Cross-sectoral Cluster approach for higher competitiveness through digital, green transition and resilience — RE-CENTRE

FIRST LEVEL ANALYSIS - CRITICAL INPUTS / SUPPLIERS / TECHNOLOGIES SURVEY			
Title	First level analysis		
WP / Task Number	**WP1 – T1.4 / WP2 – T2.1**		
Author(s)	ALL PARTNERS		
Short Description	The first level analysis including the identification of critical inputs, suppliers and technologies for the 3 sectors involved is conceived as the initial part of the RE-CENTRE RPBC Plans: 4 plans for the future continuity of the 3 involved sectors (furniture-interiors, IT and energy) and all of them as a cross-sectoral eco-system. The Plans include the following elements: - an analysis carried out by the 4 partner clusters on single cluster needs, gaps, bottlenecks and potential interlinkages for identifying innovation opportunities; - results of the 4 working groups activated and concentrate on the identification of gaps and disruptions among sectors by going deeper into potential solutions and collaborations within them and across them as a complex ecosystem of stakeholders (firms – structured or start ups, research organizations, clusters, training intermediaries, innovation hubs…)		
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1 Introduction (scope of this analysis)

The aim of this document is to provide an analysis of the three sectors involved (furniture-interiors, IT, energy) also following the new economic arrangements that have followed the Covid-19 pandemic crisis and the recent consequences of the war in Ukraine.

For each sector, the document contains a brief overview at European level, a dimensioning of the sector in economic terms, workforce and reference markets.

A second part consists of a SWOT analysis which highlights the capabilities and limitations of the production system.

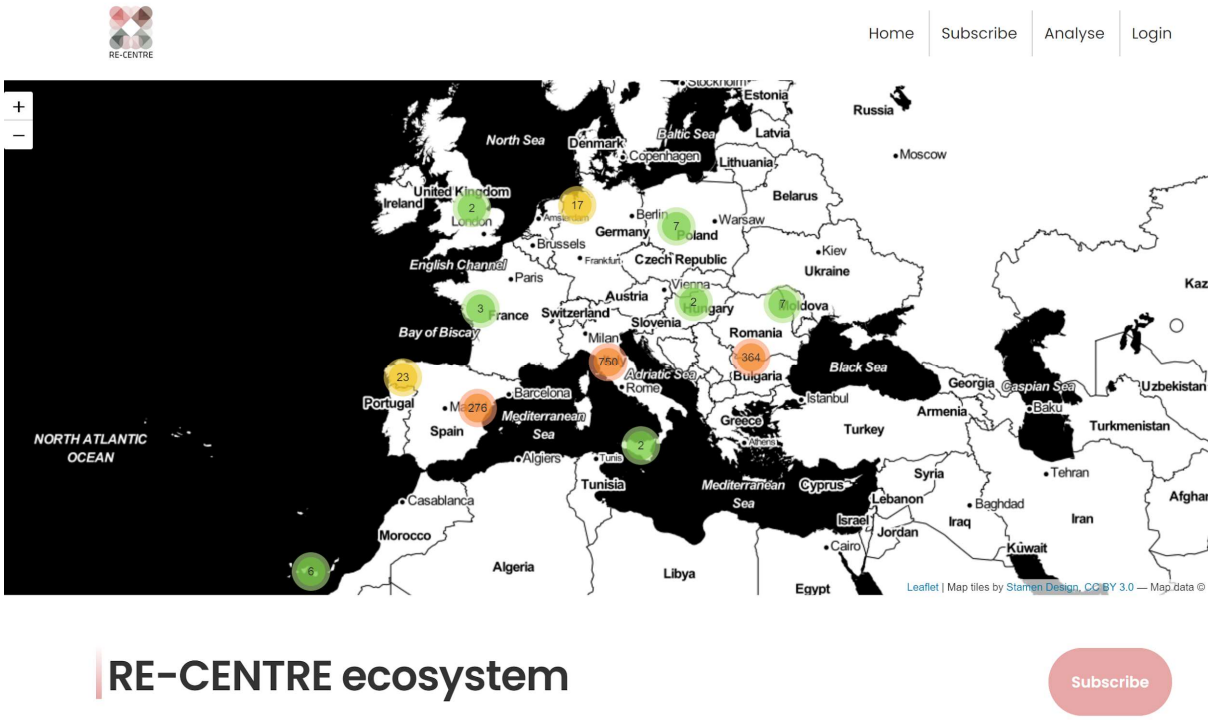
Finally, the third section is preparatory to defining, also through a survey conducted directly with companies, the barriers and opportunities resulting from the on-going crises, functional to defining the challenges on which to intervene and stimulate virtuous collaborations between the technological sectors (green and digital) and a traditional manufacturing sector such as interiors-furniture.

The document will be the starting point for reflections done during b2b meetings on innovation challenges as part of T1.2 RE-CENTRE innovation matchmaking (M7-M12) as well as for discussions activated with the 4 interdisciplinary working groups with 18 selected experts (M6-M10), the results of which will be embedded in the final RPBC Plans for the 3 sectors addressed.

2 The RE-CENTRE ecosystem map

Starting from a framework of mapping developed by dID, RE-CENTRE coordinator, in previous activities run at regional level, the ecosystem mapping of all stakeholders functional to RE-CENTRE activities has been realized by the 4 partners with a coral action that took place from M1 (September 2022) to M7 (March 2023). The partnership decided to make use of the web platform created by dID for adapting it to RE-CENTRE needs.

http://www.recentre-map.com/ has been fed with **1466 records** for which data are collected on a dedicated xls profiling sheet.



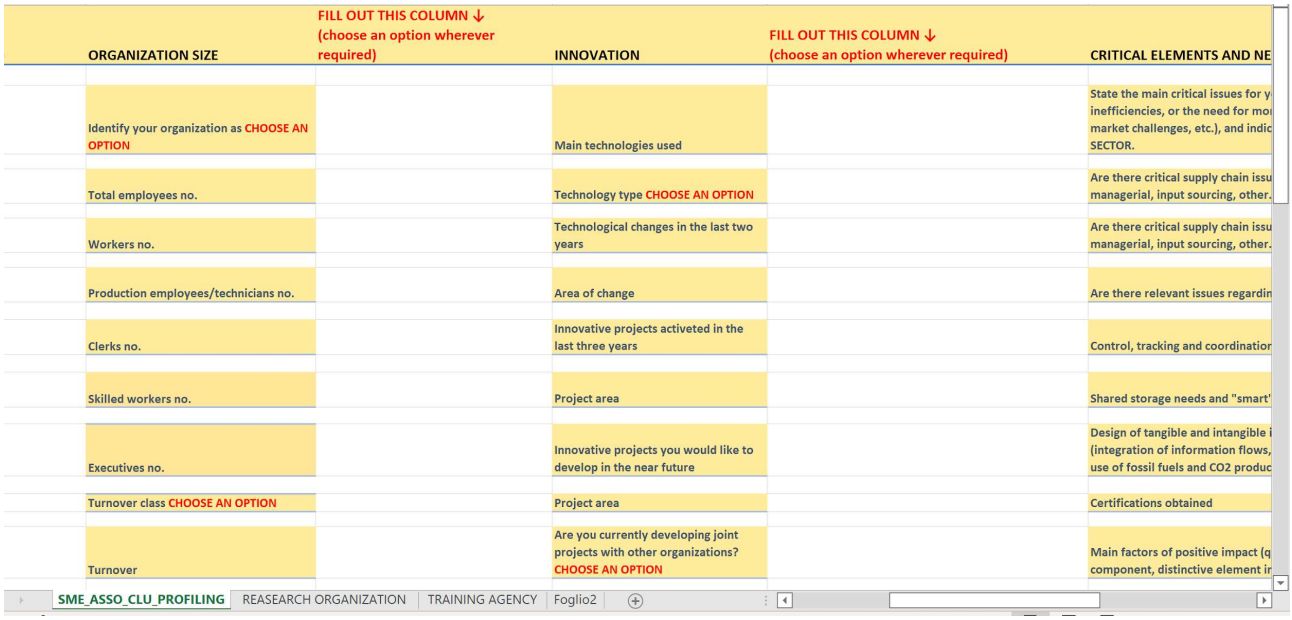
Profiling has been elaborated for all kind of stakeholders divided into the following categories:

- SMEs, large companies, start ups
- Business/trade associations, clusters and innovation hubs
- Training agencies
- Research organizations

A dedicated detailed xls file has been developed with sheets for each category where information are divided into the following sections:

- General data
- Organization size
- Innovation

- Critical elements and new opportunities



ORGANIZATION SIZE	FILL OUT THIS COLUMN ↓ (choose an option wherever required)	INNOVATION	FILL OUT THIS COLUMN ↓ (choose an option wherever required)	CRITICAL ELEMENTS AND NE
Identify your organization as CHOOSE AN OPTION		Main technologies used		State the main critical issues for y inefficiencies, or the need for mo market challenges, etc.), and indic SECTOR.
Total employees no.		Technology type CHOOSE AN OPTION		Are there critical supply chain issu managerial, input sourcing, other.
Workers no.		Technological changes in the last two years		Are there critical supply chain issu managerial, input sourcing, other.
Production employees/technicians no.		Area of change		Are there relevant issues regardin
Clerks no.		Innovative projects activeted in the last three years		Control, tracking and coordinatior
Skilled workers no.		Project area		Shared storage needs and "smart'
Executives no.		Innovative projects you would like to develop in the near future		Design of tangible and intangible i (integration of information flows, use of fossil fuels and CO2 produc
Turnover class CHOOSE AN OPTION		Project area		Certifications obtained
Turnover		Are you currently developing joint projects with other organizations? CHOOSE AN OPTION		Main factors of positive impact (q component, distinctive element ir

SME_ASSO_CLU_PROFILING | REASEARCH ORGANIZATION | TRAINING AGENCY | Foglio2

The clustering of the ecosystem mapping follows:

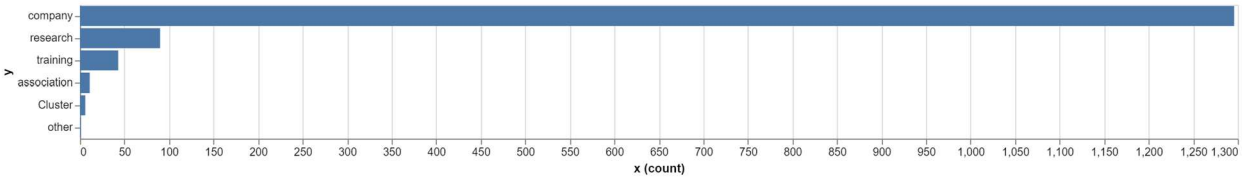
1316 companies

90 research organizations

43 training agencies

11 associations

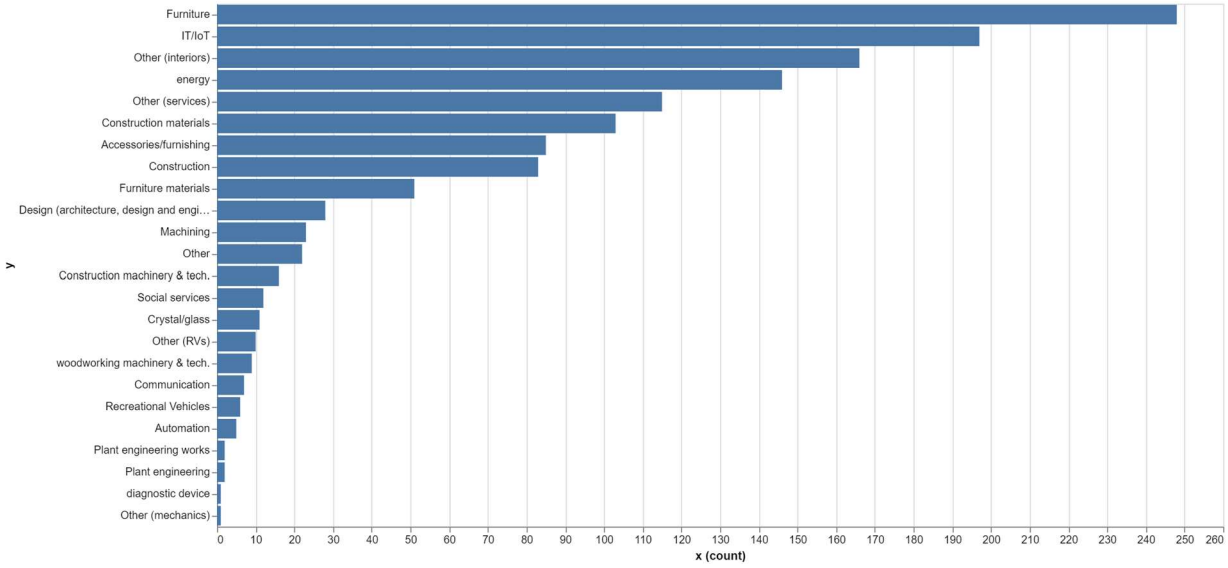
6 clusters



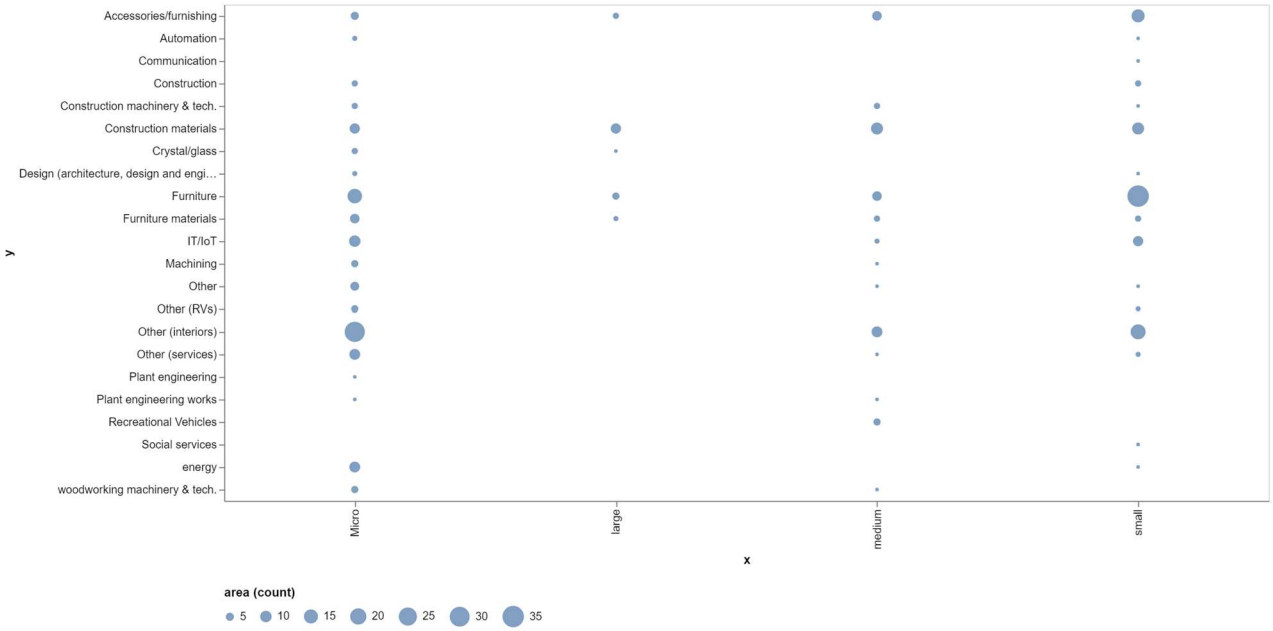
The RE-CENTRE ecosystem has been used for gathering fresh information on the 3 sectors' challenges directly from the ground, in addition to expert voice collected in working groups.

100 questionnaires / complete profiling files have been collected (25 each partner, thus 50 for the traditional manufacturing sector, 25 for energy and 25 for IT sectors) and they are analyzed thanks to the deep analysis possibilities that the platform offers.

The RE-CENTRE ecosystem has the following structure:



Companies (x) per production chain (y)



Size of companies (x) per production chain (y)

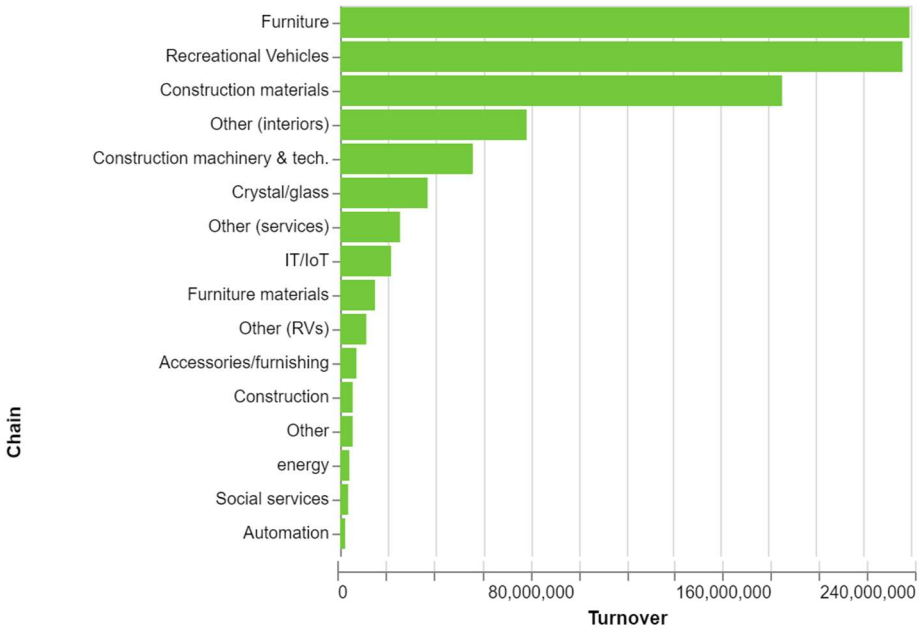
95% are small and micro companies and subsectors covered are divided (in order of importance = more companies on the total) into:

Furniture: furniture and furniture materials, other (interiors), accessories/furnishing – total of 1145 records

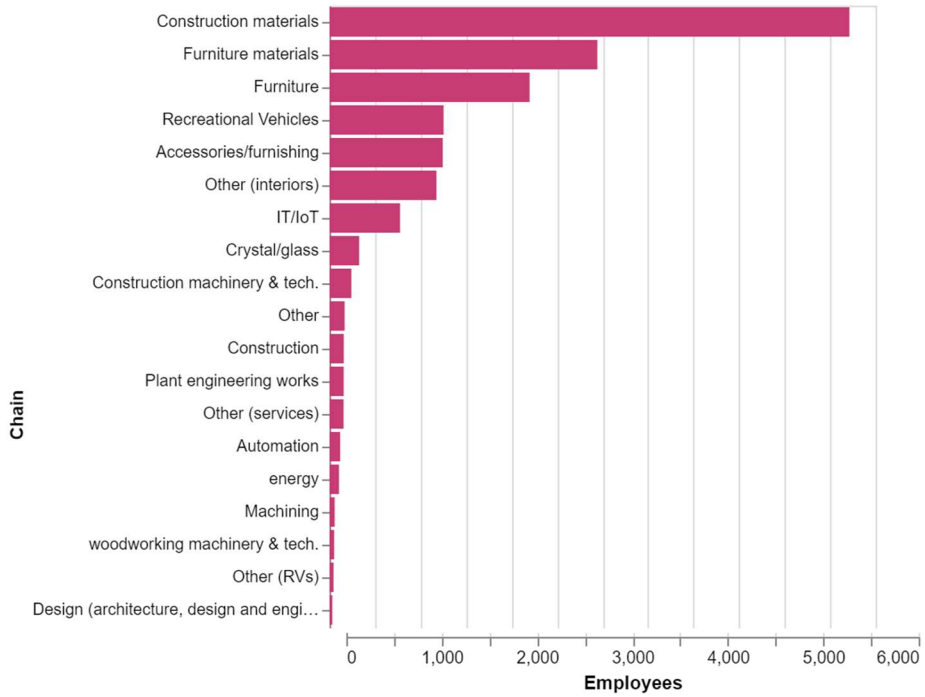
IT: total of 165 records

Energy: total of 256 records

Revenue per subsector: the furniture sector is highly represented with a total turnover of 240mln€ (many small and medium sized companies), followed by recreational vehicles (few large companies – concentrated revenues) and construction materials.



