



D2.1 Desk research and market needs.

**For a Woodworker expert in
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Summary

PARTNERS	2
SUMMARY	3
INTRODUCTION: GENERAL OVERVIEW ABOUT THE FURNITURE SECTOR AT EU LEVEL	4
CHALLENGES & THREATS & OPPORTUNITIES AT EU LEVEL	4
1. STATE OF ART OF THE W&F INDUSTRY AFTER THREE MAIN RECENT EVENTS	7
THE COVID-19	7
THE WAR IN UKRAINE AND THE SUBSEQUENT ENERGETICAL CRISIS	9
THE SUPPLY CHAIN DISRUPTION	10
THE SHORTAGE OF RAW MATERIALS	11
2. THE GREEN TRANSITION AND THE FURNITURE SECTOR	13
UPDATED EU RULES AND GUIDELINES (STANDARD AND VOLUNTARY REGULATION)	15
ECO-DESIGN PRINCIPLES	17
INNOVATIVE & SUSTAINABLE MATERIALS	19
<i>The De Sett SOFA</i>	19
<i>Meshlin's prepregs</i>	19
<i>Biobased materials</i>	20
INNOVATIVE & SUSTAINABLE PROCESSES	20
<i>Dismantlable Furniture</i>	21
<i>Modular/multipurpose furniture</i>	21
<i>Use new ways of binding materials together</i>	21
<i>Give biobased materials new properties</i>	21
CSR: THE SOCIAL IMPACT ON COMMUNITIES AND TERRITORIES	22
OCCUPATIONAL HEALTH & SAFETY	24
3. NATIONAL INSIGHTS	25
HUNGARY	25
ITALY	28
IRELAND	30
FRANCE	32
SPAIN (CATALONIA REGION)	35
CONCLUSIONS	39
SKILLS, COMPETENCES AND KNOWLEDGE REQUIRED BY THE W&F INDUSTRY AFFECTED BY THE GREEN TRANSITION	39
<i>Cabinet-maker and related workers – ISCO 7522</i>	39
<i>Furniture assembler – ISCO 8219s</i>	42
MARKET NEEDS AND TRAINING OFFER: A POSSIBLE MATCHING?	45
TABLES AND FIGURES	46
TABLES	46
REFERENCES	46
WEBSITE	47

Introduction: general overview about the furniture sector at EU level

The furniture sector is a very relevant sector for the EU economy, employing about 1 million workers in about 120.000 enterprises (composed at 99% by micro, small and medium size companies), generating an annual turnover of around €96 billion and producing 25% of world Furniture.

Europe is the world's second largest furniture market, with 26% of global consumption, second only to Asia-Pacific (43%) and larger than the North American market (23%). More than 80% internal furniture consumption in Europe comes from European manufacturers: Italy is the largest furniture producing country in the European Union with a production value of 22.365 million euros, followed by Germany, France, Spain, and the Netherlands¹.

The recognised creative capacity for new designs and the responsiveness to new demands give EU furniture manufacturers a good reputation worldwide: European industry can combine new technologies and innovation with cultural heritage and style and provides jobs for highly skilled workers. The EU is a world leader in the high-end segment of the furniture market. Nearly two out of every three high-end furniture products sold in the world are produced in the EU.

Challenges & threats & opportunities at EU level

In this historical period, the sector is affected by some specific challenges/threats²:

- **Competition** from low-labour costs countries: China is penetrating the European market very quickly and it is currently the largest furniture exporter to the EU;
- **Ageing workforce** and parallel lack of attractiveness to young workers, that means in many cases difficulty in training and maintaining specialised workers and craftsmanship having strong **green and digital skills**;

¹ <https://twinrevolution.eu/twinrevolution-blueprint-twin-transition-in-the-manufacturing-sector/>

² https://single-market-economy.ec.europa.eu/sectors/raw-materials/related-industries/forest-based-industries/furniture-industry_en

- **International protectionist measures:** EU furniture producers face both duties on imports of raw materials and tariffs on exports of finished products. Moreover, operational costs in the EU are higher due to high environmental, sustainability, and technical standards;
- **Shortages of timber and wood-based materials** supply with consequent prices increase;
- **Energetic crisis** with consequent prices increase;
- **Reliance on innovation and design combined with an increase in global trade and digitalisation,** makes the sector more vulnerable to weak protection of intellectual property rights. Boosting research and innovation also requires finance that is often inaccessible to SMEs.

In addition to that, in the last three years, the sector was heavily affected by major recent events: **the COVID-19 pandemic, the war in Ukraine, the supply chain disruption and the shortage of raw materials.**

Even in this difficult framework, the furniture sector is actively committed to contributing to reach the goal of **European climate neutrality by 2050**, by meeting the requirements contained in the European Green Deal to build a more sustainable economy in the EU.

To deal with these contemporary challenges, the EU furniture sector has undergone significant changes focusing on upgrading quality, design, and innovation, that result in several subsequent opportunities³:

- **Investment:** Investing in skills, design, creativity, research, innovation, and new technologies can lead to new products in line with changes in population structure, behaviours and needs;
- **Research:** Demand for high technology and knowledge intensive jobs is growing and the research in advanced manufacturing technologies can result in the creation of specific jobs which would make the sector attractive for the younger generation, thus rejuvenating it and helping to keep it highly competitive on the global stage;
- **New market opportunities:** other markets at global level can be explored, in particular in high-end segments and emerging economies;
- **Synergies:** Possibilities with construction and tourism should be investigated, given the sector's track records on sustainability: the use of sustainably sourced raw materials in

³ <https://design-expo.eu/it/blog/eu-furniture-industry-generates-around-96-eur-billion/>

furniture production could respond well to the growing requests from more conscious consumers.

Other opportunities are offered by the new trends emerging in the furniture sector⁴:

- **e-commerce:** the growing tendency to buy online is a trend that is involving more and more also the furniture sector: brands are exploring and testing new ways to showcase their products in innovative and visually appealing settings using advanced technology like augmented reality;
- **Sustainability:** The growing demand of the consumers for eco-friendly products is leading the sector to improve and implement their productive ways, in respect of the principles of circular design and circular economy;
- **Digitalization of the Manufacturing Process:** With the rise of customisation, furniture manufacturers must be sure to have all the useful tools to configurate and produce error-free made-to-order parts. So, they are gradually increasing the use of new technologies in the production, such as digital printing and automated nesting, that will help them eliminate stock issues, reduce costs, and improve material utilisation;
- **Smart furniture:** Many expect smart furniture, designed to offer a range of functional activities such as charging mobile devices, surfing the internet, listening to the news or radio, and more, to be the future of furniture.

⁴ <https://twinrevolution.eu/twinrevolution-blueprint-twin-transition-in-the-manufacturing-sector/>

1. State of art of the W&F industry after four main recent events

The COVID-19

The World Trade Organization said that **the COVID-19 pandemic represents an unprecedented disruption to the global economy and world trade**, as production and consumption are scaled back across the globe.

Also, social and working habits were modified: remote working is taking over and millions of people no longer face a daily commute, thus reducing their GHG emissions: individuals and businesses start questioning the business-as-usual model.⁵

Before the Covid-19 pandemic, the megatrends impacting the EU labour market were expected to result in relatively moderate employment growth, continuing growth of employment in service sectors (largely driven by 'greening' and automation) and job polarisation in terms of skill levels. This combines with an ageing population, meaning a thinning of the middle of the age distribution of the workforce, and increasing education attainment over time.

The effects of the pandemic on the labour market are mostly indirect and are linked to the measures adopted by governments to contain the spread of the virus (quarantines and restrictions on movement of workers) and to the impact of the uncertainty about future economic prospects on investments.

As stated in CEDEFOP Report "Digital, greener and more resilient – Insights from CEDOP's European skills forecast" (2021): *The combination of context and policy responsiveness drives employment impact. The nature of Covid-19 measures, the sectoral structure of the economy and its dependence on investment, consumption and trade are important factors. As can be expected, countries with extensive furlough and temporary leave schemes, such as Germany, Finland and Sweden, appear to be most resilient. In comparison with the baseline forecast, Croatia, Portugal and Romania show the highest short-term decline in employment in the scenario.*

Some Member States (including Czechia, Denmark and the Netherlands) return close to (i.e. less than 1% below) baseline employment forecast levels by 2030. In Ireland, France and Cyprus, forecast

⁵ A waste Action Plan for Circular Economy. Ireland's National Waste Policy 2020 - 2025

*employment remains around 3% below baseline in 2030. In Spain, a country heavily impacted due to its large tourism sector, the employment decline is most pronounced and persistent."*⁶

Different economic activities and jobs deal with different effects of the pandemic: **the manufacturing sector was heavily affected, because of the nature of the jobs, not easy to shift to a remote mode.** On the other hand, these sectors are also expected to recover quickest. Also the changing in consumers behaviour during and after the pandemic is a major driver of employment dynamics in heavily impacted sectors.

