Decarbonising Gypsum Industries with Biomass

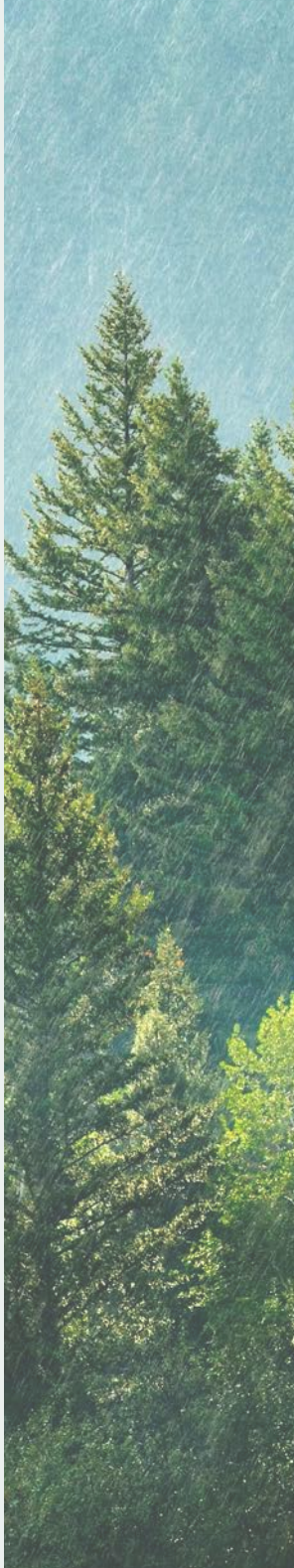
Solid Biomass Fuels & Technologies for Gypsum Product Manufacturing

Bioenergy EUROPE

The Voice of European Bioenergy

Bioenergy Europe is the voice of the European bioenergy sector. It aims to develop a sustainable bioenergy market based on fair business conditions. Founded in 1990, Bioenergy Europe is a non-profit, Brussels-based international organisation bringing together more than 40 associations and 150 companies, as well as academia and research institutes from across Europe. Bioenergy Europe hosts the European Pellet Council, a network of national associations representing the wood pellet sector from 18 countries.

Bioenergyeurope.org



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FOREWARDS

The gypsum industry's journey to climate neutrality

Gypsum-based solutions, such as plasterboards, are essential elements for the decarbonisation of our buildings, in new constructions and renovations. Reducing the greenhouse gas emissions from our manufacturing processes and contributing to the transition towards climate-neutral construction products are therefore particularly important objectives for our sector. In 2023, Eurogypsum published the roadmap "Towards Climate Neutrality with Gypsum" outlining the typical carbon footprint of gypsum-based products, the decarbonisation efforts already achieved over the past years, and the range of solutions available to support the sector's journey to climate neutrality.

Achieving deep emissions reductions will require a combination of pathways rather than a single technology. Alongside energy efficiency improvements, electrification, renewable gases or hydrogen, sustainable biomass may offer an additional option for reducing reliance on fossil fuels in manufacturing processes that require thermal energy. While the gypsum industry has more extensive experience with some of the above-mentioned decarbonisation solutions, biomass is raising an increasing level of interest due to its potential to provide renewable industrial heat

Tristan Suffys

Secretary General,
Eurogypsum

using commercially available technologies. At the same time, its deployment raises important questions relating to fuel availability, sustainability, process integration, product quality, economics and regulatory requirements.

To support informed decision-making, Eurogypsum has engaged in an exchange of knowledge with Bioenergy Europe, with a view to better understand the potential role of solid biomass in gypsum product manufacturing, the technologies available, the opportunities they may offer, and the challenges associated with their deployment. We welcome Bioenergy Europe's initiative to provide gypsum manufacturers with a supporting document explaining these aspects. We hope that Eurogypsum's contribution, including insights into gypsum manufacturing processes and their specific operational requirements, will also help Bioenergy Europe members better understand the realities and constraints of our industry.

As the representative of the European gypsum sector, Eurogypsum remains technology-neutral and recognises that the most suitable decarbonisation pathway will vary from one manufacturing site to another and will remain an individual manufacturer's decision, based on a thorough assessment of the specific circumstances.

FOREWARDS

A decision you will be happy to live with!

The energy transition is undoubtedly a major challenge for European industry. But it does not have to be a difficult one. The technologies to replace fossil fuels with solid biomass fuels are already available, proven and operating successfully in industry today. Renewable biomass fuels offer a reliable and competitive solution for many industrial processes, supported by established supply chains both locally and through international markets.

The main challenge is not whether the technology works, but judging how policy will develop and when carbon prices will be high enough. I am convinced that the earlier you decide, the happier you will be. Carbon costs will become an increasingly important part of industrial energy economics, which makes the transition a sound long-term decision. Timing the investment for the best possible outcome is difficult. Those who have already invested and signed long-term fuel supply contracts have made a profitable decision. Pellet prices tend to follow other energy prices, but an industrial buyer that also consumes fuel in summertime has an attractive negotiating position with suppliers.

My recommendation to industry is therefore simple: move to well-proven renewable fuel technologies, and make sure three things are right:

Gustav Melin

Chairman,
WTS AB,

Senior advisor
BK tech Group

Chairman of the Working Group Industry,
Bioenergy Europe

First, invest in a fuel whose long-term availability you can rely on. Where suitable local biomass resources exist, they can be an excellent solution. For many sites, however, wood pellets are the practical choice, with established supply chains and the option to source on international markets.
Second – and this is important – ask your technology supplier for performance guarantees, and make sure the supplier has the financial strength to stand behind them.
Third, talk to that supplier's previous customers and learn from their experience before you invest.

I wish you good luck in your ambition to become climate neutral. There is no need to worry that combustion is a bad thing in itself. Combustion is simply oxidation of carbon – the same net reaction that powers your own body when you go for a run. We call it respiration rather than burning, but the chemistry is the same: carbon and oxygen in, carbon dioxide and water out. Being against combustion would be like being against breathing. What we should be against is harmful emissions, not combustion. Using bioenergy instead of imported fossil fuels matters not only for the climate, but for Europe's energy security and for creating jobs and income in the regions where the biomass is sourced.

01.

The European gypsum industry

Gypsum products such as plasterboard, plaster and gypsum blocks contribute to fire performance, indoor comfort, acoustic performance and efficient construction methods. A key strength of the industry is its increasing focus on circularity through internal recycling, manufacturing scrap recovery and the growing use of recycled gypsum from construction and demolition activities.

1.1 Key facts & figures

What is gypsum?

Gypsum is a naturally occurring mineral found in sedimentary rock formations. It is composed of calcium sulphate and water ($CaSO_4 \cdot 2H_2O$), and its chemical name is calcium sulphate dihydrate.

One of gypsum's unique properties is that it can be ground into a powder, mixed with water, and then re-harden into a solid, rock-like material. This makes it highly versatile and easy to shape for a wide range of applications.

Gypsum is primarily used in the construction sector to manufacture products such as plasterboard, plaster, and gypsum blocks. These products contribute to comfortable, safe, and energy-efficient buildings thanks to their fire-resistant, acoustic, and thermal performance.

The European gypsum industry

Europe is home to significant gypsum resources, particularly in Spain, France, Germany, Italy, the United Kingdom, and Poland. Gypsum has been used in European architecture for centuries, providing fire protection, thermal comfort, and decorative finishes in buildings.

Today, the industry's principal product is plasterboard, which consists of a gypsum core encased between two sheets of paper. Plasterboard is a key component of lightweight, dry construction systems, enabling fast installation and supporting modern methods of construction, including off-site manufacturing and prefabrication.

The European gypsum industry is composed of EU-based companies, which are recognised as global leaders in the sector.