Employees per subsector: most represented sectors are construction materials (connected to the hospitality chain) with 5712 employees, while furniture materials have 2943 and the furniture sector 2199.



Other stakeholders in the RE-CENTRE mapping (Research organizations / training agencies / associations / clusters):

RE-CENTRE partners have concentrated their action also in mapping stakeholders that can potentially positively impact in the ecosystem supporting SMEs' growth and innovation processes in order to involve them in active collaborations.

Some highlights are given as follows on diversity of competences and research topics that can be of interest for RE-CENTRE SMEs ecosystem for innovation and technological transfer processes:

- Research dedicated to Packaging, Eco-Design, Life Cycle Assessment, Materials Science with several related patents
- Systemic Design, Circular Economy, Policy Making, Territorial enhancement, Industrial Innovation
- Accessibility and inclusion, cultural heritage, healthcare and wellbeing, food design, wearable devices, Internet of Things
- economics, design, virtual reality, decision making in economics via the application of digital technologies
- sustainable materials
- additive manufacturing, vision

All these fields of intervention are relevant for the 3 involved sectors. Research organizations and other stakeholders will be invited to collaborate with SMEs by addressing specific topics of interest making use of the FSTP tools designed and delivered during RE-CENTRE lifetime.

3 Furniture sector analysis

3.1 European overview of the furniture industry

The European furniture industry employs 1 million people counting on more than 120.000 thousand players on the market in EU, mostly SMEs and microenterprises. The EU furniture industry consumes and produces 25% of the world's furniture and represents about the 40% of the total world trade.
In 2023 the market is expected to grow annually by 3.37% (CAGR 2023-2027).
The market's largest segment is the segment Living Room Furniture with a market volume of more than 60bn€ expected in 2023.
The Furniture market is divided into seven segments: Living Room Furniture, Bedroom Furniture, Kitchen & Dining Furniture, Outdoor Furniture, Home Office Furniture, Lamps and Lighting, and Floor Covering. Due to rising living standards and a higher income, consumers are replacing their furniture more frequently. In 2021, the Furniture market realized a total worldwide revenue of more than 600 billion€, representing an annual growth of 12.2% compared to 2020.

The Furniture market is mostly driven by consumer spending in general. Consumer spending takes various factors into account; such as per-capita income, household debt levels, and consumer expectations. The steady increase in disposable income and the **consequent rise in living standards are responsible for the continuous growth of the market, as is the constant demand for furniture**. The growing number of internet and smartphone users has not only changed consumer behavior, but has also fundamentally changed the sales channels and retail landscape. The adoption of online shopping by consumers has made furniture one of the fastest growing markets in that regard.

The Furniture market's largest segment is the Living Room Furniture segment. It includes furniture found in living rooms, parlors, lounges and lobbies. The segment is especially propelled by consumer's need for comfort in their homes.

The Bedroom Furniture segment includes everyday bedroom items such as beds, mattresses as well as closets, nightstands and dressers. In the rather conservative Bedroom Furniture market, innovation comes from retailers focusing on offering comfort and convenience directly to consumers. The Bedroom Furniture segment accounted for 19% of the Furniture market's revenue in 2021.

The growth of the Kitchen & Dining Furniture segment is driven by **improvements in materials and designs** which are used to provide consumers a wider range of products. Revenues of the segment have experienced an increase of 11.5% in comparison to 2020.

The growth of the Home Office Furniture segment is driven by factors such as **the development of innovative products** as well as the adoption of **modern and high-quality ergonomic furniture by offices**. By 2026, the worldwide Home Office Furniture segment revenue is forecast to reach approximately 55 billion€.

The Lamps and Lighting segment accounts for 12% of the Furniture market's revenue and is mainly driven by the push for stricter regulations across the globe with regards to more energy-efficient light sources.

Improved comfort, water resistance and durability of floors, as well as consumers tendency to buy more expensive goods, are fueling the growth of the Floor Covering segment.

This Outdoor Furniture segment includes furniture made of materials other than wood. The worldwide revenue of 45 billion€ in 2021 is expected to increase to 57 billion€ by 2026.

The main key player in the Furniture market with regards to market share is the Swedish company, IKEA. With more than 42bn€, IKEA has by far the highest sales among furniture companies.
However, since eCommerce is further driving the growth of the furniture industry, Wayfair, one of the largest online-only home goods retailers, has a major potential for its future business.

The following trends currently shape the market: augmented reality apps, generative designs, eco-friendly materials, and integrated technology. From 3D-printed furniture to smart lightening, the Furniture market is experiencing innovations in design, production, and material.

3.2 The furniture industry in Italy

The Italian wood-furnishing sector today counts 73,000 companies, 311,000 employees for a turnover total of 42.5 billion euros. It employs 8.5% of employees in the entire manufacturing sector Italian and with 15.2% of companies, the wood-furniture supply chain is the second sector in Italy by number of businesses.
It is characterized in particular by being a mostly national supply chain: the industry of semi-finished and that of the finished product are often a few kilometers apart, favoring deep dynamics of relationships, exchanges and mutual knowledge of the market. The regional Clusters (public-private organisations which bring together companies, associations, the chambers system and institutional players on the territory) reflect and express the vivacity of this territorial dimension, also in dialogue with local institutions.

The fragmented nature of the sector, with a clear predominance of small and medium-sized enterprises (with peaks of 95% of SMEs in some regions), it represents at the same time its richness and its limit.
The **ability to quickly adapt to changes, a know-how able to combine innovation and tradition and the articulation in districts specialists** collide with the l**imitations of too small a size to encourage high investments,** difficulties related to the **generational change**, a progressive **aging of workers** and a marked **distance between production and the world of academic and private research**.
The sector seems to reflect the **ambiguity of the Italian word "artisanal-handcrafted":** on the one hand it expresses the whole richness of a know-how of ancient tradition, capable of personalizing the product in order to answering to the unique need of the customer, on the other hand includes the limit of something that is not on a large scale, which lacks contemporaneity.

Italian companies in the sector were among the first to develop **good practices and business models inspired by the principles of the circular economy and to raise the issue of sustainability** (in its environmental, social and economic ramifications) at the heart of their development.

The **scenario of technological evolution and digital transformation** is different: even if there are good examples of the application of the measures that the national Industry 4.0 government support package has generated, there is **still a long way to go.**

Coming to the actual market situation, it is clear that 2021 has been a dramatic year for the wood-furniture supply chain, as highlighted by FederlegnoArredo in its final year's data.

This is now confirmed by the final figures which highlight a recovery in the sector that had already started in the past last months of 2020: the production turnover of the entire sector, equal to 49.3 billion euros, is increased overall in value by 25.5% on 2020, confirming the double figure also on 2019 with a +14%, equal to approximately 6 billion more turnover and a trade balance of 8.2 billion. The overall figure is determined by the export trend, which represents 37% of the total turnover and have a value of over 18 billion euros, (+20.6% on 2020 and +7.3% on 2019), but it is above all the dynamism of the Italian market which has touched 31 billion euros (+28.7% on 2020, +18.4% on 2019), undoubtedly driven by the building bonuses put in place by the Government that they have received a driving impact on all sectors of furniture and wood related to the residential sector.
After the global economic crisis that hit Italy hard in 2020, 2021 has represented, despite considerable difficulties (raw materials, high energy costs, logistics and transport), an important year for consolidating the recovery of the sector. Given the current situation and a general concern due to the war in Ukraine, any prediction on 2023 becomes more than complicated. Efforts of companies that used to concentrate on Russian and Ukraine markets are now driven to market diversification. Moreover the commitment of companies is always aimed at the search for innovative products and materials, new markets and a new development of the sector which has in sustainability an essential element for international competitiveness.

3.2.1 Dimension and structure of the sector

The Italian wood-furniture supply chain is made up of over 70,000 companies which employs approximately 294,000 employees and which represents 4.7% of the national manufacturing turnover; 15% of companies and the 7.7% of employees.

Looking at the two macro-systems that make up the supply chain, it is evident that both have recorded a positive trend. The Furniture and Lighting Macrosystem, whose turnover at production is equal to 26 billion euros, closes 2021 with a change of +21.7% on 2020. The turnover of the Wood Macrosystem, equal to almost 20 billion euros, increased of 29.3% on 2020. As regards sales on the Italian market, there is an increase of 32.2% on 2020, while exports which represent 24% of the total turnover, closed 2021 at +20.8% on 2020.

The Tuscan interiors and furniture sector on which dID – Distretto Interni e Design action focuses, is made of a complex of more than 400 structured companies acting as international players in the "living spaces" context, including both wood and furniture macrosystems. The total of regional companies counts about 4400 with 18000 employees representing 6% of the national sector and 3,1% of the regional turnover equivalent to 2bln€, 2/3 of which coming from the furniture sector.

94% of those companies are SMEs (rarely medium size, mostly micro and small).

3.2.2 Export trends and markets

The exports of the supply chain represent 37% of the total turnover and have a value of over 18 billion euros (+20.6% on 2020 and +7.3% on 2019) and France, Germany and the United States confirm the three Countries on the podium for our Made in Italy.

France, with a value of just under 3 billion euros, is the leading export country for our supply chain (16.3% of total exports) where there was a +13.3% on 2019 and a +24.3% on 2020.

Germany is confirmed as the second market (11.4% of total exports) with an exported value of over 2 billion euros and an overall growth of +13.8% compared to 2020 and 11.8% on 2019). Since 2017, the United States has already been the third export market and the first among the outlets extra-EU, for a value of 1.9 billion euros and a share that in 2021 will exceed 10%. Medium the increase in exports is +33.8% compared to 2020 and +26.2% compared to 2019, offsetting the losses in 2020 (-5.7%). The United Kingdom confirms itself as the fourth reference market with an equal value at 1.3 billion euros and a change of +22.9% on 2020 but still negative compared to 2019 (-1.5%) and previous years due both to the pandemic crisis and to the climate of uncertainty caused by the exit of the country from the EU. Switzerland is the fifth reference market (811 million euros exported) with growth by 16.8% on 2020 and by 7.7% on 2019. With regard to exports of products in the Wood-Furniture chain towards China, with the exception of a decrease in 2020 (-10.8% on 2019), constant growth continues up to an export value of just under 680 million euros in 2021 and a growth of 22.7% on 2020 and 9.4% on 2019.

Russia, with 462 million euros in 2021, is among the top 10 countries by export value of the supply chain in growth of 12.7% on 2020, but still down on 2019 (-4.5%). In 2021 Italian exports they were worth 461.7 million euros to Russia, about 7.6 million to Belarus and 126.9 million to Ukraine which constituted respectively the 9th, 93rd and 27th market in the supply chain. From 2014, direct exports to Russia decreased, but the volume of business with Russia increased Russian customers in various countries of the world, where there are properties and important investments, while exports to Ukraine were instead increasing in recent years. It should also be taken into account fact that the wood-furniture supply chain is very fragmented and that there are companies that have shares of very important market in Russia, which is why the statistical values do not reflect the real weight on the our top-level furniture exports or our internal production of finishes. It's realistic think that the real impact can be 6/7 times higher than the data.

3.3 Furniture sector in Spain

3.3.1 Dimension and structure of the sector

The furniture sector recovered in 2021 the sales level of before the pandemic, closing the year with a positive trend. The value of sales reached €4,600 million. Companies that manufacture household furniture, bathroom furniture and upholstered furniture are those that have experienced the greatest year-on-year growth rate (15%). Kitchen furniture, for its part, grew somewhat less, 8.1% year-on-year growth rate. Finally, the office furniture segment grew modestly, only 2.6% compared to 2020.

The cost of raw materials has begun to be a very worrying variable in 2021, since, at the end of the year, the average cost increase stood at 16%. With all this, the operating margin of furniture manufacturing companies grew by 4% on average.

At the structural level, the number of manufacturing companies in the sector fell by 1.5% in 2021; up to 6,680 companies. If the evolution of furniture companies number is compared with the total manufacturing industry number evolution, it can be observed how both evolutions converge again; although the industry as a whole has lost 1% of companies between 2021 and 2020. Based on company size, medium-sized companies (between 50 and 249 employees) show the greatest reduction (-5.5%).

The furniture industry in Spain is characterized by companies fragmentation: they are very numerous and small, in terms of turnover and employment. The sector has a majority presence of micro-enterprises (89%), which represent 20% of the sector's turnover. At the other extreme there is a small number of companies (over 50 employees) that account for 1% of the sector and 46% of the total sector turnover.

At the location level, Andalusia, Catalonia, the Valencian Community, Madrid, Castilla-La Mancha and Murcia concentrate the greatest furniture manufacturing activity. By volume of business, the Valencian Community, Catalonia, Andalusia and Madrid account for 54% of the total business volume.

At employment level, this has increased by 3.5% during 2021 (65,300 workers), placing employment at a level not seen since 2012, in the midst of the previous decade financial crisis.

At activity level, 83% of the furniture manufacturing companies carry out all their production processes internally, 18 percentage points more than in the previous year. 76% of the sector's purchases are raw materials; while only 16% is dedicated to the semi-finished product.

Productivity continues to be one of the most relevant aspects for the sector. 13% of companies have not undertaken any productivity improvement project in the last three years, and only 9% have invested more than 400,000 € in the same period.

In relation to the barriers faced by the sector, investment financing problems are the most relevant for furniture manufacturers: 50% affirm the investment cost as a barrier, and 33% indicate financing problems as other one.

On the other hand, information systems integration with the main suppliers and customers, a key process for improving company productivity, has a long way to go in the sector since only 10% of companies have these integrated systems.

At distribution level, the traditional or specialized distribution channel to physical stores reaches 56% of the manufacturers business in the sector. Sales to customers / end users continue to grow and now account for 20% of sales.

On the other hand, the importance of the contract channel remains stable with 17%; despite the difficulties generated by the pandemic in the last two years. Residential customers (hotels, tourist apartments, etc.) are the ones with the highest sales percentage, followed by the hotel industry. Between both environments they account for two thirds of contract channel sales. Finally, the online

channel begins to become relevant in the manufacturers sales, representing 4.4% of the total in 2021.

3.3.2 Export trends and main markets

In relation to foreign trade, Spanish furniture exports increased by 23% in 2021, reaching €2,200 million. By area, the European market is the main destination for Spanish exports. France, Portugal, Germany and Italy concentrated 55% of the furniture exports value in 2021. The United States continues to be the main export destination to America - with €124 million value -, while Morocco consolidates as the main African market. As expanding markets, the growth of exports to markets in destinations as varied as Poland, Chile, Japan, South Africa, Romania, Qatar or the Dominican Republic stands out.

Imports amounted to €3,200 million in 2021; increasing by 25% compared to 2020. In total, Spain was the destination of imports from 127 different countries. These imports are made either from value system agents (manufacturers, shops, importers...), or by other agents that carry out import activities, such as furniture trade intermediaries and furniture wholesale trade.

By country, China remains the main source of imported furniture, with a value of €998 million in 2021. Despite the increase in transportation costs, the Chinese imports value has grown by 60%. In second place, European countries such as Italy, Portugal and Germany stand out; Imports growth from Morocco and Eastern Europe is also significant.

4 Capacities and limits of the sector

ALLVIEW is a COVEs project, a transnational cooperation platform that connects partners within the wood and furniture sector, with operational objectives on a regional, national and European level and has developed an in-depth SWOT ANALYSIS on each partner furniture producing country which can be schematized and condensed as follows:

Strengths

- Identity and tradition: high level of experience and internal know-how.
- Presence of specialized districts, characterized by homogeneity of production and widespread relationships between companies, research centres, training and education system and institutional stakeholders.
- Sector characterized by SMEs, capable of adapt quickly to changes in the market with flexibility, keeping the quality level.
- Sector characterized by Innovation, too through the use of proprietary tools intellectual
- Presence of world leading corporations of the sector in terms of innovation, design and ability to interpret trends and needs of the market.
- The Salone del Mobile in Milan is the most important trade fair in the world for the wood-furniture industry.
- Widespread awareness along the entire supply chain the crucial importance of issues such as sustainability, the circular economy, certifications environmental.
- A representative national federation of the entire supply chain, made up of 11 associations products with dedicated planning and consolidated capacity for institutional dialogue.