Employment in low-skilled occupations is projected to decline most, showing that the pandemic is likely to impact disproportionately the least well-qualified and most disadvantaged parts of the workforce. Employment for those with low level qualifications in many occupations is projected to remain 3-4% below baseline levels in 2030. Being more easily adaptable to remote work, high-skilled jobs are much less affected by the pandemic effects, thus exacerbating the inequalities in the labour market.

The impact of Covid-19 on global furniture trade growth in 2020 was significant: global furniture production in 2020 was worth \$420.000 million, down almost 10% from the previous year.⁷

Yet, according to CSIL (Centre for Industrial Studies) the recovery is imminent.

COVID-19 has exposed fragilities within our global economic model and caused a rethink about our productive, consuming and more in general living behaviours: the wood and furniture sector can respond well to the transition that our society is facing.

The pandemic changed the way we consider and live our homes, stimulating a demand for better and more durable products that can allow us to inhabit our places in a more comfortable, sustainable and healthy way.

The transition to a circular economy provides a good model for responding to the new requests of the society, for example in terms of:

- the need to design and make products to be repairable, reusable and potentially for remanufacturing (such as ventilators during the current pandemic);
- self-sufficiency and local production / consumption;
- shorter and more resilient supply chains for certain products;

⁶ Digital, greener and more resilient. Insights from Cedefop's European skills forecast. Luxembourg, Publications Office of the European Union. 2021

⁷ <https://twinrevolution.eu/twinrevolution-blueprint-twin-transition-in-the-manufacturing-sector/>

- consumption and production patterns guided by scarcity and necessity;
- creating local jobs, training and enterprise opportunities using local resources and providing local repair and refurbishment services.⁸

The war in Ukraine and the subsequent energetical crisis

Following the financial and economic crisis of 2008 (and the subsequent Eurozone crisis), and the COVID-19 pandemic, **the war in Ukraine represents the third asymmetric shock for Europe**, said the economists⁹: an “asymmetric shock” is a sudden change in economic conditions that affects some countries more than others.

The consequences of the war in Ukraine were at the centre of the informal EU leaders meeting in Versailles: the main result of this meeting is represented by the “[REPower EU Plan](#)” plan to make Europe independent from Russian fossil fuels well before 2030, starting with gas, in light of Russia's invasion of Ukraine.

Russia, together with Belarus and Ukraine, is an important supplier of wood raw and material (they accounted for a quarter of the worldwide timber trade in 2021, exporting 8.5mn cubic metres of softwood to Europe); Russians are also important customers in the European furniture industry.

On 8th April 2022, the European Union introduced a ban on the import of timber from Russia.

This situation has a double consequence: on the one hand, there is difficulty in finding the raw material; on the other hand, furniture can no longer be sold to a large chunk of the market and to potential customers (who are, furthermore, afflicted also by a large increase of the prices of food, due to food shortages, which will probably affect their purchasing power also after the end of the war).

⁸ A waste Action Plan for Circular Economy. Ireland's National Waste Policy 2020 - 2025

⁹ A waste Action Plan for Circular Economy. Ireland's National Waste Policy 2020 - 2025

The supply chain disruption

The COVID-19 pandemic and the war in Ukraine had as one of their direct effect the disruption of the supply chain: this has on the wood and furniture sector a specific impact that is worth considering.

Since the beginning of Ukraine's invasion from Russia, **several prominent woodworking companies have taken firm steps against business ventures in the state**¹⁰: just to name a few, Komatsu, one of the world's leading manufacturers of forestry, construction, mining and utility equipment, decided to suspend shipments to Russia, to show that they stand with Ukrainian people; BSW Group stopped purchasing raw material from Russia; FSC suspended all trading certificates in Russia and Belarus and blocks all controlled wood sourcing from this countries.

The resolution expressed support for the economic and financial sanctions implemented against Russia and called for the removal of the Russian Federation from the World Trade Organization and the termination of permanent normalized trading relationship status with the United States. **Russia's invasion of Ukraine is likely to impact global more and more trade in the coming months.**

The impact of COVID-19 pandemic on the forest-products industry was very significant at a local and at a global level and included the availability of raw materials, supply chain, production, and product sales. With the aim of studying the effect of COVID-19 on the forest-products industry¹¹, a group of wood scientists developed a questionnaire that consisted of four parts: demographic questions, production changes, COVID data gathering, governmental response to COVID-19, and lessons learned. Participants were mainly from furniture production, joinery, and wood processing. The results show that most significant impacts of the pandemic were in the availability of solid wood (23%) and engineered wood products (21%). Among the most critical issues were increased prices of all materials, increased transportation costs (containers costs for transporting furniture have risen as much as 1.200 per cent since the start of pandemic, forcing furniture retailers to raise their prices), extended delivery times, limited quantities for all materials, and total disruption of supply chains.

It is too soon to assess the long terms impacts; what can be said is that the response to the pandemic has shown that rapid social change is possible. **COVID-19 represents an opportunity**

¹⁰ <https://www.woodandpanel.com/woodnews/article/woodworking-industry-under-russian-invasion-supply-chain/>

¹¹ <https://www.tandfonline.com/doi/full/10.1080/17480272.2022.2109210>

to shift the global development paradigm toward greater sustainability and a greener, more inclusive economy, in which forests can play a crucial role (Stanturf and Mansuy 2021).

The shortage of raw materials

The market situation related to the supply of wood products was complex even before the Russia-Ukraine conflict, due to the pandemic and above all due to the change in global trade flows of the wood raw material, which caused an increase in prices together with speculation by main timber producers in Europe and uncontrolled increases of transport costs (especially for container freight).

In some countries - including Italy - **the war in Ukraine has exacerbated the situation being Russia, Belarus and Ukraine, an important source of timber and timber products for the European industry.** The main consequences were a complete lack of coniferous sawn timber from the Ukraine, as well as building boards and pellets and firewood, plywood and veneer panels.

Furthermore, many wood products of Russian origin cannot be imported into the EU because of sanctions on a large multinational linked to one of the sanctioned oligarchs. To this, must be added the shortage of wood materials due to the countermeasures taken by the Russian government in retaliation against the EU, especially veneers for the plywood industry, but also raw wood and pellets.

The shortage of softwood sawn timber (spruce and pine) will mainly affect the production of packaging and carpentry. The shortage of sawn timber, including temperate hardwood, is also directly affecting some furniture manufacturers (sawn timber to produce upholstered furniture drums).

The shortage of birch plywood will affect several sectors, first packaging and flooring manufacturers, then the furniture and motorhome and automotive supply sectors.

The shortage of birch veneer will affect plywood producers who will have to source from other sources.

In the short term, it will not be possible to replace birch plywood with materials of the same quality and properties for manufacturers of industrial packaging and flooring using this **semi-finished** product. For these companies, in addition to the loss of turnover, production will come to a halt. The replacement of Russian birch plywood could be carried out by using plywood

produced with other wood species, however at the moment it would be necessary to implement production lines to enable phenolic-based glueing, which would take more than a year.

Moreover, some non-European Countries, namely China, are gradually importing quality wood from Europe even before the start of the war in Ukraine, thus affecting the availability of raw material for European manufacturers.

The lack of raw material also directly affects furniture manufacturers, on whom the cost increases of the entire supply chain fall.

This will also help to accelerate the ecological transition, towards new circular business models and increasingly eco-design and waste-free design.

2. The Green Transition and the furniture sector

The European Green Deal is Europe's new growth strategy deriving from the awareness of climate changes and environmental degradation impact on global economy and on our daily life. By achieving climate neutrality by 2050, with recourse to green technology, and by creating sustainable industry and transport, the EU aspires to become a modern, resource-efficient and competitive economy able to leave no one behind. EU aims to speed up the transition towards a regenerative growth model that gives back to the planet more than it takes, preserves our natural resources and tries to reduce its consumption footprint by doubling its circular material use rate in the coming decade.¹²

To obtain these results, the transition to a **Circular Economy Model** (in opposition to the previous linear economy model) plays a crucial role. Since the release of the European Green Deal in 2019 and the Circular Economy Action Plan in 2020, the EU continues to work on the development of policies and measures to drive investments and efforts towards a just and inclusive transition.

According to the European Union, CE is a model *'where the value of products, materials and resources is maintained in the economy for as long as possible, and the generation of waste minimised'* (EC, 2015).

It is an economy model that is *"regenerative by the design: biological materials are designed to reenter the biosphere, and technical materials are designed to circulate with minimal loss of quality"* and *"restorative by intention; aims to rely on renewable energy and resources; minimize, tracks and eliminates the use of toxic chemicals; and eradicates waste through careful design"* (Ellen Mac Arthur Foundation, 2014).

