INBUILT

ADVANCING SUSTAINABLE BUILDING PRACTICES IN EUROPE

product factsheets

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ABOUT INBUILT
ADVANCING SUSTAINABLE BUILDING PRACTICES IN EUROPE

The Horizon Europe project INBUILT aims to bring a shift in the European construction industry by integrating **circular economy** and **digitalisation**. The project focuses on scaling up and demonstrating **10 innovative products and systems**, designed to make building practices more sustainable from an environmental, social, and economic perspective.

These innovations fall into two key categories:

- **Reused and Recycled Materials** – aimed at reducing waste through the smart repurposing of materials from existing sources.
- **Low-Carbon Building Products** – developed using **bio-based** or **geo-sourced** materials to significantly lower the environmental impact of construction.

To validate their real-world performance, these products will be tested across **four diverse demonstration sites** in **France, Germany, and the UK**. These locations were selected to represent a variety of European climates and landscapes, ensuring robust testing and broad applicability.

This booklet presents a series of factsheets outlining each innovation developed by INBUILT. The factsheets will be updated at the conclusion of the project to reflect final outcomes and insights gained during the project.

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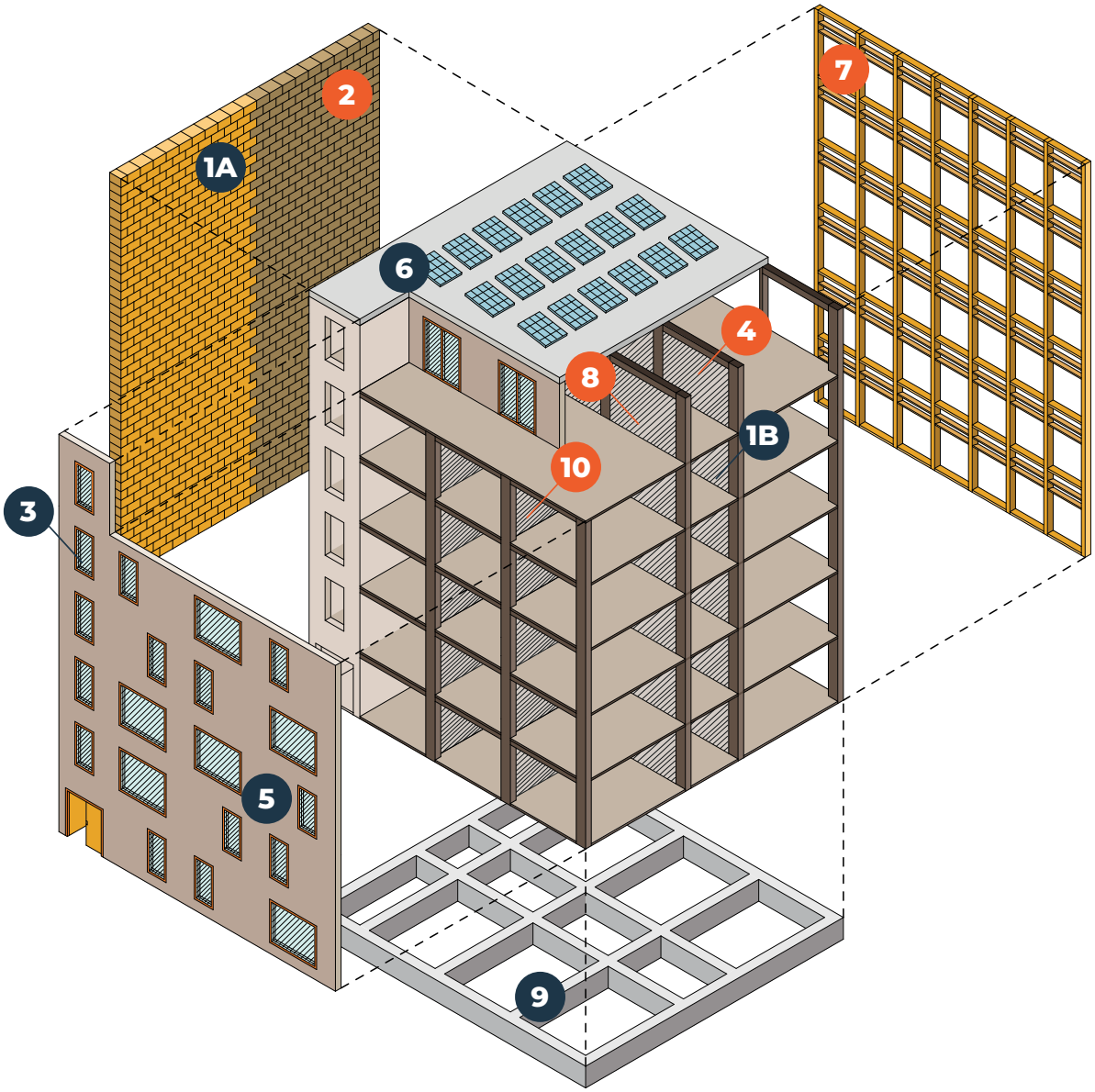

REUSED AND RECYCLED MATERIALS

- 1A Recycled Fired Bricks
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LOW CARBON BUILDING PRODUCTS

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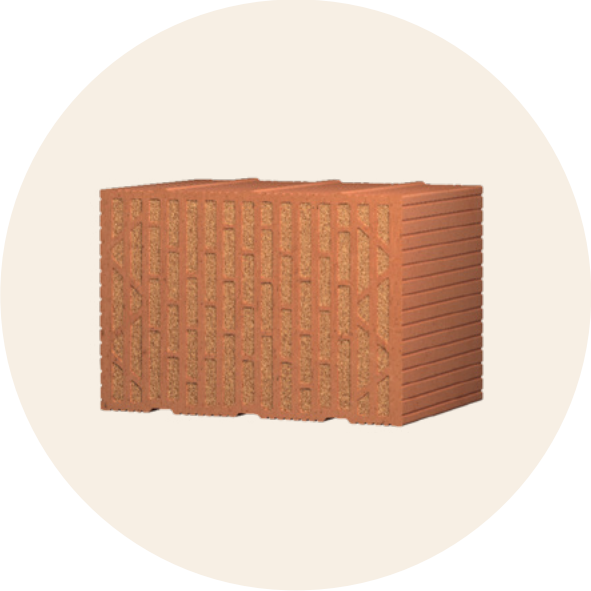
1A

Recycled Fired Bricks

Bricks made from recycled materials, reducing landfill waste.