Weaknesses

- Entrepreneurial fragmentation: the high number of small and highly specialized micro-enterprises weakens the ability to create systemic strategic actions
- Family business sector, often unwilling to take advantage of external managers.
- Unattractive sector for young people and for women. Lower attractiveness than other traditional sectors (fashion, food, automotive)
- Job positions often uncovered, for lack of staff or for little qualified personnel disputed between companies of the sector.
- Level of technological and digital maturity highly diversified and, especially in SMEs, still underdeveloped use a market approach that takes advantage of technological opportunities.
- A fragmented, traditional and not very innovative sector.
- Relationship with the academic world and the research community is irregular and far from open innovation models.
- Limited number of new businesses / startups.
- Rather advanced entrepreneurial age often accompanied by difficulty in generational changeover.
- Weak focus on inclusion of disabled – fragile people.
- Procurement of timber almost entirely from abroad. Insufficient valorization of national forest heritages.

Opportunities

- Sector with high sensitivity and innovation of business models based on sustainability and circular economy
- Evolution of the technological and digital scenario thanks to national measures accompanied by financial support in relation to digital transition
- Development of regional clusters facilitating relationships between the business world and the research system, with important implications at the policy level
- Progressive development of a training path at the service of the sector articulated at a level national level for all EQF levels (institutions of vocational training, technical institutes, Higher technical institutes, short degrees and masters, first and second level Masters)
- Development of the Twin Transition (Green and Digital): development of new sustainable materials, recycled, recyclable or functionalised, development of new digital technologies for processes production, data management, data integration systems
- Progressive evolution of professionals in the sector, increasingly attentive and trained in corporate innovation management
- Relaunching the value of the “home” asset also following the Covid-19 pandemic, with a revival of consumption hierarchies

Threats

- Dramatic increase of raw material costs in the last 2 years (Pandemic + Ukraine war)
- Difficulty in finding raw materials or semi-finished products (lack of availability on the market)
- Crisis of the European competitive capacity compared with non-EU countries with significantly lower labour cost
- Fragility of the interior finishing sector (doors, windows, wooden floors) and lower added value supply chains characterized by the scarcity of investment in innovation and design
- Difficulty in accessing the world of credit due to the small size of the companies
- Changing lifestyles in the new generations, with weakening of the value of “furniture”, furnishing” and “house” assets.

5 Barriers and opportunities of crisis

5.1 Post pandemic context

The effects of Covid-19 on the sector

According to the report published by *Cassa Depositi e Prestiti* in July 2020 it was expected and then demonstrated that, due to the pandemic, the world market of wood-furniture was going to suffer a contraction of -3.6% in 2020, reaching a total value of less than 700 billion dollars. This circumstance was completely attributable to the impact of the measures put in place to contain the spread of Covid-19 and, **in fact, starting from 2021 the market has started growing again at an average rate of 7%, to reach an expected value in 2023 of nearly 850 billion dollars**.

Due to the different temporal distribution of the production block and the different position of the markets in global value chains, the impact of Covid-19 has not been the same in the different countries affected.

For Europe the forecasts were confirmed with a decreased turnover in the sector by more than 6% compared to 2019. That is an important impact if we consider **that the entire European wood and furniture supply chain is worth almost two percentage points of the GDP and employs over 2 million people**, representing the 5th sector in terms of employment. It is clear how this block is **having important repercussions for the stability of the European labour market.**

In addition to the difficulties on the production side, a non-negligible impact on the sector has been caused by blocking people's mobility and the consequent interruption of sales. **Furniture retail is one of the most affected by the lockdown.** Furniture sales have always been worse than the non-food sectors as a whole.

Finally, a last not negligible remark, is that of how it affected traditional events and sale channels of furniture worldwide. That is the situation of the Italian furniture sector and the **cancellation of the Salone del Mobile in Milan**, an international event that attracts at least 350 thousand companies and operators every year and which has a direct and indirect impact on the entire world sector.

In this scenario, one of the **keys to resist** seems to have been, as in other sectors, the **digital channel**, which has proved to be decisive both from the production side and in the marketing of products. In some cases, in fact, the nature of the **digital manufacturing process** has made it possible to generate **innovative solutions in this atypical scenario**, quickly converting the productions: plates to turn on the antibacterial lights, phone charger that simultaneously sanitizes the screen, appendages for the printed handles in 3d avoid contact are just a few examples. From the point of view of purchases, companies that already had a developed online channel were able to benefit from it, maintaining and strengthening this type of sale.

Channels and digital tools have also made it possible to support contact and exploration of different markets in the absence of the common methods that rely on physical movement and direct contact with operators. This is especially true in the interior design & furniture sector, which is strongly oriented towards foreign markets but often still very traditional in its management methods.

THE POST-PANDEMIC SCENARIO

The Covid crisis is grafted onto a transformation path that has been affecting the wood and furniture sector for some years now. **The organization has evolved towards an increasingly "on demand" production**, which limits the accumulation of the warehouse. This was possible thanks to a **highly dynamic demand** that has continued to grow also thanks to the tendency of the modern consumer to replace furniture more frequently, in search of better housing standards as the levels of disposable income increase, accompanied by greater attention to design and comfortable solutions for different living and working solutions.

After the crisis caused by Covid, **new opportunities open up linked to the need to rethink the spaces of life, work and free time**, both for the new needs of social distancing, and for the changes in life habits that will presumably derive from it.

The pandemic has and is still producing a *substantial change in consumers' needs towards the use of living environments, both in private (home/residential) and public (contract/hospitality, schools, hospitals, airports….) contexts* considering the following issues:

- (private/residential perspective) Our homes have seen a greater **coexistence of functions** - think of home-working, remote lessons in schools and universities and the **coexistence of a greater** number of people inside the same space. And, at the same time, our homes appear smaller and smaller to be able to perform the different functions.
- (contract/hospitality/public spaces) Finally, strong attention will be given to **schools and universities**, where all reflections about spaces necessarily need to involve teaching methods and tools.
- We are moving towards **a more widespread smart working**, with the work activity that will more and more often take place partly at home, which therefore will have to be more suitable for working with multifunctional structures, partly in the office, for which it is necessary to rethink spaces in a more flexible way. In this context it could be observed a new stimulus to the dynamism of the demand for furniture and fixtures, which will be satisfied by **versatile and multi-purpose solutions**.
- **The progressive abandonment of office spaces**; think about the problems related to the leasing and sale of such spaces. And, beyond this, the transformations of the office-work space, which will increasingly be characterized by spaced and separated workstations - professional distancing -, beyond simple plexiglass spacers, and, more generally, by new rules for the open office, remembering that, however, "co-localized work teams have more ease in building relationships of trust and making decisions quickly" (www.wework.com), some speak in this sense of "the end of the open space era. " **In general, common areas and any kitchen spaces need to be rethought.**

  Among other aspects that need to be considered in the design and construction of new work / office spaces: the installation of sliding doors and sensors that detect movements, so as to minimize contact with surfaces.
- Even the **materials and their use** will have to be rethought to meet **safety requirements**. We will move towards safer materials, which offer barriers to contagion, with an important stimulus also for the search for more performing novelties for defense against the epidemic.
- **The need for greater hygiene and sanitation of public and semi-public spaces and of contract in general**. Also in this case, the **demand for distancing and privacy appears to be growing as in the hotel and catering contract sector** - waiting rooms, tables with booths -, but also airports, stations. And again: the tendency to "exploit outdoor spaces to intercept passing customers through the use of stations.

Consumption trend in the post-pandemic furniture sector

The pandemic is strengthening consumer demand for socially active brands that share their values and for products that respect the environment. In response to COVID-19's effect on personal health and its correlation to pollution and environmental habitat destruction, **many consumers are shifting their behaviour towards healthier lifestyle habits, thoughtful consumption and the betterment of society through self-improvement.** For the furniture industry, the expanding market size of eco-friendly furniture, estimated to reach $59.8 billion (USD) by 2027, best exemplifies the rapid progression of these consumer trends.

Fortuitous for furniture manufacturers, the sustainability trend s coupled with a growing focus on the importance of the home.

Future scenarios for the interiors' sector as potential solutions:
In general, the innovations are mainly related to:
1. the search for the **right balance between presence and physical distance**, capable of satisfying at the same time the desire for socialization and the search for safety;
2. the importance of **more flexible spaces** and furniture products, able to interpret the changed functions of living and working spaces, dedicated to specific functions (for example the school);
3. the **need to sanitize spaces and furnishings**, of interest above all at public, semi-public and private level, but with implications also in the private sector: entrance hall, kitchen.
All this, without forgetting, that the pandemic is part of a much wider problem: our wrong relationship with the environment – bringing towards a higher and higher sensitivity in the search and use of more ecological materials and technologies, higher attention to the production chain till a growing interest for the product disposal phase.

Beyond solutions strictly related to the need for distancing, specifically, the answer therefore is related to:
1. **The design of the spaces with an increase in the multifunctionality and flexibility of the furnishing solutions, capable of guaranteeing the new mixed functions linked to the living and working spaces.** "There will be space for objects that have a function and that solve a problem. Today the house has found a new centrality and is winning over the office.[…] However, we have studied a different way to design our products and to tell them: our lamps will no longer be placed on a pedestal, in controlled atmospheres without people, but we will focus on people and their relationship with their environment." Carlo Urbinati President of Foscarini.
What changed was the very concept of home which, in some ways, has turned towards an almost hybrid and certainly multifunctional configuration. "The house during the lockdown was adapted to an office, gym, restaurant and even a barber in some cases", explains Francesco Roesler, Senior Landscape Architect & Masterplanner at international firm Dar Al-Handasah. A clear dividing line that has established a before and after in the way of living the home, also because it is a common condition for over half of the world population: **"This has led many architectural firms to rethink furnishings and design of homes to meet those that could be the needs and trends of the future".** And the components that he believes will play a central role in shaping the post-Covid home are: the common spaces, the flexibility and technology, the square footage, the context, the outdoor spaces, the furniture and materials.

5.2 Energy and supplies' crisis

The products related to interior design from the last decades of the last century are increasingly the result of international collaborations: woods from Eastern Europe, fabrics from South America, technology from Asia, ... a series of opportunities allowed by a global approach which, in times of global crisis like the current one, it becomes a major challenge for supply chains.
The furniture industry has been impacted by both the coronavirus pandemic and the war in Ukraine – cumulative effects that are all the more felt in other sectors as it ranks further down the supply chain.
Efic, the European Furniture Industry Confederation, identifies a series of disruptive effects that have emerged in the last two years:

a) logistics difficulties, increased transportation costs
b) the shortages and increase of raw materials prices
c) the industry has to cope with soaring energy prices. Even if the furniture industry is not energy intensive per se, production costs have also risen. However, the main price increases affecting the sector come from the materials we procure. Many of our suppliers are energy

intensive and this has been reflected in pricing over the past years. Further increases may be expected due to the ongoing geopolitical tensions and implications on supply chains. Furthermore, furniture stores and factories have to be heated in the coming months and this causes high energy costs.

d) logs Volumes from Russia, Belarus and Ukraine are no longer available (alternative sources within Europe are not readily available) and several other countries are imposing export bans, which has an impact on the availability of wood to be processed.
e) increase in furniture retail prices that have resulted in a strong slowdown of the market all over Europe since June. Furniture companies are reducing margins and further increases is expected that would have disastrous effects on the industry
f) decrease in demand and an increase in prices
g) lack of skilled workforce

Coupled with this, we are seeing a decrease in demand for furniture products:

- ☐ consumer confidence dropped: less consumers in shops, lower online sales
- ☐ especially in lower and middle-end segment
- ☐ uncertainty of consumers over geopolitical challenges: consumers want to spend less because of the uncertainty of how much the price of energy will increase
- ☐ inflation rates soaring

Furthermore, production costs, energy and raw material costs have risen dramatically, and companies find it difficult to pass these costs on to customers.
Companies are having problem with contracts already signed that are difficult to adapt to the increase in production costs, companies have difficulty keeping promises on delivery times.
An increase in turnover compared to last year is reported, but this is due to price increases.
Finally, difficulties with the procurement of materials (all kinds) persist. Price hikes persist and further raises are expected. In general, the situation with availability and prices of raw materials is expected to worsen in the second half of the year.
For the next future there is even more uncertainty in terms of availability and prices, as often suppliers are not in a position to anticipate what the situation will look like.
This is what emerges also at the level of individual European countries: Jan Kurth, CEO of the Association of the German Furniture Industry (VDM) describes the current situation: “Supply chains in the German furniture industry have come under pressure over the course of the pandemic. The various effects included interruptions to production at suppliers and restrictions to the movement of goods across borders. The delivery delays for supplied parts caused by the lockdowns in China and the resulting congestion at ports are also putting the industry under strain.”
Furthermore, trade is being severely impacted by Russia’s war against Ukraine: “This comes on top of the effects of the sanctions imposed by the EU against Russia and Belarus. The import and export bans. For some of the companies, imports from those countries are vital, a significant share of the specialist wood materials used often comes from Russia and Belarus. There are also problems in logistics because of the serious shortage of truck drivers.” Other factors are also pushing prices higher and higher: “Due to rising material and energy prices, the production costs of the furniture industry have risen enormously. Our producers are forced to pass these cost increases along the chain”[1]
Raw material shortages, supply bottlenecks and the coronavirus pandemic were also singled out as the biggest threats to frictionless global trade by many respondents in a recent study by the TÜV Association.
Also Federlegno reports[2]: “The market situation linked to the supply of wood products was already complex before the Russia-Ukraine conflict, due to the Pandemic and above all to the change in

[1] https://www.imm-cologne.com/magazine/articles/supply-chain-problems-and-opportunities.php
[2] https://www.federlegnoarredo.it/contentsfiles/Nota%20Guerra%20Ucraina%20filiera%20Legno%20Arredo.pdf

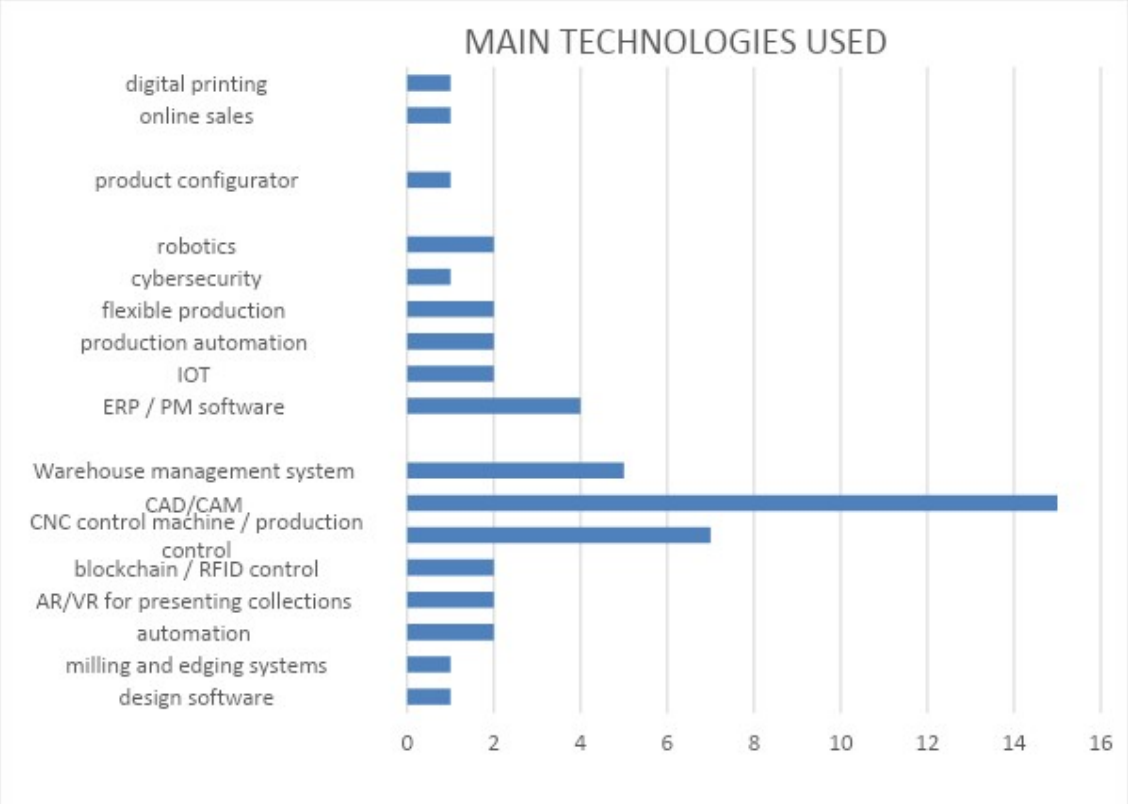
global trade flows of wood raw materials, which caused an increase in prices, together with speculation of the large timber producers in Europe and the uncontrolled increases in transport costs (especially for container freight). […] The Russia-Ukraine conflict has brought further critical issues for the national supply chain, being the Russia, Belarus and Ukraine basin an important source of supply of timber and by-products for Italian industry. In addition to the increases in energy costs, which have become unsustainable for many wood processing industries, the current war situation creates a shortage of wood material, normally imported. The current situation causes considerable criticality for companies that first transform wood, especially for the packaging, carpentry and plywood sectors and then for the furniture and motorhome sectors."
It seems inevitable that companies need to rethink their supply chains and how they source materials.

5.3 Analysis of existing critical inputs / supplies / technologies. Survey results

The following analysis derives from data present in the "innovation" and "critical elements and news opportunities" areas of the xls file used for stakeholders' profiling and it has been done by detecting through answers the state of the art of technologies adopted, the related interest in future adoption and critical elements connected to it on a sample of 100 files (50 for the furniture sector, 25 for IT and 25 for energy).

