

BioCannDo

Key messages

For communicators and multipliers



Bio-based insulation materials

This project has received funding from the Bio Based Industries Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement N° 720732.



Key message #1 – Bio-based insulation materials are mainly made from renewable resources such as flax, wood, hemp, sheep wool or straw.

- **Bio-based insulation materials are made from renewable resources which means they are plant or animal based.**
- **They can contain synthetic additives for fire safety reasons, or to protect them from moisture or insects.**
- **In order to find bio-based insulation materials, certification schemes can help. For instance, the natureplus® certification scheme, requires that at least 85% of the product weight must be made from renewable or mineral raw materials.**
- **Other examples of bio-based insulation materials are: jute, cork, reeds, seagrass, meadow grass, cellulose, kenaf and cotton.**



Key message #2 - Bio-based insulation materials are already available.

- A variety of bio-based insulation materials is already available.
- These materials have different advantages and disadvantages depending on their use.
- Product examples of these materials can be found in online databases.
- One product [database](#) is provided by natureplus®. Natureplus® certifies construction materials. Among these are bio-based insulation materials. The database offers a broad selection of products.
- Information about insulation materials and products can also be found in a [database](#) provided by the Agency for Renewable Resources (FNR).



Key message #3 – Bio-based insulation can replace conventional materials in many cases without loss of performance and offer additional positive functionalities.

Performance



In comparison to mineral and fossil-based materials **bio-based insulation materials:**

- **provide a heat and sound insulation performance which is just as good,**
- **have better moisture regulating properties,**
- **provide excellent summer heat protection.**

Heat insulation performance of bio-based products can be the same as that of conventional ones

The heat insulation performance of bio-based insulation materials can compete with mineral or fossil based materials, such as rock wool, glass wool and polystyrene. **The technical performance of several renewable insulation materials**, such as cellulose and fibres from hemp, flax, kenaf and cotton, **is comparable to that of the mineral benchmarks.**

Bio-based insulation materials provide better summer heat protection

Important is also **the ability of an insulation material to store heat and to release it to a cooler environment.** This indicator is called **specific heat capacity.** Natural insulation materials can be superior to conventional fossil or mineral based materials when it comes to heat buffering, because their specific heat capacity is higher. This can be helpful to create a more comfortable indoor climate and to prevent overheating of rooms that sit below the roof in the summer. In practice, the interior temperatures of a wood-panel insulated attic are up to 6°C lower than those insulated with conventional products.

Sound insulation of bio-based materials is comparable to conventional products

There is ample evidence showing that bio-based insulation materials have good sound insulation or sound reducing properties that are comparable to those of standard materials of mineral origin. However, the actual application of materials in buildings will determine the sound insulation levels achieved.

Insulation properties in numbers

The following table gives an overview of different insulation materials and their thermal conductivity and specific heat capacity. The heat-insulating effect is described by the thermal conductivity (denoted λ). The smaller the thermal conductivity the better the insulating effect and the thermal protection are. A thermal conductivity below 0.5 W/(mK) guarantees good thermal insulation properties. The specific heat capacity (c) indicates the amount of heat that a certain material can accumulate. A higher number indicates a higher heat storage capacity and a corresponding capacity to release heat to a cooler environment.

Insulation Material	λ (W/(m×K))	c (J/kg×K)
Bio-based materials		
Flax mats	0.036-0.040	1.600
Hemp mats	0.040-0.050	1.600-1.700
Hemp (loose)	0.048	1.600-2.200
Wood shavings	0.045	2.100
Wood fibre insulation board	0.040-0.052	2.100
Cork board	0.040	1.800
Sheep wool	0.0326-0.040	1.720
Straw bale construction	0.052-0.080	2.000
Cellulose flakes	0.040	2.200
Seagrass	0.037-0.0428	2.000
Conventional materials		
Polystyrol (PS) (Styrofoam)	0.035-0.040	1.400
Rock wool	0.033-0.040	840-1.000

Key message #4

Bio-based insulation materials contribute to a healthy living environment.

- Bio-based insulation materials contribute to a **pleasant and healthy indoor climate**.
- Bio-based insulation materials are much more **user-friendly during installation** than conventional insulation materials because the materials are non-irritating to the skin.



Indoor climate is critical for human health

We spend 90% of our time indoors and indoor air quality is identified as being critical for human health. In addition to individual characteristics (age, clothing, state of health, gender, constitution), the room climate is a determining factor for the personal sense of comfort in rooms. In addition to the type and intensity of heating and ventilation, the room climate is essentially determined by the temperature of the air and room surfaces and the humidity. Temperatures between 17°C and 24°C and a relative humidity between 35% and 75% are considered comfortable.

Bio-based materials contribute to a healthy indoor climate

Insulation measures have caused the relative air humidity in many houses to be high, thus giving rise to growth of moulds.

This is where bio-based materials can help. Scientific research has shown that **most natural insulation materials can accumulate and conduct moisture, resulting in a moisture-regulating effect and contributing to a balanced indoor climate throughout the year.** This is especially important for people with respiratory diseases, asthma, atopic dermatitis, for which constant indoor humidity is critical.

An especially positive effect has sheep wool. It has an air purification effect which means it can absorb and neutralize a large variety of volatile organic compounds (VOCs) which can contribute to a sick building syndrome. It acts as a passive air filter.

Bio-based materials have in general lower levels of chemical additives

Insulating materials from renewable resources have in general a much lower level of chemical additives or come entirely without them which is healthier for most residents.

Nevertheless they can contain chemicals. Critical ingredients of renewable insulation materials are above all the additives for fire protection. As so-called flame retardants are usually used crystalline substances, which do not emit gaseous emissions during normal use. Many of the flame retardants are slightly hazardous to water. This must be taken into account during manufacture, storage, installation and recycling.