Producer: Leipfinger-Bader
Demo site: Tiny House



Product Characteristics

The burnt recycling brick with reused and bio-based filling is designed as a lightweight vertically perforated brick for the monolithic exterior wall. The recycling proportion is at least 20% and the proportion of reused materials is 50%.

Properties		
Raw density class	0.60 kg/dm³	
Compressive strength class	6	
Rated value of thermal conductivity λR	≤0.09 W/[m·K]	
Characteristic compressive strength	2.2 MN/m²	
Perforation	≤ 65%	
Thermal insulation for wall thickness (cm)	**36.5**	**42.5**
U-Value (W/m²K)	0.18	0.16
Sound insulation properties		
Sound insulation value Rw (dB)	46.0	48.0

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Integration in the Demo Site

The new recycling brick will be used in demo site 2 to build the external walls of one mobile tiny house (19m²) and a local showroom (33m²). The aim is to achieve high insulation properties (≤0.09 W[m·K]) in combination with high proportion of recycled material and reused bio-based filling.

Current Status of the Market and Challenges

Around 10 million tonnes of recyclable brick material from demolition and dismantling are available every year, which could be fed into a closed material cycle. However, recycled bricks are still rarely offered on the market, despite urgent need for more sustainable products that reduce carbon footprint and **minimise use of primary resources**. The biggest challenge is to achieve good material properties during the production (e.g. low shrinkage & good plasticity) with use of recycled materials. In addition, the bonding quality of the components during the firing process of the brick is a key issue that determines the compressive strength of the brick.

Project Goal and Expected Impact

Aligned with the circular economy principles and INBUILT's goals to improve buildings' circularity as well as lifecycle performance, **Leipfinger-Bader uses diverse material flows**, including those from its recycling plant. This approach **saves resources and carbon**, creating a highly insulating, bio-based material that reduces heating costs in winter and keeps interiors cooler in summer. By incorporating recycled and bio-based insulation, LB aims to develop a **high-insulated brick** without compromising quality or physical properties and lower the carbon footprint within the building sector. The goal is to achieve TRL 7 by the end of the INBUILT project.

KPIs Achieved/Expected

LCA related KPIs:

- **Pollution and GHG reduction across the lifecycle:** 20%
- **Embodied energy reduction across the lifecycle:** 20%
- **Waste reduction across the lifecycle:** 20%

Product sustainability KPIs:

- **Bio & geo-sourced material:** 100% (achieved)
- **Reused material:** 50% (achieved)
- **Recycled material:** 20% (achieved)
- **Reusability of the product:** 0% (depending on the dismantling process)
- **Recyclability of the products:** 100% (achieved)

Material property KPI:

- **Insulation performance improvement:** λ≤0.09 W[m·K]

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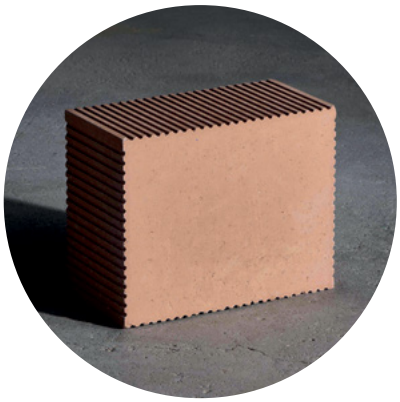
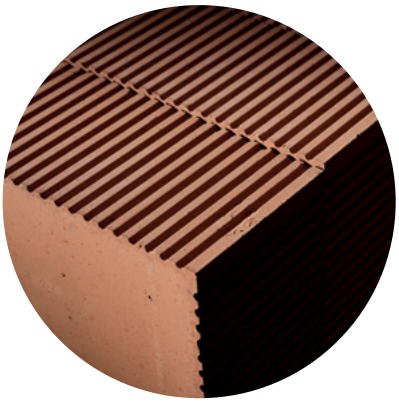
1B

Recycled non-fired Bricks

Bricks made from recycled materials, reducing landfill waste.

Producer: Leipfinger-Bader
Demo site: Tiny House





Product Characteristics

The non-fired brick (cold brick) is a compressed brick out of 90% recycled and reused materials with very good sound insulation properties and compressive strength.

Properties	
Raw density class	approx 2.0 kg/dm³
Compressive strength class	12-28
Sound insulation properties	
Sound insulation value Rw (dB)	59.0

Integration in the Demo Site

The non-fired brick will be used in a tiny house demonstrator in Bavaria (Germany) to build an internal partition wall separating the bathroom from the office space. The aim is to showcase the brick with its high sound insulation properties and its attractive surface with a positive effect on the indoor climate.

Current Status of the Market and Challenges

Each year, around 10 million tonnes of recyclable brick material from demolition and dismantling become available, offering **significant potential for a closed-loop material cycle**. However, recycled bricks are still rarely offered on the

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market, despite urgent need for more sustainable products that reduce carbon footprint and **minimise use of primary resources**. Brick produced through an air-drying process have a particularly positive environmental impact, though they present the technical challenges of achieving high compressive strength.

Meeting growing market demands for waste reduction and lower embodied energy – while maintaining high quality – makes innovations like the cold brick particularly valuable. Ideally suited for **load-bearing and sound-insulated internal partition walls**, the recycled non-fired brick offers an effective solution for circular, high-performance construction.

