimed at making end consumers aware of their brand; they own on average 1.2 trademarks per company, whereas, in the sector of paper mill machinery, companies most often focus on patents, the average in this case is 14 patents per company (Fig. 21).

Fig. 21 – Main strategies adopted by the companies of the Lucca district by sector (2017)



Fonte: Intesa Sanpaolo Integrated Database

The challenges the district has been facing are the same for the paper industry in general, focusing in particular on increasing their environmental sustainability. Innovating is a very complex process and it can concern production processes, technologies and raw materials used and can be aimed at improving company performance, by increasing productivity and reducing costs. In this connection, an example is the AirMill technology by Gambini²⁵: this process improves the characteristics of embossed paper (type of paper with a raised decorating pattern) in terms of volume, strength, absorbency and stability of the roll. Potential saving is related to paper being less refined; reduced use of long fibers; limited use of chemicals and, finally, use of lower grammage paper.

The Industry 4.0 process has motivated and encouraged the sector to implement digital solutions. Several examples can be found in the Lucca district: Fabio Perini (machinery sector) developed the Customer Service Portal that optimizes information on the piece of equipment installed in the individual customer's facilities, records the maintenance operations performed and provides recommended modifications to the machine as well as a web shop that can be used to order spare parts directly online. Knowledge of the data and skills developed makes it possible to provide a real Digital Audit as well as to detect causes remotely and establish possible solutions (using the Wearable Glasses with 3D interaction and augmented reality).

One of the factors that increases the competitiveness of the businesses is the presence in the area of the competence centers for training and technology transfer: the Organismo di Ricerca industriale Lucense operates in the district in the fields of research, experimental development, technological transfer and disclosure. One of the ongoing projects is called Eco-PulPlast, sponsored by the LIFE 2014 program and coordinated by Selene, a Lucca-based company operating in the field of plastic flexible packaging. Downstream of the paper recycling process there remains a part of non-recyclable materials (6-7%), which comprises the "pulper waste", made up mainly of plastics, metals, wood, glass or sand. The aim of this project is to demonstrate the possibility of recycling pulper waste for the production of heterogeneous plastic pallets. This project is based on a 3-year business plan requiring Selene to build three complete production lines, capable of producing approximately 1.2 million pallets/year, corresponding to 60-70,000 tons/year of pulper waste.

²⁵ Gambini S.p.A. designs and produces converting lines and equipment, works with two factories in Lucca and one branch in Wisconsin, USA and employs 145 workers.

Lucart is one of the district firms that stands out for a production based on eliminating waste and reusing raw materials: the company draws up a sustainability report that highlights the actions performed and goals achieved. Its main actions focus on:

- raw materials: selection of suppliers that comply with recognized sustainable forest management standards. Currently implemented processes and technologies provide the opportunity to utilize a wide range of recycled materials (e.g.: cellulose fibers available in cartons for drinks, Natural project); the overall raw materials can be divided based on their origin as follows: 54% from paper to be recycled and 46% from virgin cellulose fibers;
- water resources: plants mainly use water taken from wells available within the boundaries of the plants (90%) and in the last three years the company has reduced its total water usage by approximately 7%;
- energy resources: Lucart stands out as one of the first European paper manufacturers to focus on self-production of electricity by setting up methane-fueled cogeneration plants. The Group can currently use a total installed power of 30 MW with the Porcari and Castelnuovo Garfagnana located plants which fully cover the energy demands and generate a surplus which is fed back into the grid. Total energy consumption (considering production volumes, raw materials, refining levels, production mix, type of paper and grammage) has remained substantially stable over the years, whereas specific consumption (consumption per tons produced and processed) has shrunk by 4.6% thanks to both energy saving measures and increased production efficiency;
- sustainable mobility: in 2015 Lucart started the "Mobilità Sostenibile: trasferimento trasporto materie prime da gomma a rotaia" (Sustainable Mobility: moving of raw materials from road to rail) project aimed at using the railway to reduce road transportation of raw materials, for the Diecimo plant which has a railway yard inside. The number of incoming wagons used to transport raw materials and finished products grew by over 20% between 2015 and 2017, thus making it possible to avoid emitting 472 tCO₂ in the atmosphere in 2017.
- waste management: the company has always been committed to reducing waste: the desiccation system in the Porcari plant was upgraded in 2017. Overall, the company decreased the weight of waste produced per ton of paper 0.178 t/t in 2015 to 0.164 t/t in 2017.

■

4. Closing the cycle: recovering and recycling wood and paper waste

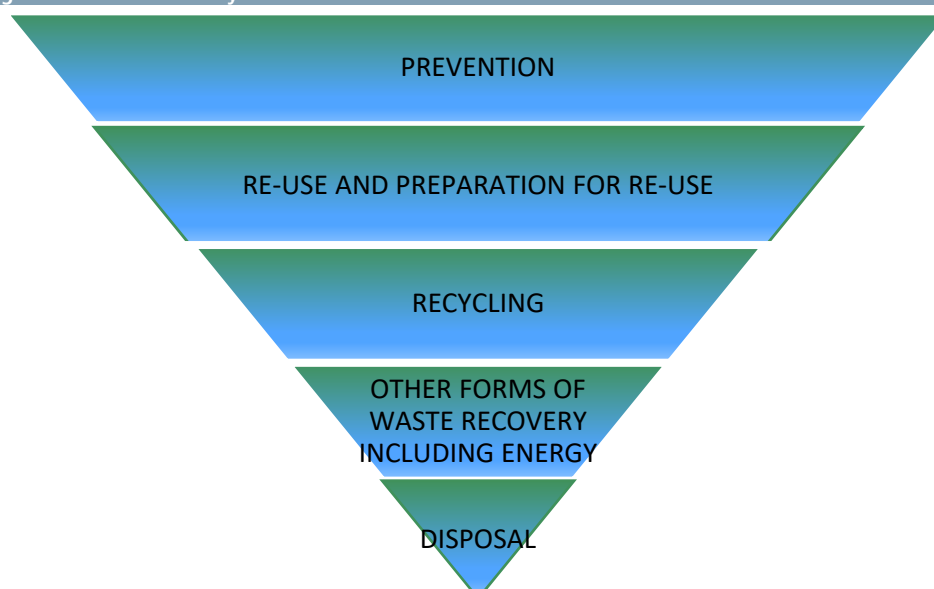
4.1 Introduction

By Laura Campanini

The circular economy implies the possibility of reducing waste production by increasing the ability to reuse, recover and recycle scraps. Waste need to have a new life in the production cycle. The "upstream" activities of the production and consumption phases are fundamental: the planning and designing of products and processes shall be such as to ensure and facilitate recovering and recycling of raw materials and reducing production waste. Prevention is a key principle in the European policy, "Community policy on the environment shall aim at a high level of protection taking into account the diversity of situations in the various regions of the Community. It shall be based on the precautionary principle and on the principles that preventive action should be taken, that environmental damage should as a priority be rectified at source and that the polluter should pay"²⁶. This principle translates into the need to act "at the source" to both avoid or reduce the waste volume and the risks associated to waste production, and to adopt a product design aimed at recovering and recycling. It is therefore necessary to concentrate efforts and attention first on preventing and only secondarily managing the subsequent phases of the waste cycle.

Based on the European principles, then incorporated into national law, the downstream activities should be considered in the context of the waste hierarchy. The principle of waste hierarchy is based on an integrated system and addresses all the phases of the waste cycle (collection, treatment and disposal) in a comprehensive way. **The waste hierarchy is expressed in an order of priority of what represents the best environmental option.** According to this principle, landfill disposal is located at the bottom of the hierarchical scale, and this is the last option to be followed, together with incineration, with insufficient energy recovery (below a minimum threshold of energy efficiency set by law, incineration qualifies as a disposal operation, rather than "recovery"). Waste-to-energy and recovery, then recycling, follow in priority order. **The activities that allow for re-using and recycling materials are to be preferred to the other treatment methods.**

Fig. 4.1 - Waste Hierarchy



Source: Intesa Sanpaolo processing

²⁶ Article 174 (2) of the European Community Treaty. The precautionary principle was first enunciated in the I Community Environmental Action Program and was developed in particular in the II Action Program. It is the basis for the EC Treaties as well as for the Waste Framework Directive (Directive 75/442/EEC modified by Directive 91/156/EEC).

Italy is the European country with the highest recycling rate. With 67% of waste sent for recycling (increasing if compared to previous years), Italy ranks fourth among European countries, after Belgium, with a recycling rate of 78%, Slovenia (75 %) and the Netherlands (72%).

The percentage of waste sent for recycling in Italy is much higher than in all other major European countries: in France it is 53%, in the United Kingdom 59%, in Germany 53% (2014 data). The European average is 55%.

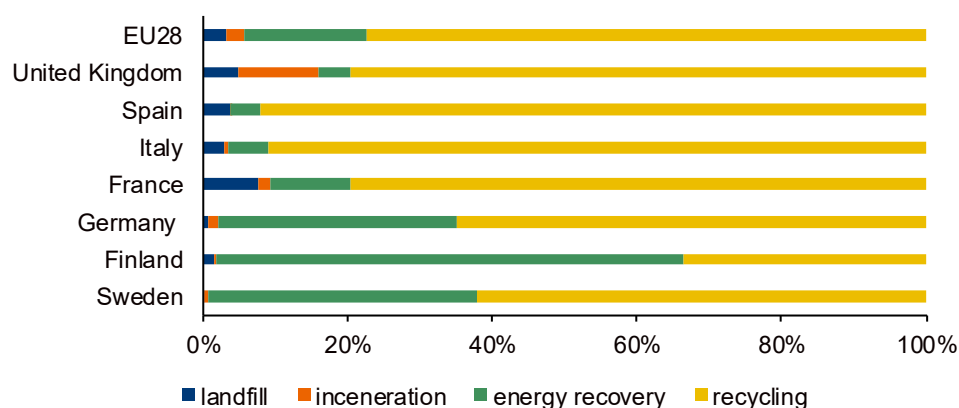
In the packaging sector - including both urban and special waste coming from industrial and commercial activities - the recycling rate is 66.9% (2016), mainly due to the management of the CONAI system Supply Chain Consortia. The European average is 67.2%.

The biocompatible component of the waste cycle that is part of the bioeconomy sector includes biodegradable waste (biowaste): organic waste from animal and vegetable sources, sludge from water treatments, paper, wood and textile waste.

The treated biowaste is recycled in 77% of cases at EU level (percentage of waste recycled out of the total waste treated), processed from waste to energy in 17% of cases (this is to be added by 2%, that is waste treated and burned without energy recovery), finally only 3% of the biowaste treated is sent to landfills.

In Italy, the incidence of recycling is higher than the European average and close to 91%, only 6% of treated biowaste is processed from waste to energy and 3% ends up in landfills. This figure confirms that **our country is strongly specialized in waste recycling**.

Fig. 4.2 - Treatment of biowaste by waste management operations (2016)



Source: Intesa Sanpaolo processing based on Eurostat data.

Further on in this chapter, we will focus on paper and wood waste, in order to fully analyse the supply chains that are the subject of this Report. First, we will compare European data on production, management and treatment of these types of waste, then we will focus on reusing and recycling of wood waste in Italy.

4.2 Wood and paper waste: production, treatment and recycling in Europe and Italy.

Wood waste

The wood waste produced in the EU amounts to almost 55 million tons per year, Germany is the country with the largest volume of wood waste (almost 13 million tons, or 23% of the European

total), followed by France and the United Kingdom (6.4 and 6 million tons respectively) and then Finland and Italy (4.7 and 4.5 million tons respectively).

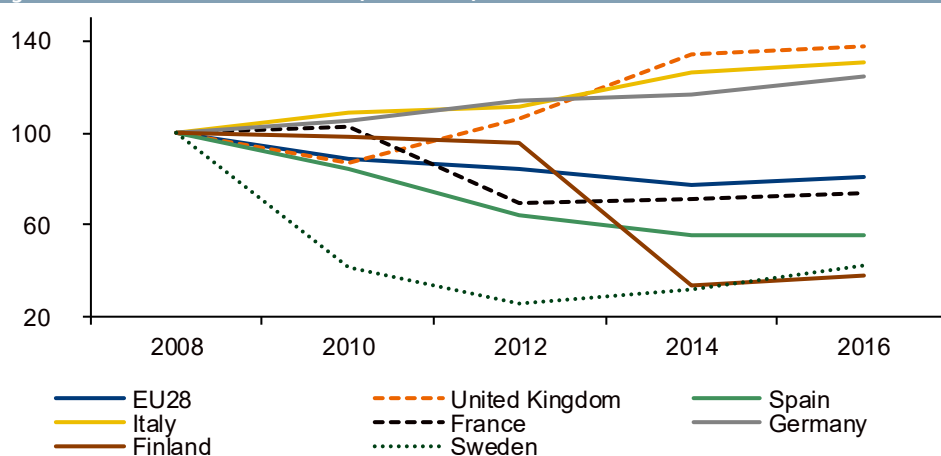
Tab. 4.1 - Production of wood waste: first 10 countries for total production (2016)

	Tons	%
European Union - 28 countries	54.760.000	100%
Germany	12.739.432	23%
France	6.414.484	12%
United Kingdom	6.043.084	11%
Finland	4.738.039	9%
Italy	4.486.957	8%
Belgium	3.723.370	7%
Romania	3.283.624	6%
Netherlands	2.630.635	5%
Poland	2.565.358	5%
Sweden	1.905.525	3%

Source: Intesa Sanpaolo processing based on Eurostat data.