1) **Technologies used by traditional companies**:

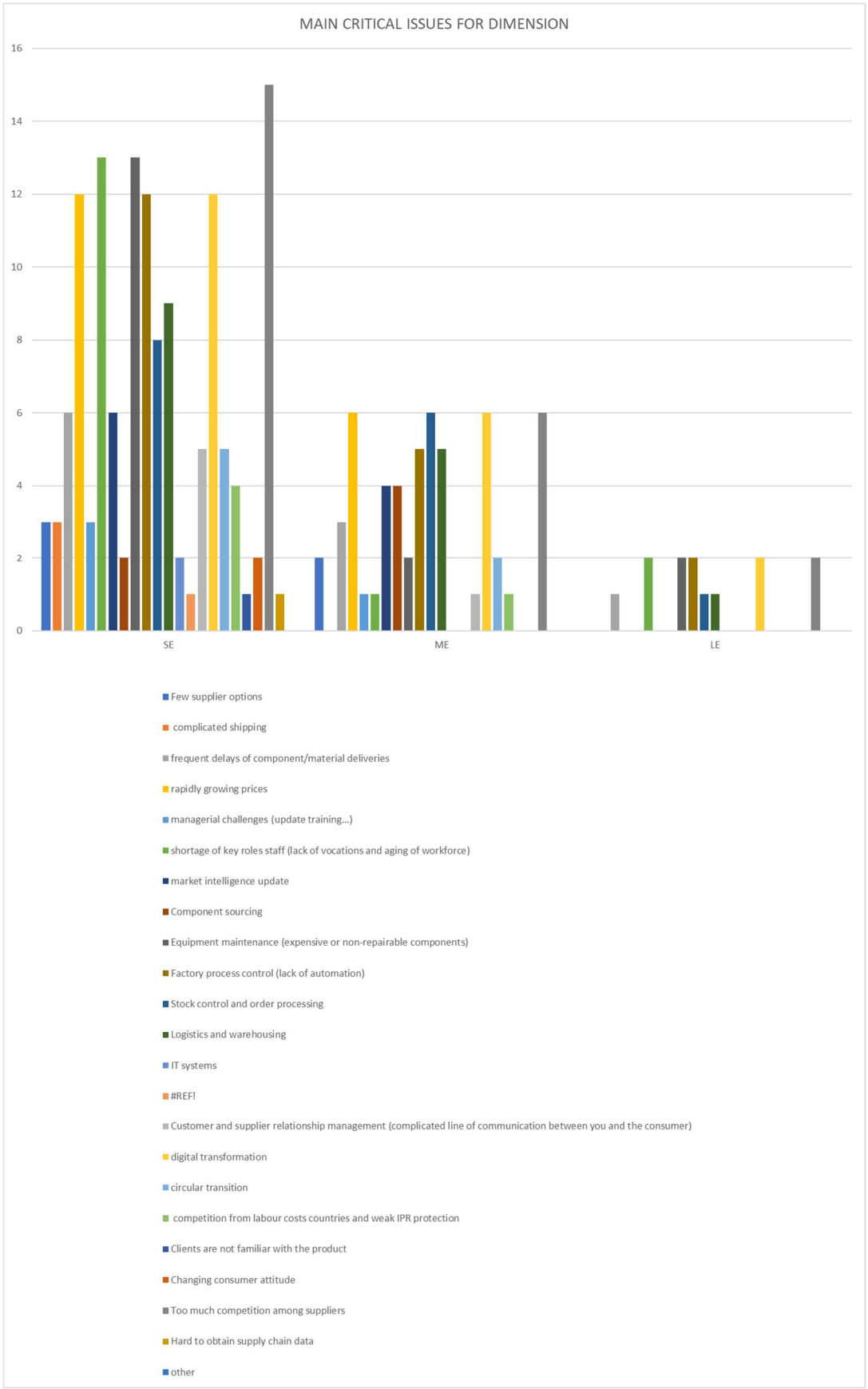
Technical production software are the most used, being related to all processes (production, logistics, warehouse, design…). Uncovered areas on which the sector must advance are mixed or extended reality, blockchain or any other traceability technology, advanced design software and 3D printing for special components.



2) **Main critical issues for companies respect to their dimension** (SE = small enterprise, ME = medium enterprise, LE = large enterprise)

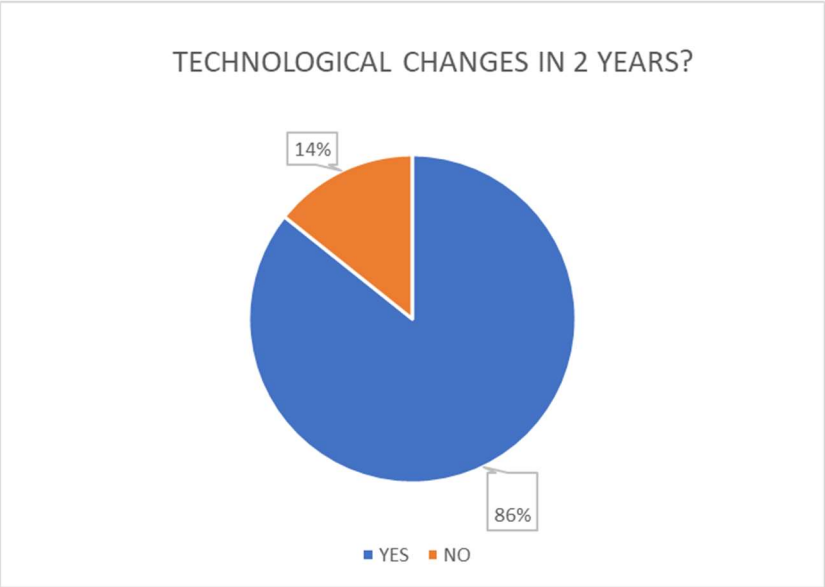
Too much competition among suppliers, rapidly growing prices, shortage of key roles staff (ageing of workforce) and equipment maintenance are main key issues for Small companies. Then digital transformation and factory process control come next.

While for the medium sized ones digital transformation together with stock control and order processing with too much competition among suppliers are the most important issues to address.


MAIN CRITICAL ISSUES FOR DIMENSION
16
14
12
10
8
6
4
2
0
SE
ME
LE
Few supplier options
complicated shipping
frequent delays of component/material deliveries
rapidly growing prices
managerial challenges (update training...)
shortage of key roles staff (lack of vocations and aging of workforce)
market intelligence update
Component sourcing
Equipment maintenance (expensive or non-repairable components)
Factory process control (lack of automation)
Stock control and order processing
Logistics and warehousing
IT systems
#REF!
Customer and supplier relationship management (complicated line of communication between you and the consumer)
digital transformation
circular transition
competition from labour costs countries and weak IPR protection
Clients are not familiar with the product
Changing consumer attitude
Too much competition among suppliers
Hard to obtain supply chain data
other

3) Technological changes in the last 2 years:

86% of companies introduced or have experienced technological changes in the last 2 years



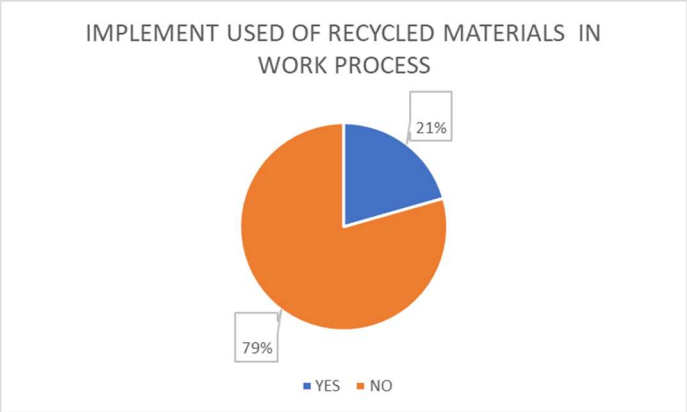
4) Training initiatives in place:

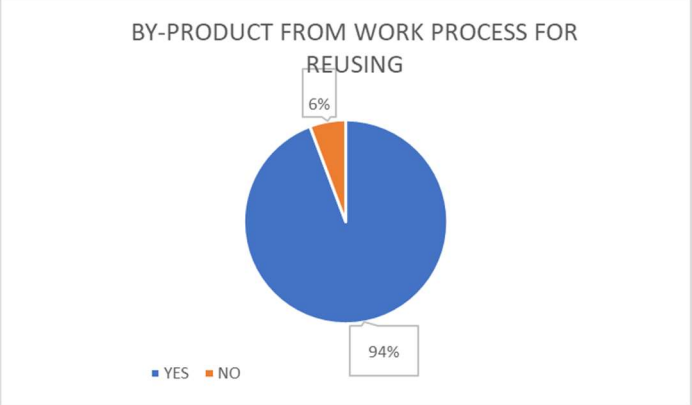
Feeling the strong need for skills update, companies, even the small and micro ones, continuously enroll their staff into training actions (81% of the total actually have training initiatives in place):

64% of total plan to activate innovative projects in the near future with 74% that are actually developing joint projects with other partners. This demonstrate a clear need of the sector in

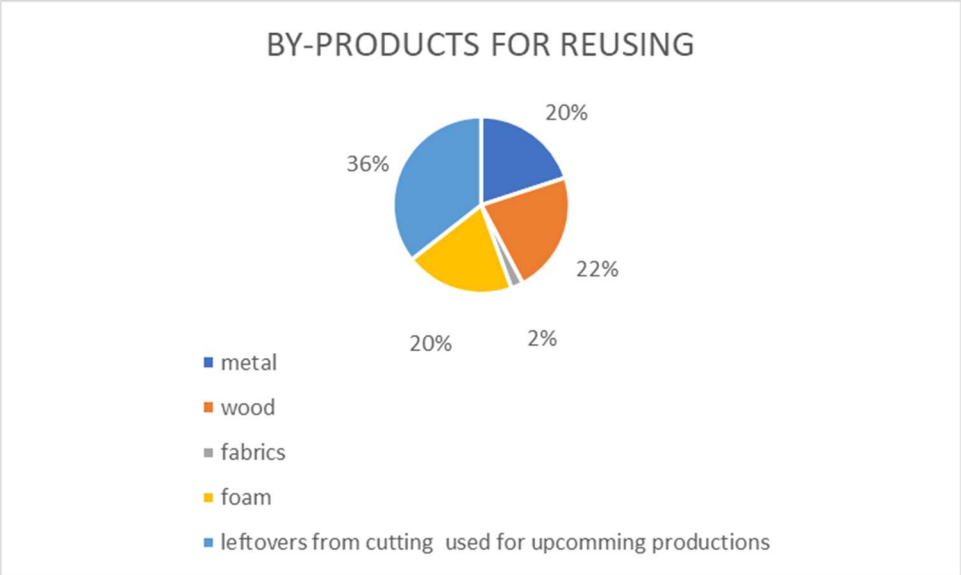
collaborating with external organizations, being companies or clusters or associations that can support their action towards innovation.

When it comes to the implementation of processes for the use and adoption of recycled materials in the work process, only 21% of answers are positive. The process towards circular practices is slow and needs big investments, also at territorial level, that cannot be afforded by micro or small companies alone. More easily they reuse their own internal by-products deriving from their work process (94% declare some practices on this).





By-products mostly reintroduces in the work process are leftovers from cutting, wood, metal and foam.



5.4 Furniture sector future challenges

In 2022 the thermometer of the sector situation at European level for sure has been provided by the last edition of Salone del Mobile, the 60th, that took place in June in Milan after 2 years of Codiv-19 stop.

Despite the climate of uncertainty and concern, indeed perhaps precisely because of this, entrepreneurs have decided to be present at the Salone del Mobile to show their creations live again after a two-year hiatus.

The event was a showcase that witnessed the investments made by sector in terms of quality and innovation. The smart home, the renewal of materials, the interweaving of tradition and innovation aiming at sustainability understood more and more as a competitive lever, they have been the thread conductor of the exhibitions presented.

The wood-furniture sector is responding to a process of change in the society, which the pandemic has accelerated and which has led people to rediscover value of the house, in the awareness that we can live it more comfortably, modern and healthy, with quality and durable products.

Following the conflict in Ukraine, the European Union has taken a number of measures restrictions and sanctions against Russia; among these the prohibition, introduced on 8 April 2022, of purchase and importation of wood raw materials throughout the EU e derivatives originating in or exported from Russia. This blockade on imports has aggravated an already complex situation, going to affect the supply of all Italian companies in the supply chain.

From this point of view, the need to acquire autonomy at a national level becomes even more urgent, also in relation to the achievement of sustainability objectives linked to environmentally friendly management, and to the development of local European forest and sawmill supply chains.

The commitment to sustainability

Sustainability is now at the center of the debate for the wood-furniture sector. In Italy, FederlegnoArredo, which includes more than 2,100 associated companies - widespread throughout the national territory - for years yes deals with analyzing the positioning of companies in the environmental field. These companies, engaged in all the links of the wood-furniture system - starting from the raw material up to the product finished -, they represent a privileged observatory for the entire supply chain, allowing return an overview of the sector, with the aim of best guiding the process green transition.

To this end, a survey of the associates in the "green" area was carried out, from the results of which to develop targeted policies and actions for the near future.

The synthesis of this analysis is represented in the Survey "Italian wood-furniture in the ecological transition"[3], a snapshot of the sector and how it is approaching the green challenge.

As far as resources are concerned, it has been found that most of the companies use recycled wood and, specifically, 67% of companies use materials first second, 81% use sustainably produced wood, 60% yes supplies from renewable energy sources, to some extent, and 19% comes to cover at least half of its needs with renewable energy.

On the subject of product/design, it was found that 50% of companies consider the design stage the reduction of packaging, the recyclability of products, and energy efficiency, around 30% consider reparability criteria in the design, disassembly and reuse.

On processes, the data speak of 64% of companies that have already implemented interventions to improve the efficiency of the production process, approximately 60% have achieved interventions aimed at reducing production waste (most of these claims to reuse internal or external waste), 44% have activated in the last 3 years mechanisms for reducing water consumption.

As far as transparency is concerned, 28% of companies have obtained at least one product certification (ISO 9001, FSC® and ISO1401 are the most common certifications).

64% of companies make more than a quarter of their products with low materials emissions, by adopting certified environmental standards, more advanced than the requirements of law.

Also interesting is the chapter on the relationship with settlement territories, therefore over 40% of companies declare that they source more than a quarter of their products locally own raw materials or semi-finished products (about 20% source more locally than half of the inputs).

A third of companies declare that they have a designated Environmental Manager and the benefit perceived by the majority of companies (65%) relating to the application of a sustainability-oriented policy is the improvement of the corporate reputation, followed by the reduction of consumption in the production process.

The results of this survey made it possible to draw up the Decalogue on sustainability and draw up the Action Plan of the Federation. This was followed by the birth of a pioneering initiative for the sector and one of the first of its kind a involve companies from the entire supply chain, i.e. FLA Plus,11 a hub of projects that respond pragmatically to all support needs in the field of ecological transition, designed to support businesses: projects of reforestation, database of sustainable materials, green training kit, support in the management of certifications, are just a few examples of the many proposals concrete launched.

As emerged during the survey, companies have highlighted some priorities on which to focus their efforts. The desire to improve process efficiency and reduce the costs certainly emerges waste (64% of companies), followed immediately by the need to acquire skills and specific professionalism on the environmental issue (56%) and deepen the theme of environmental certifications (50%); again,

[3] https://www.symbola.net/approfondimento/in-federlegnoarredo-la-sostenibilita-e-al-centro-presentata-la-survey-che-fotografa-la-filiera-e-il-decalogo-che-traccia-la-road-map-dei-prossimi-anni-verso-la-transizione-ecologica/#

the need to reduce the presence of substances dangerous products (41%), to increase the useful life of the products (30%) and also to combine production with the provision of services (28%).

Drive towards efficiency and renewable energy

More and more companies need to reformulate their use of energy and improve its exploitation. Companies are carrying out strategies and projects both to differentiate their sources of supply in favor of renewables, and projects to improve the efficiency (reduction) of the use of energy in the various cycles: production, distribution, etc. This context also includes the projects of energy recovery (e.g. thermal, etc.).

Materials, sustainable choices and recycling

There are several corporate best practices that affect procurement and therefore the choice of ecological materials or from controlled supply chains etc. but also projects which involve the use of recycled materials and the recovery of the material itself.

Circular design and certifications

Product design: a central theme for the circular economy and now for the big part of the sectors of the economy that develop products, from electronics to fashion, up to to the furniture. There are numerous best practices that focus on the central issue of design, which looks at the durability of the products over time, at maintenance of the same, to repair (reparability), and to proposals for production and assembly efficient with less waste production, etc.

Increasingly in the spotlight also the issue of Quality Certifications and Labels, and how compliance with Regulations and quality labels is a factor that affects on product design.

The Digital Product Passport

In March 2023, the European Commission published the Circular Economy Package, a package including a series of specific horizontal and sectoral regulations that aim to accelerate the transformation towards a circular economy at European level. Among these, the Sustainable Products Initiative, renamed Ecodesign for Sustainable Products Regulation (ESPR).

The initiative aims to reduce waste and make products manufactured or sold in Europe, which will have to comply with specific requirements, suitable for achieving climate neutrality, efficient in terms of resources and the circular economy. This will be essential to ensure that the EU meets its climate commitments while ensuring the competitiveness of European industry in the long term.

The new framework, inspired by the Ecodesign directive, focuses more decisively on the issue of circularity and eco-design, disengaging from the energy parameter alone.

The Commission then launched a public consultation on the product categories to be selected which will be the subject of the first Ecodesign for Sustainable Products Regulation working plan, also working in parallel on other products not related to energy consumption and on new parameters. Furniture is also present in the priority list. Furthermore, the first indications on the Digital Product

Passport (DPP) are introduced which will help consumers and businesses to make informed choices, facilitate repairs and recycling and improve transparency: the design and implementation.

The product digital passport will allow for the electronic recording, processing and sharing of product-related information between companies in the supply chain, authorities and consumers. Naturally, the most suitable technological tools must be identified to allow the creation of this document, intended to represent an important tool which must also contain information relating not only to the composition and the production chain, but also to the maintenance and end of life of the product.

Valuing the secondary material and designing to give new life

The efficiency of production processes and a better design of products, as well as the reuse of materials, is a fundamental aspect for a path sustainable virtuous. Competitiveness also passes through this element, and many companies have taken up the challenge.

Upskilling and shortage of labour force

The interiors-furniture sector is part of those luxury good sectors for which ECCIA (an European representative association dedicated to the promotion of savoir-faire and skills in Europe) declares that in the next 5 years approximately 346,000 working positions may not be covered. With particular reference to profiles of medium-high levels (technicians and operators) with an upskilling able to face the on-going digital and green transitions.
46,000 of these positions will be open in the interiors-furniture sector with particular attention to product technicians with high digital knowledge, skilled craftsmen, materials' technicians, prototypers.
Traditional sectors have been so far under the lights because of their need – and consequent difficulties – in activating a real twin transition – digital and green.