Project Goal and Expected Impact

Aligned with the circular economy principles and INBUILT's goals to improve buildings' circularity as well as lifecycle performance, Leipfinger-Bader uses diverse material flows, including those from its recycling plant. This approach saves resources and reduces carbon emissions. The project goal is to improve the thermal properties of the brick by including bio-based filling. The cold brick will be raised to **TRL 7 by the end of the INBUILT project**.

KPIs Achieved/Expected

LCA related KPIs:

- **Pollution and GHG reduction across the lifecycle:** 60%
- **Embodied energy reduction across the lifecycle:** 80%
- **Waste reduction across the lifecycle:** 90%

Product sustainability KPIs:

- **Bio & geo-sourced material:** 90% (achieved)
- **Reused material:** 90% (achieved)
- **Recycled material:** 90% (achieved)
- **Reusability of the product:** 0% (depending on the dismantling process)
- **Recyclability of the products:** 100% (achieved)

Material property KPI:

- **Insulation performance improvement:** 50% hole content with insulating filling (not achieved)

Energy and cost reduction KPI:

- **Fabrication and installation Cost reduction:** 20%

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2

Compressed Earth Blocks

Innovative, sturdy blocks made from local soil, with low carbon emission in production.

Producer: Filiater
Demo site: Residential Building

Product Characteristics

Blocks made from earthworks produced on-site with a mobile production machine.

General characteristics:

- **Dimensions:** ± 800 x 500 x 300-385 mm
- **Mass:** 240 – 320 kgs

Implementation:

- Transport on pallet (2 units per pallet) or storage rack (3 units per rack)
- Handling by crane + lifting clamp
- Masonry with traditional ready-to-use mortar
- Cutting with a water mason's saw

Integration in the Demo Site

The product will be tested in an office or residential building in Nice, Frace (TBA).
The demonstration will focus on building shells and load-bearing structural elements in **seismic zones** and integrating façade infill walls into a reinforced concrete framework in a **mixed construction scheme**.

Objectives:

- Recycle excavated soil into building materials
- Highlight thermal and hygrometric properties

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Current Status of the Market and Challenges

In France, **evolving regulations** require the construction sector to adopt a decarbonization strategy, with progressively stricter carbon impact thresholds set between 2025 and 2030. This shift is driving a strong demand for mixed construction solutions, particularly those incorporating bio-based and low-carbon materials.

However, **demand currently exceeds available supply**. The challenge for the earth materials sector is to scale up while balancing environmental, economic, and regulatory constraints. FILIATER is addressing this need by developing an industrial model supported by **advanced production processes** and a cutting-edge technical and R&D center focused on **raw earth construction**.

Project Goal and Expected Impact

The goal of the INBUILT project is to develop a demonstrator building that showcases sustainable construction by combining FILIATER's materials with innovative solutions and materials from INBUILT partners. This project will serve as a proof of concept for FILIATER's approach, with a specific focus on the **collective housing typology**.

KPIs

The sustainability of our Compressed Earth Blocks is measured through key performance indicators, ensuring material efficiency and circularity.
The KPIs are related to:

Product Sustainability KPIs:

- 95 % to 100 % of bio & geo-sourced material (validated)
- 97 % of recycled material (validated)
- 90 % of reusability of the products (expected)
- 90 % recyclability of the products (expected)

Life Cycle Assessment KPIs (compared to reinforced concrete)

- Saving 50 to 85 % CO_2 (validated, intern data)
- Saving 60 to 90% Grey energy in Kwh (validated, intern data)

Thermal KPIs

- **Thermal phase shift:** 10-12h (validated)
- **Thermal conductivity:** 0.46 W/(m.K) (validated)

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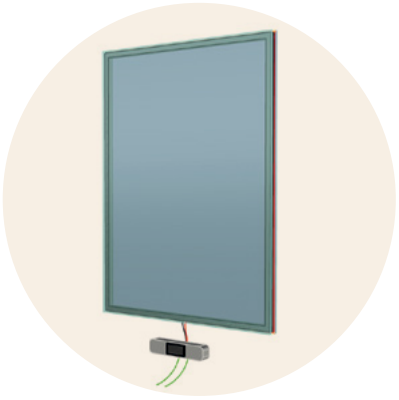
3

BioPUR-framed Smart Plasmochromic Windows

Highly insulating bioPolyurethane framed windows with plasmochromic technology, using recycled glass for better comfort.

Producer: LEITAT and INDRESMAT
Demo site: Tiny Houses



Product Characteristics

The **bio-based polyurethane window frame (KLIMA-PUR)** is a sustainable, high-performance product designed for energy efficiency, offering superior thermal insulation and acoustic comfort, while featuring a circular design similar to wooden windows.

- **Material:** Bio-based polyurethane (PUR) with 450 kg/ m^3 density
- **Thermal Insulation:** (Uframe = 0.81 W/(m^2K) / Uwindow = 1.1 W/(m^2K))
- **Acoustic Performance:** Superior sound reduction of Rw ≥43 dB
- **Mechanical Strength:** Wind load resistance Class C5
- **Sustainability:** Renewable resources, recyclable, low carbon footprint

Plasmochromic (PLSMC) or Dual-Band Electrochromic (DB-EC) smart windows are an advanced category of dynamic glazing that selectively modulate solar radiation, allowing independent control over visible (VIS) and near-infrared (NIR) light transmission.