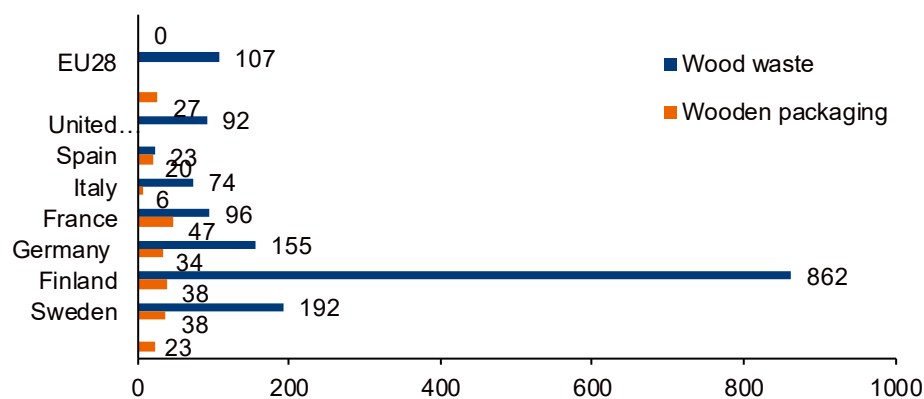
In terms of pro capite wood waste, Finland proves again to be the largest producer with 862 kg per inhabitant (Finland, as highlighted in chapter 2, is highly specialized in wood industry), followed by Estonia and Belgium with about 330 kg. Germany shows a per capita production higher than the EU28 average with 155 kg per capita, while France, the United Kingdom, Italy and Spain show a pro capite production lower than the EU28 average (107 kg per capita). Italy is positioned at 74 kg pro capite per year. Data are particularly low for Spain.

Fig. 4.3 - Production of wood waste (2008 = 100)



Source: Intesa Sanpaolo processing based on Eurostat data.

Fig. 4.4 - Wood waste and wooden packaging (2016, kg per capita)



Source: Intesa Sanpaolo processing based on Eurostat data.

The production of wood waste recorded an overall decline in Europe between 2008 and 2016, but the dynamics of the individual countries show to be quite diversified. A large group of countries reduced their wood waste whereas 10 countries increased the quantity they produced.

Italy stands out for significantly increasing volumes, from 3.4 million to 4.5 million tons.

Packaging represents an important part of wood waste. At EU level, 27 kg out of the average 107 kg of wood waste per inhabitant are made of packaging. The incidence of wooden packaging is particularly high in Italy, representing 64% of total wood waste.

Wooden packaging can consist of pallets, industrial packaging, fruit and vegetable wrapping and food packaging. Wood is in fact an excellent material for making packaging due to its technical properties (strength, compressibility, flexibility, hardness). The most commonly used types are poplar, beech, fir, pine, birch and, to a lesser extent, larch, alder and chestnut. Alternatively, plywood panels can be used.

The large quantity of wood waste undergoes different treatment modalities.

Wood waste can be recovered to allow for recycling the material. Waste can be regenerated and reused in order to be put back on the market or it **can be recycled as a raw material**. Using recycled wood to manufacture of new products is one of the solutions aimed at reducing the consumption of virgin wood, it is however necessary that the design is made in such a way as to allow its recovery to guarantee the recycling of the material.

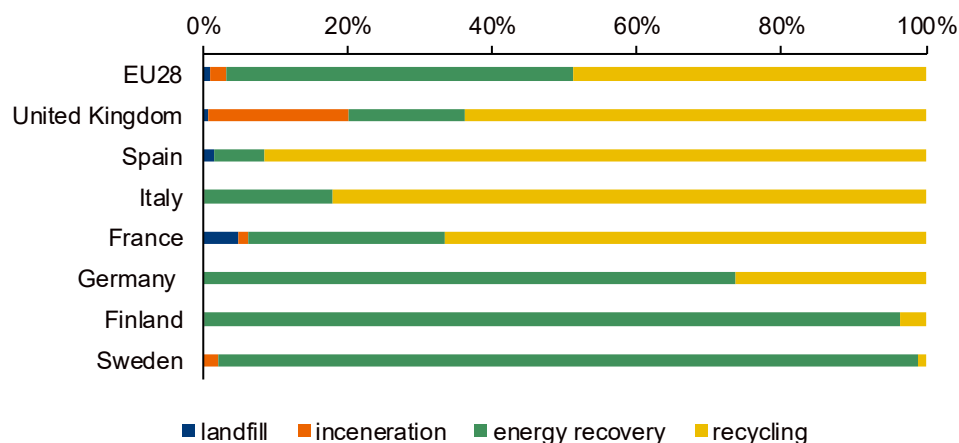
Composting is also a method to recycle wood waste collected separately. Because it is biodegradable, wood can fully enter into the creation of compost or soil.

Finally, there is a percentage of material that is destined for energy recovery. Waste-to-energy is a solution envisaged by the Waste Directive when "departing from such hierarchy may be necessary for specific waste streams when justified for reasons of setting in terms of life cycle in relation to the overall impacts of production and management of such waste." However, the most virtuous behaviours are undoubtedly those that mainly allow for regenerating and recycling.

The current European situation shows that the treated wood waste is equal to 48 million tons, which are equally divided between waste-to-energy and recycling. Only 1% of wood waste ends up in landfills and only 2% is incinerated without energy recovery.

The differences between countries are then significant and show a group of nations prioritizing waste-to-energy (Germany, Finland, Sweden and Norway) and a group of countries recycling more than three quarters of treated wood waste (Spain, Italy, Portugal and Austria).

Fig. 4.5 - Treatment of wood waste by waste management operations (2016)

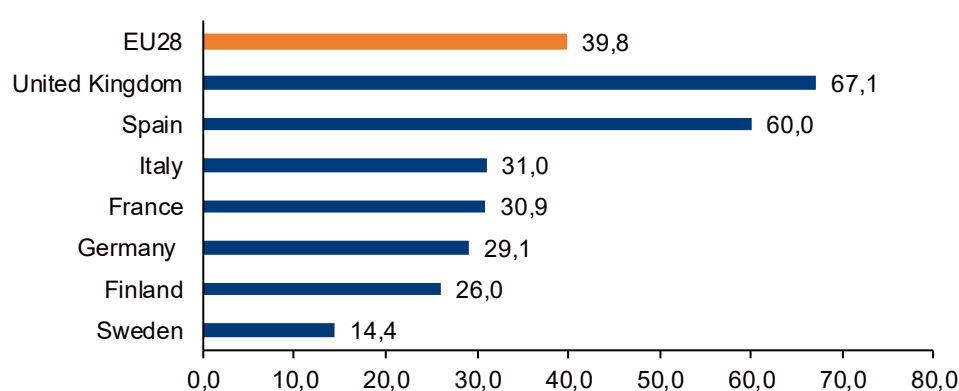


Source: Intesa Sanpaolo processing based on Eurostat data.

As for the treatment of wood packaging waste, the recycling rate in Europe is 40%, Spain and Italy are the most virtuous countries with a percentage of recycled wood packaging waste of 67% and 60% respectively.

The recovering and recycling targets set by 2008 and established by European legislation have been achieved and exceeded before the established deadline. These targets were raised at EU level starting from 4th July 2018 when the Directives forming part of the "circular economy package" entered into force and modified the main EU rules on waste. Directive (EU) 2018/852, amending Directive 1994/62/EC on packaging and packaging waste, established minimum recycling targets, in terms of weight, by 2025 and 2030. With reference to the recycling of wooden packaging, the European target for 2025 is 25%, the target for 2030 is 30%, but these have already been widely exceeded by several countries.

Fig. 4.6 - Wood packaging recycling rate (2016)



Source: Intesa Sanpaolo processing based on Eurostat data.

Paper and cardboard waste

Paper waste produced in the 28 European countries adds up to a total of 50 million tons; the United Kingdom is the largest producer of paper waste with more than 9 million tons (18% of the total), followed by Germany and France (8 and 7.3 million tons respectively), then Italy with 5.3 million of tons. The per capita production of paper waste in Belgium (316 kg per inhabitant) and in Austria (169 kg) is particularly high. Italy ranks below the European average with 87 kg per inhabitant.

Tab. 4.2 - Production of paper and cardboard waste (2016): first 10 countries for total production

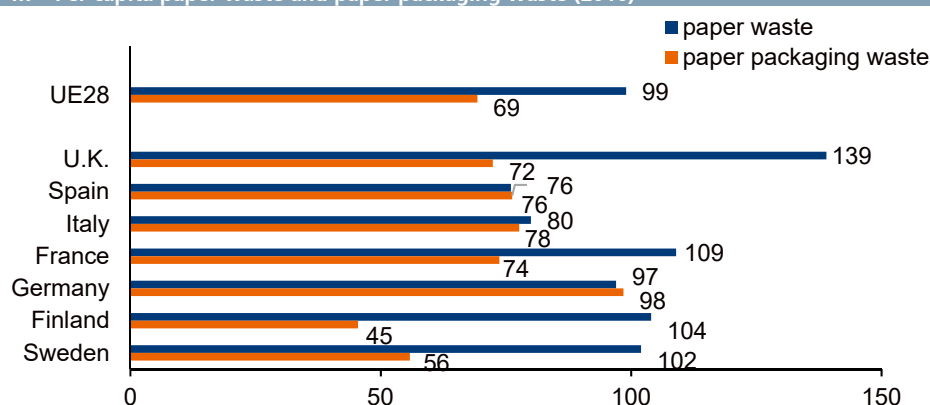
	Tons	%
European Union - 28 countries*	50.390.000	100%
United Kingdom	9.138.942	18%
Germany	7.960.794	16%
France	7.319.000	15%
Italy	5.304.638	11%
Belgium	3.580.663	7%
Spain	3.531.138	7%
Netherlands	2.202.638	4%
Poland	1.855.881	4%
Austria	1.478.821	3%
Turkey	1.406.435	3%

Note: (*) figure in 2014. Source: Intesa Sanpaolo processing based on Eurostat data.

Packaging represents a large part of paper waste. At EU level: 69 out of the 99 kg pro capite of waste paper produced is represented by packaging waste. In Italy, paper waste amounts to 80 kg per capita and 78 kg per capita packaging.

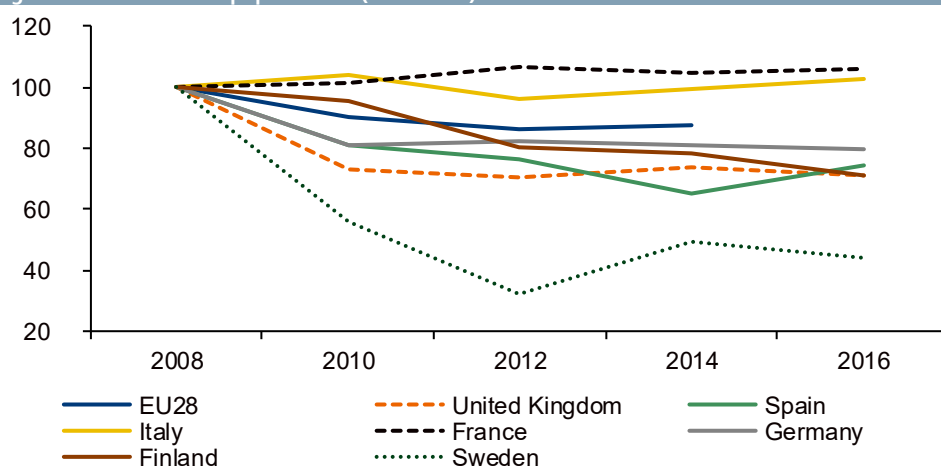
The trends in paper waste production are decreasing in Europe, in line with those regarding consumption: if we set paper waste produced in 2008 at 100, this figure falls to 88 in 2014 (latest figure available). Italy and France show an increase in paper waste production during the surveyed period while the United Kingdom, Spain and Germany reduce the amount of this type of waste. As highlighted in chapter 3, the dematerialization process, that is the transfer of paper content to digital media, is at the basis of the reduction in consumption and, consequently, production of waste, though this is partly offset by the dynamics of packaging consumption.

Fig. 4.7 - Per capita paper waste and paper packaging waste (2016)



Source: Intesa Sanpaolo processing based on Eurostat data.

Fig. 4.8 – Production of paper waste (2008= 100)

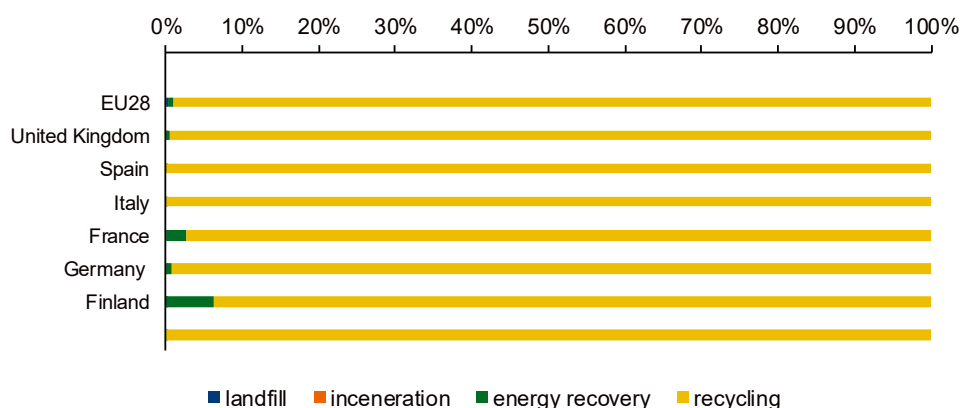


Source: Intesa Sanpaolo processing based on Eurostat data.

As for the processing methods, recycling is prevalent at EU level. The waste-to-energy process, instead, plays a marginal role: only 1% of treated paper waste is processed to produce energy.

The recycling rate of paper packaging is 85% at EU level, France recycles 94% of paper packaging, Germany 88.7%. Italy ranks below the European average with 79.7%. The target for 2025 is 75% and 85% for 2030.

Fig. 4.8 – Treatment of Waste paper by waste management operations (2016)



Source: Intesa Sanpaolo processing based on Eurostat data.

Paper recycling is efficient from both an economic and environmental point of view. The recovered paper can in fact be treated and reused several times as a secondary raw material to produce new paper, thus avoiding the extraction of cellulose from virgin raw material and therefore limiting deforestation. Furthermore, with the recycling of paper, the quantities of energy and water resources used are significantly reduced.

The transformation of paper waste into a secondary raw material requires different phases:

- first of all, waste must be separately collected and stored²⁷;
- second step, waste must be sorted in order to separate the fibre that can be used from spurious materials (twines, plastic, metals ...) that are normally incorporated in waste paper.
- subsequently, waste paper must be bleached (to eliminate inks).