No innovation process, especially in traditional manufacturing companies, can be triggered without going through the development and growth of internal competences which are the real engine of companies. More than ever this is true for the luxury segment where the market result, the appreciation of the brand and the perception of clients towards the company and the product itself depends on **highly skilled workers adding a non-replicable value to that product**.
It is then crucial **to tackle the upskilling of that workforce**, key for competitiveness on international markets, made of craft profiles and together with that working for a higher level impact in changing the actual perception on manual skills at social and cultural level which doesn't lead to the attractiveness of craft profiles being not directly connected in the collective imagination with high spending clients, unique products, luxury markets.

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7 The IT sector analysis

7.1 General data at European level

The Digital Economy and Society Index 2022 confirmed the post-pandemic trend towards more digitalization, through a slightly higher growth rate in the adoption of digital technologies by both citizens and businesses at EU level, with a significant variance among sectors. The main variance factors relate to the structure of employment (only 33-44% of jobs permit teleworking), e-commerce (increasing online customer interactions), the number of available ICT specialists (8,940 million persons in EU27 in 2021)[4], the increase in availability of fully digitized products and services brought to the market, more cloud computing services.

The total number of companies[5] registered in the European ICT sector in 2020 amounts to 1.022 K enterprises, with a total turnover of 1834117 million EUR, showing a steady increasing trend compared to the previous years, despite the pandemic situation. The sector suffers from a gender imbalance (only 19% of ICT specialists are women) and a general shortage of ICT specialists on the EU labour market, and the number of vacancies keeps growing as new jobs emerge. During 2020, 55% of enterprises that recruited or tried to recruit ICT specialists reported difficulties in filling such vacancies.

In relation to the integration of digital technology in non-IT sectors, in 2021, only 55% of small and medium-sized enterprises (SMEs) reached at least a basic level in the adoption of digital technologies, considering that the target of the Digital Decade programme is to have at least 90% of SMEs in the EU with a basic level of digital intensity by 2030. As for the use of advanced digital technologies, it remains low: 34% of enterprises rely on cloud computing (in 2021), only 8% use AI (in 2021) and 14% big data (in 2020)[6]. There is a substantial gap between large companies and SMEs, not only in the use of advanced technologies, but also in basic digital solutions, such as having an enterprise resource planning (ERP) software package and engaging in e-Commerce.

Moving forward, the EU monitors closely (through DESI) the uptake of digital technologies by businesses from a very basic to an advanced level. These include electronic information sharing, the use of social media, but also the use of more advanced technologies such as big data analytics, cloud services and artificial intelligence (AI). Specific emphasis is put on e-Commerce, with indicators related to SMEs selling online both nationally and in other EU countries (i.e., cross-border), and the share of turnover stemming from these. These indicators are sourced from the European Union survey on ICT usage and e-commerce in enterprises. Given the growing importance of

[4] https://ec.europa.eu/eurostat/databrowser/view/isoc_sks_itspt/default/table?lang=en

[5] Annual enterprise statistics for special aggregates of activities (NACE Rev. 2) https://ec.europa.eu/eurostat/databrowser

[6] The Digital Economy and Society Index (DESI) https://digital-strategy.ec.europa.eu/en/policies/desi

sustainability within enterprises, the indicator on ICT for environmental sustainability captures the share of enterprises having medium/high intensity of green action through ICT.

The digital infrastructures are another significant factor of the digital transformation: broadband connectivity, in its various types, ensures an efficient access to business process data. The statistics are correlated with usage and access to cloud computing services. In 2021, 34% of EU enterprises purchased sophisticated or intermediate cloud computing services (i.e. at least one of the following: finance or accounting software applications; enterprise resource planning (ERP) software applications; customer relationship management (CRM) software applications; security software applications; hosting the enterprise's database(s); computing platform providing a hosted environment for application development, testing or deployment) and incorporated cloud technologies to improve their operations while reducing costs. The cloud uptake of large companies (60%) almost doubled that of SMEs (33%) in 2021, hence the need to stimulate and support the SMEs in this regard. When looking at cloud usage by sector, more than two thirds of enterprises in the ICT sector (66%) use cloud computing services of sophisticated or intermediate level, while in manufacturing the percentage is 32% of enterprises. This sectoral distribution is coherent with the general digitisation of sectors, as the manufacturing sector displays a lower level of overall digitisation.

AI based technologies have a significant growth potential for businesses, nevertheless, their uptake in the EU is generally quite low, at 8%, with important variations among the EU countries. The gap's dimension goes between Denmark (24%) and Romania (1%), the lowest uptake in the EU. This is in line with the very low level of overall digitisation of enterprises in Romania. Even basic technologies are not widely used by enterprises (the share of SMEs with at least a basic level of digital intensity is the lowest in the EU), consequently more advanced technologies are not widespread either.

E-commerce: around 20% of the EU small and medium sized enterprises (SMEs) made online sales in 2021, amounting to 12% of total turnover. Given the benefit of opening new markets through cross-border e-commerce, the majority (56%) of SMEs with web sales to other EU countries have no difficulties when selling to customers in other EU countries. On the other hand, 43% report at least one obstacle that is mainly related to economic factors (e.g. high costs of delivering or returning products, a problem reported by 28% of SMEs). The problems related to resolving complaints and disputes (13%) and the lack of knowledge of foreign languages (10%) are also highlighted as difficulties by the SMEs selling online to other EU countries. Adopting integrated digital platforms by working closely with providers of digital products and services may ensure that such obstacles are overcome easier, with direct effects on the growth of businesses.

In conclusion, when looking at European level, although the European Union is the world's third-largest economy, it is not viewed as a leader in the tech sector today. For instance, Europe is home to only 13 percent of the world's tech unicorns, which are startups that have a market valuation of over USD 1 billion.

Additionally, no Europe-based company made the top 10 of Boston Consulting Group's annual report on innovative companies — Siemens was the highest at 11. Critical to this is the lack of research

and development (R&D) expenditure. The EU bloc trails behind Japan, South Korea, and the U.S. regarding tech spending.

Aside from a lack of R&D expenditure, unfortunate challenges have wounded the European technology market. The continent is constricted by a diverse language pool, different payment methods, and varying regulations across the bloc. The fragmentation between EU member states presents a considerable hurdle for companies to overcome.

7.2 General data at Romanian level

Romania is a country of strong contrasts in relation to the digital sector.

According to the report on Romania of the US International Trade Administration, Romania is the leader in Europe, and sixth in the world, in terms of the number of certified IT specialists[7], with density rates per 1,000 inhabitants, greater than in the US or Russia.

Romania also hosts the new EU Cybersecurity Competence Centre and is home to an impressive number of international technology companies (including Amazon, HP, IBM, Microsoft and Oracle, etc.), with 50 of the largest tech companies present in Romania having quadrupled their businesses and teams throughout the past years.

The Romanian IT&C industry has also been recently credited with bringing Romania's GDP "close to pre-crisis level" in Q1 of 2021.

Romania also scores high in terms of telecom networks and Internet speeds. Although the measures taken during the COVID-10 crisis significantly increased demand for Internet capacity, due to the significant infrastructure investments telecom operators succeeded to maintain and quite often to increase the quality of the electronic communication services provided. Thus, ICT companies in Romania have transitioned to remote working without major disruptions.

On the other hand, at national level, Romania ranks among the last positions related to digital skills (basic and advanced), to the rate of integration of digital technology, the digital intensity index, the usage of cloud computing services (sophisticated or intermediate level), number of enterprises analyzing big data or AI based technologies.

Looking at the ICT sector, the Romanian market for software in IT services has been growing substantially and is likely to become the most important contributor to the local GDP in the medium to long run.

Out of the market value of $6.4 billion estimated by ANIS at the end of 2019, $5.2 billion comes from the Software & IT Services sector while $1.2 billion from various activities on the IT market. At the

[7] https://www.trade.gov/country-commercial-guides/romania-information-communications-technology-ict#:~:text=There%20are%2049%2C619%20people%20employed,increase%20of%200.7%25%20from%202021

same time, the entire Romanian economic sector invested less money in hardware products, namely 88.3 million lei, about 11% less than in 2019. For 1,000 lei of total net investment, companies in industry and construction invested only 6.3 lei in hardware products, those in trade invested 29.4 lei, and companies providing services - 24.7 lei.

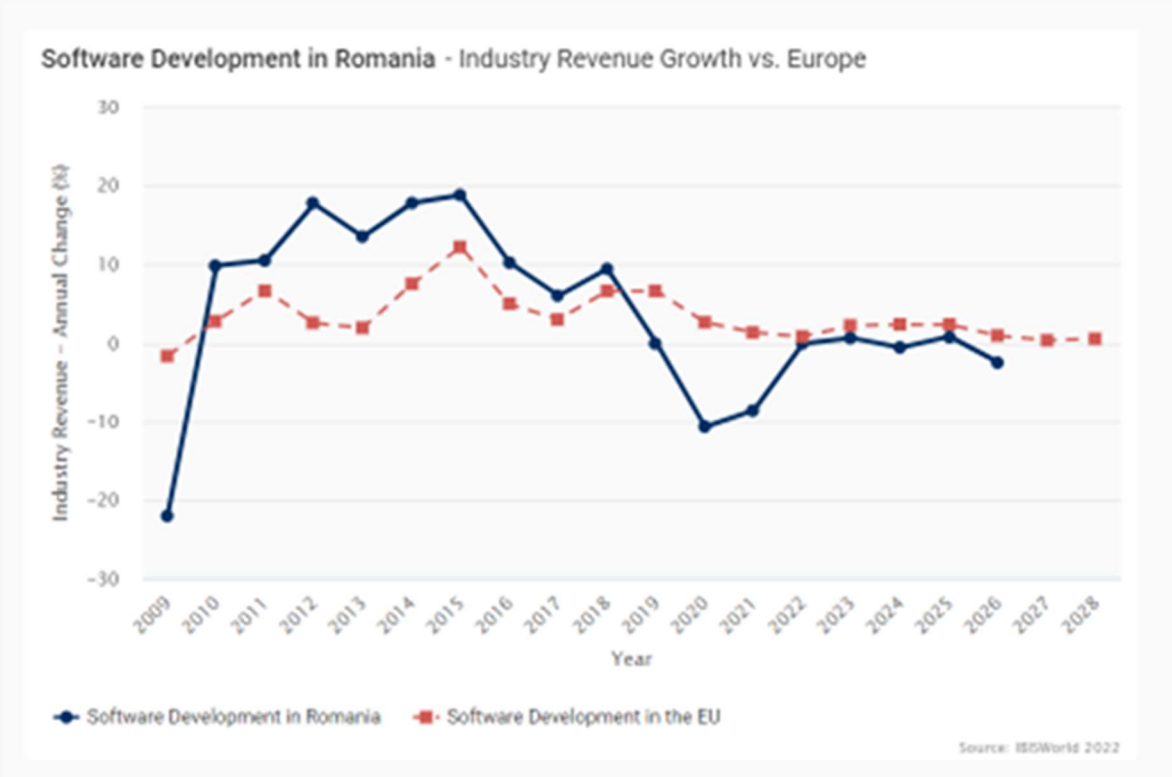
According to the NSI report, Romania's ICT sector is comprised by manufacturers of electronic components, computers and peripheral equipment, communication equipment, consumer electronics and magnetic and optical recording media; software publishing; telecommunications; information technology services; web portal, data processing, web page administration and related activities; repair of computers and communication equipment.

The countries' center point for IT development is Bucharest, holding 63% of revenues, along with regions North-West with 18%; West with 5%; Central with 6%; and North-East with 5%.

The Digital Agenda for Romania also sets priorities for key sectors for the Romanian economy and society: Employment, Research and Development (R&D), Climate Change and Energy Sustainability, Education, and Fighting Poverty and Social Exclusion.

Software Development

The market size, measured by revenue, of the Software Development in Romania industry is €3.2bn in 2022.



Software Development in Romania[8]

There are 49,619 people employed in Software Development in Romania as of 2022. The average Software Development in Romania business in Romania has six employees. There are 7,931 Software Development in Romania businesses as of 2022, an increase of 0.7% from 2021. The number of businesses in the Software Development in Romania industry has grown 0.7% per year on average over the five years between 2017 - 2022. Software development in Romania has low market share concentration and there are no companies with more than 5% market share.

Cyber Security

The cybersecurity market in Romania is still emerging. Romania boasts the highest rate of per capita technology workers in Europe in this sector. Starting in 2021, Bucharest has hosted the European Cybersecurity Industrial, Technology and Research Competence Center, a hub to distribute EU and national funding for cybersecurity research projects. Bucharest was selected from a list of seven competing cities to host the center.

The EU Cyber Centre's role is to reinforce the European Union's resilience, deterrence and response to cyber-attacks, aiming to retain and develop essential cyber-security technological capacities to secure EU's Digital Single Market (DSM). The Competence Centre will implement parts of the Digital Europe and Horizon Europe programs by allocating grants and carrying out procurements.

Regarding cyber education, in the 2019-2020 academic year more than 15 programs of cybersecurity were developed nationwide in over 11 universities and high schools on topics ranging from cybersecurity of the military information systems, cryptography, and digital investigations to machine learning and network security. In 2019, the annual European Cyber Security Challenge, the most important cybersecurity event of the year, was organized in Romania by the Cyberint Center of the Romanian Intelligence Service, the national CERT, and the National Association for Information Systems Security (ANSSI).

The nearly 212,000 employees (IT and non IT) in the IT&C sector made a 6.7% contribution to GDP formation in the third quarter of 2021, according to data published by the National Institute of Statistics. In only 4 years, the contribution of the star sector of the economy to the GDP has increased by two percentage points and is heading with rapid steps towards a share of 7% of GDP.

Romania manages in recent years to prove that it becomes a force in the IT&C field it is a field in which Romania is not only behind the West, but from many points of view converges towards a European average and frequently exceeds it as a level of competence, as a level of value of jobs, and even in recent years, as a level of labor cost in many contexts.

The IT&C sector's contribution to GDP has increased over the last four years from 4.7% to almost 7%. Each year, the number of IT professionals has increased by 10,000 to 212,000 employees.

[8] Source: IBISWorld 2022

IT&C is one of the few sectors where the contribution to GDP has increased in recent years. Industry, for example, one of the main pillars of the economy, reached a contribution to GDP of 19.6% in Q3/2021, down from 24.3% in Q3/2018.

An employee in the IT&C sector earns, on average, a salary of more than 7,100 lei net per month, double that of an employee paid the average wage in the economy. In software manufacturing, the average salary of almost 8,600 lei net in October 2021 was the highest nationwide.

Gender Parity

Regarding gender balance, Romania ranks 3rd in EU statistics on women employees in ICT.

24% of ICT graduates in Romania are female, providing one of the most inclusive and gender-balanced work culture and environment

8 Potentials and limits of the IT&C sector

8.1 Opportunities

One of the biggest opportunities for the Romanian IT&C sector is represented by the European Recovery and Resilience Facility and subsequently by Romania's National Recovery and Resilience Plan, which is based on green and digital transition.

IT&C is present in all the six pillars that make up the plan, but two of them are strongly related to the digital transformation of Romanian society.

The second Pillar (Digital Transformation) is based on four priorities:

- Public services digitalization
- Digital skills
- Secure and resilient digital infrastructures
- Digital transformation of SMEs

The main component of the second pillar is Governmental Cloud and digital public systems with a budget of $2.08 billion. It consists of four reforms and 19 investments, among which we can mention: Governmental Cloud, Electronic Identity card for 8.5 million people, and skilling/up-skilling/re-skilling for 30,000 civil servants and 100,000 citizens at 65 organizations that will improve their cyber security.

On the other hand, the third Pillar (Smart, Sustainable and Inclusive Growth) includes another important Component (Support for business, research, development and innovation) proposes two reforms and five investments with a total budget of $2.6 billion. Among the results assumed by those investments related to IT&C are that at least 3,000 SMEs must undergo a digital transformation process. Also, funds for digitalization, climate action and other areas of interest are co-managed with the European Investment Bank as an implementing partner. Also, support for at least three organizations with expertise in microelectronics to join projects of European Partnership for Key Digital Technologies.

One of the top priorities of the Romanian government's IT strategy is digitalization of the Public Sector, with the implementation of associated cybersecurity programs.

8.2 Limits to the ITC sector growth

- The qualified human resource requires significant public investment in education, as well as multi-annual time-frame actions
- The efficient integration of IT products and/or services in other sectors is conditioned by the existence of cross-sectoral integration expertise. The role is lately covered by Business Analysts, having good knowledge on the specificity of the integrating sector
- High diversity among processes in various sectors reduce the re-use and transposition of software products
- Uneven distribution of competences among the EU countries, generating unbalances, for example the Eastern Europe countries have higher IT expertize then the need, while in the Western Europe countries the need for ICT specialists is higher than the available human resources
- Differences among regulations and standards between sectors in the same region or between regions in the context of the same sector.

9 Barriers and opportunities of crisis

9.1 Post pandemic context

The post pandemic context generated significant opportunities for the ICT businesses, as more and more enterprises and public sector organizations sensed the need for digitisation and digital transformation of their processes. The growth potential is being validated by the context and resources made available through the various national and European programmes and priorities:

- the Recovery Plan for Europe – a programme leading the way out of the crisis and building a greener, more digital and more resilient Europe.
- A Europe fit for the digital age - the EU's digital strategy will empower people with a new generation of technologies.

9.2 Contribution to the energy and supplies' crisis

The IT sector can contribute to the growth of various sectors through:

- Increased resilience for the value chains through the transparent integration of all actors on the value chain using emerging technologies
- Efficient and in real – time monitoring tools and processes. Ex: automated inventory monitoring with integrated IoT solutions
- Data analysis for fast adaptation to external influences
- Increasing energy efficiency through IoT & Software tools
- Efficient procurement
- Complete monitoring of product life cycle for better service to the customer
- Circular re-use of materials within the value chain based on real time monitoring and computing
- Increased efficiency in production processes through the integration of IT tools (ex ERP)
- Cybersecurity and data protection

- Sales increase, access to new markets through e-commerce
- More efficient management of customer relationship through integration of CRM solutions
- Standardization of processes for client and provider integration in value chains
- Digital marketing
- Economy of resources and reduction of human error through integration of RPA (Robotic Process Automation)
- Certification of origin and quality, safe and transparent upstream and downstream contracting through blockchain technology.