- **NIR Modulation:** Reduces up to 50% of NIR (700–2500 nm) without affecting transparency
- **Thermal Transmittance:** 1.2 W/m^2K
- **Potential Energy Savings:** Up to 37% cooling reduction, 17% heating savings, and 27% total energy reduction
- **Potential Lighting Efficiency:** 37%–46% lower artificial lighting demand, <6% glare risk (>3000 lx)

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Integration in the Demo Site

The plasmochromic smart glazing bioPUR window frame will be displayed in a tiny house demonstrator (demo site 2) to showcase their energy efficiency and durability. Demountable installed windows will be tested for thermal performance and dynamic solar control in varying environmental conditions, aligning with the overall project goal of reducing environmental impact, energy demand and promoting sustainable construction materials.

Current Status of the Market and Challenges

Most energy-efficient window frames use hollow, multilayer structures that degrade over time, losing stability and allowing heat and moisture to pass through. The **biobased polyurethane window frame** solves this by offering a solid, high-density alternative that remains stable, provides excellent insulation, and requires minimal maintenance.

Traditional glazing struggles with solar heat, causing overheating in summer and heat loss in winter. Most smart glazing reacts passively to sunlight and temperature, offering limited control. **Plasmochromic smart glazing** overcomes this with an electrically controlled tint, blocking infrared radiation while letting visible light through, enhancing comfort and energy efficiency.

By combining **bioPUR frames with smart glazing**, the INBUILT project delivers a more efficient, low-maintenance window system for lasting comfort.

Project Goal and Expected Impact

The INBUILT project aims to optimise the manufacturing process of plasmochromic smart glazing bioPUR window, enhancing performance and increasing bio-based content. The goal is to reach a **Technology Readiness Level 7**, demonstrating the product's commercial readiness. Expected impacts include reducing carbon emissions, improving energy efficiency in buildings, and contributing to a circular economy through greater use of bio-based and recycled materials.

KPIs Achieved/Expected

The sustainability of the PMLSC windows is measured through key performance indicators, ensuring material efficiency and circularity. The KPIs are related to:

- **Bio & geo-sourced material:** 65% (expected: 70%)
- **Reused material:** 5% (expected: 15%)
- **Recycled material:** 15% (expected: 20%)
- **Recyclability of the products:** 75% (expected: 90%)
- **Energy Savings:** Reduces cooling loads during summer by up to 30%
- **Solar Modulation:** Dynamic control of NIR transmission with precise control
- **Thermal Transmittance (Glazing Only):** 1.1 W/(m^{2}K)
- **Use of Recycled Glass:** Double-glazed units consist of sustainable materials.

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LEITAT managing technologies

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4

Bio-based Insulations Panels

Fire safe, thermal and acoustic rigid insulation sheet made from industrial residues.

Producer: Mykor Portugal
Demo site: Tiny Houses and Historic Industrial Building

Product Characteristics

MykoFoam is an insulative board that offers good thermal performance, fire-safety, and negative embodied carbon, all at a competitive price point.

- **Material:** Industrial Residues and mycelium with 55 kg/m^3 density
- **Thermal Insulation:** 0,0419 [W/(m·K)]
- **Acoustic Performance:** Undergoing tests but expected Noise reduction coefficient = 0.53 [ISO 354]
- **Fire Classification:** Euroclass C
- **Size:** 1.2 m x 0.6 m
- **Thickness:** 50/100 mm
- **Sustainability:** 100% bio-based, recyclable, carbon sequestering (-11.65kg CO_2eq/m^2/50mm sequestered=)

Integration in the Demo Site

MykoFoam will be tested as insulation in **two demo sites.** In Demo Site 2 (Tiny House), 50mm boards (28m^2) will be applied externally to assess insulation, breathability, moisture absorption, and durability. In Demo Site 3 (Birmingham), 100mm boards (180m^2) will serve as the sole insulation, also testing acoustics. Partition wall use is under evaluation.

The aim is also to achieve a **35% to 55% reduction in energy demand for renovation projects.**

Current Status of the Market and Challenges

Fires like Grenfell and Valencia have pushed customers away from flammable plastic insulation. Although mineral wool is safer, it has high embodied carbon and relies on non-renewable materials for its production. **The market lacks affordable, high-performance, low-carbon alternatives.**

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The insulation market is 55% plastic and 37% mineral wool, both with drawbacks. Existing low-carbon options are costly, underperforming, and rely on virgin materials. **MykoFoam offers superior thermal performance, fire resistance, and affordability.** Derived from waste feedstock, it reduces energy costs and enhances living conditions. Strong partnerships with manufacturing construction companies ensure market reach, setting Mykor apart from competitors lacking distribution networks.

If MykoFoam captured 5% of the EU market, it could provide insulation panels for roughly 50,000 homes, both new builds and renovations alike. This would **divert 250,000 tons of biomass** from incineration. In Portugal, for instance, using MykoFoam in a 100m² home could lead to energy savings of €535 per year compared to a non-insulated building. The total payback period for the investment would be just 10 years.

Project Goal and Expected Impact

INBUILT aims to enhance **thermal performance**, targeting a lambda value of 0.038, though 0.041 has been achieved. **Fire classification** testing resulted in class C, instead of the expected class B. Durability and moisture absorption have improved through successful coating formulations. A **life cycle analysis (LCA)** is underway, supporting sustainability efforts, with current data showing -11.65kg CO_2eq/m²/50mm sequestered. The project has overcome various process challenges, improving pilot production efficiency. The target **Technology Readiness Level (TRL)** is 8, reflecting significant progress toward market readiness.

KPIs Achieved/Expected

LCA KPIs: Process started, results not yet available. These are all to be compared with mainstream insulation products in the market such as Polystyrene and Mineral wool.

- **Pollution and GHG reduction across the lifecycle:** 60%
- **Embodied energy reduction across the lifecycle:** 40%
- **Embodied carbon reduction across the lifecycle:** 76%
- **Waste reduction across the lifecycle:** 100%

Product sustainability KPIs:

- **Bio & geo-sourced material:** 100% (achieved)
- **Reused material:** 50% (achieved in lab-scale)
- **Recycled material:** 100% (achieved)
- **Reusability of the products:** Test is being performed in lab-scale (expected 50%)
- **Recyclability of the products:** 60% (expected 100%)
- **Energy demand reduction for renovation cases:** not available (demo-site application, expected from 35% to 55%)

Through continuous improvements, the project strives to enhance these metrics by optimizing our product's performance through advancements in the production process, coating development, and the promotion of a circular economy.

