

# D5.4 – BIO4EEB market analysis (1<sup>st</sup> version)

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## Technical References

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## Executive Summary

This deliverable provides an analysis of the market around of the BIO4EEB developments which is crucial inputs for effectively positioning the project results within the target markets. This report characterizes the needs of the end user segments potentially interested in energy efficiency refurbishment aligned with the outcomes from *T2.2 – Socio-economic assessment of the end-users and segmentation*. In addition to this, crucial insights are obtained in terms of competitively pricing the BIO4EEB results via the analysis of current and future competing solutions available in the market.

## Disclaimer

This publication reflects only the author's view. The Agency and the European Commission are not responsible for any use that may be made of the information it contains.



## Abbreviations and Acronyms

| Abbreviation | Description                                                                |
|--------------|----------------------------------------------------------------------------|
| BIO4EEB      | BIO insulation materials for Enhancing the Energy performance of Buildings |
| CA           | Consortium Agreement                                                       |
| EMT          | Executive Management Team                                                  |
| GA           | Grant Agreement                                                            |
| KoM          | Kick off Meeting                                                           |
| IMP          | Innovation Management Process                                              |
| IP           | Intellectual Property                                                      |
| IPR          | Intellectual Property Rights                                               |
| KER          | Key Exploitable Result                                                     |
| T            | Task                                                                       |
| TRL          | Technology Readiness Level                                                 |
| WP           | Work Package                                                               |

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# 1 Introduction

The BIO4EEB project aims to develop bio-based insulation solutions in the form of Posidonia panels and fibers, complex polyelectrolytes, PLA and bio-polyurethane, bio-based windows and finally a prefabricated façade component which aggregates most of these materials. The complementarity between the solutions is a strong point for the project. Indeed, BIO4EEB does not focus on a narrow solution, but on a wide spectrum of solutions, adapted to various situations and an additional concept which is the renovation packages (synergies between new materials and components). The solutions' development considers various typologies of buildings, and this will be exemplified through their application in five real case pilot sites and 3 virtual case pilot sites all strategically chosen to cover a large set of renovation scenarios with different buildings and climates.

Assessment of market opportunities that effectively support the wide scale diffusion and replication of the project retrofit solutions is being established in WP5. Task 5.1 and more specifically Subtask 5.1.2 will effectively position the results within the target markets. In addition to this, current and future competing solutions will be analysed. This analysis will provide crucial insights in terms of competitively pricing the BIO4EEB results, which distribution channels should be used for different segments, and which are the key features to compete effectively against state-of-the-art solutions.

Together with this, competitor assessments of established solutions include features mappings, pricing studies and SWOT analyses of BIO4EEB KERs with respect to the identified competitive pressures.

Besides, the provision of valuable market and industry data enable the definition of viable business model(s) for standalone KERs as well as the consolidated business model approach.

## 1.1 Purpose and target group

This deliverable is providing crucial inputs for effectively positioning the project results within the target markets by analysing current and future competing solutions.

## 1.2 Contributions of partners

Solintel is the task leader and responsible to deliver the present document.

## 1.3 Baseline

For the preparation of this deliverable a state-of-the-art for the technologies developed within BIO4EEB has been performed, analysing the current markets and the available systems. The assessment of the market has been focused on: Posidonia panels and fibers, complex polyelectrolytes, PLA and bio-polyurethane, bio-based windows and finally a prefabricated façade.

This deliverable is strictly linked with the Task 5.1 and most specifically with the Subtask 5.1.2.

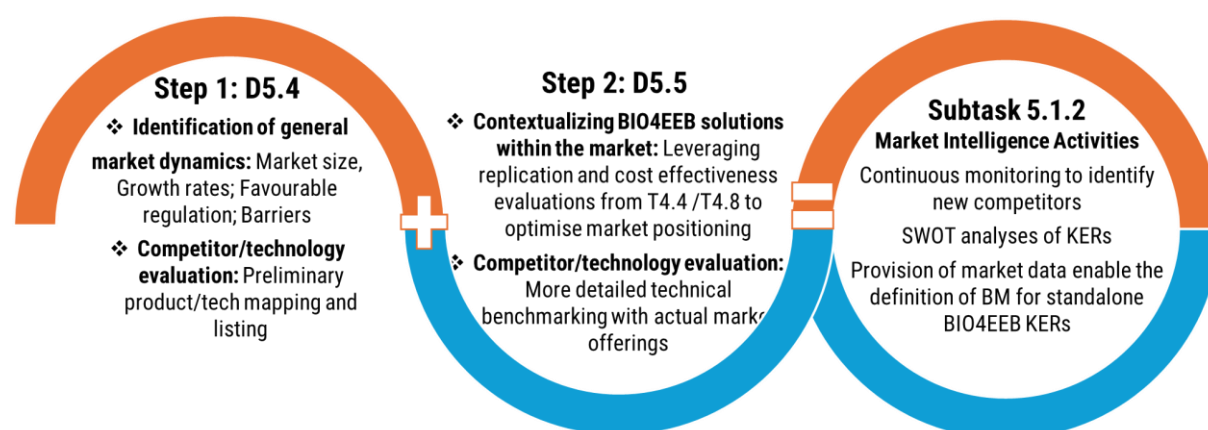
## 1.4 Relation to other activities

This deliverable will use outputs from T2.2 socio-economic assessment of end-users and segmentation and will provide a direct input for D5.5 which is the final version of D5.4. Besides, this document will provide insights to T4.8 Cost effectiveness analysis and T5.2 on business modes taxonomy and implementation plan.

## 2 Methodology

As indicated by the Grant Agreement (GA) and description of work, two market reports resulting from the work produced in Task 5.1.2 as well as the outcomes of Task 5.2 related to market intelligence activities will be produced during the course of the BIO4EEB project all meant to provide inputs and direction to the exploitation activities in Task 5.1. The main objectives of Task 5.1.2 and Task 5.2 are described as follows: General market overview with drivers, and regional dynamics. Monitoring of the competition and technological advancements, so as to identify competitors to BIO4EEB products and solutions (launched prior to the finalization of the project), with the objective of understanding how to optimize market positioning. Listing of main business models and approaches for bio-based insulation products in the European Union. Providing valuable market and industry data to Task 5.2 which will enable the definition of viable business models.

The below figure provides a breakdown of the steps that are to be deployed for the completion of these activities and deliverables.



**Figure 1-** Methodology employed for Subtask 5.1.2 completion

### Step 1

Given that step 1 corresponds to the first market deliverable and comes at a preliminary stage in the project where innovations and technologies are still in development, the objective in this step is to provide preliminary market information on general trends and competitor assessments. This deliverable will set the basis for further and more detailed activities as the project moves forward. In addition to this, the information and data contained within this document can already be used to obtain insights on the economic potential of the project results.

### Step 2

Firstly, this step will provide an update on all the initial market observations that have been provided in order to account for potential new competitors, unexpected dips in the market, or new regulations. Moreover, one of the key outputs of this stage is providing a more detailed competitor assessment. Since the project results and innovations will be at a more mature development stage, the consortium will provide a detailed analysis of competitors and the technical features of their products and be able to assess the potential strengths and weaknesses of BIO4EEB KERs with respect to these products. This will later provide key insights on the positioning of BIO4EEB within its respective markets in order to establish effective business strategies and relevant operational structures that will be contained in the BIO4EEB business plan for the commercialization of project results.

### 3 Market overview and trends

The European building sector is a significant contributor to energy use and emissions, accounting for 40% of the EU's energy consumption and 36% of its emissions<sup>1</sup>. With only 1% of buildings receiving energy-efficient renovations annually and just 25% of buildings currently meeting energy-efficient standards, the European Commission's Renovation Wave Strategy aims to double renovation rates over the next decade to reach climate neutrality by 2050<sup>2</sup>.

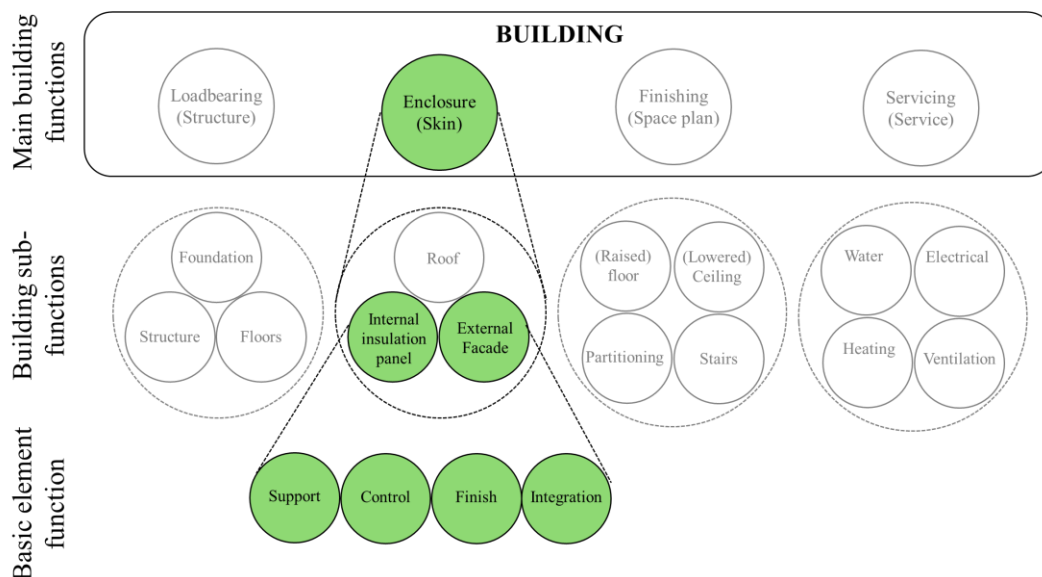
A key focus of this strategy is reducing the building sector's 12% contribution to Europe's greenhouse gas emissions from material usage<sup>3</sup>. Bio-based materials, which have a significantly lower carbon footprint than traditional fossil-based materials, present a powerful solution for reducing emissions in the building sector. Using sustainable materials like wood, hemp, or other renewable resources in construction can help decrease emissions while enhancing the energy efficiency of buildings, making bio-based materials essential to achieving the EU's climate goals<sup>4</sup>.

Bio-based materials are derived from biological sources, excluding fossil-based or geological materials. Their use in the EU's Renovation Wave offers a dual benefit: enhancing the energy efficiency of European buildings while reducing their embodied carbon footprint.

This section explores the role of bio-based products and its presence in the renovation wave, more specifically, this report provides insights about:

- The BIO4EEB market target and the different sub-segments and perspectives
- Short overview of the main stakeholders identifying priorities for building renovation
- Identification of direct competitors for BIO4EEB solutions

Buildings consists of building elements that are generally classified based on their function and the location in a building itself (**Figure 2**)



**Figure 2-** Functional decomposition of building elements

BIO4EEB is focussed on the development of bio-based materials and components for the enclosure or skin of the building which takes into account internal insulation panels and external facades.

This section provides a market research and competitor analysis to understand market viability of the BIO4EEB project solutions and creates an overall marketing strategy for the products and services developed during the project. Additionally, this section shows the total potential value of the market for these technologies in all targeted markets. In the section, bio-based insulation panels and fibres, protection coats and windows have been analysed to understand total size and value of such market.

### 3.1 Key market target

The BIO4EEB project focuses on five key aspects as already mentioned:

1. Bio-based core panel and fibres
2. Protective coat against fire
3. Bio-based spray foams insulation
4. High performance windows
5. Prefabricated building facade

Therefore, the objective should extend beyond simply marketing an innovative bio-based insulation materials and system to specialized companies and installers. It should encompass addressing the requirements of the segmented stakeholders. It is imperative to engage key players in the construction and design industry to ensure they understand the benefits of BIO4EEB solutions. Additionally, public entities associated with the energy and building markets should also be involved in this outreach effort.

Target customers for BIO4EEB solutions can be ranged from individual homeowners to large corporations, each with unique motivations centered around cost efficiency, sustainability, improved building performance, and compliance with environmental standards. By addressing these needs, the use of BIO4EEB presents a strong value proposition across the construction and renovation sector.

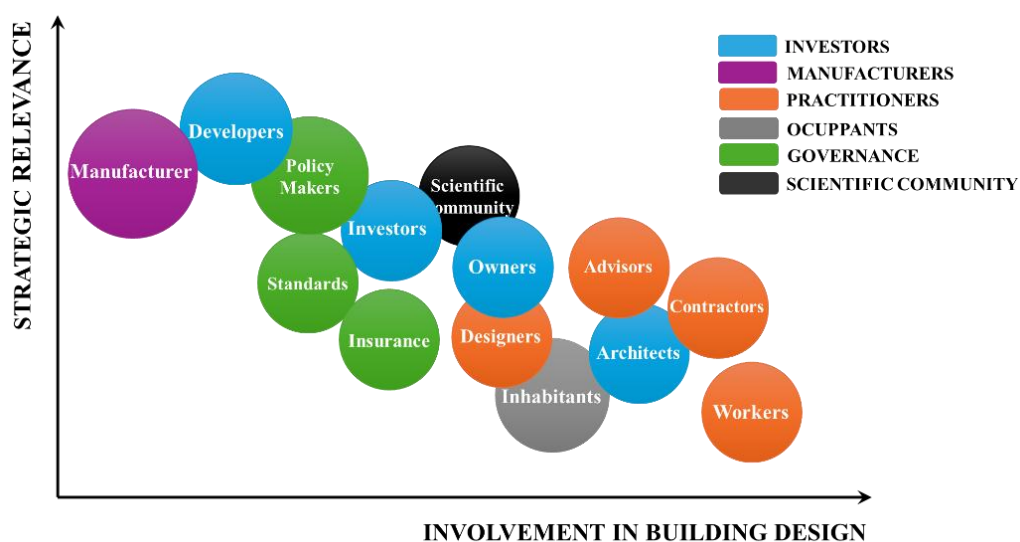


Figure 3- BIO4EEB project solutions key target customers

**Table 1-** Overview of target customers for BIO4EEB

| Target Group                                                 | Profile                                                                                                                                                            | Motivation                                                                                                                                                                                                                          | Key selling point                                                                                                                                    |
|--------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Residential homeowners</b>                                | <i>homeowners or building communities seeking to upgrade their living space with more sustainable and energy-efficient solutions.</i>                              | <i>-Lower energy bills and improved indoor comfort.<br/>-Enhanced aesthetic appeal and property value.</i>                                                                                                                          | <i>-Energy efficiency<br/>-Cost savings<br/>-Potential for higher property resale value.</i>                                                         |
| <b>Real estate investors</b>                                 | <i>Companies/individuals investing in residential or commercial properties with the aim of renovation and resale or rental.</i>                                    | <i>-Increase in property value and rental yield.<br/>-Demand for sustainable buildings by tenants or buyers.<br/>-Compliance with green building certifications to attract buyers.</i>                                              | <i>-Fast renovation with prefab. Facades<br/>-cost-effective upgrades<br/>-Compliance with sustainability standards<br/>-Enhanced market appeal.</i> |
| <b>Facility management companies</b>                         | <i>Companies responsible for managing and maintaining large-scale properties, including office parks, residential complexes, and industrial facilities.</i>        | <i>-Reduce energy and operational costs across multiple properties.<br/>-Improve the longevity and durability of building facades and windows.</i>                                                                                  | <i>-Streamlined renovation processes<br/>-Consistent quality standards, and easier maintenance.</i>                                                  |
| <b>Historic Building Owners / Conservation Organizations</b> | <i>Owners or managers of heritage buildings who seek to modernize infrastructure while preserving the building's historical and architectural integrity.</i>       | <i>Improve energy efficiency while maintaining the building's historical character.<br/>Access subsidies or grants for sustainable renovation of heritage sites.<br/>Ensure long-term durability and reduce operational costs.</i>  | <i>Aesthetic preservation, use of natural and biobased materials, improved energy efficiency, and eligibility for conservation grants.</i>           |
| <b>Commercial Building Owners</b>                            | <i>Owners of office buildings, retail spaces, and other commercial properties looking to improve energy efficiency and aesthetics</i>                              | <i>Reduce operational energy costs.<br/>Improve indoor comfort and productivity in office environments.<br/>Comply with sustainability targets, especially in corporate settings</i>                                                | <i>Reduction in energy costs, improved indoor environment, enhanced building facade appeal, and alignment with corporate sustainability goals.</i>   |
| <b>Public Sector and Municipalities</b>                      | <i>Local governments or public institutions responsible for maintaining public buildings such as schools, hospitals, government offices, and cultural centres.</i> | <i>Achieve energy efficiency and carbon reduction targets set by regional or national governments.<br/>Access public funding or incentives for green renovations.<br/>Improve public building quality and community aesthetics.</i> | <i>Compliance with public policies, long-term energy savings, positive environmental impact, and increased occupant comfort.</i>                     |

## 3.2 Total market valuation and trends

The need for circular construction using bio-based materials has never been more urgent. Buildings account for about 50% of resource extraction and consumption, over 30% of the EU's annual waste, 40% of its energy use, and 36% of energy-related greenhouse gas emissions<sup>i</sup>.

Bio-based products can enhance sustainability, reduce reliance on fossil fuels, and drive innovation in product development. The European Commission anticipates steady growth in the use of bio-based materials across industries, with biomass increasingly used as a raw material in diverse applications, including construction<sup>ii</sup>. In recent decades, innovations in bio-based products have surged in response to fossil resource depletion, climate change, and the potential for added product functionalities. Accurate measurement of bio-based content will be crucial, ensuring clear and transparent communication about product characteristics to avoid market confusion

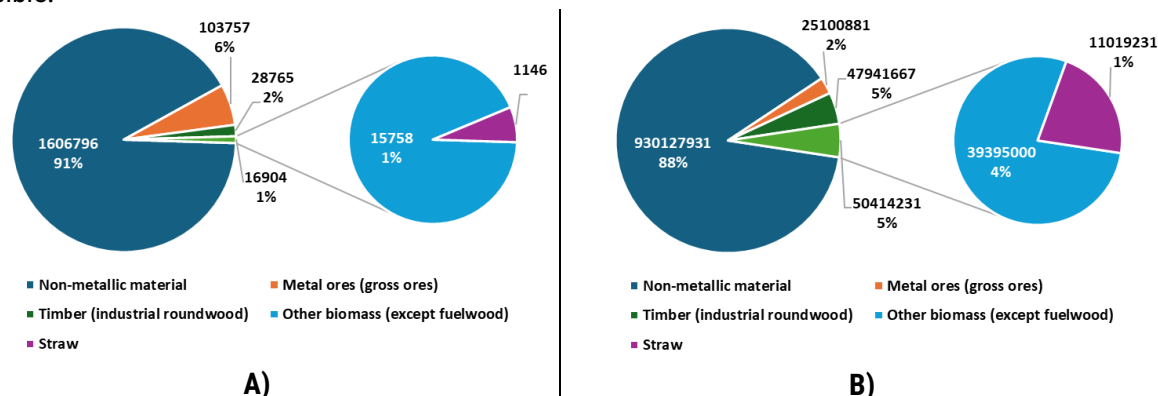
### 3.2.1 Market size

This section provides an overview of the market size for bio-based materials in construction, based on the Raw Material Consumption (RMC) indicator for 2020. The RMC represents the total domestic, foreign, direct, and indirect raw material needed to meet industry demands within the EU, covering both new construction and renovations. While it does not specify the proportion of bio-based materials used exclusively for renovations, it offers valuable insights into overall market trends and the role of bio-based materials in the construction sector.

The primary raw material categories considered<sup>5</sup> are:

- **Non-metallic minerals:** Includes materials like marble, granite, clay, sand, and gravel.
- **Metal ores:** Covers mineable metals such as iron, copper, nickel, and gold.
- **Timber:** Encompasses industrial roundwood, including natural lumber and engineered wood products, excluding fuel wood.
- **Straw:** Represents biomass used specifically for construction purposes.
- **Other biomass:** Accounts for bio-based materials not explicitly categorized as timber or straw.

These categories reflect materials directly used in physical construction. Energy sources (both bio-based and non-renewable) required for producing final materials are excluded from the calculations whenever feasible.