According to the **Ellen MacArthur Foundation**, the Circular Economy rests on three principles, all driven by design¹³:

Eliminate waste and pollution: waste is not present in nature; it is a concept that we have introduced because of design choices. So, it is an issue that can be addressed starting from the design phase, by choosing materials that will re-enter the economy at the end of their **use (by**

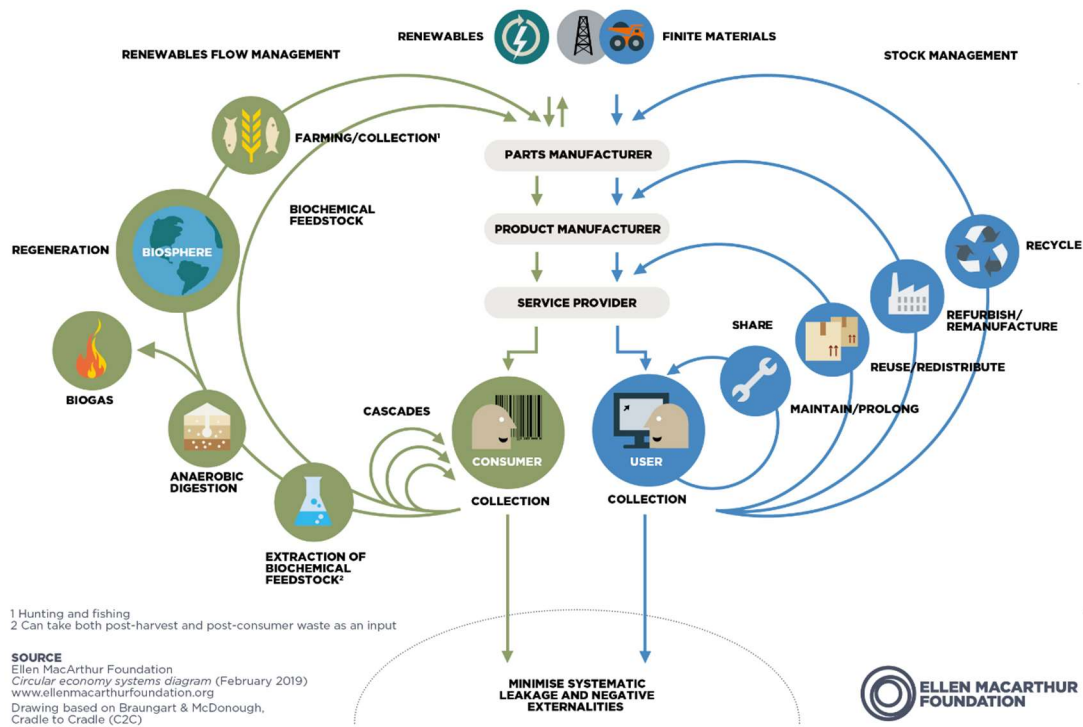
¹² https://reform-support.ec.europa.eu/what-we-do/green-transition_en

¹³ <https://ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview>

being maintained, shared, reused, repaired, refurbished, remanufactured, and, as a last resort, recycled).

2. **Circulate products and materials:** Products can be kept in use either as a product (by being reused, repaired, remanufactured or repaired) or, when that can no longer be used, as components or as raw materials (by returning them to the earth through composting and anaerobic digestion).

The “Butterfly Diagram” shows the continuous flow of materials in circular economy:



Regenerate nature: this can happen by shifting from a take-make-waste economy (the linear economy model) to a model that takes into serious consideration and supports natural processes (the circular economy model). This means, in concrete, to focus from extraction to regeneration, to boost farming practices that allow nature to rebuild soils, increase biodiversity and return biological materials to the earth. By multiplying our efforts for keeping material in circulation after use, we’ll diminish our need for virgin materials and more and more land can be returned to nature, thus facilitating the rewilding process. More, the transition to renewables will only tackle 55% of global GHG emissions; The rest can be done by changing the way we make and use products and food and manage land.

The Circular Economy transition promoted by the EU affects the furniture sector in a direct way and on the whole value chain: from product ideation and design to company purchasing, manufacturing and logistics.

European Green Deal (2019) and **Circular Economy Action Plan** (2020) are the main legal tools adopted by the European Union to regulate and lead all the economic sectors towards the transition. **Although this legal framework certainly represents a great challenge for the furniture sector, it can still be considered a great opportunity for companies:** they have the chance to improve their competitiveness and eco-efficiency, generate new business models and attract new young workforces.

There is a high potential inside the furniture sector to drive circular economy further, considering that wood, the raw material used in the industry, is climate neutral. Moreover, many enterprises are already implementing good practices about circular economy, like, for example, the recycling of wood to produce panels, or the growing use of secondary raw materials, and this is the trend in Europe in general.

The commitment towards sustainability is also something that must involve all the stakeholders interested in the whole process of producing and making use of wood and furniture: this means, for example, to raise awareness and empower consumers, public buyers, civil society and to stimulate their active contribution in participatory processes related to circular economy. Transparency plays a key role in this process.

Updated EU rules and guidelines (standard and voluntary regulation)

Since the release of the [European Green Deal](#) in 2019 and the [Circular Economy Action Plan](#) in 2020, the EU has developed and is still developing a set of policies and measures to drive investments and efforts towards a just and inclusive transition. Such policies aim at deeply transforming the economy across production and consumption. In the furniture sector, this includes the following ones:

- As a part of the [Circular Economy Package I](#): the communication [COM\(2022\) 140 final - On making sustainable products the norm](#) and the proposal for a regulation and [“COM\(2022\) 142 final - Proposal for a Regulation of the European Parliament and of the Council establishing a framework for setting ecodesign requirements for sustainable products and repealing Directive 2009/125/EC](#) also known as “ESPR - Ecodesign for

Sustainable Products Regulation - ESPR" (already published a communication and a proposal for a regulation, Q1 2022).

- Also as a part of the [Circular Economy Package I](#): the new rules on empowering consumers for the green transition [COM\(2022\) 143 final Proposal for a Directive of the European Parliament and of the Council amending Directives 2005/29/EC and 2011/83/EU as regards empowering consumers for the green transition through better protection against unfair practices and better information](#) (already published a proposal for a Directive, Q1 2022).
- [EU strategy for sustainable textiles](#) and its communication [COM\(2022\) 141 final - EU Strategy for Sustainable and Circular Textiles](#) (already published a Communication under the umbrella of the [Circular Economy Package I](#), Q1 2022).
- Regulation implementing the [Taxonomy Regulation specifying activities substantially contributing to a circular economy](#) (planned a proposal for a Regulation, Q2 2022).
- Right to repair (proposal for a Directive expected in Q3 2022).
- Substantiating green claims – PEF and OEF methods - (proposal for a Regulation expected in Q3 2022).
- [EU's Chemicals strategy for sustainability towards a toxic-free environment](#) (published, Q4 2020) and its [Restrictions Roadmap](#) (published, Q2 2022).
- [Deforestation and forest degradation – reducing the impact of products placed on the EU market](#) (Commission planned adoption by Q4 2021).
- [Revision of EU ambient air quality legislation](#) (planned a legislative proposal, Q3 2022).
- [Fit for 55 package initiatives](#) (developments on EU Forest Strategy, Bioeconomy...).
- EPR-Schemes in EU-members states and legislative proposals on waste and packaging waste.
- Restrictions on formaldehyde and formaldehyde releasing substances in articles (under discussion in REACH committee).
- [Proposal for a Machinery regulation COM\(2021\) 202 final](#) (already published, Q4 2021).
- [Review of the Packaging and Packaging Waste Directive \(PPWD\)](#) (expected in Q3 2022).

As it can be seen above, there are many legislative challenges that Furniture companies have to face on the short and medium term, but **there are also many and varied voluntary instruments that companies can also apply**, among others, the following:

- Environmental Management Systems - EMS (EMAS III published in 2009 with an update of its annexes in 2017 and 2018 & ISO 14001 last version published in 2015).
- Ecodesign (ISO 14006 last version published in 2020).
- Ecolabels - Type I (EU ecolabel, Blue Angel, Nordic Swan, NF Environment, etc.).
- Review of EU Ecolabel criteria for furniture (validity of criteria has been prolonged until 31 December 2026. In future, criteria of furniture and bed mattresses will be merged. Revision of criteria synchronized with textiles & wood floorings).
- Ecolabel - Type II (ISO 14021 last version published in 2017).
- Ecolabel - Type III (EPD System).
- Chain of Custody - CoC (FSC, PEFC).
- Green building certifications (BREEAM, LEED, WELL).
- Green Product Procurement - GPP (EU GPP criteria for furniture published in 2017, potential revision for furniture, expected for Q4 2021 but not yet published).
- Standardisation activities on Circular Economy in CEN TC 207 and its WG 10 as well as ISO TC 323.
- Activities of Alliance for Flame Retardants Free Furniture.