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mykor

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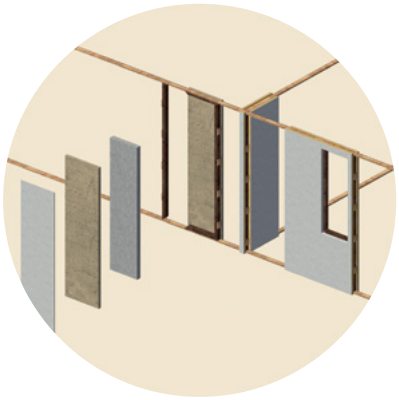
5

Reclaimed Wood Wall Panels

Reusable external and internal wall systems crafted from local reclaimed wood.

Producer: KIT
Demo site: Tiny Houses and Historic Industrial Building



Product Characteristics

The prefabricated reclaimed wood wall panels are a reusable external and internal wall system crafted from local reclaimed wood.

- Prefabricated, non-load bearing external and internal wall element
- Made from approx. 75% waste wood and biogenic materials (TBD)
- Designed for both renovation and new construction
- Developed using circular construction principles;
- Includes reversible connections for easy maintenance and reuse

Integration in the Demo Site

The wall elements will be integrated in two demo sites to showcase a sustainable construction solution for both renovation and new construction. They will be tested for thermal performance, mechanical strength, sustainability, and adaptability in renovation and new construction settings. The innovative product will be tested in Demo 2 as an external wall module in a Tiny House demonstrator. In Demo 3 in Birmingham, the principles will be implemented as an internal partition wall system within a renovation setting. Their contribution to material reuse and circular economy principles will be assessed.

Current Status of the Market and Challenges

Timber has a long tradition in construction but has only regained significance in the past 15–20 years, particularly in façade applications.

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Despite its advantages, timber still has a **low market share** in Europe, especially in multifamily buildings (2.7%). As a biogenic, locally available resource, timber plays a crucial role in climate strategies, acting as a carbon sink (~1m³ stores 1t CO_2). However, **most waste timber**—around 11 million tons annually in Germany—**is burned**, releasing 15 million tons of CO_2 instead of being reused. This represents a significant loss of material value.

Prefabricated reclaimed timber wall panels address this issue by enabling **efficient reuse**. They reduce emissions, minimize waste, and enhance resource efficiency. Prefabrication ensures high precision, shorter construction times, and better quality control, making timber a viable alternative for sustainable building solutions. Its **low thermal conductivity** and **adaptability** make it particularly well-suited for renovations, helping to expand timber's role in the built environment.

Project Goal and Expected Impact

The INBUILT project aims to develop circular, prefabricated wall elements using reclaimed wood and biogenic materials, enhancing **material reuse** and **reducing construction waste**. The goal is to improve product durability, flexibility, and carbon storage, **extending timber's lifecycle by 50–200 years**. The expected **TRL is 6–7**, demonstrating feasibility in real-world applications. Technical benefits include optimized material processing and reversible connections. Socially, it supports sustainable building practices and environmentally, it lowers emissions, conserves resources, and promotes circular economy principles, contributing to climate goals and sustainable construction.

KPIs Expected

Process started, results not available yet for sustainability and LCA KPIs. All the values below are expected to be reached by the end of the project.

Sustainability KPIs:

- **Bio & geo-sourced material: mycelium cellulose board:** 5%
- **Reused material: reused reclaimed wood:** 78%
- **Recycled material: recycled reclaimed wood or paper:** 17%
- **Reusability of the products: after the first life cycle:** 95%
- **Recyclability of the products: after the second life cycle:** 100%

Life Cycle Assessment KPIs:

- **Embodied carbon reduction across the lifecycle:**
  (a) – 80% (compared to concrete)
  (b) – 80% (compared to gypsum drywall construction)
- **Embodied energy reduction across the lifecycle:**
  (a) – 50% (compared to concrete)
  (b) – 50% (compared to gypsum drywall construction)
- **Pollution and GHG reduction across the lifecycle:**
  (a) – 50% (compared to concrete)
  (b) – 50% (compared to gypsum drywall construction)

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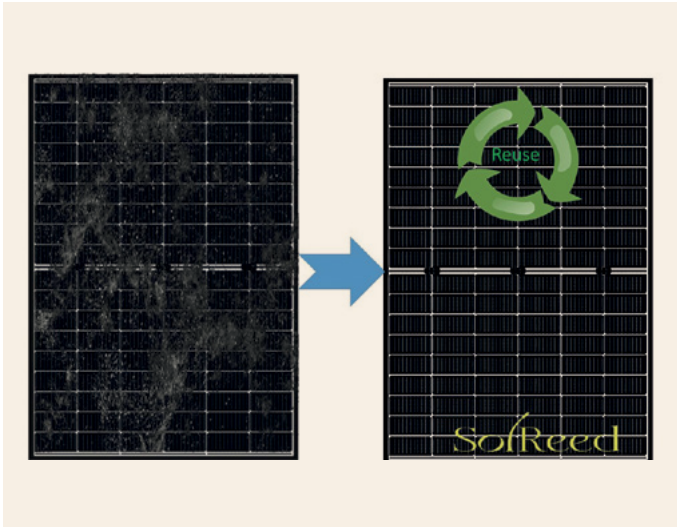
6

Second-life Photovoltaic Panels

Repaired and reconditioned carbon-free photovoltaic panels with enhanced energy efficiency and lifespan over 10 years.