At this stage of the cycle, the cellulose contained in the waste paper has once again become a raw material, ready to re-enter the production cycle. While recycling means saving raw material (trees and cellulose), energy and water consumption are reduced, the quantities of materials destined for landfills decrease (thus saving a precious resource that would otherwise be destroyed); on the other hand, **the recycling process produces waste that, in turn, must be managed in the most appropriate way**. The waste sorting process produces the pulper, which is made of all those materials found with paper when this is delivered to the paper mill: it therefore contains plastic, wood and metal. At the same time, the recycling process produces sludge, deriving from paper processing and composed of small cellulose fibres and mineral fillers.

Such waste is minimal if compared to the quantity of non-produced waste thanks to recycling, yet it needs to be managed and treated in suitable plants. The pulper has a high calorific value which makes it suitable to be processed using the waste-to-energy system (even if today it continues to be often destined for landfills²⁸); the sludge can be reused and given value. The inadequate plant equipment currently represents an important barrier to the development of the recycling chain in our country.

The quality of the collected paper material is another obstacle. For the paper, it is a matter of quality, and not only of how much the service is increasingly spread among the population. In fact, poor quality paper waste cannot be recycled in a sustainable way. At the current stage, the uncertain paper quality is precisely one of the main obstacles faced by operators who want to use the secondary raw material.

The potential for recovering and recycling depends on the intrinsic quality of the materials and their homogeneity. To ensure the waste quality, upstream interventions on the product and its design are very important. **The packaging design is crucial for paper waste, because it determines its economic and environmental sustainability, life cycle, recycling or reusing.**

In general, special waste quality is higher than that of urban waste. In particular, secondary and tertiary packaging waste guarantees a better performance in terms of material recovery, as it is characterized by a higher quality. Assimilated waste is generally more homogeneous and this leads to an improvement in the yield of waste sorting collection that public waste management companies carry out.

For municipal solid waste, the way in which waste sorting collection is organized has a significant impact on the recycling performance. The organisational model turns out to be fundamental in

²⁷ For regional details on the diffusion of waste sorting collection, see chapter 5, in-depth study "The recycling of paper and cardboard in the regions of Southern Italy".

²⁸ See the experience of alternative use in the in-depth study of the Paper District of Lucca.

determining the efficiency of the collection in terms of intercepted waste and its quality. In Italy, there are mainly two types of organisational structures: kerbside and door-to-door collection. In some local contexts, organisational structures may be also combined and waste is collected by using both models. In other European countries, however, multi-material collection is widespread, which implies still different problems.

In the case of Italy, the model guaranteeing a greater separation is undoubtedly the door-to-door collection (D2D). In the first instance, the D2D collection allows for limiting improper waste disposals, favouring an increase in the quality of the intercepted waste. In fact, this collection system allows for minimizing the risk that waste sorting at the source is not properly carried out, also by imposing sanctions which, in the case of kerbside collection, are difficult to apply (for example the fine for condominiums in case of wrong waste sorting collection), guaranteeing a greater precision in the disposal and separation of the material waste types. The collection system is accompanied by the education of citizens and the dissemination of good practices.

4.3 The Italian situation in wood waste: closing the cycle

Wood waste arises from two macro categories of sources: the part collected by using a waste sorting system from the cycle of household and similar waste and the part coming from industries, trade and large-scale retail (special waste). These latter types are mainly:

- wood packaging;
- scraps of first and second processing of virgin and non-virgin wood;
- waste deriving from building construction and demolition processes;
- bulky waste (furniture, fixtures) coming from urban waste sorting collection.

As regards the first component, namely urban solid waste, in Italy, the waste sorting collection (WSC) of wood waste materials amounted to 800,000 tons in 2017, of which about 16% was represented by packaging waste.

Waste sorting collection is carried out mainly through waste disposal to the recovery platform (community waste areas). In some cases, the Municipality proposes a home collection service for wood residues. There is no evidence of packaging collections through dedicated road bins or through multi-material collection systems.

A significant proportion of wood waste, which disposed of by the public service, derives from the assimilation of the waste produced by companies in the industrial, handicraft and distribution sectors to urban waste. Moreover, the service to remove and dispose of fruit and vegetable crates used in weekly local markets in dedicated urban areas is spreading.

The development of the waste sorting collection channels allows for a very dynamic growth in waste wood collection: **between 2013 and 2017 the collected quantities grew by 26%** compared to a 20% increase in biodegradable waste collection. Between 2016 and 2017 there was an increase in the collection by 8.2% which followed the 6.3% growth already recorded between 2015 and 2016.

Tab. 4.3 - Separate collection of wood and biodegradable waste (1,000 t)

	Wood	Total amount of biodegradable materials
2013	635.2	9.014.40
2014	676.0	9.674.20
2015	695.3	10.045.80
2016	739.5	10.608.70
2017	800.2	10.832.10

Source: Intesa Sanpaolo processing based on the ISPRA Municipal Waste Report [ISPRA = The Italian Institute for Environmental Protection and Research]

Considering the macro-geographical area, there are net inflow figures close to 600,000 tons for the North (21 kg per inhabitant per year) and figures of almost 130,000 tons and 80,000 tons for Central and Southern Italy respectively. In the central regions, slightly less than 11 kg per inhabitant of wood waste were collected in 2017, while in the South, per capita collection was below 4 kg per inhabitant.

Regional differences are significant and can be traced back to different consumption habits and to a different diffusion of the waste sorting collection service. Furthermore, the uneven distribution of timber processing activities and industrial, commercial and cargo handling activities also affects territorial differences. The waste of part of the industrial and commercial pattern falls into the municipal waste sorting collection, as it is composed of the so-called "assimilated" waste.

Tab. 4.4 - Separate wood collection per macro-geographical area (2017)

	Collected quantity (000 tons)	Per capita collected quantity (kg)	% of Municipalities carrying out SC on the total
North	592.6	21.4	88.1
Centre	128.8	10.7	67.1
South	78.8	3.8	36.2
Total	800.2	13.2	68.8

Source: the ISPRA Urban Waste Report

The percentage of Municipalities that have carried out the waste sorting collection of wood waste on the total of Municipalities is 88.1% in the North, 67.1% in the Centre and 36.2% in the South. In the Southern regions, wooden waste is therefore delivered in an unsorted way, with the obvious negative consequences on the possibility of recovering and recycling the material, in two Municipalities out of three.

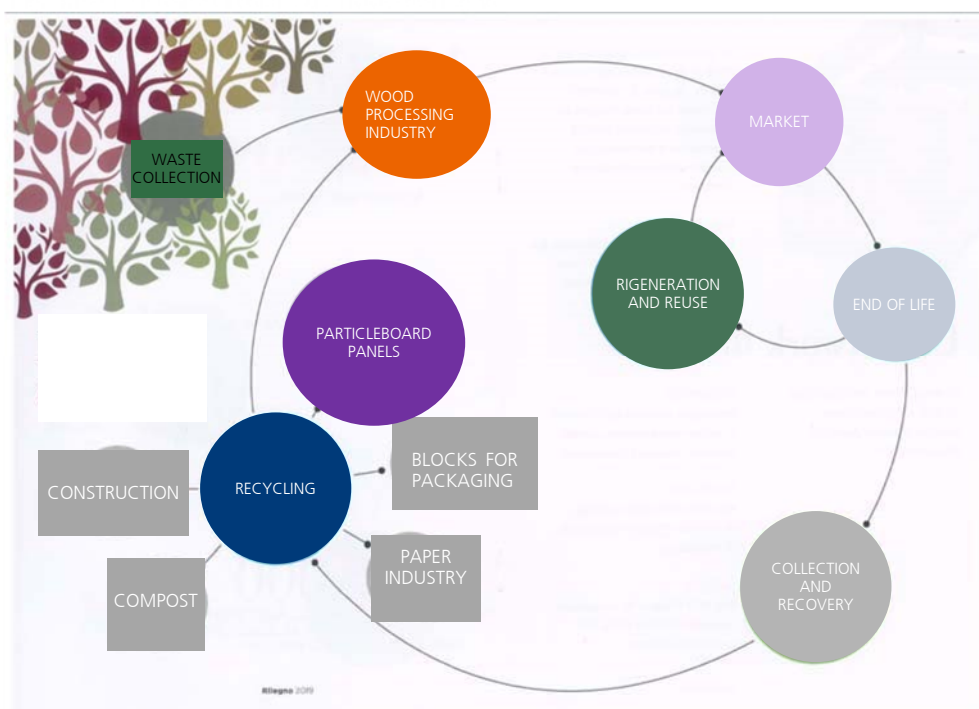
In 2016, the total production of special wood waste amounted to 3,747,487 tons and therefore it represented the majority of total wood waste. The economic sectors that contribute most to the production of wood waste are the wood industry (24%), the furniture industry (13%) and the construction sector (5%). The role of the recycling sector is also significant, producing 35% of special wood waste.

Wood waste collected using a waste sorting system for the city cleaning service and that deriving from industrial and commercial activities are delivered to recovery platforms.

Public and private platforms carry out, directly and/or on behalf of Municipalities, the collection of wood waste on the territory, guaranteeing the subsequent recycling process. The waste materials delivered are first treated to be recycled, e.g. treatments such as cleaning (removal of foreign materials) and then their volume is reduced through shredding, grinding and (in some cases) pressing. The role of the platforms is important, as they bring together different actors favouring the connection between different supply chains.

Once delivered to the platforms, wood waste is largely recycled so as to generate a new raw and/or regenerated material so that it can be re-introduced onto the market. Less than 20% of wood waste is processed from waste to energy.

Fig. 4.10 - The Wood Cycle



Source: Rilegno

The main products of the recycling activities are particleboard panels. Rilegno²⁹ estimates an annual production of about 4,000,000 cubic meters of particleboards, using virgin wood and wood waste: the wood waste used is over 2,300,000 tons. The particle board made from wood waste has the same characteristics and quality as that created with virgin wood, so its potential is also identical. The particle board is also recyclable with a considerable advantage if compared to other supply chains.

Another product that uses recycled wood is represented by shuttering blocks and timber/concrete slabs for green building applications. Its use is limited, because most wood waste is used for panels; however, these products are an excellence in the Italian production scenario. These are sustainable recycling and recovering solutions that meet the green building and low-impact construction rules.

The recycling of wood packaging waste can also be oriented to produce chemo-mechanical pastes, which are used to obtain different qualities of paper and cardboard. These may be: hygienic-sanitary paper (toilet paper, handkerchiefs, napkins and tablecloths, towels, paper for medical use); industrial paper used by furniture manufacturers (printed decorative papers and impregnated papers for furniture finishing); graphic papers for printing brochures, advertising

²⁹ The National Italian Consortium for the collection, recovery and recycling of wooden packaging.

volumes, periodicals, books, office paper and many other offset prints; valuable paper used for example for packaging.

In Italy, the use of wood as a renewable energy source is definitely limited: recovering and recycling are the prevalent processing methods in line with the waste hierarchy. However, it should be pointed out that in some situations and contexts the transformation into energy can be economically favourable. In case transport costs are high or the material quality is poor, the waste-to-energy process may be preferable also from the environmental point of view.

Based on an analysis by the Politecnico di Milano³⁰ (Polytechnic University of Milan), **the management and treatment system for wood waste generates an impact on the national production of 1,387.83 million euros.** The estimate is calculated considering: a) the direct effect of the companies operating within the post-consumer wood recycling chain; b) the indirect effect due to the production of the supply chain of these companies; c) the induced effect due to the consumption generated by the wage bill.

The turnover of the 2300 companies operating in the recycling chain amounts to 822 million. The turnover of the suppliers of these companies (321 million euros) and the effect induced by the consumption generated by wages (244 million euros) are to be added.

In terms of employment, the wood recycling chain employs a total of 6,000 people, and only 1,000 are directly employed in it. The economic effect is also added to the environmental effect, estimated at one million tons of CO₂ not released into the environment, about 2% of the total CO₂ produced in Italy.

The wood waste recycling industry is characterized by a heterogeneous distribution of plants: in fact, there is a greater concentration in Northern Italy. This element creates a disadvantage for the Central-Southern area as transport costs to companies that produce panels do increase in the North. "The strong recycling skills of the "wood sector" are geographically, as well as historically, concentrated in Northern Italy, whereas processing capability is still limited in Central and Southern Italy. In the case of Southern Italy, it is clear that the collected waste is transported even for long distances with considerable transport costs. Without the economic intervention of Rilegno³¹, the collection of the batches of waste in the South made by the recycling industries concentrated in the North would be impractical because it would not be economically efficient and the missed transport would also compromise their own waste sorting collection"³².

Wooden packaging.

The main types of wooden packaging are pallets, industrial packaging such as packing cases, crates, reels and fruit and vegetable packaging. Wooden packaging, when domestic and therefore collected using a waste sorting system, are typically boxes for fruit and vegetables, wine boxes, small food boxes and cork stoppers. A significant amount of packaging waste collected using a waste sorting system and included in municipal solid waste originates from similar waste and therefore comes from the industrial and commercial sector. The wood waste stream from packaging coming from street cleaning following local street markets is also relevant.

Industrial and commercial wood packaging (special waste) is generally collected through containers located in the company premises. Wooden packaging from companies represents the

³⁰ "The circular system of the wood supply chain for a new economy", Politecnico di Milano, 2019.

³¹ On the role of Rilegno and consortia, see the in-depth analysis at the end of this chapter.

³² Rilegno, "The wood packaging supply chain", 2017.

main part of packaging and is used in the transport, handling and maintenance of goods destined to user companies.

End-of-life wooden packaging retains its value in the material and therefore recycling is always possible: the material can always be used as a resource to make panels, paper, wood-cement blocks, compost for agriculture but also thermal or electrical energy, if this is used as fuel.