9.3 Analysis of existing critical inputs / supplies / technologies. Survey results

95% of interviewed companies in Romania are concentrated on technical production software, rarely on sensors (1 case of Medium company) and 1 in network management.

Only in very few cases it is stated that the company started developing its own software solution or IT product.

Very much concentrated on the supply of services, they are not into or plan the development of innovative projects for the future as well as they don't seem to be used to collaborations (only in 1 case a joint project on public procurement is mentioned).

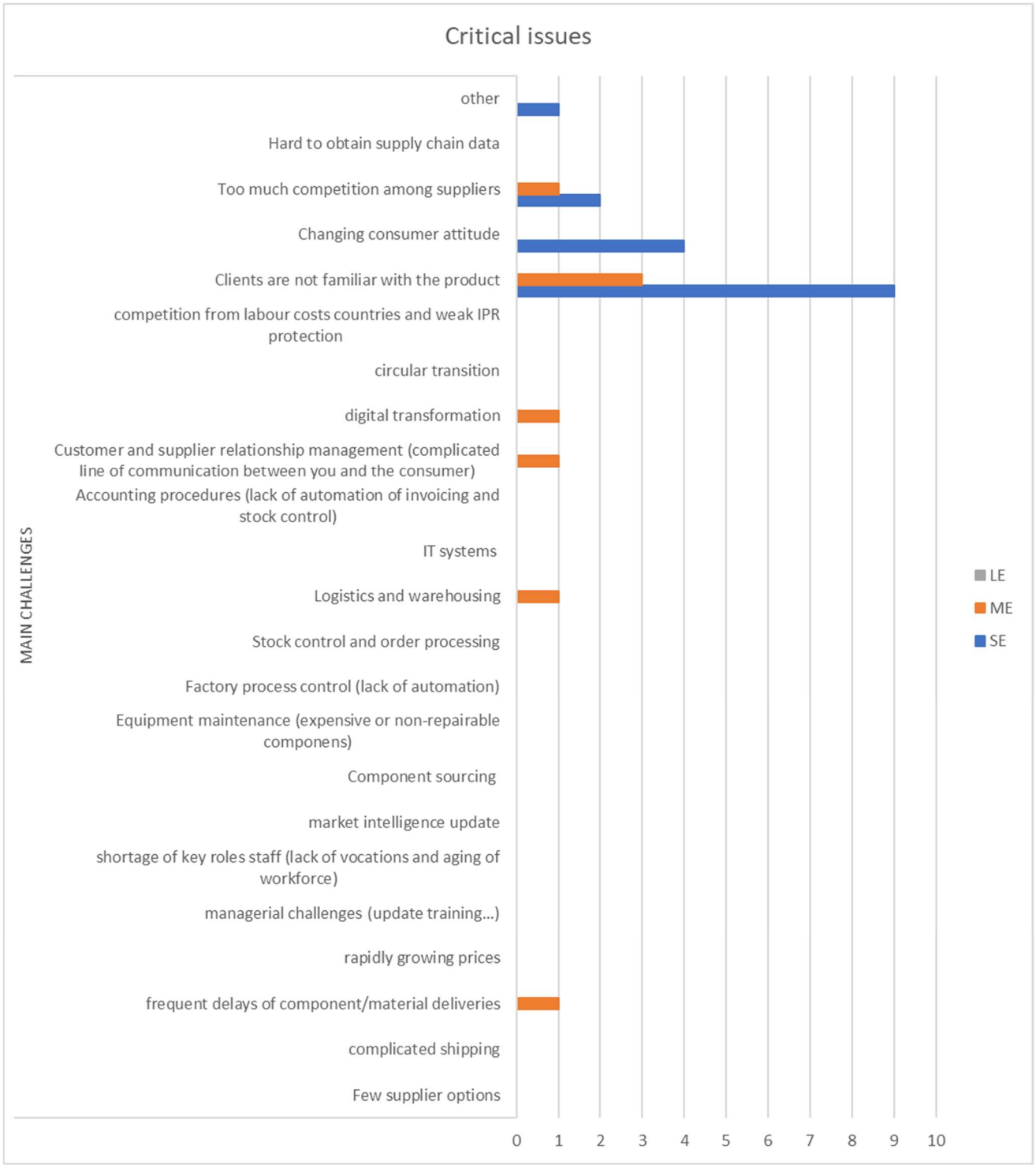
More training initiatives planned than those actually in place and mainly concentrated on internal competences on advanced digital skills or marketing and sales skills.

20% of the total are adopting practices for reusing components or other critical materials in their processes.

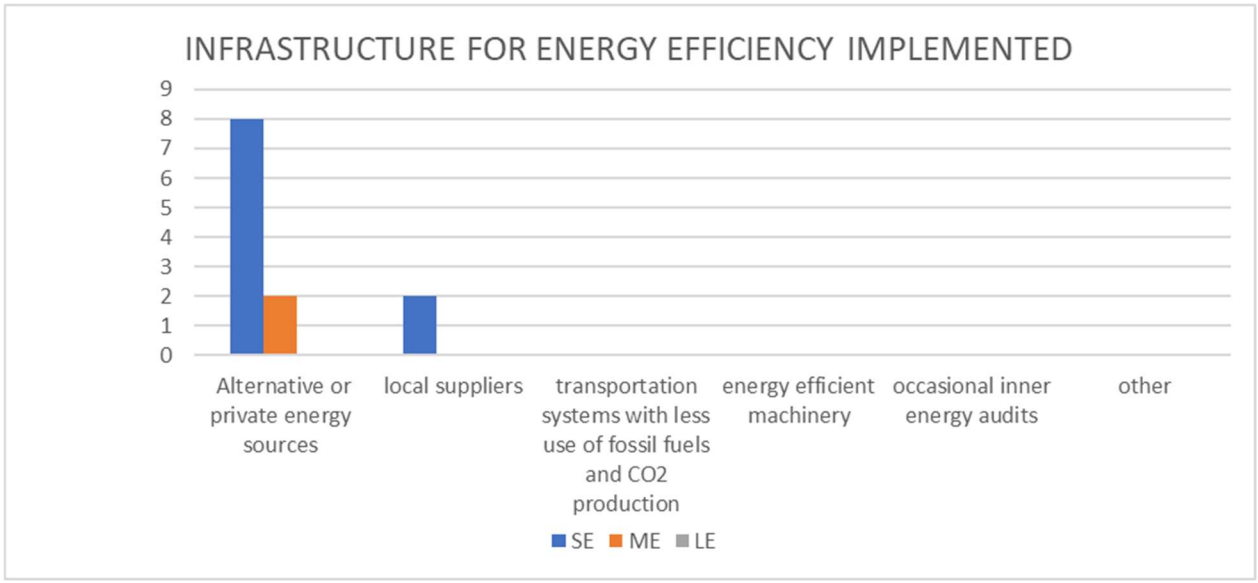
The adoption of green energy sources is also at the attention of the company management for 25% of them.

Main critical issues are represented here down with a general concentration on the client related topics: "Changing consumer attitude" and "Clients are not familiar with the product".

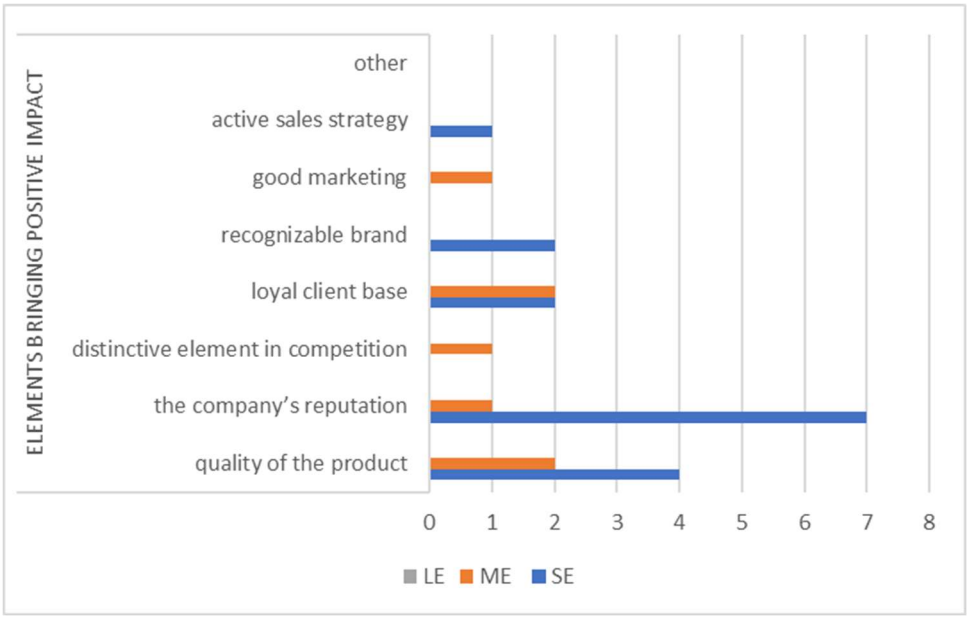
Both answers are relevant in a project that supports the dialogue of technological companies (IT and energy related) with traditional manufacturing sectors: addressing the need for "mediating the language" with dedicated actions on training and collaboration for innovation processes is the key for making clients closer to the technological content and approach and viceversa support technological companies to "speak the language" of traditional sectors where staff they relate with has no specific technological culture.



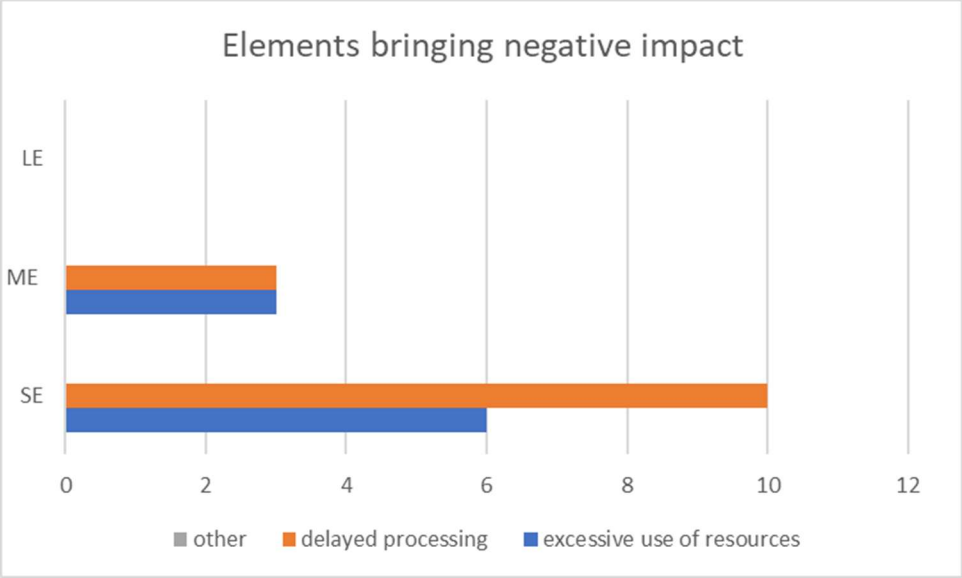
Most of the interviewed companies have activated alternative or private energy sources or are using local suppliers.



Stated element, both for small and medium sized companies that bring the most positive impact are considered as the company's reputation, the quality of the product, but also a loyal client base together with a recognizable brand.



While elements that bring the most negative impact are the delayed processing first and the excessive use of resources as second.


Elements bringing negative impact
LE
ME
SE
0
2
4
6
8
10
12
other
delayed processing
excessive use of resources

10 The energy sector analysis

This analysis aims to study the needs, gaps, and bottlenecks that will serve for the identification of potential linkages between the RE-Centre partners and identify critical inputs, suppliers, and technologies within the renewable energy sector.

Renewable energy sources (RES) include solar installations, wind turbines, geothermal and hydro plants, biofuels, hydrogen, and others – as opposed to oil, coal, and natural gas, these sources are inexhaustible and have a much lower CO2 footprint.

The global energy crisis is driving a sharp acceleration in installations of renewable power, with total capacity growth worldwide set to almost double in the next five years, overtaking coal as the largest source of electricity generation along the way and helping keep alive the possibility of limiting global warming to 1.5 °C, according to the “Renewables 2022” report by the International Energy Agency.

Energy security concerns caused by Russia’s invasion of Ukraine have motivated countries to increasingly turn to renewables such as solar, wind, hydrogen, and biomass to reduce reliance on imported fossil fuels, whose prices have spiked dramatically. Global renewable power capacity is now expected to grow by 2 400 gigawatts (GW) over the 2022-2027 period, an amount equal to the entire power capacity of China today.

10.1 General data at European level

The European Renewable energy sector employed 12 million people in 2020, according to the annual review “Renewable Energy and Jobs” by the International Renewable Energy Agency (IRENA). A third of them – 4 million – were in the solar photovoltaics subsector, followed by bioenergy with 3.5 million people and hydropower with another 2.2 million. Wind energy comes fourth with 1.25 million jobs, with a growing number in operations and maintenance and in offshore wind energy.

The European Renewable energy sector is mostly driven by the dedication to the Green deal and the actions to achieve the set goals, as well as by the volatile energy market that experienced disruptions due to COVID-19 and the Russian invasion in Ukraine which led to raised prices, energy shortages and global uncertainty. Renewable sources help diversify the energy production mix, therefore lowering the dependency on Russian gas and thus granting countries, as well as individual consumers more flexibility and security. In addition, RES are crucial to the strategies for lowering carbon emissions, and environmental recovery, which are in turn meant to improve public health and battle climate change.

There are many technologies in the renewable energy sector, the most predominant ones in the EU being:

-**Utility-scale solar PV and wind turbines** - the cheapest options for new electricity generation in a significant majority of countries worldwide. Global solar PV capacity is set to almost triple over the 2022-2027 period, surpassing coal and becoming the largest source of power capacity in the world.

- **Biofuels** – the need for lower greenhouse gas intensity fuels has encourages producers to turn to practical inputs for biofuel production - by 2027, a third of the global biofuel productions is expected to derive form waste and residues, both eliminating the need to discard them and acquiring cheap input materials for the production process. In Europe, the existing Renewable Energy Directive and member state policies reward biofuels made in such a way.

- Renewables in **transport and the heating sector** experience slower growth in the EU. With the current progress of those two sectors, the prognosis states that they will go from 9% in 2020 to 15% in 2027, which unfortunately fall short from the EU's aspirations for 2030. For heating and cooling, the annual increase in the share of renewables would need to almost quadruple from historical and forecasted growth to be on track with the REPowerEU plan targets.

- A lot more interest is dedicated lately to producing **hydrogen** - Policies and targets introduced in more than 25 countries across all continents are expected to result in 50 GW of wind and PV capacity focused on producing hydrogen over the 2022-2027 period.

- **Heat pumps** experienced rapid growth in Europe in 2021 – they are universally recognized as a critical technology for heat decarbonization, and more and more policies are drafted in order to support their development. By leveraging electricity to harness ambient heat from the ground, water or air, heat pumps can supply useful heat with one-third to one-fifth of the electricity used by conventional electric equipment. Considering national electricity generation portfolios for the year 2021, more than four-fifths of global space and water heating demand could be met with lower CO2 emissions by using heat pumps instead of condensing gas boilers.

- **Geothermal** - In Europe, 13 new geothermal heating and cooling plants, connected to district heating were announced in 2021. In the Danish city of Aarhus, the development of Europe's largest geothermal district heating facility was announced at the beginning of 2022, to be partly operational by 2025.

The following trends currently shape the market:

- **Circularity** – As a concept, it means that products are created with their own end-of-life taken into account, so that when they have fulfilled their purpose, they can be returned to the value chain, instead of sent out to landfills. It prolongs the lifespan of resources by reusing, repurposing, and recycling them, and in doing so reduces greenhouse gas emissions and creates waste management.
- **Innovations and technology** – there are increasingly more and more investment made in R&D, aiming to lower production prices, improve efficiency and tackle the matter of recyclability of the materials used in RES installations.
- **Power storage** – By having the opportunity to store electricity at proper conditions, prosumers can choose to charge batteries when the price of electricity is low and then use the batteries

when the price rises. It can not only stable pricing by managing demand from consumers, but also reduce the grid loads during peak times.

- **Public investments in RES –** thanks to the European financing in the stride to achieve CO2 neutrality, more and more citizens, businesses and public bodies are able to take advantage of financing programs and invest is new RES, that they would not have been able to incorporate otherwise

10.2 General data at national level

Due to climate change and the environmental degradation, the very survival of Europe and the world is threatened. In order to counter these challenges, the European Commission has adopted the plan “Fit for 55” - a set of proposals to make the EU's climate, energy, transport and taxation policies fit for reducing net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels.

All 27 EU Member States, including Bulgaria, committed to turning the EU into the first climate neutral continent by 2050. To get there, they pledged to reduce emissions by at least 55% by 2030, compared to 1990 levels. As the most significant component of the “Fit for 55” plan, Bulgaria has to radically modernize its thermal plants or more likely close 50% of them down by 2026 – therefore comes the growing need for alternative and renewable energy sources.

Over the last decade or so, the energy sector in Bulgaria has been steadily diversifying the implemented technologies in order to keep up with the EU’s commitment to climate neutrality. Although coal thermal plants still have the biggest share of the energy contribution, there are many incentives and efforts in order to promote the increase of RES solutions.

Shifting fossil fuels to RES

- 39% of the energy produced in Bulgaria for 2019 came from thermal power plants. The main local energy resource is lignite coal – according to the 2019 data, it amounted to 95,9% of all coal mining, the other 4,1% being brown coal. According to the Strategy for Sustainable Energy Development of Bulgaria, primary energy generation from fossil fuels will drop to **613 GWh annually by 2050** from **65,121 GWh in 2020**. Given that oil and natural gas, as well as nuclear energy will maintain their volumes by 2050, the bulk of this drop will be compensated by renewable sources.

Solar power plants

- Solar energy currently stands on 1,664 GWh and will more than triple to 5,440 GWh in the base scenario and to 7,374 GWh in the targeted scenario. There are many photovoltaic parks in Bulgaria, the largest one being in the Aprilovtsi village with a capacity of 50 MW and planned new investments of EUR 125 mln, meant to upgrade the park to 150 MW in 2023. The photovoltaic sector is quickly growing - from 2019 to the end of 2022, there were 3100

submitted applications for joining the "Electricity System Operator" (ESO) of new solar and wind power plants with a total installed capacity of 32,300 MW.