18,600
employees

>140
factories manufacturing plasterboard and other plaster products

>200
gypsum quarries

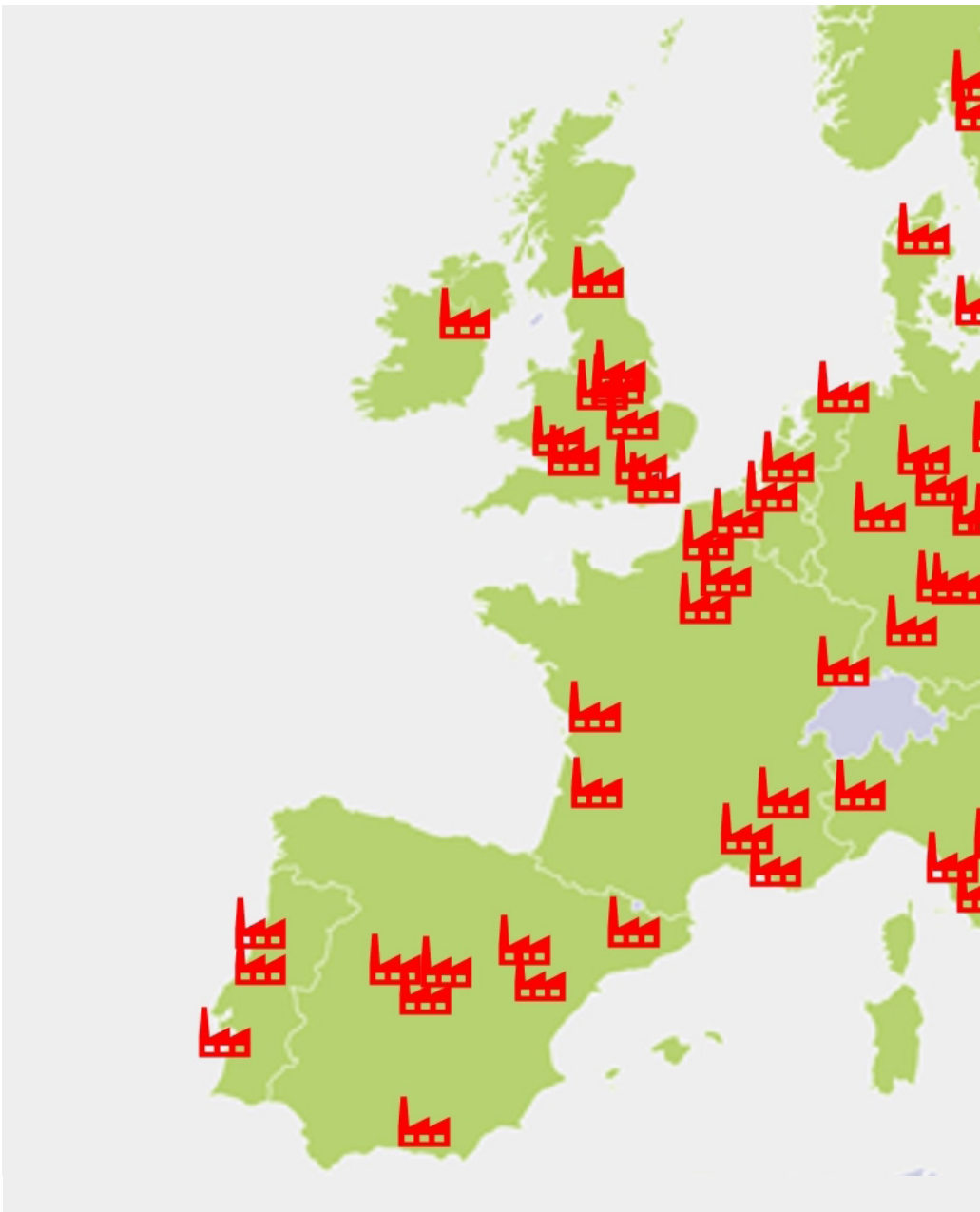
23 Million
tonnes of raw materials processed every year

(mainly natural gypsum, but also recycled gypsum from construction, renovation and demolition waste, and synthetic gypsum as by-product of other manufacturing processes)

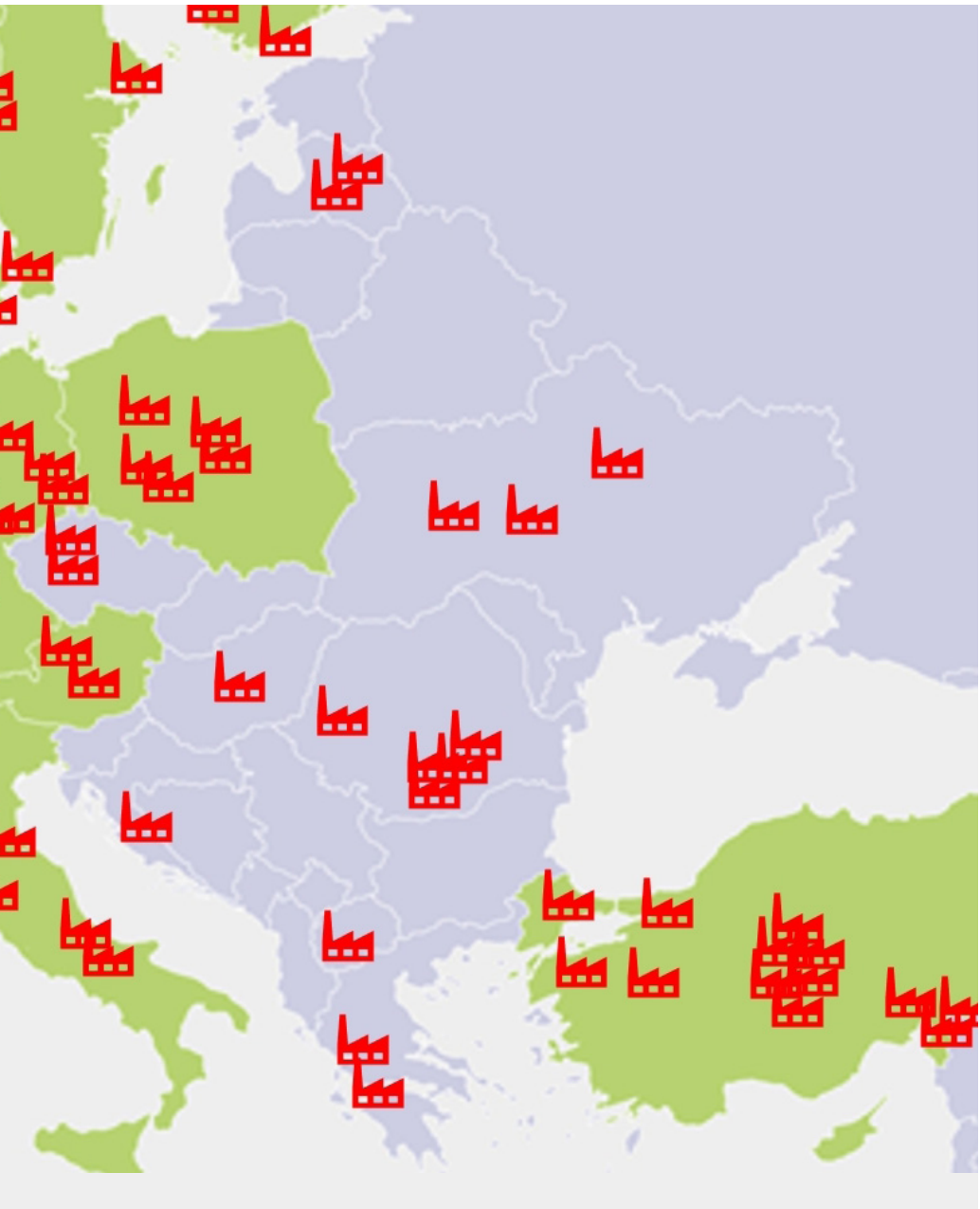
7.2 Million
tonnes of plaster and other gypsum-based products manufactured every year

1.8 Billion
m^2 plasterboard produced annually

Figure 1: Location of plaster product facilities across Europe (in 2025).