Eco-design principles

As stated in ISO 14006 – 2020, ecodesign is *“the integration of environmental aspects into product design and development with the objective of reducing negative environmental impacts throughout the life cycle of a product.”*

Eco designing a product means making it useful and desirable minimizing, at the same time, its environmental impact throughout its life cycle, which means from the extraction from raw materials to production, distribution, use and end of life.¹⁴

There are different definitions of eco-design, but the most common characteristics of eco-design definitions are: **environmental impact reduction; life cycle thinking; taking a product design focus**. Traditionally, eco-design was applied only to products; nowadays its application includes services and systems.¹⁵

¹⁴ Local Guide of Circular Economy in the furniture sector, Generalitat de Catalunya

¹⁵ Envisioning ecodesign: definitions, case studies and best practices, ENEC (European Network of Ecodesign Centers)

As stated in the Article 5 of the European Commission's Regulatory Proposal (ESPR), the aspects to take into account in eco-design for furniture products are¹⁶:

- Product durability and lifetime
- Reliability
- Reusability
- Upgradeability
- Reparability
- Possibility of maintenance and refurbishment
- Presence of substances of concern
- Energy use or energy efficiency
- Recycled content
- Possibility of remanufacturing or recycling
- Possibility of recovery of materials
- Environmental impacts, including carbon and environmental footprint
- Expected generation of waste materials
- Technical aspects of EPR (Extended Producer Responsibility)
- Digital Product Passport

At an operational level, in the furniture sector, the three main principles to follow in eco-design are¹⁷:

1. **Using efficiently materials**, preferring renewable and recycled materials where possible, and according to their environmental performances
2. **Separating different materials and parts**, boosting reparability, reuse, refurbishment and remanufacturing possibilities, prioritising these circular loops over recycling and increasing the lifetime and durability of furniture products;
3. **Using chemicals in a responsible way**, avoiding hazardous substances (for example toxic flame retardants).

¹⁶ <https://www.cencenelec.eu/media/CEN-CENELEC/Events/Webinars/2022/ce-tg-webinar-hlight-ce-ce-principles-of-furniture-20221026.pdf>

¹⁷ "The furniture sector and circular economy 2.0", EFIC

Innovative & sustainable materials

In the paper “The furniture sector and circular economy 2.0”¹⁸ EFIC underlines the importance of taking into consideration as a whole the differences in the potential of materials for circularity and climate impact, such as end-of-life potential, climate footprint, functionality, availability and cost.

Starting from the design phase, the focus should be put on the choice of materials, trying to increase the use of secondary raw materials, given the many business opportunities that these materials can offer.

The key to increasing the competitiveness of secondary raw materials is promoting the EU market: that will also improve their safety, tackling the insufficient information on the presence of substances of concern in products and waste, and will help the research for new ways of production able to maintain performance and quality between primary and secondary materials.

In synthesis, *“Innovation in materials is the process of meeting user needs through improvements in existing products or processes or creating and developing something completely new to achieve greater differentiation, a reduction in costs or sustainability”*.¹⁹

Some examples of innovative and sustainable materials currently in use in the furniture follow:

The De Sett SOFA

Through the use of 3D printing, Peter van de Water, Netherland, created a 3D printed sofa (made from 95% of recycled materials and reusable and recyclable up to ten times before needing to add some new materials).

Meshlin’s preregs

Meshlin’s innovative material offers an affordable and environmentally conscious alternative for the industry. Preregs are made from flax fabric or other natural plant fibres (hemp, jute, kenaf, etc.) and PLA (polylactic acid). In the production of our sandwich panels, cork, paper, PP and

¹⁸ https://9e2160bf-a0b5-460b-aec7-e9af818978ee.filesusr.com/ugd/a1d93b_48bd99599fc04853bd7bb96b9a280c29.pdf

¹⁹ Twin transition in the manufacturing sector. A blueprint. TwinRevolution project, September 2022

aluminum honeycombs are used, as well as technical foam as core materials, prepreg, HPL, aluminum and plywood as surface materials. Prepregs are composite materials that are made by laminating fibre-reinforced core materials or thermoplastic matrix materials at high temperatures. Prepregs are used alone or as a surface material in sandwich panels. In terms of the raw materials used for the production of prepregs, it is flax fabric or other natural fibres (hemp, kenaf, etc.), binder PLA (polylactic acid). PLA is made from vegetable starch and is therefore biodegradable.²⁰

Biobased materials

There are different biobased materials that can be used to replace mineral/plastic/animal product-based materials. One of them is PAPER

Paper is one the most recyclable and recycled materials, despite the fact that after a few times fibres get too damaged to be recycled again. Nowadays, however, paper can be used as a raw material for particle/fibre boards.

In addition to that, other resources are now used to create new types of particle board, such as seaweed, fish scale (that is 100% biodegradable), sunflower fibbers, artichoke thistles, coconut fibbers.

Boards could also be created from wastes derived by the use of leather or from other resources alternative to the use of leather such as cork powder, orange peels, wine Trester, cactus protein, hemp residues, mushrooms

Innovative & sustainable processes

Considering that 80% of the environmental impact of a product is determined by its design, it is possible to take action since the beginning of the production to reduce the impact, by applying the principles of circular design.

This is the reason why companies are investing resources in research to find new production processes able to respond to sustainability principles (durability, reusability, upgradability and reparability), to meet both legal requirements and the needs of the consumers.

²⁰ [The material of the future, https://meshlin.com/hu](https://meshlin.com/hu)

In Twin Revolution project final Report It is possible to find some detailed examples. Some of them are listed below:

Dismantlable Furniture

Dismantlable furniture is designed to prolong a product's life: some companies design products in order to make the final consumer able to repair them by simply substituting the component that is damaged. Dismantlable furniture has a lower carbon footprint, thanks to the fact that pieces are more easy to transport since they occupy less room.

Modular/multipurpose furniture

Furniture that serves multiple purposes or that are designed to "evolve" together with their user (like baby chairs that can change into different positions, following the change of the consumer when one is growing up and thus reducing the waste.

Use new ways of binding materials together

Scientists' research on how to bind materials together led to the discovery that by rubbing two pieces of wood together with enough friction, the lignin (a mechanical component of wood) will liquify and act like a glue when dried. This process is used to bond pieces of wood together without using any petrochemical product.

Give biobased materials new properties

It is now possible to give bio-based/eco-friendly material new properties that can replicate the ones of others: for example, some European sapwood species have been processed through a hydraulic press with biobased reagents to provide them tropical wood properties, thus avoiding the transport emissions.

CSR: the Social impact on communities and territories

The green and digital workforce knowledge gap should be at the centre of the social concerns towards a twin transition. As there is already a growing gap between highly skilled specialists, who can use complex technologies, and low-skilled workers, who might get unemployed because of automation, investing resources in upskilling the current workforce to the challenges of such a twin transition remains a top priority.

Improving the knowledge, skills, and competences of the furniture sector to navigate this multi-sectoral green and digital revolution will, therefore, ensure that this transition is also socially sustainable.²¹

It's possible to summarise **the main areas of CSR development for a company operating in furniture industry**²² in:

- Relationship with collaborators and employees, including training and people development programmes
- Companies' governance and structure, including knowledge management systems
- Key resources (raw materials, financial resources, energy and water consumption)
- Business activities and processes, including products' life cycle and business models oriented to circular economy practices
- Supply chain and providers, with a specific focus of local suppliers' involvement
- Companies value proposition
- Clients and beneficiaries, including their involvement in managing of end-use of the products
- Stakeholders, at local, national, and global level
- Relationship spaces, including logistics and packaging
- Costs, including taxes and legal minimums
- Value return

²¹ <https://twinrevolution.eu/twinrevolution-blueprint-twin-transition-in-the-manufacturing-sector/>

²² Handbook on Corporate Social Responsibility for strengthening the Furniture industry – FurnCSR Project – www.furncsr.eu

Three dimensions define CSR practices for each area: economic and organisational, societal, and environmental. The environmental dimension impacts on each of the below areas and contributes to a systemic approach towards CSR practices.

The following table exemplifies some CSR practices, pertaining to the environmental dimension, for each of the areas considered:

AREA	CSR ENVIRONMENTAL PRACTICES
RELATIONSHIP WITH COLLABORATORS AND EMPLOYEES	Environmental training and awareness; workers empowerment (for instance to reduce travels or energy/water consumption); sustainable facilities (bike park, charging points for electric vehicles)
Governance and Structure	Participation in training programmes that strengthen environmental values and culture
KEY RESOURCES	Control of consumption of natural resources; Environmental management of spaces; Selection and monitoring of suppliers, compliant with environmental regulation
BUSINESS ACTIVITIES AND PROCESSES	Life cycle, ecodesign and circular economy; Measures for controlling emissions and noise; Sustainable mobility; Waste prevention and management; Digital transformation of the organisation
SUPPLY CHAIN AND PROVIDERS	Traceability of the products and their components
VALUE PROPOSITION	Environmental value proposition
CLIENTS AND BENEFICIARIES	End of the use cycle
STAKEHOLDERS	Collective action for the environment

RELATIONSHIP SPACES	Digitalisation of relationship interfaces; Sustainable transport; sustainable packaging
COSTS	Environmental impacts
VALUE RETURN	Environmental benefits

Table 1. CSR and Environmental practice

The systemic approach of CSR practices in all areas in which a company is operating implies awareness of social, environmental and economic impact the activities carried out in all collaborators. CSR can therefore be considered a cross-cutting competence of all workers and managers in manufacturing companies, including those operating in the wood-furniture sector.