Wind power plants

- Wind energy produced annually will reach 16,659 GWh in the base scenario and 11,719 GWh in the targeted scenario from 1,451 GWh in 2020. Investments are greatest in North-Eastern and South-Eastern Bulgaria, which this is not surprising, as the region has the most sunny and windy terrains with the potential for greater electricity production. Towards the end of the year for the region of North-Eastern Bulgaria, for example, more than 4000 MW of wind and photovoltaic plants have applied for construction, the ESO report shows. Plans to develop off-shore wind farms are gaining speed - based on the technical-economic assessment of the resource in the Bulgarian Black Sea area, the law will plan first tenders for the most promising areas with a total capacity of at least 1 GW by 2027 and for another 2 GW by 2030.

Biomass from agriculture

- Agriculture is one of the important supplying industries for renewable energy generation. The usage of agricultural waste or land for renewable power generation can decrease energy costs in agriculture and help mitigate the impact of climate change. The biomass derived from the farming of corn is used as a raw material for ethanol production. Although the number of biomass power plants is still small, amounting to slightly over 1% of all renewable power-producing facilities in Bulgaria, there is growth potential, especially in projects for own consumption developed by farmers. Farmers and agricultural landowners can also develop solar and wind facilities on their land, supported under the sub-measure 4.1 Investments in agricultural holdings of EU's Rural Development Programme.

Hydrogen development

- One of the main technologies set to achieve sustainable renewables goals within the Bulgarian Recovery and Sustainability Plan (ref. as the Plan) is the hydrogen technology. Reform #7 of the Plan aims to adopt a National Roadmap for improving the conditions for the deployment of hydrogen technologies and the mechanisms for the production and supply of hydrogen. Several schemes are set to be financed: development of new hydrogen infrastructure, a pilot scheme for the set-up of pilot biogas and hydrogen projects, as well as a scheme to assist the process of decarbonization by building highly efficient low carbon fuel power plants. One of the main targets of the Plan is to develop a pilot project for the production of hydrogen with a total installed capacity of 20 MW by 2030. The successful implementation of the reform would lead to the construction of 55 MW electrolysers and the production of 7,800 tons of green hydrogen per year.

Heat pumps

- Heat pumps are an essential technology for the transition to sustainable heating with a major potential for CO2 emissions reduction. Around 10% of space heating needs globally were

met by heat pumps in 2021, however, this growth is not sufficient to fit into the European current targets and further policy support and technical innovation are needed, in particular to reduce upfront purchase and installation costs, remove market barriers to complex renovations, improve energy performance and durability, and exploit the potential of heat pumps as an enabler of power system integration and flexibility.

Geothermal power

- Increasing the use of geothermal energy in Bulgaria has the potential to significantly reduce the need to use fossil fuels when in synergy with other renewable energy sources. The Bulgarian government has set itself the goal developing 400 MW of geothermal energy by 2026. Deep geothermal energy in Bulgaria is associated with an increase in temperature at depth, locally, from between 25°C per kilometer to more than 40°C per kilometer. This means that temperatures can exceed 150°C in parts of the country at depths between 4000m to 6000m, and potentially have an abundance of low (25 - 95°C), medium (95 - 150°C) and high (150 - 230°C) temperature sources for deep geothermal energy at accessible depths.

10.3 Dimension of the sector (size, n. enterprises/businesses, employees, turnover, target, export value, markets, …)

Energy generation:

When it comes to producing energy - in 2019 the power generation sector of Bulgaria was firmly centred around fossil fuels and nuclear power. Thermal plants amounted to 39% of all the domestically produced energy, followed by nuclear power plants - at 37%, and Renewable energy sources covering 13%.

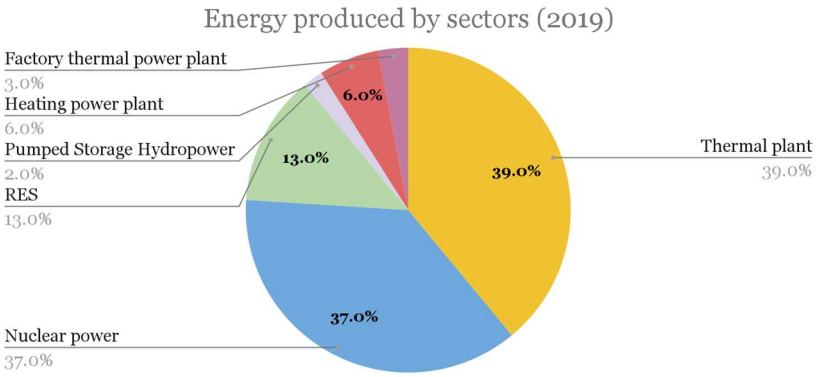


Figure 1

Renewable electricity generation in the energy sector

The renewable energy industry is increasingly becoming an integral part of the national economy and contributed EUR 1.054 billion to Bulgaria's 2020 GDP, or 1.7% of the total. This share excludes the turnover of NEK EAD's hydropower plants, which have the largest installed capacity among all HPPs in Bulgaria, but precise identification of their aggregate revenue is impossible from the publicly available financial statements of the incumbent.

Renewable power accounted for 39.8% of the overall installed power generation capacity in Bulgaria in 2020 with a total of 5,114 MW. Hydro plants had the highest contribution to the RES power generation with 3213 MW, followed by photovoltaic plants – 1121 MW, wind farms – 701 MW, and lastly – biomass with 71 MW of electricity produced.

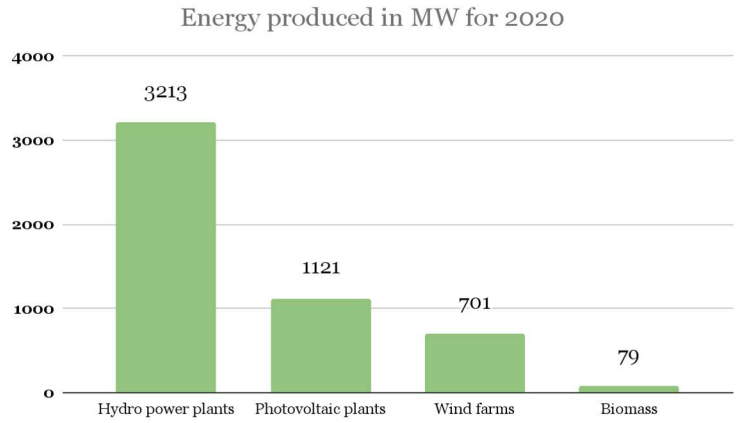


Figure 2

The current renewable energy sector report encompasses 1,537 companies from all renewable segments engaged in the operation, maintenance, construction, engineering, or project development of power plants generating renewable energy, as well as manufacturing of batteries, engines, turbines, and other equipment for renewable power facilities

Operation and maintenance of solar facilities dominated the market - a total of 1,150 companies operating in this sub-segment in 2020, almost ten times more than in any other sub-segment of the renewables power sector. In the same year, the renewable energy sector had a total of 4,833 full-time employees (FTEs). By 2023, the number of employees is expected to exceed 5,100.

Employment by sectors:

- Operation and maintenance of power plants were responsible for the majority of the employment in the sector, or 66% of the total full time equivalents in 2020. However, the construction, engineering, and project development segment will nearly double its current headcount in the next three years and will account for the majority of the jobs.

Increases in salary expenses

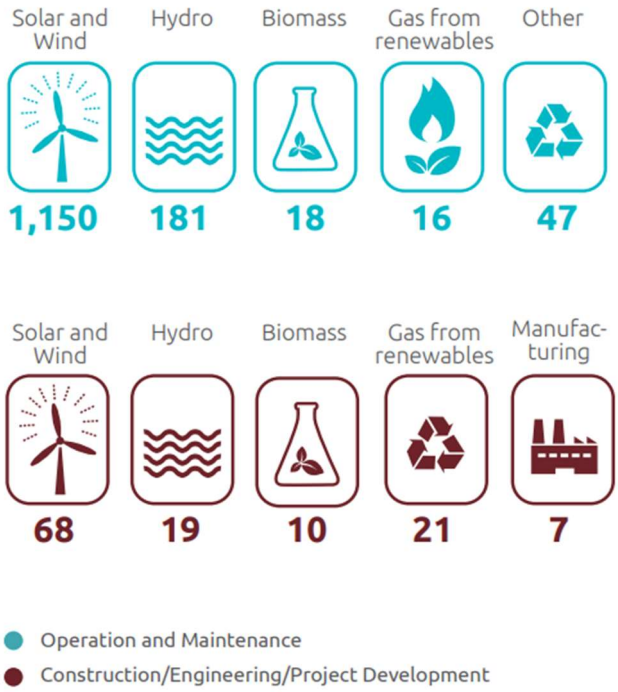
- Salary expenses of renewable energy companies in 2020 advanced by 4.7%, a slightly lower rate than the 6.5% recorded in the previous year. Despite the deceleration, salary costs and social security contributions outstripped the growth of employment in the sector, which added

0.8% to its 2019 headcount, thus leading to an increase in average wages per employee in the sector.

Companies from the RES are becoming more profitable year by year

- Renewable companies became more profitable in 2020, as their aggregate net profit advanced twice as fast as the sectors' operating revenue. It totalled EUR 80.7 million, up by 10.5% year-on-year. This pushed the net profit margin up to 7.7%, compared with 7.3% in 2019 and 7.5% in 2018. Operation and maintenance had the edge over the other two segments in terms of profitability with a net profit margin of 23.7%

The currently active renewable energy generation and construction companies in Bulgaria have been established comparatively uniformly throughout the last 30 years with a sharp spike in the period 2008 – 2012, immediately after the EU accession of the country. As a result of a new renewable energy law, which stipulated state support for environmentally friendly energy, including the introduction of preferential tariffs for the purchase of energy from renewable sources, more than 60% of the currently operating solar, wind, hydro, and biomass facilities were set up in the first five years of Bulgaria's EU membership.



As a highly regulated sector, the structure and number of companies in the renewable energy field depend on government policies. In accordance with the Integrated National Plan for Energy and Climate of Bulgaria until 2030, the majority of new capacity by the end of the decade will come from solar facilities, which are expected to more than triple their aggregate annual production. Hydro plants are planned to keep their current capacity, while wind and biomass facilities will increase their capacities somewhat.

Companies with main activity in the operation and maintenance segment noticeably dominate Bulgaria's renewable power sector structure. Almost 92% of all vendors included in this analysis are engaged in the generation of electricity from renewable sources, while companies operating in the segment construction, engineering, and project development of renewable power plants accounted for less than 8% of the total number. The third major segment, manufacturing of batteries, engines, and turbines for renewable power consisted of only seven companies since most of the equipment for power generation facilities is imported from foreign producers.

Figure 3

The large number of solar and wind power facilities in comparison with the other sub-segments can be attributed to the lower barriers to market entry in terms of capital intensity, geographical constraints, and operations complexity compared with the other fields of renewable power generation and plant construction and development.

10.4 Export trends (export values, main markets, …)

Bulgaria does not have a strong export presence in the energy sector, other than electricity, most of which is produced by non-renewable sources. Energy carriers (fuels and electricity) are one of the main categories in the Bulgarian export mix, after electronics, copper and copper products, machinery and apparatus.

The export of fuel grew from EUR 1,019 million in 2020 to EUR 1,190 million in 2021, of electricity - from EUR 211 million to EUR 574 million, of gas - from EUR 26 million to EUR 296 million. Quantitatively, the export of fuel in 2020 was 2’813 thousand tons, and for 2021 – 1’997 thousand tons, electricity - from 4’422 to 5’853 GWh, pentane gas - from 90 thousand tons of 357 thousand tons.

The buying countries for biodiesel are Romania with 21%, Italy – 16%, Hungary – 15%, Austria – 8%, and Greece – 7%. The current export price is EUR 1,545 per ton (60% of the 2020 price), which ranges from EUR 1,291 to EUR 1,752.

Bulgarian companies most often export to developed countries, as subcontractors of large multinational companies, in order to enter global supply chains.

11 SWOT Analysis

Within the renewable energy sector, technologies can vary in sources and scale, however, they share many similar characteristics that can act as incentives or barriers towards large-scale implementation. Below is a SWOT Analysis of these attributes to further shed light on the Renewable Energy Sector:

Strengths:

Access to sources – there is abundant solar, wind, and geothermal potential in Bulgaria
Abundant technologies – there are many types of technologies available, making the RES sector more diverse and unsusceptible to turmoil
Established infrastructure – once the installation of the plants is completed, they can easily be connected to existing electricity infrastructure in order to sell into the grid
Relatively low start-up capital investment and quick capital return – this means lower entry barriers to the market and a higher incentive for new start-up companies

High share of university graduates – abundance of engeneers and specialized workers

Weaknesses:

High dependence of the economy on imports of resources from outside EU – most components are not produced domestically and have to be imported from China, meaning deliveries may be expensive, complicated and unreliable
The efficiency of renewable technologies is less than traditional non-renewable sources – for example, solar panel efficiency is 15% - 20%. On the other hand, traditional technologies that use natural gas can reach efficiency levels of up to 60%.
Lack of a national policy for adaptation to climate change – the set goals for the green transition are under debate within the political parties, bringing unsertainty in the sector's growth
Not smoothly functioning legislation network – complicated administrative procedures, lack of transposition of EU directives, etc.
Landscape and Land Use – according to Bulgarian law and defined categories of land – certain spaces require special permits for installations and can complicate the administrative process, discouraging people from using land they already own for RES

Opportunities:

Many EU programs for financing – There are financial option for SMEs, citizens and public entities
Strategies for countries' economic independence – in the face of global crises, political turmoil and price fluctuations, countries have incentives for implementing renewable technologies that can make them more independent and much less susceptible to energy crises

Increased adoption of better and more energy-efficient technology – thanks to the growing interest in the sector, there are constantly developed innovative technologies that better the performance and lower the costs
Rising rate of investment in renewable energy – more and more financial instruments meant to facilitate the financing of green-energy projects
Growing demand for energy – because of the overall growth in energy needs, there is an increased demand in the market for new power plants

Threats:

Requires large-scale shift of electric production – as is the current state of the Bulgarian energy sector, non-renewable sources make up the most part of the energy produced and shifting to renewable sources will be a slow and expensive process
Rising costs of electric grids – with the global increase in RES interest, demand is growing along with prices and it is leading to scarcity for certain materials
Public targets for renewable energy are not fixed – currently there are attempts to renegotiate the National Recovery and Resilience Plan along with the previously established targets for Bulgaria,

aligned with the European green transition, which would decrease incentives for RES investments and slow down the sector's growth

Unfavourable demographic and social trends – aging population, high share of low-income population, suspiciousness in older generations towards new technologies

12 Potentials and limits of the sector

The regulatory landscape of the energy market in Bulgaria is largely determined by the EU's strategic goals and related legal framework. Bulgaria is still in the process of transforming and harmonizing its energy sector to achieve its Green Deal commitment and EU requirements for a targeted policy of RES sector development.

In recent years, the consumption of renewable energy has increased significantly, reaching a share of 20.53% in the final gross consumption of energy in the country in 2018, which exceeds the mandatory national target set in the National Action Plan for Energy from Renewable Sources of 16% by 2020

To counter climate change and its impact on the economy, Bulgaria prepared a National Strategy for Adaptation to Climate Change and an Action Plan for it, adopted by a decision of the Council of Ministers in 2019. In the context of the European plan to achieve a 32% share of RES in the gross final energy consumption in the EU by 2030, Bulgaria has set a national goal of 27.09%. In order to achieve this goal, the following distribution by sector is planned:

- 30.33% share of renewable energy in the electricity sector;
- 42.60% share of renewable energy in the heating and cooling energy sector;
- 14.2% share of renewable energy in the transport sector.

Some of the measures taken in order to encourage the green sector in Bulgaria include

- **Administrative measures**:
  - in 2019, the administrative burden was eased and deadlines were shortened in the procedures for connecting producers and customers of electricity to the transmission or distribution grids
  - Increasing the administrative competence and capacity of the employees responsible for issuing permits and licenses; Representatives of the Agency for Sustainable Energy Development currently participate in meetings of regional councils for sustainable development in the country and provide methodological assistance in the preparation of energy efficiency plans, programs for their implementation and programs to promote the use of renewable energy and biofuels.

- **Regulatory measures**: The Electricity System Security Fund covers the costs of providing a premium to renewable energy producers with a total installed capacity of 500 kW and over 500 kW under the Law on Energy from Renewable Sources, determined by a decision of the Energy and Water Commission regulation, including for past regulatory periods.

- **Financial measures including programs financing measures for the use of energy from RES**
  - **RES and batteries for local energy storage (for SMEs)**
    In the beginning of 2023, the Ministry of Innovations and Growth will announce an open call for the "RES and batteries for local energy storage" procedure for EUR 100 million. SMEs can be provided with financing to install electricity systems from renewable sources for their own consumption (up to 1 MW), in combination with facilities for local storage of the produced energy with an intermittent and non-uniform mode of operation.

  - **RES and batteries for local energy storage (for citizens)**
    A similar procedure is expected to begin around the same time, where residents could take advantage of financing in accord with the Recovery and Sustainability Plan - financing for solar panels and solar water heaters. With EUR 30 million in total funding - EUR 25 million comes from EU funds, and EUR 5 million - from national funds. Residents can install either solar water heaters with 100% financing, or solar panels with up to 70% financing, and once in use, the electricity produced can only be used for personal needs, as the sale of electricity back into the grid is not permitted under the program. Priority are households that perform the worst in the sense of efficiency – the ones using a heat source such as a stove, boiler or a fireplace with solid fuel - wood, coal, etc.

  - **Energy efficiency schemes at SMEs level**
    Also in the first half of 2023 will begin the program “Energy efficiency of buildings in the sector of production, trade, services and tourism”. The scope of the financing includes construction works for energy efficiency measure, renewable energy sources implementation and accompanying activities. A requirement of the procedure is to achieve a minimum of 30% primary energy savings for each object after implementing the measures in the buildings.