<sup>i</sup><https://www.consilium.europa.eu/en/press/press-releases/2023/06/30/council-adopts-position-on-the-construction-products-regulation/>

<sup>ii</sup> [https://single-market-economy.ec.europa.eu/sectors/biotechnology/bio-based-products\\_en](https://single-market-economy.ec.europa.eu/sectors/biotechnology/bio-based-products_en)

**Figure 4-** Building materials in the construction sector based on A) weight (1000 tonnes) and B) Volume (m<sup>3</sup>)

The **Figure 4A)** illustrates the RMC of the construction sector in thousand tonnes, with percentages calculated for each material category: Non-metallic minerals dominate at 91%; Metal ores account for 6%; Bio-based materials make up 3%, with timber at 2%, "other biomass" at 1%, and straw contributing less than 1%.

While mass is a standard metric in material flow analysis, it can misrepresent market significance. Volume-based market shares (in cubic meters) are also calculated using material densities<sup>6</sup> to provide a fuller picture: Non-metallic minerals are subdivided into concrete, marble/granite/sandstone, clay, and limestone. Metal ores are split into steel (iron) and non-ferrous metals, with aluminium as a proxy for the latter. Bio-based materials (timber, straw, and "other biomass") are analysed individually. For "other biomass," a density of 400 kg/m<sup>3</sup> is assumed due to undefined plant species in Eurostat data, resulting in higher uncertainty for this category's volume estimate.

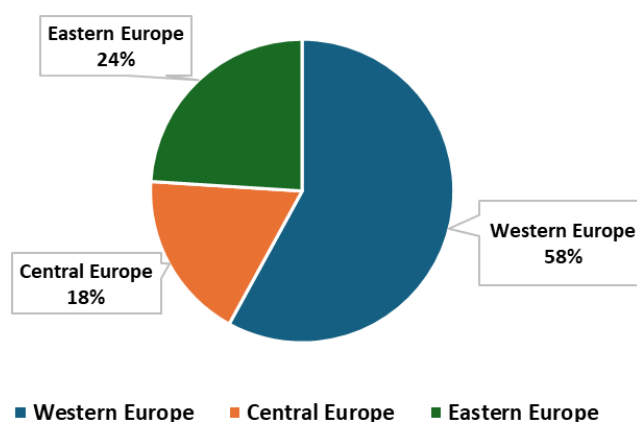
**Figure 4B)** shows market shares based on volume rather than weight. Compared to weight-based shares, bio-based materials gain prominence due to their lower density: Non-metallic minerals decrease to 88%. Metal ores drop to 2%. Bio-based materials rise to 10%, with timber increasing to 5%, "other biomass" to 4%, and straw to 1%.

These figures represent the broad category of bio-based materials, without distinguishing their usage in new versus renovated buildings or in specific applications like insulation (relevant to renovations) versus structural elements.

#### **EU market for thermal insulation products**

The European thermal insulation market reached a total volume of 274.2 million m<sup>3</sup> (10.3 million tonnes) in 2022, with an estimated market value of €29.6 billion. Inflation, exacerbated by the Russia-Ukraine war, significantly impacted most European countries in 2022, leading to flat or negative growth in many regions, except for Hungary, Turkey, Ireland, and Italy.

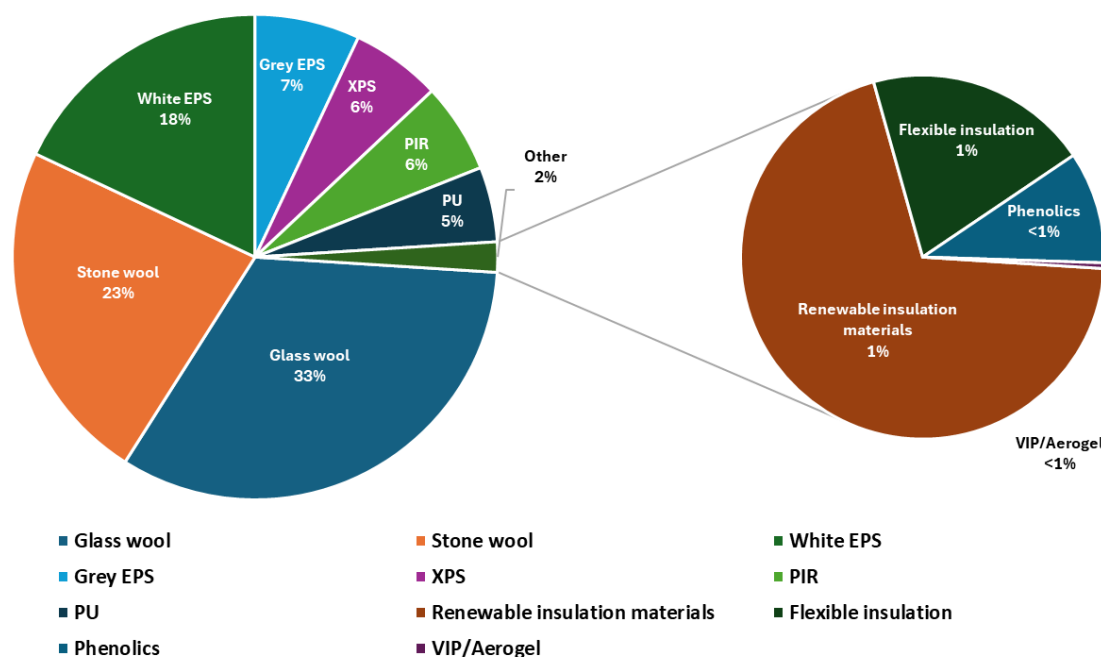
Western Europe dominated the market in 2022, accounting for 58% of total demand. Central Europe represented 18% of demand. Eastern Europe's share rose to 24%. Russia, the largest market in the region, experienced a slight decline but remains a significant contributor to Eastern European demand. This picture highlights the uneven growth dynamics across Europe, with regional differences driven by economic challenges and geopolitical factors.



**Figure 5-** European thermal insulation market by region

Insulation materials play a crucial role in enhancing the energy efficiency and sustainability of buildings by minimizing heat loss through the building envelope, appliances, and equipment. However, no single material or technology can fully address the energy challenges in buildings. Instead, a combination of various insulation materials is required to optimize energy performance in both new nearly zero-energy buildings (NZEBS) and retrofitting/renovation projects.

Traditionally, insulation relies on mineral wool (e.g., stone wool, glass wool) and plastic foams (e.g., polyurethane, polystyrene), which offer thermal resistance, durability, and cost-effectiveness<sup>7</sup>. However, concerns over the environmental impact of synthetic materials have led to growing interest in bio-based insulation alternatives. These materials, derived from renewable resources, offer low embodied carbon, enhanced moisture regulation, and biodegradability, making them suitable for circular economy models<sup>8</sup>. The building sector dominates the European thermal insulation market, accounting more than 80% of demand, while industrial applications represent around 10%. In buildings, walls are the primary application, while in industrial settings, pipe lagging is most common.



**Figure 6-** European thermal insulation market by product

According to **Figure 6**, **Mineral Wool (Glass Wool and Stone Wool)** make up 56% of the market. Glass wool is the most popular due to EU regulations favouring non-combustible materials (European class A1 and A2) and its fire-resistant properties. **EPS (Expanded Polystyrene)** represents nearly 25% of the market, particularly in external wall systems. However, its poor fire resistance limits its use in Western Europe, though it remains popular in cost-sensitive Central and Eastern Europe. **XPS (Extruded Polystyrene)**, comprising 6% of the market, it is valued for its strength and low permeability, making it ideal for cold stores, perimeter insulation, and refrigerated transport. **PUR/PIR Foams**, together, they account for 11% of the market. PIR is gaining share over PUR due to better thermal performance. Both materials are versatile but face challenges from high costs and regulatory changes. **Phenolic Foam**, a niche material with rapid growth, primarily used in industrial applications like pipe lagging. **Flexible Insulation (ENR and PE)**, together, they account for 1% of the market, with ENR showing faster growth due to better fire resistance. **Renewable Insulation Materials**, these eco-friendly alternatives, such as cellulose and wood

fibres, represent ~1,4% of demand. They are favoured for retrofitting and environmental benefits. **VIPs and Aerogels:** These high-performance materials have the smallest market share, used in niche applications like cryogenics and areas requiring thin panels.

Given that insulation materials are typically lighter than other building elements, the fact that bio-based materials account for 10% of the total construction sector volume indicates their primary use in structural elements rather than insulation. Overall, bio-based materials play a secondary yet significant role in construction, **with timber dominating this market segment.**

### 3.2.2 Market perspective

Bio-based materials currently have a limited role in the construction sector, with timber dominating this segment. However, their market importance is expected to grow due to European policies like the bioeconomy strategy, which previously drove a 30% increase in the bio-based economy's turnover between 2008 and 2018. Significant growth was seen in the chemicals and plastics (+68%) and pharmaceutical (+42%) sectors.

Key questions for the market outlook include the economic competitiveness and consumer acceptance of bio-based materials and the sustainable supply of bio-based feedstock.

Studies<sup>9,10,11</sup> indicate that bio-based insulation materials tend to be slightly more expensive than conventional options. For example:

- EPS (expanded polystyrene) is the cheapest insulation material, while miscanthus is only about 10% more expensive.
- Hemp and wood-based insulation are less cost-efficient compared to fossil-based alternatives.

Economic performance of building retrofitting studies<sup>12</sup> revealed that economic benefits only arise in buildings with high energy consumption or costs. Cork-based insulation, while bio-based, remains more expensive than EPS due to its higher market price.

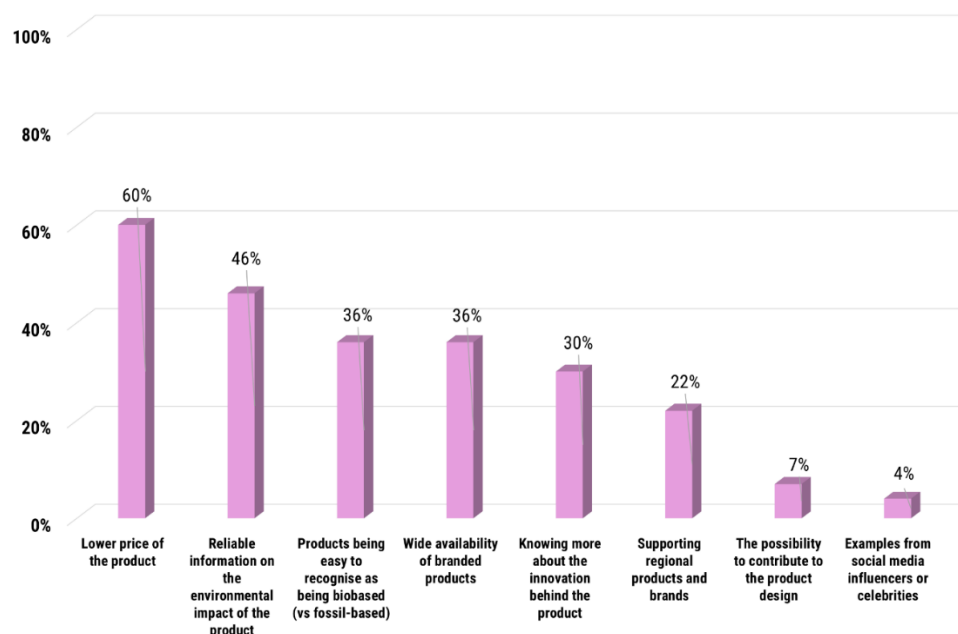
Overall, while bio-based materials face challenges in cost-competitiveness, policy-driven incentives and sustainable practices may enhance their role in the future.

**Table 2-** Life cycle costs of insulating 1 m<sup>2</sup> of external wall of a residential building with 0,24W/m<sup>2</sup>K for 70 years with different materials

| Life cycle stage | Costs in € per FU |              |              |             |             |              |
|------------------|-------------------|--------------|--------------|-------------|-------------|--------------|
|                  | Wood fiber        | Hemp fiber   | Flax         | Miscanthus  | EPS         | Stone wool   |
| Cultivation      | 1,51              | 2,21         | 2,79         | 0,9         | 0           | 0            |
| Manufacturing    | 10,33             | 9,19         | 6,35         | 2,76        | 4,13        | 8,35         |
| Use phase        | 0,81              | 3,7          | 0,81         | 3,74        | 3,7         | 3,64         |
| End-of-life      | 1,22              | 1,31         | 1,37         | 1,39        | 0,46        | 0,81         |
| Transport        | 0,37              | 0,39         | 0,4          | 0,41        | 0,09        | 0,25         |
| <b>Total</b>     | <b>14,24</b>      | <b>16,79</b> | <b>11,72</b> | <b>9,18</b> | <b>8,39</b> | <b>13,05</b> |

EPS production is well-established and benefits from economies of scale, while cork insulation boards face limitations due to restricted cork supply and competition with other industries. Many bio-based materials, being part of a nascent sector, remain niche products with low technological readiness and inefficient production processes, making them less economically competitive compared to widely used materials like mineral wool and plastic foams. However, as the bio-based sector grows, cost competitiveness is expected to improve for products that achieve significant market size.

Consumer behaviour is vital for the adoption of bio-based materials, as purchasing choices directly impact demand, supply, and market prices. Studies<sup>13</sup>, show that price is the primary factor influencing consumer decisions, with many unwilling to pay more for bio-based products. To ensure sustainability, it is crucial to balance increased demand with the sustainable supply of bio-based feedstocks, avoiding overexploitation of natural resources. Consumers generally have positive perceptions of bio-based materials due to their sustainability benefits, despite limited knowledge about them. Studies in the Netherlands and Ireland reveal that price is the key factor influencing purchases, with about half of consumers unwilling to pay more. To prevent overexploitation of natural resources, it is essential to assess the realistically achievable sustainable supply of bio-based feedstocks.



**Figure 7-** Motivation of consumers for adopting bio-based products

### 3.2.3 Market versus resources issues

Biosourced materials such as timber, straw, hemp, and cork play a crucial role in Europe's efforts to decarbonize the building sector. Studies on land availability<sup>14</sup> in highlight **straw** as the most promising material due to its carbon storage potential, low land-use impact (being a by-product of wheat farming), and economic benefits for farmers. **Timber** is also a viable option given its availability, carbon sequestration properties, and established market infrastructure, though competition for wood is expected to rise. However, **hemp and cork** currently lack the capacity to meet large-scale renovation demands in the EU-27+UK, despite hemp's strong global warming impact mitigation potential.

Material Economics (2021)<sup>1</sup> underscores the increasing demand for biomass across sectors, warning that rising reliance on bio-based materials could exceed sustainable supply. The study suggests prioritizing biomaterials over bioenergy, given their long-term benefits in construction. Expanding circular practices, such as cascading use and valorizing bio-waste streams, could enhance biomass availability while reducing environmental impact.

Europe's dependence on imported materials also presents challenges, with two-thirds of its non-food bioeconomy land needs met through imports, raising concerns about land-use displacement and leakage effects. Careful resource management is essential to ensure the sustainable scaling of biosourced building materials while balancing competition with other bioeconomy sectors.

### 3.3 Incentives to promote bio-based materials in Europe

The promotion of bio-based materials in European building renovation is driven by a combination of environmental, economic, and regulatory incentives, aligned with the European Green Deal and the Circular Economy Action Plan.

This section outlines the key incentives for promoting bio-based materials in European building renovation. **Deliverables D2.3 and D2.5** provide a comprehensive analysis of socio-economic segmentation, highlighting its role in increasing the adoption of these materials. Additionally, they examine policies and initiatives that strengthen sustainability and carbon reduction in the construction sector. The following summary presents the main findings from these deliverables.

The **BIO4EEB project** aims to develop cost-effective and high-performance renovation solutions tailored to diverse socio-economic groups. This report analyzes potential buyers—**investors and building owners**—by examining socio-economic segmentation in key markets: **France, Spain, Germany, Czech Republic, and Lithuania**. Key indicators such as **disposable income, savings, and ownership rates** are evaluated alongside prevalent **building typologies** in each country. This approach ensures that renovation strategies align with both financial capacity and housing characteristics, promoting wider adoption of bio-based solutions.

By integrating socio-economic insights, the project enhances the **market relevance and accessibility** of bio-based renovations, fostering sustainable building practices across Europe (**European Commission, 2020; UNEP, 2021**).

The European Union is actively promoting bio-based materials in building renovation through multiple policies and initiatives, reinforcing sustainability, circularity, and carbon reduction in the construction sector.

1. **Circular Economy Action Plan (2020)**<sup>iii</sup> – Encourages bio-based materials by integrating them into sustainable production and public procurement, supporting research, and ensuring their sustainability within a circular value chain.
2. **EU Bioeconomy Strategy (2018)**<sup>iv</sup> – Highlights bio-based products as viable alternatives to fossil-based materials, fostering innovation and market integration while ensuring coherence across multiple sectors.
3. **Renovation Wave (2020)**<sup>v</sup> – Promotes the reuse of materials, including bio-based solutions, and emphasizes their environmental benefits based on life-cycle assessments in building renovation projects.
4. **New European Bauhaus (2021)**<sup>vi</sup> – Advocates for bio-based materials as circular and low-carbon choices, particularly for thermal insulation and structural reinforcement in historic buildings.
5. **Whole Life Carbon Roadmap (2023)**<sup>vii</sup> – Establishes a framework to measure and reduce carbon emissions in buildings, reinforcing the environmental advantages of bio-based materials.
6. **Normative Mechanisms** – Develops and refines standards for bio-based materials to ensure their quality, performance, and sustainability, supporting regulatory alignment and market confidence.

<sup>iii</sup> <https://www.eu2020.de/resource/blob/2429166/156d2d98b66b2ff28b6990161eed91e9/12-17-kreislaufwirtschaftsaktionsplan-bericht-de-data.pdf>

<sup>iv</sup> <https://op.europa.eu/en/publication-detail/-/publication/edace3e3-e189-11e8-b690-01aa75ed71a1/language-en>

<sup>v</sup> [https://www.bpie.eu/wp-content/uploads/2021/04/BPIE\\_Renovation-Wave-Analysis\\_052021\\_Final.pdf](https://www.bpie.eu/wp-content/uploads/2021/04/BPIE_Renovation-Wave-Analysis_052021_Final.pdf)

<sup>vi</sup> [https://new-european-bauhaus.europa.eu/index\\_en](https://new-european-bauhaus.europa.eu/index_en)

<sup>vii</sup> [https://environment.ec.europa.eu/news/have-your-say-development-new-roadmap-reduce-whole-life-carbon-building-sector-2023-07-17\\_en](https://environment.ec.europa.eu/news/have-your-say-development-new-roadmap-reduce-whole-life-carbon-building-sector-2023-07-17_en)



Together, these policies create financial, regulatory, and technical incentives that accelerate the adoption of bio-based materials, aligning building renovation with Europe's climate neutrality and resource efficiency goals.

In conclusion, to accelerate the transition to bio-based materials in building renovation, Europe is leveraging a mix of **regulatory measures, financial support, carbon accounting frameworks, and innovation incentives**. Strengthening these incentives will be crucial in scaling up bio-based solutions, reducing dependency on fossil-based materials, and achieving the EU's climate-neutrality targets by 2050.

## 4 Construction materials and product overview

This section is specifically dedicated to the technology and product landscape for construction materials and components. The objective is to observe performance standards and features of competing materials and components in the market to ensure that BIO4EEB solutions comply with minimal market requirements and can be effectively positioned.

To do this and as part of the project framework, a comprehensive construction product listing (ones most relevant to BIO4EEB KERs) will be developed to systematically evaluate the state of the art in construction materials, components, and technologies (**see Annex**). This database, currently in its preliminary form, will evolve and be updated throughout the course of the project in the next deliverable iterations to reflect ongoing research findings, advancements in technology, and newly identified materials.

The primary objective of this database is to provide a structured assessment of materials and systems from the perspective of their performance characteristics and functional features. By maintaining a dynamic and detailed record, the database will enable the project team to benchmark and analyse products, thereby facilitating informed decision-making.

### Key Categories

Focus will initially be brought on the following main categories which are aligned with BIO4EEB markets and KERs:

1. **Insulation:** Materials and solutions designed for thermal, acoustic, and fire resistance.
2. **Windows:** Advanced glazing systems, frames, and related technologies aimed at optimizing energy efficiency and indoor comfort.
3. **Building Boards and Systems:** Panels, boards, and integrated systems used in interior and exterior applications for improved functionality and sustainability.
4. **Other Subcategories and Elements:** Additional materials, technologies, and components that contribute to the performance and integration of the building envelope and internal systems.