In 2017, wooden packaging for a total weight of just under 3 million tons was released for consumption. Pallets, with 2.2 million tons, are prevalent. **Two-thirds of the pallets released for consumption are made from virgin raw material while one third of them is released for consumption after being regenerated.**

Tab. 4.5 - Wooden packaging released for consumption by type (thousands of tonnes in 2017 and variation in 2013-2017)

	2017	% Share 2017	% Variation 2013-17
Packaging materials	54	2	4
Fruit and vegetable packaging	194	7	-6
Pallet	1.424	48	28
Pallet returned for consumption by reuse / reconditioning	746	25	33
Industrial packaging	477	16	-8
Reels and lags	13	0	-41
Cork	9	0	50
Other	29	1	12
Total	2.946	100	18

Source: Intesa Sanpaolo processing based on Rilegno data

In 2017, the waste wood packaging sent for recycling amounted to 1,772 million tons, equal to 60% of the packaging released for consumption.

As a whole, there are about 400 operating platforms on the national territory; they have an agreement with Rilegno and deal with organizing and managing the process of wood waste recycling.

The development of the wood packaging recycling industry was boosted by the environmental contribution introduced in 1998. The economic benefit induced by the contribution given to companies has in fact attributed an important advantage to recovering and recycling activities. The facilitated procedures introduced for new and used, repaired or simply selected pallets, have driven the search for packaging solutions by manufacturers and users³³.

The packaging sent for recycling is recycled for a third to raw material: in fact, particleboards, wood fibre, plywood, block boards, lamellar and OSB boards are obtained from the packaging. A distinctive feature of the wood packaging supply chain is that little recycled material is used to produce packaging products. Recyclers do not coincide with packaging manufacturers: in most cases, the separated material is instead destined for different purposes, because the semi-finished products produced by the recycling industries do not have the characteristics required to replace

³³ Starting from January 2013, the tax break implies paying the CONAI Environmental Contribution (CAC) for 60% of the weight (instead of 100%) of used, repaired or simply selected and transferred pallets. Payment of CAC decreases to 40% of weight for new and used packaging structurally designed for multi-year use, respectively produced and repaired in compliance with specifications for known and validated production circuits, for which minimum requisites have already been identified. From 1st January 2019, the weight the Environmental Contribution should not be paid for has increased to 80% (so contribution applies to 20% of the weight)..

virgin wood in packaging. However, the recycled material can be absorbed by other wood industries.

A relevant part of packaging is regenerated and can put back onto the market since it is robust and easy to reuse. The regeneration process at the end of its lifetime allows the packaging to be reused.

Generally, the regeneration process involves the replacement of broken elements so as to make the used packaging able to perform its original function again. Re-use is defined by the Legislative Decree No. 152/2006³⁴ as "any operation in which the packaging conceived and designed to perform a minimum number of movements and rotations during its life cycle is filled again or reused for the same use it was conceived for. And this has to be possible with or without the support of auxiliary products available on the market enabling the packaging to be refilled: such reused packaging will become packaging waste when it ceases to be reused".

The producers of new packaging themselves often carry out the regeneration activity, as a completion of an additional service to be provided to their customers.

Rilegno sets³⁵ the number of companies reselling repaired or selected pallets to about 250 units. "the network formed by these companies dealing with pallet regeneration, indirectly stirs the development of collateral activities, triggering a virtuous process of collaboration with other companies on the territory, favouring a potential added value to the socio-economic context".

These companies are located homogeneously around the main centres for the use and production of pallets, particularly in Northern and Central Italy; they deal with the collection, reception, selection, repair and redistribution of used pallets.

A modest portion of the collected packaging is destined to energy recovery.

Tab. 4.6 - Treatment of Wood packaging by waste management operations (2016)		
	1000 tons	% on packaging released for consumption
Feedstock recycling	1.014	35
Regeneration	725	25
Compost	33	1
Waste-to-energy	81	3
Total recovery	1.853	63

Source: Intesa Sanpaolo processing based on Rilegno data

International trade flows of recycled paper

The recycling and recovering of paper, as illustrated in this chapter, represent a fundamental part of the bioeconomy, as well as one of the examples of circularity implemented over the years, even if results differ according to the countries and territories (see also chapter 5 dedicated to Southern Italy).

In this focus, we will highlight the flows of exports and imports related to the collection and subsequent re-use of paper. For this purpose, we will use the Comtrade database, supplied by

By Laura Campanini and
Stefania Trenti

³⁴ Article 218, paragraph i and subsequent amendments

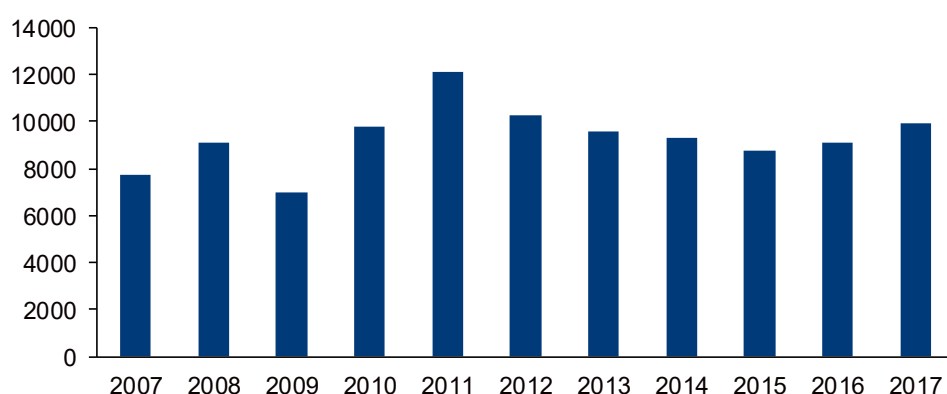
³⁵ Via databases of the CONAI Environmental Contribution databases: Rilegno.

UNCTAD [United Nations Conference on Trade and Development], which allows for analysing the international trade at a very high level of disaggregation (Harmonized System, 6-digit HS). It was possible to identify the codes relating to paper and cardboard defined as to be recycled. It is about those "scraps or waste" (as specified in the description of the nomenclature) not yet reused or retransformed. In most cases, international trade, should therefore concern exchanges between countries where the paper is consumed and collected and those where the equipment necessary for recycling the material is adequate and the paper sector needs production inputs that guarantee the re-use of the second raw material (even if triangulations are not to be excluded, as it happens for other categories of goods).

As highlighted in chapter 3, the high volume and low unit value of goods in the paper sector have always limited the range of action to supply foreign markets, leading to productive rather than commercial internationalization processes. However, in recent years there has been a growth in the propensity to export among countries, even in the case of recycled paper (see figure 3.23, Chapter 3), a product which, a fortiori, should suffer from economic constraints relating to long-distance transport. For paper waste, international trade flows are linked firstly to the plant equipment of the countries of origin, which may be insufficient to transform all the collected cellulose waste and therefore make export a useful channel to guarantee the sustainability of the supply chain. Another driver is represented by the domestic and foreign demand for second-raw materials and above all by the quality of the paper waste. Paper and cardboard waste to be recycled must in fact be "thoroughly cleaned" from foreign materials such as plastics, glues and paraffins. As highlighted in chapter 4, the quality of the collected waste is very heterogeneous, so much as to identify quality waste on the one hand and waste material with a lower qualitative yield on the other one. The trade flows must therefore be set in this context.

Global export flows in value, measured at current exchange rates, grew by around 30%, although with a non-regular trend over time, between 2007 and 2017, to reach almost 10 billion dollars (after exceeding 12 billion in 2011).

Fig.1 – Worldwide exports of waste paper (million USD)



Source: Intesa Sanpaolo processing based on Comtrade data

These flows mainly originate in Europe, 45.6% of the value of world exports in 2017 alone, about 27% of those flows remains on the European continent while the remaining 18.4% takes the road to Asia. A considerable share of world exports of waste paper (37%) also goes from the Americas to Asia. The flow between the Americas and Asia is, however, by far the most significant one among world exports of waste paper, covering almost one third (28%) of the world total in value.

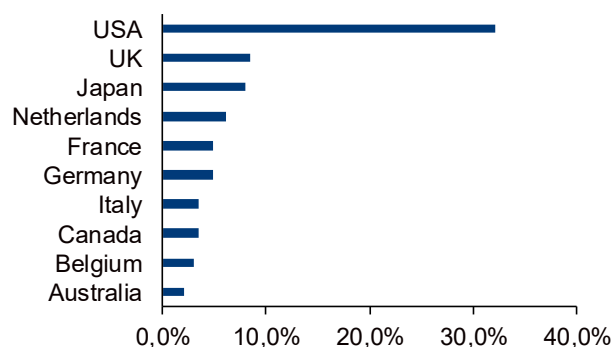
Tab. 1 – Worldwide exports of waste paper by area of origin and destination (%)

Origin	Destination					World
	Europe	Americas	Asia	Africa	Other	
Europe	27,1	0,1	18,4	0,0	0,0	45,6
Americas	0,8	8,0	28,1	0,0	0,0	37,0
Asia	0,1	0,0	16,8	0,0	0,0	16,9
Africa	0,1	0,0	0,4	0,1	0,0	0,5
World	28,0	8,1	63,7	0,2	0,0	100,0

Source: Intesa Sanpaolo processing based on Comtrade data

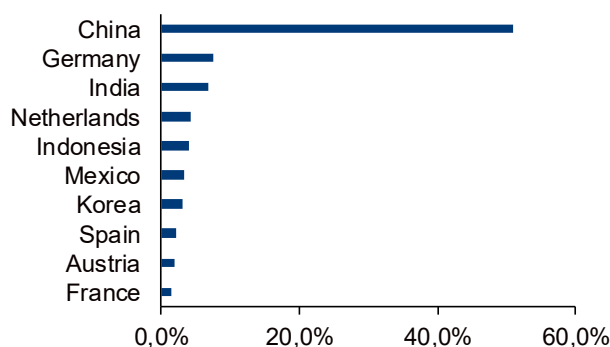
Considering each individual country more in detail, the significant role the United States play is clear, as far as exports are concerned, they account for about a third of the global paper recycling flows, followed at a distance by the United Kingdom and Japan. **Italy ranks seventh, with 3.5% of the world total (in line with our share of total exports of goods).**

Fig. 2 - The main exporters of waste paper in 2017 (% shares, current USD)



Source: Intesa Sanpaolo processing based on Comtrade data

Fig. 3 - The main importers of waste paper in 2017 (% shares, current USD)



Source: Intesa Sanpaolo processing based on Comtrade data

From the importers' perspective, the situation is even more concentrated, with China receiving 50% of world imports of waste paper. In the ranking of the 10 top importers we find, then, other emerging countries such as India, Indonesia and Mexico, as well as numerous European countries starting from Germany (that ranks second with 7.5% of world flows). Italy ranks only fifteenth with a share below 1%.

Waste paper therefore ends up by travelling long distances: by considering the distances in kilometres between countries (measured from capital to capital in a straight line) for export flows in value, it can be calculated that waste paper in 2017 travelled on average 5600 km³⁶.

The concentration of international trade in waste paper is very high: the first 15 flows in 2017 by value covered more than 50% of global exports. In this connection, the flow of waste paper that from the United States takes the path to China stands out (17.2% of total world exports in 2017), a country that appears as a partner of 7 of the largest export flows in 2017. It is worthwhile to note the US shipments to two other emerging countries, India and Mexico, but also the interchange with Korea and Canada. Even within Europe, however, there are exchanges of waste paper between France and Spain and between the Netherlands and Germany (in both directions), also related to the main ports of departure and arrival of goods from China being located in the

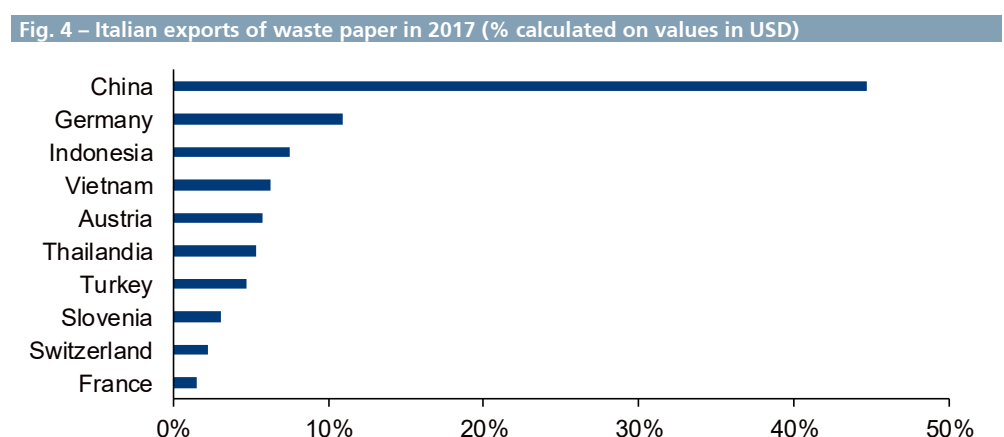
³⁶ A similar analysis recently conducted on the exports of Italian industrial districts indicates an average distance of about 3,200 km. Intesa Sanpaolo "Economics and Finance of industrial Districts" No. 11, 2018.

Netherlands. Italy is also among the main exporters, with a result of USD 157 million directed towards China, representing around 45% of the Italian exports of waste paper in 2017.

The scenario outlined by the statistics updated to 2017 could, however, be strongly modified when the 2018 data are available. In fact, **as a result of the measures introduced by China, starting from the first of March 2018, the situation has changed radically: China has adopted new and rigid quality standards, which provide for a maximum level of contamination of waste paper equal to 0.5 %.** Chinese imports, traditionally of low quality, have therefore been reduced. The Chinese stricter quality standards are substantially modifying the distribution among countries of the commercial flows of waste paper (with the other Asian countries absorbing increasing amounts of flows) and are causing significant difficulties in the global paper and board recycling chain. As for Italy, which exported most of its low-quality waste to China, the risk of hindering waste sorting collection is outlined together with the risk of saturating storage capacity and disposal of recoverable materials in landfills.

Exporter	Importer	Million USD	% Share of the total
USA	China	1,71	7.2
Japan	China	524	5.3
UK	China	472	4.8
USA	India	377	3.8
USA	Mexico	346	3.5
Netherlands	China	220	2.2
France	Spain	187	1.9
Netherlands	Germany	174	1.8
Germany	Netherlands	171	1.7
USA	Korea	169	1.7
USA	Canada	158	1.6
Italy	China	157	1.6
Hong Kong	China	156	1.6
Canada	China	156	1.6
Canada	USA	152	1.5

Source: Intesa Sanpaolo processing based on Comtrade data



Source: Intesa Sanpaolo processing based on Comtrade data

Managing the recycling of packaging: CONAI – Rilegno and Comieco

The protagonists of the recovery of packaging waste in Italy are the supply chain Consortia.