Occupational Health & Safety

Manufacturing processes in the furniture industry can be hazardous for workers. They can cause both injuries and occupational diseases. From the use of machinery and tools, handling heavy materials to exposure to dust, noise and chemicals – potentially harmful events can happen at any time. These events can affect the health of workers, for example causing them to suffer skin and respiratory diseases. They can cause injuries such as a loss of fingers or even death.

The twin transition (green and digital) will also impact the hazards that workers can face.

The final report of SAWYER project²³ identifies properly the new hazards due to the ecological and digital transition.

Regarding the green transition, if it is true that professional risk may decrease for workers due to a better design of products (eco-design), considering aspects such as easier assembly and disassembly, better selection of joining systems, etc. and if safe maintenance of the machinery is taken into consideration from the beginning. In the meanwhile, remanufacturing and selective disassembling could require new types of tools, and specific training will be necessary.

The dismantling of manufactured goods might cause Musculoskeletal Disorders (MSDs) (e.g. awkward positions, heavy lifting and carrying) and the disassembly operations as well.

Recycling of wood products produces high levels of wood dust and fine particles during the crushing. Without efficient dust extraction the risk of explosion may increase.

²³ *Impact of the Twin Transition on the EU furniture Industry. Forecast of the sector by 2030 due to its circular economy transition and digital transformation – SAWYER Project – www.circularfurniture.sawyer.eu*

Solvents, cleaning products and lubricants used in the woodworking sector may be based on less hazardous substances (e.g. solvents) and therefore prevent fire hazards.

Regarding dust exposure, recycling – may increase exposure to dust: exposure to fibres or dust when disassembling, remanufacturing and repairing furniture; dust from recycled material of unknown origin might cause occupational asthma (cases of occupational asthma have been reported in association with wood and paper recycling).

The same regarding chemical risk: the disassembling of old furniture might expose workers to chemical substances now restricted by law.

Recycled materials may concentrate hazardous substances (impurities and hazardous flame retardants mainly in upholstery products) during successive recycling or may change the composition due to different factors such as light, heat and ageing of material made up by unknown content and kind of hazardous substances.

In summary, working with materials, which have previously been manufactured: new skills need to be acquired throughout the production cycle and supply chain. Repairing, remanufacturing and selective disassembling require new methods and procedures. All the workers must be properly trained to make them aware and able to also prevent new hazardous risks.

3. National Insights

Hungary

Hungary's first long term framework strategy helping set the Hungarian society on a sustainable path was adopted by the government in June 2007. The strategy was developed with respect to the guiding principles and headline objectives defined in the EU's Sustainable Development Strategy. Considering both the domestic and global trends and conditions, the strategy outlined a means and reform system based reflecting a sustainable vision for all social, economic and environmental areas.

The effective national core document of sustainable development, **the National Framework Strategy on Sustainable Development 2012–2024 (NFFS) was adopted by the Parliament in 2013.** The NFFS was developed between 2009 and 2012 based on broad public consultation taking into account the recommendations of interested citizens, the representatives of the scientific community, businesses, minorities, civil organisations and religious communities.

The framework strategy sets out, inter alia:

- The protection of natural resources and the reduction of negative impacts
- The Framework Strategy aims to protect natural and renewable resources, reduce their environmental impacts and promote the rational and prudent use of natural and renewable resources.
- It identifies as an important task the strengthening of an entrepreneurial mentality and the promotion of innovation, the expansion of employment, the strengthening of employment, the strengthening of the entrepreneurial class.

The Roundtable of Hungarian Civil Society Organisations for the Sustainable Development Goals was established by 11 Hungarian organisations in October 2017 to meet the following objectives:

- to promote familiarity with the UN's SDGs in Hungary and represent them in social communication and public discourse;
- to monitor the implementation of the SDGs in Hungary, provide recommendations to the government and social players;
- to facilitate structured dialogue between government and non-governmental organisations;
- to promote information exchange between the members, help learn about the members' related efforts and activities.

Different plans and strategies are currently carried out in Hungary to boost the green transition of the National economy.

For instance, **the Smart Budapest – Budapest smart city vision document was published in January 2017**, which frames the city administration's objectives towards a more sustainable economy and living.

Key objectives of the circular economy:

- Promoting environmentally friendly energy use in the public, business and public sectors by raising awareness, setting good examples and using regulatory tools. The target is to reduce both per capita and aggregate energy consumption and carbon dioxide emissions by 30% by 2030 compared to 2005. In addition, in terms of energy consumption, the city has a target of increasing the share of renewable energy sources to 20% by 2020 and 27% by 2030.

- In terms of waste management, the targets include reducing the landfill rate to 10% by 2030 and increasing the recycling rate of municipal waste to 65% by 2030.
- The aim of the city administration is to utilise unused business premises on a community basis and to support the use of equipment based on community use.

Focusing on the creative sector (including the furniture sector), the creation of the Hungarian Fashion & Design Agency's design LAB incubation programme combines the awareness about design and functionality with the important aspect of sustainability. Some of the projects have been developed thanks to innovative and sustainable processes and new materials or technologies.

The University of Sopron summarized the main evidences about the green transition of the timber sector identifying strengths and weaknesses of the industry²⁴.

Forestry, the timber industry and timber products ensure the principle of sustainable development in the medium and long term and are in line with EU and national strategies such as climate strategy, energy strategy, circular economy. Wood is a renewable raw material and wood processing allows the cascade of biomass to be used, i.e. to exploit the full life cycle as much as possible, all of which creates jobs.

The woodworking industry is relevant in several respects:

- Unlike other building materials: renewable, carbon sequestering, its production has a significantly lower specific carbon footprint and energy demand.
- Using wood products, the principle of substitution is implemented as one of the criteria for sustainability (Agenda 21).
- As mentioned above, it is closely linked to the climate strategy.
- The wood industry can be used as a source of zero-waste technologies, provided that the development of an appropriate industry, such as wood chemistry, is encouraged.
- The development of the timber industry can be of particular importance in rural areas, where it can create jobs and reduce labour costs.
- It is linked to decentralised energy production.
- It fits in with the principles of circular economy.

²⁴ *Circular Economy in the Timber industry* – University of Sopron - 2021

It is fundamental to promote the cascading use of wood; the industrial wood extracted should be kept as a product through cyclical use, the carbon locked up in it should be preserved as long as possible and only as a last resort should it be released back into the atmosphere (even then for energy), where it can be reabsorbed by the trees and the sea. In the meanwhile, a specific strategy of waste management is necessary to support the recycling and reuse practices, also for the furniture sector.

Italy

The Italian annual Report “GreenItaly” takes stock of the evolution of the Italian industrial system towards the circular economy and sustainability, in its various sectors. The last two editions²⁵ (GreenItaly 2021 and GreenItaly 2022) devote increasing attention to the wood-furniture sector, highlighting its efforts to become an increasingly sustainable and environmentally conscious supply chain.

In the wood-furniture supply chain, **95% of wood is already recycled to produce furniture panels**, saving almost 2 million tonnes/year in CO2 consumption. This is the most relevant data, which shows how the national shortage of raw material and the insufficient wood harvest from national forests have turned into an opportunity and the creation of a new business model based on the circular economy.

Research conducted among a sample of furniture companies by FederlegnoArredo - the national federation of wood-furniture industries, representing over 2200 companies - shows the growing awareness of companies on the topic of sustainability²⁶. The topics covered in the survey ranged from **resources, products, design, processes, transparency, relationships with the local community, well-being**, etc., and returned data and results that give an overview of how the wood-furniture sector is approaching the green transition.

As far as resources are concerned, it could be seen that most companies use recycled wood and, specifically, **67% of companies use secondary raw materials, 81% use sustainably produced and certified wood**, 60% obtain their supplies from **renewable energy sources** to some extent, and 19% cover at least half of their needs with renewable energy.

Regarding products design and eco-design: **50% of companies consider packaging reduction**, recycling of products, and energy efficiency in the design phase and about **30%** consider **reparability** criteria in the design, together with **disassembling** and **reuse**.

²⁵ *GreenItaly 2021. Un'economia a misura d'uomo per il futuro dell'Europa* – Fondazione Symbola 2021 and *GreenItaly 2022. Un'economia a misura d'uomo contro la crisi* – Fondazione Symbola 2022.

²⁶ Survey “*Legno-arredo italiano nella transizione ecologica*” – FederlegnoArredo - 2021

With regard to processes, **64%** of companies have already implemented **efficiency measures in the production process**, about **60%** have carried out **measures aimed at reducing production waste** and **44%** have implemented practices and tools **to reduce water consumption** in the last 3 years.