The preliminary database serves as a foundational structure that will grow progressively. Continuous updates will incorporate:

- New materials and products identified during market research.
- Performance data.
- Feedback from stakeholders and industry professionals.

This resource will ultimately act as a key reference tool for both current and future construction projects, supporting the project's goals of optimizing building performance and sustainability using biomaterials.

### 4.1 Insulation products

Insulation plays a critical role in the performance of any building, significantly influencing its energy efficiency, thermal comfort, and acoustic properties. It serves as a barrier to heat flow, reducing energy demand for heating and cooling systems, and contributes to the overall sustainability and cost-effectiveness of construction projects.

In addition to its thermal benefits, modern insulation materials and technologies offer advancements in areas such as fire resistance, soundproofing, and environmental impact. These developments make insulation a cornerstone of building innovation, particularly in the context of meeting stringent energy performance standards and sustainability goals.

This section will focus on evaluating insulation materials and solutions based on their key performance metrics, including thermal conductivity, durability, environmental impact, ease of installation, and compatibility with other building components. The aim is to identify and categorize state-of-the-art products that optimize building envelope performance while aligning with the project's overarching objectives.

#### 4.1.1 Types of insulation materials

Both natural materials and more conventional synthetic materials have been involved in the current analysis. The table below provides an overview of the materials that have been comprised in the listing so far through products and companies included.

**Table 3-** Insulation product material categories

| Product Type         | Material type      | Material                               |
|----------------------|--------------------|----------------------------------------|
| Insulation (thermal) | Natural materials  | Hemp                                   |
|                      |                    | Mycelium                               |
|                      |                    | Wood fibre                             |
|                      |                    | Wool                                   |
|                      |                    | Cellulose fibre                        |
|                      |                    | Natural fibres (other) or combinations |
|                      | Plastic & Polymers | EPS (Expanded Polystyrene)             |
|                      |                    | PIR (Polyisocyanurate)                 |
|                      |                    | XPS (Extruded Polystyrene)             |
|                      |                    | Synthetic resin                        |
|                      |                    | Polymer (Other)                        |

#### 4.1.2 Overview of main KPIs in general and per material

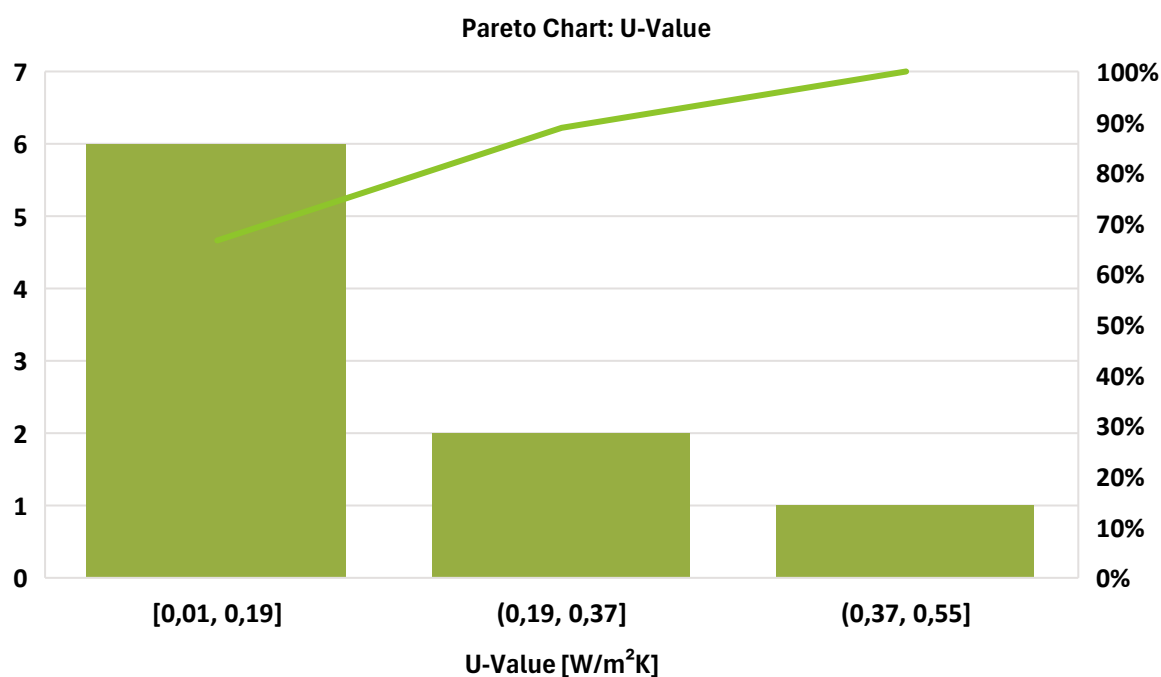
Main KPIs included in this report will be U-Value [ $\text{W}/\text{m}^2\text{K}$ ], Density [ $\text{kg}/\text{m}^3$ ] and Service Life [Yr]. Other KPIs have been obtained in the process but provide overlapping information with the latter three such as thermal conductivity or grammage.

##### 4.1.2.1 U-Value [ $\text{W}/\text{m}^2\text{K}$ ] and thermal conductivity [ $\text{W}/\text{mK}$ ]

###### U-Value

The U-Value measures the thermal transmittance of a material or system, indicating how much heat passes through it per unit area for every degree of temperature difference (measured in Watts per square meter per Kelvin). A lower U-Value means better insulation, as less heat is lost or gained through the

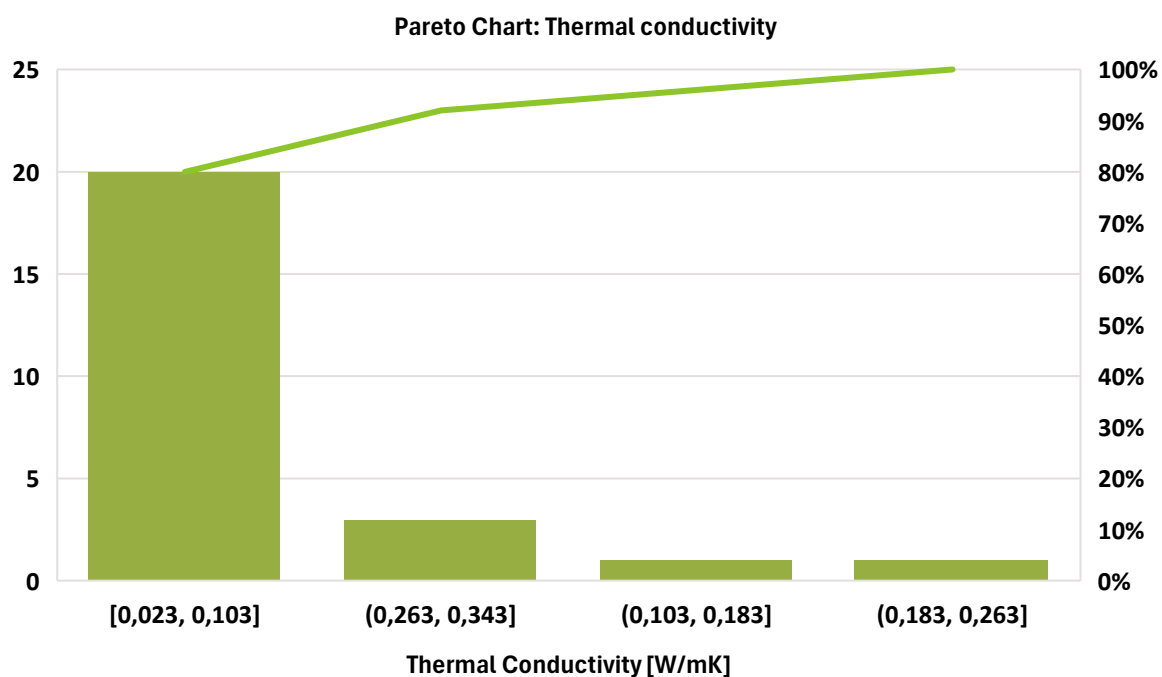
material. This KPI is critical for assessing the overall thermal performance of building elements, such as walls, roofs, or windows.



**Figure 8-** Pareto chart: U-value, insulation

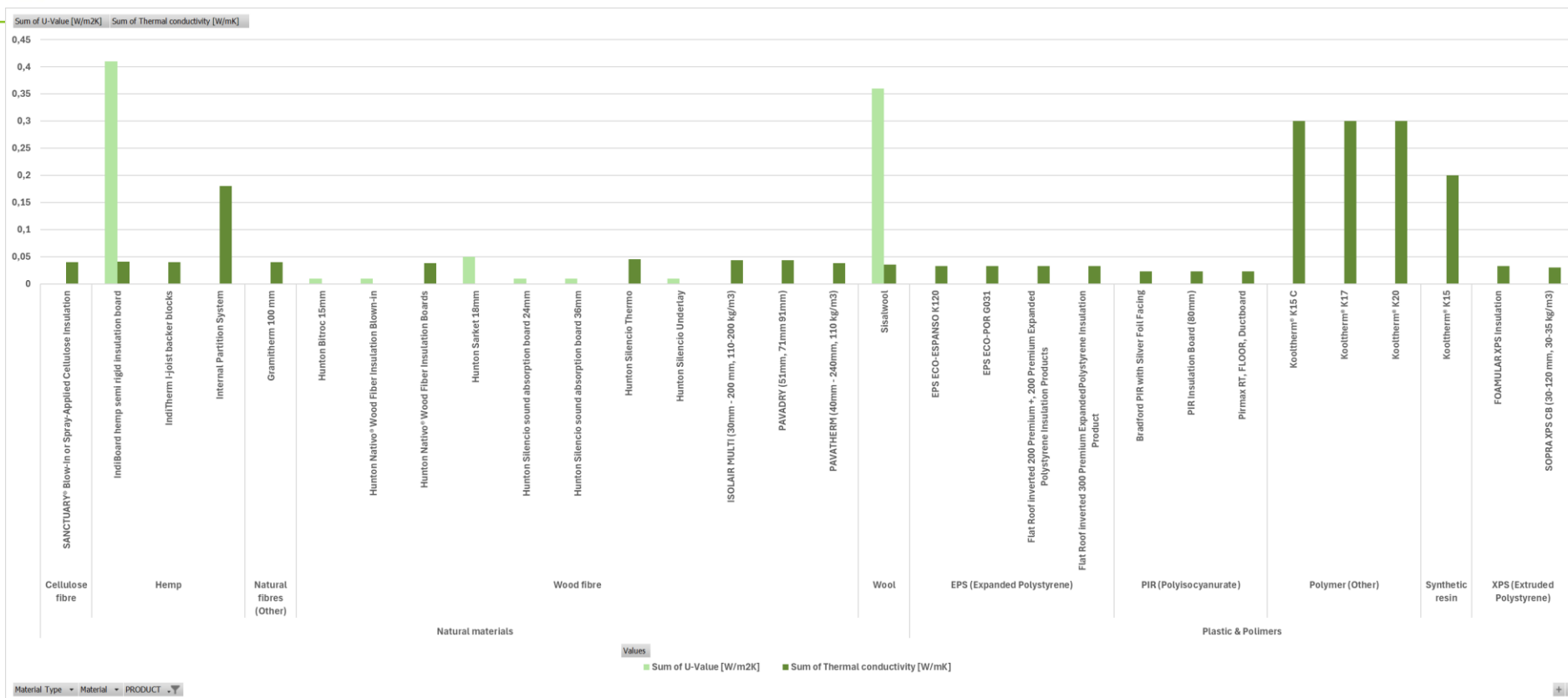
### Thermal conductivity

Thermal conductivity measures the ability of a material to conduct heat. It is expressed in Watts per meter per Kelvin (W/mK). Materials with lower thermal conductivity are better insulators because they resist heat flow more effectively. This KPI is a fundamental property of insulation materials and directly influences the U-Value when combined with the material thickness.



**Figure 9-** Pareto chart: Thermal conductivity, insulation

The table below disaggregates these results among the products listed so far in insulation where KPIs are available. Thermal conductivity varies only slightly among materials with slightly better average results for synthetic materials except for polymers which in itself depends wholly on the product being studied.



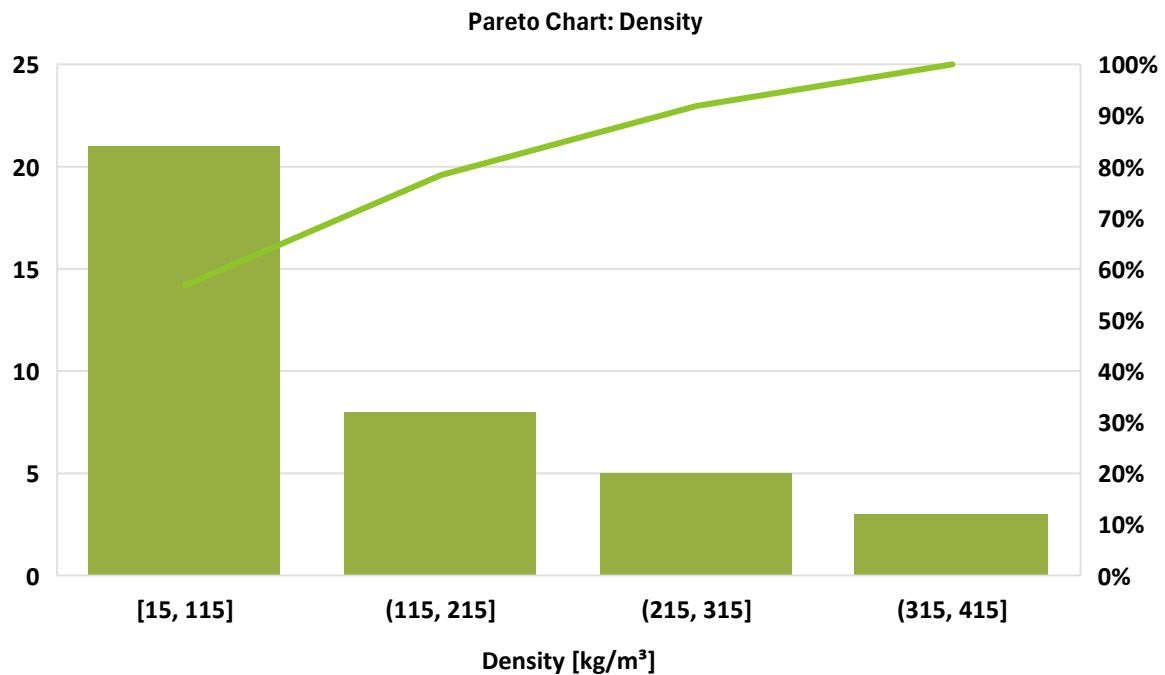
**Figure 10- Disaggregated U-values and thermal conductivity, insulation**

#### 4.1.2.2 Density [kg/m<sup>3</sup>]

Density is the mass of the material per unit volume, expressed in kilograms per cubic meter (kg/m<sup>3</sup>).

Pros and cons come with higher density. Indeed, higher density materials can offer improved thermal mass and sound insulation but may be heavier and harder to handle.

For insulation, density is often balanced to achieve both good thermal performance and ease of installation.



**Figure 11- Pareto Chart: Density, insulation**

The table below disaggregates these results among the products listed so far in insulation where KPIs on density are available. Higher density offers better thermal mass but may be more difficult to handle. Clearly, natural materials are able to offer higher densities than synthetic materials with some natural materials such as hemp covering a larger spectrum depending on build and product.

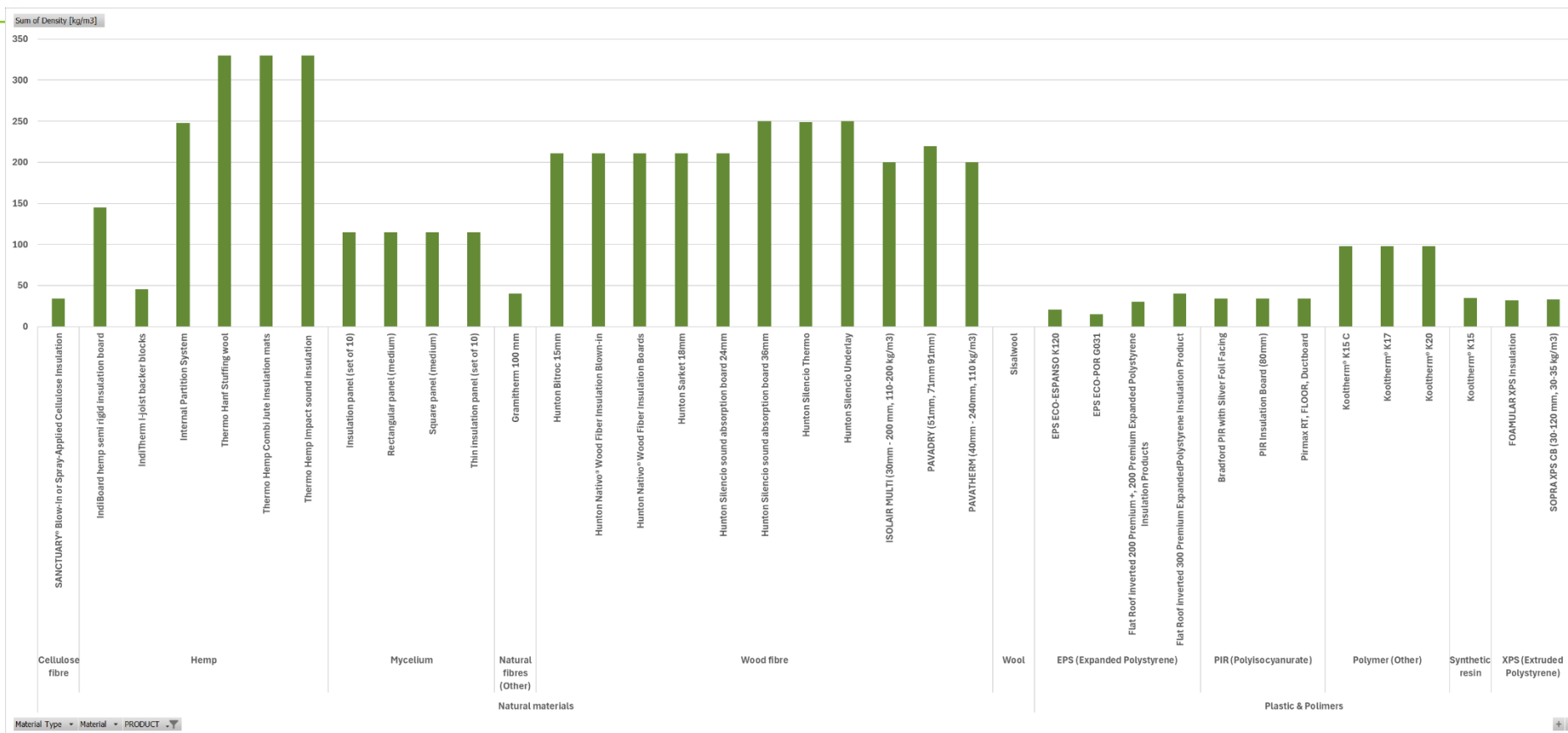
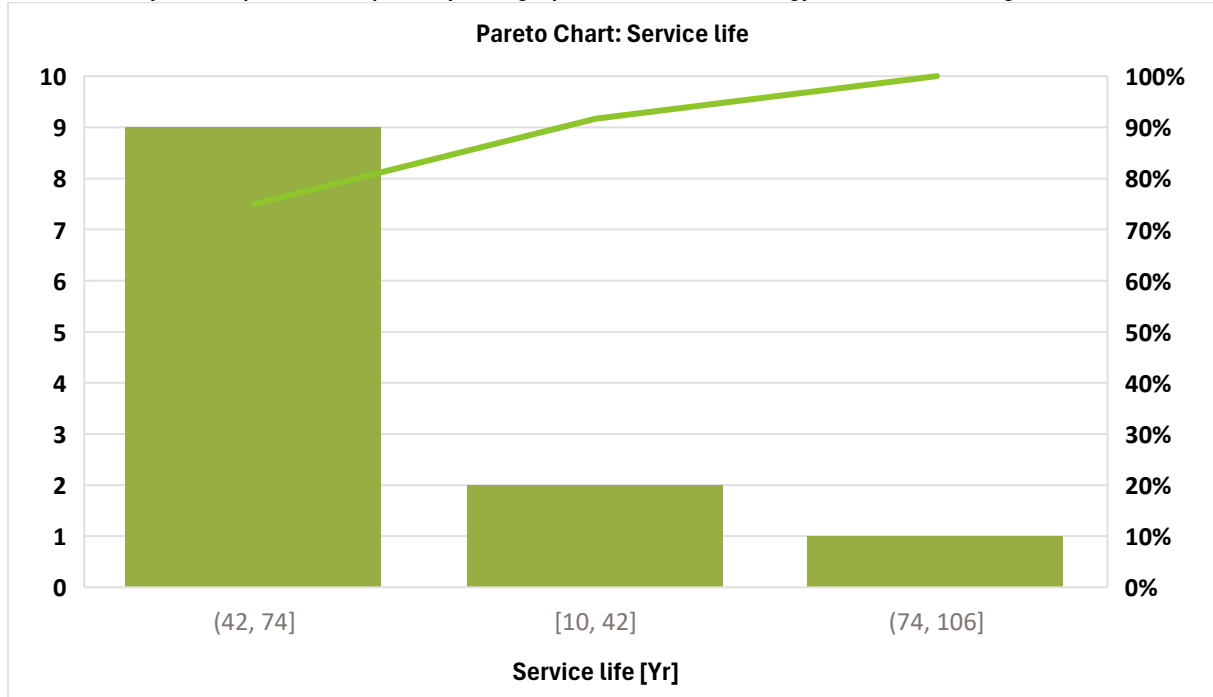