By Laura Campanini

The packaging supply chain was among the first to be regulated in Europe as well as in the individual countries. In Italy, in the current regulatory framework, the principle of extended producer responsibility (EPR) is developed in a model where, according to the Testo Unico Ambientale³⁷ (hereafter referred to as TUA) packaging producers and users are entrusted in “achieving the final recycling and recovery goals” (Art. 220) and are required to “take back used packaging and collect secondary and tertiary packaging waste from private areas, and (...) to collect packaging waste delivered by the public service” (Art. 221). Packaging producers and users are therefore assigned the entire financial and management responsibility for the end-of-life of their products. These activities must be implemented through cooperation among all interested operators, both public and private (shared responsibility).

A fundamental role is played by CONAI (National Packaging Consortium), whose members, packaging producers and users, operate to guarantee the "achievement of the overall recycling recovery objectives and (...) the necessary coordination of the activity of waste sorting collection" (Art. 224). There are 6 supply chain consortia dealing with recovering and recycling of packaging; with reference to the supply chains surveyed in this report, the following ones are emerging:

- Comieco, which is the Consortium for the Recovery and Recycling of Cellulose-based Packaging (paper and cardboard). The companies of the paper value chains and paper transformation industry including producers, transformers and regenerators are among its associate members;
- Rilegno, which is the Consortium that has the task of recovering the wooden packaging waste and brings together all the producers in the category: suppliers of packaging materials; manufacturers of fruit and vegetable packaging, of pallets and industrial packaging; importers of packaging materials and empty wooden packaging; finally, companies recycling wooden packaging.

At present, it is compulsory to be a CONAI member to perform the collection of primary packaging, that is to say the packaging containing a single sales unit (the single bottle of water) and that flows into urban solid waste and is then collected by the public service manager.

For secondary and tertiary³⁸ packaging that can be included in the household and similar waste but which generally qualifies as special waste, it is not mandatory to be a CONAI member and individual producers can choose among:

- joining the consortium system;
- organizing an autonomous system, which must only perform the collection of the packaging of its members and guarantee this service throughout the national territory;
- creating a deposit refund system, which has remained unimplemented until today.

³⁷ Law n. 152/2006

³⁸ Secondary packaging groups a number of sales units (for example, the plastic wrap that holds the plastic bottle package together). Tertiary packaging is designed to facilitate the transport and handling of a certain number of sales units (e.g. plastic films used for packaging large quantities of goods)

5. The wood-paper production chain in Southern Italy

5.1 Introduction

Wood and paper production chains, as described in the previous chapters, represent an important element of bioeconomy, above all in terms of circularity. Key elements appear to be the geographic aspect: building ways towards full circularity is possible in local contexts only if all the players (institutions, enterprises, citizens) take full part in the process.

By Silvia Capasso e Agnese Casolaro

This chapter will analyse the wood and paper chain in the south of Italy, where the regions are likely to take up the challenge of a circular bioeconomy. While still appearing very far from the central-northern regions in terms of figures, as a matter of fact, southern regions are showing signs of awareness towards growth; an example is represented by Rete 100% Campania, a sort of environmental friendly district created in Campania with the purpose of gathering the strength of the single enterprises and of increasing, by so doing, its positive effect in the area. Or, again, if we think about the fact that data related to paper and cardboard recycling have registered in the recent years more increasing trends compared to those of the Central-Northern regions.

The wood sector, although not highly representative if compared to the entire national sector, is showing for the southern regions an entrepreneurial network (enterprises and operators) considerably more influential on the regional economy than in other areas.

There are regions in the South showing signs of interest and desire to converge with the remaining areas in the Country, more oriented towards circular economy. The South has all the necessary potential to succeed in this project, so the next step of paramount importance will be to exploit this potential, in order to bridge the existing gap.

5.2 The wood processing sector in the South of Italy

In the wood processing sector³⁹, excluding the furniture chain, there are a lot of companies specialized in manufacturing finished or intermediate products with different characteristics in terms of quality. Specifically, the internal production shows a clear predominance of low-quality products destined to energy-producing purposes, such as firewood (see also chapter 2).

Therefore, a segmentation of the production partly characterizes the single territorial enterprises, even if it does not affect the value the sector has on them.

In terms of enterprises, indeed, the southern ones of the sector account for 7,8% of the entire manufacturing sector, compared to 6,6% at national level, reaching 10,1% in Calabria and 13% in Sardinia.

However, wood processing enterprises in the south of Italy, as a whole, account for 10.236 (equivalent to 31,8% of the national figure) and are broadly distributed throughout the entire territory. Sicily and Campania are the regions where their presence reaches the highest percentage of over 45% of all the southern enterprises of the sector, representing, as well, 14,5% of the entire domestic industry.

³⁹ With reference to the code Ateco C 16 "Manufacture of wood and of products of wood and cork (except for furniture); manufacture of articles of straw and of plaiting materials" including both "sawmilling and planing of wood" and "manufacture of products of wood, cork, straw and plaiting materials".

In comparison with the past, the industry has registered a contraction with a ten-year decrease of 30,4% in the south, against a national average value of -27,2%.

Tab. 5.1 - Wood processing enterprises (2018)

	Active enterprises	% on total Italian enterprises	% on total manufacturing sector
Italy	32.142		6,6
Central and Northern Regions	21.906	68.2	6.2
Southern regions	10.236	31.8	7.8
Abruzzo	799	2.5	6.8
Molise	170	0.5	7.9
Campania	2.567	8.0	6.5
Apulia	1.752	5.5	7.0
Basilicata	350	1.1	9.3
Calabria	1.193	3.7	10.1
Sicily	2.091	6.5	7.6
Sardinia	1.314	4.1	13.0

Source: SRM on Movimprese data

As far as the number of persons employed in the sector is concerned, the South of Italy is less representative. According to the latest available data, the Southern regions account for around 20% of the national figure: that means 20.477 units, almost half of which are based in Campania and Apulia.

In respect of the whole manufacturing sector, the percentage is 4%, which, is, however, higher than the national average percentage (2,8%) also in this case, and reaches 7,3% in Calabria and 8,8% in Sardinia.

Tab. 5.2 – Wood sector employment (2016)

	Person Employed	% on Italy	% on total manufacturing sector
Italy	103.543		2,8
Central and Northern Regions	83.066	80.2	2.6
Mezzogiorno regions	20.477	19.8	4.0
Abruzzo	2.042	2.0	2.7
Molise	349	0.3	4.7
Campania	5.040	4.9	3.2
Apulia	4.219	4.1	3.6
Basilicata	750	0.7	3.7
Calabria	1.914	1.8	7.3
Sicily	3.496	3.4	4.3
Sardinia	2.666	2.6	8.8

Source: SRM on Istat datat

Moreover, if we observe the distribution of persons employed in the different categories of enterprises, the Southern Regions display a less structured organizational pattern compared to the rest of Italy, represented exclusively by SMEs. In detail, more than 65% of the employees refers to micro-enterprises (53,9% at national level), 26,5% to companies with 10-49 employees (31,9% for Italy) and the remaining share (6,9%) to companies belonging to the category with 50-249 employees (11,1%).

If we consider single regions, small enterprises are predominant in Molise and Calabria, where the entire number of operators refers to companies that do not exceed 49 employees.

Tab. 5.3 – Person employed in the wood sector by employment size class (% , 2016)

	0-9	10-49	50-249	250 and more	Person employed (n.)
Italy	53.9	31.9	11.1	3.1	103,543
Central and Northern Regions	50.7	33.2	12.2	3.8	83,066
Mezzogiorno regions	66.7	26.5	6.9	0.0	20,477
Abruzzo	58.0	31.7	10.4		2,042
Molise	78.6	21.4	0.0		349
Campania	61.9	31.8	6.3		5,040
Apulia	67.3	28.1	4.6		4,219
Basilicata	65.6	26.7	7.7		750
Calabria	75.7	24.3	0.0		1,914
Sicily	76.1	22.1	1.8		3,496
Sardinia	61.2	17.8	21.0		2,666

Source: SRM on Istat datat

Overall, the average size of a company for Southern Regions is represented by 2,8 employees, against 3,8 in Italy and 4,2 only for Central and Northern Regions.

An estimated Value Added of 600 million euros is associated to such a productive pattern, 13,5% of the entire national sector, that represents 2% of the Value Added of the manufacturing sector of the Southern Regions (1,9% Italy).

When it comes to the single regions, Campania and Apulia are the most representative ones, as, together, they account for 45% of the Added Value of the manufacturing sector of the macro area. Moreover, if we take a closer look at each regional economy singularly, Calabria and Sardinia stand out with values that are far above the average of the macro area (4,4%for the former and 5,8% for the latter).

Tab. 5.4 – Estimated valued added in the wood industry in Mezzogiorno regions (2016)

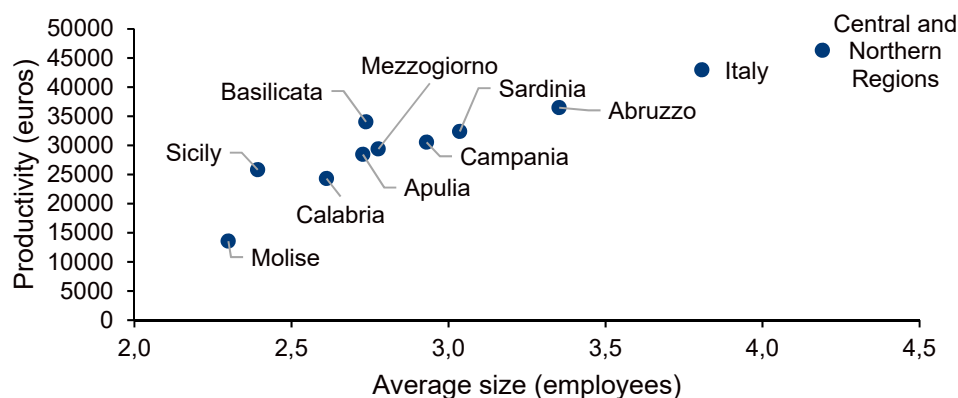
	Estimated VA Mln euro	% on Italy	% on total manufacturing sector
Italy	4.448.2		1.9
Central and Northern Regions	3.847.2	86.5	1.9
Mezzogiorno regions	601.7	13.5	2.0
Abruzzo	74.5	1.7	1.5
Molise	4.7	0.1	0.8
Campania	153.9	3.5	1.7
Apulia	120.0	2.7	1.8
Basilicata	25.5	0.6	1.4
Calabria	46.5	1.0	4.4
Sicily	90.2	2.0	2.1
Sardinia	86.3	1.9	5.8

Source: SRM on Istat datat

The apparent productivity of the sector (value added per employee) equals 29,383 euros, which is lower than the national average figure (42,960 euros). If we consider each single region, Abruzzo (36,480 euros), Basilicata (34,035 euros) and Sardinia (32,385 euros) stand out.

The data shows how productivity of the sector is higher in areas where there is a more structured entrepreneurial pattern; that is, it increases as the average company size increases. The factor of company size is confirmed as a driver of development and the Southern Regions, as a consequence, are penalized by the lack of large enterprises, with a considerable gap if compared to the rest of the country.

Fig. 5.1 – Average size and productivity in the wood sectors (2016)



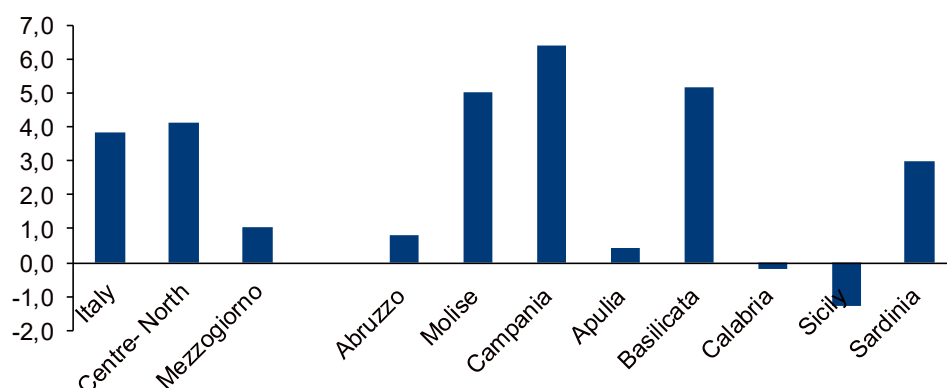
Source: SRM on Istat data

In terms of the sector turnover⁴⁰, the main Southern Regions are Campania and Apulia. The analysis carried out shows, indeed, that together they represent 50% of the 2007 sample turnover, equal to almost 800 million euros.

Southern Regions account for just over 10% of the national figure and are growing at a slower pace compared to the rest of Italy. The average turnover variation in the period 2014/17 amounts to 1,1% against +3,8% for Italy. Moreover, while at national level an increasing trend has been observed over the last three years, in the Southern Regions a drop has been registered since 2016, when an inversion in the trend occurred, if compared to the past (-2% in 2016 and -1.4% in 2017 against +6.6% in 2015).

When it comes to each single region, the trend has fluctuated over time and, except for Apulia (-0.2%) and Sardinia (-1.3%) this has led to a positive change over the last few years.

Fig. 5.2 – Average turnover % change in the wood industry 2014-2017



Source: SRM on AIDA-BVD

However, as we have already mentioned, Southern Regions and, more generally speaking, our Country are characterized by a limited availability of raw material, that makes it necessary for

⁴⁰ For the analysis, 752 enterprises have been extracted from AIDA-BVD as a sample (3.406 at a national level) belonging to Ateco code C 16 and having available turnover for the last 4 years (2014-2017).

companies to turn to the international market, in order to completely fulfil the internal demand and to increase production of destined to export.

This scenario determines a negative trade balance for Southern Regions amounting to more than 194 million euros. All the Southern Regions, except Sardinia, show similar trends.