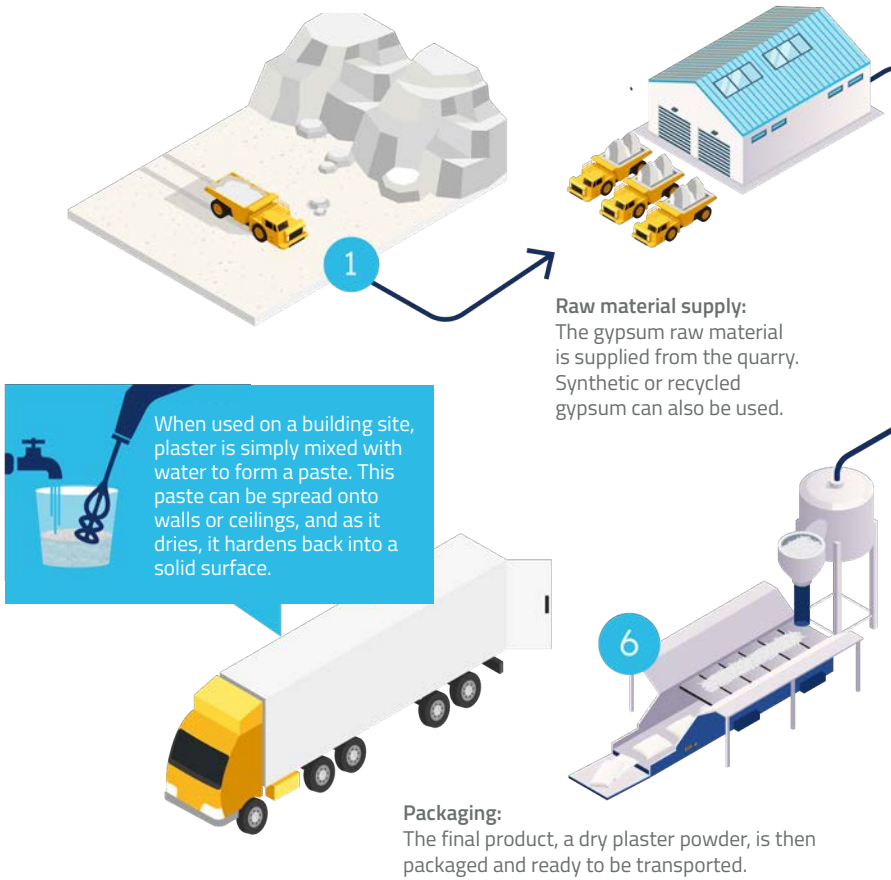


Source: Eurogypsum



1.2 Manufacturing process of gypsum products

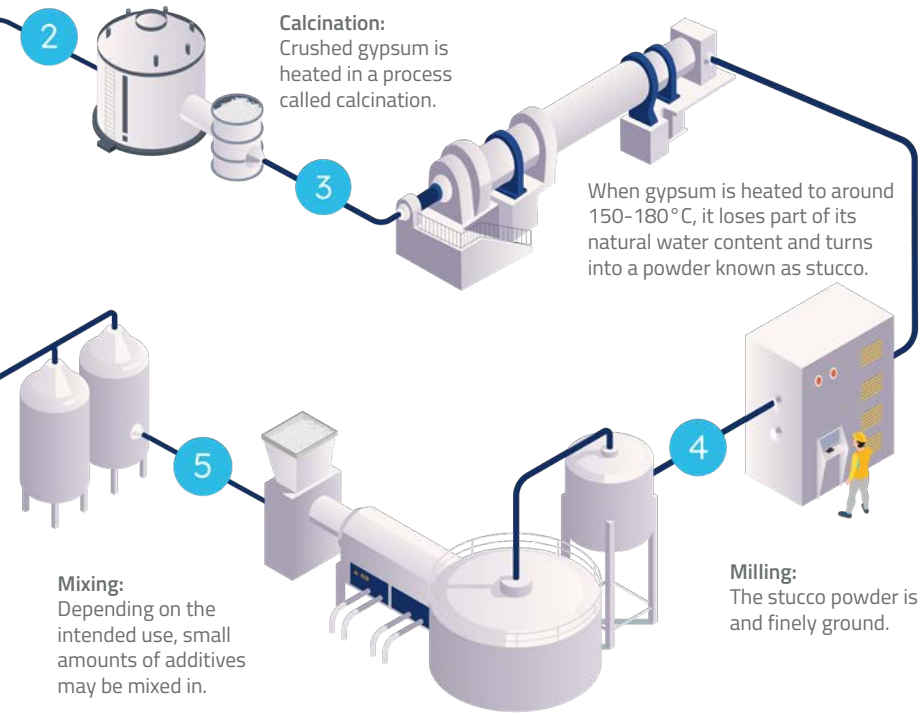
Figure 2: Overview of plaster production process



How is plaster made?

1. Crushed gypsum is heated in a process called calcination. When gypsum is heated to around 150–180°C, it loses part of its natural water content and turns into a powder known as stucco.
2. The stucco powder is cooled and finely ground.

Rock grinding:
The raw material is ground to obtain the desired size.



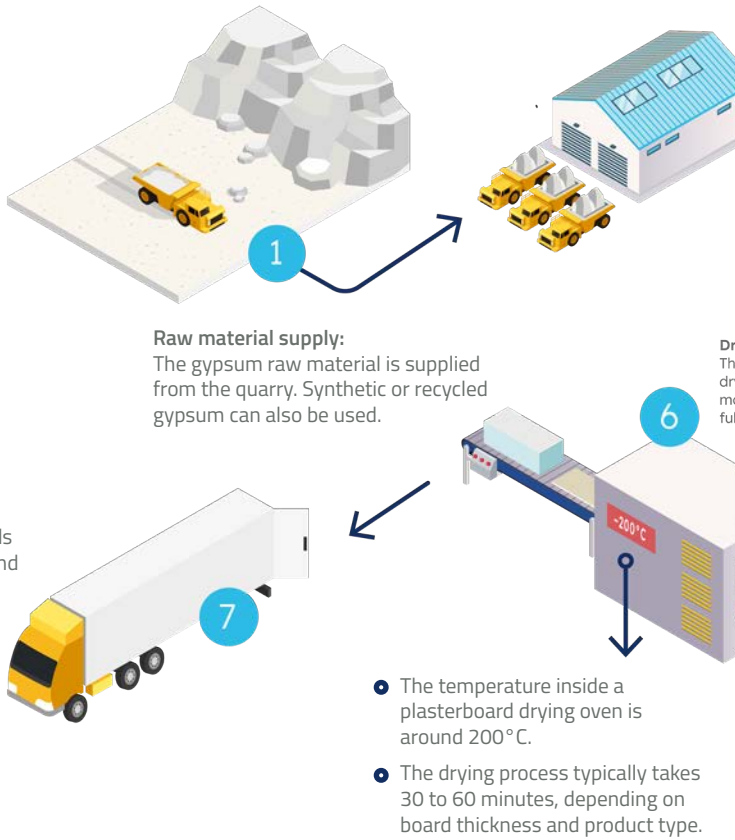
Source: Eurogypsum

3. Depending on the intended use, small amounts of additives may be mixed in.

4. The final product - a dry plaster powder - is then packaged and ready to be transported.

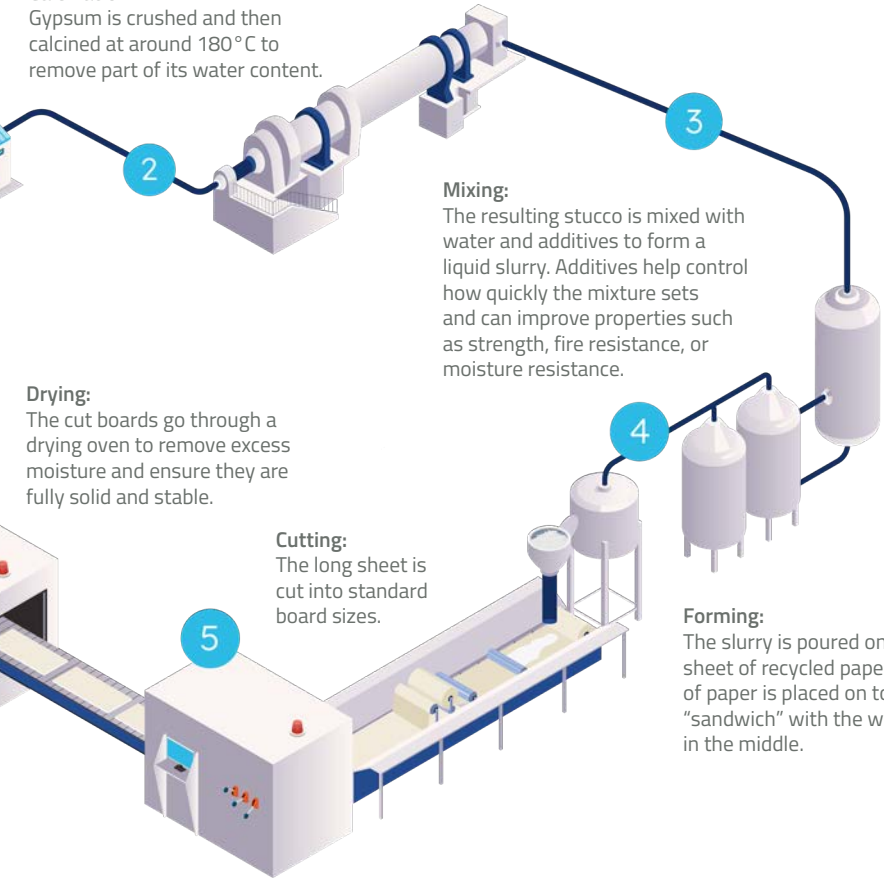
5. When used on a building site, plaster is simply mixed with water to form a paste. This paste can be spread onto walls or ceilings, and as it dries, it hardens back into a solid surface.

Figure 3: Overview of plasterboard production process



How is plasterboard made?

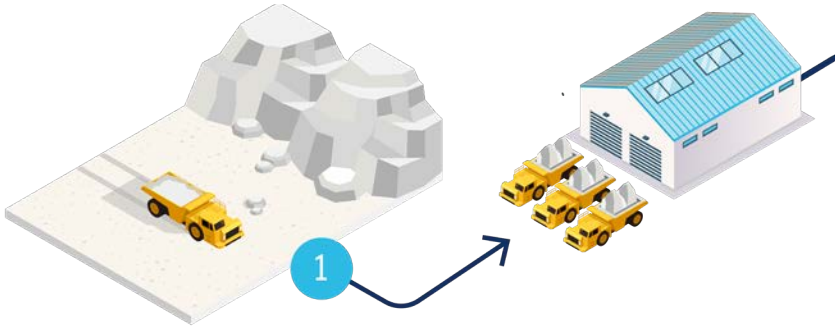
1. Gypsum is crushed and calcined at around 180°C to remove part of its water content.
2. The resulting stucco is mixed with water and additives to form a liquid slurry. Additives help control how quickly the mixture sets and can improve properties such as strength, fire resistance, or moisture resistance.
3. The slurry is poured onto a continuous sheet of recycled paper. Another layer of paper is placed on top, forming a "sandwich" with the wet plaster slurry in the middle.