Regarding transparency, **28% of the companies have obtained at least one product certification** (ISO 9001, FSC® and ISO1401 are the most widespread certifications).

64% of companies manufacture more than a quarter of their products with **low-emission materials**, adopting **certified environmental standards** that are **more advanced than legal requirements**. One third of companies claim to have a designated **Environmental Manager** and the perceived benefit for most companies (65%) related to the implementation of a sustainability-oriented policy is both the **improvement of corporate reputation** and the **reduction of consumption in the production process**.

With regard to future plans, the survey definitely shows a desire to **improve process efficiency** and **reduce waste** (64%), followed immediately by the need to **acquire specific skills** and **expertise on environmental issues** (56%) and **deepen the environmental certifications** (50%); again, the need to **reduce the presence of hazardous substances** in hazardous substances in products (41%), to **increase the useful life of products** (30%) and also to include in their offering **the provision of services** (28%).

This was followed by the birth of **a pioneering initiative for the sector** and one of the first of its kind to involve companies from the entire supply chain, namely FLA Plus, a hub of projects that pragmatically respond to all needs for support in the field of ecological transition:

- reforestation projects
- database of sustainable materials
- training courses about sustainability and green skills
- support in the management of certifications
- digital tool to investigate the “green” maturity of the companies and their path towards a full green transition

FederlegnoArredo has already gained recognition as the first wood-furniture supply chain to participate in the United Nations Global Compact, which attests to the validity and quality of the choices made. At the same time, it is involved in a new Horizon project (Ecorefibre) **devoted to** investigating innovative technologies for recycling fibreboards from wood waste into new fibreboards.

Much remains to be done, however, for timber used in building and construction, as well as for windows, doors, wooden floors and wooden packaging. **Italy currently imports about 80% of the timber used by the industry** for its processing and the National economy is still far from a sustainable exploitation of the Italian forestry ecosystem. To face this challenge, a digital marketplace to favour the exchange of timber and wooden products has been set-up (Borsa Italiana del Legno).

In terms of **employment** at the end of last year the employed in *green jobs* – at National level and for all the industrial sectors - accounted for 13.7% of total employment. In 2021 it is estimated that activations of green contracts will be more than 1,600,000 units or 34.5% of all activated contracts. A figure that grows in high added value areas, with 85.3% of the new contracts envisaged in the year in the research and development area reserved for workers development area reserved for green workers, 80.2% in the logistics area, and 78.6% and 78% in the technical and technical area and in marketing and communication, respectively.

Ireland

Ireland has a large-scale national waste management plan as part of a broader strategy of transition to circular economy models²⁷.

The waste plan aims to go beyond the management of waste and addresses how we look at resources more broadly, capturing and maximising the value of materials that may in the past have been discarded. A key objective of this Action Plan is therefore to shift the focus away from the product life cycle, to remove or design out harmful waste, to extend the life of the products and goods we use and prevent waste arising in the first place – consistent with the concept of a zero-waste future. The plan also recognises the importance of eco- and smart design in waste prevention through the delivery of products that are more amenable to recycling or reuse of constituent components and commits to incentivising innovation and research.

The final hope of the plan is to also support the creation of new job opportunities, linked to the new market needs in the green jobs field.

²⁷ *A Waste Action Plan for a Circular Economy Ireland's National Waste Policy 2020-2025* – Department of Communications, Climate Action and Environment - Government of Ireland – 2021.

A strategy for waste sorting and recycling has been in place for some time and involves both businesses and citizens. The results achieved were significant, and now all sectors are called upon to improve their contribution.

Recent revisions to the Waste Framework Directive introduced the following recycling targets for MSW:

- 55% by 2025
- 60% by 2030
- 65% by 2035

A mix of measures will be set up to improve the waste sorting at domestic, businesses and municipal level.

The extended producers responsibility (EPR) will be improved for the Waste Electrical and Electronic Equipment (WEEE), Batteries, Packaging, End-of-life vehicles (ELVs), Tyres, Farm plastics. The Government is examining the feasibility of introducing further EPR arrangements for other waste streams including, for example:

- textiles
- **bulky waste including mattresses**
- paint
- medicines
- farm hazardous waste.

The furniture sector should be included in the “bulky waste and mattresses scheme”. However, also for the furniture industry it is time to innovate their design, **according to the principles of eco-design**, to strengthen their circular business models.

Another set of measures to foster the circular transition is to strengthen the Green Public Procurement model. GPP is acknowledged as a vital policy lever in driving the prevention of waste and related environmental policy objectives and the public sector must be a leader in this regard. It is an important element of Sustainable Public Procurement policy.

The procurement of goods and services by government departments, LAs and public bodies, in line with the Government’s own policies, will underpin the credibility of national policy objectives and enhance Ireland’s standing as a green economy.

France

A National Strategy for a successful green transition has been defined, with challenges goals²⁸. The strategy towards ecological transition is presented as a societal project, in which all actors are involved: companies and the business community, citizens, local, regional and national governance.

The main goals – to increase the effectiveness of the Circular business models - are described in different areas:

- Reduce natural resource use related to French consumption: 30% reduction in resource consumption in relation to GDP between 2010 and 2030.
- A 50% reduction in the amount of non-hazardous waste landfilled by 2025, compared to 2010.
- Aim towards 100% of plastics recycled by 2025.
- Reduce greenhouse gas emissions: avoid the emission of 8 million additional tonnes of CO₂ each year thanks to plastic recycling.
- Create up to 300,000 additional jobs, including in new professions.

The last point also closely involves the education system (primary / VET and HE), with specific targets.

According to these main objectives, specific actions are identified for different stakeholders' categories.

Regarding business activities, 7 policy trajectories for a better production are identified:

1. Use more secondary raw materials in products
2. Support productive investment
3. By 2020, support 2,000 voluntary companies through the ADEME [French Environment and Energy Management Agency] mechanism "SMEs winning every time"
4. Enable the EPR [Extended Producer Responsibility] schemes to secure investments from industrial recycling sectors and sectors of producers of recycled products
5. Manage resources more sustainably

²⁸ *50 Measures for 100% Circular Economy* - Ministry for an Ecological and Solidary Transition / Ministry for the Economy and Finance - 2018

6. Adapt professional skills for better production at national level and in the regions, including the creation of Create certifications or “skill blocks” [units of a professional qualification] recognizing the skills that contribute to the circular economy to enhance the value of these jobs, particularly in the area of the repair and reuse of products.
7. Roll out voluntary environmental labelling of products and services in the five pilot sectors and extend this voluntary scheme to other sectors

In parallel, a roadmap for a **better consumption**, for a **better waste management** and for **mobilizing** all the actors are defined, with specific actions.

The companies from all the industrial sectors are made aware on the following actions:

- A. **Actions for a better consumption**, that can have an impact on companies belonging to the furniture industry:
 1. Strengthen the range of services offered by actors involved in reuse, repair and the economy of functionality (product-service systems)
 2. Strengthen the effective implementation of the legal guarantee of conformity and bring about an extension of its duration at the European level
 3. Roll out the implementation of eco-modulation criteria for all the EPR schemes and make eco-modulation a tool for encouraging real behaviour change
- B. **Actions for a better managing waste**, that can have an impact on companies belonging to the furniture industry:
 - Adapt taxation to make waste recovery cheaper than waste disposal
 - Recycle all high-quality biowaste and enable the agricultural sector to drive the circular economy
 - Take the ban on the use of fragmentable plastics, expanded polystyrene containers and plastic microbeads to the European level
 - Reinforce the confidence pact between the EPR schemes in order to restore room for manoeuvre to eco-organizations by reinforcing the monitoring means of the State and penalties
 - Educate the actors involved on the creation of new EPR schemes or the extension of existing sectors to include the ‘polluter pays’ principle for new products
 - Develop certain EPR schemes to improve their operation

- Give producers more freedom to exercise their responsibility within EPR schemes
- Review the operation of building waste management by making collection more efficient
- Adapt waste regulations to promote the circular economy
- Facilitate end of waste status

C. **Actions for a mobilizing all the actors**, that can have an impact on companies belonging to the furniture industry:

- Make unprecedented communication efforts to mobilise citizens and businesses
- Roll out and sustain regional action about the circular economy
- Strengthen synergies between companies and research centres
- Strengthen national governance and steering by developing the National Waste Council into a National Circular Economy Council

Under this umbrella, the “**Woodwaste plan**” is a specific strategy for the wood and furniture sector, for more and better recovery of wood waste.

In France (2018), an estimated 5 million tonnes a year of non-hazardous wood waste is deposited (excluding waste from sawmills, packaging and in-house consumption in businesses): 0.8 million tonnes are recycled into particle boards, 1.1 million tonnes are used in energy, 1 million tonnes are exported and 1.2 million tonnes are buried.

The wood waste plan of the strategic agreement of the wood sector is a collective campaign that brings together professional associations and the organisations in question (FEDEREC, SRBTP, CIBE, FEDENE, eco-organizations VALDELIA and eco-furniture organisations, UIPP, SER, COPACEL, CODIFAB) the MTES signatory of the sector agreement and ADEME, which co-funds the work.