In detail, the area imports wood products for more than 273,8 million euros, against an export of 79,8 million euros (on total Italy bases 8,2% imports and 4,3% exports).

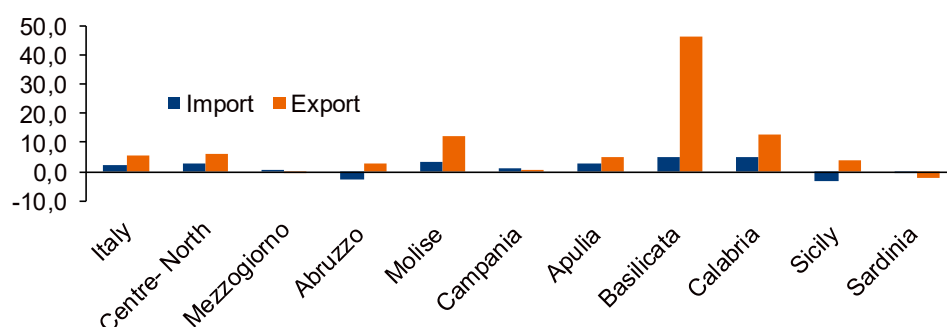
Tab. 5.5 – Foreign trade in the wood industry (2017)

	Import		Export		Balance Euro
	Euro	% on Italy	Euro	% on Italy	
Italy	3.331.029.671		1.838.764.381		-1.492.265.290
Central and Northern Regions	3.054.459.293	91,7	1.755.159.486	95,5	-1.299.299.807
Mezzogiorno	273.831.071	8,2	79.809.972	4,3	-194.021.099
Abruzzo	37.875.530	1,1	11.824.449	0,6	-26.051.081
Molise	4.338.941	0,1	3.113.988	0,2	-1.224.953
Campania	75.260.769	2,3	30.288.716	1,6	-44.972.053
Apulia	53.772.353	1,6	5.354.366	0,3	-48.417.987
Basilicata	6.026.900	0,2	1.085.397	0,1	-4.941.503
Calabria	32.074.613	1,0	3.288.607	0,2	-28.786.006
Sicily	49.309.191	1,5	3.452.285	0,2	-45.856.906
Sardinia	15.172.774	0,5	21.402.164	1,2	6.229.390

Source: SRM on Istat datat

Compared to the past, the last decade has registered a substantially stable yearly average growth rate (with a significantly different scenario at regional level) against a national picture showing a higher growth rate (+2,5% average yearly bases for import and +5,7% for export).

Fig. 5.3 – Foreign trade in the wood industry: average % change 2009-17



Source: SRM on Istat datat

Finally, analysis on partner Countries shows a considerable concentration of incoming and outgoing goods. Although international trade in Southern Regions in the wood sector reaches a large number of countries (82 for imports against 123 at national level and 113 for exports against 183 for Italy), it is mainly concentrated on a limited number of partners: the top 5 supplying countries account for over 60% of the incoming flows in the southern regions and the top 5 destination countries for wood products (excluding furniture) absorb over 50% of total exports.

Tab. 5.6 – Wood industry foreign trade: top partner country by regions (% , 2017)

Top 5 supplier Countries			Top 5 Countries of destination		
Mezzogiorno		Italy	Mezzogiorno		Italy
Austria	39.1	Austria	26.9	USA	11.4
Russian Fed.	7.2	Germany	9.0	France	11.1
China	6.3	France	5.9	Spain	10.7
Germany	5.1	China	5.3	China	10.4
Bulgaria	4.2	Poland	4.9	Germany	6.6
Total	62.0	51.9	50.2		50.2

Source: SRM on Istat datat

The available data for 2018 (referring to the first nine months of the year) describe a similar situation with a negative trade balance, a representation of the area on the total Italian data equal to 7.7% in terms of imports and 4% in terms of exports and a decreasing trend compared to the same period of 2017 (-1.5% for imports and -2.9% for exports).

5.3 The paper industry in the Southern Regions

Almost one quarter of the national paper processing companies⁴¹ is located in the Southern Regions; in detail, there are 1,010 companies out of a total of 4,228 which account for less than 1% on the entire manufacturing industry of the area.

The paper and cardboard manufacturing sector represents over 90% of the total. The territorial distribution of companies shows a more or less significant presence in all the southern regions with Campania accounting alone for about 40% of the total (393 companies).

The trend of the last few years, also in this case, shows a contraction of the market, with a ten-year drop of 9.4% (-11.5% the national average figure); this trend may also be found at the level of individual regions, with the exception of Molise, which, compared to 2009, saw an increase in the number of companies in the sector on its territory (from 15 in 2009 to 17 in 2018).

Tab. 5.7 – Active firms in the paper industry (2018)

	Active firms	% weight on Italia	% weight on total manufacturing
Italy	4.228		0.9
Central and Northern Regions	3.218	76.1	0.9
Mezzogiorno	1.010	23.9	0.8
Abruzzo	98	2.3	0.8
Molise	17	0.4	0.8
Campania	393	9.3	1.0
Apulia	180	4.3	0.7
Basilicata	26	0.6	0.7
Calabria	71	1.7	0.6
Sicily	196	4.6	0.7
Sardinia	29	0.7	0.3

Source: SRM on Movimprese

According to the latest available data, if we consider the number of employees in the sector, 9,646 units are located in the Southern Regions, that means 13.5% of the national total and mostly related to Campania, which absorbs about 43%. Compared to the entire manufacturing sector,

⁴¹ Referring to code ATECO C 17 "Manufacture of other articles on paper and paperboard" that includes to items "Manufacture of pulp, paper and paperboard" and "Manufacture of articles on paper and paperboard".

operators in the southern paper industry account for 1.9% (in line with the Italian figures), although, in some areas (Campania 2.6%; Abruzzo 3,4%) they reach a higher percentage.

Tab. 5.8 – Person employed in the paper industry (2016)

	Person employed ⁱ	% weight on Italy	% weight on total manufacturing
Italy	71.192		1.9
Central and Northern Regions	61.546	86.5	2.0
Mezzogiorno	9.646	13.5	1.9
Abruzzo	2.550	3.6	3.4
Molise	69	0.1	0.9
Campania	4.168	5.9	2.6
Apulia	1.542	2.2	1.3
Basilicata	57	0.1	0.3
Calabria	166	0.2	0.6
Sicily	884	1.2	1.1
Sardinia	211	0.3	0.7

Source: SRM on Istat data^t

Furthermore, observing the distribution of employees by size, Southern Regions show a more structured entrepreneurial pattern than the one observed for the wood processing sector with, for example, the presence of large companies. In fact, 28.4% of employees in the southern sector (almost in line with the national figure of 28.7%) refer to this type of business. SMEs absorb the remaining 71.6%.

If we consider individual regions, large companies are concentrated in just three areas (Abruzzo, Campania and Apulia). In Abruzzo, in particular, operators linked to large companies represent about 62% of the regional total amount of the sector, a figure well above the average, not only in the area but also at national level⁴².

Tab. 5.9 –Persons employed in the paper industry by employment size class (% , 2016)

	0-9	10-49	50-249	More the 250	(n. persons employed)
Italy	11.5	29.3	30.4	28.7	71.192
Central and Northern Regions	10.2	29.3	31.6	28.8	61.546
Mezzogiorno	19.7	29.1	22.8	28.4	9.646
Abruzzo	6.7	17.6	13.8	61.9	2.550
Molise	38.8	61.2	0.0	0.0	69
Campania	15.5	28.0	35.6	20.9	4.168
Apulia	26.0	41.4	13.9	18.7	1.542
Basilicata	54.3	45.7	0.0	0.0	57
Calabria	63.6	36.4	0.0	0.0	166
Sicily	51.8	41.1	7.1	0.0	884
Sardinia	28.3	29.8	41.9	0.0	211

Source: SRM on Istat data

Overall, the average company size for Southern Regions is 11.8 employees, against 18.9 for Italy and 20.9 for Central and Northern Regions. It is, however, necessary to specify that the figure from the south is linked to very diverse regional contexts, with Abruzzo reaching an average size of 33.5 employees, Campania of 14.4 and the remaining regions that do not exceed 10 employees per company.

⁴² Specifically, the presence of FATER S.p.A., a company specialized in the manufacture of absorbent hygiene products, has an impact on the analysis, which by 2017 has 1,383 employees (Source: AIDA-BVD).

Considering this productive pattern, Southern Regions register an estimated Added Value for the sector of almost 880 million euros, equal to about 15% of the national total amount, in addition to 2.9% of the A.V. registered for the entire manufacturing sector in the area.

It is possible to observe, how, at regional level, 80% of the Value Added of the area's paper industry is concentrated in just two regions, Abruzzo and Campania, whose paper industry sector accounts for a higher percentage on the total manufacturing sector than both the southern average and the national ones (8.2% for Abruzzo and 3.3% for Campania).

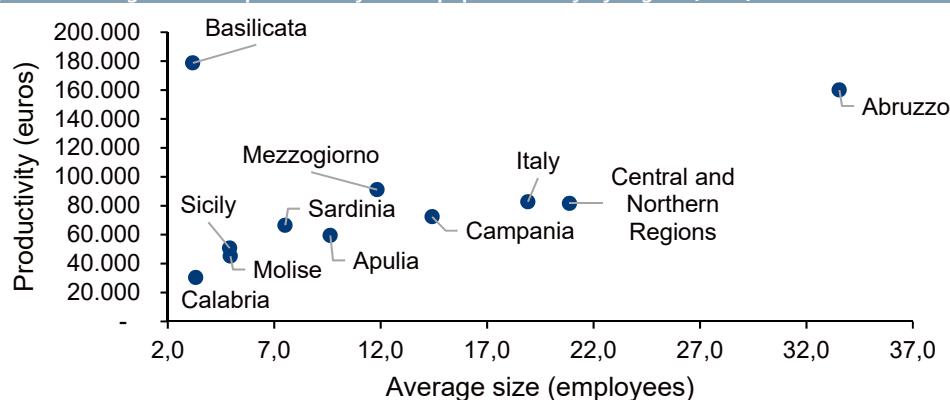
Tab. 5.10 – Estimated Value Added of the paper industry in Southern Regions (2016)

	Estimated value added Mln euro	weight % on Italy	% weight on total manufacturing
Italy	5.885.2		2.5
Central and Northern Regions	5.018.7	85.3	2.5
Mezzogiorno	878.3	14.9	2.9
Abruzzo	408.0	6.9	8.2
Molise	3.1	0.1	0.5
Campania	301.4	5.1	3.3
Apulia	91.7	1.6	1.4
Basilicata	10.2	0.2	0.6
Calabria	5.0	0.1	0.5
Sicily	44.8	0.8	1.0
Sardinia	14.0	0.2	0.9

Source: SRM on Istat data

The productivity of the sector equals 91,047 euros, a higher value than the national average (82,667 euros), which is affected by data from Abruzzo and Basilicata equal, respectively, to over 160,000 and 178,000 euros. Such figures, partly unusual if we consider the average of the area, are connected, in the first case, to the relevance of the added value (the region absorbs about half the entire southern Added Value) and, in the second case, to the low number of existing employees.

Fig. 5.4 – Average size and productivity in the paper industry by region (2016)



Source: SRM on Istat data

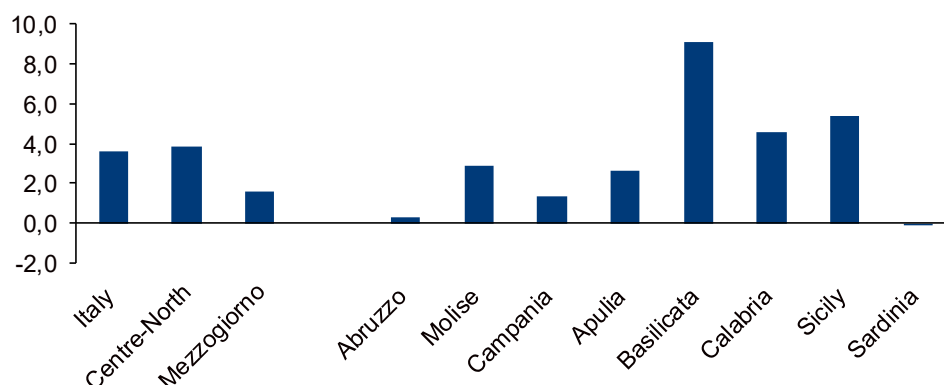
Abruzzo stands out, even if we consider the sector turnover⁴³ of the area; in fact, it is the region of greatest relevance with 52.3% of the total amount, equal to approximately 2.6 billion euros. Campania also performed well, representing 22.8%.

⁴³ To perform this analysis AIDA-BVD took a sample of 308 factories (1.847 at national level) belonging to ATECO code C17 and having available the turnover of the past 4 years (2014-2017).

The Southern Regions also represent 13.3% in absolute national term and show a smaller growth than the one recorded for the entire Country. In detail, the average variation in turnover in the recent years has been equal to + 1.6% against +3.6% for Italy.

Such percentages result from very different regional scenarios with a range from -0.1% in Sicily (the only region with a negative average trend) to + 9.1% in Molise.

Fig. 5.5 – Paper processing companies average turnover variation for the period 2014-17 (%)



Source: SRM on AIDA-BVD

As far as foreign trade is concerned, despite a considerable share of the fibres used by the paper factories derives from recycling (over half of the total required amount at national level), the sector highly relies on foreign countries.

For the Southern Regions, in fact, there is a negative trade balance of almost 280 million euros, determined by a volume of imports equal to about twice the exported one. All regions of the South, with the exception of Molise, show a similar trend.

In detail, imported paper products in the area account for almost 640 million euros, compared to exports of 361.7 million euros and account on the total of the Country for 9.2% in terms of imports and 5.4% in terms of exports.