Figure 12- Disaggregated density, insulation

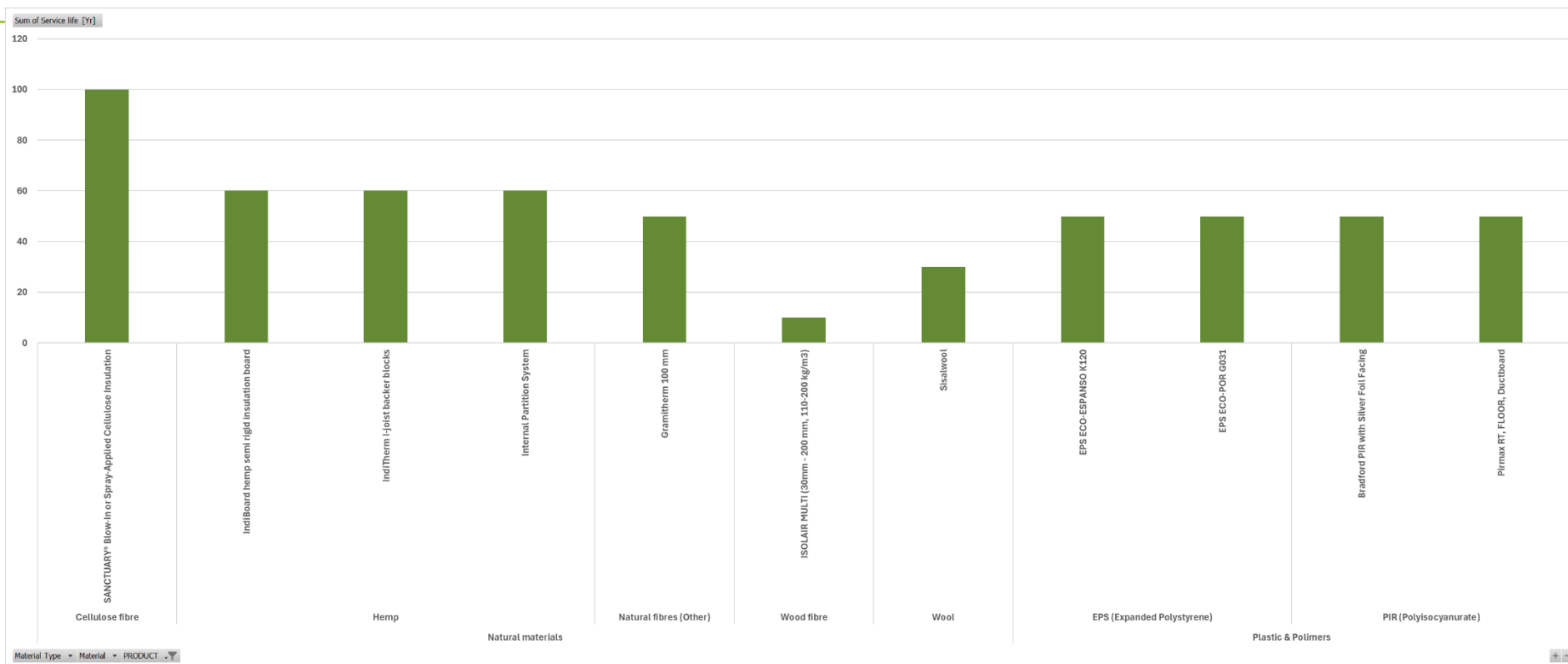
#### 4.1.2.3 Service Life [Yr]

The service life refers to the expected operational lifespan of the insulation material, typically measured in years. A longer service life ensures durability and sustained performance over time, reducing the need for replacement and maintenance. This KPI is important for assessing the long-term value and sustainability of the product, especially in high-performance or energy-efficient buildings.



**Figure 13-** Pareto Chart: Service life, insulation

The table below disaggregates these results among the products listed so far in insulation where KPIs on service life are available. Natural materials are often more prone to moisture which can lead to deterioration if not treated. Nevertheless, when treated and sealed well, natural materials offer fantastic durability on par or above with synthetic materials. The market seems to be moving at a 40 to 60 year interval for service life.



**Figure 14-** Disaggregated service life, insulation

### 4.1.3 Overview of qualitative characteristics of materials

Taking into consideration the above KPIs along with other qualitative information on the materials, a table for qualitative characterization is presented below:

**Table 4-** Insulation material overview

| Material                                      | Thermal Performance                                                            | Durability                                                                                  | Ease of Installation                                               | Weight Efficiency                                   | Sustainability                                                          |
|-----------------------------------------------|--------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|--------------------------------------------------------------------|-----------------------------------------------------|-------------------------------------------------------------------------|
| <b>Hemp</b>                                   | Moderate to good insulation (higher $\lambda$ compared to synthetic materials) | Long-lasting (resistant to pests and rot)                                                   | Easy (lightweight and easy to work with)                           | High (low density options, good thermal mass)       | Highly sustainable (renewable, carbon-sequestering, biodegradable)      |
| <b>Mycelium</b>                               | Generally good insulation (low $\lambda$ )                                     | Medium (requires sealing and protection from moisture)                                      | Moderate (lightweight but fragile)                                 | Moderate to High (relatively low density)           | Extremely sustainable (renewable, biodegradable, low energy production) |
| <b>Wood Fibre</b>                             | Good insulation (low $\lambda$ )                                               | Medium to low (prone to moisture if untreated)                                              | Easy (cuttable, compatible with various systems)                   | Moderate to low (medium density, good thermal mass) | Highly sustainable (renewable, recyclable, low embodied energy)         |
| <b>Wool</b>                                   | Good insulation (low $\lambda$ )                                               | Low to moderate (resistant to settling, naturally moisture-regulating depending on product) | Easy (flexible and simple to install)                              | Moderate (medium density)                           | Highly sustainable (renewable, biodegradable, natural material)         |
| <b>Cellulose Fibre</b>                        | Good insulation (low $\lambda$ )                                               | Medium (prone to moisture unless treated) but can be long lasting when treated              | Moderate (requires specialized blowing equipment for installation) | High (lightweight, loose-fill material)             | Sustainable (made from recycled paper, low embodied energy)             |
| <b>Natural Fibres (Other or Combinations)</b> | Good insulation                                                                | Medium (depending on                                                                        | Moderate to easy (depends on format and                            | Highly dependent on material mix or                 | Highly sustainable (renewable,                                          |

## D5.4

| Material                          | Thermal Performance                                                                                          | Durability                                                          | Ease of Installation                               | Weight Efficiency                              | Sustainability                                           |
|-----------------------------------|--------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|----------------------------------------------------|------------------------------------------------|----------------------------------------------------------|
|                                   | (varies with composition)                                                                                    | treatment and use case)                                             | handling requirements)                             | combination and resulting density              | biodegradable, or recycled material)                     |
| <b>EPS (Expanded Polystyrene)</b> | Good insulation (low $\lambda$ )                                                                             | Medium (can degrade in UV light and is flammable without additives) | Easy (lightweight and flexible panels)             | High (low density and grammage)                | Moderate (non-biodegradable, recyclable with challenges) |
| <b>PIR (Polyisocyanurate)</b>     | Excellent insulation (very low $\lambda$ , thinner layers required)                                          | High (moisture-resistant, long lifespan)                            | Moderate (rigid panels, cutting tools needed)      | High (low density)                             | Low (petroleum-based, limited recyclability)             |
| <b>XPS (Extruded Polystyrene)</b> | Excellent insulation (low $\lambda$ , better moisture resistance than EPS)                                   | High (resistant to moisture and compression)                        | Easy (rigid, lightweight panels)                   | High (low density)                             | Low (petroleum-based, limited recyclability)             |
| <b>Synthetic Resin</b>            | Moderate insulation (higher $\lambda$ compared to PIR/XPS)                                                   | High (long-lasting, moisture-resistant)                             | Moderate (requires proper installation techniques) | High (low density)                             | Low (petroleum-based, challenging to recycle)            |
| <b>Polymer (Other)</b>            | Varies (depending on composition, typically moderate $\lambda$ ) In examples taken here, it performs poorly. | Varies (moisture and UV resistance depend on polymer type)          | Moderate (depends on format: rigid or flexible)    | Moderate (depends on specific polymer density) | Low (petroleum-based, limited recycling options)         |

As a conclusion, materials like PIR and XPS offer superior thermal insulation, while natural fibers like hemp and wool are almost on par but slightly less effective. While natural materials may require treatment to resist moisture or pests, they are still very durable options with cellulose fiber lasting a very long time when treated. Lightweight and flexible materials like wool, hemp and EPS or other polymer & plastic options are easier to handle. Indeed, both natural fibers and synthetics like EPS and XPS are generally lightweight, but some materials can be denser depending on the construction properties of the panel. Hemp for instance offers high spectrums of density.

Of course, natural materials are the most sustainable options due to renewability and biodegradability, while synthetic options have environmental concerns due to their petroleum base and recycling difficulties.

## 4.2 Windows

Windows significantly impact the thermal properties and energy efficiency of a building envelope by influencing heat transfer, insulation, and solar gain. They can either enhance or compromise a building's thermal performance depending on their design, materials, and placement. High-performance windows with double or triple glazing, low-emissivity (Low-E) coatings, and insulated frames help reduce heat loss in winter and limit heat gain in summer, improving overall energy efficiency. Properly sealed and thermally broken window frames prevent air leakage, reducing the need for heating and cooling. Strategic window orientation and shading devices further optimize solar heat gain and natural ventilation, lowering reliance on artificial climate control systems.

The objective of BIO4EEB is to introduce bio foams for insulating the frame. Currently, bio-materials for windows are mainly used for frames (wood) but some new innovations are emerging in the market as detailed below.

- **Wood Frames:** Sustainably sourced timber provides natural insulation, durability, and aesthetic appeal. Engineered wood products, like laminated veneer lumber (LVL), offer enhanced strength and resistance to warping.
- **Bio-based Polymers:** Window frames made from bioplastics or composites incorporating plant-based resins reduce reliance on fossil fuels while maintaining strength and durability.
- **Aerogels from Biomass:** Lightweight, transparent bio-aerogels derived from cellulose or silica improve insulation while allowing natural light penetration.
- **Bio-based Coatings:** Nanocellulose and other bio-based coatings can enhance durability, UV protection, and self-cleaning properties of glass.
- **Algae-based Photovoltaic Glass:** Experimental biomaterials like algae-infused glass generate renewable energy while filtering sunlight and enhancing thermal efficiency.

At this stage, common market offerings are still based around synthetic materials and PVC frames. Commonly, thermal conductivity is at around 0.19 W/mK and density is at around 1530 kg/m<sup>3</sup>. More bio-based market offerings will be listed as the project moves forward.

## 4.3 Building Boards and Systems

Building boards are essential components of the building envelope, providing structural support, insulation, fire resistance, and weather protection while enhancing energy efficiency and sustainability. These boards come in various types, each with specific properties suited for different applications in walls, roofs, floors, and facades.

### 4.3.1 Types of materials

Within the BIO4EEB project, bio sourced materials are investigated as potential replacements for the common synthetic materials that are present within the market. Benefits can then be observed in terms of emissions for production, embodied carbon and recyclability and circularity.

The table below covers the material types and materials that constitute the listed products so far in the ongoing database being developed for the competitive benchmarking of BIO4EEB solutions. Systems (flooring and partitions) have also been included.

**Table 5-** Building boards material categories

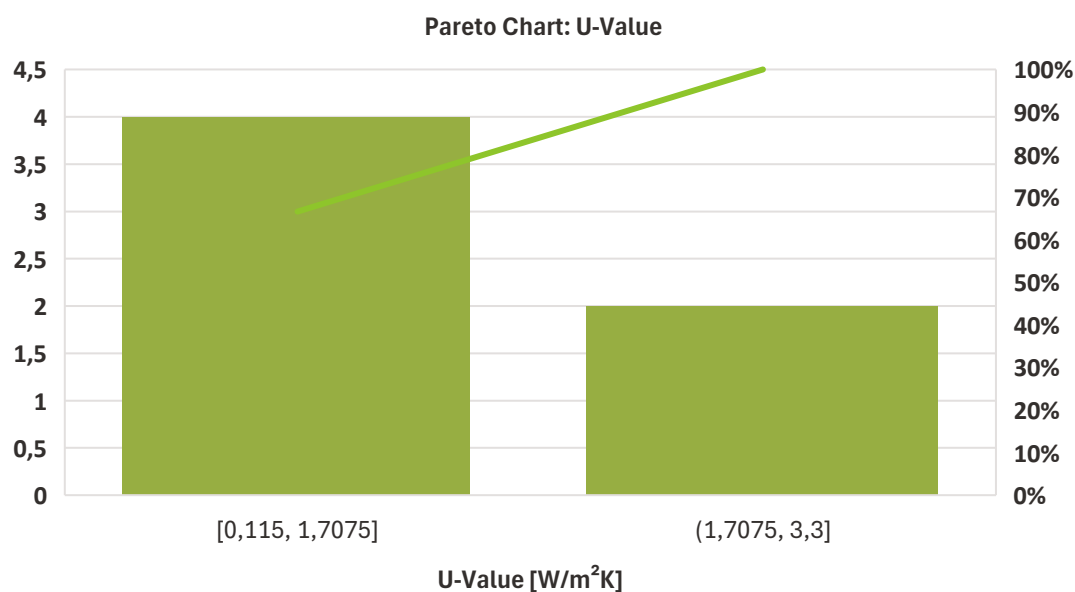
| Product Type                             | Material type      | Material                               |
|------------------------------------------|--------------------|----------------------------------------|
| <b>Building Boards</b>                   | Natural materials  | Chipboard (Particleboard)              |
|                                          |                    | MDF (Medium Density Fibreboard)        |
|                                          |                    | Wood fibre                             |
|                                          |                    | Natural fibres (other) or combinations |
|                                          |                    | Cork                                   |
|                                          |                    | Hemp                                   |
|                                          |                    | Cellulose fibre                        |
|                                          |                    | Straw                                  |
|                                          |                    | Clay                                   |
|                                          | Plastic & Polymers | PET                                    |
|                                          |                    | Polyester                              |
|                                          |                    | XPS (Extruded Polystyrene)             |
| <b>Systems<br/>(flooring/partitions)</b> | Natural materials  | Engineered wood (Other)                |
|                                          |                    | Chipboard (Particleboard)              |
|                                          | Plastic & Polymers | EPS (Expanded Polystyrene)             |

### 4.3.2 Overview of main KPIs in general and per material

As stated prior, the main KPIs included in this report will be U-Value [ $\text{W}/\text{m}^2\text{K}$ ], Density [ $\text{kg}/\text{m}^3$ ] and Service Life [Yr]. Other KPIs have been obtained in the process but provide overlapping information with the

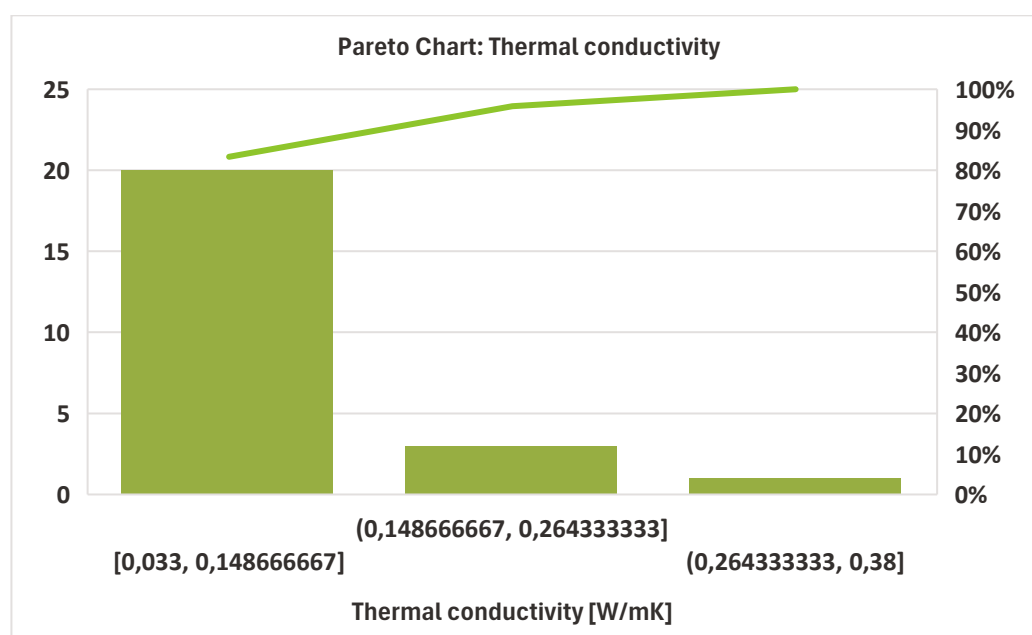
#### 4.3.2.1 U-Value [ $\text{W}/\text{m}^2\text{K}$ ] and thermal conductivity [ $\text{W}/\text{mK}$ ]

##### U-Value



**Figure 15-** Pareto chart: U-value, building boards

#### Thermal conductivity



**Figure 16-** Pareto chart: Thermal conductivity, building boards

The table below disaggregates these results among the products listed so far in building boards where KPIs are available. Thermal conductivity is rather homogenous among all categories. Slightly higher conductivity is observed in synthetic materials (Plastics and polymers).