Producer: CEA/Solreed
Demo site: Residential Building



Product Characteristics

CEA/SolReed technology allows reconditioning operations to be carried out in the workshop or directly on-site, at the heart of power plants, to detect defects, repair modules, and optimize their reuse for a second life.

- One second life PV module = at least 10 years of additional use
- 1.2 tons of CO_2 avoided per repaired module
- A concrete solution for maintaining existing farms and securing supply

Integration in the Demo Site

The second life PV modules will be integrated in one demo site (Demo site 1 - managed by FILIATER) to demonstrate their reliability and durability. The installation is made of several modules (about 100 modules) and will be monitored in order to remotely follow the performances of the modules.

Current Status of the Market and Challenges

The sector is rapidly developing in Europe, and Solreed and the CEA are pioneers in the

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field. Despite its enormous environmental and technical advantages, the second-life photovoltaic sector faces two challenges:

- Second life PV modules face **competition from new Asian modules**, which are currently entering the European market at very low prices. The low price price make it difficult for the reuse sector to establish itself and for second-life panels to enter the market on equal footing.
- Second-life modules are still **relatively new**, and standards for reclaimed products have yet to be fully developed. This lack of established standards has led to hesitancy among insurers, who are cautious about covering products not governed by these standards.

Project Goal and Expected Impact

The INBUILT project aims to advance second-life photovoltaic (PV) module technology by setting the value chain, developing repair and qualification protocols, and producing 200 prototype modules. The project will test the reliability of repaired PV modules and demonstrate their performance in a real-world setting through a live demo site.

INBUILT aims to achieve a **Technology Readiness Level (TRL) of 7**, demonstrating the product's commercial readiness. The expected impact includes reducing carbon emissions, improving energy efficiency in buildings. By integrating second life PV modules, the INBUILT project will demonstrate the credibility of this new highly circular sector and prepare the industrialization of the PV modules by SolReed (start-up from CEA) in the near future.

KPIs Expected

The sustainability of the second life PV modules is measured through key performance indicators, ensuring material efficiency and circularity.
All the following values are expected, as the measurement results are not available yet.

Sustainability KPIs:

- **Reusability of the product:** 99%
- **Recycled material:** 99%

Life Cycle Assessment KPIs:

- **Embodied carbon reduction:** -50% (*compared to new PV across the lifecycle*)
- **Embodied energy reduction:** -50%
- **Pollution and GHG reduction:** -50%
- **Waste reduction:** -99%

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SolReed cea

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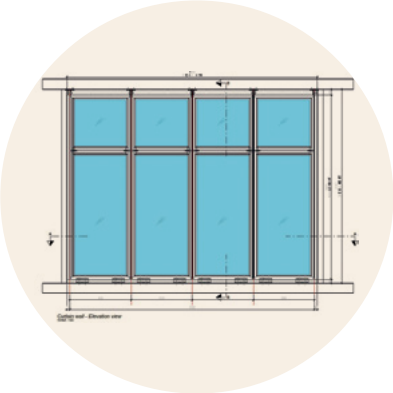
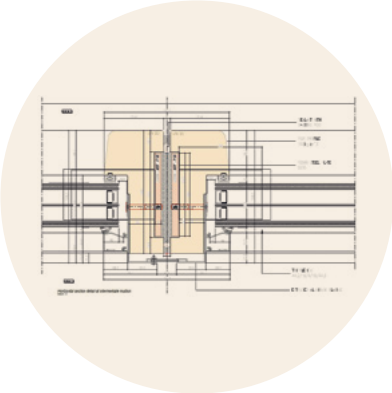
7

Bio-based Curtain Walls

Modular wall system using a novel biobased Polyurethane curtain wall framing system to create energy efficient building exteriors.

Producer: INDRESMAT and LFE





Product Characteristics

The bioPUR framing system for prefabricated curtain walls, developed by LFE and INDRESMAT, offers a sustainable, high-performance alternative to aluminum and steel structures.

- **System Type:** Semi-unitized curtain walls with factory-fabricated façade elements, full-height vision glass, and bioPUR mullions/transoms.
- **Frame Material:** Bio-based Polyurethane (bioPUR) with 65-75% bio-sourced and up to 20% recycled content.
- **Infill:** Triple-insulated glass with thermal conductivity up to 0.6 W/m²·K.
- **Performance:** 40-50% better thermal and acoustic insulation than aluminum and steel.
- **Structural Efficiency:** 30-40% lighter, reducing installation costs. BioPUR density: 700 kg/m³, flexural resistance: 15.7 MPa, tensile strength: 11.2 MPa, with high impact resistance.
- **Sustainability:** 65-75% bio-based content from natural oils, reducing embodied carbon and improving material circularity.

Integration in the Demo Site

A prototype mock-up of the bioPUR curtain wall, consisting of four modules, will be manufactured and tested to simulate its structural stability, although it is not implemented at the demo sites. The glazing bead, made of extruded aluminum, is mechanically fixed to the bioPUR frame to secure the glass panel. Weather sealant is applied to both the exterior and interior to ensure system tightness, and the internal void is filled with

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injectable foam. The specimen will be mounted to a steel chamber using steel brackets.

The bioPUR curtain wall is designed to comply with **European standard EN 13830** and will be tested as follows:

- **Air permeability:** Tested per EN 12153, targeting a minimum Class A4 classification (EN 12152) with a pressure of +600 Pa.
- **Watertightness:** Tested per EN 12155, aiming for at least Class R7 (EN 12154) under a pressure of +600 Pa.
- **Wind load resistance:** Tested per EN 12179 (EN 13116), designed to withstand a 1.2 kPa design load and a 1.8 kPa safety load without unacceptable deformation or leakage.