  - **Energy efficiency schemes at public and residential buildings level**
    Another type of measure taken to further the green transition is the Program for the renovation of residential buildings from the Recovery and Sustainability Plan - in 2022 the Ministry of Regional Development and Public Works announced the beginning of the program meant for citizens to renovate residential buildings. BGN 1,13 bln (~EUR 570 million) of European funds are allocated for the program, divided between single-family households and multi-family buildings. The end goals are both to improve energy efficiency, giving priority to the worst-performing buildings, as well as to lay the groundwork for implementing green energy sources in the residential infrastructure in the future. It is one of the few Bulgarian subsidizing programs that grants 100% of the funding required

  - **Competitiveness and innovation in enterprises for the period 2021-2027** – The main priorities of the Program are two - "Innovations and Growth" and "Circular Economy". Its

goals are development and strengthening of research and innovation capacity, digitization, and sustainable growth and competitiveness of SMEs as well as job creation. Funds are provided for scientific research and development activities in companies, increasing export potential, creating new or developing companies from the more high-tech sectors of industry, protecting patents, industrial property, etc. The areas meant to be stimulated are digitization, the increase of cyber security, the confidentiality of data in SMEs and the skills of the staff to work with the technologies of Industry 4.0.

Bulgaria's development policies are dedicated to transforming the energy landscape and completing the goals set by the EU and the Green Deal. According to the National Strategy for Adaptation to Climate Change and the Action Plan drafted for it, besides encouraging the implementation of greener sources of electricity, the political incentives are targeted most specifically towards implementation of RES such as solar PV panels, heaters and batteries, as well as towards fighting energy poverty and improving public and private energy efficiency. As additional administrative measures – the procedures accompanying RES exploitation experience a trend of simplification in order to minimize the barriers for market entry. On many levels, there are distinct measures taken in order to diversify the Bulgarian energy sector and further the EU transition towards a sustainable economy.

13 Barriers and opportunities of crisis

13.1 Post pandemic context

Recent disruptions have raised important supply chain questions. The Covid 19 crisis, record commodity prices and Russia's invasion of Ukraine have all focused attention on the high reliance of many countries on imports of energy, raw materials, and manufacturing goods that are key to their supply security. Countries can improve resilience by investing to diversify their manufacturing and imports.

The restrictions introduced due to the coronavirus led to unexpected changes in the electricity market - business consumption decreased at the expense of household consumption after workers and students switched to home office. This caused a crash in electricity exchange prices, with the sector subsequently able to normalize.

Similar to the Covid 19 pandemic, the war in Ukraine has strongly affected the European energy sector through the complication of trading with Russian gas and the fast-rising prices of electricity. All of this has showcased the need for diversification of energy sources and for renewable energy that can be produced domestically.

13.2 Energy and supplies' crisis

There are, however, other issues with the RES that need to be addressed - mainly, the fact that almost none of the components for the Photovoltaic panels are produced domestically.

We've seen how the dependency on a sole supplier can disbalance the value chain and disrupt entire economic sectors, as is the case with Russian gas.

PV manufacturing capacity has systematically moved to China from Europe, Japan, and the United States over the last 10 years. With investments of over USD 50 billion in manufacturing capacity, China has managed to create as many as 300 000 manufacturing jobs across the solar PV value chain since 2011. In present day, their share of global manufacturing stages of PV panels (such as polysilicon, ingots, wafers, cells, and modules) exceeds 80%. Europe's dependency on importing key materials for photovoltaic panels is becoming an increasingly bigger challenge with the growth of interest in the renewable energy sector and the Green transition initiative - it raises costs due to shipping, prolongs the installation process, and most importantly - brings significant uncertainty and lack of independence to the entire sector.

Solar PV manufacturing capacity by country and region, 2021

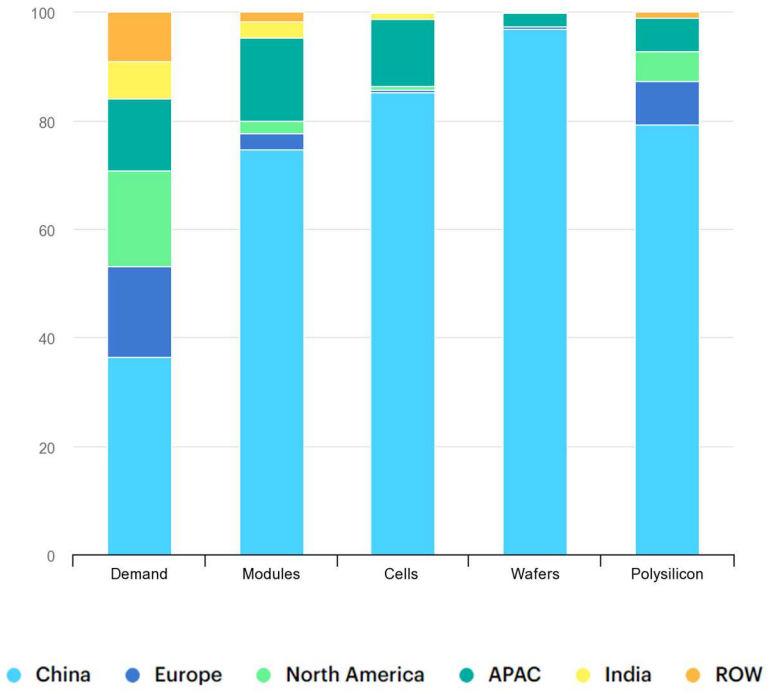


Figure 4

As is visible in the graph, although the demand for components is semi-evenly distributed between the different countries, the state of production capacity is anything but. Europe's contribution to production is almost non-existent, with China's shares so predominant, the others are barely visible.

Recycling

When discussing supply chain issues, besides the input materials, it is inevitable to consider the other end of the spectrum as well - that is what happens to the installation after the end of its useful

life. A major concern with wind turbines for example is the inability to recycle the turbine blades. Tens of thousands of blades end up in landfills worldwide every year. They are built to be able to withstand hard weather and decades of exposure to the elements, so after they have exceeded their use, these parts prove to be almost impossible to recycle. What is more, because they are so large, the logistics of their transport create a significant carbon footprint. Even though wind turbines are one of the best green alternatives for creating electricity, this problem remains a relevant one, dividing public opinion regarding their overall benefits.

The same issue is present in the photovoltaic sector - Global photovoltaic capacity has grown from 1.4 GW in 2000 to 760 GW in 2020 and since more than 90% of photovoltaic (PV) panels rely on crystalline silicon and have a life span of about 30 years - that means that about 8 mln metric tons of these panels will have reached the end of their working lives by 2030. PV panels contain toxic materials, like lead, that can cause environmental pollution and currently there are no viable strategies on how to handle that issue. In the EU there are legislations that require PV recycling, however, usually only materials like aluminium frames and glass covers are processed and others like silver, copper, and silicon are either stored or incinerated.

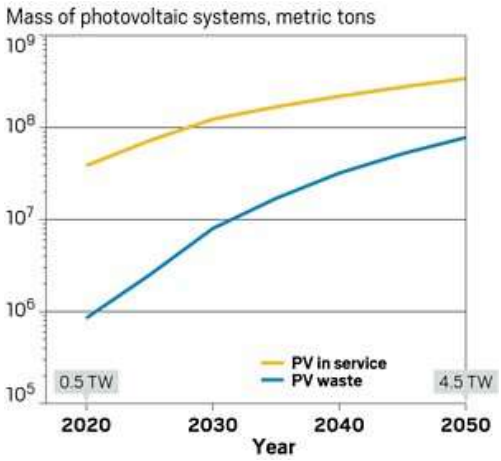
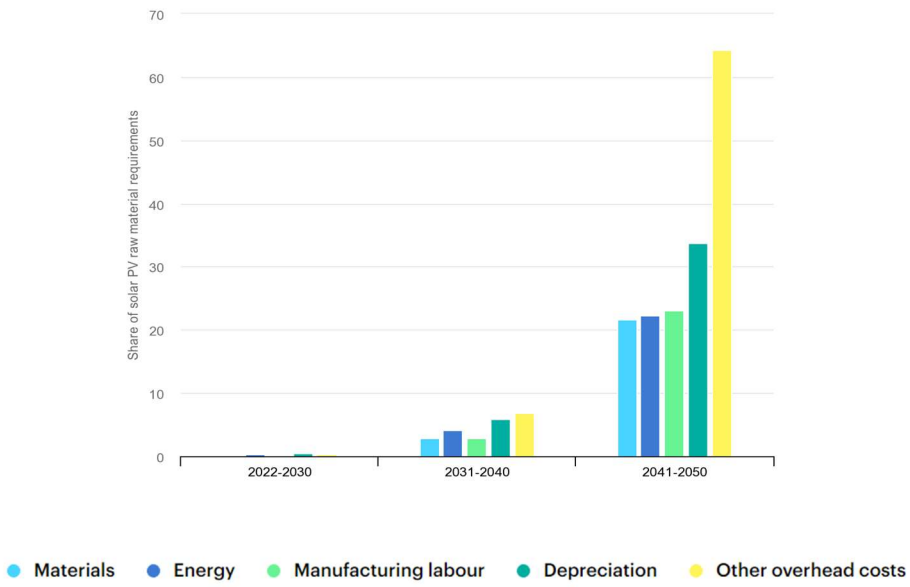


Figure 5

According to the IEA's Roadmap to Net Zero Emissions, if panels were systematically collected at the end of their lifetime, supplies from recycling them could meet over 20% of the solar PV industry's demand for aluminium, copper, glass, silicon, and almost 70% for silver between 2040 and 2050. However, due to the expensive nature of the process with the currently available recycling technologies, it simply isn't cost-effective to do so, as the cost of the process significantly outweighs the price of the salvaged materials.

The potential contribution of module recycling to solar PV material demand under the Net Zero Scenario for selected materials, 2022-2050

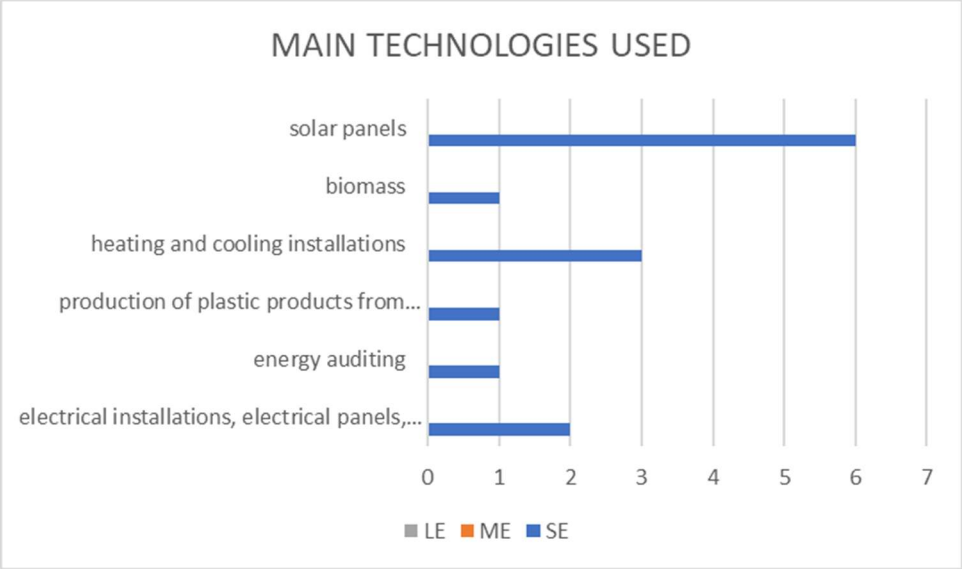


Alternatives in critical inputs

A Bulgarian battery producer “ELHIM ISKRA” AD has developed a new type of modular solutions for energy storage and power supply. Obtaining materials and components for PV installations in Europe has proven to be a lengthy and somewhat complicated process, as most of the crucial elements are produced in China. The Bulgarian company is aiming to provide a viable solution with their quick execution times, a recycling rate over 98%, the safety of the modules and the price advantage. In addition, the raw materials with which the modules are produced come from local suppliers.

13.3 Analysis of existing critical inputs / supplies / technologies. Survey results

The Bulgarian energy sector is made of micro and small companies dedicated to the following main technologies related activities: solar panels installation, electrical installations, energy auditing, heating and cooling systems, biomass production.



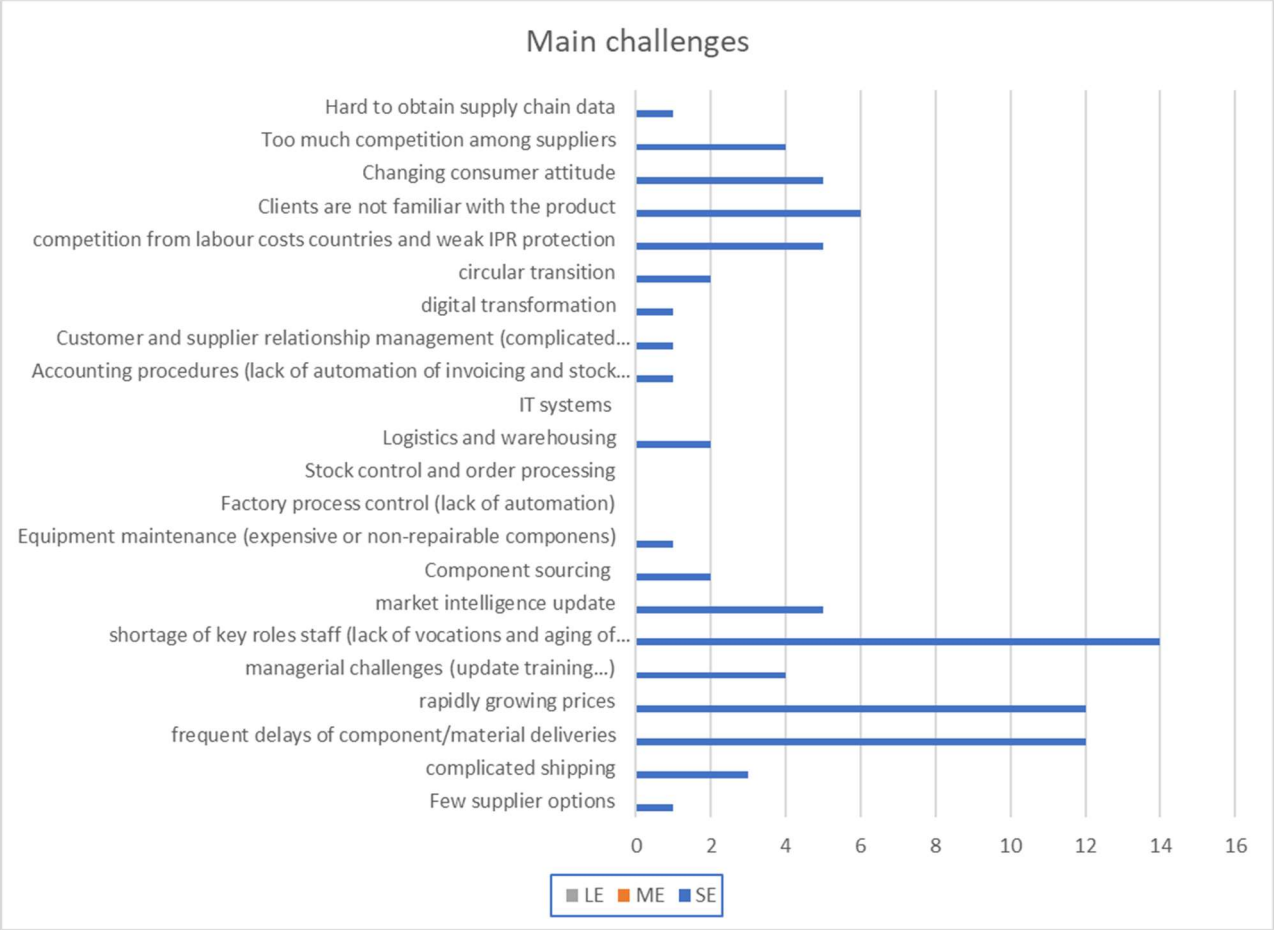
28% of answering companies declare they have innovative projects for the future on the following topics:

- Development of smart technologies for management of energy produced by photovoltaic plants and storage
- Development of accumulation of electrical energy systems
- Development of biofertilizer products with reclamation of infertile and compromised soils, strengthening of landslides
- the PASSIV HAUS in Bulgaria suitable for living comfort and energy efficiency
- conversion of generated energy into hydrogen
- 3D fiber-optic system for photovoltaic
- Development of intelligent energy management systems

Some of them are involved in joint projects with other organizations focusing biogas installation or in the field of energy cooperatives, energy storage as well as the reuse of construction materials.

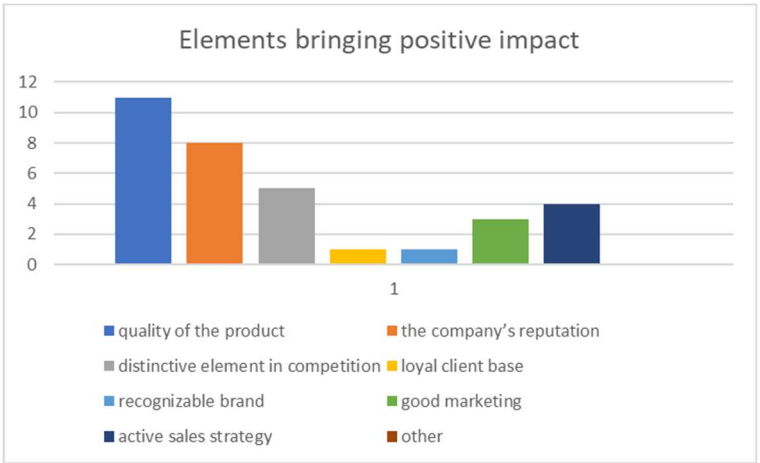
Very few companies declare that they have training initiatives in place such as regular training for all levels (administrative, technical, marketing, management) led by senior employees or outside experts.

As for the adoption and use of recycled materials in their processes some of them plan to incorporate recycled or biobased materials in the near future, some already use metal scraps, recycled copper pipes or recycled paper packaging.



Main declared challenges for the sector are the shortage of key roles staff, rapidly growing prices and frequent delays of components/materials delivery.

Finally companies declare that elements bringing the most positive impact are mainly the quality of the product and the company's reputation.



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