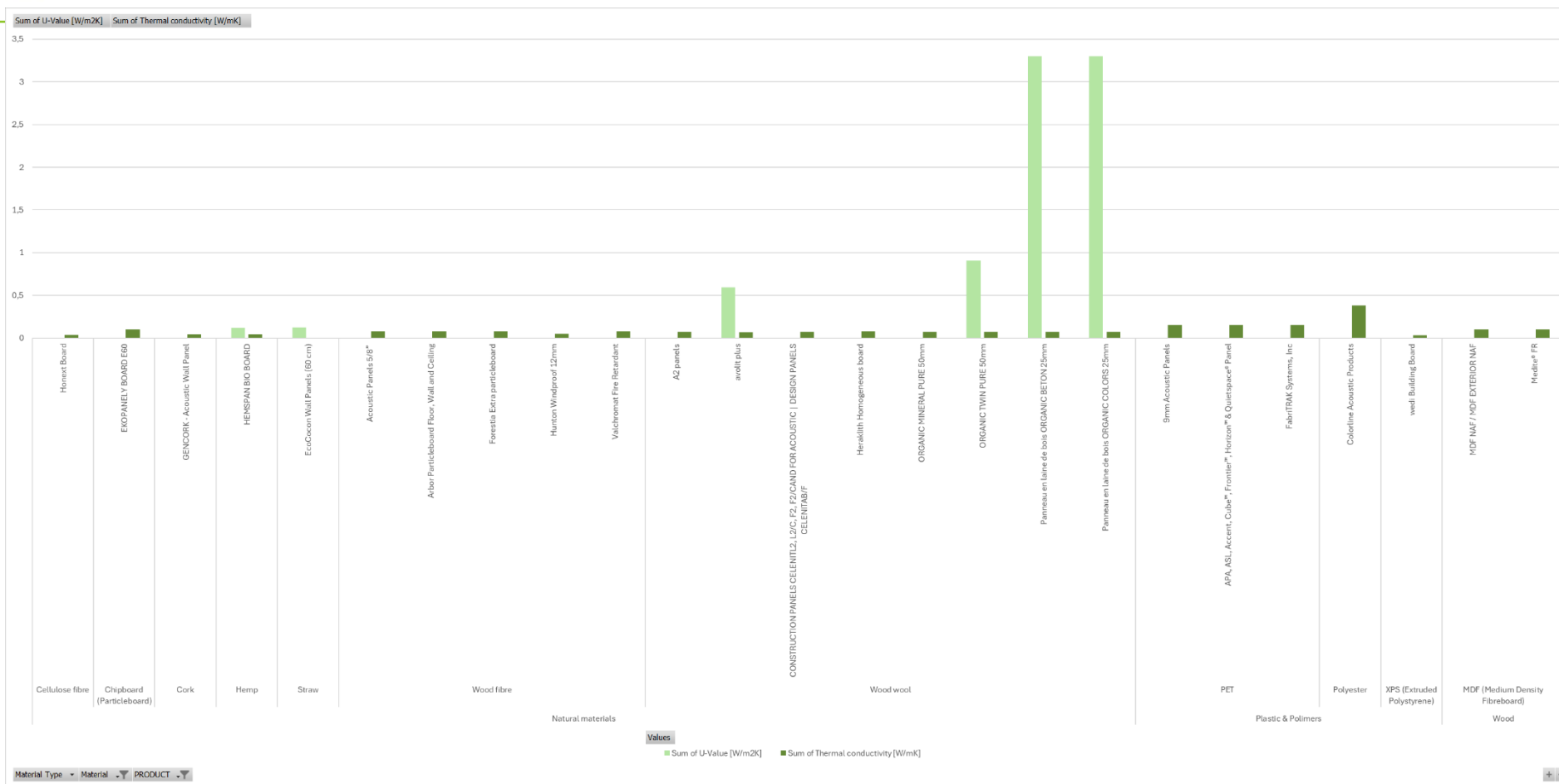
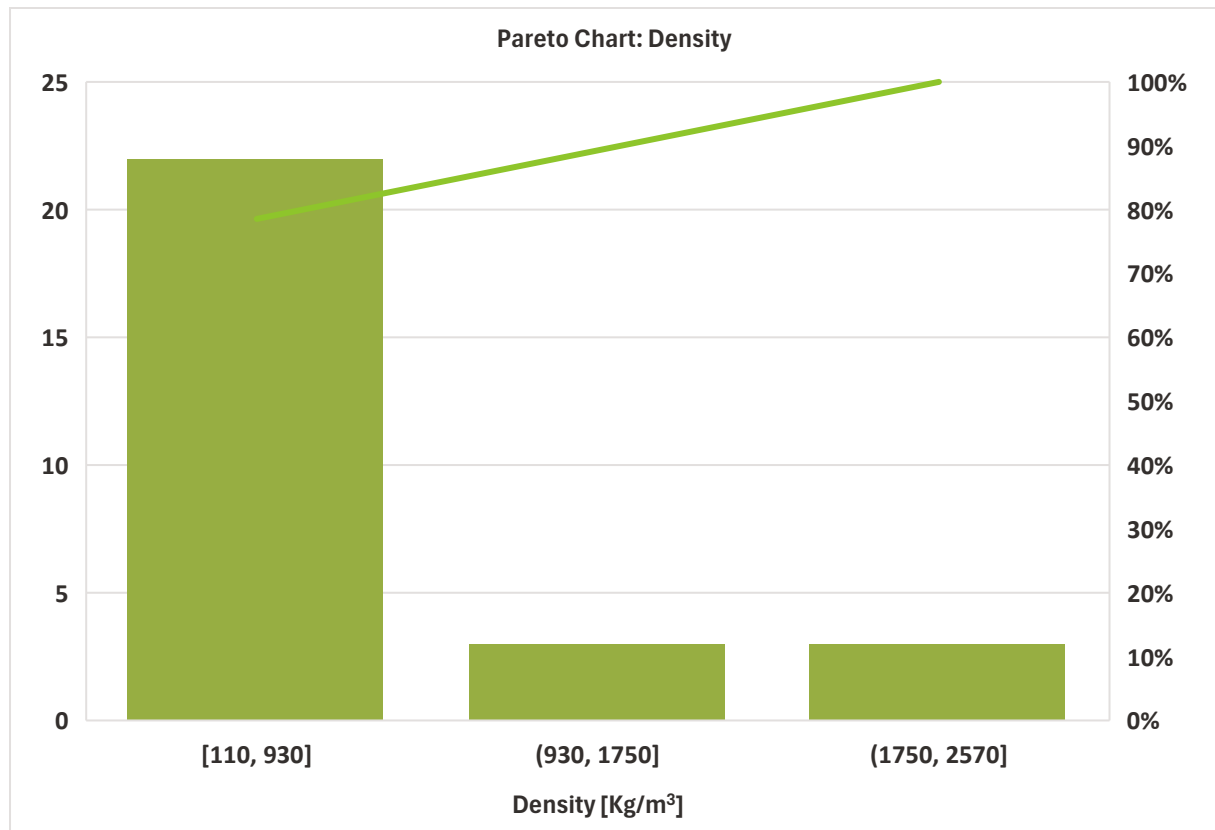


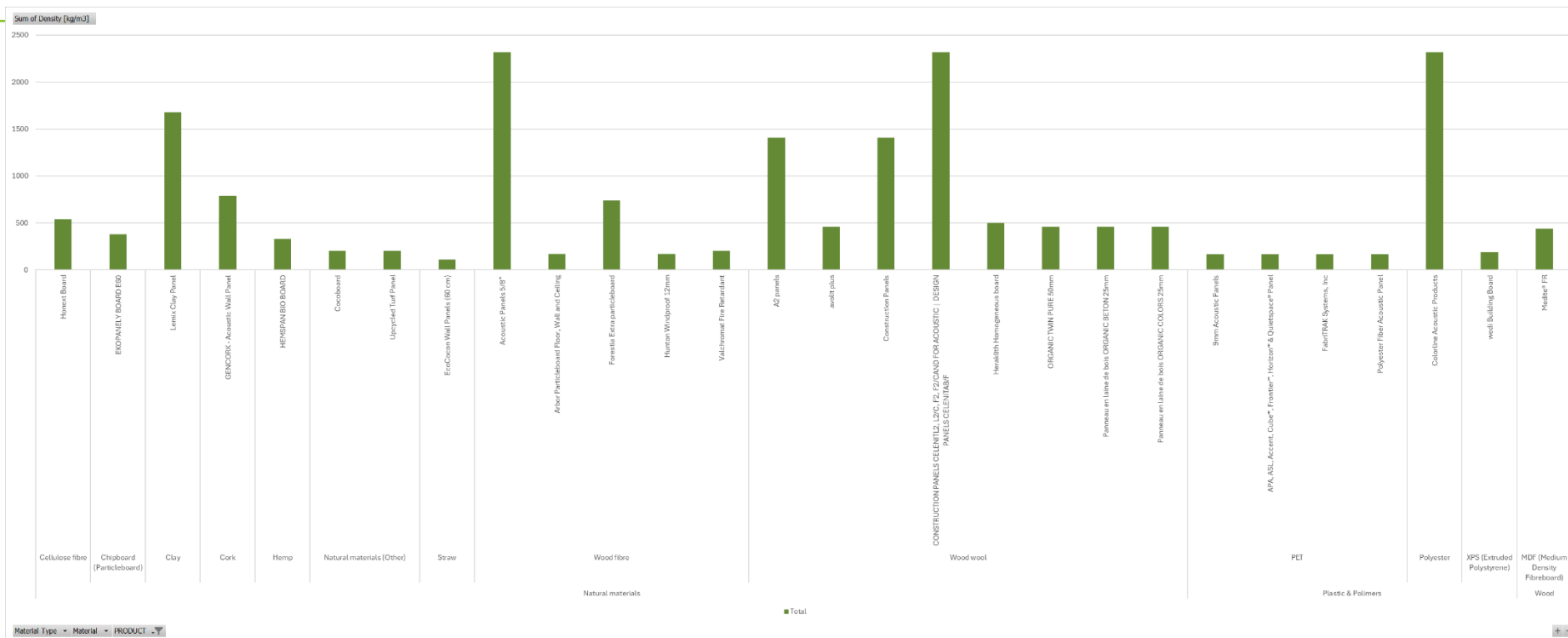
Figure 17- Disaggregated U-values and thermal conductivity, building boards

#### 4.3.2.2 Density [kg/m<sup>3</sup>]



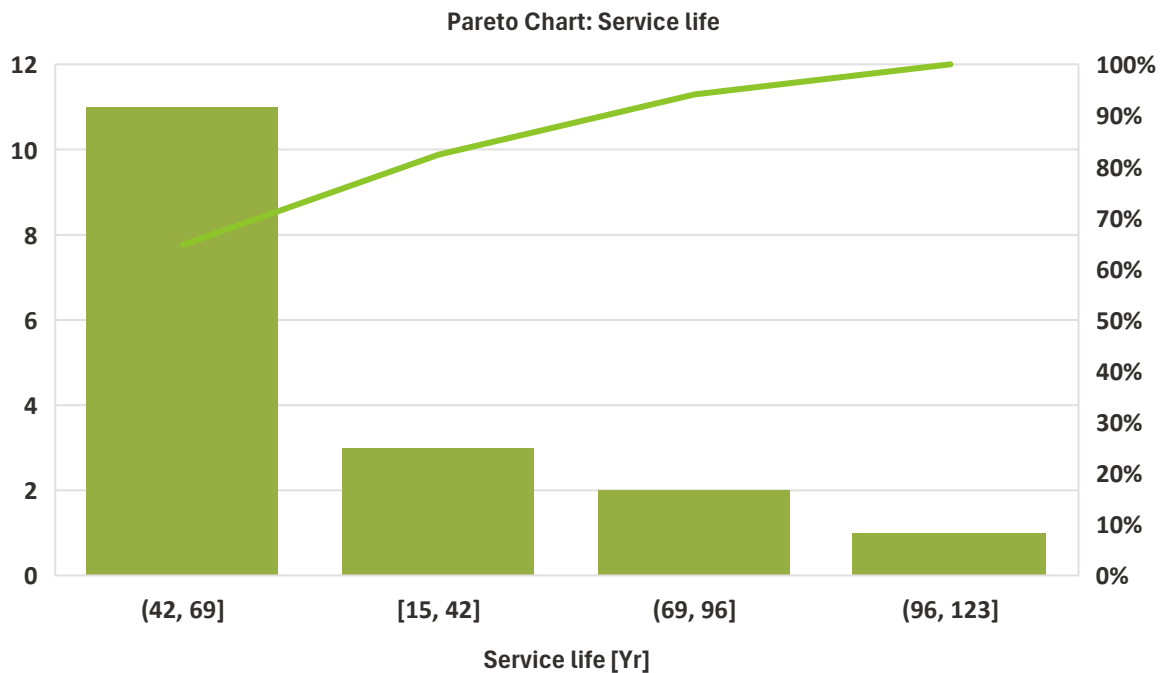
**Figure 18-** Pareto Chart: Density, building boards

The table below disaggregates these results among the products listed so far in building boards where KPIs on density are available. Higher density offers better thermal mass but may be more difficult to handle. Apart from certain exceptions, natural materials are able to offer higher densities than synthetic materials. Moreover, some natural materials such as wood fiber covering a larger spectrum depending on build and product.



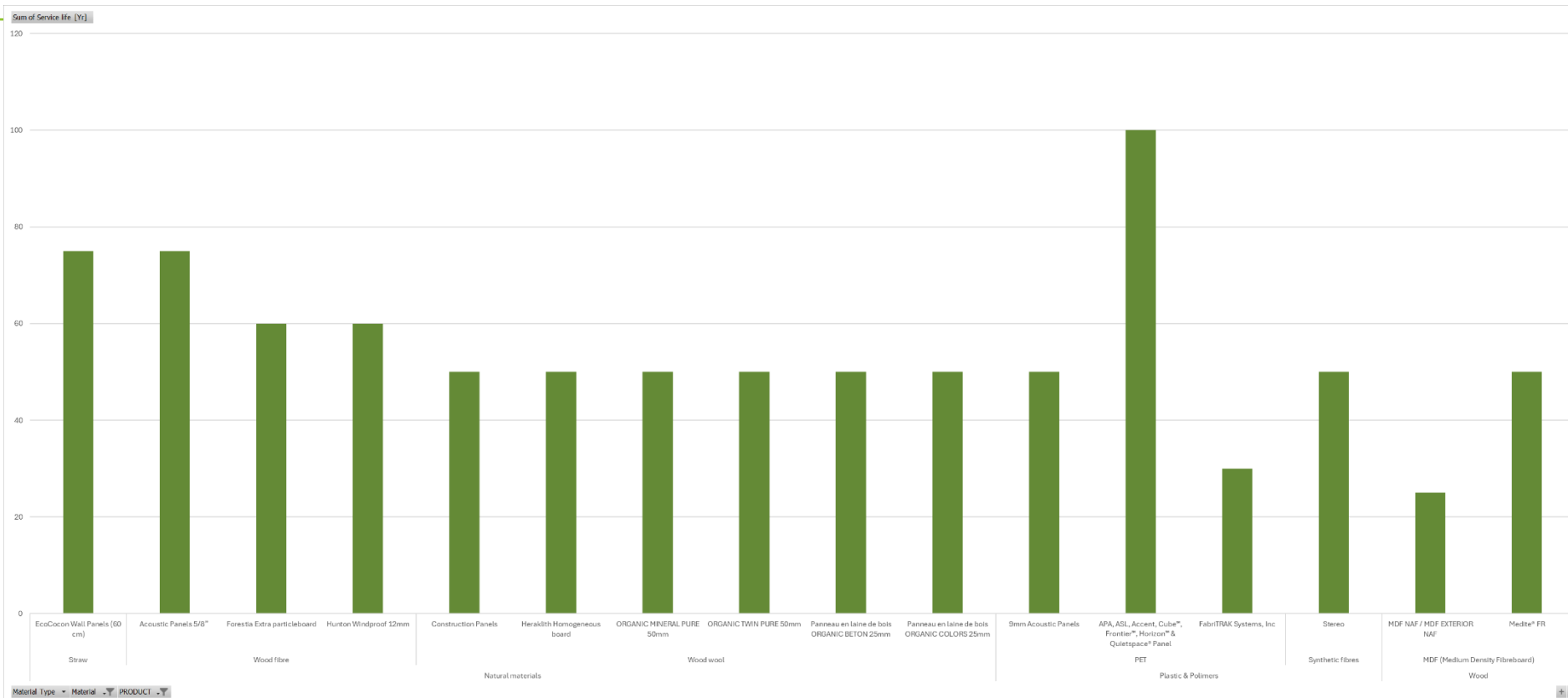
**Figure 19-** Disaggregated density, building boards

#### 4.3.2.3 Service Life [Yr]



**Figure 20-** Pareto Chart: Service life, building boards

The table below disaggregates these results among the products listed so far in building boards where KPIs on service life are available. Natural materials are often more prone to moisture which can lead to deterioration if not treated. Nevertheless, when treated and sealed well, natural materials offer fantastic durability on par or above with synthetic materials. The market seems to be moving at a 40 to 80 year interval for service life.



**Figure 21- Disaggregated service life, building boards**

### 4.3.3 Overview of qualitative characteristics of materials

Contrary to insulation, building boards and systems are more uniform in their KPIs with only slight differences for certain specific products and materials except in density which indicates more adaptability towards structural strength.

Nevertheless, the materials still differentiate themselves along other a different set of criteria and metrics as presented in the comparative table below.

**Table 6-** Building boards material overview

| Material                                              | Structural Strength & Durability    | Moisture Resistance                               | Fire Resistance                     | Thermal & Acoustic Insulation                      | Cost        | Best Use                                                      |
|-------------------------------------------------------|-------------------------------------|---------------------------------------------------|-------------------------------------|----------------------------------------------------|-------------|---------------------------------------------------------------|
| <b>Chipboard (Particleboard)</b>                      | Low (not suitable for load-bearing) | Low (swells when wet)                             | Low                                 | Moderate sound insulation, poor thermal insulation | Low         | Interior non-load-bearing walls, furniture, flooring underlay |
| <b>MDF (Medium Density Fibreboard)</b>                | Moderate (stronger than chipboard)  | Low (MR-MDF available)                            | Moderate (fire-rated MDF available) | Good sound insulation, moderate thermal insulation | Mid         | Interior wall panels, partitions, furniture                   |
| <b>Wood Fibre Board</b>                               | Moderate (depends on density)       | Low to moderate (some treated versions available) | Moderate (can be treated)           | Good sound and thermal insulation                  | Mid         | Insulation panels, eco-friendly wall sheathing                |
| <b>Natural Fibres (Flax, Jute, Kenaf, Coir, etc.)</b> | Moderate (depends on binder used)   | Moderate (can be mold-resistant)                  | Low (unless treated)                | Good sound and thermal insulation                  | Mid to high | Bio-composite wall panels, insulation boards                  |
| <b>Cork Board</b>                                     | Moderate (soft but durable)         | High (naturally moisture-resistant)               | Moderate (self-extinguishing)       | Excellent thermal and acoustic insulation          | High        | Wall insulation, flooring, acoustic panels                    |
| <b>Hemp Board</b>                                     | Moderate to high                    | High (resistant to)                               | High (naturally)                    | Excellent thermal                                  | Mid to high | Sustainable wall                                              |

## D5.4

| Material                                            | Structural Strength & Durability               | Moisture Resistance                          | Fire Resistance                              | Thermal & Acoustic Insulation                           | Cost        | Best Use                                                       |
|-----------------------------------------------------|------------------------------------------------|----------------------------------------------|----------------------------------------------|---------------------------------------------------------|-------------|----------------------------------------------------------------|
|                                                     | (stronger than MDF)                            | mold and mildew)                             | flame-resistant)                             | and acoustic insulation                                 |             | panels, insulation, partitions                                 |
| <b>Cellulose Fibre Board (Recycled Paper-based)</b> | Moderate (treated versions improve durability) | Low (requires sealing)                       | Moderate (fire-resistant coatings available) | Excellent thermal insulation, good acoustic insulation  | Mid         | Thermal insulation panels, eco-friendly wall sheathing         |
| <b>Straw Board</b>                                  | Moderate (compressed straw improves strength)  | Low to moderate (treated versions available) | Moderate                                     | Good sound and thermal insulation                       | Low to mid  | Sustainable wall panels, non-load-bearing partitions           |
| <b>Clay Board (Clay-Infused Fibre Panels)</b>       | Brittle (but long-lasting)                     | High (naturally regulates humidity)          | Excellent                                    | High thermal mass, moderate insulation                  | High        | Eco-friendly wall panels, thermal regulation in passive houses |
| <b>PET Board (Recycled Plastic Panels)</b>          | High (impact-resistant)                        | Excellent (waterproof)                       | Low (unless treated)                         | Moderate                                                | Mid to high | Cladding, insulation panels, durable wall linings              |
| <b>Polyester Board</b>                              | Flexible and durable                           | Excellent                                    | Low                                          | Excellent sound insulation                              | Mid         | Acoustic panels, lightweight partitions                        |
| <b>XPS (Extruded Polystyrene)</b>                   | High (rigid, compressive strength)             | Excellent (fully waterproof)                 | Low (unless treated)                         | Excellent thermal insulation, moderate sound insulation | Mid to high | Wall insulation, under-slab insulation, foundation insulation  |

For structural or load-bearing applications in construction, Hemp Board, Clay Board, and XPS (Extruded Polystyrene) are the most suitable materials. Hemp Board offers high strength and durability while also being sustainable. Clay Board provides excellent stability and long-term performance, particularly in eco-friendly and passive building designs. XPS, although not typically structural on its own, is highly compressive and can support loads in applications such as foundation insulation and flooring systems. When selecting materials for areas exposed to high humidity or water, Cork, Hemp, PET (Recycled Plastic Panels), and XPS are excellent choices. Cork is naturally moisture-resistant and helps prevent mold growth, making it ideal for humid environments. Hemp Board resists mold and mildew while providing insulation benefits. PET panels are waterproof, durable, and often used in cladding or insulation applications. XPS is one of the most water-resistant materials available, making it perfect for below-grade insulation, basements, and exterior applications.