Current Status of the Market and Challenges

Curtain wall systems, commonly used as non-load-bearing façades, are available in stick, unitized, and semi-modular typwes. While materials like iron and aluminum are widely used, their high thermal transmittance results in energy loss, impacting building efficiency. Timber curtain walls offer sustainability but face challenges such as high maintenance and vulnerability to moisture and pests. The INBUILT project addresses these issues with a **bioPUR frame**, which offers **40-50% improved insulation** and is **30-40% lighter than traditional materials.** Made with 65-75% bio-based and up to 20% recycled content, it enhances circularity, reduces CO_2 emissions, and promotes low-carbon construction.

Project Goal and Expected Impact

The INBUILT project seeks to optimize and scale up bioPUR curtain walls to TRL 7-8 through extensive full-scale testing. Expected impacts include:

- **Energy Savings:** Enhanced insulation reduces building energy consumption.
- **Circular Economy:** Improved reusability and recyclability using bio-based and recycled materials.
- **Structural Innovation:** BioPUR profiles designed for durability under stress while maintaining high performance.
- **Sustainability Impact:** Significant reduction in CO_2 emissions and embodied carbon, contributing to low-carbon construction practices.

KPIs Achieved/Expected

The sustainability of the bioPUR curtain wall is measured through key performance indicators, ensuring material efficiency and circularity. The KPIs are related to:

- **% of reused material:** Targeting up to 20% (expected)
- **% of recycled material:** Expected 20% recycled bioPUR (15% achieved)
- **% of reusability of the products:** Designed for disassembly and reuse (expected)
- **% recyclability of the products:** High recyclability with mechanical processing (achieved)

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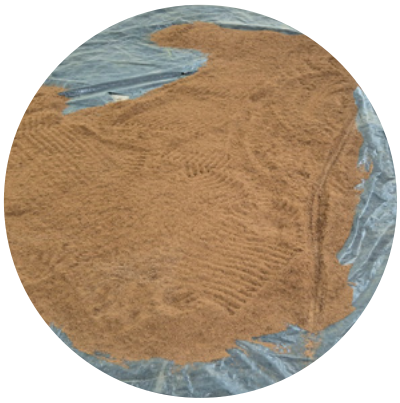
Hybrid Straw-clay Boards

A unique mix of straw and clay that offers natural insulation, utilising renewable resources.

Producer: Leipfinger-Bader
Demo site: Tiny Houses



Product Characteristics

Properties	
Raw density class	0,563 kg/dm³
Thermal conductivity λR (DIN EN 12664)	0,06924 W/(mK)
Specific heat capacity cP	In progress
Water vapor sorption (DIN 18948,A.2/EN ISO 10456)	In progress
Length (mm)	1250
Wide (mm)	625
Thickness (mm)	45

Integration in the Demo Site

Leipfinger-Bader's straw clay boards will be tested as a wall element in Demo Site 2 (Tiny House), with 28m² installed on interior surfaces. The evaluation will focus on key performance metrics such as **insulation, breathability, moisture absorption, and durability**. Additionally, a primary goal of the trial is to achieve a **waste reduction** of 80%. The straw-clay boards will also be integrated into the wall system for **Innovative Product 5 – Reclaimed Wood Wall Panels**, further demonstrating their versatility and potential in sustainable building applications.

Current Status of the Market and Challenges

The current market for straw clay boards in house construction is expanding, driven by

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demand for sustainable and eco-friendly building materials. Despite this momentum, widespread adoption faces several obstacles such as **limited public awareness, the absence of standardised products, and a lack of user-friendly solutions**. The Hybrid Straw-clay Board addresses these challenges by offering high-performance solutions that meet industry standards while promote circular construction principles. By offering **natural insulation, low embodied energy and carbon sequestration benefits**, this product is positioned to align with rising sustainability goals and overcome current market adoption barriers. Additionally, in light of ecological concerns and the finite availability of raw materials, transitioning away from traditional products such as drywall and plaster is necessary.

Project Goal and Expected Impact

The project aims to develop straw clay boards for interior application as sustainable alternative to conventional materials. Technically, the boards will provide excellent **hygrothermal and thermal performance**. From a social perspective, the use of natural, non-toxic resources supports **healthier indoor environments** and promotes **local job creation in eco-construction**. Environmentally, the boards help **reduce energy consumption, carbon emissions, and reliance on finite resources** by utilising renewable materials like straw and clay. This approach supports circular construction practices and lowers the ecological footprint. Overall, the project contributes to a more sustainable, healthy, and efficient building industry through innovative material development.

KPIs Achieved/Expected

Life Cycle Assessment KPIs: Process started, results not yet available.

- **Embodied energy reduction across the lifecycle:** 20% (pending LCA)
- **Pollution and GHG reduction across the lifecycle:** 70% (pending LCA)
- **Waste reduction across the lifecycle:** 80% (pending LCA)

Product sustainability KPIs:

- **Bio & geo-sourced material:** 95% (achieved)
- **Reused material:** 50% (achieved)
- **Recycled material:** 70% (achieved)
- **Reusability of the products:** 50 % (achieved)
- **Recyclability of the products:** 80% (achieved)

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LEIPFINGER BADER

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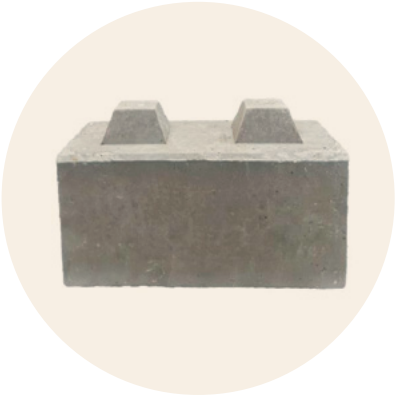
9

Recycled Concrete Blocks and in-situ Recycled Concrete

Concrete made from demolition waste, reducing the need for new materials.