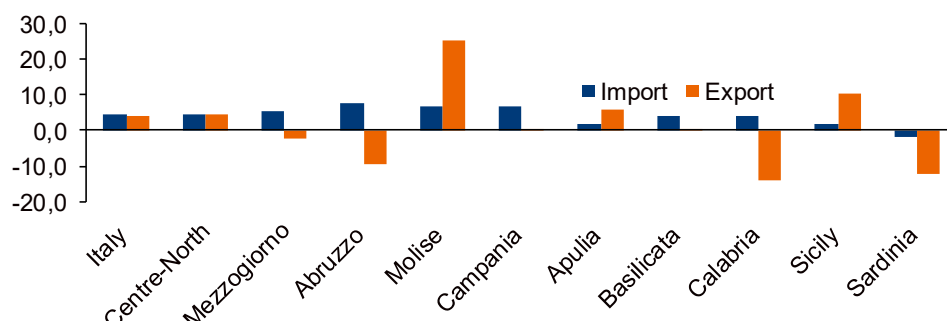
Over 80% of imports refer to the category of semi-finished pulp-paper, paper and cardboard (83.4% for Southern Regions compared to 83.1% for Italy) and only the residual portion refers to paper and cardboard items. On the other hand, about three-quarters of exports (77.3% against 48.4% nationally) are reported for finished products. This confirms how much the southern paper industry needs raw materials from abroad, not only to satisfy domestic consumption but also to support exports of products that are *made in Italy* (see also chapter 3).

Tab. 5.11 – Foreign trade in the paper industry: import, export and balance (2017)

	Import		Export		Balance euro
	Euro	% on Italy	Euro	% on Italy	
Italy	6.951.538.233		6.730.470.630		-221.067.603
Central and Northern Regions	6.311.846.974	90,8	6.349.813.753	94,3	37.966.779
Mezzogiorno	639.674.259	9,2	361.694.413	5,4	-277.979.846
Abruzzo	236.166.583	3,4	57.341.051	0,9	-178.825.532
Molise	7.699.793	0,1	12.334.003	0,2	4.634.210
Campania	285.266.827	4,1	251.294.387	3,7	-33.972.440
Apulia	45.541.873	0,7	19.688.745	0,3	-25.853.128
Basilicata	13.052.407	0,2	10.417.971	0,2	-2.634.436
Calabria	8.776.255	0,1	229.764	0,0	-8.546.491
Sicily	30.497.595	0,4	7.782.460	0,1	-22.715.135
Sardinia	12.672.926	0,2	2.606.032	0,0	-10.066.894

Source: SRM on Istat data

Fig. 5.6 – Foreign trade of the paper industry (average % change 2009-17)



Source: SRM on Istat data

Finally, the analysis of commercial partners shows a considerable concentration of incoming and outgoing goods flows in Southern Regions also for this sector. While reaching a vast number of countries (66 for imports against 99 at the national level and 124 for exports against 194 of Italy) the international trade of the paper sector is mostly concentrated on a small number of partners: the top 5 supplier countries represent over 60% of incoming flows in the southern regions and the top 5 countries of destination of paper products absorb 51.2% of the total amount of exports.

Tab. 5.12 – Il commercio con l'estero del settore cartario: principali Paesi partner (peso %, anno 2017)

Top 5 supplier Countries			Top 5 Countries of destination		
Mezzogiorno		Italy	Mezzogiorno		Italy
Germany	20.3	Germany	18.2	France	18.4
USA	18.4	Sweden	10.0	Germany	14.7
Sweden	10.1	France	8.7	UK	7.4
Austria	7.2	Brazil	8.1	Spain	6.2
Finland	4.5	USA	6.8	Netherlands	4.5
Total	60.5		51.7		48.5

Fonte: elaborazione SRM su dati Istat

The available data for 2018 (referring to the first nine months of the year) describes a similar situation with a negative trade balance and a representation of the area on the total amount for Italy equal to 9.2% in terms of imports and 5.5% % in terms of exports.

Furthermore, compared to the same period of 2017, imports show a further increase of + 13%, while exports, deviating from the average of the last decade, grow by 2.6%. Therefore, recovery of the export trend started in 2017 and is still ongoing, indicating a growing competitiveness in the productive pattern, despite fierce international competition.

An example of circular territorial economy: the Network *Rete 100% Campania* for sustainable packaging ⁴⁴

Established in 2013, *Rete 100% Campania* is a Network that brings together six companies from Campania for the creation of what can be interpreted as a true green district. It is an aggregate paper supply chain that offers packaging with reduced environmental impact, starting from the

By Salvio Capasso e Agnese Casolaro

⁴⁴ For further information on the *rete*: www.packagingsostenibile.com

recovery of waste to finished products with a production capacity of 200 thousand tons a year (well beyond the current amount of wastepaper in the region). All this starting from a production structure that, as a whole, reaches a turnover of 120 million euros and can count on 350 employees.

Tab. 1 – The companies of the network

Antonio Sada & Figli	Manufactures corrugated cardboard packaging with high quality features and added value for major Italian and multinational companies.
Cartesar	Specialized in the production of paper for corrugators made exclusively from the wastepaper deriving from citizens' recycling in Campania.
Sabox	Specialized in designing and producing corrugated cardboard packaging for the pasta-making sector.
Sada Packaging	Sada Group's folding boxboard production unit among the first companies in Europe able to print offsets directly on microcorrugated cardboard.
Greener Italia	It creates value through the integration of sustainability in the corporate strategy, in the operating model, in the processes and systems of customer organizations.
Formaperta	It designs and produces furnishings, objects, promostands and exhibition stands according to the principles of eco-design packaging, using mainly recycled cardboard.

Source: www.packagingsostenibile.com

Starting from wastepaper, the Rete's activities aims to develop innovative and sustainable products according to local value chain, thanks to which it is possible to support the territory itself.

The activity starts, therefore, from the collection of wastepaper at customer-plants; this is then recycled in the vicinity of the companies belonging to the network and returns to the client companies in the form of packaging, ensuring that the entire value chain remains in the territory.

Among the various projects, we can mention the partnership signed by the Rete with Comieco, Municipality of Gragnano, Associazione Gragnano - city of pasta, to increase separate waste collection and the correct launch of paper and cardboard recycling campaigns, involving the pasta packaging chain. In fact, Gragnano is the headquarters of several companies that produce and use cellulose packaging for packaging and shipping. This agreement aims at developing a circular economy, where paper and cardboard produced for pasta canning are used, recycled and re-used in the same place.

A proximity transformation cycle is put in place with a considerable economic value: if we think that 100 thousand tons of paper from waste sorting, if worked on site, create 300 job positions and over 80 million euros of added value.

Furthermore, it should be highlighted how the common action underlying the *Rete* gives the network a new productive force that goes far beyond the one of individual companies. A multiplicative force comes into play (linked, among other things, also to the concept of supply chain) which, by making it possible to increase the volumes of processed paper, acts as a further incentive for the promotion of an ever more careful and intense sorting of the waste.

The Network *Rete 100% Campania* is therefore a model for integrating the activities and phases of the paper and cardboard production process, where the individual participants work together in synergy, to the point of forming the Charter Ecosystem. The ultimate goal is to activate a circular economy business model capable of creating value and employment in the area while respecting the environment. In fact, the paper recycling and re-use on site creates a virtuous circle that influences positively the local economy as well as the ecosystem.

Paper and cardboard recycling in the Southern Regions⁴⁵

By **Salvio Capasso and Agnese Casolaro**

Recycling is the basis of the circular economy system and the Italian paper industry represents a best practice. The international comparison of data presented in chapter 4 highlights the good positioning of Italy among the main European countries. In fact, according to the last annual COMIECO report, in our country, the attention to the correct management of post-consumer materials is growing together with the waste sorting and recycling activities that have now become daily routine.

The Southern Regions, however, still show a significant gap with the Central and Northern Regions. If, in fact, we consider the pro capita recycling data of paper and cardboard, in the southern regions we reach 35 kg per inhabitant, while in the remaining areas of the country this figure exceeds 60 kg (54.2 kg the national average figure).

In terms of single areas, there are, however, cases that are more in line with the Central and Northern Regions (in Abruzzo the *pro capita* figure equals 59.5 kg) or, in any case, show performances higher than the average of the macro area: Sardinia and Apulia recorded 50 and 41.8 kg of separate waste collection *pro capita* respectively. However, the situation in the remaining regions is still complex, particularly in Sicily and Molise, which show considerably lower data than the average (22 kg in the first case and 24 kg in the second). These are realities that need particular attention, in which there is still a lot of work to do, in order to be able to talk about virtuous paths of paper and cardboard recycling.

Tab. 1 - Municipal separate waste collection of paper and cardboard for Southern Regions

	Paper sep.waste coll 2017 (tonn)	% ch. 2016/17	Separate coll.pro capita (kg)
Italy	3.262.495	1.6	54.2
North	1.736.719	-0.1	63.3
Centre	801.162	1.6	67.4
Mezzogiorno	724.614	6.1	34.7
Abruzzo	79.440	6.5	59.5
Molise	7.711	6.4	24.0
Campania	182.809	0.6	31.3
Apulia	170.338	5.7	41.8
Basilicata	21.723	6.4	36.8
Calabria	68.000	7.2	33.9
Sicily	111.051	16.1	22.0
Sardinia	83.542	5.7	50.0

Source: COMIECO 2018

The data, however, show how the South contributes for more than three quarters to the additional national volumes of 2017, even though it only accounts for 22.2% of the country's overall stock.

The Southern Regions represent therefore the area with the best performance in the period 2016-17 with a growth of 6.1% (+ 1.6% for Italy) supported, among other things, by a series of targeted interventions that the Consortium has been carrying out, for some years now, to support the development of the separate waste collection. Estimates for 2018 follow this scenario with Southern Regions growing at a quadruple rate compared to Central and Northern ones (+ 6.9% compared to + 1.4%).

⁴⁵ Data by COMIECO 2018

However, the described gap raises the need for greater attention; hence the presence of special projects performed, as already mentioned, to give a boost to separate waste collection in this area.

Among such projects, the Plan for the South (sponsored by the Ministry of the Environment and the Protection of the Territory and the Sea) for the purchase of equipment and vehicles to support the separate collection of paper and cardboard in larger companies, and the ANCI-Comieco Call in smaller companies.

Both these tools had a significant impact on the territory. If we think that, through the ANCI – Comieco Call for Proposals, in the period 2014-2017, the Consortium committed medium-small municipalities for over 6.2 million euros and 221 out of 272 municipalities involved are from the South.

The bioeconomy as an opportunity for developing Southern Regions: towards a new catching up?

The ability of Italy to identify its own role in the international competition passes also from how its economic pattern and in general the whole of the country-system will be able to exploit the potential of new productive and technological models, combining them with the potential, richness and skills that the territory already has.

By Luca Bianchi, Amedeo Lepore and Stefano Palermo

After having missed the international economic recovery of the late nineties, the Country cannot lose the opportunities now offered by this new productive revolution. If, for the first phase of globalization between the late 1980s and the early 2000s, one of the most important aspects was the ability of traditionally more advanced countries to exploit the opportunities offered by the opening of the markets and the ICT revolution, starting from the last decade, the rise of the players of the new global economy players and the further evolution of the technological revolution towards the development of industry 4.0 and the digital economy require - especially for countries like Italy – reassessing their own forms of economic and productive organization. Especially following the great recession of the years 2007-2014, there were new differences between companies and territorial areas better able to meet the double challenge of innovation and internationalization compared to those still linked to more traditional models. A division in some cases, as we will see later, not necessarily corresponding to the traditional North / South divide. The possibility for the Country to fully grasp the opportunities of the new industrial revolution in progress will derive - as in all phases of transformation of economic systems - from different internal and external factors: first, from the ability to enhance the wealth of resources and competences available and functional to fit into the new competitive arena; secondly, by favouring the conditions necessary for the development of new production models with specific public policies, investments in tangible and intangible infrastructures; thirdly, from the absolute need to complete (and in various cases to start) a deep transformation of the productive pattern, useful to promote its repositioning in the most advanced global value chain, redefining the role of the enterprises, the players involved in future growth and new ways of working.

The revolution in production can benefit from some existing favourable preconditions throughout the Country and, also in Southern Regions, where in recent years sectors, companies, models linked to circular economy and bioeconomy have developed, which is completely new if compared to the most recent past. Hence the possibility that bioeconomy and circular economy could represent a new opportunity for development in the South, making it easy for the economy of these regions to keep up not only with the rest of the Country, but also with the most advanced economies in the current international scenario, as in the years of “the economic boom”, a period of great transformation.

Circular economy, bioeconomy and economic development from a diachronic perspective.

Between the end of the twentieth century and the first two decades of the new millennium, industrially advanced countries experience a series of structural transformations in the relationship between innovation, development and reorganization of social processes. The impact of these changes involves more and more directly even those countries that a few years before used to be considered as developing or second comers, and it defines the boundaries of a new industrial revolution.

The transition from the Fordist to the post-Fordist model, which started at the end of the 1970s, is in fact part of an overall transition that has affected the so-called "advanced economies" starting from the end of silver age. A path led by an array of factors and that has led to a process of industrial restructuring capable of marking a gap between those countries that are able to maintain or recover high productivity increases and those - for example Italy - which instead have gradually eroded the competitiveness gained during the golden age. The changes of these years are accompanied by a parallel review of economic theories, marked by the progressive abandonment of the neo-Keynesian model towards a neoliberal model, with a consequent reorganization of international relations on the basis of the so-called Washington Consensus criteria. In the last two decades of the twentieth century, this process of repositioning the industrial system was favoured and accelerated by two simultaneous elements: the expansion of new markets, made possible since the end of the Cold War, and the reorganization of their control and management models (for example with the establishment of the WTO and the European Union) and the ICT revolution, especially in the tertiary and financial sectors. Starting from 2010, on the one hand, there has been a progressive redefinition of the international geo-economic balance with the growth of the role of the new global players and, on the other hand, the digital revolution inside the "factory" and the development of a 4.0 Industry (C. Anderson, *Makers. The New Industrial Revolution*, New York, 2012; R. Varaldo, *The new match of innovation. The future of the industry in Italy*, Bologna, 2014; L. Beltrametti, N. Guarnacci, N. Intini, *The connecting factory. Italian manufacturing through and towards a 4.0 industry*, Milan, 2017).