For fire-resistant construction, Clay Board, Hemp Board, and fire-treated MDF or Cellulose Fibre Board are the top options. Clay Board is inherently fire-resistant due to its mineral composition, making it an excellent choice for passive fire protection in walls and ceilings. Hemp Board naturally resists flames and can be used in fire-rated partitions. Additionally, MDF and Cellulose Fibre Board can be treated with fire-retardant coatings to enhance their fire resistance for use in interior applications.

If thermal insulation is a priority, Cork, XPS, Cellulose Fibre, and Hemp Board provide the best performance. Cork is an exceptional natural insulator that also regulates indoor temperature and humidity. XPS offers excellent thermal resistance (high R-value) and is widely used for insulating walls, roofs, and foundations. Cellulose Fibre Board is made from recycled paper and provides sustainable and effective insulation. Hemp Board is another environmentally friendly option that delivers high thermal efficiency while also being breathable, reducing the risk of condensation.

For soundproofing applications, Cork, Polyester Board, Cellulose Fibre, and MDF are highly effective. Cork has superior sound absorption properties, making it an excellent choice for flooring and wall insulation. Polyester Board is widely used in acoustic panels for offices and theaters due to its lightweight and high sound-dampening ability. Cellulose Fibre Board provides both thermal and acoustic insulation benefits, making it suitable for eco-friendly construction. MDF, with its high density, is commonly used for doors and wall panels to reduce noise transmission between rooms.

For sustainable and environmentally friendly construction, Hemp Board, Straw Board, Clay Board, Cellulose Fibre Board, and Cork are the best choices. Hemp Board is biodegradable, renewable, and offers excellent insulation properties. Straw Board is an affordable and sustainable option made from agricultural byproducts, reducing waste. Clay Board is a natural and non-toxic material that enhances indoor air quality while providing fire resistance. Cellulose Fibre Board, made from recycled paper, is both energy-efficient and environmentally responsible. Cork is another sustainable option as it is harvested from trees without harming them, making it a renewable and durable building material.

## 4.4 Specific KERs to be evaluated

In the very early stage of the project seven key exploitable results have been identified as the project went forward some of them have been experimented some changes (responsible, technical configuration). This section is devoted to update the following table accordingly.

**Table 7-** Updated KERs list

| # | KERs                                                   | Involved Partners |
|---|--------------------------------------------------------|-------------------|
| 1 | Renewable Posidonia bio-based core panel and fibers    | SOPHIA/Starcell   |
| 2 | Development of Polyelectrolyte complex (PECs) coatings | AIMPLAS           |

|   |                                                                                                                                 |         |
|---|---------------------------------------------------------------------------------------------------------------------------------|---------|
| 3 | Modified PLA form                                                                                                               | AIMPLAS |
| 4 | BIO Polyurethane foams                                                                                                          | INDRE   |
| 5 | BIO Polyurethane foams for high performance windows                                                                             | INDRE   |
| 6 | Prefabricated building envelope integrating new materials for enhancing prefabricated of construction and renovation components | GOYER   |
| 7 | BIO4EEB platform                                                                                                                | R2M     |

#### 4.4.1 Renewable Posidonia bio-based core panel and fibers (60% Rice straw+40% Posidonia)

A completely unexpected problem occurred: the type of Posidonia received is completely different from that collected to produce the samples for formulation setting and development activities at the beginning. Posidonia consists of short and very chopped leaves instead of long leaves we generally collected during the development phases of the panel product. Long leaves are fundamental to give stability, compactness and the correct density to the panel. In fact, Long Posidonia leaves can intertwine with each other during the formation of the panels allows for a compact, low-density panel with air voids inside which ensure a low thermal conductivity value.



60% Rice Straw + 40 % Posidonia panels

The idea is to use rice straw as an additive inside the panel and mix it with Posidonia. Rice straw is a waste product of the rice production process and is made up of long, thin fibers (like Posidonia leaves in optimal conditions). The presence of long fibers allows to get a stable, compact and low-density panel with good thermal characteristics. In this way, it can still achieve the objective of creating a bio-based insulation panel by valorizing Posidonia. Furthermore, the use of rice straw allows to maintain bio-based characteristics of the panel and reuse a waste substance. The thermal conductivity values have the same trend as those obtained with full Posidonia panels. The average values are higher than 5%.

#### 4.4.2 Development of polyelectrolyte complex (PECs) coatings

In BIO4EEB, bio-based phosphorous nitrogen polyelectrolyte complexes (PECs) based in chitosan and phytic acid will be used as innovative intumescent additive for coatings for solvent-free production of bio-based products. PEC will be synthesized according to AIMPLAS' innovative process at pre-industrial level. Such obtained PEC will be incorporated in bio-based resins to produce bio-based coatings for they to be applied on isolating panels.

#### 4.4.3 Modified PLA foams

Several innovations will be addressed in the project related with PLA foams. BIO4EEB will develop innovative formulations by combining i) several blowing agents in the framework of more sustainable systems including SCO<sub>2</sub> and biobased chain extenders, ii) tailor-made plasticizers based on biobased oligomers such as lactic acid among others, iii) biobased polyols based on lactide for polyurethane and

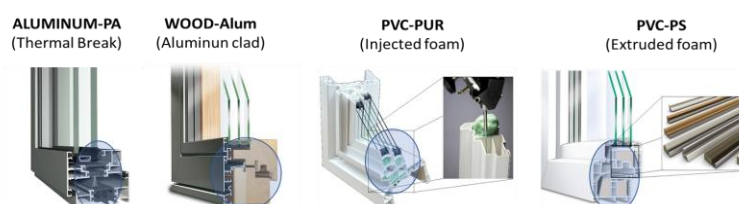
biobased isocyanates, and iv) flame retardants such as DOPPO and derivatives whose production will be evaluated by novel environmentally favourable strategies avoiding the use of chlorinated compounds.

#### 4.4.4 BIO polyurethane foams

The main novelty of these foams is the use of a disruptive chemical composition in one of the two major components of PUR so called isocyanates. The use of aliphatic isocyanates - widely used in paints industry, despite being more expensive, allows SAFE-PUR to show a much safer fire behaviour when burning, even without using fire retardants. These isocyanates have never been tested as insulating PUR foams due to a limited number of available polyols the other main component of PUR materials that are appropriate to produce SAFE-PUR foams. Consequently, these foams were not used before for insulation purposes while PUR industry has focused on the production of Aluminum-PUR multilayer panels and using retardants to mitigate flammability. Another key feature is the use of water as self-foaming agent instead of toxic CFC volatile compounds. Water reacts with isocyanates releasing small amounts of CO<sub>2</sub> gas, thus leading to a microcellular structure. The self-foaming property of PUR allows an exclusive property: the easiness-to-control of the foaming process. SAFE-PUR has shown to provide the following results: reduction of flammability (>70%), decrease of fire propagation (>30%), reduction of the smoke emission (>80%) and significantly lower smoke toxicity (>90%), thus allowing to reduce the impact on fatalities and intoxications while increasing of the response time for firefighters, as well as lowering the economic impact & damages produced in architectural structures. Within BIO4EEB, the patented SAFE-PUR formulation will be adapted to ensure the optimum thermal and acoustic insulation, as well as improving its passive fire safety (through commercial fire retardant ensuring an A2 classification. Moreover, the sprayable process will be optimized to ensure a fast installation in a real environment

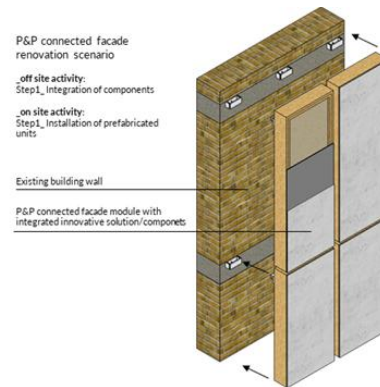
#### 4.4.5 BIO polyurethane foams for high performance windows

While INDRE has just launched to the market the petrol-based KLIMA-PUR windows with a thermal transmittance of 0.8W/m<sup>2</sup>K, through BIO4EEB, a new lab-developed formulation (TRL-5) with 20-30% biobased raw material and 20-30% of recycled content will be integrated in a pilot-plant production scale, including an improvement in density reduction that will lead to higher thermal insulation (with a thermal transmittance of 0.7W/m<sup>2</sup>K) to be implemented in real environment after prototypes certification.



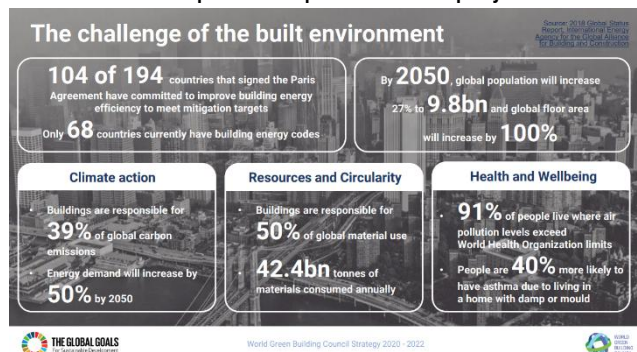
#### 4.4.6 Prefabricated building envelope integrating new materials for enhancing prefabricated of construction and renovation components

The innovation brought by the BIO4EEB façade is the technical optimization of façade system in terms of thickness and cost, starting from the previous experience. The BIO4EEB prefabricated building envelope will integrate the beforementioned new materials developed within the Bio4EEB project in one single solution which permits to reduce the carbon footprint of the façade as well as the energy consumption required for the product. In addition, the prefabrication allows to reduce the installation activities with the consequences of time and number of actors in the construction site and to increase the quality value of the building façade.



#### 4.4.7 BIO4EEB platform

The BIO4EEB platform represents the open-source, user-friendly knowledge and practice hub for the bio-based insulation products proven in the project and their operative employment in EU residential buildings.



Thanks to this project, for the first time the platform features several functions: based on a repository consisting of technical, energy and sustainability (LCA) performance characteristics for each product (alone and in relation to collected data from BIO4EEB real case demo sites), the innovative products are also featured on virtual, market-ready demo sites (exemplary of existing residential building models); a collection of good practices derived from public and private initiatives; an area for

end-users where they can digitally play and visualize how the insulation products can be used on new envelopes of residential buildings; a section focused on the synergies with benchmark bio-based, sustainable insulation products coming from the Colombian and Latin American Construction Markets.

## 5 Conclusion

This deliverable has enabled established preliminary elements of market analysis for biobased material building markets and foundations for future work that will be produced in all Work Package 5 deliverables as detailed below in next steps.

Regarding the **market analysis**, it concludes that bio-based products, while environmentally advantageous and growing in use, remain a marginal market in construction. Wood dominates bio-based materials, though other feedstocks like hemp and flax are gaining traction, especially in insulation. Despite their better environmental performance compared to fossil-based materials, bio-based products face low cost-competitiveness, hindering broader adoption.

The biomass resource is finite and under strong competition from the bioenergy sector, limiting bio-based materials to a supporting role in renovation efforts.

In section 4, a comprehensive construction product listing with most relevant to BIO4EEB products have been produced to systematically evaluate the state of the art in construction materials, components, and technologies (**see Annex**). This database, currently in its preliminary form, will evolve and be updated throughout the course of the project in the next deliverable iterations to reflect ongoing research findings, advancements in technology, and newly identified materials. The primary objective of this database is to provide a structured assessment of materials and systems from the perspective of their performance characteristics and functional features. By maintaining a dynamic and detailed record, the database will enable the project team to benchmark and analyse products, thereby facilitating informed decision-making.

### Next steps

The next step will focus on an update on all the initial market observations that have been provided in order to account for potential new competitors, unexpected dips in the market, or new regulations. Moreover, one of the key outputs of this is providing a more detailed competitor assessment. Since the project results and innovations will be at a more mature development stage, the consortium will provide a detailed analysis of competitors and the technical features of their products and be able to assess the potential strengths and weaknesses of BIO4EEB KERs with respect to these products. This will later provide key insights on the positioning of BIO4EEB within its respective markets in order to establish effective business strategies and relevant operational structures that will be contained in the BIO4EEB business plan for the commercialization of project results.