Producer: Heinrich Feeß GmbH & Co. KG
Demo site: TBA



Product Characteristics

- **Material:** concrete C 20/25
- **Special feature:** 100% recycled mixed CDW (construction and demolition waste) aggregates
- **Size:** 40 x 20 x 20 cm
- Made with up to 100% recycled aggregates from construction and demolition waste.
- Mixes optimized for compressive strength and fresh concrete handling.
- Suitable for structural/non-structural walls and modular block production.
- Manufactured outside of DIN 1045 regulations, allowing higher recycling rates.
- Modular block design allows flexible formwork and stacking (e.g., “Lego” type).

Integration in the Demo Site

Recycled concrete and blocks will be tested and demonstrated at the German pilot site (TBA). In-situ mixes will be applied for concrete elements, while modular recycled concrete blocks will be used in wall segments. The demonstration aims to validate the material’s performance under real-world conditions and its integration into circular construction workflows.

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Current Status of the Market and Challenges

Recycled concrete products currently face **significant market barriers**, including stringent standards (e.g., EN DIN 1045), low customer awareness, and restrictive regulations. As a result, recycled construction and demolition waste materials are often downcycled into **low-value applications** such as backfill material, while higher-value uses—such as masonry blocks or site-mixed concrete—remain largely underexploited. Although demand for circular, low-carbon construction solutions is rapidly increasing, the market still lacks a wide range of practical, certified, and proven products to meet this need.

Project Goal and Expected Impact

The project aims to bring Recycled Concrete blocks and in-situ recycled concrete up to **TRL 6, validating performance in real construction scenarios**. The goal is to demonstrate their suitability for non-structural and/or structural applications and develop documentation for regulatory approval.
This promotes local reuse of construction and demolition waste, reduces the carbon footprint of building materials, and supports the EU's circular economy goals.

KPIs Achieved/Expected

The sustainability of the Recycled Concrete Blocks is measured through key performance indicators, ensuring material efficiency and circularity.

Sustainability KPIs:

- **% of recycled material:** 85–100% (expected 100%)
- **% of reusability of the products:** 60% (expected 80%)
- **% recyclability of the products:** 100% (achieved)

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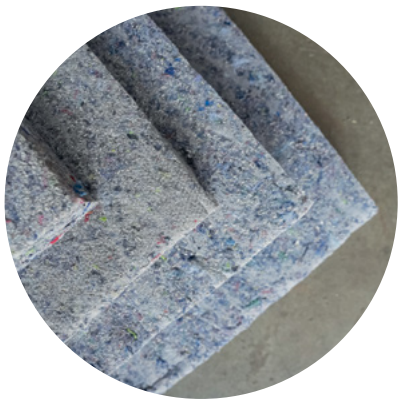
10

Recycled Paper and Textile Fiber Insulation Mats

Insulation solutions made from recycled paper and textiles for improved building thermodynamics.

Producer: BalticFloc
Demo site: Historic Industrial Building, Tiny House and Residential Building



Product Characteristics

The new innovative building insulation material is made from recycled paper and recycled textile fibres. Designed for thermal and sound insulation of building cavity walls, ceilings, floors, roofs, between rafters or in wooden frames. The insulation sheets are light, flexible, but at the same time retain their shape, making them easy to install.

- **Thermal conductivity:** 0.037 λd, mW/(m*K)
- **Specific heat capacity:** 1183 J/kgK
- **Sheet density:** 38-48 kg/m^3
- **Excellent sound absorption:** Class A, 0,9 αw
- **Fire safety class:** class E
- **Biological resistance:** no mold formation occurs
- **Sheet size:** 1200 x 600 mm with 50 mm or 100 mm thicknesses

Integration in the Demo Site

The new thermal insulation product will be tested in three demonstration buildings in real-world environments with different climates:

- **1st demo building:** an office building in France or a residential building - still in process.
- **2nd demo building:** a timber-framed tiny house building of 19.6m^2.
- **3rd demo building:** a historic industrial building that will be renovated for public use in Birmingham, UK.

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In all demonstration buildings, the indoor climate will be monitored to assess the insulation performance in real-world environments in different buildings, geographies and climates.

Current Status of the Market and Challenges

The insulation material market in Europe primarily consists of **mineral wool, polystyrene, and polyurethane rigid** foam insulation products. Mineral wool production is characterised by high energy consumption, involving fossil fuels and non-renewable raw materials. Glass wool and stone wool production employ similar technologies, including melting, fiberizing, and curing processes. These processes involve **high temperatures** and are **energy intensive**. Notably, the energy use during the melting phase of mineral and stone wool production accounts for a significant portion of the total energy consumption.

Balticfloc offers an **innovative thermal insulation material** made from recycled paper cellulose and recycled textile. The benefits of recycled raw materials include their recyclability and biodegradability at the end of life, CO_2 savings, and improved indoor air quality. Reusing wastepaper and textile materials into insulation provides many advantages in product properties, such as superior moisture absorption, enhanced breathability of indoor spaces, and lower irritability compared to the mineral materials they replace.

Project Goal and Expected Impact

The Balticfloc team with the INBUILT project aims to show that **alternative thermal insulation materials** can be less energy-intensive into production, use secondary materials over fossil resources, reduce CO_2 emissions, and support sustainable, circular construction.

The project aims to develop the new insulation material from an initial prototype **TRL 4** to a finished commercial product **TRL8** and test it in demonstration buildings in the operational environment for new and existing buildings.

KPIs Expected

The share of reused and recycled materials/ components, reduction of embodied carbon, embodied energy, CO_2 emissions, material reuse, and recyclability, decreased energy demands and building related life-cycle costs, are yet to be evaluated. All the following targets are expected to be reached by the end of the project.

Sustainability KPIs:

- **% of reusability of the products:** up to 50%
- **% of recycled material:** 94%
- **% recyclability of the products:** up to 100%

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Balticfloc

The INBUILT project will run from December 2023 to May 2027.
The consortium consists of 19 partners, coordinated by Université Côte d'Azur.

Partners

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INBUILT project

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