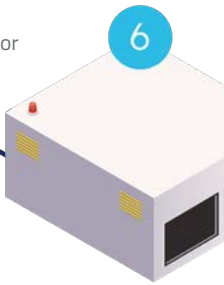
Source: Eurogypsum

4. The long sheet is cut into standard board sizes.
5. The cut boards go through a drying oven to remove excess moisture and ensure they are fully solid and stable. The temperature inside a plasterboard drying oven is around 200°C. The drying process typically takes 30 to 60 minutes, depending on board thickness and product type.
6. Finally, the plasterboards are cooled, inspected, and packaged for transport.

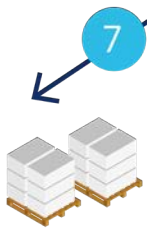
Figure 4: Gypsum block production



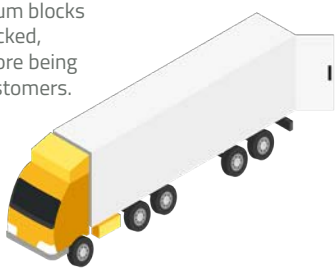
Raw material supply:
Natural gypsum rock, as well as recycled or synthetic gypsum can be used.



Drying:
The blocks are dried in drying chambers to remove excess moisture. Drying temperatures generally range from 80°C to 140°C and the process takes between 12 to 48 hours depending on the block characteristics.

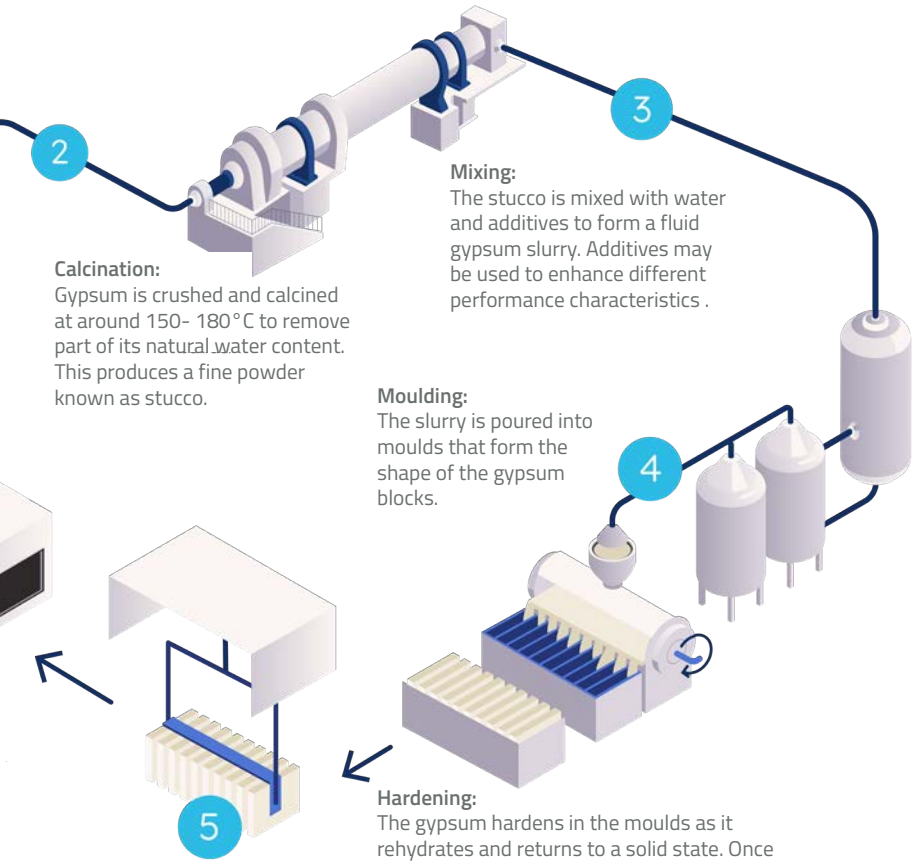


Packaging:
The finished gypsum blocks are inspected, stacked, and packaged before being transported to customers.



How are gypsum blocks made?

1. Gypsum is crushed and calcined at around 150–180°C to remove part of its natural water content. This produces a fine powder known as stucco.
2. The stucco is mixed with water and additives to form a fluid gypsum slurry. Depending on the intended application, additives may be used to control setting time, improve strength, reduce water absorption, or enhance other performance characteristics.
3. The slurry is poured into moulds that form the shape of the gypsum blocks, including any tongue-and-groove profiles or interlocking features required for assembly.



Source: Eurogypsum

4. The gypsum hardens in the moulds as it rehydrates and returns to a solid state. Once sufficient strength has been achieved, the blocks are removed from the moulds. This setting process is largely driven by a natural chemical reaction and requires no additional heat generation.
5. The blocks are dried in drying chambers to remove excess moisture and ensure dimensional stability. Drying temperatures generally range from 80°C to 140°C, depending on the block size, density, and production process. The drying process usually takes 12 to 48 hours, considerably longer than plasterboard drying because of the greater product thickness.
6. The finished gypsum blocks are inspected, stacked, and packaged before being transported to customers. The blocks are then ready for use in the construction of non-load-bearing partitions and other interior applications.

02.

The decarbonisation challenge

Energy considerations for plaster production

Calcination is the main thermal process in plaster production. It requires a reliable source of low- to medium-temperature heat and is most commonly fuelled by natural gas, although alternative fuels and electrified solutions are emerging. Key requirements include stable temperature control, product quality and cost-effective operation.

Energy considerations for plasterboard production

The two principal thermal processes are calcination and drying. Calcination converts gypsum into stucco and requires consistent heat delivery to ensure product quality. Drying is typically the most energy-intensive stage, requiring large volumes of hot air to remove water from the board. Decarbonisation options must provide reliable heat while maintaining process efficiency, product quality and competitiveness.

Energy considerations for gypsum block production

Calcination and drying are the main thermal processes in gypsum block production. Both require stable and controllable heat to ensure product quality, dimensional stability and efficient moisture removal. Future low-carbon energy solutions must deliver the same level of reliability and process control as conventional natural gas systems.

03.

Decarbonisation pathways for gypsum manufacturing

Contributing to Europe's climate goals

The European gypsum industry contributes to the decarbonisation of the built environment through low-carbon, resource-efficient construction solutions. Gypsum-based products are widely used in lightweight systems for partitions, linings and ceilings, helping improve building energy performance, indoor comfort and construction efficiency. Their light weight also makes them well suited to offsite construction methods, reducing material consumption and construction time.