# Annexes

| PICTURE | PRODUCT                                                                            | DESCRIPTION                                                                                                                                                                                                                                                                                                         | TECHNICAL SPECIFICATIONS |                             |                   |                 |            | PRODUCT TYPE    | MATERIAL                   | APPLICATION                | COMPANY                                           | BUILDING TYPE                           | PERFORMAN                                                                                                                                                                                         | PRODUCT CERTIFICATES                                                                                                                                                                                      | ICE RANGE (°C)                                                                                                                                                                    | DATA SHEET                                                               | WEBSITE                                                                  |                                                        |
|---------|------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|-----------------------------|-------------------|-----------------|------------|-----------------|----------------------------|----------------------------|---------------------------------------------------|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|--------------------------------------------------------------------------|--------------------------------------------------------|
|         |                                                                                    |                                                                                                                                                                                                                                                                                                                     | U-Value (W/m²K)          | Thermal conductivity (W/mK) | Service life (Yr) | Density (kg/m³) | Guarantee  |                 |                            |                            |                                                   |                                         |                                                                                                                                                                                                   |                                                                                                                                                                                                           |                                                                                                                                                                                   |                                                                          |                                                                          |                                                        |
|         | Indobond hemp core rigid insulation board                                          | Made from UK crops are carbon negative, reproducible and result in zero waste. Durable & healthy for installers, perfect fit for easy install. Indobond provides passive regulation of temperature & humidity, and is vapour insulation for indoor comfort & health.                                                | 0.41                     | 0.041                       | 60                | 145             | 74.5 kg/m³ | Insulation      | Insulation (Thermal)       | Hemp                       | INDOBOND                                          | Residential Commercial Other            | EUROCLASS E<br>EN 12938 PASS                                                                                                                                                                      | <a href="https://www.indobond.co.uk/wp-content/uploads/2021/06/Indobond-Technical-Data-Sheet.pdf">https://www.indobond.co.uk/wp-content/uploads/2021/06/Indobond-Technical-Data-Sheet.pdf</a>             | -                                                                                                                                                                                 | <a href="https://www.indobond.co.uk/">www.indobond.co.uk</a>             | <a href="https://www.indobond.co.uk/">www.indobond.co.uk</a>             |                                                        |
|         | Indobond hemp insulation batts                                                     | Indobond hemp insulation batts, made from UK crops are carbon negative, reproducible and result in zero waste. Durable & healthy for installers, perfect fit for easy install. Indobond provides passive regulation of temperature & humidity, and is vapour insulation for indoor comfort & health.                | 0.2-0.4                  | 0.04                        | 60                | 45              | 74.5 kg/m³ | Insulation      | Insulation (Thermal)       | Hemp                       | INDOBOND                                          | Residential Commercial Industrial       | EUROCLASS E<br>EN 12938 PASS                                                                                                                                                                      | <a href="https://www.indobond.co.uk/wp-content/uploads/2021/06/Indobond-Technical-Data-Sheet.pdf">https://www.indobond.co.uk/wp-content/uploads/2021/06/Indobond-Technical-Data-Sheet.pdf</a>             | -                                                                                                                                                                                 | <a href="https://www.indobond.co.uk/">www.indobond.co.uk</a>             | <a href="https://www.indobond.co.uk/">www.indobond.co.uk</a>             |                                                        |
|         | This insulation panel (set of 10)                                                  | This panel was designed to simply be used between two walls. However, we have seen people putting it between two glass layers as they still wanted to see the beautiful mushroom texture. This insulation panel (set of 10) is made from hemp and is suitable for use in a variety of applications.                 |                          |                             |                   | 115             |            | Insulation      | Insulation (Thermal)       | Mycelium                   | GROWN/BO                                          | Residential Commercial Other            | <a href="https://www.grownbo.co.uk/wp-content/uploads/2021/06/GROWNBO-Technical-Data-Sheet.pdf">https://www.grownbo.co.uk/wp-content/uploads/2021/06/GROWNBO-Technical-Data-Sheet.pdf</a>         | 650-20                                                                                                                                                                                                    | <a href="https://www.grownbo.co.uk/">www.grownbo.co.uk</a>                                                                                                                        | <a href="https://www.grownbo.co.uk/">www.grownbo.co.uk</a>               |                                                                          |                                                        |
|         | Insulation panel (set of 10)                                                       | The material properties of insulation made in very suitable for insulation. This panel is made to be simply used between two walls. We have even seen people putting it between two glass layers to be able to keep seeing its beautiful mushroom texture                                                           |                          |                             |                   | 115             |            | Insulation      | Insulation (Thermal)       | Mycelium                   | GROWN/BO                                          | Residential Commercial Other            | <a href="https://www.grownbo.co.uk/wp-content/uploads/2021/06/GROWNBO-Technical-Data-Sheet.pdf">https://www.grownbo.co.uk/wp-content/uploads/2021/06/GROWNBO-Technical-Data-Sheet.pdf</a>         | 670-00                                                                                                                                                                                                    | <a href="https://www.grownbo.co.uk/">www.grownbo.co.uk</a>                                                                                                                        | <a href="https://www.grownbo.co.uk/">www.grownbo.co.uk</a>               |                                                                          |                                                        |
|         | Square panel (medium)                                                              | This is a sample to a great way to experience the organic texture and natural appearance of organic material. It offers a material for testing, designing, or building with insulation materials                                                                                                                    |                          |                             |                   | 115             |            | Insulation      | Insulation (Thermal)       | Mycelium                   | GROWN/BO                                          | Residential Commercial Other            | <a href="https://www.grownbo.co.uk/wp-content/uploads/2021/06/GROWNBO-Technical-Data-Sheet.pdf">https://www.grownbo.co.uk/wp-content/uploads/2021/06/GROWNBO-Technical-Data-Sheet.pdf</a>         | 817.50 - 030.00                                                                                                                                                                                           | <a href="https://www.grownbo.co.uk/">www.grownbo.co.uk</a>                                                                                                                        | <a href="https://www.grownbo.co.uk/">www.grownbo.co.uk</a>               |                                                                          |                                                        |
|         | Rectangular panel (medium)                                                         | This mycelium panel is in between our smaller panels and our larger insulation panels. It is very suitable to experiment or built with our mycelium material.                                                                                                                                                       |                          |                             |                   | 115             |            | Insulation      | Insulation (Thermal)       | Mycelium                   | GROWN/BO                                          | Residential Commercial Other            | <a href="https://www.grownbo.co.uk/wp-content/uploads/2021/06/GROWNBO-Technical-Data-Sheet.pdf">https://www.grownbo.co.uk/wp-content/uploads/2021/06/GROWNBO-Technical-Data-Sheet.pdf</a>         | 642.55                                                                                                                                                                                                    | <a href="https://www.grownbo.co.uk/">www.grownbo.co.uk</a>                                                                                                                        | <a href="https://www.grownbo.co.uk/">www.grownbo.co.uk</a>               |                                                                          |                                                        |
|         | FAVADRY (52mm, 72mm, 102mm)                                                        | Products are breathable panel-shaped heat insulation materials for buildings in accordance with EN 12171. The panels are produced in a so-called dry process. Wooden fibres gained from forest chips are glued with a resin adhesive and pressed into panels.                                                       |                          | 0.044                       |                   | 220             |            | Insulation      | Insulation (Thermal)       | Wood fibre                 | SOPHIA/UK LIMITED                                 | Residential Commercial                  | <a href="https://www.sophia.co.uk/wp-content/uploads/2021/06/SOPHIA-Technical-Data-Sheet.pdf">https://www.sophia.co.uk/wp-content/uploads/2021/06/SOPHIA-Technical-Data-Sheet.pdf</a>             |                                                                                                                                                                                                           | <a href="https://www.sophia.co.uk/">www.sophia.co.uk</a>                                                                                                                          | <a href="https://www.sophia.co.uk/">www.sophia.co.uk</a>                 |                                                                          |                                                        |
|         | SOLAR MULTI (200mm, 250mm, 300mm, 350mm)                                           | Breathable panel shaped heat insulation materials for buildings in accordance with EN 12171. The panels are produced in a dry process. Wooden fibres gained from forest chips are glued with a resin adhesive and pressed into panels.                                                                              |                          | 0.044                       |                   | 10              | 200        | Insulation      | Insulation (Thermal)       | Wood fibre                 | SOPHIA/UK LIMITED                                 | Residential Commercial                  | E                                                                                                                                                                                                 | <a href="https://www.sophia.co.uk/wp-content/uploads/2021/06/SOPHIA-Technical-Data-Sheet.pdf">https://www.sophia.co.uk/wp-content/uploads/2021/06/SOPHIA-Technical-Data-Sheet.pdf</a>                     |                                                                                                                                                                                   | <a href="https://www.sophia.co.uk/">www.sophia.co.uk</a>                 | <a href="https://www.sophia.co.uk/">www.sophia.co.uk</a>                 |                                                        |
|         | Hempcrete (40mm, 240mm, 120 kg/m³)                                                 | RECYCLED WOODEN FIBRE INSULATION PRODUCTS are breathable panel shaped heat insulation materials for buildings in accordance with EN 12171. The panels are produced in a so-called dry process. Wooden fibres gained from forest chips are glued with a resin adhesive and pressed into panels.                      |                          | 0.038                       |                   | 200             |            | Insulation      | Insulation (Thermal)       | Wood fibre                 | SOPHIA/UK LIMITED                                 | Residential Commercial                  | E                                                                                                                                                                                                 | <a href="https://www.sophia.co.uk/wp-content/uploads/2021/06/SOPHIA-Technical-Data-Sheet.pdf">https://www.sophia.co.uk/wp-content/uploads/2021/06/SOPHIA-Technical-Data-Sheet.pdf</a>                     |                                                                                                                                                                                   | <a href="https://www.sophia.co.uk/">www.sophia.co.uk</a>                 | <a href="https://www.sophia.co.uk/">www.sophia.co.uk</a>                 |                                                        |
|         | Strawbale                                                                          | Breathable panel shaped heat insulation materials for buildings in accordance with EN 12171. The panels are produced in a so-called dry process. Wooden fibres gained from forest chips are glued with a resin adhesive and pressed into panels.                                                                    |                          | 0.36                        |                   | 30              |            | Insulation      | Insulation (Thermal)       | Wood                       | DISALTECH LTD                                     | Residential Commercial Industrial Other | <a href="https://www.disaltech.co.uk/wp-content/uploads/2021/06/Disaltech-Technical-Data-Sheet.pdf">https://www.disaltech.co.uk/wp-content/uploads/2021/06/Disaltech-Technical-Data-Sheet.pdf</a> |                                                                                                                                                                                                           | <a href="https://www.disaltech.co.uk/">www.disaltech.co.uk</a>                                                                                                                    | <a href="https://www.disaltech.co.uk/">www.disaltech.co.uk</a>           |                                                                          |                                                        |
|         | Granthem 100 mm                                                                    | Granthem is a high performance, sustainable, and healthy insulation material. It is made from natural materials and is suitable for use in a variety of applications. It offers a material for testing, designing, or building with insulation materials.                                                           |                          | 0.04                        |                   | 50              | 40         | Insulation      | Insulation (Thermal)       | Natural fibres (Other)     | GRANTHEM EUROPE SA                                | Residential Commercial Other            | EUROCLASS E                                                                                                                                                                                       | <a href="https://www.granthem.co.uk/wp-content/uploads/2021/06/Granthem-Technical-Data-Sheet.pdf">https://www.granthem.co.uk/wp-content/uploads/2021/06/Granthem-Technical-Data-Sheet.pdf</a>             |                                                                                                                                                                                   | <a href="https://www.granthem.co.uk/">www.granthem.co.uk</a>             | <a href="https://www.granthem.co.uk/">www.granthem.co.uk</a>             |                                                        |
|         | Thermo Hemp Impact sound insulation                                                | This hemp felt and strips for sound decoupling of floating floors, between joint layers and between partition walls and adjacent building components.                                                                                                                                                               |                          |                             |                   | 330             | 74.5       | Insulation      | Insulation (Thermal)       | Hemp                       | THEWOO HEMP                                       | Residential Commercial                  | Z, CLASS E/PL                                                                                                                                                                                     | <a href="https://www.thewoo.co.uk/wp-content/uploads/2021/06/TheWoo-Technical-Data-Sheet.pdf">https://www.thewoo.co.uk/wp-content/uploads/2021/06/TheWoo-Technical-Data-Sheet.pdf</a>                     |                                                                                                                                                                                   | <a href="https://www.thewoo.co.uk/">www.thewoo.co.uk</a>                 | <a href="https://www.thewoo.co.uk/">www.thewoo.co.uk</a>                 |                                                        |
|         | Thermo Hemp Stuffing wool                                                          | Hemp fibres for filling joints, ideal for uneven or hard-to-reach corners and complex surfaces. Contains: 100% loose hemp fibres. Facts: ✓ Free from pollutants ✓ Extremely durable ✓ Excellent humidity absorption ✓ Very good heat and cold protection.                                                           |                          |                             |                   | 330             | 74.5       | Insulation      | Insulation (Thermal)       | Hemp                       | THEWOO HEMP                                       | Residential Commercial                  |                                                                                                                                                                                                   | <a href="https://www.thewoo.co.uk/wp-content/uploads/2021/06/TheWoo-Technical-Data-Sheet.pdf">https://www.thewoo.co.uk/wp-content/uploads/2021/06/TheWoo-Technical-Data-Sheet.pdf</a>                     |                                                                                                                                                                                   | <a href="https://www.thewoo.co.uk/">www.thewoo.co.uk</a>                 | <a href="https://www.thewoo.co.uk/">www.thewoo.co.uk</a>                 |                                                        |
|         | Thermo Hemp Cordless insulation                                                    | Contains: 50% hemp fibres, 50% recycled jute fibres. It is a high performance, sustainable, and healthy insulation material. It is made from natural materials and is suitable for use in a variety of applications. It offers a material for testing, designing, or building with insulation materials.            |                          | 0.039-0.043                 |                   | 330             | 74.5       | Insulation      | Insulation (Thermal)       | Hemp                       | THEWOO HEMP                                       | Residential Commercial                  | E                                                                                                                                                                                                 | <a href="https://www.thewoo.co.uk/wp-content/uploads/2021/06/TheWoo-Technical-Data-Sheet.pdf">https://www.thewoo.co.uk/wp-content/uploads/2021/06/TheWoo-Technical-Data-Sheet.pdf</a>                     |                                                                                                                                                                                   | <a href="https://www.thewoo.co.uk/">www.thewoo.co.uk</a>                 | <a href="https://www.thewoo.co.uk/">www.thewoo.co.uk</a>                 |                                                        |
|         | Huntion Silence Insulation                                                         | Huntion Silence has been developed to be the market's best sound insulating floor insulation, ideal for parapet and laminate floors etc.                                                                                                                                                                            |                          | 0.01                        |                   | 250             | 9          | Insulation      | Insulation (Thermal)       | Natural materials          | HUNTION FIBER AS                                  | Residential Commercial Industrial Other | E                                                                                                                                                                                                 | <a href="https://www.huntion.co.uk/wp-content/uploads/2021/06/Huntion-Technical-Data-Sheet.pdf">https://www.huntion.co.uk/wp-content/uploads/2021/06/Huntion-Technical-Data-Sheet.pdf</a>                 |                                                                                                                                                                                   | <a href="https://www.huntion.co.uk/">www.huntion.co.uk</a>               | <a href="https://www.huntion.co.uk/">www.huntion.co.uk</a>               |                                                        |
|         | Huntion Silence Thermal Insulation                                                 | Huntion Silence Thermal is an acoustic insulation impact sound sheet designed for waterborne underfloor heating. The sheet has a cut groove for heating pipes.                                                                                                                                                      |                          | 0.045                       |                   | 240             | 9          | Insulation      | Insulation (Thermal)       | Natural materials          | HUNTION FIBER AS                                  | Residential Commercial Industrial Other | E                                                                                                                                                                                                 | <a href="https://www.huntion.co.uk/wp-content/uploads/2021/06/Huntion-Technical-Data-Sheet.pdf">https://www.huntion.co.uk/wp-content/uploads/2021/06/Huntion-Technical-Data-Sheet.pdf</a>                 |                                                                                                                                                                                   | <a href="https://www.huntion.co.uk/">www.huntion.co.uk</a>               | <a href="https://www.huntion.co.uk/">www.huntion.co.uk</a>               |                                                        |
|         | Huntion Silence sound absorption board 10mm                                        | Huntion Silence sound absorption board is designed to provide the market's best sound insulating floor insulation. Huntion Silence 10mm is designed and manufactured to satisfy the requirements for impact sound and airborne sound moving between floors.                                                         |                          | 0.01                        |                   | 250             | 9          | Insulation      | Insulation (Thermal)       | Natural materials          | HUNTION FIBER AS                                  | Residential Commercial Industrial Other | E                                                                                                                                                                                                 | <a href="https://www.huntion.co.uk/wp-content/uploads/2021/06/Huntion-Technical-Data-Sheet.pdf">https://www.huntion.co.uk/wp-content/uploads/2021/06/Huntion-Technical-Data-Sheet.pdf</a>                 |                                                                                                                                                                                   | <a href="https://www.huntion.co.uk/">www.huntion.co.uk</a>               | <a href="https://www.huntion.co.uk/">www.huntion.co.uk</a>               |                                                        |
|         | Huntion Silence sound absorption board 20mm                                        | Huntion Silence sound absorption board is designed to provide the market's best sound insulating floor insulation. Huntion Silence 20mm is designed and manufactured to achieve good sound-dampening results when used on concrete and in renovation.                                                               |                          | 0.01                        |                   | 211             |            | Insulation      | Insulation (Thermal)       | Natural materials          | HUNTION FIBER AS                                  | Residential Commercial Industrial Other | E                                                                                                                                                                                                 | <a href="https://www.huntion.co.uk/wp-content/uploads/2021/06/Huntion-Technical-Data-Sheet.pdf">https://www.huntion.co.uk/wp-content/uploads/2021/06/Huntion-Technical-Data-Sheet.pdf</a>                 |                                                                                                                                                                                   | <a href="https://www.huntion.co.uk/">www.huntion.co.uk</a>               | <a href="https://www.huntion.co.uk/">www.huntion.co.uk</a>               |                                                        |
|         | Huntion Sarking 10mm                                                               | Huntion Sarking™ is an underlayment board that combines underlayment and anti-protection board and can be used for cold and warm insulated roof structures.                                                                                                                                                         |                          | 0.05                        |                   | 211             | 4.61       | Insulation      | Insulation (Thermal)       | Natural materials          | HUNTION FIBER AS                                  | Residential Commercial Industrial Other | E                                                                                                                                                                                                 | <a href="https://www.huntion.co.uk/wp-content/uploads/2021/06/Huntion-Technical-Data-Sheet.pdf">https://www.huntion.co.uk/wp-content/uploads/2021/06/Huntion-Technical-Data-Sheet.pdf</a>                 |                                                                                                                                                                                   | <a href="https://www.huntion.co.uk/">www.huntion.co.uk</a>               | <a href="https://www.huntion.co.uk/">www.huntion.co.uk</a>               |                                                        |
|         | Huntion Nature Wood Fiber Insulation Boards                                        | Huntion Nature™ is mainly based on natural wood fiber. The quick chips we use in production come from Norwegian forests with FSC® certification. The insulation boards can be used in walls, floors and ceilings.                                                                                                   |                          | 0.038                       |                   | 211             |            | Insulation      | Insulation (Thermal)       | Natural materials          | HUNTION FIBER AS                                  | Residential Commercial Industrial Other | E                                                                                                                                                                                                 | <a href="https://www.huntion.co.uk/wp-content/uploads/2021/06/Huntion-Technical-Data-Sheet.pdf">https://www.huntion.co.uk/wp-content/uploads/2021/06/Huntion-Technical-Data-Sheet.pdf</a>                 |                                                                                                                                                                                   | <a href="https://www.huntion.co.uk/">www.huntion.co.uk</a>               | <a href="https://www.huntion.co.uk/">www.huntion.co.uk</a>               |                                                        |
|         | Huntion Nature Wood Fiber Insulation Boards in                                     | Huntion Nature™ is mainly based on natural wood fiber. The quick chips we use in production come from Norwegian forests with FSC® certification. The insulation boards can be used in walls, floors and ceilings.                                                                                                   |                          | 0.01                        |                   | 211             |            | Insulation      | Insulation (Thermal)       | Natural materials          | HUNTION FIBER AS                                  | Residential Commercial Industrial Other |                                                                                                                                                                                                   | <a href="https://www.huntion.co.uk/wp-content/uploads/2021/06/Huntion-Technical-Data-Sheet.pdf">https://www.huntion.co.uk/wp-content/uploads/2021/06/Huntion-Technical-Data-Sheet.pdf</a>                 |                                                                                                                                                                                   | <a href="https://www.huntion.co.uk/">www.huntion.co.uk</a>               | <a href="https://www.huntion.co.uk/">www.huntion.co.uk</a>               |                                                        |
|         | Huntion Bionic 15mm                                                                | HUNTION BIONIC is used as an external wall barrier in new builds and renovations to protect homes from cold and drafts. Main characteristics: made from renewable raw materials, absorbs moisture and prevents condensation, easy to handle and use, reduces cold bridges.                                          |                          | 0.01                        |                   | 211             |            | Insulation      | Insulation (Thermal)       | Natural materials          | HUNTION FIBER AS                                  | Residential Commercial Industrial Other |                                                                                                                                                                                                   | <a href="https://www.huntion.co.uk/wp-content/uploads/2021/06/Huntion-Technical-Data-Sheet.pdf">https://www.huntion.co.uk/wp-content/uploads/2021/06/Huntion-Technical-Data-Sheet.pdf</a>                 |                                                                                                                                                                                   | <a href="https://www.huntion.co.uk/">www.huntion.co.uk</a>               | <a href="https://www.huntion.co.uk/">www.huntion.co.uk</a>               |                                                        |
|         | Wood wool insulation panel (uncompressed)                                          | WOOD WOOL INSULATION PANEL COMPOSED WITH AN EPS CORE. COMPRESSION IS 20% ON COMPRESSION. 20-40 kg.                                                                                                                                                                                                                  |                          |                             |                   | 50              | 70-70      | Insulation      | Insulation (Thermal)       | Natural materials          | BAE                                               | Residential Commercial                  |                                                                                                                                                                                                   | <a href="https://www.bae.co.uk/wp-content/uploads/2021/06/Bae-Technical-Data-Sheet.pdf">https://www.bae.co.uk/wp-content/uploads/2021/06/Bae-Technical-Data-Sheet.pdf</a>                                 |                                                                                                                                                                                   | <a href="https://www.bae.co.uk/">www.bae.co.uk</a>                       | <a href="https://www.bae.co.uk/">www.bae.co.uk</a>                       |                                                        |
|         | Huntion Windproof 12mm                                                             | Huntion Windproof is a diffusion open membrane which protects against cold, wind and moisture. It is mainly made of wood fibres and is impregnated to provide exceptional performance and robustness.                                                                                                               |                          | 0.049                       |                   | 60              | 38         | Building boards | All                        | Natural materials          | HUNTION FIBER AS                                  | Residential Commercial Industrial Other | E                                                                                                                                                                                                 | <a href="https://www.huntion.co.uk/wp-content/uploads/2021/06/Huntion-Technical-Data-Sheet.pdf">https://www.huntion.co.uk/wp-content/uploads/2021/06/Huntion-Technical-Data-Sheet.pdf</a>                 |                                                                                                                                                                                   | <a href="https://www.huntion.co.uk/">www.huntion.co.uk</a>               | <a href="https://www.huntion.co.uk/">www.huntion.co.uk</a>               |                                                        |
|         | CONSTRUCTION PANELS CEMENT, LIME, F.P. PORTLAND FOR ACUSTIC DESIGN PANELS CEMENTAL | CEMENTAL CONSTRUCTION PANELS are made of organic waste from sustainable management forests (FSC® or PEFC®) and mineral binders mainly Portland cement, white or grey, and marble powder. The mix of the mentioned raw materials, the density of the mixture and the thickness of the panels are adapted to the use. |                          | 0.07                        |                   | 2200            | 25.1       | Building boards | All                        | Natural materials          | ROCKWELL INTERNATIONAL LAB ROCKWELL NORTH AMERICA | Residential Commercial                  |                                                                                                                                                                                                   | <a href="https://www.rockwell.com/wp-content/uploads/2021/06/Rockwell-Technical-Data-Sheet.pdf">https://www.rockwell.com/wp-content/uploads/2021/06/Rockwell-Technical-Data-Sheet.pdf</a>                 |                                                                                                                                                                                   | <a href="https://www.rockwell.com/">www.rockwell.com</a>                 | <a href="https://www.rockwell.com/">www.rockwell.com</a>                 |                                                        |
|         | Acoustic Panels 15'                                                                | These acoustic panels are made of organic waste from sustainable management forests (FSC® or PEFC®) and mineral binders mainly Portland cement, white or grey, and marble powder. The fibres mentioned raw materials, the density of the mixture and the thickness of the panels are adapted to the use.            |                          | 0.0765                      |                   | 75              | 2200       | 7.57            | Building boards (Acoustic) | Natural materials          | CARDINAL ACUSTICS                                 | Residential Commercial                  |                                                                                                                                                                                                   | <a href="https://www.cardinalacustics.com/wp-content/uploads/2021/06/Cardinal-Technical-Data-Sheet.pdf">https://www.cardinalacustics.com/wp-content/uploads/2021/06/Cardinal-Technical-Data-Sheet.pdf</a> |                                                                                                                                                                                   | <a href="https://www.cardinalacustics.com/">www.cardinalacustics.com</a> | <a href="https://www.cardinalacustics.com/">www.cardinalacustics.com</a> |                                                        |
|         | ORGANIC MINERAL PURE 15mm                                                          | ORGANIC MINERAL PURE 15mm.                                                                                                                                                                                                                                                                                          |                          | 0.07                        |                   | 50              | 12.9       | Building boards | Building boards (Acoustic) | Natural materials          | KNAPF INSULATION                                  | Residential Commercial                  |                                                                                                                                                                                                   | <a href="https://www.knapf.co.uk/wp-content/uploads/2021/06/Knapf-Technical-Data-Sheet.pdf">https://www.knapf.co.uk/wp-content/uploads/2021/06/Knapf-Technical-Data-Sheet.pdf</a>                         |                                                                                                                                                                                   | <a href="https://www.knapf.co.uk/">www.knapf.co.uk</a>                   | <a href="https://www.knapf.co.uk/">www.knapf.co.uk</a>                   |                                                        |
|         | Purmoor on site de l'air ORGANIC COLORE 15mm                                       | 25mm ORGANIC COLORE wood wool panel.                                                                                                                                                                                                                                                                                |                          | 3.33333333                  |                   | 0.07            | 50         | 408             | 12.9                       | Building boards (Acoustic) | Wood wool                                         | KNAPF INSULATION                        | Residential Commercial                                                                                                                                                                            |                                                                                                                                                                                                           | <a href="https://www.knapf.co.uk/wp-content/uploads/2021/06/Knapf-Technical-Data-Sheet.pdf">https://www.knapf.co.uk/wp-content/uploads/2021/06/Knapf-Technical-Data-Sheet.pdf</a> |                                                                          | <a href="https://www.knapf.co.uk/">www.knapf.co.uk</a>                   | <a href="https://www.knapf.co.uk/">www.knapf.co.uk</a> |