To understand where this path of reorganization and growth of the international economic system meets the theory of circular economy, of which bioeconomy is an integral part, it is necessary to highlight the points of contact with the concepts of "environmental economy" and then of "sustainable development", which developed in conjunction with the above mentioned global transformations. After a number of early analyses, that mostly focused on the environmental damage of industrial development (R. Carson, *Silent spring*, Boston, 1962; B. Commoner, *The Closing Circle. Nature, Man, and Technology*, New York, 1971), in the following decade, a new perspective of investigation develops, also thanks to the observations contained in the MIT report for the Club of Rome in 1972 aimed at questioning a model of development based up to then on the assumption of low-cost and unlimited access to natural resources (D.L. Meadows, D.H. Meadows, J. Randers *The Limits to Growth*, Rome, 1972). Regardless of the discussion on the validity of those conclusions and forecasts (which perhaps underestimated the capability of technological innovation to allow access to resources at lower costs), the power of the report lies in the ability to make the incidence of economic costs clear, as well as environmental aspects of resource / development dynamics. In this context we can find the line of studies linked to the concept of "environmental economy" of which Nicholas Georgescu-Roegen was one of the main representatives and which, applying the principles of thermodynamics to the economy, intends to demonstrate how the use of fossil resources leads inevitably to a reduction of available resources and therefore to the entropy of the economic system. These are the scientific assumptions on which the concept of "sustainable development" is defined during the 1980s (WCED, *Bruntland Report*, Oxford, 1987). Starting from this scientific approach, during the rise of the third industrial revolution of the 1990s and the Twentieth Century – characterized, as Rifkin stated, by the ability to link the digital revolution to sustainable development (J. Rifkin, *The Third Industrial Revolution*.

How Lateral Power Is Transforming Energy, the Economy and the World, London, 2011) - the conceptual transition takes place first towards the "green economy" and then, in recent years towards the "circular economy". At the root there is the abandonment of that model of "linear economy" based on the use of raw materials to produce goods and services that are consumed and eliminated, in favour of another model founded on the continuous reproduction of the system, in which the products and the final wastes themselves are the starting point of another production cycle. This is a true systemic production revolution, potentially capable of affecting and driving the rest of the industrial pattern.

As mentioned by the Ellen MacArthur Foundation, the circular economy could favour a growth of 11% of world GDP by 2030, allowing a drastic reduction in carbon dioxide emissions equal to 48% of the total (Growth Within: A Circular Economy Vision for a Competitive Europe, 2015). The circular economy thus represents, in many respects, a new evolution in the interpretation of the "environmental issue", capable however of going hand in hand with the ongoing production transformations through the enhancement and the intake of the recent technological revolution and its effects on structural aspects of the economic system. This is because the transition to a circular model presumes the ability to adopt and foster an innovative impulse capable of involving the different stages of production, distribution and consumption, thus involving the design, the factory organization, methods for transforming the products (and waste), widespread consumption patterns. Therefore, a transformation based not only on the concept of circularity, but also on the interdependence of the various production phases.

As in all phases of technological transition, the assumption of a new developmental model is possible only in the presence of a dual force. Top-down, through public policies capable to favour the necessary infrastructural endowment (material and immaterial) and to stimulate the remodelling of the productive pattern; bottom-up, through a reorganization process that directly affects companies and work, capable of challenging even consolidated models to favour technological transformation processes, (see EU, Documents on the Circular Economy Package, January 2018) and, at the same time, supported within Horizon 2020 by the enhancement of some projects focused on the application of innovative solutions for value production. The different sectors of the circular economy are also essential elements of the new Smart Specialization Strategy (S3) which informs about the 2014-2020 cohesion policy and its application on a national and regional scale, as shown by the indications contained in the various documents of Smart Specialization elaborated by the Italian Regions on the occasion of the launch of the planning of the ERDF, EAFRD and ESF 2014-2020 funds.

It is in this context that the development of bioeconomy has taken place in the last few years. Its centrality also derives from the ability to combine the issue of environmental sustainability of the developmental model with the innovations and needs present in some strategic sectors, such as agriculture, health and industry. The strength of bioeconomy lies in taking on and disseminating technologies that are useful for the sustainable production of renewable organic resources and the conversion of these resources and waste material flows into added-value industrial products.

It is estimated that for every euro invested in research and innovation in bioeconomy, the added value impact in the sectors will be equal to ten euros by 2025. These figures and indicative forecasts are based on the assumption, already reported by the OECD in 2009, of how bioeconomy can represent a push towards a new industrial revolution, capable of favouring innovation in mature sectors, such as materials raw materials, energy production and intermediates, while ensuring environmental, economic and social sustainability (OCSE, *The Bioeconomy to 2030. Designing a Policy Agenda*, April 2009).

Southern Regions' potential

According to the State Regions Conference, there are several reasons for the growth of bioeconomy on a national and regional scale (Document on the positioning of Autonomous Regions and Provinces on the bioeconomy in implementing the National strategy for Smart Specialization (SNSI), November 2016), favoured by the presence throughout the territory - and in the Southern Regions in particular - of wealthy and functional resources for the development of its productive sectors. In particular, it is useful to remember: the already excellent positioning of the Country in the agri-food and green chemistry sector; the strong appeal of the "Made in Italy" brand, also linked to different sectors of bioeconomy; the ease with which the transformation of some sectors can adhere to local production processes; the close relationship between the agricultural sector for food production and the chemical industry, for pharmaceuticals, cosmetics and biomass energy; the potential of the food and wine and food chain (from primary production, to processing, to distribution and consumption) with a high content of knowledge and skills; the dynamism of the chemical industry from renewable sources; the potential of blue economy and the sea bioeconomy; the presence of projects and technological clusters able to favour the development of some sectors linked to bioeconomy; the development of new production models and supply chains in the wood, paper and packaging sectors connected to the food sector.

The analysis of territorial aspects of the bioeconomy (see Institution for the Territorial Cohesion, *Bioeconomy in Italy. A unique opportunity to put back together again environment, economy and society*, 2016) confirms this interpretation by highlighting the great potential spread throughout the southern territory, where in recent years some specific chains and sectors of excellence have developed, which have already started a reconversion process not only in terms of production sustainability, but also of industrial reorganization from the perspective of bioeconomy.

In particular, this concerns the agri-food, wood, paper and packaging supply chain and, not least, the green chemistry, which sees the establishment of several experiences in Campania as part of bio-based productions (with the pilot plant of the GF Biochemicals in Caserta on the production of levulinic acid from biomass, with the biotechnological research centre of Novamont in Piana di Monte Verna and the headquarters at the CNR of Pozzuoli, in the Zoological Station Anton Dohrn); in Apulia (where significant university and startup spin-off projects are underway); in Sardinia (where the joint venture between Novamont and Versalis was established in Porto Torres in 2011 to build a biorefinery); in Basilicata (with the ENEA green chemistry research centre in Rotondella and with the development of the bioeconomy cluster), in Sicily (with the project for the recovery of the ENI refinery in Gela).

The growth of these sectors of the bioeconomy crosses, not coincidentally, the more general paths of the economic recovery of the Southern Regions after the great recession of the years 2007-2014. As it is known, in fact, during the so-called "twenty years of solitude" the planning policies that had replaced the extraordinary intervention in the early nineties failed to support the reduction of the gap between North and South. On the contrary, between the 1990s and the 2010s, the internal gap was substantially widened, as shown by the data on GDP growth, wealth distribution and infrastructural endowment and investments.

The process of outsourcing to third parties of the economy which, like the other advanced areas of the planet, has also affected the South since the end of the Seventies is combined, between the end of the twentieth and the beginning of the twenty-first century with the loss of competitiveness of the industrial sector (less innovative and undersized). The South is thus experiencing a new divergence within the Italian stagnation crisis of the recent years. The crisis in 2008 was triggered under such conditions, and in seven years led to a 13% decline in GDP in the South compared to - 7% recorded by Central and Northern Regions. In this context, a process of industrial downsizing is defined (marked by the withdrawal of some large production centres and by the downsizing towards the SME model of the productive pattern) together with a selection process. The brief recovery of the years 2015-2017, in which the Southern Regions experienced positive and higher growth rates than those of the Central and Northern Regions, is also based on the growth capacity of the companies that proved more resilient to the crisis and concentrated above all in some sectors such as automotive, clothing, aerospace, food and pharmaceutical industries. Many of these, therefore, linked not only to the dimension of the circular economy but of the bioeconomy itself. In this context, the entrepreneurial dynamism of Southern Regions in these sectors was also favoured by the fact that new companies were inclined to bridge the "production gap" created by the Italian long stagnation in recent years and the great recession of the period 2007-2014. In this way, for example, the distance between the South and the rest of the Country in the bioeconomy sector appears to be significantly lower than that found, for example, in the application of the 4.0 industry model.

Circular economy and bioeconomy represent two new elements of the international production system capable of defining the boundaries and criteria of the economic and social development in the coming years, its quality and durability. The new industrial revolution that we are experiencing is driven, under several aspects, by biological resources and industrial biotechnologies and it is likely to redefine the traditional boundaries between the primary, secondary and tertiary sectors, towards a re-composition in new areas based on ever closer vertical and horizontal interpenetration and integration of the various production sectors.

This transformation is already underway in the most advanced economies, even in the new global geo-economic scenario, which involves different sectors (just to quote a few examples, from automotive, to home automation, green building, life sciences, etc.) and that can potentially put Italy in a position to fill the currently existing gap with other European countries - first and foremost with Germany - as regards, for example, the reorganization of forms of enterprise and the adherence to the 4.0 industry. And this is not the only advantage, the consequences of this technological revolution are potentially wide and affect the dynamics of production as well as those of redistribution and, not less important, of social and territorial inequalities, increasingly linked to the issue of environmental quality and to sustainable development. As far as competitiveness is concerned, at national and international level, the ability to take on the challenge of innovation and to reconcile it with the relaunch even of the more traditional sectors of the economy, appears more and more as a decisive element, able to add important and transversal differences to the historical territorial existing ones. A dichotomy that is also affected by the selective effects of the great recession of 2007-2014 between the companies that were most ready to accept the challenge of change and those less attentive to these needs.

In the current configuration of the bioeconomy on a national scale, our Country has a good positioning, not only in terms of quantity but, above all, for the composition of the sectors and of those sectors affected by this productive transformation. And in this context, Southern Regions present some points of strength that can give hope not only to their diffusion and implementation in the coming years, but also to the development of a new production model in line with those of the most advanced economies. This is possible given the presence of some systemic preconditions that make the South a favourable place for the bio-economic innovation, such as: 1) the persistence of spaces and territories where it is possible to invest and intervene with new production models; 2) a wide network of companies, often linked to new large production centres and which, thanks to investments in these sectors, have been able to overcome the crisis and to accompany the recovery of the years 2015-2017; 3) the diffusion of talents and skills related to the different sectors of the bioeconomy, agri-food in the first place; 4) a widespread awareness, both among the operators and in the institutions of the importance of these issues for the future of the South (as demonstrated for example by the regulations inserted in favour of these sectors by the Regione Campania in the Regional Law n. 23 of 2017 on simplification). After many years, the Southern Regions thus seem to have the conditions to face the challenge of innovation and global competition with other national and international economic realities; adherence to the circular economy and bioeconomy models can therefore potentially accompany the South towards a new phase of catching up with the most advanced economies.

The goal and challenge must be to enhance the potential and the entrepreneurial experiences of Southern Regions, so that they become driving and supporting elements to the transformation of all the productive pattern. In order to do that, it is necessary to start with acknowledging the strengths and the weaknesses, and the contradictions that, if persisting, can slow down or hinder this path. Among the strengths we can find competences and the richness, both in terms of entrepreneurial abilities and technology transfer, displayed by the numerous active companies in the chain of the agri-food sector, of biochemistry, of green and pharmaceutical chemistry, of paper and of biotechnology. Among the weaknesses, there is the poor intensity of investments in research and development and technology transfer; a human capital still composed of few people

with university degrees and specialized in scientific disciplines and, that, when qualified, too often are pushed to move to other areas of the Country or abroad; last but not least, the social context, marked by the presence of distortions in public policy and organized crime that can drain resources originally destined to support these expanding sectors.

As a general rule, it seems necessary, first of all, to take on the indications contained in the European strategy, based on three main principles: investments in research, innovation, skills; greater interaction among public policies; strengthening of the markets and quality of the leading sectors of the bioeconomy.

At a national and regional level, on the contrary, it will be necessary to implement interventions based, on the one hand, on precise public policies and, on the other, on incentives and support for private investments for a reorganization of the production model. From an institutional point of view, the ability of the government, at different levels, to find balance and complementarity between the various policies to support the development of these sectors in the South will be decisive. According to the indications contained in the National Bioeconomy Strategy, it will be necessary to activate a national programme of interventions aimed at material and immaterial investments and including also fiscal support for the growth of southern industries, incentives for the creation of networks and supply chains, and the dissemination of a new business culture, to enhance the Clusters and the Competence Centres.

Considering also the current constitutional configuration and the distribution of European resources, some conditions make the role of the Regions crucial, from different points of view: 1) they are possible catalysts and promoters of a joint effort of the European Commission, the national government and local autonomies to identify complementary policies and instruments capable of stimulating the spread of technologies linked to bioeconomy and circular economy; 2) they can take incentivizing measures, that are supportive and do not substitute private capital; 3) they are stimulator of a new business culture and approach towards technology, innovation and sustainable growth in the society and new generations; 4) favouring the diffusion of an entrepreneurial ecosystem of innovation, useful to facilitate new start-ups, to spread experiences of technological transfer through pre-seed measures and new infrastructures for research; 5) favouring the birth of Bio-Communities or Bio-regions that take on certain sectors or projects of circular economy; 6) implementing the various measures and the different objectives also indirectly linked to circular economy and bioeconomy present in the regional S3.

From a merely entrepreneurial point of view, the challenge for a new catching-up can only be won through a renewed deal for the development of the Southern Regions to be signed between companies and the business world, assuming, within it the prevailing themes, precisely those of the spread of the circular economy and the bioeconomy. A deal to be applied concretely by encouraging companies to implement investment in technology and digitalisation policies, increasing the companies' size, establishing networks and supply chains, taking on the double challenge of innovation and internationalization as a reference master plan capable of driving the recovery of the South and with it the reduction of existing social and territorial inequalities.

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