The aim is to recover more wood waste and in a better way, by better using resources and monitoring the air quality. By expanding collection, reducing burials and exports, promoting the development of recycling into particle board and optimising the recycling of non-hazardous wood waste as particle board, the economic model using biomass boilers can be improved, as can the end-of-life scenarios for wood products, which are essential for the environmental performance of wood in construction.

The possible presence of chemical pollutants and the lack of descriptive data for the targeted waste wood are constraints on energy recycling and recovery in combustion, one of the challenges to be addressed by the plan.

Spain (Catalonia Region)

A guide to support the circular transition of companies in the furniture sector has been produced by the Catalan Furniture Cluster Ambit (former Cenfim) and AMIC, subsidized by Generalitat de Catalunya and Agència de Residus de Catalunya²⁹.

This guide - realized after an open debate with 18 relevant companies of the sector - establishes the axes for transit towards a circular economy in the furniture sector, showing the regulatory context, sustainable strategies, megatrends, good practices and future scenarios.

After a review of existing standard regulations at EU, global and National level, the Guide shows the main key economic pillars for the furniture industry and some insights relevant to Catalonia Region.

One of the main challenges for the sector is the increasing reuse and recycling of the furniture waste. In Catalonia, furniture is included in the category of bulky waste, which also includes other old junk (mattresses, large utensils and junk of all kinds) collected on the street through specific collections and collected in waste reception centres. In 2019, 268,589t of bulky waste was collected, much of which was furniture waste. In 2014, in the Barcelona metropolitan area, only 1% of all collected wood waste was reused, 64% was used for recycling and 33% for energy recovery. However, the Catalan Waste Agency in the report "Diagnosis on reuse and preparation for reuse in Catalonia" includes the composition and typology of potentially reusable materials in waste reception centres, under current conditions and for the different categories. The results show that, without taking textile waste into account, the highest percentage corresponds to the "Furniture" category, which accounts for 45% of this potential.

To face this challenge some strategies should be implemented by companies, designers, and the whole furniture value chain:

- Improving the quality of products materials to increase the potential for second life
- Increasing eco-design principles in products design; design products for their disassembly, reassembly, repair, reuse, recycling

²⁹ *Local Guide of Circular Economy in the furniture sector* – CENFIM / AMIC - 2021

- Implementing effective furniture waste collecting systems, including producers' responsibility mechanisms
- Implementing economies of scale and economic incentives to boost the opportunities of repair and reform
- Implementing communication and training activities towards the consumers, to support them in reparability and maintenance of furniture products
- Favoriting an increasing of the demand of recycled materials
- Increasing the availability of spare parts
- Supporting the "second hand market", following some good practices of the fashion model system

The 18 companies interviewed declared the five main strategies for their own circular transition:

- Material optimization
- Recovery and reuse
- Use of renewable energies
- Prolongation of service life
- Analysis and management of the end of life

Among their good practices, four distinct trends emerge:

- **More circular management of the materials, that encompasses several technological trajectories:**
 - About materials
 - Reduced use of finite resources
 - Substitution of virgin materials for recycled
 - New materials from renewable sources
 - About manufacturing processes
 - Optimization of the use of materials
 - Prioritise materials of recycled origin
 - Reduction of furniture elements
 - About packaging

- Compostable and/or biodegradable packaging
 - Eliminate any single-use plastic
 - About selling
 - Guarantee materials with a certificate of origin
 - About maintenance
 - Design for disassembly
 - About product end-of-life management
 - Simplification of joints and structures
 - Efficient lifecycle management
 - Implementation of a closed loop
- **Less is more** (The change of format or the elimination of parts and pieces is a key trend that can help optimise the space, rethink the shape of the furniture and the material used):
 - About materials
 - Use of virgin materials
 - About manufacturing processes
 - Simplification and unification of materials
 - Use of renewable energy
 - Dematerialization of components
 - About packaging
 - Storage timing
 - Production of packaging materials
 - About selling
 - Guarantee materials with a certificate of origin
 - About maintenance
 - Prolongation of the useful life of the product
- **Technology and the way to the future:**

- About materials
 - Traceability of the origin of the components
- About manufacturing processes
 - Collaboration with research centres and other companies
 - Industry 4.0 (Auto ID / robotics and automation)
- About selling
 - Augmented reality
- About maintenance
 - Reduced operational impact on the value chain
 - Internet of Things
 - Labelling: QR codes (paper removal instructions)
- About product end-of-life management
 - Calculation of emissions to validate new technologies
- **Sustainable communication towards an informed user:**
 - About materials
 - Certificates and stamps of origin
 - Green suppliers
 - Material and process certifications
 - About manufacturing processes
 - Environmental quality certifications
 - Green Comparison Criteria
 - About selling
 - Servitization
 - About maintenance
 - Environmental communication: certifications and emissions
 - Analysis of user behaviour (Call to Action)
 - About product end-of-life management

- Communicate materials management
- Sustainable story

Conclusions

Skills, competences and knowledge required by the W&F industry affected by the Green Transition

In the Final Report of the SAWYER project, 25 experts state as key conclusion that, **to be efficient, Circular Economy needs to be deployed with a strategic approach and supported by a set of key knowledge and skills**³⁰. It must proceed together with digital transition.

To succeed in the creation of a more resilient EU furniture industry, the sector faces many barriers related to different aspects, which can be overcome by a proper provision of skills, as identified in the new “European Skills Agenda for sustainable competitiveness, social fairness and resilience”, emphasising that the green transition will require investments in skills of people and the definition of a taxonomy of skills for the green transition.

Relatively to the figures targeted in the WOODCIRCLE project, two key-figures were identified and their SCK for 2030's circular economy transition were fine-tuned as follows:

Cabinet-maker and related workers – ISCO 7522

The forecasted tasks changes of cabinet-makers due to sector circular economy transition define the following **occupational profile in 2030**:

The cabinet-makers and related workers make, decorate and repair wooden furniture, carts and other vehicles, wheels, parts, fittings, patterns, models and other wooden products using ecoefficient and more automated woodworking machines and tools as well as specialized hand tools.

With a focus on the green transition changes, these specialised workers add the following new skills, knowledge and competences to their work:

- Beside costs and time-effectiveness, they take into consideration also the **environmental impact** when planning and organizing their work;

³⁰ SAWYER Project, Final Report 2021: Impacts of the twin transition on the EU furniture industry – Forecast of the sector by 2030 due to its circular economy transition and digital transformation.

- Assist in the implementation of quality assurance and **sustainability activities**;
- **Assist in the reduction of the environmental impact** of the manufacturing, repair, remanufacturing or recycling processes (e.g. waste generation or energy use reduction);
- **Apply a life-cycle thinking** and favour the future disassembly of the product for maintenance, repair, reuse or recycling.

The 2030's profile tasks dealing with the circular economy transition are:

- **Operating ecoefficient woodworking machines**, such as power saws, jointers, mortisers and shapers, and using hand tools to cut, shape and form parts and components;
- **Optimising the use of resources and energy and reducing to maximum the generated waste**;
- Optimizing plans, verifying dimensions of articles to be made, preparing specifications and check the quality of pieces to **ensure adherence to technical and environmental specifications, including product durability, reparability, etc.**;
- Fit and subassemble together parts to form complete units, **taking into consideration the future disassembly needs and potential reparability of the product** (e.g. reducing glued components);
- Through human-robot interaction, **make, restyle and repair wooden articles, in line with the circular economy-oriented strategies** of the organisation (e.g. increase products durability);
- **Create environmental-friendly designs** and decorate furniture and fixtures by inlaying wood or applying veneer and carving designs with the use of automated and **ecoefficient machines, using sustainable materials and taking into account future disassembling and whole product life cycle**;
- Finish the surface of wooden articles or furniture **using non-hazardous substances (e.g. low-VOCs chemicals)**;
- **Disassemble selectively out of use or defective wood-based furniture products** for separation of materials and elements for further recovery or recycling;
- **Operate tools and highly digitalized woodworking machines for the maintenance, reparation and/or manufacturing of wood-based furniture products**, including cleaning, polishing and/or additional finishing treatments.

The new skills related to the above listed new tasks can be summarized as follows:

- **Regenerate:** shift to renewable materials;
- **Share:** Reduce product replacement speed and increase product utilisation by sharing it among different users; reuse products throughout their technical lifetime; prolong products lifetime through maintenance; prolong products lifetime through repair; prolong products lifetime through design for durability;
- **Optimise:** Increase performance/efficiency of products; customisation/made to order; reproducible and adaptable manufacturing; minimize waste in production and supply chain; increase efficiency of production processes;
- **Loop:** Remanufacture products and/or components; implement take-back programs; recycle materials; promote the cascade use of wood; promote extraction of biochemicals from organic waste;
- **Exchange:** replace old materials with advanced renewable ones; choose new products and services.