## D5.4

|  |                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                             |       |       |              |        |                 |                                      |                     |                                 |                                 |                                                 |                                    |                                         |               |                                                                                 |                                                                                 |                                                                                 |                                                                   |
|--|---------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------|--------------|--------|-----------------|--------------------------------------|---------------------|---------------------------------|---------------------------------|-------------------------------------------------|------------------------------------|-----------------------------------------|---------------|---------------------------------------------------------------------------------|---------------------------------------------------------------------------------|---------------------------------------------------------------------------------|-------------------------------------------------------------------|
|  | Brick 45                                                                              | Bricks - EXISTENT EXISTED FROM BRICKS, glazed earth bricks made from clay-rich earth and shaped stone. Perfect for structural walls, supporting up to 3 stories. Why choose? Structural: ideal for robust structural walls. Homogeneous: This best clay mortar makes a perfect wall. Thermal: Excellent.                                                                                                    | 0,157 | 0,27  | insufficient | 1720   | 165             | Masonry                              | Masonry (Brick)     | Ceramic                         | Clay                            | Frame Upper floor External walls Internal walls | HC MATTHEWS                        | Residential Commercial Industrial Other | EN 13823:2020 | <a href="https://www.brick45.com/">https://www.brick45.com/</a>                 | <a href="https://www.brick45.com/">https://www.brick45.com/</a>                 | <a href="https://www.brick45.com/">https://www.brick45.com/</a>                 |                                                                   |
|  | Hemp concrete block P-HC- 80x20x6                                                     | The hemp concrete block is a natural, sustainable, and lightweight material. It is made of hemp shavings and a mixture of natural cement at time. The product is resistant, porous then hardened and dried in the open air without any chemical treatment.                                                                                                                                                  |       | 0,043 |              | 340    | 122             | Masonry                              | Masonry (Brick)     | Natural materials               | Hemp                            | Frame Upper floor External walls Internal walls | BOENP S.A.                         | Residential Commercial                  |               | <a href="https://www.boenp.com/">https://www.boenp.com/</a>                     | <a href="https://www.boenp.com/">https://www.boenp.com/</a>                     | <a href="https://www.boenp.com/">https://www.boenp.com/</a>                     |                                                                   |
|  | EPS ECO-ESPANO K20                                                                    | The EPS ECO-ESPANO product is a high-density expanded polystyrene (EPS) with high thermal insulation value. It is used above all for the start of external insulation in accordance with the EN24 standard as it has certifications in accordance with the EN24 standard and the requirements of the EN24 standard.                                                                                         | 0,025 | 50    | 20,5         | 0,0707 | Insulation      | Insulation (Thermal)                 | Plastic & Polymers  | EPS (Expanded Polystyrene)      | EPS (Expanded Polystyrene)      | External walls Internal walls                   | ISOLCONFORT SRL                    | Residential Commercial                  |               | <a href="https://www.bolocofort.it/">https://www.bolocofort.it/</a>             | <a href="https://www.bolocofort.it/">https://www.bolocofort.it/</a>             | <a href="https://www.bolocofort.it/">https://www.bolocofort.it/</a>             |                                                                   |
|  | PIR insulation board (50mm)                                                           | The PIR insulation board is a high-performance, rigid, and lightweight material. It is made of polyisocyanurate (PIR) and is used for external and internal insulation of buildings for wall, floor, flat roof, pitched roofs, according to EN 12956. The rigid insulation boards are faced on both sides with a multi-layer facing. The product is available in the thickness from 20 mm to 100 mm.        | 0,023 |       | 34,4         | 0,847  | Insulation      | Insulation (Thermal)                 | Plastic & Polymers  | PIR (Polyisocyanurate)          | PIR (Polyisocyanurate)          | Roof External walls Internal walls              | UNILIN                             | Residential Commercial                  |               | <a href="https://www.unilin.com/">https://www.unilin.com/</a>                   | <a href="https://www.unilin.com/">https://www.unilin.com/</a>                   | <a href="https://www.unilin.com/">https://www.unilin.com/</a>                   |                                                                   |
|  | Flat roof insulated 300 Premium Expanded Polystyrene Insulation Product               | Shape insulated expanded polystyrene (EPS) for internal flat roof applications. This EPS refers to the table Flat Roof Insulated - 300 Premium & 300 Premium products and is calculated from a production weighted average.                                                                                                                                                                                 | 0,025 |       | 40           | 0,952  | Insulation      | Insulation (Thermal)                 | Plastic & Polymers  | EPS (Expanded Polystyrene)      | EPS (Expanded Polystyrene)      | Roof External walls Internal walls              | ABLEBY BEM                         | Residential Commercial                  |               | <a href="https://www.ablebybem.com/">https://www.ablebybem.com/</a>             | <a href="https://www.ablebybem.com/">https://www.ablebybem.com/</a>             | <a href="https://www.ablebybem.com/">https://www.ablebybem.com/</a>             |                                                                   |
|  | Flat roof insulated 200 Premium + 200 Premium Expanded Polystyrene Insulation Product | Shape insulated expanded polystyrene (EPS) for internal flat roof applications. This EPS refers to the table Flat Roof Insulated - 200 Premium & 200 Premium products and is calculated from a production weighted average.                                                                                                                                                                                 | 0,025 |       | 30           | 0,952  | Insulation      | Insulation (Thermal)                 | Plastic & Polymers  | EPS (Expanded Polystyrene)      | EPS (Expanded Polystyrene)      | Roof External walls Internal walls              | ABLEBY BEM                         | Residential Commercial                  |               | <a href="https://www.ablebybem.com/">https://www.ablebybem.com/</a>             | <a href="https://www.ablebybem.com/">https://www.ablebybem.com/</a>             | <a href="https://www.ablebybem.com/">https://www.ablebybem.com/</a>             |                                                                   |
|  | EPS ECO-POR G25                                                                       | This EPS refers to the construction product EPS-POR G25 made by extruded expanded polystyrene and produced by Isotherm S.r.l. at its production sites in Cologno Veneta (VR), S. Vito al Tagliamento (PN) and Pozzuolo del Friuli (UD).                                                                                                                                                                     | 0,025 | 50    | 15           | 1,5    | Insulation      | Insulation (Thermal)                 | Plastic & Polymers  | EPS (Expanded Polystyrene)      | EPS (Expanded Polystyrene)      | Roof External walls Internal walls              | ISOLCONFORT SRL                    | Residential Commercial                  |               | <a href="https://www.bolocofort.it/">https://www.bolocofort.it/</a>             | <a href="https://www.bolocofort.it/">https://www.bolocofort.it/</a>             | <a href="https://www.bolocofort.it/">https://www.bolocofort.it/</a>             |                                                                   |
|  | SD 27 mm bare base                                                                    | Technical floor tiles composed of a central core of First Quality wood, with a galvanized steel base, suitable for the construction of high floor pavements in buildings.                                                                                                                                                                                                                                   | 0,17  |       | 9            |        | Systems         | Raised access floor                  | Wood                | Engineered wood (Other)         | Engineered wood (Other)         | Roof External walls Internal walls              | DPSO PAVIMENTOS S.A.               | Residential Commercial                  |               | <a href="https://www.dpsopavimentos.com/">https://www.dpsopavimentos.com/</a>   | <a href="https://www.dpsopavimentos.com/">https://www.dpsopavimentos.com/</a>   | <a href="https://www.dpsopavimentos.com/">https://www.dpsopavimentos.com/</a>   |                                                                   |
|  | EPS ECO-DURZETA                                                                       | The EPS refers to the construction product EPS-DURZETA made by extruded expanded polystyrene and produced by Isotherm S.r.l. at its production sites in Cologno Veneta (VR) and Pozzuolo del Friuli (UD).                                                                                                                                                                                                   | 0,025 |       | 22,5         | 2,35   | Systems         | Internal partition system            | Plastic & Polymers  | EPS (Expanded Polystyrene)      | EPS (Expanded Polystyrene)      | Internal walls External walls Internal walls    | ISOLCONFORT SRL                    | Residential Commercial                  |               | <a href="https://www.bolocofort.it/">https://www.bolocofort.it/</a>             | <a href="https://www.bolocofort.it/">https://www.bolocofort.it/</a>             | <a href="https://www.bolocofort.it/">https://www.bolocofort.it/</a>             |                                                                   |
|  | EXOPANEL BOARD 50                                                                     | Particularized (extruded) without surface treatment for permanent installation in buildings for non-load bearing purposes in the use class 2 according to EN 12518 (dry conditions).                                                                                                                                                                                                                        | 0,099 |       | 379          | 22     | Building boards | Building boards (Multiple Functions) | Natural materials   | Chipboard (Particleboard)       | Chipboard (Particleboard)       | Roof External walls Internal walls              | EXOPANEL                           | Residential Commercial Industrial Other | E             | <a href="https://www.exopanel.com/">https://www.exopanel.com/</a>               | <a href="https://www.exopanel.com/">https://www.exopanel.com/</a>               | <a href="https://www.exopanel.com/">https://www.exopanel.com/</a>               |                                                                   |
|  | HDF NF                                                                                | HDF with certified Class A (1) flame spread rating made with no added formaldehyde (HDF).                                                                                                                                                                                                                                                                                                                   | 0,1   |       | 50           | 440    | Building boards | Building boards (Multiple Functions) | Wood                | HDF (Medium Density Fibreboard) | HDF (Medium Density Fibreboard) | Roof External walls Internal walls              | ROSEBRO FOREST PRODUCTS S.A.       | Residential Commercial Industrial Other |               | <a href="https://www.rosebro.com/">https://www.rosebro.com/</a>                 | <a href="https://www.rosebro.com/">https://www.rosebro.com/</a>                 | <a href="https://www.rosebro.com/">https://www.rosebro.com/</a>                 |                                                                   |
|  | HDF NF / HDF EXTERIOR NF                                                              | Exterior HDF is a board for exterior (HDF) insulation thicknesses (7 mm to 30 mm). The adhesive used in the production process of Exterior HDF does not contain formaldehyde. FIBRAPAN Exterior NF NF is made of selected wood fibres (HDF), it shows high resistance to moisture and is suitable for exterior use.                                                                                         | 0,1   | 25    |              |        | Building boards | Building boards (Multiple Functions) | Wood                | HDF (Medium Density Fibreboard) | HDF (Medium Density Fibreboard) | Roof External walls Internal walls              | FISPA                              | Residential Commercial Industrial       |               | <a href="https://www.fispa.com/">https://www.fispa.com/</a>                     | <a href="https://www.fispa.com/">https://www.fispa.com/</a>                     | <a href="https://www.fispa.com/">https://www.fispa.com/</a>                     |                                                                   |
|  | Insulated PIR with Silver Foil Facing                                                 | Polyisocyanurate (PIR) rigid thermal panels that can be used in many applications. Designed to achieve excellent thermal performance where minimal cavity is available. Insulated PIR is a thermal insulation material with a silver foil facing.                                                                                                                                                           | 0,023 | 50    | 34,4         | 0,800  | Insulation      | Insulation (Thermal)                 | Plastic & Polymers  | PIR (Polyisocyanurate)          | PIR (Polyisocyanurate)          | Roof External walls Internal walls              | CBR BRADFORD                       | Residential Commercial Industrial       |               | <a href="https://www.cbrbradford.com/">https://www.cbrbradford.com/</a>         | <a href="https://www.cbrbradford.com/">https://www.cbrbradford.com/</a>         | <a href="https://www.cbrbradford.com/">https://www.cbrbradford.com/</a>         |                                                                   |
|  | Polyester Fiber Acoustic Panels                                                       | Our Polyester Fiber Acoustic Panels are available in a broad range of colors, and customizable into many configurations for walls and ceilings, as well as stand-alone decorative products with sound absorbing properties.                                                                                                                                                                                 | 20+   | 105   |              |        | Building boards | Building boards (Acoustic)           | Plastic & Polymers  | PET                             | PET                             | Internal walls External walls Internal walls    | ZENFLEX                            | Residential Commercial                  |               | <a href="https://www.zonaflex.com/">https://www.zonaflex.com/</a>               | <a href="https://www.zonaflex.com/">https://www.zonaflex.com/</a>               | <a href="https://www.zonaflex.com/">https://www.zonaflex.com/</a>               |                                                                   |
|  | Pimox RT, FLOOR, Ductboard                                                            | PIMOX RT, FLOOR, Ductboard Panels are all Acoustic made, modified Polyisocyanurate (PIR) rigid thermal panels that can be used in many applications. Designed to achieve excellent thermal performance where minimal cavity is available. Pimox RT, FLOOR, Ductboard Panels are all Acoustic made.                                                                                                          | 0,023 | 50    | 34,4         | 0,800  | Insulation      | Insulation (Thermal)                 | Plastic & Polymers  | PIR (Polyisocyanurate)          | PIR (Polyisocyanurate)          | Roof External walls Internal walls              |                                    | Residential Commercial Industrial       |               | <a href="https://www.pimox.com/">https://www.pimox.com/</a>                     | <a href="https://www.pimox.com/">https://www.pimox.com/</a>                     | <a href="https://www.pimox.com/">https://www.pimox.com/</a>                     |                                                                   |
|  | SANCTUARY Blow in or Spray Applied Cellulose Insulation                               | Sanctuary is a cellulose-based insulation material that can be blown in or spray applied. It is made of recycled paper and is suitable for all climates and conditions. Suitable for use in attics, walls, and floors.                                                                                                                                                                                      | 0,04  | 100   | 34,2         |        | Insulation      | Insulation (Thermal)                 | Natural materials   | Cellulose fiber                 | Cellulose fiber                 | Roof External walls Internal walls              | GREENFIBER                         | Residential Commercial Industrial       |               | <a href="https://www.greenfiber.com/">https://www.greenfiber.com/</a>           | <a href="https://www.greenfiber.com/">https://www.greenfiber.com/</a>           | <a href="https://www.greenfiber.com/">https://www.greenfiber.com/</a>           |                                                                   |
|  | SOPRA EPS CB (30-120 mm, 30-35 kg/m³)                                                 | Extruded polystyrene foam (EPS) is a thermoplastic insulation foam produced according to EN 13356/ SOPRA EPS CB is mainly used as thermal insulation of external walls. The rough surface of the panel allows interior plastering.                                                                                                                                                                          | 0,03  |       | 33           | 1,15   | Insulation      | Insulation (Thermal)                 | Plastic & Polymers  | EPS (Expanded Polystyrene)      | EPS (Expanded Polystyrene)      | Internal walls and partitions                   | SOPREMAUX LIMITED                  | Residential Commercial Industrial Other | E             | <a href="https://www.sopremaux.com/">https://www.sopremaux.com/</a>             | <a href="https://www.sopremaux.com/">https://www.sopremaux.com/</a>             | <a href="https://www.sopremaux.com/">https://www.sopremaux.com/</a>             |                                                                   |
|  | RMS2000-Access Floor system                                                           | The RMS2000 panels are based on a different, square module made of a high-performance high-density 30mm particle chipboard core in a galvanized steel envelope. It is electric and fireproof, made with 50% renewable energy and has a maximum of 80% recycled content.                                                                                                                                     | 4     | 0,15  | 25           | 996    | 30,6            | Systems                              | Raised access floor | Wood                            | Chipboard (Particleboard)       | Chipboard (Particleboard)                       | Roof External walls Internal walls | KINGS PAN DATA AND FLOORING             | Commercial    | EN 1501-1 BPS-15 / EN 1501-2 REISER                                             | <a href="https://www.kingspan.com/">https://www.kingspan.com/</a>               | <a href="https://www.kingspan.com/">https://www.kingspan.com/</a>               | <a href="https://www.kingspan.com/">https://www.kingspan.com/</a> |
|  | Kooltherm K17                                                                         | The Kooltherm panels are based on a different, square module made of a high-performance high-density 30mm particle chipboard core in a galvanized steel envelope. It is electric and fireproof, made with 50% renewable energy and has a maximum of 80% recycled content.                                                                                                                                   | 0,3   |       | 97,8         | 2,76   | Insulation      | Insulation (Thermal)                 | Plastic & Polymers  | Polymer (Other)                 | Polymer (Other)                 | Roof External walls Internal walls              | KINGS PAN                          | Commercial Residential                  |               | <a href="https://www.kooltherm.com/">https://www.kooltherm.com/</a>             | <a href="https://www.kooltherm.com/">https://www.kooltherm.com/</a>             | <a href="https://www.kooltherm.com/">https://www.kooltherm.com/</a>             |                                                                   |
|  | Kooltherm K25-C                                                                       | The Kooltherm panels are based on a different, square module made of a high-performance high-density 30mm particle chipboard core in a galvanized steel envelope. It is electric and fireproof, made with 50% renewable energy and has a maximum of 80% recycled content.                                                                                                                                   | 0,3   |       | 97,8         | 2,76   | Insulation      | Insulation (Thermal)                 | Plastic & Polymers  | Polymer (Other)                 | Polymer (Other)                 | Roof External walls Internal walls              | KINGS PAN                          | Commercial Residential                  |               | <a href="https://www.kooltherm.com/">https://www.kooltherm.com/</a>             | <a href="https://www.kooltherm.com/">https://www.kooltherm.com/</a>             | <a href="https://www.kooltherm.com/">https://www.kooltherm.com/</a>             |                                                                   |
|  | Kooltherm K23                                                                         | The Kooltherm panels are based on a different, square module made of a high-performance high-density 30mm particle chipboard core in a galvanized steel envelope. It is electric and fireproof, made with 50% renewable energy and has a maximum of 80% recycled content.                                                                                                                                   | 0,2   |       | 35           | 1,23   | Insulation      | Insulation (Thermal)                 | Plastic & Polymers  | Synthetic resin                 | Synthetic resin                 | Roof External walls Internal walls              | KINGS PAN                          | Commercial Residential                  |               | <a href="https://www.kooltherm.com/">https://www.kooltherm.com/</a>             | <a href="https://www.kooltherm.com/">https://www.kooltherm.com/</a>             | <a href="https://www.kooltherm.com/">https://www.kooltherm.com/</a>             |                                                                   |
|  | FORMULAR EPS insulation                                                               | The FORMULAR EPS insulation is a high-performance, rigid, and lightweight material. It is made of expanded polystyrene (EPS) and is used for external and internal insulation of buildings for wall, floor, flat roof, pitched roofs, according to EN 12956. The rigid insulation boards are faced on both sides with a multi-layer facing. The product is available in the thickness from 20 mm to 100 mm. | 0,023 |       | 31,9         | 1,15   | Insulation      | Insulation (Thermal)                 | Plastic & Polymers  | EPS (Expanded Polystyrene)      | EPS (Expanded Polystyrene)      | Roof External walls Internal walls              | OSING CONING                       | Commercial Residential Industrial       |               | <a href="https://www.osingconing.com/">https://www.osingconing.com/</a>         | <a href="https://www.osingconing.com/">https://www.osingconing.com/</a>         | <a href="https://www.osingconing.com/">https://www.osingconing.com/</a>         |                                                                   |
|  | Kooltherm K20                                                                         | The Kooltherm panels are based on a different, square module made of a high-performance high-density 30mm particle chipboard core in a galvanized steel envelope. It is electric and fireproof, made with 50% renewable energy and has a maximum of 80% recycled content.                                                                                                                                   | 0,3   |       | 97,8         | 2,76   | Insulation      | Insulation (Thermal)                 | Plastic & Polymers  | Polymer (Other)                 | Polymer (Other)                 | Roof External walls Internal walls              | KINGS PAN                          | Commercial Residential                  |               | <a href="https://www.kooltherm.com/">https://www.kooltherm.com/</a>             | <a href="https://www.kooltherm.com/">https://www.kooltherm.com/</a>             | <a href="https://www.kooltherm.com/">https://www.kooltherm.com/</a>             |                                                                   |
|  | Internal Partition System                                                             | An internal wall solution made up of individually demountable 240mm x 600mm insulated casettes. Building: 30mm 25mm woodwool 25mm casette 25mm woodwool.                                                                                                                                                                                                                                                    | 0,18  |       | 60           | 248    | Insulation      | Internal partition system            | Natural materials   | Hemp                            | Hemp                            | Internal walls and partitions                   | NATURAL BUILDING SYSTEMS           | Residential Commercial Industrial Other | BS EN12956-1  | <a href="https://www.naturalbuilding.com/">https://www.naturalbuilding.com/</a> | <a href="https://www.naturalbuilding.com/">https://www.naturalbuilding.com/</a> | <a href="https://www.naturalbuilding.com/">https://www.naturalbuilding.com/</a> |                                                                   |



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