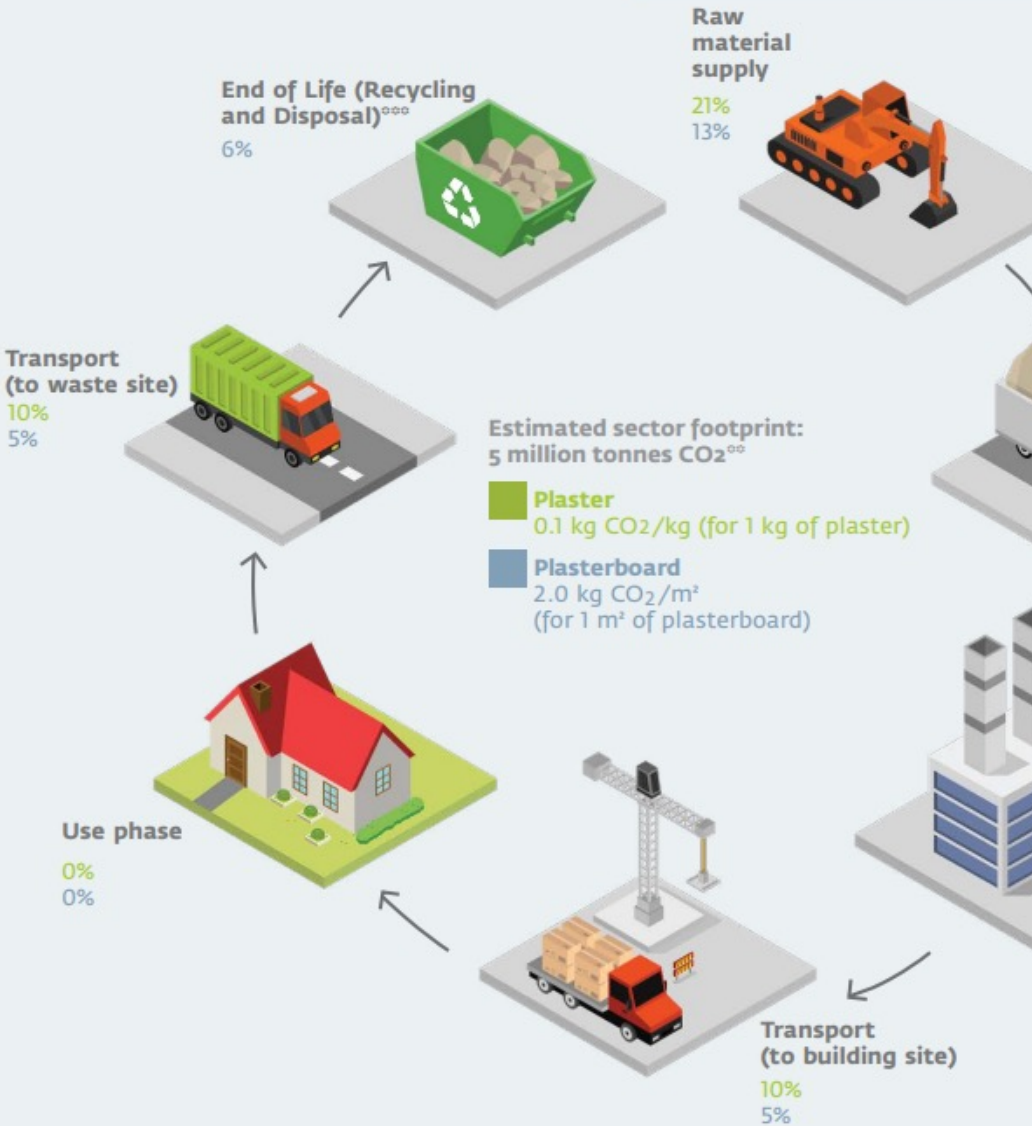
Gypsum is a unique mineral that can be recycled repeatedly without loss of quality. The industry has been a pioneer in plasterboard recycling and continues to expand closed-loop recycling systems across Europe, supporting the transition to a circular economy.

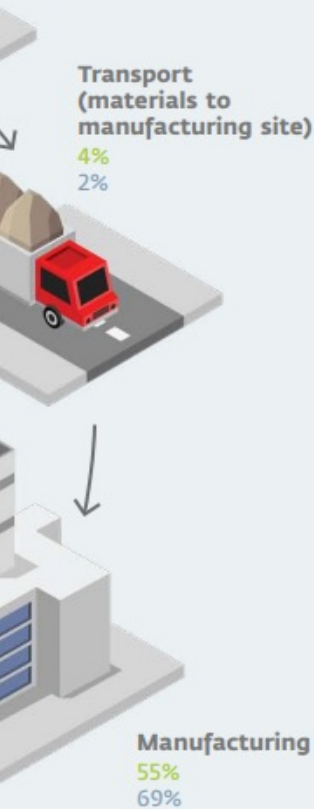
Reducing the industry's own carbon footprint

Alongside its contribution to sustainable construction, the gypsum industry is committed to reducing emissions from its own manufacturing processes. In 2024, Eurogypsum published its roadmap, *Towards Climate Neutrality with Gypsum: The European Gypsum Industry's Journey to Net Zero*, which identifies the main sources of emissions across gypsum-based products and outlines potential pathways towards climate neutrality.

Figure 5: Typical carbon footprint of gypsum-based construction products

Source: Eurogypsum





Manufacturing represents the largest share of the carbon footprint of gypsum products, accounting for around 69 % of emissions for plasterboard and 55 % for plaster (though this can vary substantially between the various products and solutions in our range). Energy use is one of the main emission sources within manufacturing, making the transition away from fossil fuels a key pillar of the industry's decarbonisation strategy.

Decarbonisation pathways

The gypsum industry's transition to climate neutrality will require a combination of solutions rather than a single technology. Improving energy efficiency through process optimisation and waste heat recovery can reduce energy demand and emissions in the short term. In parallel, manufacturers are exploring alternative energy sources and technologies capable of providing reliable industrial heat while maintaining competitiveness and product quality. Potential pathways include renewable electricity and electrification, biomass and biofuels, renewable gases, hydrogen, and circular economy initiatives that reduce the demand for virgin materials and associated emissions. The suitability of these options will depend on site-specific factors, including process requirements, existing infrastructure, energy availability, local conditions and economic considerations.

04.

Understanding solid biomass fuels

4.1 What is biomass?

Biomass encompasses a broad range of renewable fuels derived from biological material. These fuels originate from forestry, agriculture, industrial processing residues and other biogenic sources. Biomass can be converted into solid, liquid or gaseous energy carriers for use in heat, power and transport applications.

This booklet focuses on **solid biomass fuels**, as they are currently the most widely used biomass option for industrial heat generation.

4.2 Main types of solid biomass fuels

Several categories of solid biomass fuels may be relevant for industrial applications. The availability of these fuels varies across regions and depends on local resources, existing supply chains and market conditions. Each fuel type presents specific advantages and challenges. Consequently, fuel selection must take account of the requirements of the industrial process and local market conditions.

There are many ways to classify solid biomass fuels that can be relevant for sourcing considerations, policy purposes or technical considerations. Table 1 presents a rough classification considering different criteria.

Figure 6: Different types of solid biomass fuels

From top to bottom: Wood pellets, Wood chips, Straw, Tree prunings

Table 1: Examples of solid biomass fuels used for industrial heat generation.

Classification	By origin of material	By tradeable form	By moisture content	By ash content
Types and examples	• Forests (e.g. forest wood chips) • Agriculture (e.g. straw, prunings of fruit trees,) miscanthus) • Wastes & residues of processing industries (e.g. sawdust, olive stones, sunflower husk)	• Pellets (e.g. wood pellets, sunflower husk pellets) • Briquettes • Chips • Granular material (e.g. olive stones, nut shells)	• Low moisture content (e.g. pellets, olive stones, straw) • Higher moisture content (e.g. wood chips)	• Low ash content (e.g. wood pellets, wood chips olive stones) • Higher ash content (e.g. straw, olive cake)
Relevance (indicative)	• Supply chain organization • Renewable Energy Directive sustainability requirements	• Design of handling and logistics systems (e.g. conveying)	• Design of combustion system	• Design of combustion system • Impact on gypsum product quality (in cases of direct heating) • Design of air emission control systems

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Wood pellets

Pellets are short, compressed cylinders of a biomass material made through a densification process called "**pelletization**", often preceded by a drying step to ensure low moisture content (typically below 10 % by weight) in the final product. Because they are made through a specific technical process, pellets exhibit more homogeneous properties compared to most other types of solid biomass fuels.

Wood pellets are the most common form of biomass pellets found in markets today. There are two main variants on the market. **Premium (or heating) wood pellets** are mostly made from sawmilling residues (such as sawdust) and have a very low ash content which makes them suitable for combustion in residential appliances – or in applications with a higher sensitivity to the ash content of the fuel. **Industrial wood pellets** usually include – apart from residues – wood fractions that are sourced directly from forestry, such as thinnings and low-quality stemwood. As a result of their composition, they exhibit somewhat higher ash content than premium pellets.

In both cases, thanks to pelletization and the control of the moisture content, the bulk and energy density of wood pellets is quite high, making them quite suitable for international transportation as well as for application where fuel storage limitations are an issue. This has led to the development of a vibrant European and international market, with an annual supply volume exceeding 51 Mt in 2025. At the same time, their advantages as well the costs associated with their production and transportation means that wood pellets represent a higher cost option compared to other solid biomass fuels.

Another important aspect to consider when considering wood pellets is their **hydrophilic** properties: if exposed to water through rain or elsewhere, wood pellets will readily absorb moisture, leading to swelling, loss of structural strength, and rapid disintegration. This requires special considerations for the storage and handling of wood pellets. Closed silos and/or roofed storage and specialized delivery systems are needed; existing infrastructure for solid fossil fuels (if existing) can be modified and made fit for wood pellets.

Wood chips & other woody biomass assortments

Wood chips are small to medium sized pieces of wood that formed by a mechanical treatment of larger pieces of wood with sharp tools, such as knives. Different types of largest pieces of wood can be used to make wood chips: branches, treetops, tree trunks (especially from trees unsuitable for sawmilling), stumps, roots, wood waste fractions, etc.

Wood chips can be offered in different size assortments, depending on the shredding process employed, the raw material properties and whether a screening process is used or not. Smaller sized wood chips are generally easier to handle, while larger sized assortments require more robust and specialized equipment. But in both cases, a properly designed handling system can automate the feeding process of wood chips into a combustion system.