Also the hazard and risks related to this figure are expected to change due to sector circular economy transition. In particular, the impact of the change can be summarized as follows:

- **Mechanical hazards:** Increased or new presence of unprotected moving parts (dealing with the presence of cobotics and subsequent squeezing, bumping, crushing, cutting, amputation, drawing-in, trapping); parts with hazardous shapes (cutting, pointed, rough); uncontrolled moving parts (flying objects, wood chips); slip and trips. Remanufacturing and selective disassembling could require new type of tools not available; **eco-design could reduce hazards** associated to assembly/disassembly operations, using optimised joining systems, etc.
- **Ergonomic hazards:** reduction of heavy loads/heavy dynamic work; awkward positions/unbalanced strains. Maintenance, remanufacturing and repair services as well as dismantling of manufactured goods may be related to Musculoskeletal Disorders (MSDs); this risk could be reduced with eco-design strategies to assembly/disassembly if occupational safety and health is taken into account when designing the product.
- **Hazards due to typical effects/physical agents:** Decreased/increased noise: noise may be reduced due to eco-design of machinery operating quieter and more environmental-friendly; however, dismantling activities may expose workers still to noise. Decreased/increased vibration: vibration may be reduced due to eco-design of machinery operating with less vibration and more environmental-friendly.

- **Fire and explosion hazards:** reduced presence of flammable substances. Dust maybe emitted during dismantling, remanufacturing and repair activities – inappropriate dust extraction system increases risk of dust explosion. Risk from explosion and fire may decrease, depending on the substitution of flammable solvents in glue.
- **Work environmental hazards:** Increased risk of poor lighting, ventilation and climate conditions; poor ventilation.
- **Hazards through dangerous substances:** Increased presence of dust; new materials (e.g. Nanomaterials); recycled materials. Both increased and reduced presence of solvents (neurotoxic, allergens) and carcinogens. Chemical hazards may be reduced if OSH will be included in the design of the products/materials and if dangerous substances will be substituted by less dangerous ones. Risk of exposures to dangerous substances may be increased through lack of information on chemicals contained in recycled products and on ways how to deal with them appropriately.
- **Biological hazards:** Non-targeted activities with microorganism: selective and/or destructive disassembling for separation of materials and elements for further recovery or recycling may expose workers to microorganism such as mould. (recycled, old and reused material may contain mould).
- **Psychosocial hazards:** Work tasks not clearly defined; poor organisation of work; poorly designed workplace environment (incl. software); cognitive strain; increased demand of flexibility; lack of work experience; lack of involvement in making decisions that affect the worker; ineffective communication, lack of support from management or colleagues; workload: overload or underload.

Furniture assembler – ISCO 8219s

The forecasted tasks changes of cabinet-makers due to sector circular economy transition define the following **occupational profile in 2030**:

Furniture assemblers place together all parts of furniture and auxiliary items such as furniture legs and cushions. They may also fit springs or special mechanism.

With a focus on the green transition changes, these specialised workers add the following new skills, knowledge and competences to their work:

- Beside costs and time-effectiveness, they take into consideration also the **environmental impact** when planning and organizing their work;

- Assist in the implementation of quality assurance and **sustainability activities**;
- **Assist in the reduction of the environmental impact** of the manufacturing, repair, remanufacturing or recycling processes (e.g. waste generation or energy use reduction);
- **Apply a life-cycle thinking** and favour the future disassembly of the product for maintenance, repair, reuse or recycling.

The 2030's profile tasks dealing with the circular economy transition are:

- **Considering the future disassembly of the product** for maintenance, repair, refurbishment or recycling (e.g. reducing glued components);
- Reviewing work orders, specifications, diagrams and drawings to determine materials needed and assembly instructions of the highly digitised enterprise ecosystem, **optimising also the future disassembly of the product for repair, refurbishment or recycling**;
- Recording production and operational data of the highly digitised and ecoefficient manufacturing plant on specified digitalized forms, **including environmental performance indicators**.
- Inspecting and testing components and completed assemblies **to fulfil quality and circular economy-oriented requirements** (e.g. disassembly sequence for maintenance, repair, etc.) as integrated part of the fully digitised smart manufacturing ecosystem of the company
- Supervising the highly autonomous rejection system of faulty products, **reducing as much as possible the scrap generated and promoting the internal reuse of part or components**;
- **Defining and following disassembly instructions for selective disassembling of out of use or defective wood-based products for separation of materials and elements for further recovery or recycling**;
- **Defining and following instructions for the maintenance, reparation and/or re-manufacturing of wood-based products, including re-assembly and final quality inspection and testing**.

The new skills related to the above listed new tasks can be summarized as follows:

- **Regenerate:** shift to renewable materials;

- **Share:** Reduce product replacement speed and increase product utilisation by sharing it among different users; reuse products throughout their technical lifetime; prolong products lifetime through maintenance; prolong products lifetime through repair; prolong products lifetime through design for durability;
- **Optimise:** Increase performance/efficiency of products; customisation/made to order; reproducible and adaptable manufacturing; minimize waste in production and supply chain; increase efficiency of production processes;
- **Loop:** Remanufacture products and/or components; implement take-back programs; recycle materials; promote the cascade use of wood; promote extraction of biochemicals from organic waste;
- **Exchange:** replace old materials with advanced renewable ones; choose new products and services.

2030's hazard and risks related to this figure and dealing with circular economy transition can be summarized as follows:

- **Mechanical hazards:** unprotected moving parts (dealing with the presence of cobotics and subsequent squeezing, bumping, crushing, cutting, amputation, drawing-in, trapping); parts with hazardous shapes (cutting, pointed, rough); moving means of transport and tools (run over, roll over, falls from height). Remanufacturing and selective disassembling could require new type of tools not available; **eco-design could reduce hazards** associated to assembly/disassembly operations, using optimised joining systems, etc.
- **Ergonomic hazards:** reduction of heavy loads/heavy dynamic work; awkward positions/unbalanced strains. The disassembling and dismantling of manufactured goods may be related to Musculoskeletal Disorders (MSDs); this risk could be reduced with eco-design strategies to assembly/disassembly if occupational safety and health is taken into account when designing the product.
- **Hazards due to typical effects/physical agents:** Decreased/increased noise: noise may be reduced due to eco-design of machinery operating quieter and more environmental-friendly; however, dismantling activities may expose workers still to noise. Decreased/increased vibration: vibration may be reduced due to eco-design of machinery operating with less vibration and more environmental-friendly.

- **Fire and explosion hazards:** reduced presence of flammable substances. Dust maybe emitted during dismantling, remanufacturing and repair activities – inappropriate dust extraction system increases risk of dust explosion. Risk from explosion and fire may decrease, depending on the substitution of flammable solvents in glue.
- **Work environmental hazards:** Increased risk of poor lighting, ventilation and climate conditions; poor ventilation.
- **Hazards through dangerous substances:** Increased exposure to fibres or dust when disassembling or dismantling products; new materials (e.g. Nanomaterials); recycled materials. Reduced presence of solvents (neurotoxic, allergens) and carcinogens. Chemical hazards may be reduced if OSH will be included in the design of the products/materials and if dangerous substances will be substituted by less dangerous ones. Chemical hazards may increase depending on the quality of recycled materials (during successive recycling of unknown raw materials) Risk of exposures to dangerous substances may be increased through lack of information on chemicals contained in recycled products and on ways how to deal with them appropriately.
- **Biological hazards:** Non-targeted activities with microorganism: selective and/or destructive disassembling for separation of materials and elements for further recovery or recycling may expose workers to microorganism such as mould (recycled, old and reused material may contain mould).
- **Psychosocial hazards:** Work tasks not clearly defined; poor organisation of work; poorly designed workplace environment (incl. software); cognitive strain; increased demand of flexibility; lack of work experience; workload: overload or underload.

Market needs and training offer: a possible matching?

Formal training courses dedicated to woodworkers now include some specific modules devoted to occupational health and safety. The culture of occupational safety in European countries is growing, and training has grasped this need.

However, much remains to be done on updating wood operator pathways geared toward sustainability and circular economy. It is to move beyond training on the principles and definitions of sustainability to a deeper understanding of the impact these practices have on manufacturing processes. In short, it is about highlighting the co-responsibility of the workforce toward the green transition, within the scope of the activities for which they are responsible.

Introducing workers to the concepts of **eco-design, sustainability standard and voluntary certification, innovative sustainable materials, resource saving and conservation, and waste management** would help young students and workers become familiar with the principles of sustainability and circular economy that permeate all business processes: production, design, and management.

The wood operator skilled in the circular economy is therefore a production worker who is aware of the environmental and sustainable challenges of his or her business and capable of operating in accordance with these principles. It is therefore time to design a specific sustainability training course that integrates the traditional technical skills of the wood operator with this new and necessary awareness.

Tables and figures

Tables

Table 1. CSR and Environmental practice

4

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