Key message #5 – Bio-based insulation materials are as durable and safe as conventional ones.

- Bio-based insulation materials **do not pose an increased risk of fire** if properly installed and used in accordance with fire protection regulation.
- Bio-based insulation materials **last as long as conventional materials.**



Bio-based insulation lasts as long as conventional materials

Research shows that natural insulating materials are as durable as conventional materials. The Münster Chamber of Crafts can prove this in a **long-term test based on the natural insulating materials installed in the "Construction and Energy" demonstration centre since 2004**. Insulation materials made of flax, hemp, cellulose, wood shavings and wood fibre insulation boards were installed in the Münster demonstration centre and equipped with sensors. **The thermal conductivity of the materials remained almost constantly low over the entire period** and the insulation materials used provide for a very good, lasting heat protection. Moisture measurements also showed that condensation has not accumulated in any wall or ceiling construction.

Bio-based materials do not pose increased risk of fire compared to conventional ones

Bio-based insulation materials do not pose an increased risk of fire if properly installed and used in accordance with fire protection regulation. **Fire protection requirements can be met for a large number of construction projects through the application of certain fire retardants or cladding**. In case of fire, bio-based insulation avoids extremely toxic fumes which cause great damage and mortal danger to those affected by the fire.

Key message #6 – Bio-based insulation materials contribute to environmental and climate protection.

- **Bio-based insulation contributes to climate protection** in three ways: by storing CO₂ during growth, by saving energy in the production and by avoiding CO₂ emissions through thermal insulation during the lifetime of buildings.
- Many bio-based insulation materials can be sourced from regional agriculture and forestry.
- **At the end of life bio-based insulation causes less pollution** and can be disposed of easier.



Bio-based insulation products contribute to climate protection

Bio-based insulation contributes to climate protection in three ways:

Firstly, **renewable resources have the advantage of requiring much less energy** than conventional building materials such as mineral wool and petroleum-based plastics to be produced, which means they typically have much lower “embodied energy” levels compared with conventional materials. Secondly, **natural insulation materials also bind CO₂ during the growth phase** and therefore contribute to climate protection. Thirdly, **natural insulation avoids CO₂ emissions through thermal insulation** during the lifetime of buildings.

Raw materials can be sourced from regional agriculture

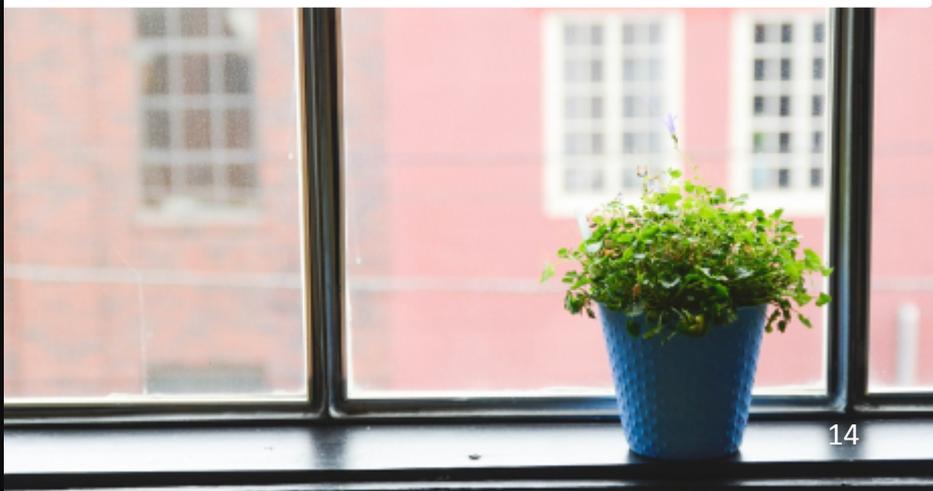
Many natural insulation materials come from regional agriculture and forestry or can be obtained here in the future when demand increases. This means **short transport distances, less import dependency and opportunities for rural areas**. For many materials there is no conflict of use for other purposes.

Disposing of bio-based insulation materials

The picture is differentiated when it comes to disposing of bio-based insulation materials. Some materials can be reused (cellulose flakes, seagrass), some can be recycled (hemp mats, sheep wool). Theoretically, a lot of these materials could be composted, but composting facilities are reluctant to accept them. Therefore, in most cases bio-based insulation materials will be incinerated. 13

Key message #7 – Bio-based insulation offers more for your money than conventional materials.

- With the exception of cellulose and wood fibre chips, which have been competitive for years, natural insulating materials are more expensive than conventional insulating products because of lower production volumes and sometimes more expensive raw materials.
- Therefore, **in price comparison additional positive benefits such as moisture regulation, summer heat protection, health and climate protection should be taken into account.**
- Unfortunately, additional and beneficial properties such as vapour permeability or heat storage capacity are not included in current standards and testing methods. Therefore the advantages of bio-based insulation materials cannot be marketed effectively.



For further reading:

Wageningen UR: Health, comfort, energy use and sustainability issues related to the use of bio-based building materials - To what extent are the effects supported by science and data? What are next steps to take?

Open-BIO: Opening bio-based markets via standards, labelling and procurement

IsoBio Project: Reducing the environmental impact of construction by using renewable materials

Agency for Renewable Resources (FNR):

Marktübersicht - Dämmstoffe aus nachwachsenden Rohstoffen (in German)

Deutsche Umwelthilfe: Naturdämmstoffe – Wider die falschen Mythen (in German)

Münster Chamber of Crafts Demonstration Center

Where to find bio-based insulation materials:

Natureplus product database

FNR: Die nachwachsende Produktwelt – German product database (in German)

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