The moisture content of wood chips usually ranges between 25 – 45 % by weight; forced drying of wood chips is rare, so the exact moisture content during delivery depends primarily on the length of natural conditions and climate of the area. Because of this higher moisture content and the lack of a densification step in their production, wood chips have lower energy density than wood pellets and are typically traded over shorter distances. However, there are cases where wood chips can also be traded over longer distances and through international supply chains. Unlike wood pellets, wood chips can be stored in open yards.

Their production modalities often make wood chips quite competitive in terms of price and attractive for medium and larger sized combustion applications (e.g. larger sized boilers, district heating systems, industries, etc.).

Beyond wood chips, biomass fuel suppliers may be able to offer **other types of woody biomass assortments** that could be relevant for a fuel switch. For example, in locations close to a sawmilling industry, it is possible to source wood powder directly, i.e. without it first being processed and upgraded into wood pellets. In locations where debarking of trees take place, bark can also be made available as a separate fraction and used as a solid biomass fuels.

Commodity agrobiomass fuels

Suppliers can offer to end-users several different types of biomass assortments that originate as residues of agricultural processing industries. Indicatively, these include olive pits and olive cake, sunflower husk pellets, nut shells, palm kernel shells (PKS) and others.

Depending on the product, these assortments come from different supplying regions and exhibit a wide range of fuel properties. But there are some general remarks than can be made of them. First, most of them generally low moisture contents and a quite high bulk density (either naturally or because of the integration of a drying / pelletization step in their production process), which makes them suitable for international transportation. Most of them have more challenging fuel properties compared to wood pellets or wood chips: higher ash content, presence of alkali metals

in the ash, and chlorine. This results in more challenging combustion conditions for these types of fuels.

The combination of their generation mode (residues from the production of a main agricultural commodity) and their fuel properties means that these fuels are typically offered at a discounted price compared to wood pellets. Therefore, they can be an interesting choice in certain conditions.

Locally sourced solid biomass fuels

Beyond the "commoditized" solid biomass fuels and the supply of forest fuels, there are several other local supply options that could be relevant for a gypsum industry – or other industries – that wish to switch from a fossil fuel to biomass. In most locations in Europe, these potentials remain largely untapped. One of the most found materials that could be used in this context is straw, a residue from the cultivation of cereals. In Mediterranean countries and areas with a high concentration of permanent crops, prunings from such trees (e.g. olive trees, vineyards, etc.) can also be a relevant biomass source. Another possibility is the establishment of dedicated energy crops, either herbaceous such as miscanthus or woody such as poplar and willow, when there is land available for the purpose.

The potential for such biomasses remains significant. But before the potential can be realized, there are some issues to be considered. The first and foremost is fuel supply. The locality of the supply means lower transportation costs and very cost-competitive fuel prices, but the supply chain needs to be established in collaboration with local actors. The other consideration is the fuel properties which – especially in the case of the residual fractions – are typically more challenging than the "standard" wood fuel assortments: higher ash content, chlorine, etc.

Processed biomass

Beyond the raw biomass assortments described above, dedicated processing installations exist that transform raw biomass — whether of woody or agricultural origin — into a fine, pulverized biomass fuel. This "biomass fines" product is designed to closely replicate the particle size and combustion characteristics of pulverized lignite ("braunkohle"), making it a direct substitute in applications currently reliant on this type of fossil fuel. These processes typically combine drying, grinding and, in some cases, torrefaction (thermal treatment of biomass in the absence of oxygen) steps to achieve the required fineness and homogeneity, offering a pathway for industries to switch away from lignite without requiring major modifications to their existing fuel handling and combustion systems.

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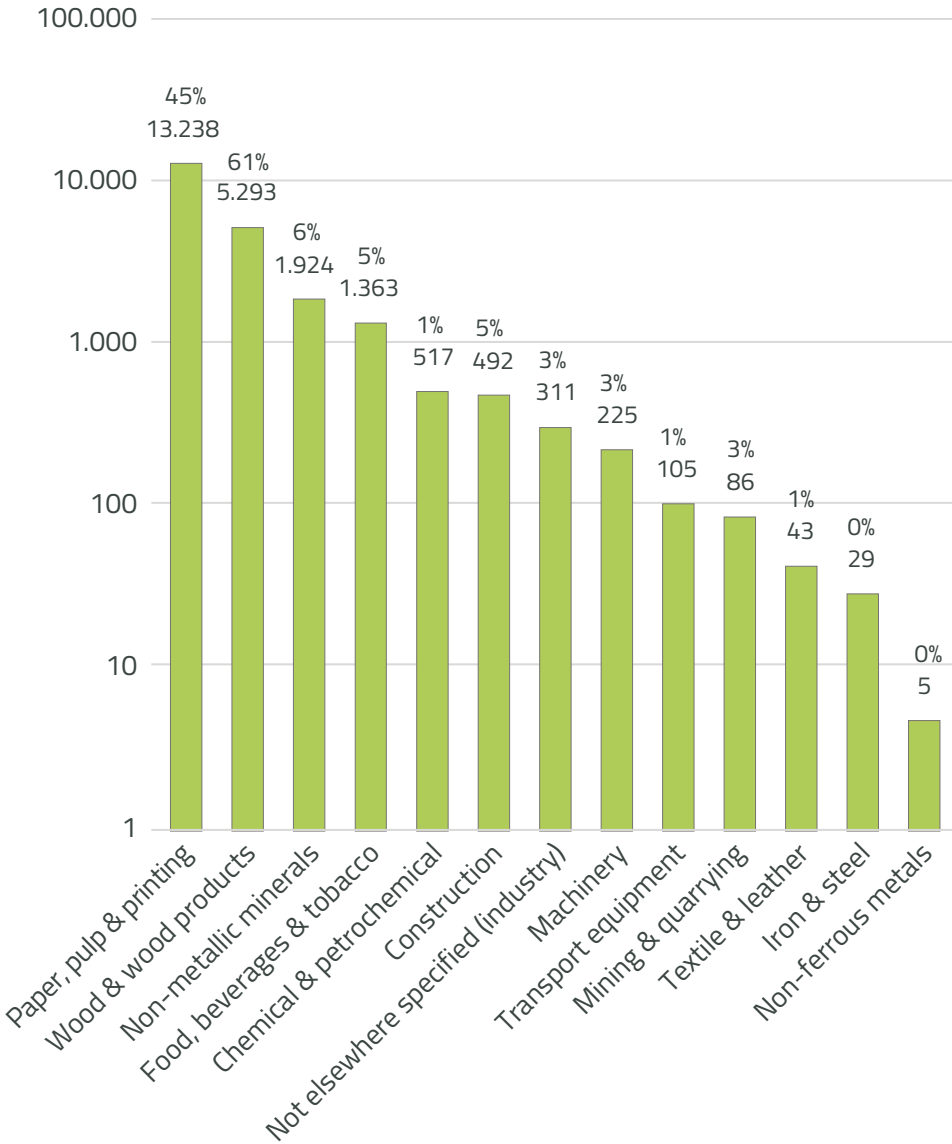
4.3 Biomass and industrial heat

Bioenergy already plays an established role in industrial heat production across Europe, particularly in sectors with access to biomass resources and well-developed supply chains: paper & pulp, wood processing, food processing. Opportunities have also emerged in other sectors; for example, the non-metallic minerals sector (which includes cement and lime production) already sources about 6 % of its industrial energy demand from biomass fuels. In total, industrial consumption represents around a quarter of biomass used for heat production in the EU.

In addition to its renewable character, biomass can offer greater fuel price stability than some fossil energy carriers, particularly where local or regional supply chains are available. However, fuel costs remain dependent on local market conditions, fuel quality, transport requirements and supply-demand dynamics.

The use of biomass / bioenergy in European industries is expected to grow in the future, as efforts to phase out – the still huge share of – fossil fuels in their energy sourcing mix will intensify. Electrification technologies are expected to play a major role in these efforts, but alone they will not be enough. Several issues limit their deployment potential: cost competitiveness of electricity as an energy source, grid capacity issues, compatibility with certain production technologies. Solid biomass fuels can provide an alternative pathway for industrial defossilisation that combines climate benefits with competitiveness and a value chain that – both in terms of technology and fuel supply – remains primarily within Europe. While biomass may not be the appropriate solution for every site, it represents an established option for reducing reliance on fossil fuels and can contribute to the defossilisation of industrial heat where the necessary conditions are in place.

Figure 7: Absolute consumption and relative share compared to total energy consumption of bioenergy in the EU27 industrial sector (ktoe, % / log scale, 2023 data)



Source: Bioenergy Europe, based on Eurostat data

05.

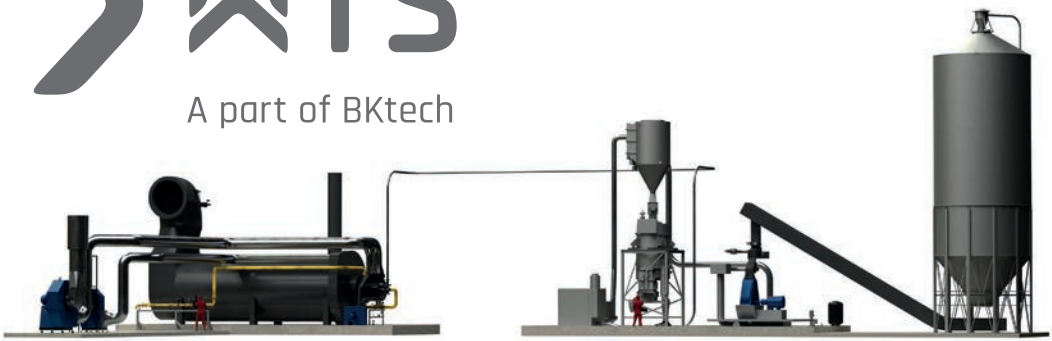
Solid biomass fuel technologies for gypsum manufacturing

A Biomass Grate Combustion System

Biomass can provide renewable thermal energy for gypsum manufacturing processes that currently rely largely on natural gas – gypsum calcination, plasterboard drying, and gypsum blocks drying. Calcination is the principal thermal process in plaster production, and an essential starting process for both plasterboard and gypsum blocks manufacturing. As such, fuel switching for calcination is a significant opportunity for emissions reduction. Biomass can potentially provide the low- to medium-temperature heat required for calcination through a range of combustion technologies. Drying is present in the plasterboard and gypsum blocks manufacturing and is often the largest consumer of thermal energy in the production process. Biomass systems can supply hot air either directly or indirectly, depending on process requirements and plant design. The suitability of different technologies depends on factors such as process design, product quality requirements, fuel availability and site-specific constraints.

WTS

A part of BKtech



Renewable Process Heat for Gypsum Production

The gypsum industry is under pressure to reduce fossil fuel use without compromising product quality, emissions performance or process reliability. Production systems must deliver stable temperatures and fast response, day after day.

WTS, part of Swedish bioenergy specialist BK Tech Group, has worked with industrial combustion systems since 1989. A 14 MW multifuel solution developed for the gypsum industry shows how wood powder can replace fossil fuels while maintaining the operating characteristics producers have come to expect from conventional burners.

Highlights

- Complete fuel handling, milling and combustion solution
- Integrated with the customer's process
- 14 MW multifuel system for wood powder and gas
- Less than 50 seconds from minimum to maximum load
- Biomass turndown ratio of 1:4

Helping gypsum producers move beyond fossil fuels.

World Thermal Service AB
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Web: www.wtsab.com

5.1 Multifuel Burner Systems

For gypsum industry plants currently using natural gas burners, multifuel burners can provide a relatively direct route for introducing biomass fuels. These systems can operate with biomass powders, bio-oils and gaseous fuels, while maintaining the high levels of automation, responsiveness and temperature and emissions control required by industrial processes. Such burners are typically available in sizes ranging from 1 to 100 MW.

To achieve stable combustion, solid biomass is typically used in a finely ground form. Occasionally, the fuel can already be delivered to a plant in this form (e.g. if sawdust is sourced directly from a sawmill). In several cases, wood pellets are used as a fuel, which means that the multifuel burner needs to be coupled with a system for grinding the pellets and then dosing the produced wood powder.

In direct-heating applications, fuel quality is particularly important, as ash and other biomass constituents can affect product quality. Low-ash fuels such as wood powder or wood pellets are therefore often preferred.

5.2 Biomass Boiler Systems

Biomass boilers are sophisticated systems that combust solid biomass fuels and transfer the energy of the hot flue gases in the combustion chamber to a heat utilization system. Biomass boilers can utilize a wide range of solid biomass fuels with different forms. Depending on the needs of the industry using a biomass boiler, the heat can be transferred to a variety of technical media: from hot water (with temperatures typically in the range of 110 – 200 °C), hot gas (with temperatures approximately between 130 and 950 °C), hot air (temperatures approximately 100 – 350 °C), process or superheated steam, and thermal oil.

The most common combustion technology used in small to medium sized biomass boilers is the so-called grate combustion system. Grate combustion systems typically can in sizes from around 1 and up to 30 – 50 MW; bigger sized systems are also offered by some suppliers. For capacities above 20 MW, the Bubbling Fluidized Bed (BFB) technology is also an option. The BFB technology can also be used to retrofit older combustion systems using coal and enable them to switch to solid biomass fuels.

These systems can be particularly attractive where indirect heating is used or where manufacturers wish to limit direct contact between combustion gases and the gypsum product. Their suitability depends on process requirements, available space and the characteristics of the biomass fuel supply.

5.3 Choosing the Appropriate Technology

There is no single optimal solution for all gypsum industry plants. When a choice between biomass technologies is considered, decisive factors should include production process, plant layout and available fuels. Multifuel burners may be advantageous when considering burner replacement in direct heating systems, while biomass boilers can offer greater fuel flexibility and easier integration into indirect-heating systems. In all cases, it is relevant to ask for the experience and the references of your potential equipment suppliers in the handling of different types of solid biomass fuels, especially in industrial applications.

06.

Benefits and key considerations for biomass deployment

Biomass can be an attractive option for reducing fossil fuel use and decarbonising industrial heat in gypsum manufacturing. However, its suitability depends on factors such as plant configuration, fuel availability, infrastructure, economics and regulatory requirements. As with any industrial energy transition project, a site-specific assessment is essential to identify the most appropriate solution and maximise the benefits of implementation.

6.1 Potential benefits

- **Reduced fossil carbon emissions**

  Biomass can contribute to reducing fossil carbon emissions from industrial heat generation and support the implementation of corporate and sectoral decarbonisation strategies.

- **Energy diversification and resilience**

  Biomass can broaden the energy mix available to gypsum manufacturers and reduce dependence on a single fuel source. In some regions, local or regional biomass resources can also strengthen energy resilience and reduce exposure to external energy market disruptions.

- **Commercially available solutions**

  Biomass heating technologies are already deployed in many industrial sectors and can provide reliable thermal energy across a wide range of process requirements. Proven technology solutions and established fuel supply chains are available in many parts of Europe.

- **Potential competitiveness advantages**

  Depending on local market conditions and fuel sourcing options, biomass may provide a competitive energy alternative. In addition, replacing fossil fuels can reduce exposure to carbon-related costs and support long-term compliance with climate policies.

6.2 Key considerations for successful implementation

- **Securing an appropriate fuel supply**

  A successful biomass project depends on access to reliable fuel supplies with consistent quality and suitable logistics arrangements. The optimal fuel choice will vary according to local availability, market conditions and process requirements.

- **Integrating biomass into existing facilities**

  Biomass systems generally require fuel storage, handling and combustion equipment that must be integrated into existing plant layouts. Early assessment of space requirements and infrastructure needs can help identify the most suitable technical solutions.

- **Maintaining product quality and process performance**

  For gypsum products manufacturers, maintaining product quality remains paramount. Particular attention may be required where combustion gases interact directly with the production process, ensuring that fuel characteristics and combustion systems remain compatible with product specifications.

- **Ensuring sustainability and regulatory compliance**

  Biomass projects must comply with applicable sustainability criteria, permitting requirements and emissions regulations. These considerations should form an integral part of project planning from the outset.

- **Evaluating project economics**

  As with any industrial investment, biomass projects require a careful assessment of capital expenditure, operating costs and expected performance. Additional operating costs may arise from fuel preparation, equipment maintenance, ash management and logistical requirements. The business case for biomass therefore depends on a combination of factors, including fuel prices, carbon costs, and available policy support measures.

07.

Biomass, Life Cycle Assessment and EPDs

Reducing fossil fuel consumption can contribute to lowering the carbon footprint of gypsum manufacturing. However, the benefits of biomass projects should be assessed not only through operational emissions reductions at plant level, but also through their influence on the overall environmental performance of gypsum products.

7.1 The growing importance of Life Cycle Assessment

Life Cycle Assessment (LCA) is widely used to evaluate the environmental impacts of construction products across their life cycle, from raw material extraction and manufacturing to use and end-of-life treatment. LCA provides a recognised framework for quantifying environmental performance and comparing improvement options.

In the construction sector, environmental considerations are increasingly influencing purchasing decisions, green building schemes and sustainability reporting. As a result, understanding the life-cycle implications of decarbonisation measures is becoming increasingly important for manufacturers.

7.2 Environmental Product Declarations in the gypsum sector

Environmental Product Declarations (EPDs) are widely used by the gypsum industry to communicate the environmental performance of products in a transparent and standardised manner. EPDs provide quantified environmental information based on LCA methodology and are increasingly requested by customers, designers, contractors and building certification schemes.

For gypsum manufacturers, EPDs have become an important tool for demonstrating progress towards sustainability objectives and for supporting informed material selection in construction projects.

7.3 Assessing biomass through a product

When evaluating biomass projects, manufacturers should consider how the change in energy source may influence the environmental indicators reported in product EPDs. Depending on the fuel, supply chain and technology used, biomass may contribute to reducing the product's fossil carbon footprint and other life-cycle impacts.

At the same time, a comprehensive assessment should take account of all relevant stages of the fuel supply chain, including feedstock sourcing, processing and transport, as well as applicable sustainability requirements.

08.

Regulatory considerations

Biomass deployment projects should be assessed not only from a technical and economic perspective, but also from a regulatory one. A range of requirements at EU and national level, including the EU ETS, the Renewable Energy Directive, environmental permitting obligations and other national regulations, can influence both project design and operation. As the regulatory framework continues to evolve and may differ between Member States, these considerations should be addressed at an early stage with support from relevant authorities, project developers and biomass suppliers. However, responsibility for compliance with applicable requirements ultimately remains with the installation operator.

8.1 EU Emissions Trading System (EU ETS)

Gypsum plants with a production capacity exceeding 20 tonnes per day within the EU fall under the scope of the EU Emissions Trading Scheme (EU ETS), unless exempted by the Member State. Such plants are expected to monitor, report and verify the emissions of greenhouse gases (GHG) from their installations. These emissions are primarily CO_2 originating from fuel combustion.

Up to 2026, plasterboard industries under the EU ETS receive up to a maximum of 30 % of their benchmark-calculated allowances for free. This is due to reduce further – to reach zero free allocation by 2030. Plaster installations are subject to carbon leakage measures, so they receive a higher level of free allocation. Therefore, the economic motivation for the gypsum products industry to switch to carbon-neutral energy sources is expected to become even more relevant in the future.

Solid biomass fuels offer such a possibility for gypsum production plants and other industries. **The EU ETS treats the combustion of biomass fuels as zero-rated**, meaning that their emission factor is zero and no allowances need to be surrendered for their combustion. There is an important precondition for this, however: **for biomass fuels to be zero-rated, they must meet the sustainability and GHG saving requirements of the Renewable Energy Directive**. Further information on these criteria and how they can be demonstrated is provided in the next section.

Under the current rules, a full switch to solid biomass fuels also allows for a possible exception of an installation from EU ETS altogether. Annex I of the EU ETS Directive allows for the exclusion of installations for which more than 95 % of their total average GHG emissions are attributable to sustainable biomass (and hence zero-rated).

8.2 Renewable Energy Directive requirements

The Renewable Energy Directive (RED) establishes sustainability and greenhouse gas saving criteria for biomass fuels. Compliance with these requirements influences how biomass use is treated under other regulatory frameworks, including the EU ETS.

Who needs to demonstrate compliance with the RED requirements – the exemption threshold

For installations that use biomass fuels to produce heat, the size of the installation is the main criterion for assessing whether compliance with the sustainability and GHG requirements is needed. Under the current version of the Directive (the so called RED III), installations with a total rated thermal input equal to or exceeding 7,5 MW are required to demonstrate compliance with the RED requirements. An installation with a lower total rated thermal input may still opt for demonstrating compliance with the RED criteria on a voluntary basis.

Sustainability requirements

Sustainability requirements – also referred to as "land requirements" are introduced in RED to protect ecosystems and biodiversity and maintain soil health and carbon stocks from any potential negative impacts of excessive biomass removals. These sourcing requirements vary depending on whether biomass is originating from forests or from agricultural land. For example, RED III does not allow the sourcing of forest biomass for energy purposes from primary and old-growth forests, highly biodiverse forests, grasslands, peat lands and heathlands. The exact definition of such ecosystems from which harvesting of biomass for energy purposes is not allowed takes place on the Member State level.

Waste and Residues is a special category applicable to biomass fuels for the purposes of RED. Several types of solid biomass fuels can be classified under this category, for example sawdust from sawmilling, as well as wood pellets made from sawdust, olive stones from olive oil production, etc. The most relevant benefit in using such materials is that they are not subject to sustainability criteria, only for GHG Saving criteria (see section below) from the point of their generation onwards.

If biomass is part of the solution, sustainability must be part of the conversation

Industrial sectors across Europe are exploring biomass as one pathway to reduce emissions and strengthen energy resilience.

For biomass to maintain stakeholder confidence, sustainability claims must be transparent, verifiable and supported by robust data.

The Sustainable Biomass Program (SBP) provides an internationally recognised certification scheme for demonstrating:

- **Responsible sourcing**
- **Supply chain transparency**
- **Verified sustainability performance**
- **Greenhouse gas emissions data and reporting**
- **Independent assurance**

Providing confidence and credibility where biomass is used.

Sustainable biomass. Demonstrated with confidence.

sbp-cert.org

GHG saving requirements

The supply chains of biomass fuels typically require – as is the case with practically all commodities today – some fossil energy inputs for transportation, pre-processing, etc. The conversion of biomass fuels into useful heat also needs to take into consideration certain efficiency requirements.

The GHG saving requirements is the criterion used in RED to demonstrate that a biomass fuel can achieve a certain level of environmental performance through its value chain. It follows a simplified LCA methodology outlined in the Annex VI of the Directive and considers the cultivation, processing, transportation & distribution, and finally the non-CO_2 emissions of the fuel in use. The conversion efficiency of the installation (i.e. to heat) is taking into account, as well as the so called "Fossil Fuel Comparator" (FFC) which is the benchmark against which the GHG savings are ultimately calculated. Under the requirements of RED III, the benchmark for the GHG savings at least 80%.

RED facilitates the calculations of the GHG savings by providing several tables with default values of GHG emissions and savings for different types of biomass fuels and production pathways. **Operators are always entitled to use the default values of the Annexes** and in most cases the GHG saving threshold can be met with those values. In those cases where the default GHG savings are below the required level, operators can use actual values (i.e. related to the actual performance of their supply chain) to demonstrate compliance.

How to demonstrate compliance with the RED requirements: the role of certification schemes

The main means of demonstrating compliance with the RED requirements for sustainability and GHG saving of biomass fuels is through **voluntary or national certification schemes**. Voluntary and national schemes can apply for recognition by the Commission; the list of the approved schemes is published on the Commission's website[1]. A key advantage of using a recognised scheme is that the certification is accepted by the competent authorities of all Member States. Member States may allow the use of schemes that are not (yet) recognized by the Commission if they come to their own conclusion that the scheme ensures compliance with the RED criteria.

1. https://energy.ec.europa.eu/topics/renewable-energy/bioenergy/voluntary-schemes_en

The rules under which such certification schemes operate have to follow a dedicated Implementing Regulation[2] accompanying RED. The specificities of this Regulation go beyond the scope of the booklet, but a fundamental aspect is the implementation of a mass balance system for ensuring that there are neither data gaps nor double counting of biomass quantities.

Certification schemes issue Proof of Sustainability (PoS, i.e. a certificate of compliance with that scheme's rules) to economic operators, such as biomass producers, traders and end-users. An operator – such as a gypsum production plant – that purchases a biomass fuel that has received a PoS from a recognized voluntary scheme may assume that it is compliant with the RED criteria and thus benefitting from a zero-rating in the EU ETS. Some considerations that are relevant to note.

What does this mean in practice when sourcing solid biomass fuels for a fuel switch project in the gypsum industry? The answer depends on the type of biomass sourcing arrangements in the supply chain:

- When a solid biomass fuel is sourced as a "commodity" and/or from well-established biomass markets, it is almost a given that a reputed supplier will be well versed in the RED sustainability GHG saving requirements and will be able to provide all necessary PoS documents up the point of the fuel delivery at the installation.

- If a new biomass supply chain is established in an area of untapped potential and for the explicit purpose of supplying a new installation, then it is to be anticipated that the economic operators in the supply chain will have to be "educated" in their obligations and that the supply chain will also have to ensure that all documentation and proof required to demonstrate the biomass sustainability can be delivered. This may require more legwork in the initial steps and collaboration with consultations and project developers with previous experience on the issue. But once the system is operational and integrated in everyday practice, it quickly becomes part of the background.

2. The current applicable version is Commission Implementing Regulation (EU) 2022/996.

8.3 Environmental permitting and emissions

The installation of biomass combustion equipment may require updates to existing environmental permits or the issuance of new permits, depending on the scale and configuration of the project.

Operators should assess applicable requirements relating to:

- Air emissions;
- Fuel storage and handling;
- Combustion plant operation;
- Monitoring and reporting obligations.

Specific requirements vary between Member States and may depend on the fuel type, combustion technology and plant size.

8.4 Local and national considerations

In addition to EU legislation, national, regional and local requirements may apply to biomass projects. These may include planning requirements, environmental permits, sustainability obligations and energy-related regulations. Early engagement with competent authorities, technology providers and fuel suppliers can help identify regulatory requirements and facilitate project development.

Notes

Notes

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